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Operating Instructions
FLOWSIC100 Transmitter

Gas Flow Rate Measuring Device

Endress+Hauser
People for Process Automation

Described product
Product name: FLOWSIC100 Transmitter

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

Warning symbols

Warning

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 personal injury or property damage.

NOTICE
Hazard which *could* result in property damage.

Information symbols

Important technical information for this product

Important information on electric or electronic functions

Supplementary information

FLOWSIC100 Transmitter

1 Important information

Function of this document
Scope of application
Target groups
Data integrity
Intended use
Safety information and protective measures

1.1 Function of this document

These Operating Instructions describe for the FLOWSIC100 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 FLOWSIC100 Transmitter measuring system with the described system components.

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

These Operating Instructions cover only 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 who install, operate and maintain the device.

Requirements for the qualification of the personnel

The FLOWSIC100 measuring system may only be 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 technicians are persons according to DIN VDE 0105, DIN VDE 1000-10 or IEC 60050-826 or directly comparable standards.

The persons named must have precise knowledge of operational hazards, e.g. due to low voltage, hot, toxic, explosive or pressurized gases, gas-liquid mixtures or other media, as well as sufficient knowledge of the measuring system 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 product availability and features.

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 FLOWSIC100 Transmitter measuring system is designed for non-contact measurement of the flow velocity and air temperature in pipelines, exhaust gas and exhaust air ducts as well as stacks.

Correct use

▶ Use the device only as described in these Operating Instructions. The manufacturer bears no responsibility for any other use.

▶ Carry out all measures required to maintain the device, e.g. maintenance and inspection, 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 dangerous.
- Any warranty by the manufacturer becomes void.

1.6 Safety information and protective measures

1.6.1 General information

WARNING: **General information**
Handling or using the device incorrectly can result in personal injury or material damage. Read this Chapter carefully and ensure you observe the safety precautions during all work on the FLOWSIC100 Transmitter. Always observe the warnings provided in these Operating Instructions.
The following applies at all times:

- The relevant legal stipulations and associated technical regulations must be observed when preparing and carrying out work on the installation.
- Pay particular attention to potentially hazardous aspects of the equipment, such as pipelines and ducts with overpressure and hot gas. The applicable special regulations must be followed at all times.
- All work must be carried out in accordance with the local, system-specific conditions and with due consideration paid to the operating dangers and specifications.
- The Operating Instructions for the measuring system as well as system documentation must be available on site. The instructions for preventing danger and damage contained in these documents must be observed at all times.

WARNING: **Danger through power voltage**
The FLOWSIC100 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 if the electrical wiring (cables, terminals, ...) is damaged.

WARNING: **Hazards through ultrasonic signals**
Do not expose unprotected hearing to the sonic beam of the transducer (especially type H).

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

WARNING: **Hazard through hot, corrosive and/or pressurized gases**
The sender/receiver units are mounted directly on the gas-carrying duct. On equipment with low hazard potential (no danger to health, ambient pressure, low temperatures), the installation or removal can be performed while the equipment is in operation providing the valid regulations and equipment safety notices are observed and suitable protective measures are taken.

- Systems and processes with toxic gases, high pressure or high temperatures must be shut down before the sender/receiver units are installed or removed.

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 FLOWSIC100 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 FLOWSIC100 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 FLOWSIC100 Transmitter not described in this manual.
- ▶ Do not remove, add or modify any components to or on the FLOWSIC100 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 FLOWSIC100 Transmitter can become dangerous.
  - The approval for use in potentially explosive atmospheres is no longer valid.

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.
- Smoke or unusual odors.

> Contact Endress+Hauser Customer Service for any malfunctions you cannot clear yourself.
> To help Customer Service to understand malfunctions that have occurred, you have the possibilty to create diagnostics files that can be sent to Customer Service, → p. 75, §4.2.4.

1.6.4 Preventing damage

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

- The maintenance personnel responsible can reach the site immediately, and at any time.
- The maintenance personnel is sufficiently qualified to respond correctly to malfunctions on the FLOWSIC100 Transmitter and any resulting operational malfunctions.
- In case of doubt, switch the defective equipment off immediately.
- Switching off the equipment does not indirectly cause further malfunctions.

FLOWSIC100 Transmitter

2 Product description

System features and areas of application
System overview and functional principle
System components
Computations
Check cycle

2.1 System features and areas of application

The FLOWSIC100 Transmitter conducts simultaneous measurements of the gas flow rate and temperature. The volume flow under actual conditions can be calculated and output from the gas flow rate.

Features and benefits

- Integrated measurement of the gas flow rate across the duct diameter, independent of the pressure, temperature, and gas composition
- Digital processing of measured values ensures high accuracy and low susceptibility to interference
- Self-test by means of automatic check cycle
- No pressure-reducing fittings in the gas flow, which ensures the gas flow is not disrupted
- Easy to install
- Low wear and tear by selecting the most suitable modules for the application
- Minimum maintenance requirements

Applications

The measuring devices in the FLOWSIC100 series can be used to measure gas flows in pipelines, flue gas and exhaust gas ducts, as well as chimneys. If configured accordingly, the devices can measure the flow rate in both clean and raw gases upstream of filter installations. As a result, applications range from determining the volume flow in open and closed-loop control systems used in process control to flow monitoring for emission measurements.

The system is suitable for use in the following areas:

- Operating measurements and emissions monitoring in:
  - Energy supply: Power station and industrial boilers for all energy sources
  - Waste disposal: Waste and residual waste incineration plants
  - Basic industries: Systems in the cement and steel industry
- Process control engineering
  - Chemical industry
  - Drying and processing systems in the pharmaceutical, food, and foodstuffs industries
  - Heat treatment and extraction plants used in plastics processing
- Flow measurements in ventilation, heating, and air-conditioning systems in both industry and agriculture

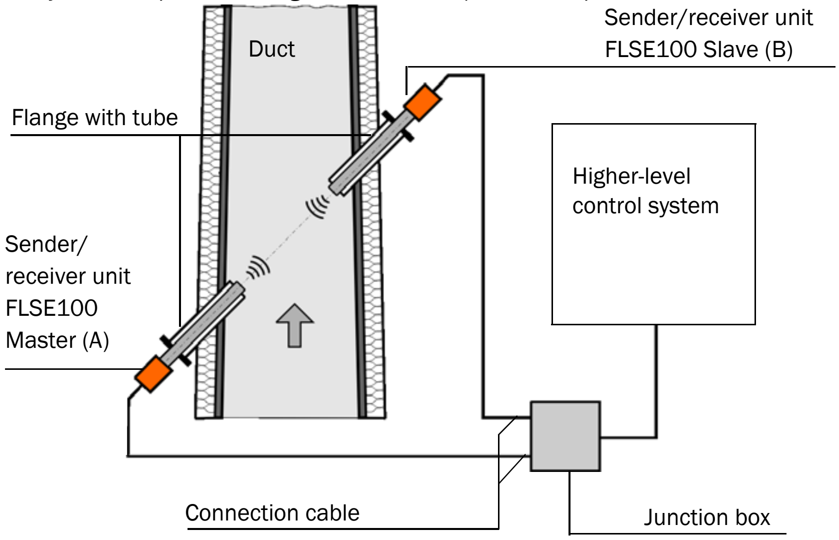
2.2 System overview and functional principle

2.2.1 System overview

The measuring system comprises the following components:

- FLSE100 sender/receiver unit
  For transmitting and receiving ultrasonic pulses, signal processing and controlling the system functions, data evaluation and output
- Flange with tube
  For mounting the sender/receiver units on the gas duct
- Junction box for connection cable
  For connecting the connection cables

Fig. 1 System components using FLOWSIC100 M/H as example

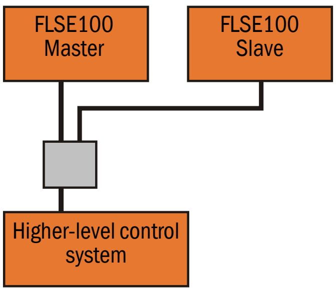


2.2.2 Communication between sender/receiver units and higher-level control system

The two sender/receiver units 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 the measured values from the master units independently of the measuring cycle (asynchronous to the measuring cycle).

For the cabling, the junction box used to separate the interfaces has to be installed on the master FLSE. The junction box is optional for FLOWSIC100 types PR and S (for longer cable lengths).

Fig. 2 Standard version (1 sensor pair)



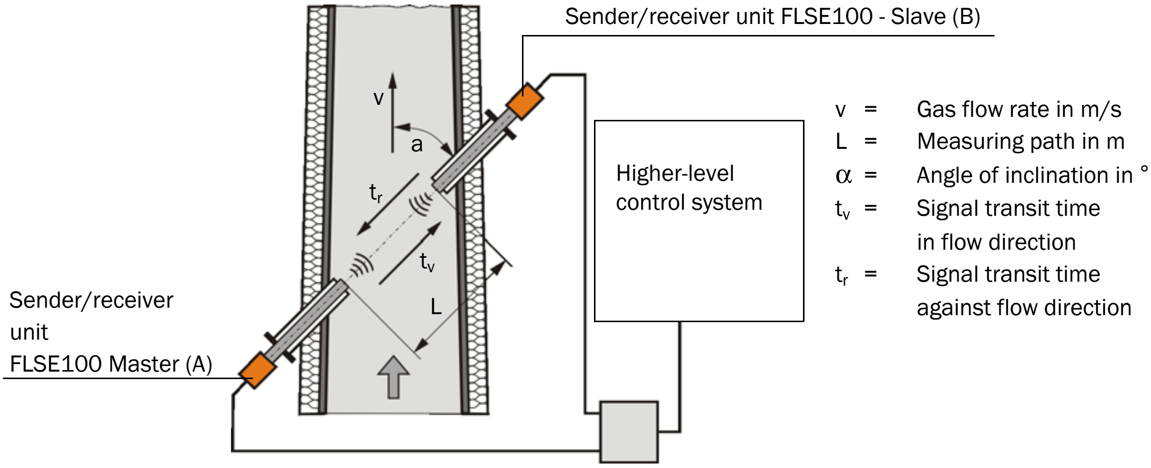
2.2.3 Functional principle

The FLOWSIC100 gas flow rate measuring devices operate according to the principle of ultrasonic transit time difference measurement. Sender/receiver units are mounted on both sides of a duct/pipeline at a certain angle to the gas flow.

These sender/receiver units contain piezoelectric ultrasonic transducers that function alternately as senders and receivers. The sound pulses are emitted at an angle α to the flow direction of the gas. Depending on angle α and gas flow rate v, 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 gas flow rate and the smaller the angle to the flow direction are, the higher the difference in the transit times of the sound pulses.

Gas flow rate v is calculated from the difference between both transit times, independent of the sound velocity value. Therefore changes in the sound velocity caused by pressure or temperature fluctuations do not affect the calculated gas flow rate with this method of measurement.

Fig. 3 Functional principle of the FLOWSIC100



Calculating the gas flow rate

Measuring path L is equal to the active measuring path, that is, the area through which the gas flows. Given measuring path L, sound velocity c, and angle of inclination α between the sound and flow direction, the sound transit time in the direction of the gas flow (forward direction) when the signal is transmitted can be expressed as:

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

Against the gas flow (backward direction):

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

After the resolution to v:

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

Apart from the two measured transit times, this relation only contains the active measuring path and the angle of inclination as constants.

Sound velocity

Sound velocity c can be calculated by resolving formulas 2.1 and 2.2.

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

Based on the dependencies in formulas 2.5 and 2.7, the sound velocity can be used to determine the gas temperature and for diagnosis purposes.

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

Calculating the gas temperature

Since the sound velocity is dependent on the temperature, the gas temperature can also be calculated from the transit times (by resolving formulas 2.4 and 2.5 to derive ϑ).

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

Formula 2.6 shows that, in addition to the measured transit times, the square of the values of L and the standard velocity are included in the calculation.

This means precise temperature measurement is only possible when the gas composition is constant, measuring path L has been measured extremely accurately and a calibration has been carried out (see Section → p. 84, 4.3).

Determining the volume flow

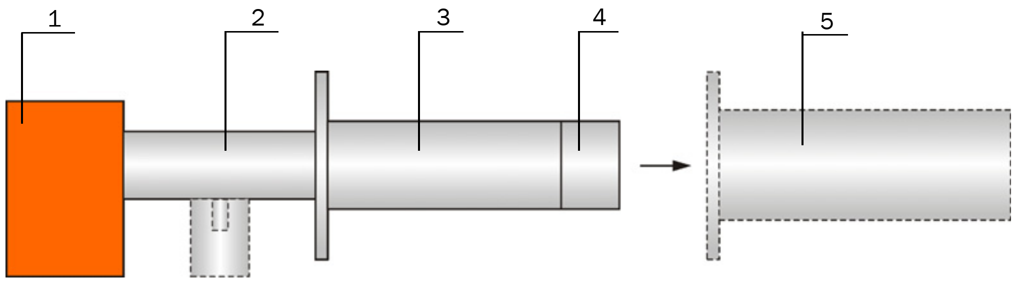
The volume flow in operating state is computed using the geometric constants of the duct.

2.3 System components

2.3.1 FLSE100 sender/receiver unit

The sender/receiver unit consists of the electronics, connector, duct probe, and transducer modules. These modules are available in different versions that can be combined on the basis of the relevant application data to produce the optimum configuration for the application in question.

Fig. 4 Schematic diagram with modules of the sender/receiver unit and flange with tube



1 Electronics unit
2 Connection piece
3 Duct probe
4 Transducer
5 Flange with tube

The modules are selected on the basis of the following criteria:

- Gas temperature
  Selection of the duct probe according to type of material
- Gas composition (corrosive / slightly corrosive or not corrosive)
  Selection of the duct probe and transducers on the basis of their resistance to corrosion
- Duct diameter, sound dampening, dust content
  Selection of the transducers on the basis of the required transmitter power (medium power / high power)
- Dust properties
- Wall and insulation thickness of the gas duct
  Selection of the duct probe and flange with tube according to the nominal length (graded standard lengths). Other lengths can be supplied on request.
- Assembly type
  On two sides, each with a sender/receiver unit on the opposite duct walls, or on one side with one sender/receiver unit (as measuring probe version)
- Internal duct pressure
- Certification requirements
  Selection after performance tests for emission measuring.

The various configuration options are identified by a type code structured as follows:

Type code sender/receiver unit: **FLSE100-XX XX XX XX**

Ultrasonic transducer
- M: Medium power
- H: High power
- S: Low power with small dimensions (Small size)
- PR: Low power with small dimensions and measuring probe version

Signal transmission
- D: Digital (identification for FLSE100-SD only)
- A: Analog (identification for FLSE100-SA only
- Empty: Digital

Nominal length of duct probe
- 12: 125 mm
- 20: 200 mm
- 35: 350 mm
- 55: 550 mm
- 75: 750 mm

Duct probe material
- SS: 1.4571 (stainless steel)
- TI: Titanium
- HS: Hastelloy

Transducer material
- TI: Titanium
- HS: Hastelloy

Example: **FLSE100-M 35SSTI**

Medium transducer power
Duct probe nominal length 350 mm
Duct probe material 1.4571
Transducer made of titanium

The possible versions, areas of application, configurations, and characteristics are listed in the following Tables.

Basic versions

Type FLSE100	Description	Number of FLSE100 per system
M 	● Not purged ● Medium power ● Digital signal transmission to higher-level control system	2
H 	● Not purged ● High power ● Digital signal transmission to higher-level control system	2
PR 	● Not purged ● With two transducers, small size and high frequency ● Version as measuring probe for installation on one duct side ● Digital signal transmission to higher-level control system	1
SA/SD 	● Not purged ● With one small size and high frequency transducer ● Digital signal transmission to higher-level control system	1 each

Application range

Type FLSE100	Material Duct probe	Material Transducer	Max. gas temperature [°C]	Active meas. distance 2) [m]	Duct/pipe diameter [m]
M	SS, TI	TI 1)	260	0.2 - 4	0.15 - 3,4
	Hastelloy 1)			0.2 - 2	0.15 - 1,7
H	SS, TI	TI 1)		2 - 15	1.4 - 13
				1.5 - 2.5 3)	1.1 - 2.5 4)
	Hastelloy 1)			2 - 5	1.4 - 4.3
PR	SS, TI	TI 1)		0.27 - 0.28	> 0.40
SA/SD	SS 1)		150	0.2 - 1.4	0.15 - 1

1): On request

2): The maximum possible measuring path depends on the dust content, gas temperature, and gas composition

3): For extremely high dust concentrations up to max. 100 g/m^3

4): For installation across secant (→ p. 38, 3.1.3)

Duct probe configuration options

Type FLSE100	Duct probe							
	Nominal length in mm					Material		
	125	200	350	550	750	SS	TI	HS
M		x	x	x		x	x	x
H		x	x	x	x	x	x	x
PR			x	x	x	x	x	
SA/SD	x	x	x			x		

2.3.1.1 Standard sender/receiver units

A special transducer design makes it possible to use these sender/receiver units without cooling by external purge air even with higher gas temperatures. A purge air unit is therefore not necessary. The advantages are:

- Lower expense for mounting and installation
- Easier maintenance
- Lower operating costs.

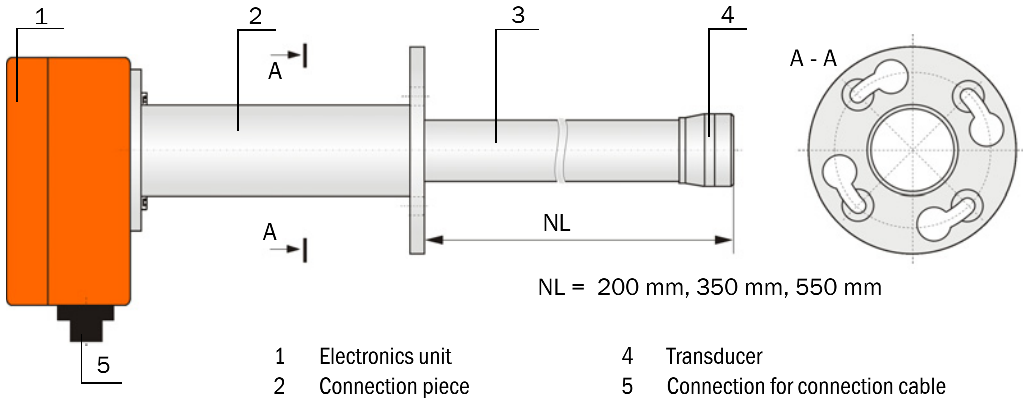
For these reasons, standard sender/receiver units should be used where possible.

- The types FLSE100-M, H and PR intended for use with gas temperatures up to max. 260 °C. The types FLSE100-SA and SD are intended for use up to 150 °C.
- The measuring system FLOWSIC100 S contains one sender/receiver unit FLSE100-SA and FLSE100-SD and one connection cable between the sender/receiver units.
- The type FLSE100-SA has no electronics unit. Communication to the FLSE100-SD as master runs via an analog connection cable (fixed length: 3 m). Install one FLSE100-SA and one FLSE100-SD per sampling point (1-path configuration).
- Fit the sender/receiver units at an angle of 60° to the gas flow direction for dust concentrations > 1 g/m³ (only applicable for FLSE100-H). The downstream sender/receiver unit (B in → p. 16, Fig. 3) has to be equipped with an impact protector.

The following differences exist in addition to the possible versions:

Type FLSE	Transducer and duct probe
M	Nominal diameter 35 mm
H	Nominal diameter 60 mm
PR	Measuring probe version (2 transducers)
SA, SD	Duct probe Ø 35 mm, transducer 15 mm

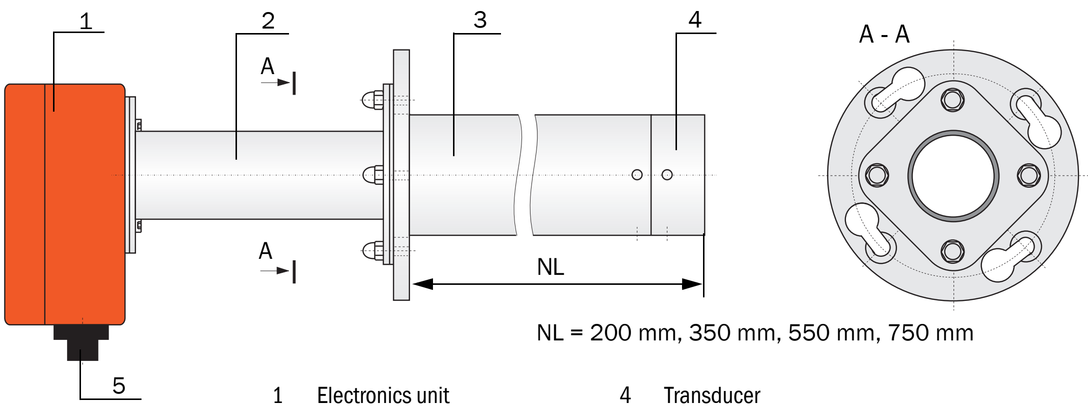
Fig. 5 FLSE100-M



1 Electronics unit
2 Connection piece
3 Duct probe
4 Transducer
5 Connection for connection cable

> The type FLSE100-M is also available with other flanges on request (→ p. 92, 6.3.1).

Fig. 6 FLSE100-H



1 Electronics unit
2 Connection piece
3 Duct probe
4 Transducer
5 Connection for connection cable

Fig. 7 FLSE100-PR

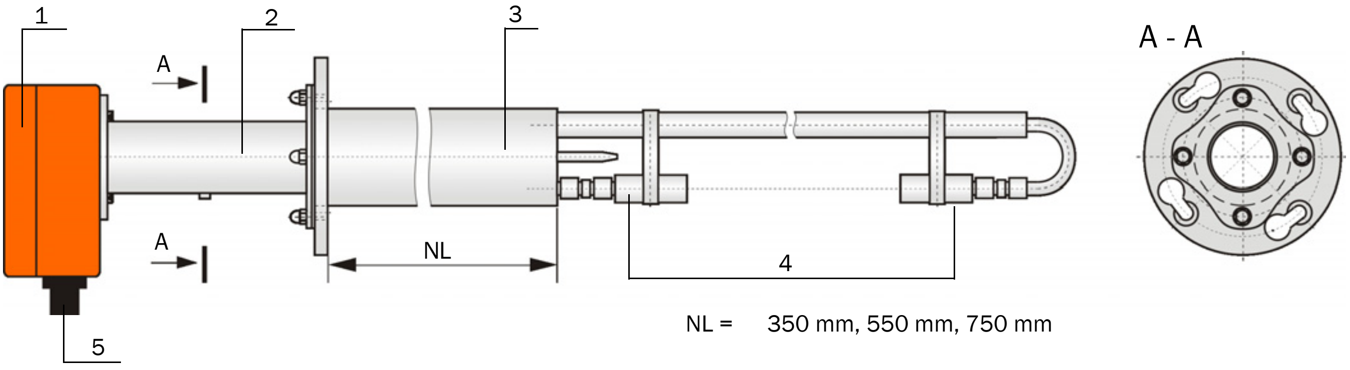


Fig. 8 FLSE100-SA

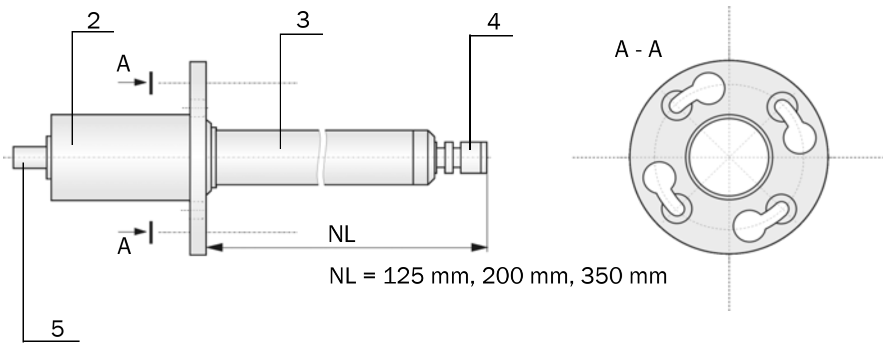
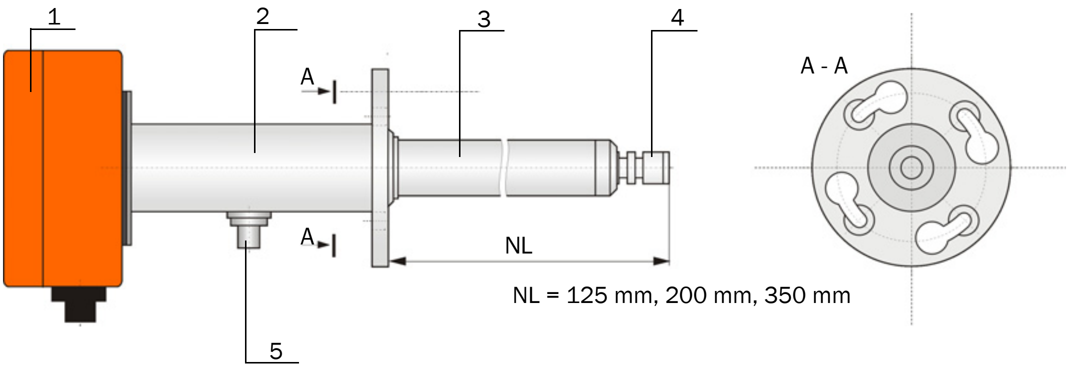


Fig. 9 FLSE100-SD



1 Electronics unit
2 Connection piece
3 Duct probe
4 Transducer
5 Connection for connection cable

2.3.2 **Flange with tube**

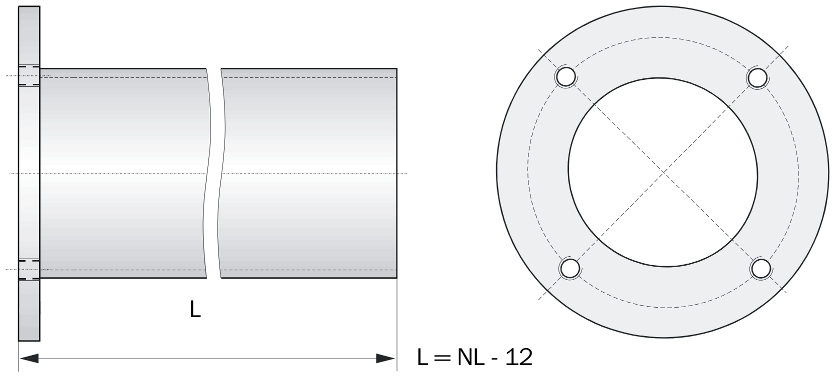
The sender/receiver units are mounted in flanges with tube available in graded nominal lengths, different steel types and pitch diameters.

Selection of a flange with tube depends on:

- Installation angle and wall and insulation thickness of duct wall
  → Determining the nominal length (Assembly and installation Chapter, → p. 31)
- Type of sender/receiver unit
  → Pitch diameter of flange, pipe diameter
- Duct material
  → Steel type

> +i If required, the flanges with tube can also be delivered in advance.

Fig. 10 Flange with tube

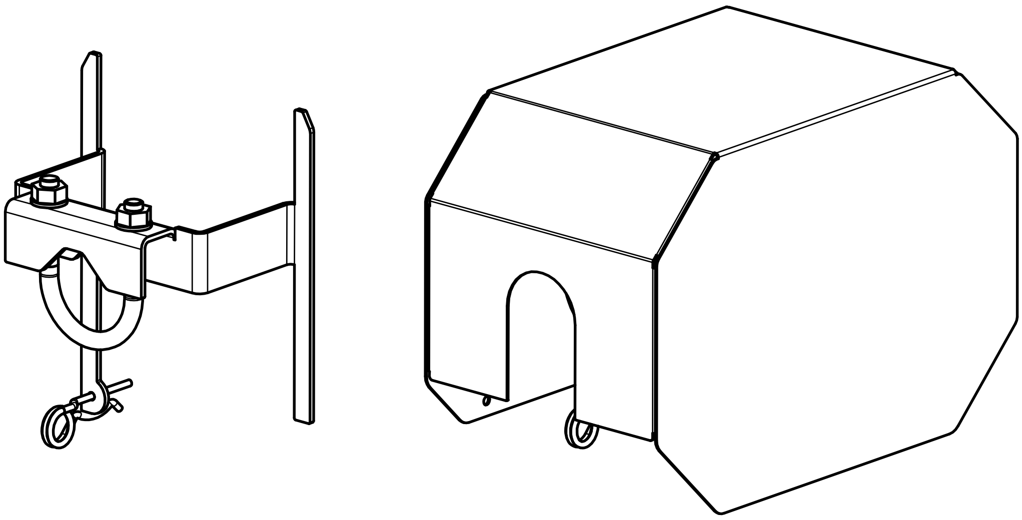


Type FLSE100	Nominal length in mm	Material
S	125	St37, V4A (others on request)
S, M	200	
S, M, H, PR	350	
M, H, PR	550	
H, PR	750	

2.3.3 Weather hood

The weather hood protects the electronics of the sender/receiver unit against sunlight and rain.

Fig. 11 Weather hood with holder

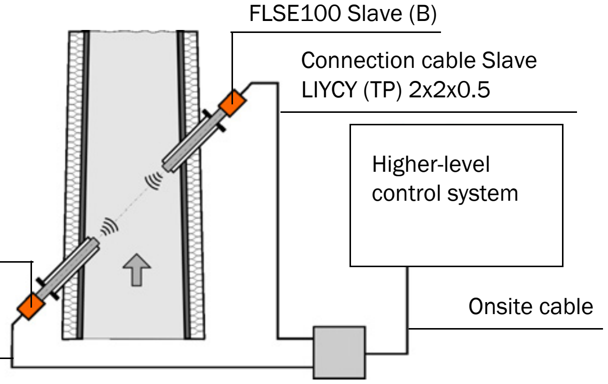


2.3.4 Connection cable

The connection cables master (Master FLSE100) and slave (Slave FLSE100) are used to connect the sender/receiver units with the higher-level control system. Both cables are available in different lengths. The connection cable master is marked with a red marker behind the cable box.

Fig. 12 Connection cable

Standard cables
FLOWSIC100 S (length 3 m),
all other FLOWSIC100 variants (length: 5 m, 10 m, 50 m)



Cables provided onsite must fulfill the following requirements:
- Lead/lead operational capacity less than 110 pF/m
- Min. lead cross-section 0.5 mm^2 (AWG20).

We recommend cable type UNITRONIC Li2YCYv(TP) 2x2x0.5 mm^2 with reinforced outer sheath (from Lappkabel).

2.4 Computations

2.4.1 Calculating and calibrating the volume flow

Volume flow in operating state

Acoustic velocity monitors from the FLOWSIC100 series are usually used to determine the volume flow in closed pipes and ducts. The volume flow $Q_{a.c.}$ through the representative cross-sectional area A and the mean gas flow rate across the cross-section v_A (area velocity) is defined as:

$$Q_{act.} = v_A \cdot A$$

The FLOWSIC100 Transmitter however, determines the representative mean value of the flow velocity on a sound path v (path velocity) between the two sender/receiver units. The sound path is generally arranged across the diameter (→ p. 33, 3.1.1).

Since the mean values of the path and area velocity are not identical (particularly in small duct diameters), a functional, systematic correlation between the calculated path velocity and the mean area velocity similar to the point-based flow measurement (for example, a pitot tube probe) has been introduced.

$v_A = K \cdot v$ K = correction function

The correction factor k can be used for K with unimpeded, axial-symmetric flow profiles in round pipes. The correction factor k enters the velocity correction as cv_1.

$$k = \frac{v_A}{v} \qquad 0.9 < k < 1$$

In many cases, however, an unimpeded, axial-symmetric flow profile is not guaranteed due to the installation conditions (short inlet sections, rectangular ducts, unsymmetrical flow profiles, and so on). For this reason, a second degree calibration function has been implemented in FLOWSIC to show the relation between middle path and area velocity.

$$v_A = Cv\_2 \cdot v^2 + Cv\_1 \cdot v + Cv\_0$$

> If the flow in a round pipeline is unimpeded and axial-symmetric, Cv_1 is equal to the correction factor k.

The coefficients in this calibration function can be determined by means of network measurements and regression analysis (see DIN EN 13284-1). The calculated regression coefficients must then be entered in the measuring device using SOPAS ET (→ p. 84, 4.3).

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

2.4.2 Temperature calibration

The temperature measurement must be calibrated for exact calculation of the flue gas temperature with the FLOWSIC100 Transmitter. There are only two cases where this calibration is not necessary:

- Exact knowledge of the sound velocity in the flue gas under standard conditions (1013 mbar, 0 °C), as is the case with air, for example, (331 m/s)
- Exact knowledge of the active measuring path.

Calibration is carried out using a reference measurement with a separate temperature sensor (for example, Pt100) with at least 2 different temperatures (calculating and entering the coefficients → p. 84, 4.3).

2.5 Check cycle

A check cycle can be triggered on the FLOWSIC100 Transmitter to test whether the device components are functioning correctly. The check cycle can also be triggered automatically (the interval can be set using the operating program) and/or also manually via the SOPAS user interface. Any deviations from normal behavior are output as a warning.

If a malfunction is present or a warning is displayed, a check cycle can be triggered manually to locate the cause of the problem (see Service Manual).

The check cycle consists of a zero point control. The check values can be output 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.

- For the duration of the check cycle (approx. 6 seconds if there are no errors in the sensor), the last measured velocity value is output in the SOPAS user interface and MODBUS.
- Zero point check and check cycle can be triggered manually via the SOPAS user interface in the "Manual Function Check" menu.
- Automatic check cycles are carried out periodically from the configured time interval, until the interval setting is changed (or the device is reset). After a device reset (or power failure), the check cycle begins at the defined time when the device resumes operation.
- If the automatic check cycle and check cycle triggered manually via the SOPAS user interface occur at the same time, only the cycle triggered first takes effect.

The detailed description of the MODBUS protocol is available as a separate document on the product CD.

2.5.1 Zero point control

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 path and gas temperature). In this case, check the transducers and electronic components. If the signal amplitude 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”

2.5.2 Measuring path arrangement

No direct path arrangements can be given, as this is the responsibility of the plant operator. Suggestions for possible measuring path arrangements can be taken from the corresponding standards (e.g. ISO 16911-2, ...).

FLOWSIC100 Transmitter

3 Assembly and electrical installation

Project planning
Assembly
Electrical installation

3.1 Project planning

The following Table provides an overview of the project planning work to be carried out to ensure the device is correctly installed and fully functional. You can use this Table as a checklist by ticking off all the steps you have carried out.

Task	Requirements		Work step	☑
Determine the measuring and installation locations for the device components (→ p. 33, 3.1.1)	Inlet and outlet sections must be of sufficient length Homogeneous flow distribution	If possible, no bends, cross-section variations, feed pipes, discharge pipes, flaps, or fittings in the inlet and outlet sections	Comply with specifications for new installations; choose the best possible location for existing installations; if necessary, determine flow profile in accordance with DIN EN 132841; if inlet/outlet sections are too short: Inlet section > outlet section.	☐
	Accessibility, accident prevention	Device components must be easily and safely accessible	Provide platforms or pedestals when necessary	☐
	Vibration-free installation	Accelerations < 1 g	Take appropriate measures to eliminate/reduce vibrations	☐
	Ambient conditions	Limit values in accordance with Technical Data	If necessary: Fit weather hoods/sun protection Cover or insulate device components.	☐
Choose the device components	Internal duct diameter	Type of sender/receiver unit	Choose components according to the Configuration Table and information in → p. 18, 2.3. If necessary, plan additional measures to install the flange with tube (→ p. 41, 3.2.1).	☐
	Duct wall strength with insulation	Nominal length of sender/receiver unit, flange with tube		
	Internal duct pressure	Type of sender/receiver unit		
	Gas temperature	Type of sender/receiver unit		
	Dust concentration	Type of sender/receiver unit		
	Gas composition	Material of duct probe and transducer		
	Installation locations	Cable lengths		
Plan the calibration openings	Accessibility	Easy and safe	Provide platforms or pedestals when necessary	☐
	Distances to the measurement level	No mutual interference between calibration probe and FLOWSIC100 Transmitter	Ensure sufficient distance between the measurement and calibration level (approx. 500 mm)	☐
Plan the voltage supply	Operating voltage, power requirements	In accordance with Technical Data in → p. 90, 6.1	Ensure sufficient cable cross-sections and fuse	☐

3.1.1 Determining the measurement and installation location

Flow profile

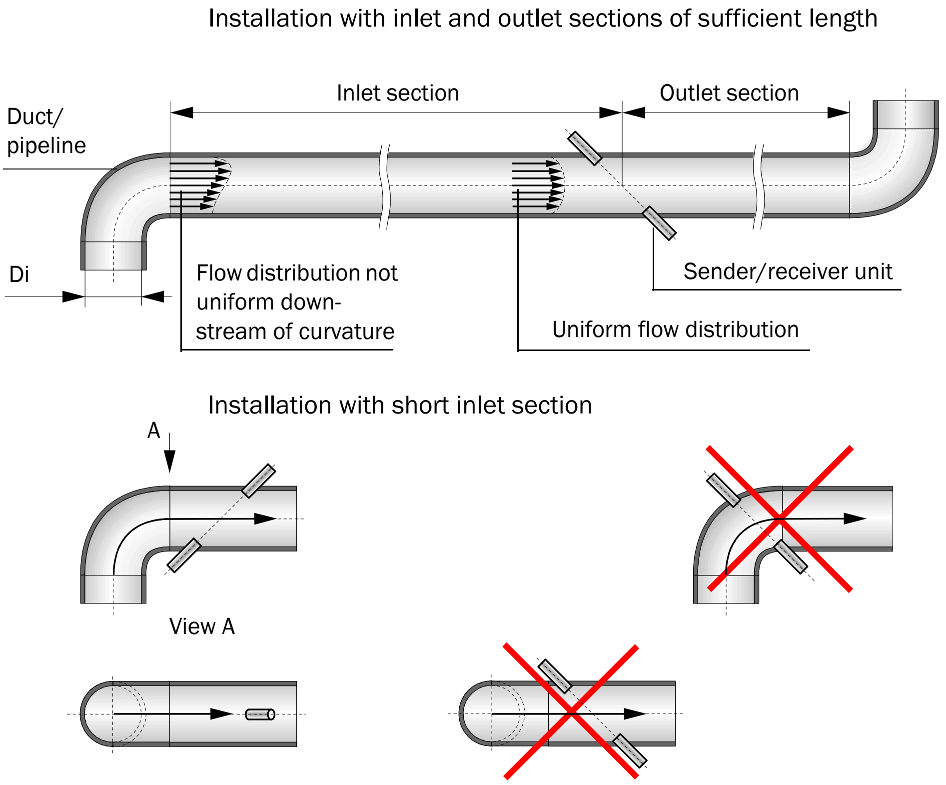
Measuring precision is subject to the flow conditions and the position of the measurement axis. Significant changes in the cross-section, duct curvatures, fittings in the duct, air dampers, or inlets can cause profile deformations or turbulence that will impair the result of the measurement. To ensure measurement is as accurate and trouble-free as possible, select a measuring location where the gas flow is, to a large extent, homogeneous (→ Fig. 13).

Regular, unimpeded profiles are most likely with long inlet and outlet sections. The longer the inlet section, in particular, the greater the reproducibility of the measurement results. If possible, the inlet section should be more than 20 times greater, and the outlet section 10 times greater than the internal diameter of the duct (Di). With rectangular cross-sections, the diameter is calculated as 4 times the cross-section divided by the duct circumference.

On existing installations, choose the optimum location.

If flow conditions are uncertain, measure the profile at the measuring location, for example, using dynamic pressure probes (see DIN EN 13284-1). Calibration apertures must be provided for this purpose. The measuring axis must then be defined in such a way that any changes in the profile will only have a minimum impact on the result of the measurement.

Fig. 13 Installing the sender/receiver units



Installation location

The sender/receiver units can be installed on vertical, horizontal, or inclined ducts or pipelines. In vertical stacks, a minimum distance from the stack outlet must be observed to prevent noise disturbance caused by rain drops on the probe head.

The installation location for the device components must be as free as possible from vibrations.

The installation location should be equipped with power connections and permanent lighting.

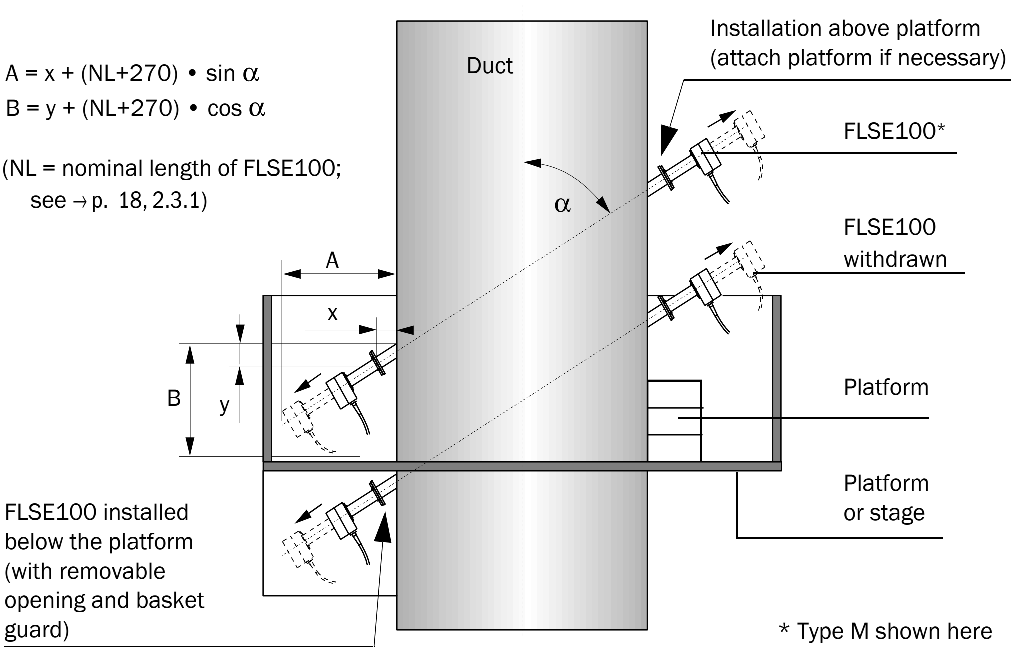
Platform

The sender/receiver units must be easily accessible for installation and maintenance. If necessary, provide a suitably wide platform secured by a handrail.

> **WARNING:**
> The plant operator is responsible for ensuring that the applicable accident prevention and occupational health and safety regulations are observed.

In vertical ducts, the installation angle should be selected depending on the duct diameter so that only one platform is necessary. An additional basic platform and/or sealable opening in the platform with a protection cage or similar can be helpful (→ Fig. 14). Ensure sufficient clearance is provided for installing and removing the sender/receiver units.

Fig. 14 Installing the sender/receiver units on a vertical duct



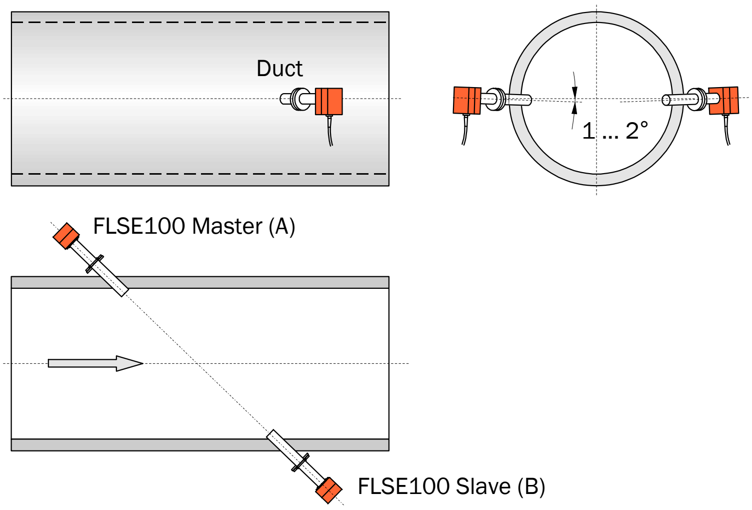
> Select an installation angle of 60° for duct diameters as from approx. 4.5 m.

3.1.2 Further planning information

Installing the FLSE100 in horizontal ducts

On horizontal ducts and pipelines, the sender/receiver units should be installed slightly inclined from horizontal to prevent possible condensate from entering the duct (→ Fig. 15).

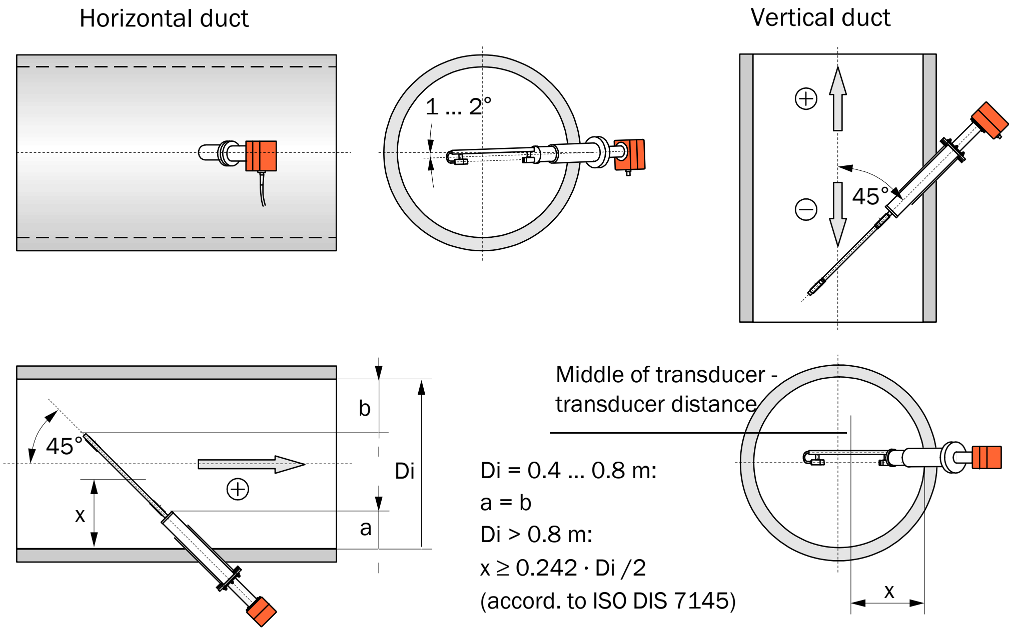
Fig. 15 Installing the sender/receiver units on horizontal ducts



> **NOTICE:**
> On FLOWSIC100 S devices, the sender/receiver unit FLSE100-SD with electronics unit is the master.

Installing the sender/receiver unit type FLSE100-PR

Fig. 16 Installing the sender/receiver unit type FLSE100-PR



x = representative wall clearance at which the local gas flow rate is the same as the mean velocity in the duct cross-section

Sender/receiver units with special lengths can be delivered if the condition for x with standard nominal lengths cannot be observed.

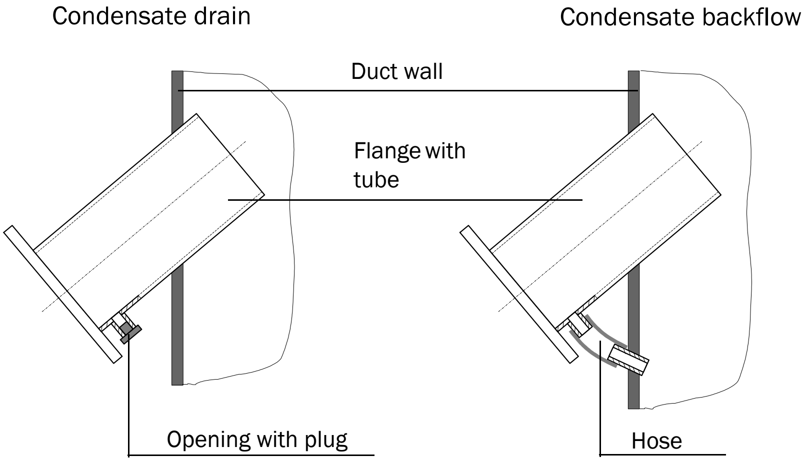
> +i For vertical ducts, a negative sign is output for a flow direction from top to bottom. To change the displayed values to positive values, enter a negative linear regression coefficient (→ p. 84, 4.3).

Preventing condensate accumulations

If standard sender/receiver units are installed in vertical ducts, wet gases can cause condensate to accumulate in the flange tube of sender/receiver unit A (→ p. 16, Fig. 3). The following onsite solutions can help prevent measuring problems (malfunctions caused by solid-borne noise, see Service Manual), or damage when removing the sender/receiver unit (condensate runs out):

- Completely insulating the flange with tube (reduces temperatures on the flange with tube below the dew point)
- Draining continuous or periodical condensate through an opening (if necessary closeable) at the deepest point of the flange tube (e.g. hole Ø 4 mm with plug: → Fig. 17) (only when the condensate cannot damage the system or the environment)
- Returning the condensate to the duct through a hose connection between flange tube and duct (→ Fig. 17).

Fig. 17 Condensate drain / backflow



Using the sender/receiver units with high dust contents (> 1 g/m³)

The measuring path must be as short as possible. This requires installing the sender/receiver units at an angle of 60° to the flow direction.

In addition, fit impact protectors on the downstream sender/receiver unit (→ p. 16, Fig. 3) to prevent particles impacting on the transducer surface causing malfunctions impairing measuring behavior.

For further options, see → »Shortening the measuring path« (page 39)

3.1.3 **Selecting the flanges with tube**

The criteria listed under → p. 24, 2.3.2 are applicable for selection.

Inside coated ducts

The following points must also be taken into account when the inside of the duct/pipeline is coated (rubber insulation):

- Since the inside of the flange tubes also has to be coated, it might be necessary to select flange tubes with a larger inside diameter. The minimum distance between the probe tube and flange tube is 3 mm.
- If a standard flange with tube cannot be used, make the flanges with tube onsite (deliverable by Endress+Hauser on request).
- To ensure coating is complete, the flanges must be mounted before being coated.

Plastic ducts

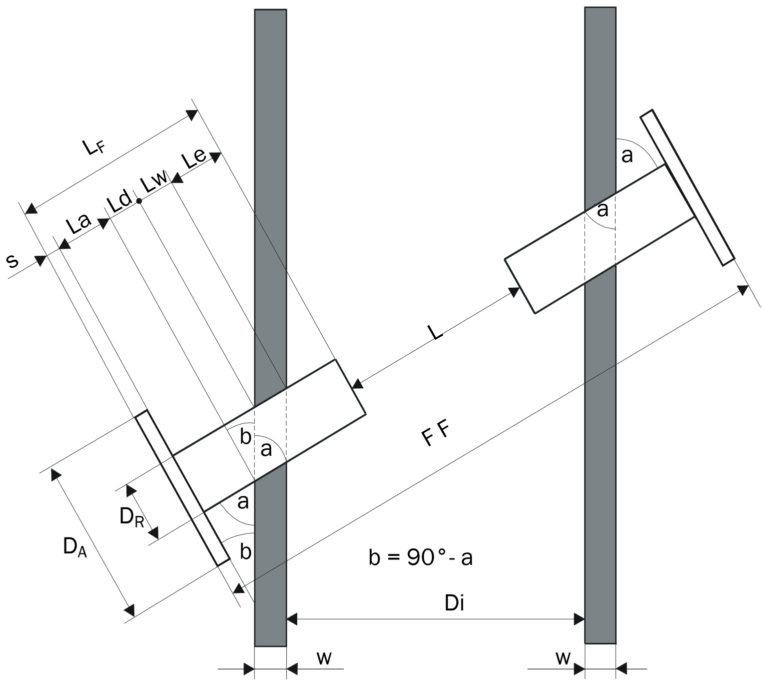
The standard flanges with tube generally cannot be used for plastic ducts/pipelines. Possible solutions (to be carried out onsite):

- On GRP ducts[1]: Laminate the steel core with pitch diameter of the mounting holes. The inside diameter of the laminated flange tube must match the selected FLSE100.
- Use flanges with tube made from duct/pipe material; weld-mount or fit with plastic adhesive.
- Mount adapter flanges on openings prepared onsite.

Determining the nominal length

The required nominal length of the flanges with tube can be determined using the following Figures.

Fig. 18 Determining the nominal length of the flanges with tube



Dimensions in mm

- Lf = Length of flange with tube (minimum)
- Le = Draw-in length (min. 20)
- D_A = Outer diameter of flange
- D_R = Outer diameter of tube
- α = Installation angle
- s = Flange thickness = 10
- L = Active measuring path (input value)
- w = Thickness of duct wall + insulation
- Di = Inside diameter of duct

$$Lw = \frac{w}{\sin\alpha}$$

$$Ld = D_R \cdot \tan\beta$$

$$La_{min} = \frac{(D_A - D_R)}{2} \cdot \tan\beta$$

$$L_{Fmin} = s + \frac{(D_A + D_R)}{2} \cdot \tan(90° - \alpha) + \frac{w}{\sin\alpha} + Le$$

$$L = \frac{Di}{\sin\alpha} - 2 \cdot Le - Ld$$

1 GRP = glass fiber reinforced plastic

Maximum possible wall (and insulation) thickness as a function of the nominal length of the flanges with tube, flange size (pipe diameter D_R) and installation angle α (Le = 20 mm):

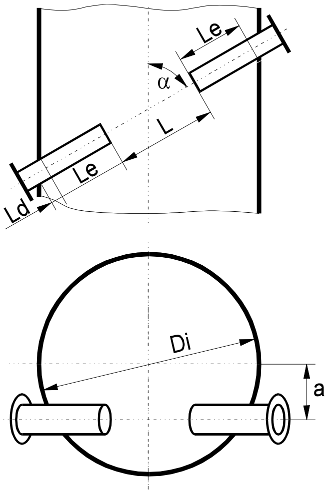
Nominal length L_F [mm]	Maximum wall and insulation thickness w [mm]					
	D_R = 114.3		D_R = 76.1		D_R = 48.3	
	α = 45°	α = 60°	α = 45°	α = 60°	α = 45°	α = 60°
125					15	45
200			49	97	68	110
350	112	196	155	227	174	240
550	253	369	297	400	315	413
750	395	543	438	573		

Shortening the measuring path

It may be necessary to shorten the measuring path to prevent problems in signal transmission in certain cases, e.g. when using FLSE100-H with high dust concentrations (→ p. 18, 2.3.1). This can be achieved by installing extended flange tubes and/or flanges with tube across the secant.

The installation conditions are shown in Fig. 19 and in the following Table.

Fig. 19 Installation across secant



L = Active measuring path
Le = 20 ... 500 mm
a_{max} = Di / 4
a = 60 °
Ld as in Fig. 18

With a = a_{max} and circular ducts then (α = 60°)

Di_{max}= L +2 Le + Ld

Correlation between inside diameter Di and measuring path L depending on draw-in length Le and installation type (dimensions in m):

Di	Measuring path L at a = 60°, Le = ... and installation across											
	Diameter										Secant	
	Le=0.05	Le=0.10	Le=0.15	Le=0.20	Le=0.25	Le=0.30	Le=0.35	Le=0.40	Le=0.45	Le=0.50	Le=0.50	a_{max}
1.00	1.01											
1.05	1.07											
1.10	1.13	1.03										
1.15	1.18	1.08										
1.20	1.24	1.14	1.04									
1.25	1.30	1.20	1.10	1.00								
1.30	1.36	1.26	1.16	1.06								
1.35	1.41	1.31	1.21	1.11	1.01							
1.40	1.47	1.37	1.27	1.17	1.07							
1.45	1.53	1.43	1.33	1.23	1.13	1.03						
1.50	1.59	1.49	1.39	1.29	1.19	1.09						
1.55	1.65	1.55	1.45	1.35	1.25	1.15	1.05					
1.60	1.70	1.60	1.50	1.40	1.30	1.20	1.10	1.00				
1.65	1.76	1.66	1.56	1.46	1.36	1.26	1.16	1.06				
1.70	1.82	1.72	1.62	1.52	1.42	1.32	1.22	1.12	1.02			
1.75	1.88	1.78	1.68	1.58	1.48	1.38	1.28	1.18	1.08			
1.80	1.93	1.83	1.73	1.63	1.53	1.43	1.33	1.23	1.13	1.03		
1.85	1.99	1.89	1.79	1.69	1.59	1.49	1.39	1.29	1.19	1.09		
1.90		1.95	1.85	1.75	1.65	1.55	1.45	1.35	1.25	1.15		
1.95		2.01	1.91	1.81	1.71	1.61	1.51	1.41	1.31	1.21		
2.00			1.97	1.87	1.77	1.67	1.57	1.47	1.37	1.27		
2.05				1.92	1.82	1.72	1.62	1.52	1.42	1.32	1.01	0.51
2.10				1.98	1.88	1.78	1.68	1.58	1.48	1.38	1.06	0.53
2.15					1.94	1.84	1.74	1.64	1.54	1.44	1.11	0.54
2.20					2.00	1.90	1.80	1.70	1.60	1.50	1.16	0.55
2.25						1.95	1.85	1.75	1.65	1.55	1.21	0.56
2.30							1.91	1.81	1.71	1.61	1.26	0.58
2.35							1.97	1.87	1.77	1.67	1.31	0.59
2.40								1.93	1.83	1.73	1.36	0.60
2.45								1.99	1.89	1.79	1.41	0.61
2.50									1.94	1.84	1.46	0.63
2.55									2.00	1.90	1.51	0.64
2.60										1.96	1.56	0.65
2.65											1.61	0.66
2.70											1.66	0.68
2.75											1.71	0.69
2.80											1.76	0.70
2.85											1.81	0.71
2.90											1.86	0.73
2.95											1.91	0.74
3.00											1.96	0.75

3.2 Assembly

All the assembly work has to be carried out onsite. This includes:

- Installing the flanges with tube or glands for high-pressure versions
- Installing the weather hoods

WARNING:
- When carrying out munting and installation work, observe the relevant safety regulations and safety information in § 1.
- Assembly and installation work on potentially dangerous installations (hot or corrosive gases, high internal duct pressure) must only be carried out when the system is shut down!
- Suitable protective measures must be taken to protect against local or system-specific danger.

3.2.1 Installing the flanges with tube

3.2.1.1 Duct/pipe diameter > 0.5 m

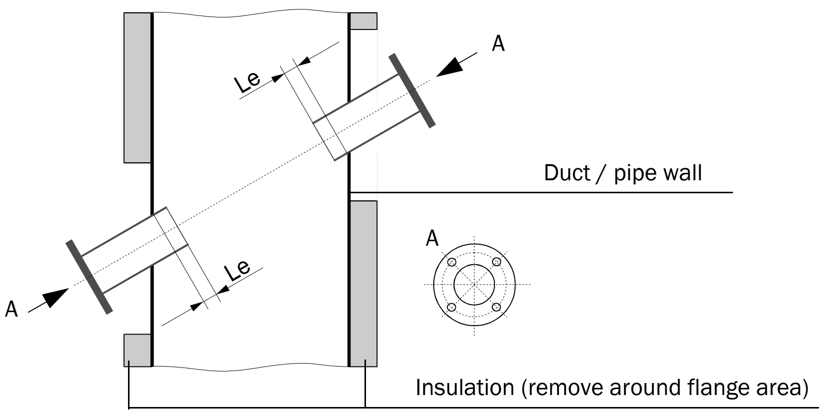
Work to be performed

- Measure out the installation location so that the planned installation angle is reached (if mounting two flanges with tube, observe the diameter) and mark the installation location.
- Remove the insulation (if present).
- Cut out suitable oval openings in the duct wall; drill suitably sized holes in brick and concrete ducts (see the Annex for templates for openings).

NOTICE:
Make sure parts cut off do not fall into the duct!

- Insert the flange with tube in the opening as shown in Fig. 20,
  - Observe the minimum draw-in length Le (>20 mm or as shown in Fig. 19 and Table)
  - Roughly align it and tack it into position with a few spot welds
  - With brick and concrete ducts, tack it to a holding plate (→ p. 42, Fig. 21).

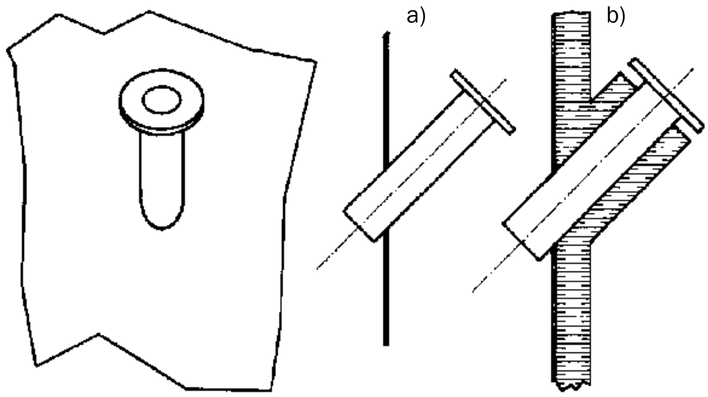
Fig. 20 Fitting the flanges with tube



When installing FLSE100-PR sender/receiver units, insert the flange with tube as far as possible into the duct (with the longest possible length Le).

Fig. 21 Fitting options for the flange with tube

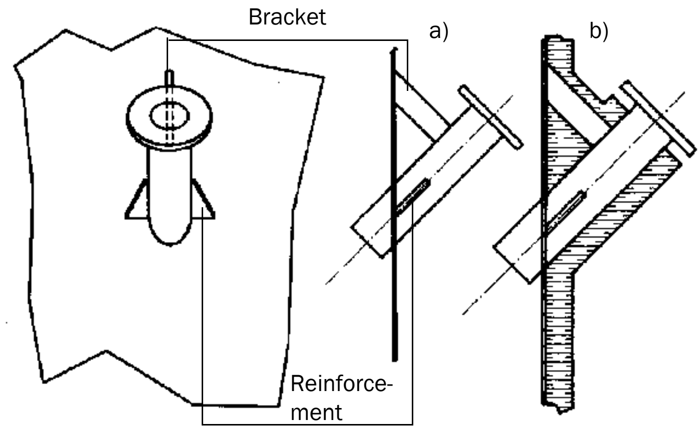
Flange with tube welded to a stable and sturdy steel wall



a) Duct without insulation

b) Duct with insulation

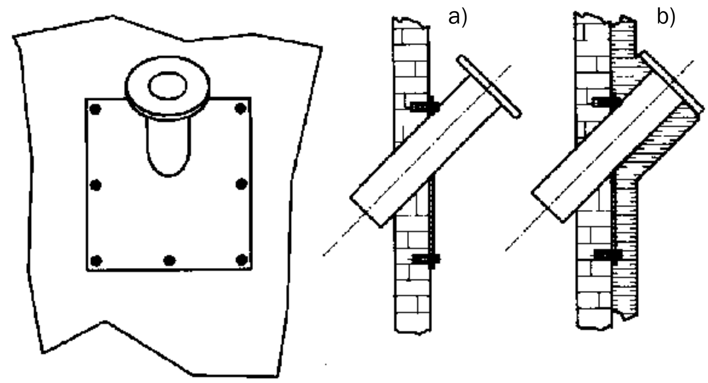
Flange with tube welded to thin steel wall



a) Duct without insulation

b) Duct with insulation

Flange with tube mounted on brick or concrete duct



a) Duct without insulation

b) Duct with insulation

- When fitting two flanges with tubes, align both exactly to each other after tacking using a suitable tube (for smaller ducts).
- Weld on the flange tubes, while constantly ensuring that the alignment is exact (correct if necessary).
- Measure and note the installation angle for configuring the parameters later.
- Measure and note the distance between the two flanges (dimension F-F in Fig. 18) and make a note of it for configuring the parameters later. The DME 2000 distance sensor from Endress+Hauser can be used (consult Endress+Hauser, if required) for this purpose.
- With thin-walled ducts/lines, provide suitable brackets/reinforcement to prevent distortion and vibration (→ p. 42, Fig. 21).
- Seal the flange with a blind plug (optional).
- Insulate the flange tube (if necessary).

+i
- When mounting two flanges with tube, the alignment of the two flange tubes has priority over the installation angle.
- Distortions as a result of temperature changes or mechanical stresses can change the measuring path.

3.2.1.2 Duct/tube diameter < 0.5 m

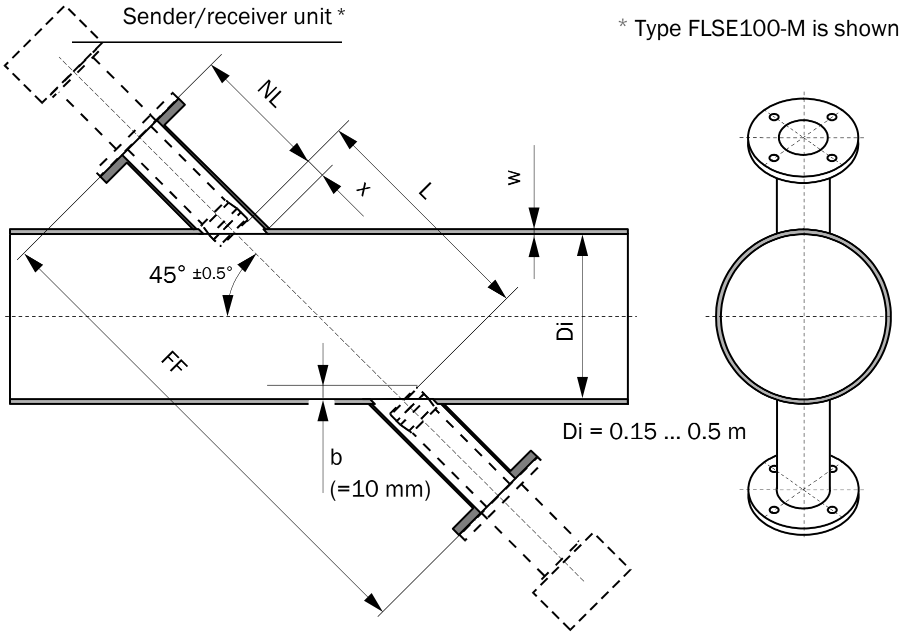
The work is generally the same as for larger diameters. The difference with small diameters is that installing the flanges and sender/receiver units can have a greater impact on the flow characteristics. To minimize this impact, the flange tubes should not be inserted in the pipeline, but rather mounted and welded flush on the outside.

Two options are available for installation (→ Fig. 22):

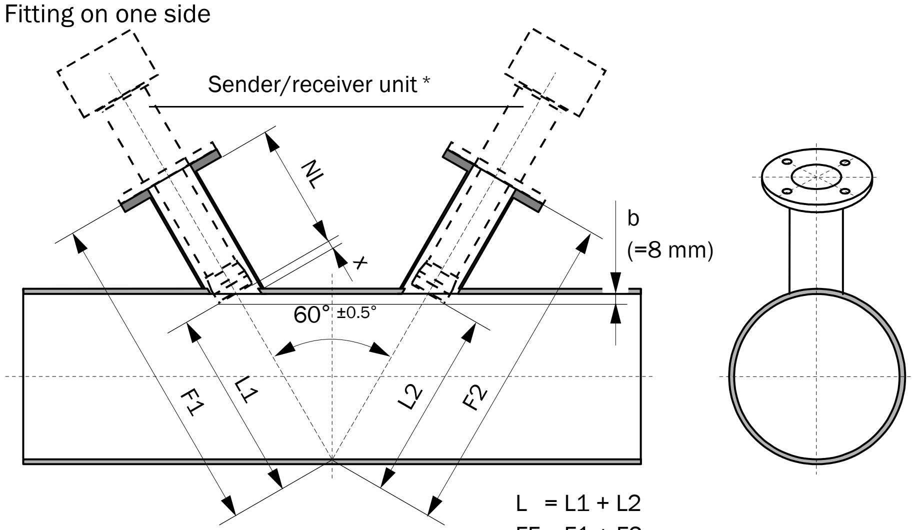
- On two sides
- On one side, using the sound reflection on the opposite inside wall. This solution can be used with very small ducts to lengthen the measuring path, or if access is only possible from one side.

Fig. 22 Fitting the flanges with tube

Fitting on both sides

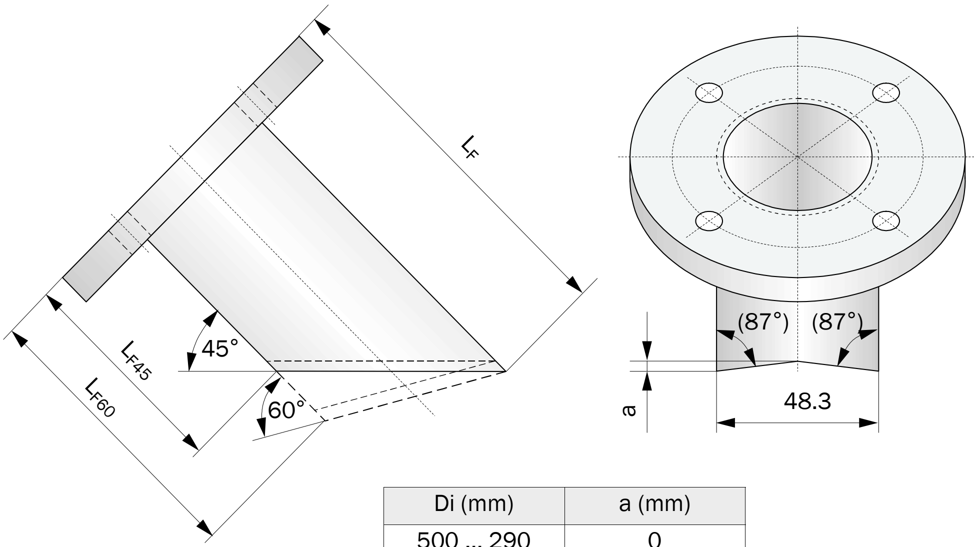


Fitting on one side



Carry out the following before fitting the flanges with tube:
- ▶ Cut out suitable oval openings in the duct wall (see Annex for templates).
- ▶ Bevel the flange tubes at an angle of 45° or 60°.
- ▶ If necessary, adapt the flange tubes to the wall curvature as shown in Fig. 23.

Fig. 23 Adapting the flanges with tube



Di (mm)	a (mm)
500 ... 290	0
290 ... 150	3

Flange tube length L_F (L_{F45}, L_{F60}) depends on installation angle α, wall thickness w and nominal length NL (→ Fig. 22, → Fig. 23). This correlation is expressed by the following formulas:

$$L_F = NL + x \qquad L_{F45} = L_F - 48.3 \qquad L_{F60} = L_F - 27.9$$

$$x = \frac{48,3 + 35}{2 \cdot \tan\alpha} - \frac{(w + b)}{\sin\alpha}$$

α	b
45°	10
60°	8

A selection of values is provided in the following Table. The Table shows that flanges with tube with the next longest nominal length than that of the sender/receiver units must be selected.

			Tube length L_F, L_{F45}/L_{F60} at nominal length NL									
			NL=125		NL=200		NL=310		NL=350		NL=550	
α	w	x	L_F	L_{F45}	L_F	L_{F45}	L_F	L_{F45}	L_F	L_{F45}	L_F	L_{F45}
45°	1	26.1	151.1	102.8	226.1	177.8	336.1	287.8	376.1	327.8	576.1	527.8
	2	24.7	149.7	101.4	224.7	176.4	334.7	286.4	374.7	326.4	574.7	526.4
	3	23.3	148.3	100.0	223.3	175.0	333.3	285.0	373.3	325.0	573.3	525.0
	4	21.9	146.9	98.6	221.9	173.6	331.9	283.6	371.9	323.6	571.9	523.6
	5	20.4	145.4	97.1	220.4	172.1	330.4	282.1	370.4	322.1	570.4	522.1
	6	19.0	144.0	95.7	219.0	170.7	329.0	280.7	369.0	320.7	569.0	520.7
	7	17.6	142.6	94.3	217.6	169.3	327.6	279.3	367.6	319.3	567.6	519.3
	8	16.2	141.2	92.9	216.2	167.9	326.2	277.9	366.2	317.9	566.2	517.9
	9	14.8	139.8	91.5	214.8	166.5	324.8	276.5	364.8	316.5	564.8	516.5
	10	13.4	138.4	90.1	213.4	165.1	323.4	275.1	363.4	315.1	563.4	515.1
α	w	x	L_F	L_{F60}	L_F	L_{F60}	L_F	L_{F60}	L_F	L_{F60}	L_F	L_{F60}
60°	1	13.7	138.7	110.8	213.7	185.8	323.7	295.8	363.7	335.8	563.7	535.8
	2	12.5	137.5	109.6	212.5	184.6	322.5	294.6	362.5	334.6	562.5	534.6
	3	11.3	136.3	108.5	211.3	183.5	321.3	293.5	361.3	333.5	561.3	533.5
	4	10.2	135.2	107.3	210.2	182.3	320.2	292.3	360.2	332.3	560.2	532.3
	5	9.0	134.0	106.1	209.0	181.1	319.0	291.1	359.0	331.1	559.0	531.1
	6	7.9	132.9	105.0	207.9	180.0	317.9	290.0	357.9	330.0	557.9	530.0
	7	6.7	131.7	103.8	206.7	178.8	316.7	288.8	356.7	328.8	556.7	528.8
	8	5.6	130.6	102.7	205.6	177.7	315.6	287.7	355.6	327.7	555.6	527.7
	9	4.4	129.4	101.5	204.4	176.5	314.4	286.5	354.4	326.5	554.4	526.5
	10	3.3	128.3	100.4	203.3	175.4	313.3	285.4	353.3	325.4	553.3	525.4

Matching flanges with tube can be provided by Endress+Hauser on request (please specify with order).

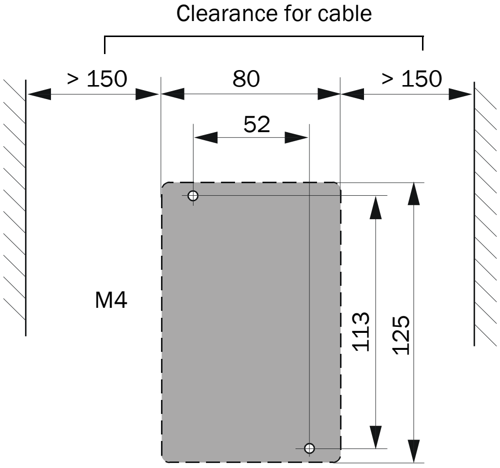
A tube with suitable diameter can be used to align the flange tubes for face-to-face mounting.

After welding, determine and note measure F-F (→ p. 44, Fig. 22) for later parameter setting.

3.2.2 Installing the junction box

Install these subassemblies on a level base plate (secure with 2 M4x20 bolts).

Fig. 24 Junction box assembly dimensions



> Suitable fastening sets are available for installation on stone / concrete ducts.

3.2.3 Installing the sender/receiver units

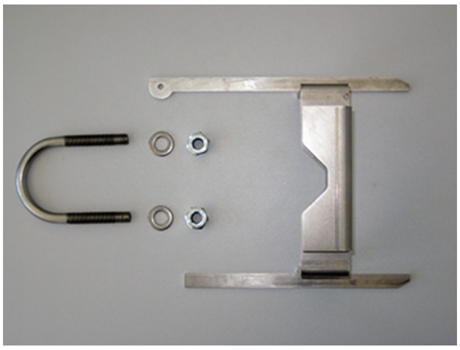
Check the following points before installing the sender/receiver units in the prepared flange tubes:

- The sender/receiver units must have at least the same nominal length as the flanges with tube (→ p. 24, 2.3.2).
- The inside of the flange tubes must be free of welding beads.
- Optional: Fitting an impact protector on the sender/receiver unit (→ p. 49, §3.2.5)
- The inside of the probe tubes on the sender/receiver units must not come into contact with the flange tubes.
- The cable connection on the electronics unit for sender/receiver units with digital signal transmission must be at the bottom.

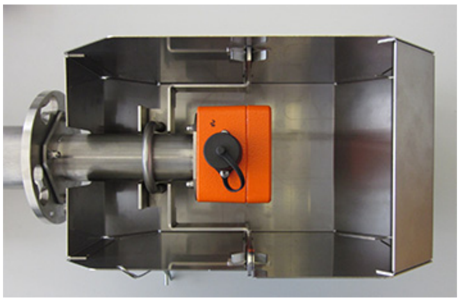
> For type FLSE100-PR and under consideration of the fitting specifications as shown in → p. 36, Fig. 16, when necessary, loosen the screw connections between the electronics unit and PR connection, rotate the device to the required position (90°, 180°, 270°) and then screw the parts back together again.

3.2.4 Installation of the weather hood for the sender/receiver units

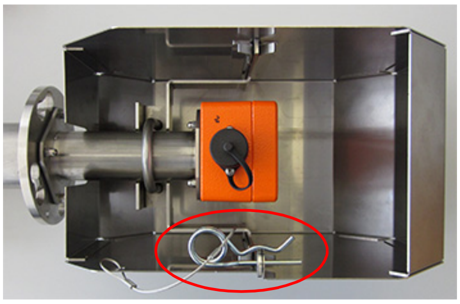
▸ Fix the holder to the sender/receiver unit:
- Use the fixing accessories to attach the holder with round steel bow to the probe neck of the FLSE100
- Pay attention to the correct alignment of the holder. See adjacent figure.



▸ Position the protective hood on the holder.



▸ Secure the weather hood with the split pin.



3.2.5 Installation of impact protector/dust protector option

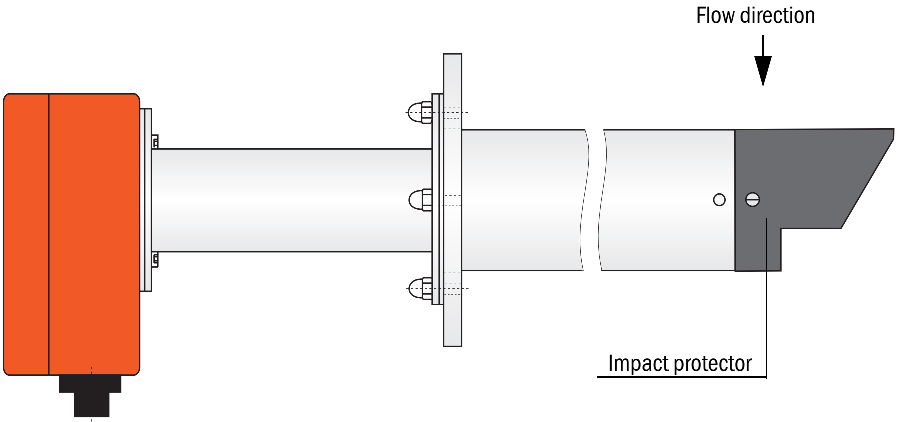
3.2.5.1 Impact protection for FLSE100-H

The impact protector option is intended for the use of the FLOWSIC100 Transmitter in high-dust applications or applications with particle sizes > 0.5 mm. Installing this component provides effective protection for the surface of the ultrasonic transducer against particle impact.

It is normally sufficient to fit the impact protector on the downstream sender/receiver unit (probe B) (→ p. 16, Fig. 3).

Installing the impact protector option for FLSE100-H

Fig. 25 Installing the impact protector option for type H

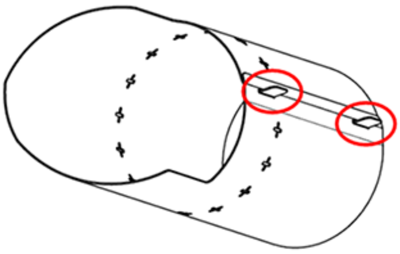


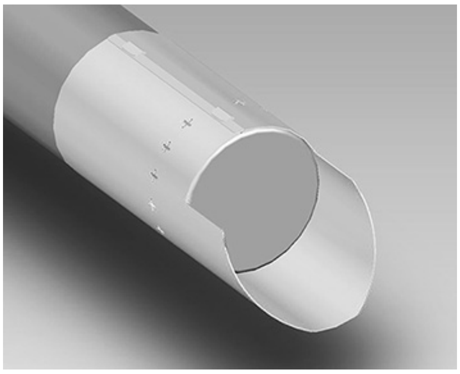
The impact protector is located on the probe head as shown in Fig. 25 and must be aligned facing the flow direction.

Follow the following instructions for installing the impact protector.

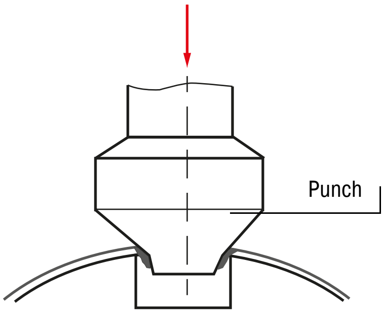
Installing the impact protector option for type H

- Fold the impact protector plate around the transducer and press the angled clips into the recesses on the opposite side of the plate.
- Keep folding the clips towards the folded edge until they touch the plate.





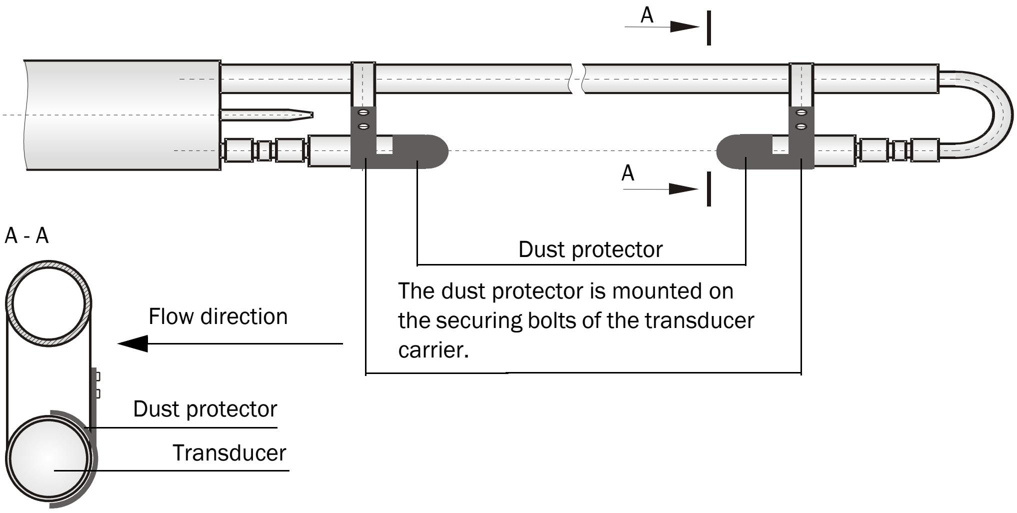
- Align the impact protector facing the flow direction and use a punch to drive the crosswise recesses into the four mounting holes of the transducer.



3.2.5.2 Dust protector for FLSE100-PR

The optionally available dust protector PR can be used when dust contamination on the transducer surface of the single-probe version FLSE100-PR causes a problem. This option is designed to prevent possible contamination of dust on the ultrasonic transducers. It comprises the components “right dust protector” and “left dust protector”. Fit the components to the downstream sides of the transducers in accordance with Fig. 26.

Fig. 26 Fitting of the dust protector option on type FLSE100-PR



> **NOTICE:**
> The effectiveness of the dust protector depends on the dust texture and flow conditions in the duct and can therefore considerably vary.

3.2.6 Installation of solid-borne noise damping set option K100/K75

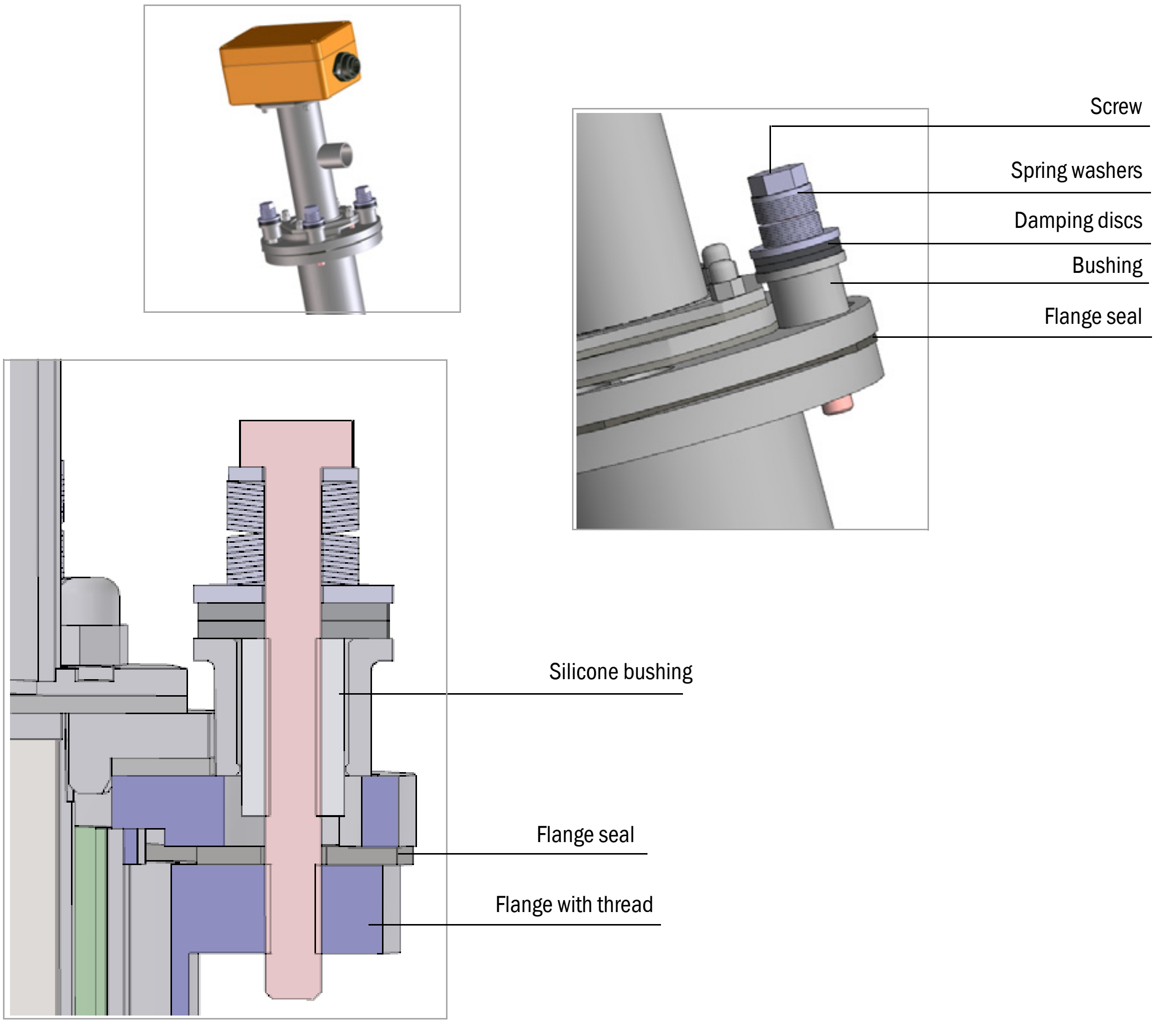
In some installations, vibrations in the resonance range of the ultrasonic transducer come from the system over the flange to the sender/receiver units and therefore have an effect on the transducer and create interference signals (direct acoustic coupling). The optional solid-borne noise damping set K100/K75 can be used to prevent such disturbances. It comprises additional gaskets, cup springs and washers as well as appropriate longer securing bolts, which are used for fitting the sender/receiver units.

A damping set is already included in the assembly material at the factory for device types M and H. The set serves to prevent coupling of solid-borne noise from the system in the ultrasonic transducer. The assembly/damping set is delivered as shown in Fig. 27 and is ready for installation.

Fig. 27 Damping sets

Designation	For type FLSE100	Part No.	Scope of delivery
Damping set K100	FLSE100-H	2056565	
Damping set K75	FLSE100-M	2056564	

Fig. 28 Installing the assembly/damping set



Installation instructions for solid-borne noise damping set option K100/K75

- ▶ Position the flange seal between the flange plates
- ▶ Fit the screws with all delivered parts in the flange (see Fig. 28)

> **NOTICE:**
> - ▶ Tighten the screws until the gap between the spring washer sets is no longer visible.
> - ▶ Then loosen the screw by approx. ¼ turn until the gap between the spring washer sets is visible again to ensure full damping effect.

> **NOTICE:**
> Should interference signals occur although a solid-borne noise damping set is used, the additionally delivered flange seal can be installed to increase damping effect.

3.3 Electrical installation

3.3.1 General instructions, prerequisites

Carry out the steps described in → p. 41, 3.2 before starting installation work.

Unless otherwise agreed with Endress+Hauser or an authorized representative, all of the installation work must be carried out by the plant operator. This includes:

- Laying all the power supply and signal cables
- Connecting the power supply and signal cables to the system components
- Installing the switches and mains fuses,

WARNING: Danger through power voltage

- Observe the relevant safety regulations as well as all safety notices in during all installation work.
- Suitable protective measures must be taken to protect against local or system-specific danger.
- 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: Hazard by electrical voltage

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

NOTICE:

- Plan adequate line cross-sections
- The cable ends with plug 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).

Cables

- Protect cables especially endangered by thermal, mechanical or chemical stress, e.g. by laying in protective tubes.
- Cables must be flame-retardant according to DIN VDE 0472 Part 804. The fire behavior according to B / IEC 60332-1 must be approved.
- The cross-section of each individual wire must not be smaller than 0.5 mm^2.
- Protect the wire ends with connector sleeves against fraying.
- Connect or safeguard unused wires to ground so that a short circuit with other conductive parts is excluded.
- Cable cross-section, insulation and construction must be dimensioned according to the connection parameters.

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.

3.3.2 Connection diagrams

NOTICE:

- The connection cable between the higher-level control system and the junction box or on-site terminal box must be provided and laid onsite. When choosing the cable type, make sure the lead/lead operational capacity is less than 110 pF/m and the minimum lead cross-section is 0.5 mm^2 (AWG20).

  We recommend using cable type UNITRONIC Li2YCYv(TP) 2x2x0.5 mm^2 with reinforced outer sheath (from Lappkabel).
- For bus wiring, the set termination set at the factory must be deactivated in those system components not at the line end (see Service Manual).

Fig. 29 Connection of the FLOWSIC100 Transmitter to the higher-level control system (types M, H)

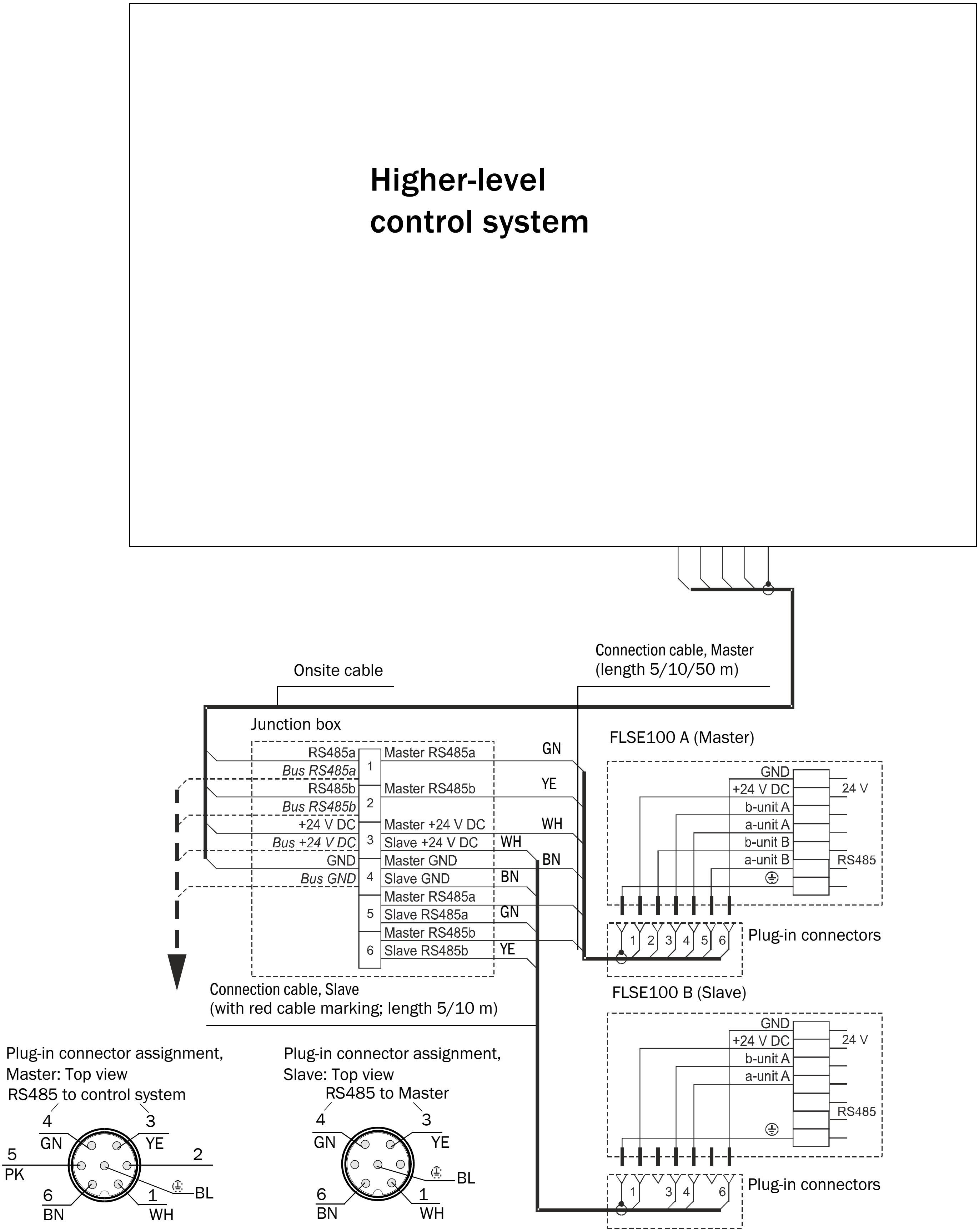


Fig. 30 Connection of the FLOWSIC100 PR to the higher-level control system

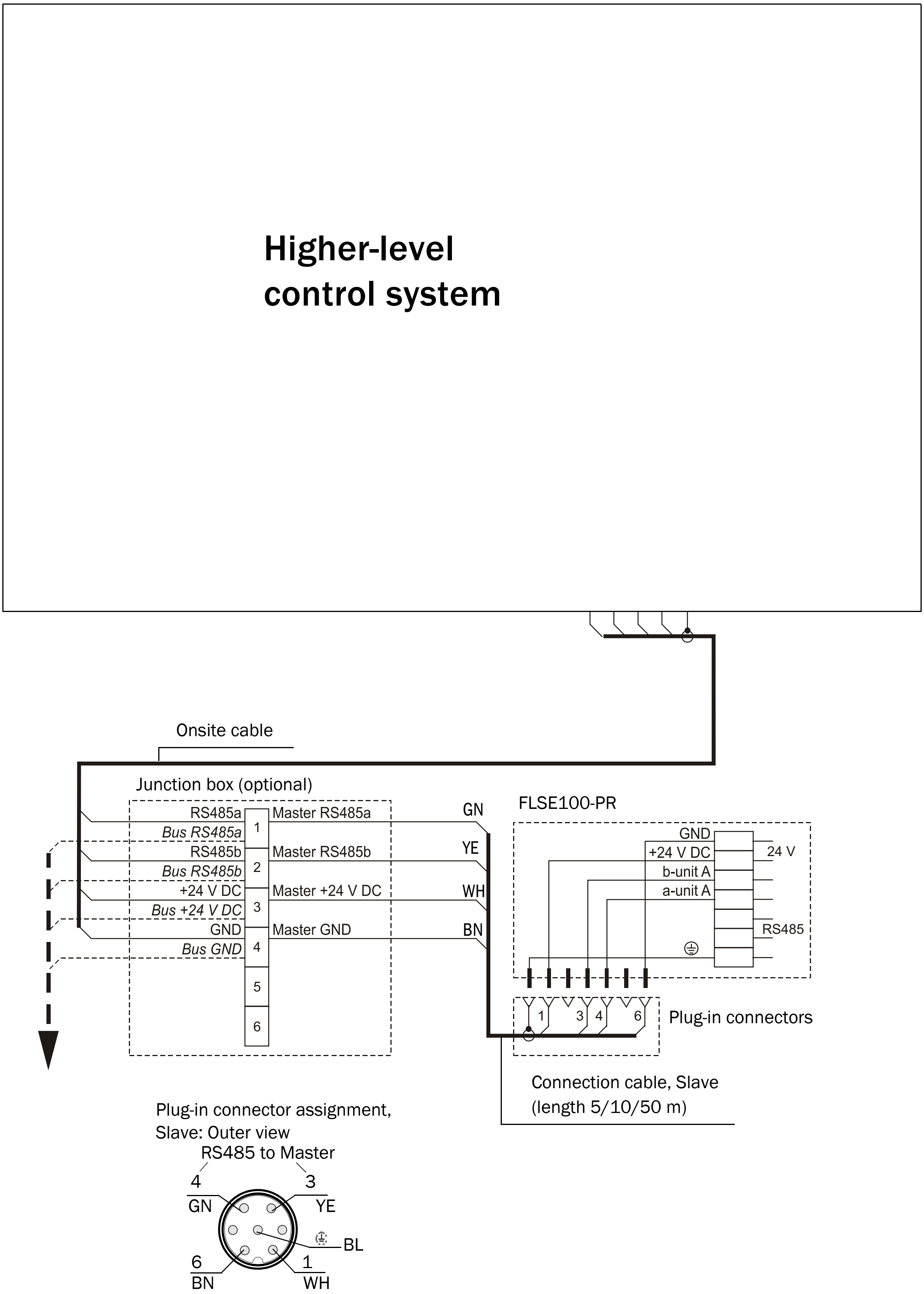
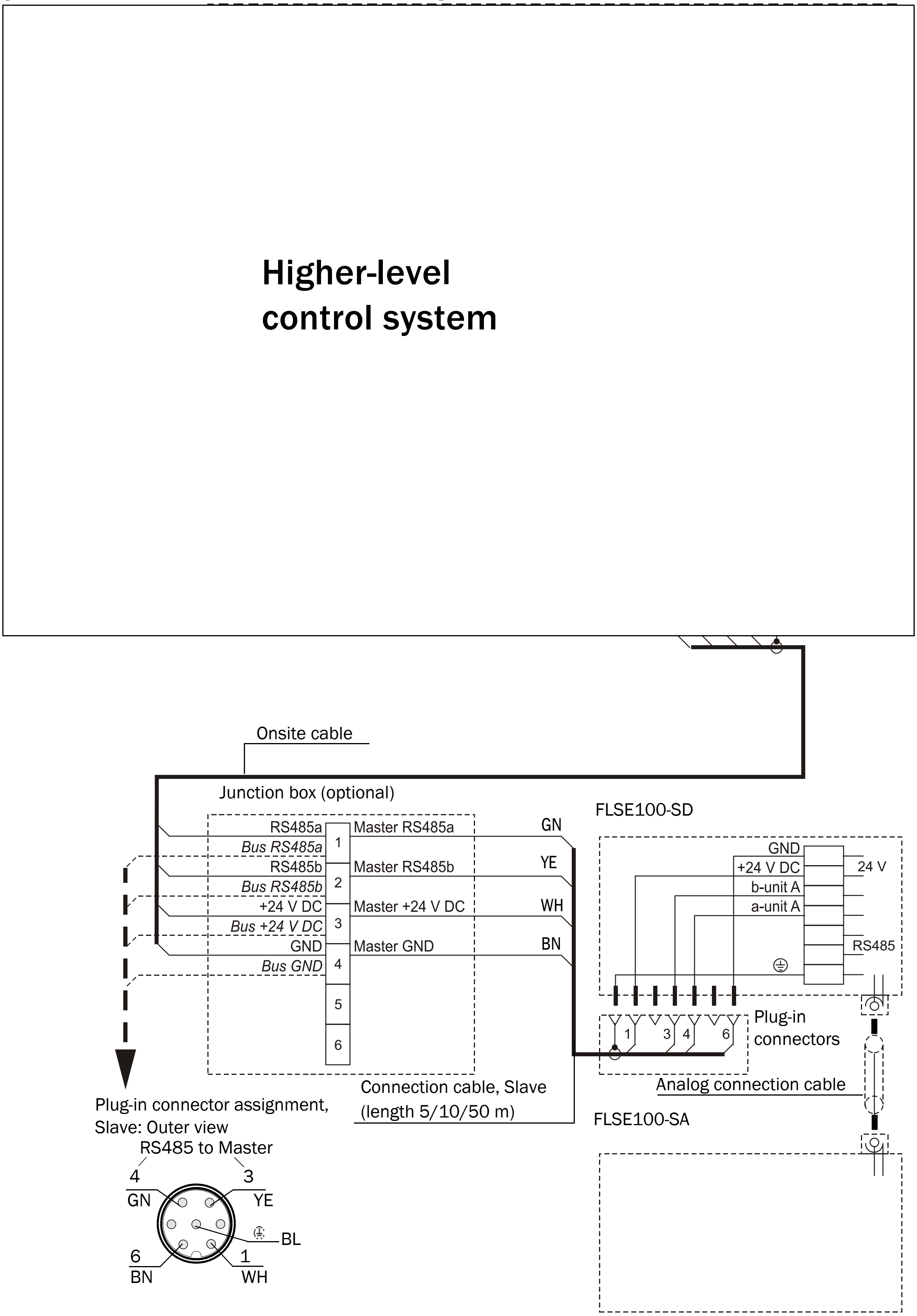


Fig. 31 Connection of the FLOWSIC100 S to the higher-level control system



FLOWSIC100 Transmitter

4 Commissioning and parameter settings

Basics
Standard commissioning procedure
Calibrating flow rate and temperature measurement
Maintenance

4.1 Basics

4.1.1 General information

Commissioning primarily comprises entering system data (e.g. measuring path, installation angle), parameter settings for output variables and reaction times and, if required, the check cycle setting (→ p. 71, 4.2). A zero adjust is not required.

Additional calibration of the velocity measurement by means of a network point measurement using a reference system (for example, dynamic pressure probe) is only necessary when the velocity profile along the measuring axis is not representative for the entire cross-section (→ p. 33, 3.1.1). The regression coefficients determined can then be entered into the device without problems (→ p. 84, 4.3).

The operating and configuration software “SOPAS Engineering Tool” (SOPAS ET) is supplied with the device for configuring the system parameters. The required settings can be easily configured using the software menus.

If the standard settings do not provide adequate stability under all plant conditions (for example, if the device is not used according to the specifications set out in the Technical Data), system performance can be enhanced by optimizing the internal parameter settings. These settings, however, must only be configured by adequately qualified personnel, since correct device operation cannot be guaranteed if the settings are defined incorrectly. Changes of this kind should be carried out by Endress+Hauser Service personnel only. Possible settings are listed in the Service Manual.

4.1.2 Installing SOPAS ET

Prerequisites for configuring using SOPAS ET

- 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 MB
  - Operating system: MS-Windows XP, VISTA, Windows 7, Windows 8 (32/64 bit) and Windows 10 (32/64 bit)
  - Free memory: 450 MB
- RS485/USB interface set (Part No. 6030669): Adapter, USB cable, plug for connecting laptop/PC and FLOWSIC100 Transmitter
- The operating and parameter program must be installed on the laptop/PC.
- The device must be supplied with voltage.

Installing SOPAS ET

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

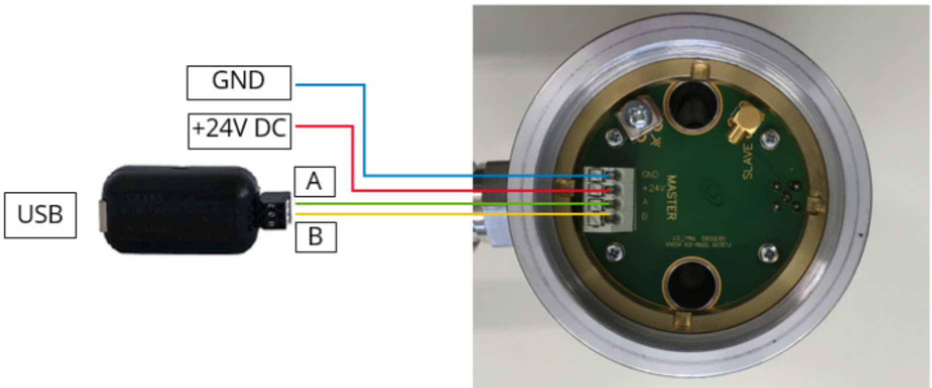
4.1.3 Connecting the device

If commissioning is performed directly on the transmitter/receiver unit, a mobile power supply is required and care must be taken to ensure correct pin assignment.

> **WARNING: Electrical hazard**
> Incorrect wiring can result in serious injury, device malfunction or measuring system failure.
> ▸ When carrying out installation work, observe the relevant safety regulations and safety information in → p. 10, § 1.6.
> ▸ Suitable protective measures must be taken to protect against local or system-specific danger.

1 Open the electronics cover 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. 32 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 Start SOPAS ET

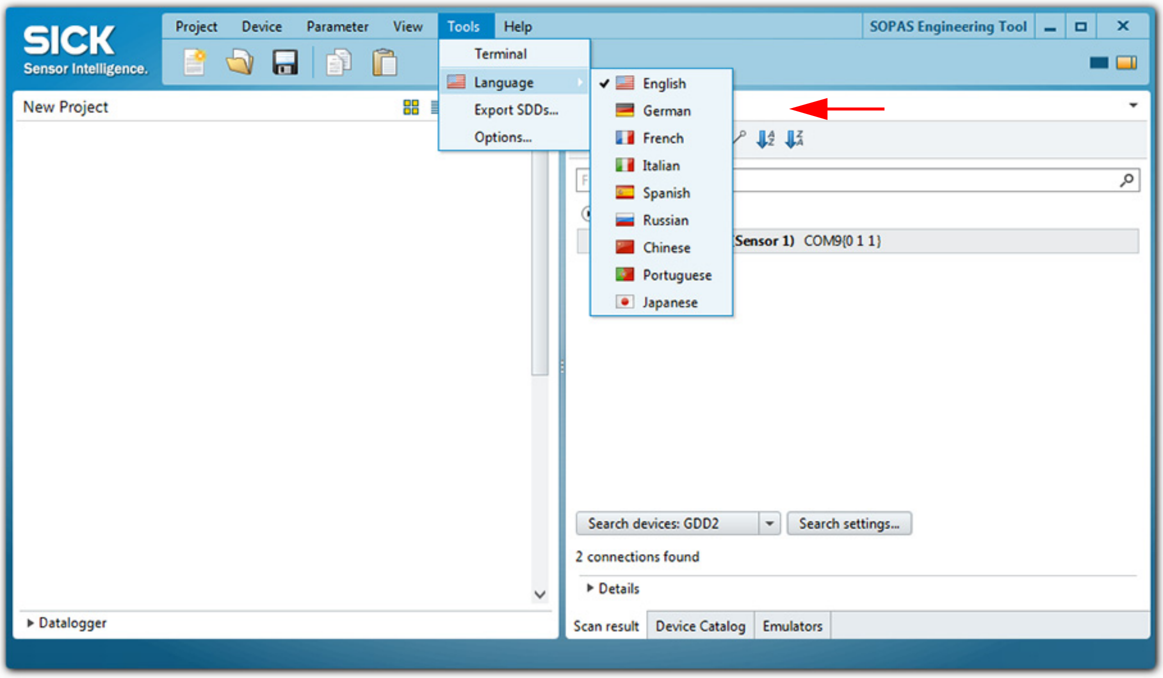
1 Install SOPAS ET, → p. 60, § 4.1.2.
2 Start the software from the “SICK\SOPAS” start menu.
3 The start page is displayed.

4.1.5 Changing the language

1 If required, set the desired language in the “Tools / Language” menu (→ p. 62, Fig. 33).

2 Confirm the dialog shown with “Yes” to restart SOPAS ET with the changed language.

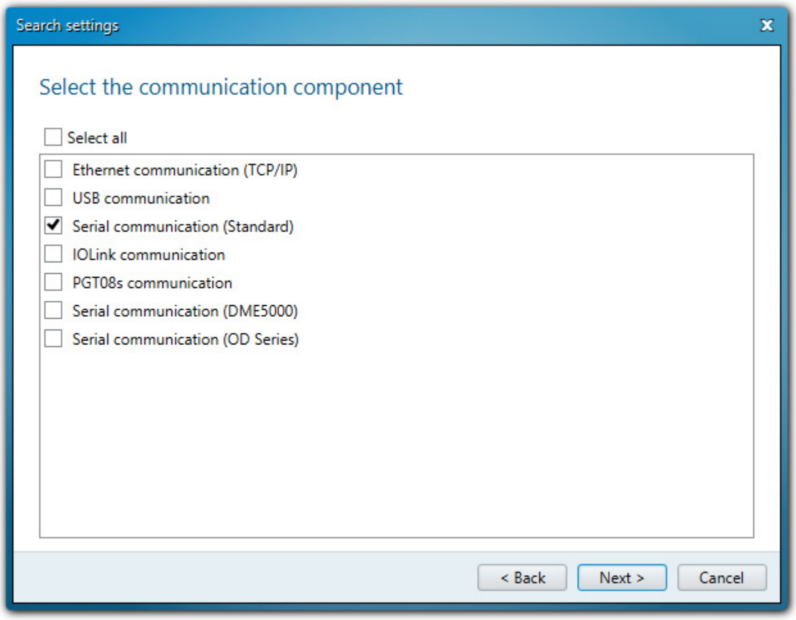
Fig. 33 Changing the language setting



4.1.6 Establishing connection with SOPAS ET via advanced mode

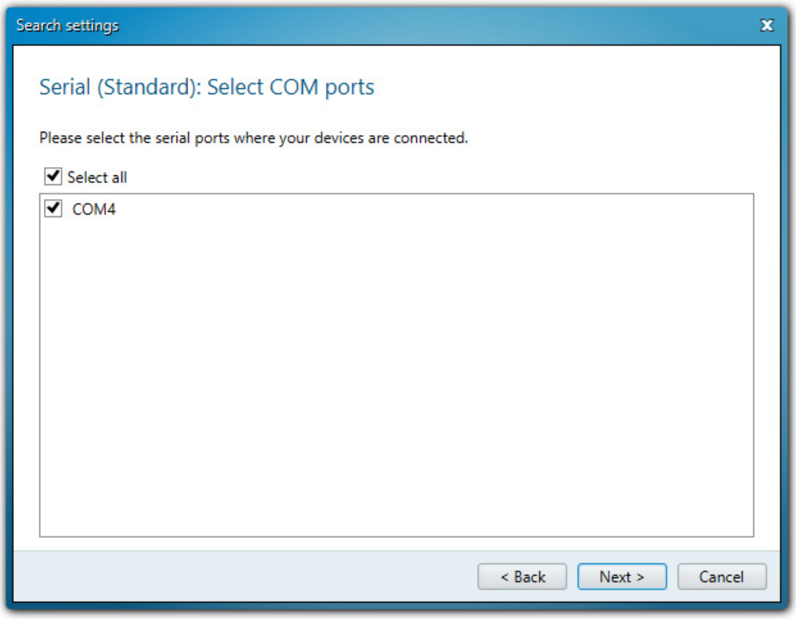
1 Click “Search settings”.
2 Select search mode “Interface oriented search”.
3 Select “Serial communication” and press the “Next” button.

Fig. 34 Selecting the communication components



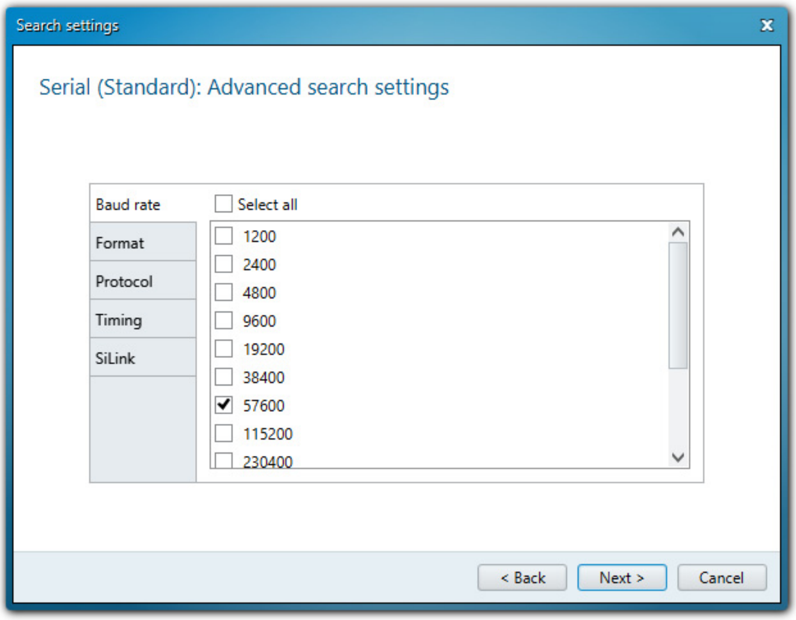
4 Select the COM ports used and click “Next”.
If you are not sure which COM ports are used, select all COM ports.

Fig. 35 Selecting COM ports



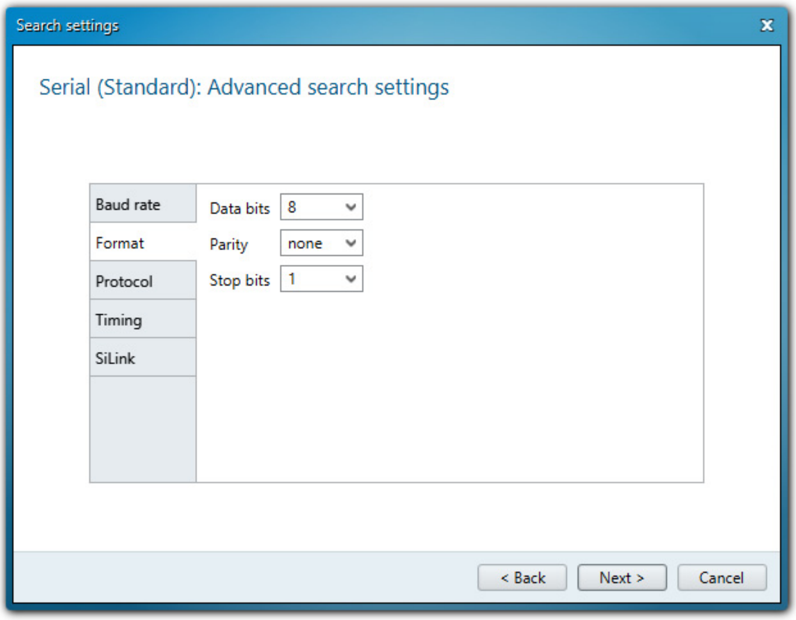
5 Configure the “Advanced search settings”.
– Define the baudrate settings in the “Baudrate” directory according to → p. 64, Fig. 36.

Fig. 36 Defining the baudrate



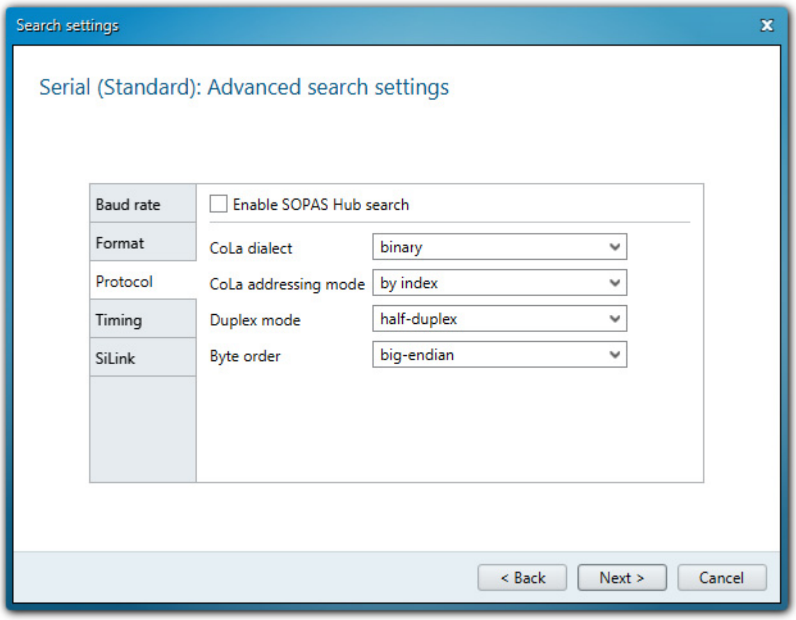
– Configure the data format in the “Format” directory according to → p. 64, Fig. 37.

Fig. 37 Configuring the data format



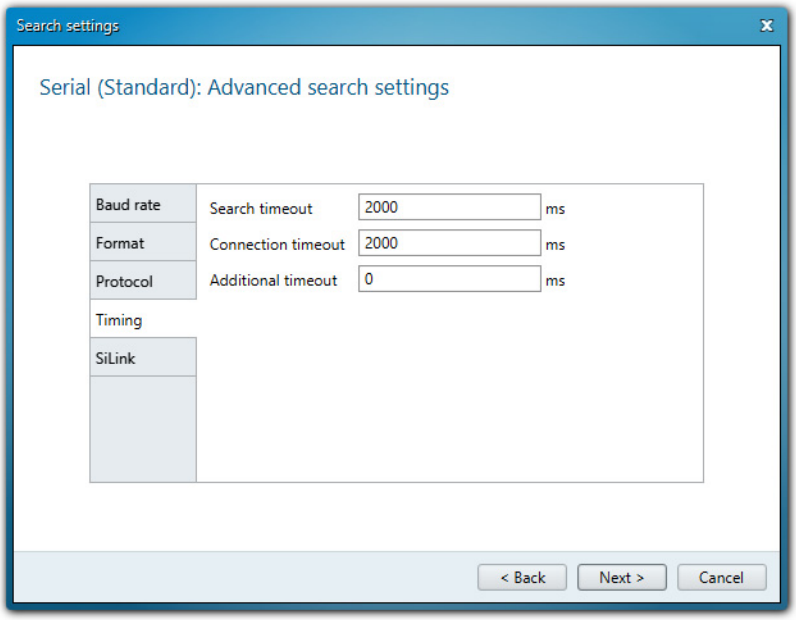
– Define the protocol settings in the “Protocol” directory according to → p. 65, Fig. 38.

Fig. 38 Configuring the protocol



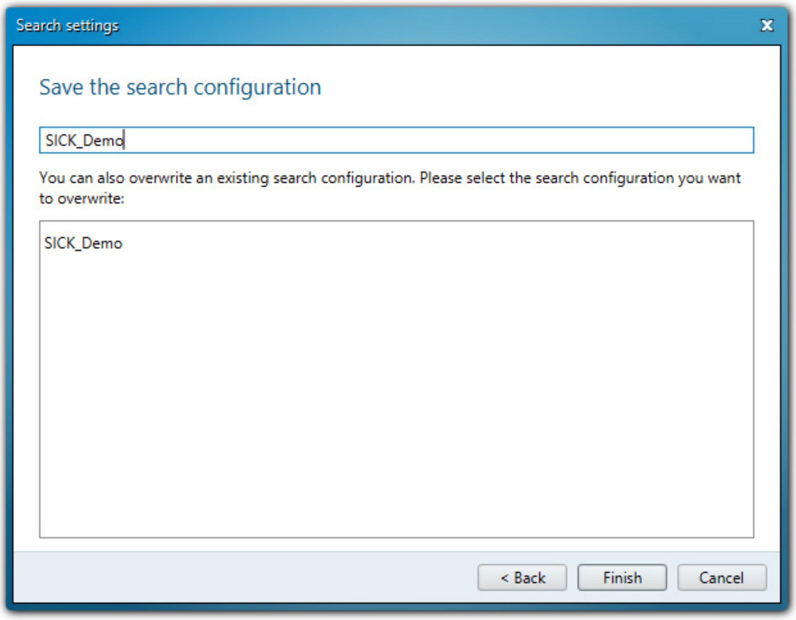
– Define the timeout settings in the “Timing” directory according to → p. 65, Fig. 39.

Fig. 39 Defining the timeout settings



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

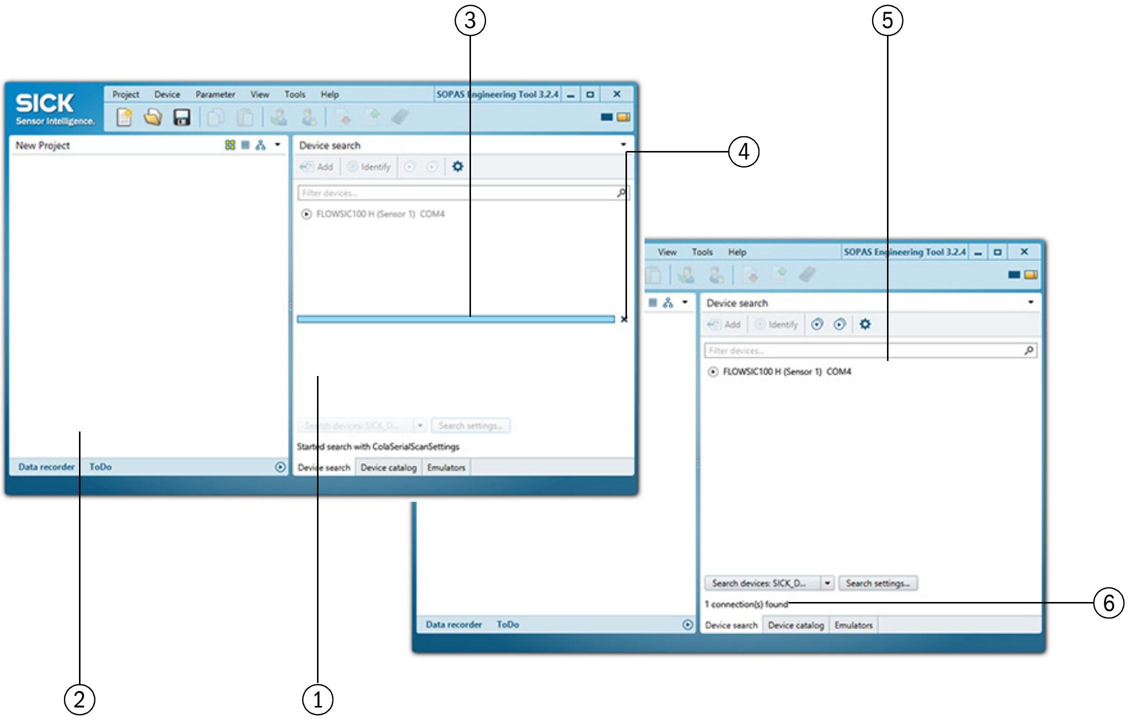
Fig. 40 Saving the scan configuration



SOPAS ET starts the device search. The devices found are displayed in the “Device search” area when device search is finished (→ p. 67, Fig. 41).

4.1.7 Information on using SOPAS ET

Fig. 41 Overview

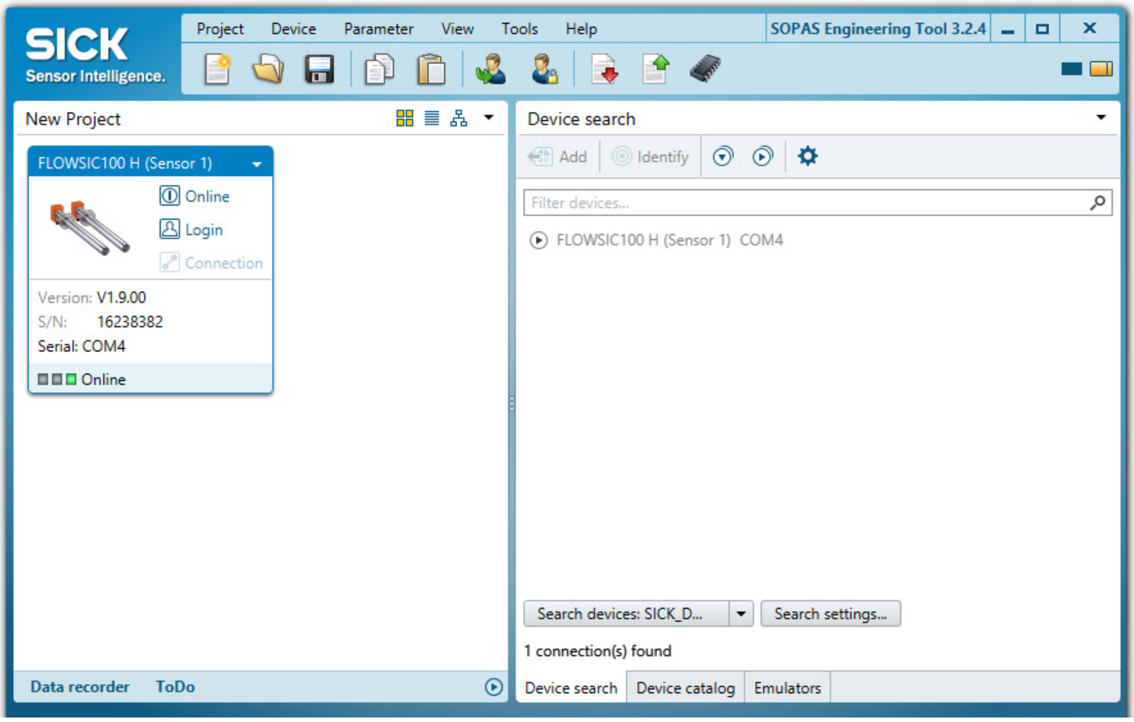


1 Device search
2 Project area
3 Device search progress
4 Device search abort
5 Device search result
6 Number of devices found

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. 69, Fig. 43).

Fig. 42 Device selection



Device context menu

Fig. 43 Device context menu

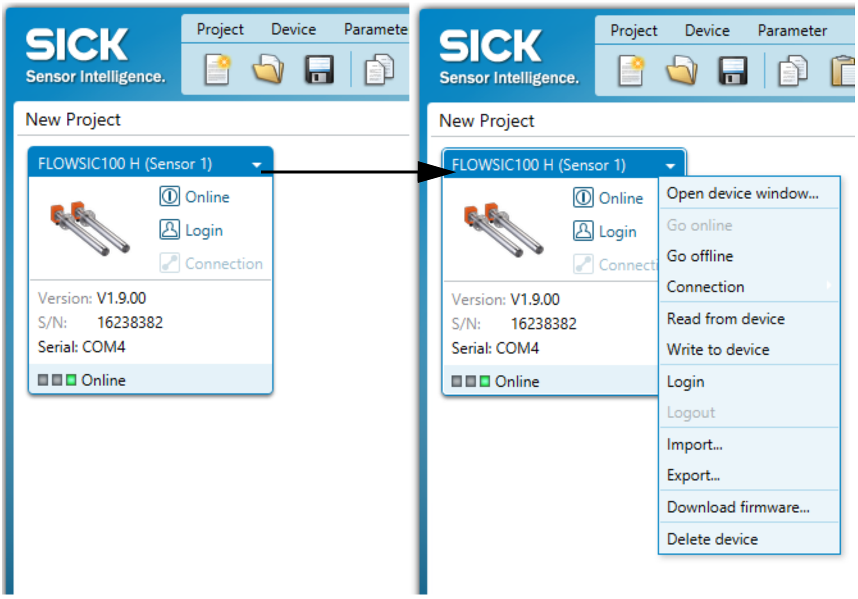


Table 1 Contents of device context menu

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. – Deselect 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.

4.1.8 Password

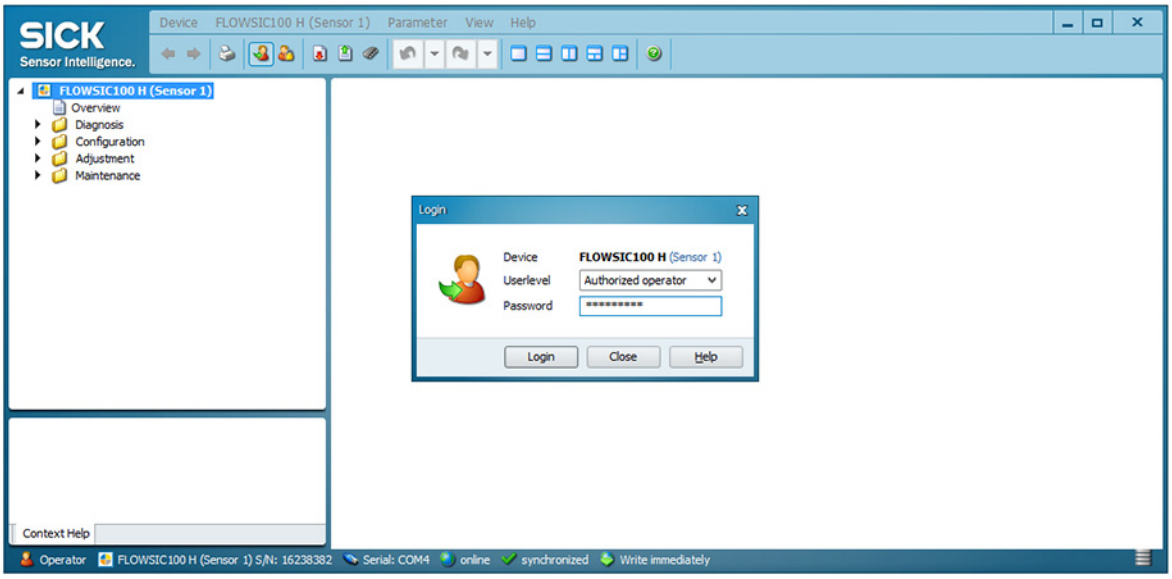
Certain device functions are first accessible after a password has been entered (→ Fig. 44). Access rights are assigned in 3 user levels:

User level		Access to
0	"Operator" (machine supervisor) *	Displays of measured values and system status
1	"Authorized Operator" (Authorized Client) *	Displays, inquiries and parameters required for commissioning or adjustment to customer-specific demands and diagnosis
2	"Service"	Displays, inquiries as well as the main parameters required for service tasks (e.g. diagnosis and clearance of possible malfunctions)

*): Depending on program version

The Level 1 password is "sickoptic".

Fig. 44 Entering the password



4.2 Standard commissioning procedure

This Section describes all the settings essential to ensure the device functions correctly. These include entering system data (active measuring path, installation angle, cross-sectional area).

> **NOTICE:**
> - Error message “Error Parameter” is output as long as the system data have not been entered completely on the system component “FLOWSIC100 X (Sensor)”.
> - Parameter settings can only be made when the relevant system component “FLOWSIC X (Sensor)” is in the “Maintenance” operating state.

> **NOTICE:**
> Endress+Hauser recommends creating a data backup after completion of commissioning, → p. 75, §4.2.4.

The device is parameterized via SOPAS ET on the system components “FLOWSIC X (Sensor)” as follows:

Setting	FLOWSIC X (Sensor)
Measuring path	X
S/R unit(s) installation angle	X
Cross-sectional area	X
Check cycle	X

> Calibration settings → p. 84, 4.3

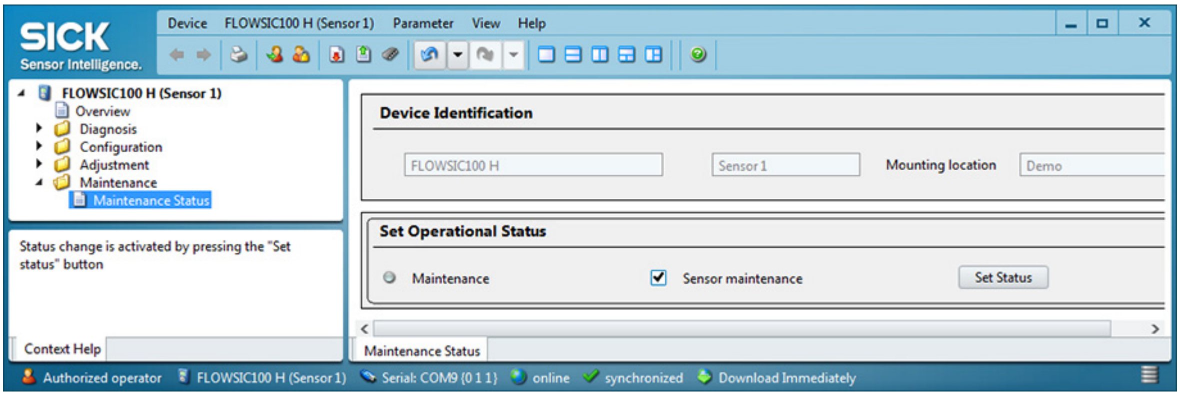
To set/change the parameters, carry out the following procedure:

- ▶ Connect the measuring system to program SOPAS ET, scan the network and add the required device file “FLOWSIC100 X (sensor)”) to the current project.
- ▶ Enter the Level 1 password (→ p. 70, Fig. 44) and set the relevant system components to “Maintenance” operating mode (→ p. 72, §4.2.1).

4.2.1 Setting "Maintenance" mode

- Open the directory "Maintenance/Maintenance Status".
- Activate the "Sensor maintenance" checkbox (sender /receiver unit) and click the "Set Status" button.

Fig. 45 Switching to Maintenance mode



A control lamp signals the "Maintenance" state as follows:

- In the SOPAS menu "FLOWSIC100 X (Sensor) / Overview",
- In the SOPAS status indicator in the field at the bottom left,

4.2.2 Setting the system data parameters on the FLOWSIC100 Transmitter sensor

- Open the device file "FLOWSIC100 X (sensor)" and enter the Level 1 password (→ p. 70, §4.1.8).
- Set the maintenance mode (→ p. 72, §4.2.1).

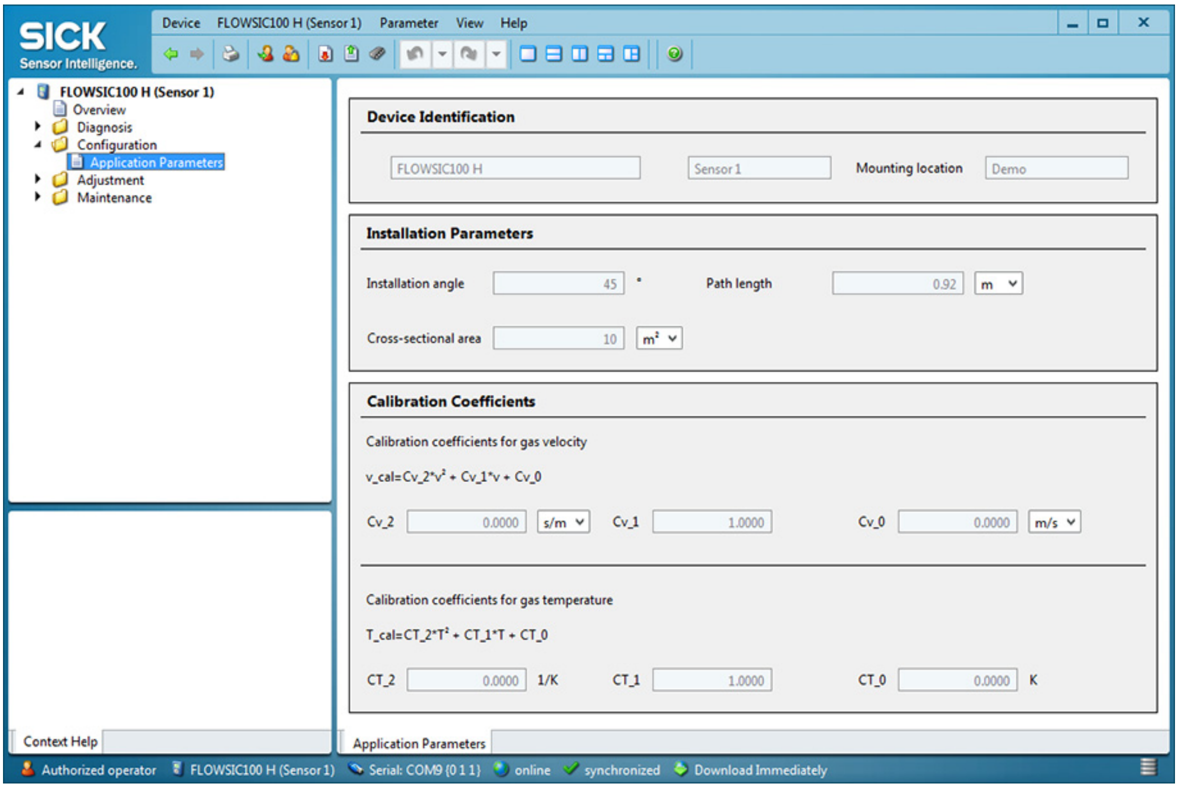
Basic requirements for every measurement are selecting the unit system (metric or imperial units) to be used and entering the application parameters (measuring path, installation angle, cross-sectional area). Select directory "Application Parameters" to enter settings (→ Fig. 46). The settings are uploaded to the FLOWSIC100 after switching from "Maintenance" to "Measurement".

> +i The application parameter settings are converted automatically when the unit system is changed.

The following is applicable for application parameters:

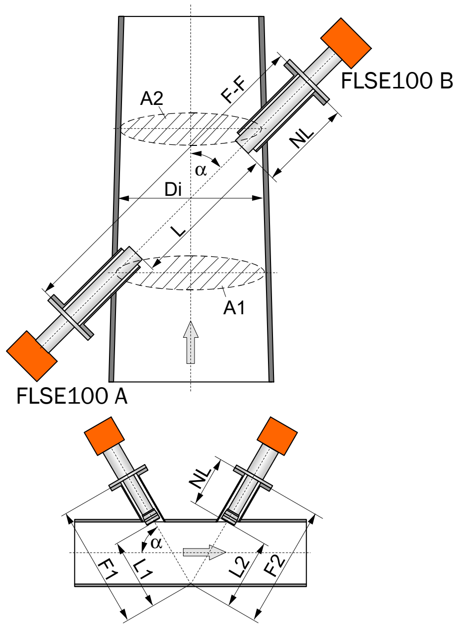
Measuring path	Distance between the transducers (L in Fig. 47)
Installation angle	Angle between the measuring axis and main direction of the gas flow (α in Fig. 47)
Cross-sectional area (required to calculate the volume flow)	Area in range of the ultrasonic transducer that is vertical to the flow direction and enclosed in the inner duct walls. If the cross-sectional area changes in the vicinity of the measurement setup, enter the mean value of the areas between the sender/receiver units A and B.

Fig. 46 Directory “Application Parameters” (settings example)



+i Entering the calibration coefficients → p. 84, 4.3

Fig. 47 Basic parameters



Cross-sectional area:

Circular ducts:

$$A = \frac{\pi}{4} \cdot Di^2$$

Rectangular ducts:

$$A = a \cdot b$$

Cross-sectional changes

$$A = \frac{A1 + A2}{2}$$

Measuring path length:

$L = FF - 2 \cdot NL$

$FF = F1 + F2$

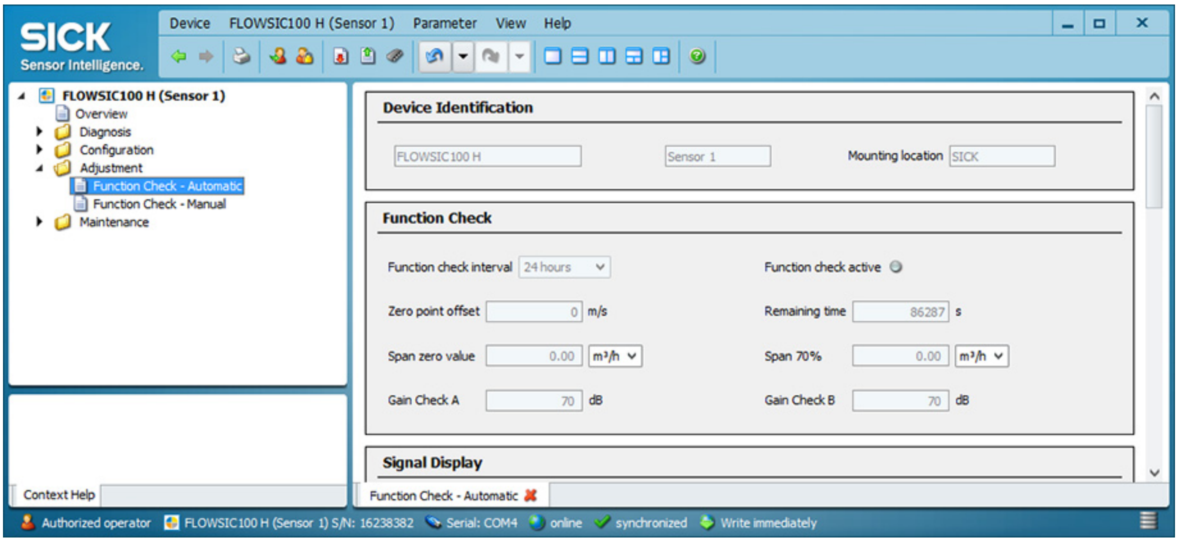
$L = L1 + L2 = (F1 + F2) - 2 \cdot NL$

For small duct dimensions < 0.5 m (short measuring paths), take the thickness of the seals used into account when determining measuring path L.

4.2.3 Setting the check cycle parameters

- ▶ Open the device file “FLOWSIC100 X (sensor)” and enter the Level 1 password, → p. 70, §4.1.8.
- ▶ Set the maintenance mode (→ p. 72, §4.2.1).
  Define the check cycle output in the “Adjustment/Function Check - Automatic” menu (→ Fig. 48). The function check can also be started manually.
- ▶ Define the execution interval for the check cycle in the “Function check interval” selection field.

Fig. 48 “Adjustment/Function Check - Automatic” menu



4.2.4 Data backup

All parameters relevant for the collection, processing and input/output of measured values and current measured values can be saved and printed. This simplifies reentering set device parameters (e.g. after a firmware update) as well as registering device data or device states for diagnostic purposes.

The following options are available.

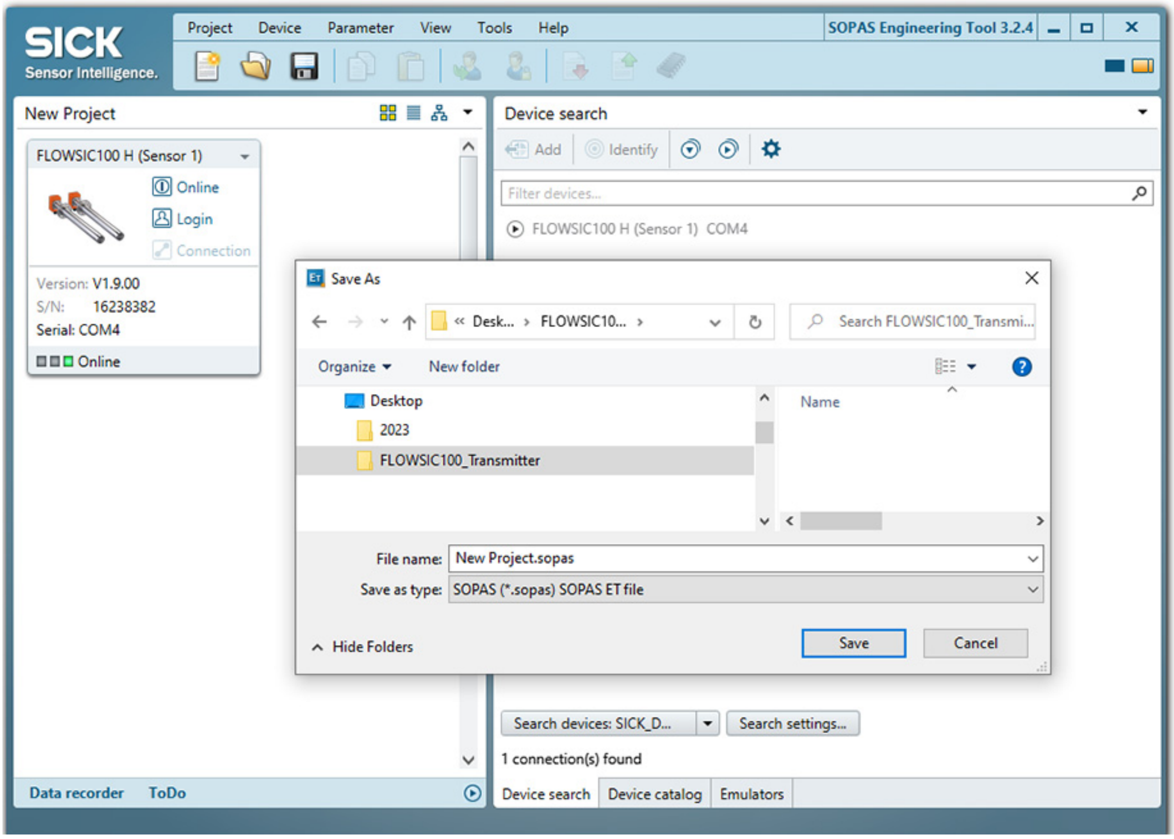
- Saving as project
  Saving the data as a project allows saving not only device parameters but also data logs.
- Saving as protocol
  Device data and parameter are recorded In the parameter protocol.
  A diagnosis protocol can be generated for analyzing the device function and to identify possible malfunctions.

Saving as project

- Call up menu "Project / Save" and specify the target directory and file name. The name of the file to be saved is freely selectable.

  It is useful to specify a name with a reference to the respective sampling point (name of company and facility).

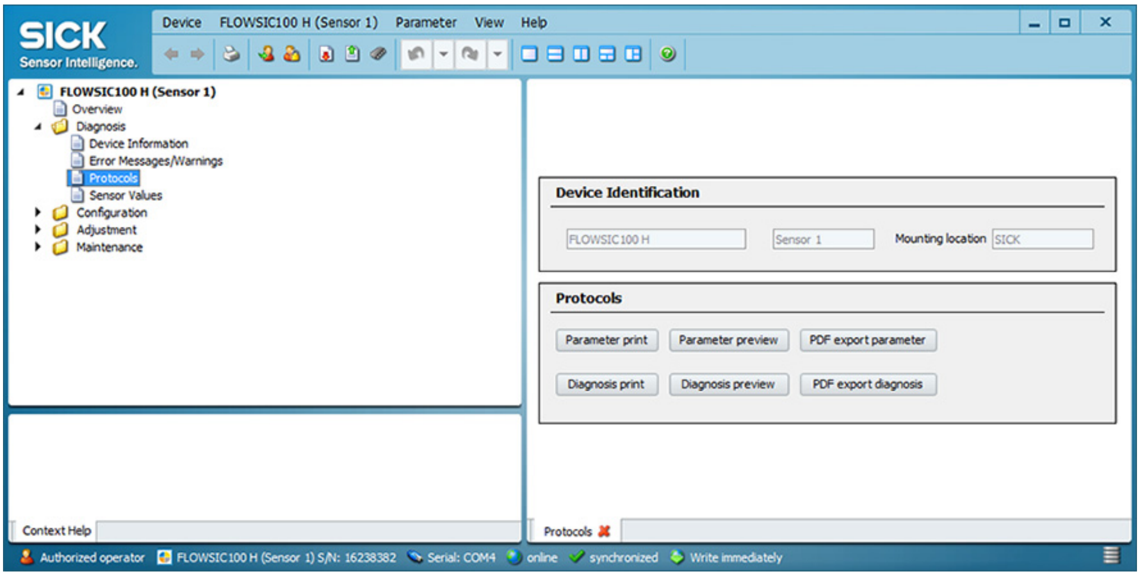
Fig. 49 Menu "Project / Save"



Saving as protocol

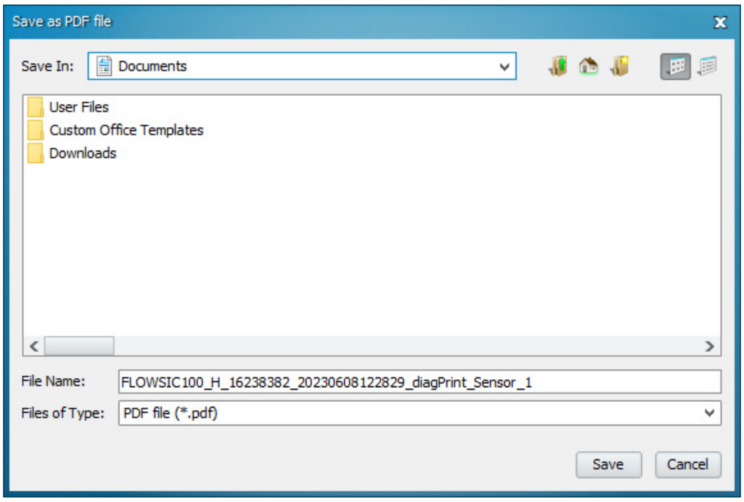
▶ Select a device, call up the "Diagnosis / Protocol" menu and click the button for the desired type of protocol.

Fig. 50 "Diagnosis / Protocol" menu



▶ Specify file names and storage location.

Fig. 51 Specifying file names and storage location



Example of a Parameter protocol

Fig. 52 Parameter protocol (example)

FLOWSIC100 - Diagnosis Protocol

Device type: FLOWSIC100 H
Mounting location: SICK
Sensor 1

Device Information

Device type	FLOWSIC100 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
Autom. Checkcycle	yes

System Status

Malfunction	inactive
Maintenance	inactive
Maintenance request	inactive
Function check	inactive
Operation	active

Errors and Warnings

Parameter	inactive
Measuring range	inactive
Heavy noise	inactive
Communication Master-Slave	inactive
No signal	inactive
Zero point offset	active
Transducer temperature	inactive

Measured Values

Volume flow a.c.	-504.25m³/h
Velocity of gas	-1.40m/s
Speed of sound	429.98m/s
Acoustic temperature	186.4°C
Transducer temperature A (Master)	20.0°C
Transducer temperature B (Slave)	20.0°C

Diagnosis Values Transducer A/B

Error rate A (Master)	0%
Error rate B (Slave)	0%
SNR A (Master)	43.1dB
SNR B (Slave)	44.6dB
AGC A (Master)	11.6dB
AGC B (Slave)	11.2dB
Supply voltage A (Master)	23.86V
Supply voltage B (Slave)	23.74V
Resonance freq. A (Master)	17.96kHz
Resonance freq. B (Slave)	17.96kHz
Transit time A (Master)	0.6966ms
Transit time B (Slave)	0.6993ms

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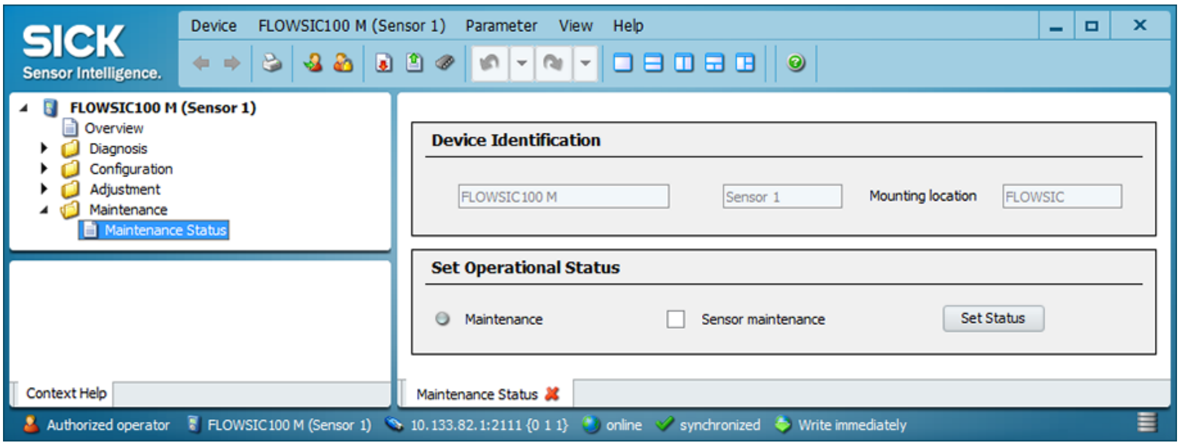
4.2.5 Starting normal measuring operation

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

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

Fig. 53 Starting measurement mode



Standard commissioning is now completed.

4.2.6 Signal waveform

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

- ▶ To enable the display on the screen, open the device file of the used FLOWSIC100 type.
- ▶ Select the menu “Diagnosis/Sensor Values” in operating mode “Measurement”.
- ▶ The ultrasonic signals of both transducers are displayed as unconditioned signals under “Signal Display”. If the option “View Envelope” is checked, the envelopes of both transducers are displayed. The signal waveform should match the waveforms in the Fig. 54 to Fig. 61, depending on the device type.

Type FLSE100-M

Fig. 54 Burst waveform HF signal (unconditioned signal)

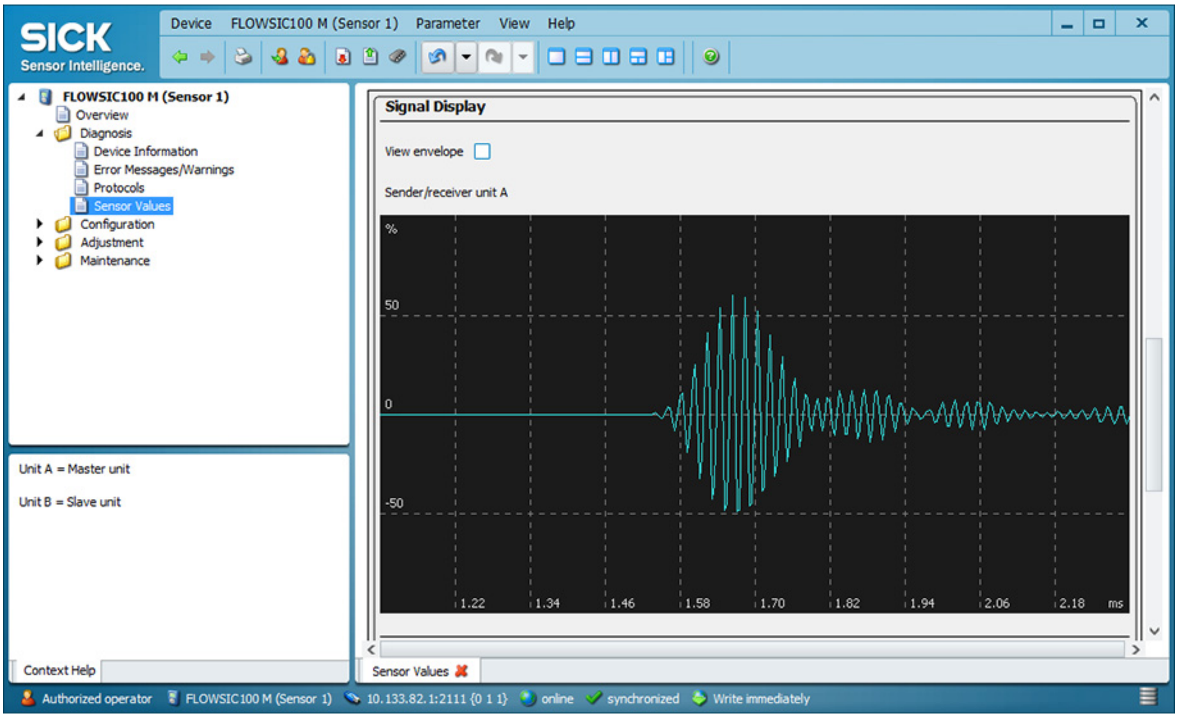
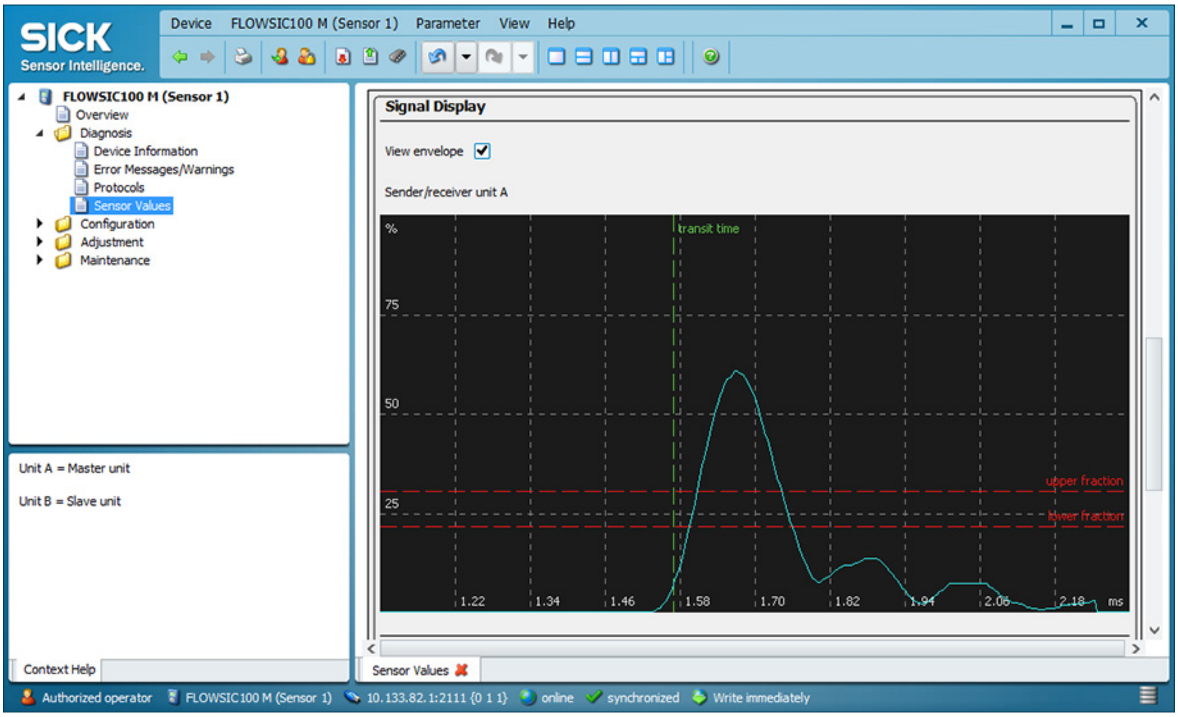


Fig. 55 Burst waveform demodulated signal (envelope)



Type FLSE100 H

Fig. 56 Burst waveform HF-signal (unconditioned signal)

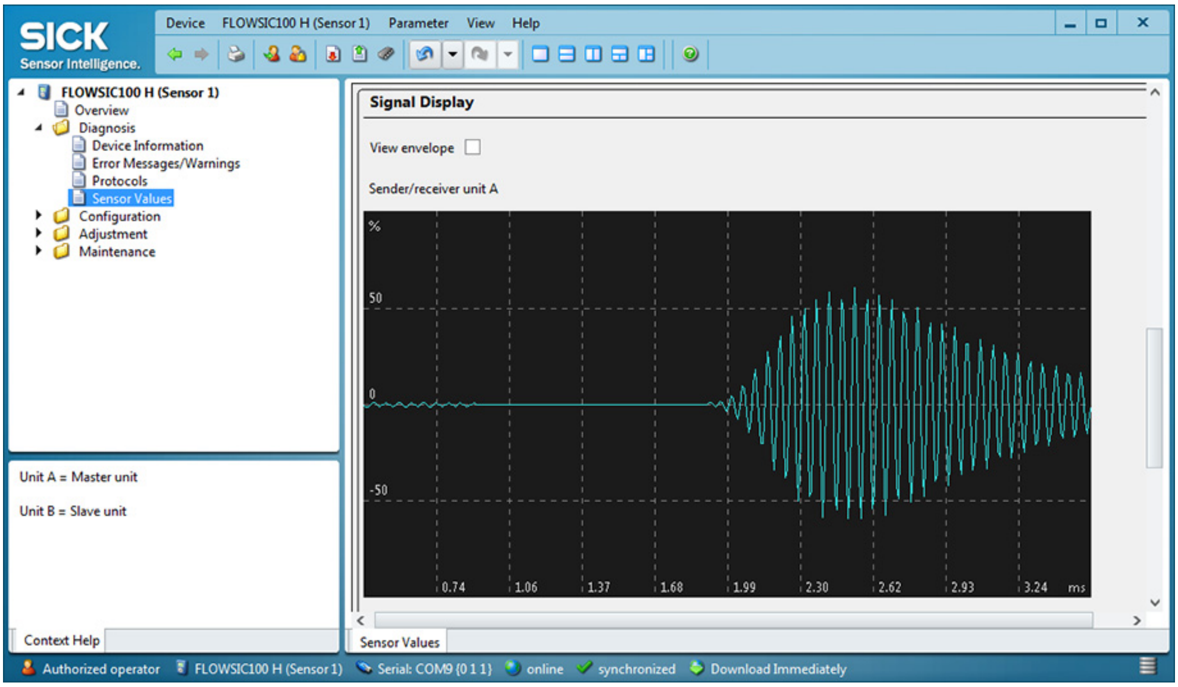
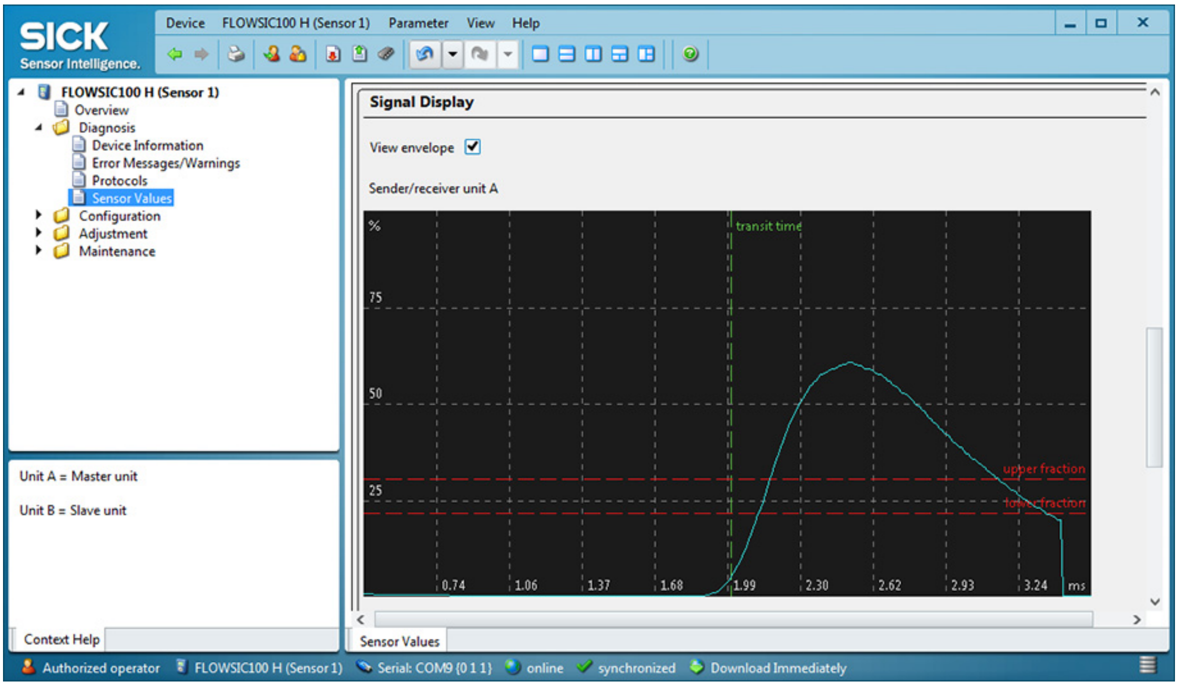


Fig. 57 Burst waveform demodulated signal (envelope)



Type FLSE100-S

Fig. 58 Burst waveform HF-signal (unconditioned signal)

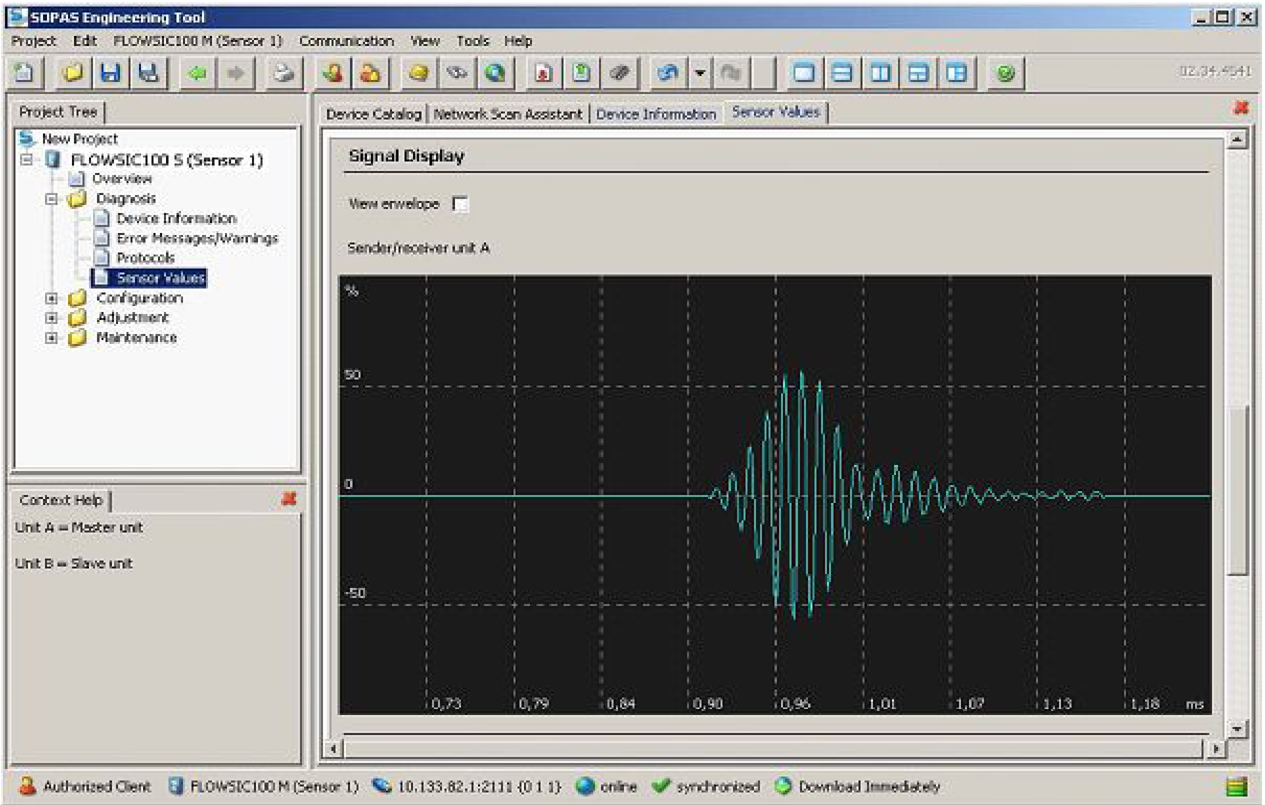
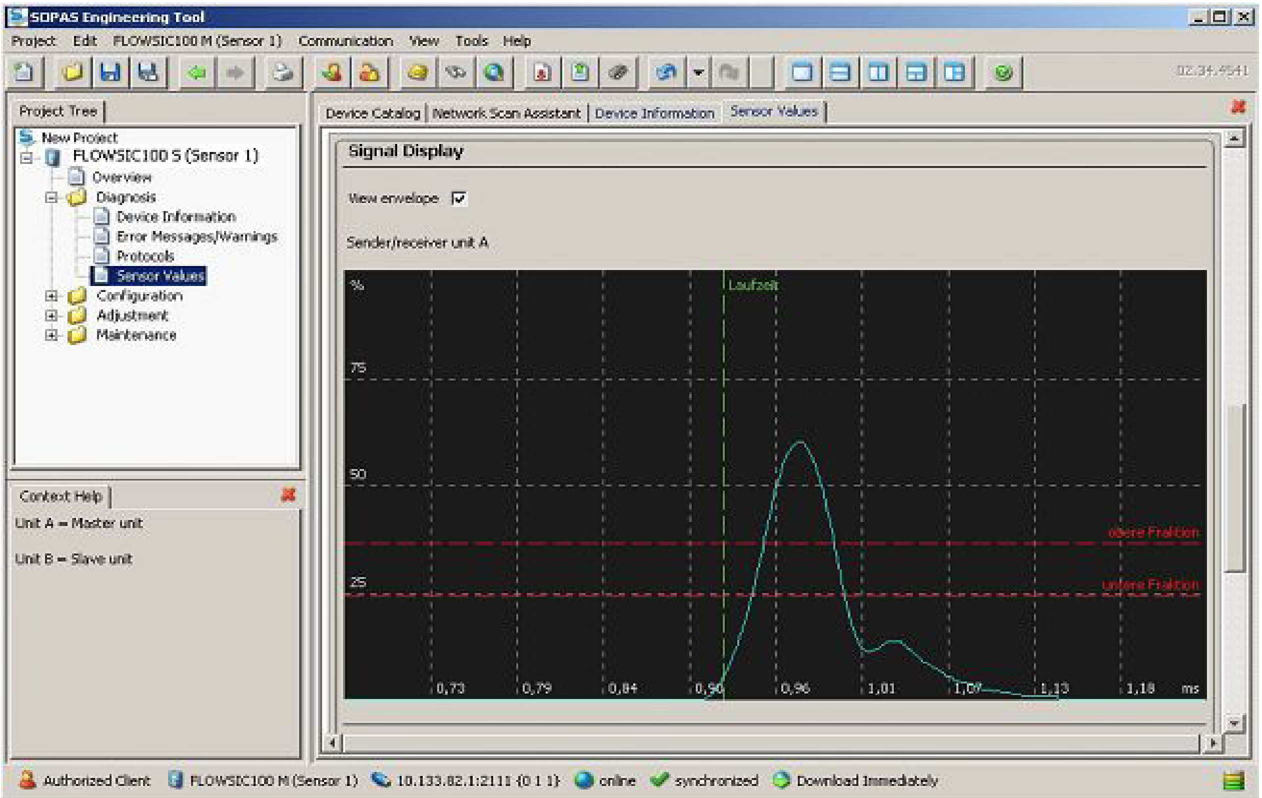


Fig. 59 Burst waveform demodulated signal (envelope)



Type FLSE100-PR

Fig. 60 Burst waveform HF-signal (unconditioned signal)

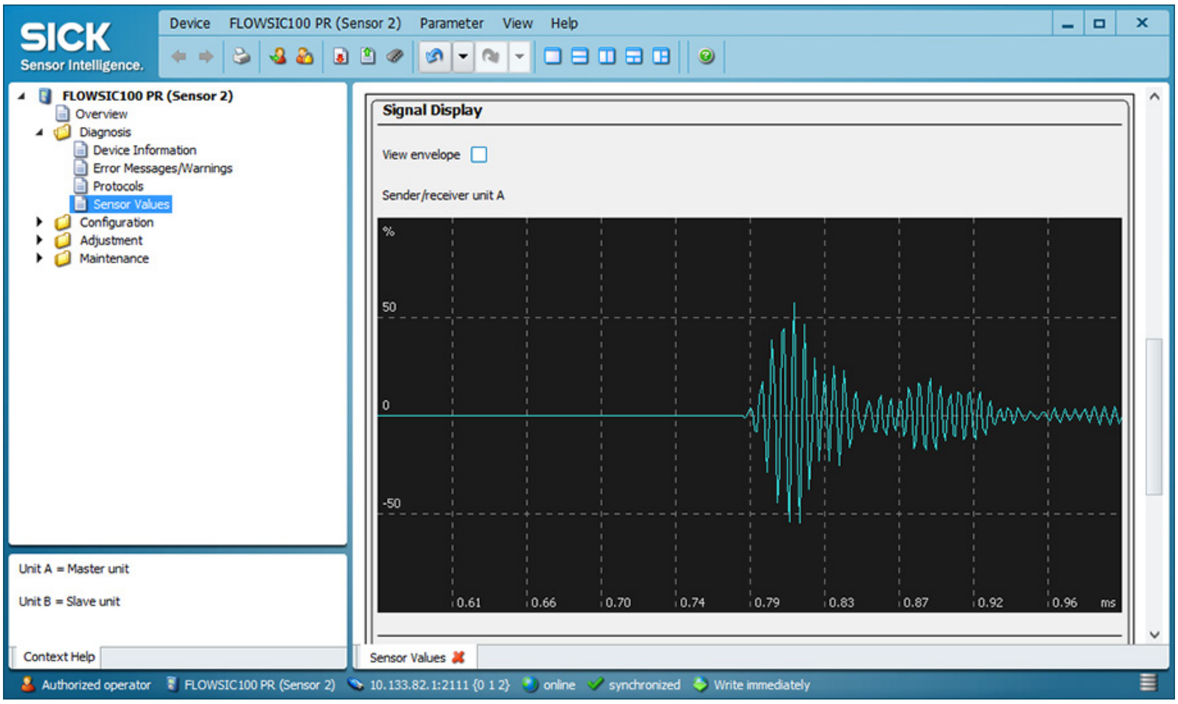
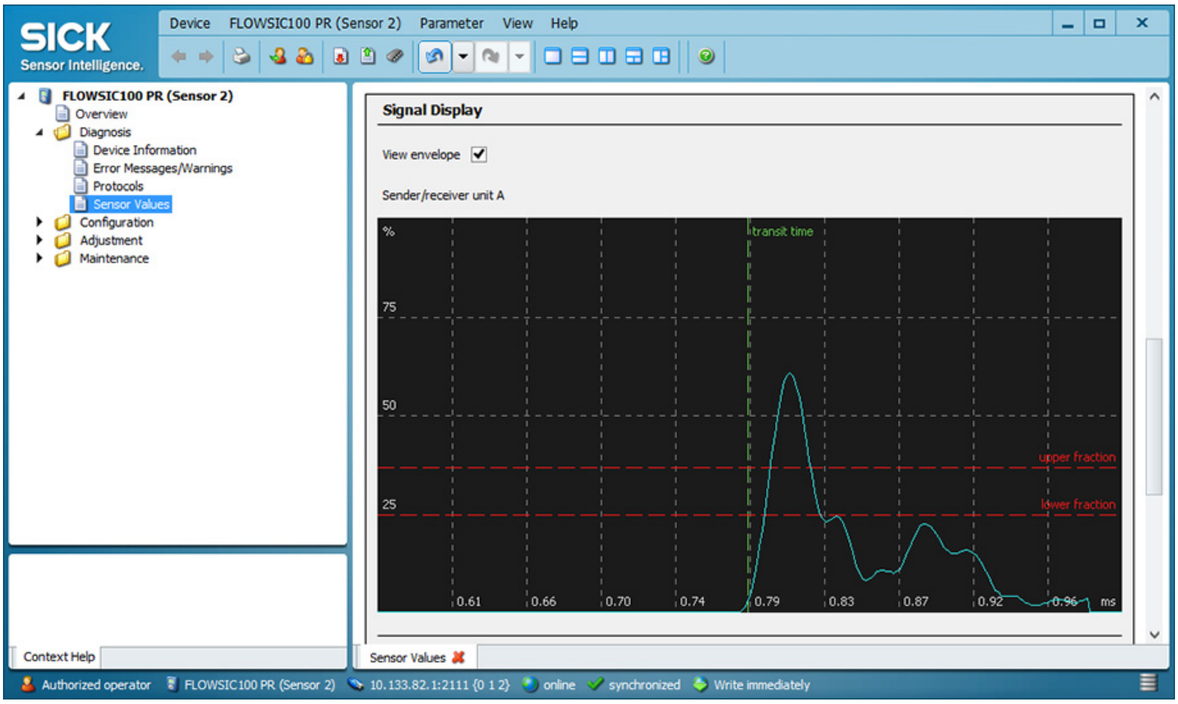


Fig. 61 Burst waveform demodulated signal (envelope)



4.3 Calibrating flow rate and temperature measurement

This Section describes parameter settings that are necessary for calibrating gas flow rate and temperature measurements, and for outputting the volume flow in the standard state.

- Set the measuring system to “Maintenance” mode, → p. 72, §4.2.1.
- Enter the Level 1 password, → p. 70, §4.1.8.
- Open the “Configuration/Application Parameters” submenu.

4.3.1 Entering calibration coefficients for gas flow rate measurement

Enter the calibration coefficients determined with a network point measurement using a reference system in the group “Calibration coefficients / Calibration coefficients for flow rate”.

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

4.3.2 Calibrating temperature measurements

The accuracy of the acoustic temperature measurement with the FLOWSIC100 depends quadratical on the active measuring path and sound velocity of the real gas under standard conditions (→ p. 16, 2.2.3). Exact acoustic temperature measurements are only possible when the sound velocity of the real gas remains constant at a reference temperature. Since this is seldom the case, the internal temperature calculation in the device must be calibrated if it is to be used to scale the volume flow.

To calibrate the measurement, determine the value pairs from separately measured gas temperature (for example, with PT100 sensor) and display 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 quadratic 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

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

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

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

CT_1 = 0.9483

CT_0 = 7.7310

FLOWSIC100 Transmitter

5 Maintenance

5.1 General information

> **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 FLOWSIC100 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.

Even though the FLOWSIC100 is often deployed in harsh environments, its design and measuring principle are such that the device requires only minimal maintenance.

Maintenance tasks

The maintenance tasks are limited to:

- Sender/receiver unit

Before you carry out these maintenance tasks, set the FLOWSIC100 to Maintenance Mode. This can be done by means of an external maintenance switch or by using the operating and parameterization program SOPAS ET.

Switch the system from “Maintenance” back to “Measuring” after completing the work.

Maintenance intervals

The maintenance intervals are assessed according to the qualification test. The maintenance interval depends on the specific conditions at the plant, such as operation, gas composition, temperature and humidity, as well as the ambient conditions and therefore shorter maintenance intervals may be necessary if conditions are unfavorable.

The activities required and their completion must be documented by the operator in a Maintenance Manual.

Maintenance agreement

Regular maintenance activities can be carried out by the plant operator. These activities must be carried out by qualified persons according to § 1 only. 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 Maintaining the sender/receiver units

The sender/receiver units must be cleaned at regular intervals and inspected for signs of corrosion and damage. To do so, remove the sender/receiver units from the flanges with tube.

> **WARNING:**
> When carrying out any work on the system, observe the relevant safety precautions as well as the safety instructions in § 1.6 (in particular § 1.6.1).

Required tools and aids:

- Spanner for Allen screws, SW 2 and 4
- Screwdriver
- Possibly a blind plug for flange with tube
- Brush, clean cloth, alcohol

5.2.1 Removing the sender/receiver units

> **WARNING:**
> - Hot and/or aggressive gases can escape when removing and installing sender/receiver units → use suitable safety equipment!
> - Shut the flange with tube with a blind flange after removing the sender/receiver unit.
> - Carry out repair work only when hot parts have cooled sufficiently!

Procedure

- Loosen the cable connection on the sender/receiver unit by rotating the knurled nut on the plug counterclockwise and carefully removing the plug.
- Protect the loose cable ends from dirt or moisture. Seal the socket on the sender/receiver unit using the associated screw cap.

> **NOTICE:**
> Moist or corroded contacts will cause malfunctions.

- Loosen the screws on the sender/receiver unit flange.
- Carefully remove the sender/receiver unit and place it in a suitable location.
- If necessary (for example, if the duct is pressurized), seal the flange with tube using a blind plug (available as an option).

5.2.2 Cleaning the sender/receiver unit

Clean the outside of the sender/receiver unit after it has been removed. Inspect the probe tube and transducers for signs of corrosion, and replace them if necessary. Dust deposits and caked dust can generally be removed without disassembling the transducer.

> **NOTICE:**
> The transducer must be cleaned with extreme care. Do not damage the transducer diaphragm.

> Depending on system conditions, the probe tube and transducers may initially require maintenance more frequently (approx. every 2 weeks, or less if necessary). If contamination is limited, the cleaning intervals can be gradually extended to max. 6 months.

Reinstall the sender/receiver unit after completing the work.

The work required for possible replacement of parts (probe tube, transducers) is listed in the Service Manual.

FLOWSIC100 Transmitter

6 Specification

6.1 Technical Data

<table>
<tr><td colspan="9">Measured value recording</td></tr>
<tr><td>Measured variables</td><td colspan="8">Gas flow rate, volume flow act., gas temperature, sound velocity</td></tr>
<tr><td>Measuring range</td><td colspan="8">Min. limit -40 to 0 m/s, max. limit from 0 to +40 m/s; continuously variable</td></tr>
<tr><td>Accuracy of emission measurement [1)]</td><td colspan="8">±0.1 m/s</td></tr>
<tr><td>Reproducibility of process measurement, standard sender/receiver units</td><td colspan="8">±1% for v > 2 m/s; ±0.02 m/s for v < 2 m/s</td></tr>
<tr><td colspan="9">Installation</td></tr>
<tr><td>FLSE100</td><td colspan="2">M</td><td>H</td><td colspan="2">PR</td><td colspan="2">SA</td><td>SD</td></tr>
<tr><td>Measuring path transducer–transducer [m] [2)]</td><td colspan="2">0.2 - 4 [3)]</td><td>2 - 15 [4)]</td><td colspan="2">0.27 - 0.28</td><td colspan="3">0.2 - 1.4</td></tr>
<tr><td>Internal duct diameter [m] [5)]</td><td colspan="2">0.15 - 3,4</td><td>1.4 - 13</td><td colspan="2">> 0.40</td><td colspan="3">0.15 - 1</td></tr>
<tr><td>Gas temperature [°C]</td><td colspan="5">-40 ... +260</td><td colspan="3">-40 ... +150</td></tr>
<tr><td>Installation angle (recommended) [°] [6)]</td><td colspan="3">45 ... 60</td><td colspan="2">45</td><td colspan="3">45 ... 60</td></tr>
<tr><td>Internal duct pressure [bar]</td><td colspan="8">± 0,1</td></tr>
<tr><td>Max. dust concentration [g/m³ std.] [7)]</td><td>1</td><td>100 [8)]</td><td colspan="2">1</td><td>1</td><td>100 [8)]</td><td>1</td><td>100</td></tr>
<tr><td colspan="9">Communication interfaces</td></tr>
<tr><td>RS485</td><td colspan="8">MODBUS RS485 RTU / ASCII</td></tr>
<tr><td colspan="9">Power supply</td></tr>
<tr><td>Operating voltage</td><td colspan="8">24 V d.c.</td></tr>
<tr><td>Maximum power input</td><td colspan="8">Approx. 40 W FLSE types: FLSE100-S, M, H, PR</td></tr>
<tr><td colspan="9">Ambient conditions</td></tr>
<tr><td>Temperature range [9)]</td><td colspan="8">-40 ... +60 °C</td></tr>
<tr><td>Storage temperature</td><td colspan="8">-40 ... +70 °C</td></tr>
<tr><td>Degree of protection</td><td colspan="8">IP 65 sender/receiver units (electronic housing)</td></tr>
<tr><td>Transient overvoltage</td><td colspan="8">Overvoltage category II</td></tr>
<tr><td>Environmental conditions</td><td colspan="8">Degree of contamination 2</td></tr>
<tr><td>Installation site</td><td colspan="8">Indoor, outdoor</td></tr>
<tr><td>Altitude</td><td colspan="8">Up to 2000m above sea level</td></tr>
<tr><td>Rel. humidity</td><td colspan="8">≤ 95%</td></tr>
<tr><td colspan="9">Dimensions, weight</td></tr>
<tr><td>FLSE100</td><td colspan="8">Nominal length (type specific) 200 / 260 / 350 / 550 / 750 mm;
Weight (type specific) max. approx. 10.6 kg</td></tr>
<tr><td>Flange with tube</td><td colspan="8">Nominal length 125 / 200 / 350 / 550 / 750 mm;
Pitch diameter of mounting holes 75 / 100 / 170 mm (depends on FLSE100 type);
Material St37, V4A (others on request), max. weight approx. 6 kg</td></tr>
</table>

1): The accuracy of flow measurements depends on calibration, installation conditions, flow profile, and variation range of pressure and temperature parameters. Typical values for one-path measurement are 1 ... 5%.
2): Maximum possible measuring path depends on dust content, gas temperature, and gas composition.
3): Maximum possible measuring path FLSE100-M HSHS (duct probe and transducer made of Hastelloy) is 2 m.
4): Maximum possible measuring path FLSE100-H HSHS (duct probe and transducer made of Hastelloy) is 5 m.
5): Minimum diameter for installation angle 45°, maximum diameter for installation angle 60°.
6): Use installation angle 60° for high dust contents.
7): Maximum possible dust concentration depends on the measuring path and gas temperature.
8): Only for dry and non-sticky dust.
9): Lower ambient temperatures on request.

6.2 Standard components

The standard components required for a complete measuring system depend on the mechanical design of the sender/receiver unit. The following Table shows the possible combinations and the quantities required:

Sender/receiver unit		Flange with tube[1]	Connection cable		Junction box
Type	Number		Master	Slave	
FLSE100-M, H	2	2	1	1	1
FLSE100-PR	1	1	–	1	– [2]
FLSE100-SA/SD	1 each	2	–	1	– [2]

[1]:The flange with tube or connection must be suitable for the sender/receiver unit (see Flange with Tube Table)

[2]:Junction box optional for longer cable lengths

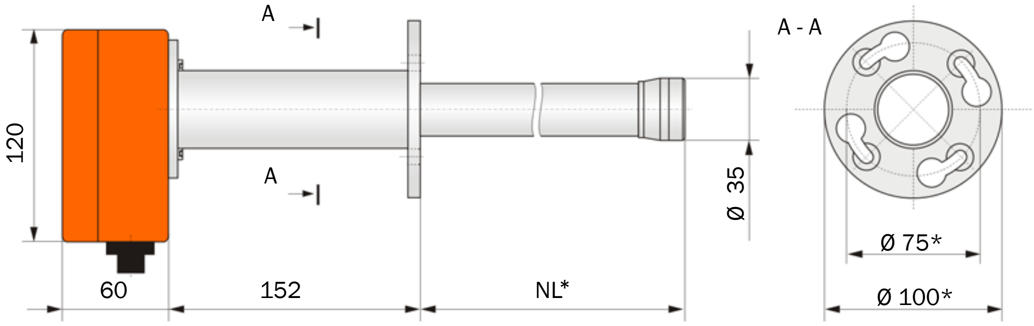
6.3 Dimensions

All dimensions are in mm.

6.3.1 Sender/receiver units

Standard sender/receiver units

Fig. 62 FLSE100-M

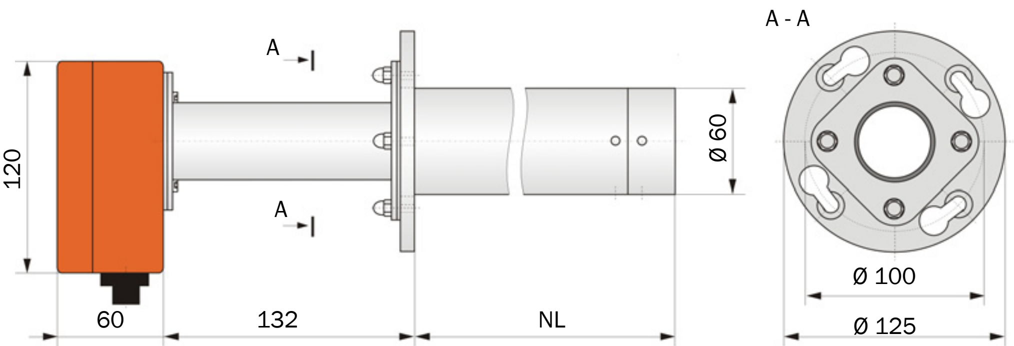


NL = 200 / 350 / 550**

*: Deliverable with pitch diameter 100 mm and flange diameter 125 mm on request

**: Other nominal lengths on request

Fig. 63 FLSE100-H



NL = 200 / 350 / 550 / 750 *

* Other nominal lengths on request

Fig. 64 FLSE100-PR

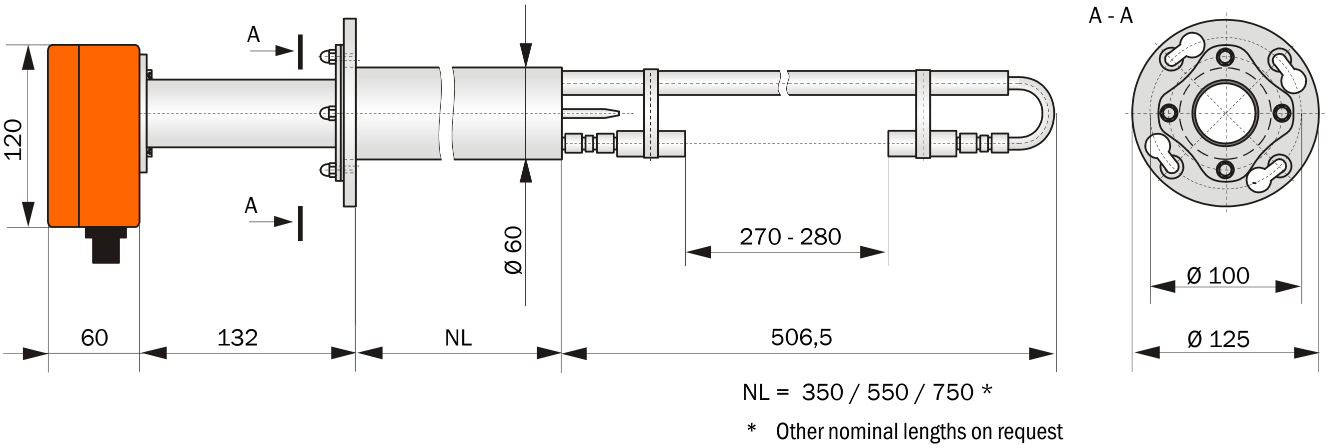


Fig. 65 FLSE100-SA

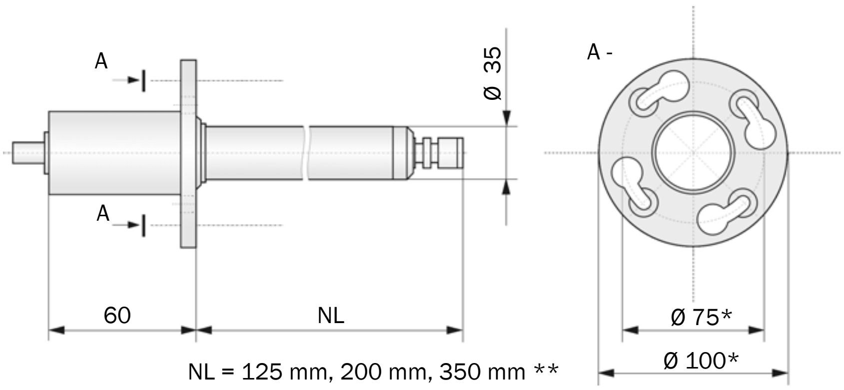
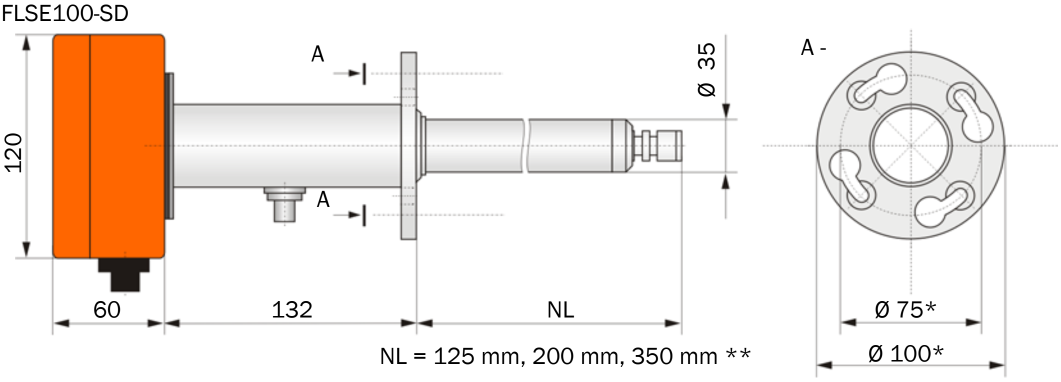
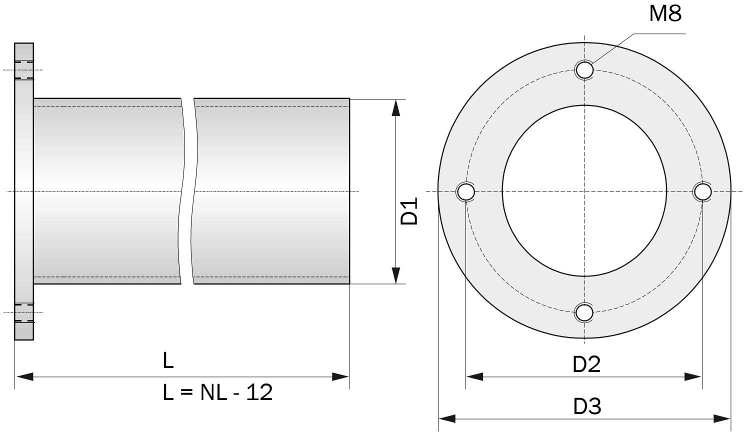


Fig. 66 FLSE100-SD



6.3.2 Flange with tube

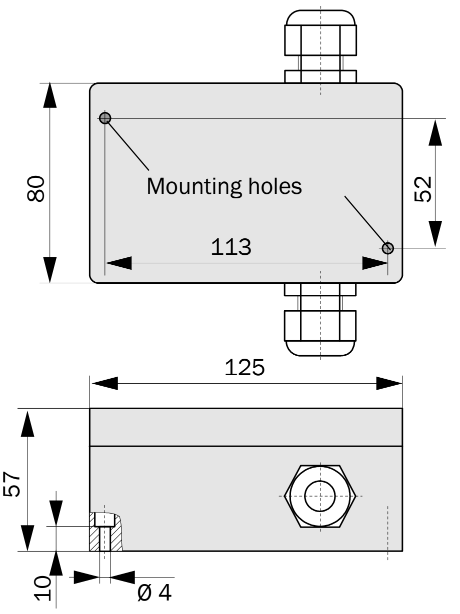
Fig. 67 Flange with tube



D1	D2	D3	NL	Type FLSE100
48,3	75	100	125	SA, SD
			200, 350	SA, SD, M
			350, 550	M
76,1	100	122	200	H
			350	H, PR
			550	H, PR
			750	H, PR

6.3.3 Junction box for connection cable

Fig. 68 Junction box for connection cable



NOTICE:

- Self-locking terminals for wire sizes 0.5 mm^2 ... 2.5 mm^2 (AWG20 ... AWG12)

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