

Operating Instructions

FWE200DH

Dust Measuring Device



Described Product

Product name: FWE200DH

Manufacturer

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

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Contents

1	Important information	7
1.1	Main hazards.....	7
1.1.1	Hazard through hot and/or aggressive gases and high pressure	7
1.1.2	Hazard through electrical equipment	7
1.1.3	Hazards through laser beam	7
1.1.4	Hazard through moving parts.....	7
1.2	Symbols and document conventions	8
1.2.1	Warning Symbols	8
1.2.2	Warning levels and signal words.....	8
1.2.3	Information Symbols.....	8
1.3	Intended use	8
1.4	Responsibility of user.....	9
1.4.1	General information.....	9
1.4.2	Safety information and protective measures	9
2	Product description	11
2.1	System features and application areas	11
2.1.1	System features and advantages	11
2.1.2	Application areas	11
2.2	FWE200DH operating principle.....	12
2.2.1	Functional principle	12
2.2.2	Isokinetic behavior	14
2.2.3	Scattered light measuring principle.....	14
2.2.4	Response time	15
2.2.5	Automatic function check.....	15
2.3	Device components	18
2.3.1	Sample gas probe.....	18
2.3.2	Flange with tube	18
2.3.3	Extraction and return hoses	19
2.3.4	Measuring and control unit	19
2.3.4.1	Thermo cyclone	22
2.3.4.2	Measuring sensor	22
2.3.4.3	Control unit.....	24
2.3.4.4	Extended calibration function.....	26
2.3.5	Blower unit.....	27
2.3.6	Options	27
2.3.6.1	Backpurge unit	27
2.3.6.2	Heated extraction hose.....	28
2.3.6.3	Remote unit.....	28
2.3.6.4	Cover at the bottom	29
2.3.6.5	Test equipment for linearity test	29
2.4	SOPAS ET (PC program)	30

3	Assembly and installation	31
3.1	Project planning.....	31
3.2	Assembly	32
3.2.1	Fitting the flange with tube	32
3.2.2	Installing the measuring and control unit	33
3.2.3	Installing the blower unit	35
3.2.4	Installing the remote unit option	36
3.3	Installation	37
3.3.1	General information	37
3.3.2	Connecting the control unit	38
3.3.2.1	Connecting cables for digital, analog and status signals	39
3.3.2.2	Connecting the blower unit and supply voltage	42
3.3.3	Fitting and connecting the Interface module option	43
3.3.4	Installing the backpurge option (only necessary when ordered separately).....	44
3.3.5	Connecting the remote unit option.....	46
4	Start-up and configuration	47
4.1	Putting the FWE200DH into operation	47
4.1.1	Preparatory work	47
4.1.2	Starting the FWE200DH.....	48
4.1.3	Fitting the sample gas probe	49
4.2	Basics.....	50
4.2.1	General information	50
4.3	Install SOPAS ET	50
4.3.0.1	Password for SOPAS ET menus.....	50
4.3.1	Connection to the device via USB line	50
4.3.1.1	Finding the DUSTHUNTER COM port.....	51
4.3.2	Connection to the device via Ethernet (option)	52
4.4	Setting standard parameters	53
4.4.1	Factory settings	53
4.4.2	Setting "Maintenance" mode	54
4.4.3	Changing function parameters	55
4.4.3.1	Change temperature settings	55
4.4.3.2	Define limit value for the flow rate	55
4.4.3.3	Set the suction.....	56
4.4.4	Setting the function check	57
4.4.5	Setting the analog output parameters	58
4.4.6	Setting the analog input parameters	60
4.4.7	Setting the response time.....	60
4.4.8	Defining regression coefficients	62
4.4.9	Calibration for dust concentration measurement	63
4.4.10	Data backup	65
4.4.11	Starting measuring operation	67

4.5	Setting the Interface module parameters.....	68
4.5.1	Modbus TCP module.....	68
4.5.1.1	Check MCU settings.....	68
4.5.1.2	Installing the configuration program.....	70
4.5.1.3	Integrating the Modbus module in the network.....	71
4.5.1.4	Configuring the Modbus module.....	75
4.5.1.5	Checking the functional capability.....	77
4.5.2	Setting the Ethernet module parameters.....	78
4.6	Activating the backpurge option.....	79
4.7	Operating/setting parameters via the LC-Display.....	80
4.7.1	General information on use.....	80
4.7.2	Password and user levels.....	80
4.7.3	Menu structure.....	81
4.7.4	Setting parameters.....	82
4.7.4.1	Sample gas temperature.....	82
4.7.4.2	Analog outputs / inputs.....	82
4.7.5	Using SOPAS ET to modify display settings.....	84
5	Maintenance.....	85
5.1	General information.....	85
5.1.1	Maintenance intervals.....	85
5.1.2	Maintenance contract.....	85
5.1.3	Auxiliary means required.....	85
5.1.4	Setting "Maintenance" mode.....	86
5.2	Maintenance work.....	87
5.2.1	Preparatory work.....	87
5.2.2	Visual inspection.....	88
5.2.3	Cleaning the inlet nozzles on the thermo cyclone.....	89
5.2.4	Cleaning the ejector.....	90
5.2.5	Cleaning the suction nozzle.....	91
5.2.6	Cleaning the intermediate nozzle.....	92
5.2.7	Clean the sample gas probe, extraction and return hose.....	92
5.2.8	Cleaning the swirl chamber.....	93
5.2.9	Cleaning optical interfaces.....	94
5.2.10	Checking / replacing the filter element of the blower unit.....	95
5.3	Putting the measuring system out of operation.....	96
6	Troubleshooting and error handling.....	97
6.1	General information.....	97
6.1.1	Display of warning and malfunction messages.....	97
6.1.2	Malfunctions.....	98
6.2	Warning and error messages in SOPAS ET.....	99
6.2.1	Measuring sensor.....	99
6.2.2	Measuring system.....	100
6.2.3	Control unit.....	102

7	Specifications.....	104
7.1 Technical Data	104
7.2	Dimensions, Part Nos.	107
7.2.1	Sample gas probe	107
7.2.2	Flange with tube	107
7.2.3	Measuring and control unit.....	108
7.2.4	Blower unit.....	108
7.3	Options	109
7.3.1	Remote unit	109
7.3.2	Frame.....	110
7.3.3	Weatherproof cover for blower unit.....	111
7.3.4	Measuring system	111
7.3.5	Interface module	111
7.3.6	Device check accessories.....	111
7.4	Consumable parts for 2-years operation	112
7.4.1	Measuring sensor.....	112
7.4.2	Blower unit.....	112
8	Annex.....	113
8.1	Standard settings FWE200DH	113

1 Important information

1.1 Main hazards

1.1.1 Hazard through hot and/or aggressive gases and high pressure

The optical subassemblies are fitted 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.

**WARNING: Danger from exhaust gas**

Hot and/or aggressive gases can escape from gas-carrying system components (sample gas probe, gas hoses, thermo cyclone, measuring unit, ejector) and cause serious health damage if the operator is unprotected.

- ▶ Switch the measuring system off before starting any work.
 - ▶ Only perform work with adequate protection devices (protective clothes, protective mask).
 - ▶ Let gas-carrying and hot system components cool down sufficiently before touching or use protective equipment.
 - ▶ Plants with toxic gases, high temperatures or high pressure must be shut down before the sample gas probe is removed or fitted
-

1.1.2 Hazard through electrical equipment

**WARNING: Danger through power voltage**

Measuring system FWE200DH is an electrical equipment.

- ▶ 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.
-

1.1.3 Hazards through laser beam

**WARNING: Hazards through laser beam**

FWE200DH The sender/receiver unit of the FWE200DH uses a laser with laser class 2.

- ▶ Never look directly into the beam path
 - ▶ Do not point the laser beam at persons
 - ▶ Pay attention to laser beam reflections.
-

1.1.4 Hazard through moving parts



**WARNING: Hazard through moving parts**

The backpurge unit option has an electrically controlled ball valve which can cause crushing in case of improper handling.

- ▶ Do not insert any body parts (fingers) or objects into the openings during actuation.
-

1.2 Symbols and document conventions

1.2.1 Warning Symbols

Symbol	Description
	Hazard (general)
	Hazard by voltage

1.2.2 Warning levels and signal words

Danger

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

Warning

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



Caution

Hazard or unsafe practice which could result in personal injury or property damage.

NOTICE

Hazard which *could* result in property damage.

1.2.3 Information Symbols

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

1.3 Intended use

Purpose of the device

The FWE200DH measuring system only serves continuous measurement of dust concentrations in exhaust gas and exhaust air plants.

Correct use

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

Restrictions of use

- The FWE200DH measuring system is not approved for use in potentially explosive atmospheres.

1.4 Responsibility of user

1.4.1 General information

Designated users

The FWE200DH measuring system may only be installed and operated by skilled technicians who, based on their technical training and knowledge as well as knowledge of the relevant regulations, can assess the tasks given and recognize the hazards involved.

Special local conditions

- ▶ Observe the valid legal regulations as well as the technical rules deriving from implementation of these regulations applicable for the respective equipment during work preparation and performance.
- ▶ Carry out work according to the local conditions specific for the equipment as well as operational hazards and regulations.

Keeping documents

Keep the Operating Instructions belonging to the measuring system as well as equipment documentation onsite for reference at all times. Pass the respective documentation on to any new owner of the measuring system.

1.4.2 Safety information and protective measures

Protection devices

**NOTE:**

Depending on the particular hazard potential, an adequate number of suitable protection devices and personal safety equipment must be available and used by the personnel.

Behavior during a purge air failure

The purge air supply serves to protect optical subassemblies fitted on the duct against hot or aggressive gases. Leave the supply switched on when the equipment is at a standstill. Optical subassemblies can be severely damaged in a short time if the purge air supply fails.

**NOTE:**

If no quick-release shutters are available:

The user must ensure that:

- ▶ The purge air supply runs reliably and continuously
 - ▶ Failure of the purge air supply is immediately detected (e.g., by using pressure monitors)
 - ▶ Optical subassemblies are removed from the duct if the purge air supply fails and the duct opening is closed off (e.g. with a flange cover)
-

Preventive measures for operating safety

**NOTE:**

The user must ensure that:

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

Recognizing malfunctions

Every deviation from normal operation is to be regarded as a serious indication of a functional impairment. These are, amongst others:

- Warning indications
- Significant drifts in measured results
- Increased power consumption
- Higher temperatures of system components
- Monitoring devices triggering
- Smells or smoke emission
- Heavy contamination.

Avoiding damage

**NOTE:**

In order to avoid malfunctions that can cause direct or indirect personal injury or property damage, the operator must ensure:

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

Electric connection

It must be possible to switch off the device using a power isolating switch/circuit breaker according to EN 61010-1.

2 Product description

2.1 System features and application areas

The measuring system FWE200DH serves for continuously measuring dust concentrations up to 200 mg/m³ (typical range of application) in wet gases (temperatures below the dew point) with a resolution of up to approx. 0.1 mg/m³. It can be used in a wide range of applications and features low installation effort and simple handling.

2.1.1 System features and advantages

- Extraction of a partial gas flow from the gas duct
- Drying and overheating the wet partial gas flow with adjustable electrical heating for constant sample gas temperature to rule out measurement errors caused by droplets existing before
- Gas extraction and return with one sample gas probe which means only one mounting flange is required
- Dust content determination using scattered light measurement for low to medium dust concentrations
- Compact measuring system design means simple assembly and installation
- Operating values and system status displayed on an LC-Display
- Flow monitoring with integrated differential pressure measurement
- Simple configuration and operation using user-friendly software
- Self-control via automatic function control (see [“Automatic function check”, page 15](#)) of the scattered light sensor and numerous control functions such as overvoltages, low voltages, high and low temperatures, pressure, flow monitoring, filter monitor for recognizing high filter contamination

2.1.2 Application areas

- Measuring dust emissions in power stations downstream from flue gas desulfurization plants
- Measuring dust in wet purifiers and waste incineration plants
- Measuring dust content in wet exhaust air from technological processes

2.2 FWE200DH operating principle

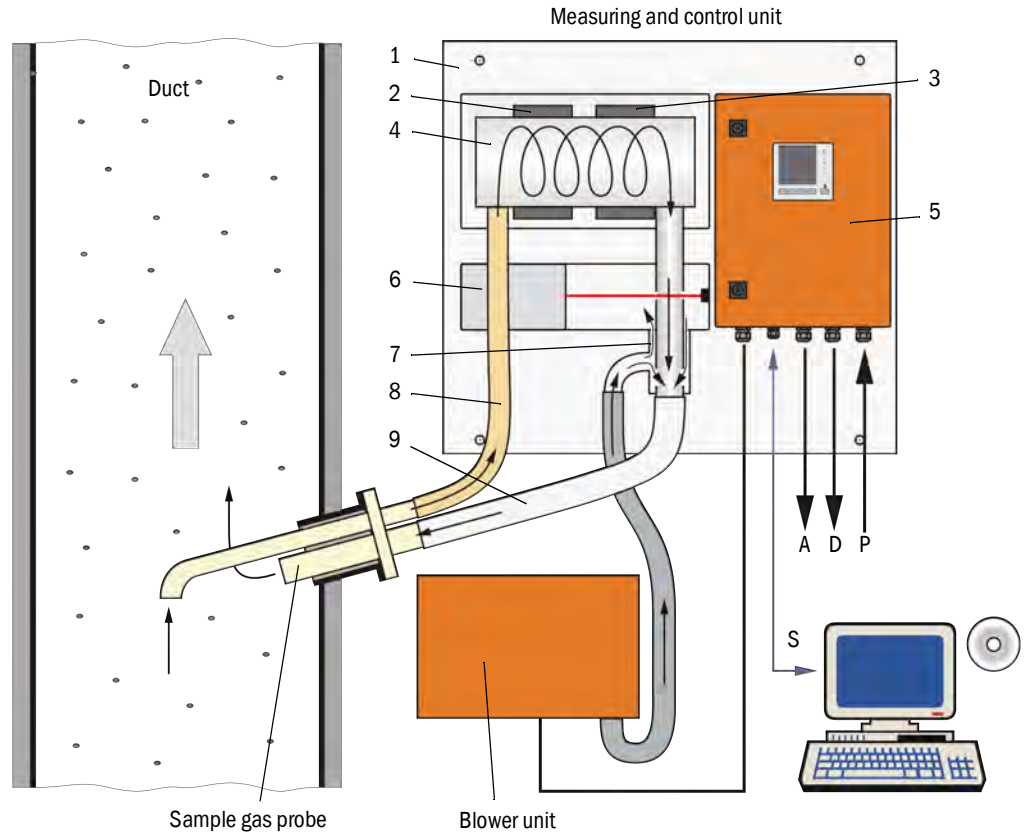
2.2.1 Functional principle

The FWE200DH functions as a bypass system. A partial gas flow is suctioned from the gas duct via a sample gas probe, overheated in a thermo cyclone so that water drops and aerosols vaporize and then fed into a measuring cell. A laser beam passes through the sample gas in the measuring cell and the light scattered by the particles in the gas flow is measured by the receiver. The measured scattered light intensity serves as basis for determining the dust concentration. The sample gas is then fed back to the sample gas probe again to be returned to the duct.

The gas flow through the measuring system is fed by an ejector. The ejector is driven by a blower.

A small part of the partial flow is led from the blower to the measuring cell as purge air flow to ensure that the optical windows in the measuring cell are kept clean and to prevent sample gas condensing in the measuring cell.

Fig. 1: FWE200DH basic layout



- 1 Base plate
- 2 Heating band 1
- 3 Heating band 2
- 4 Thermo cyclone
- 5 Control unit
- 6 Measuring sensor with measuring cell
- 7 Ejector
- 8 Extraction line
- 9 Return line

- S SOPAS ET operating software
- P Power supply 115 / 230 V AC
- A Output signal 0 ... 20 mA
- D Status signals

2.2.2 Isokinetic behavior

The measuring behavior of the FWE200DH is mainly independent of gas velocity changes in the duct. Therefore an isokinetic extraction (extraction velocity = gas velocity) is not required.

In standard state, the measuring system FWE200DH works with a stable volume flow between approx. 8...14m³/h. A volume flow between approx. 12...13m³/h is recommended as design state. Set this design state by adjusting the speed of the blower during start up.

It is recommended to select the extraction nozzle of the sample gas probe depending on the average gas velocity according to the following Table.

Possible errors due to a non-isokinetic extraction are secondary and will be compensated by calibration of the measuring system (see "Scattered light measuring principle", page 14).

In addition, the blower speed (see "Blower unit", page 27) is set during startup so that the flow rate is within the ideal range. This ensures reliable operation even with changing gas velocities.

The following effects can occur when the flow rate is not adapted to the equipment conditions:

- Flow rate too low
→ particles can be deposited in the gas-carrying parts.
- Flow rate too high, gas/ambient temperature very low, gas wetness very high
→ the set sample gas temperature is not reached → aerosols/water droplets do not vaporize completely (heating output of thermo cyclone is limited).

Sample gas probe extraction aperture	Gas velocity in the duct in m/s
Nominal diameter	
DN23	0 ... 8
DN18	6 ... 15
DN14	12 ... 25



If $v_{\text{design state}}$ is not known when ordered (e.g. no information in Technical Questionnaire), the sample gas probe is delivered with the standard value DN 18.

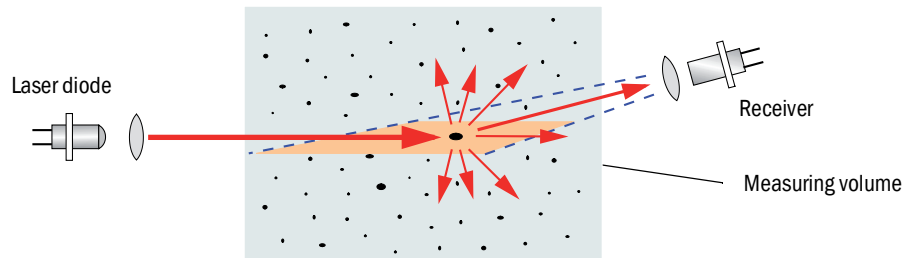
2.2.3 Scattered light measuring principle

The FWE200DH works according to the scattered light measurement principle (forward dispersion). The high sensitivity of this principle makes it particularly suitable for measuring low particle concentrations.

A laser diode beams the dust particles in the sample gas flow with modulated light in the visual range (wavelength approx. 650 nm). The light scattered by the particles is recorded by a highly sensitive measurement receiver, amplified electrically and processed by a microprocessor in the measuring sensor ("DHSP200") electronics. The measuring volume in the gas duct is defined through the intersection of the sender beam sent and the receive aperture.

Continuous monitoring of the sender output registers the smallest changes in brightness of the light beam sent which then serves to determine the measurement signal.

Fig. 2: Measuring principle



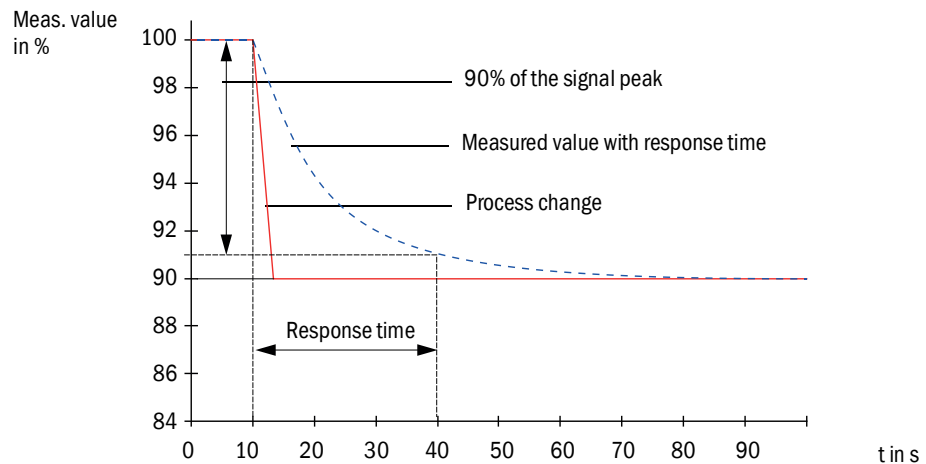
Determining the dust concentration

Measured scattered light intensity (SI) is proportional to dust concentration c . Scattered light intensity not only depends on the number and size of particles but also on the optical characteristics of the particles and therefore the measuring system must be calibrated using a gravimetric comparison measurement for exact dust concentration measurement. The calibration coefficients determined can be entered directly in the measuring system (available calibration functions see [“Extended calibration function”](#), page 26, standard factory settings see [“Factory settings”](#), page 53, input see [“Calibration for dust concentration measurement”](#), page 63).

2.2.4 Response time


The damping time is the time until 90% of the peak is reached after a step change in the measurement signal. It can be set anywhere between 1 and 600 s. As the response time increases, transient measured value fluctuations and interruptions are damped stronger and stronger which "smoothes out" the output signal.

Fig. 3: Response time



2.2.5 Automatic function check

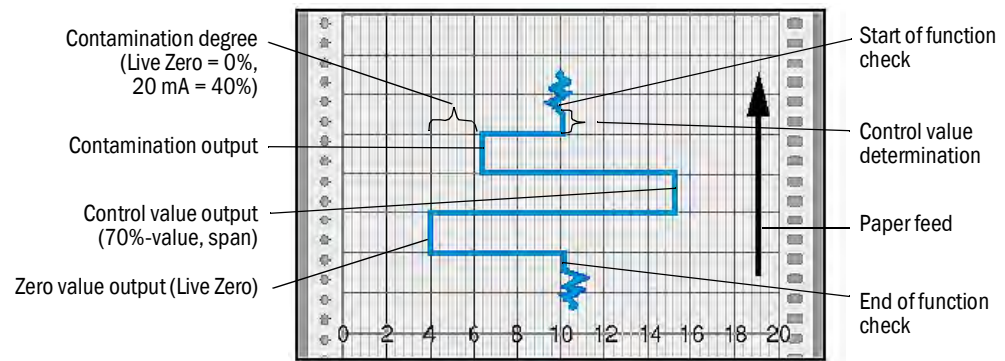
A function check can be started at fixed intervals as from a definable starting timepoint for an automatic function control of the measuring system. The setting is made using SOPAS ET (see [“Setting the function check”](#), page 57). Any unallowed deviations from normal behavior that may occur are signaled as errors. A function check triggered manually can help localize possible error causes should a device malfunction occur.

 Further information → Service Manual

The function check comprises:

- Approx. 30 s measurement of zero value, control value and contamination of optical interfaces
- Every 90 s (standard value), output of values determined (duration parameter can be modified [see "Setting the function check", page 57](#)).

Fig. 4: Function check output on a plotter



- The analog output must be activated to output control values on the analog output ([see "Setting the function check", page 57](#)).
- The value measured last is output on the analog output during control value determination.
- If the control values are not output on the analog output, the current measured value is output when control value determination has completed.
- Relay 3 is switched on during a function check ([see "Connecting cables for digital, analog and status signals", page 39](#)). The single phases of the function check can be output separately via further digital outputs ([see "Extended calibration function", page 26](#)).
- A function check is not started automatically when the measuring system is in "Maintenance" mode.
- "Function control" is displayed on the LC-Display of the control unit during the function check.
- If the start timepoint or cycle interval are changed, a function check timed between parameter setting and new start timepoint is still carried out.
- Changes to the interval time are first effective after the next start timepoint.

Zero value measurement

The sender diode is switched off for zero point control so that no signal is received. This means possible drifts or zero point deviations are detected reliably in the overall system (e.g., due to an electronic defect). An error signal is generated when the "zero value" is outside the specified range.

Control value measurement (span test)

Sender beam intensity changes between 70 and 100% during control value determination. The light intensity received is compared against the standard value (70%). The measuring system generates an error signal for deviations greater than $\pm 2\%$. The error message is cleared again when the next function check runs successfully. The control value is determined with high precision through statistical evaluation of a high number of intensity changes.

Contamination measurement

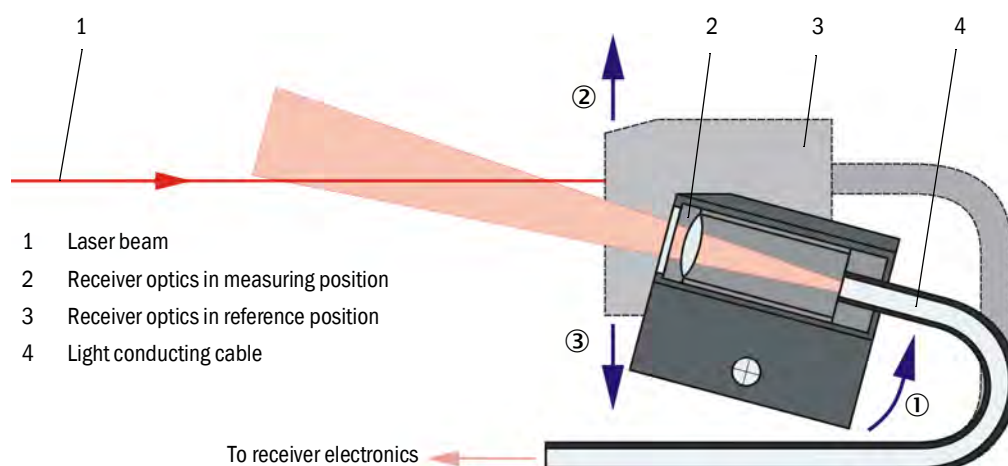
For contamination measurement, the receiver optics is moved through the laser beam while the transmission is measured. Here the whole transfer path from the light source via the receiver optics to the optical sensor is measured and compared to the internally saved value for "clean optics". Every deviation from the output value determined at the factory is compensated.

The measured value determined and the value defined as factory setting are used to calculate a control factor. This fully compensates any contamination that occurs.

A value between live zero and 20 mA is output on the analog output for contamination values $< 40\%$.

For values $> 30\%$ a warning message is output, for values as from 40% "malfunction" is output (for the fault current set on the analog output for this case; see "Factory settings", page 53, see "Setting the analog output parameters", page 58).

Fig. 5: Contamination and control value measurement



2.3 Device components

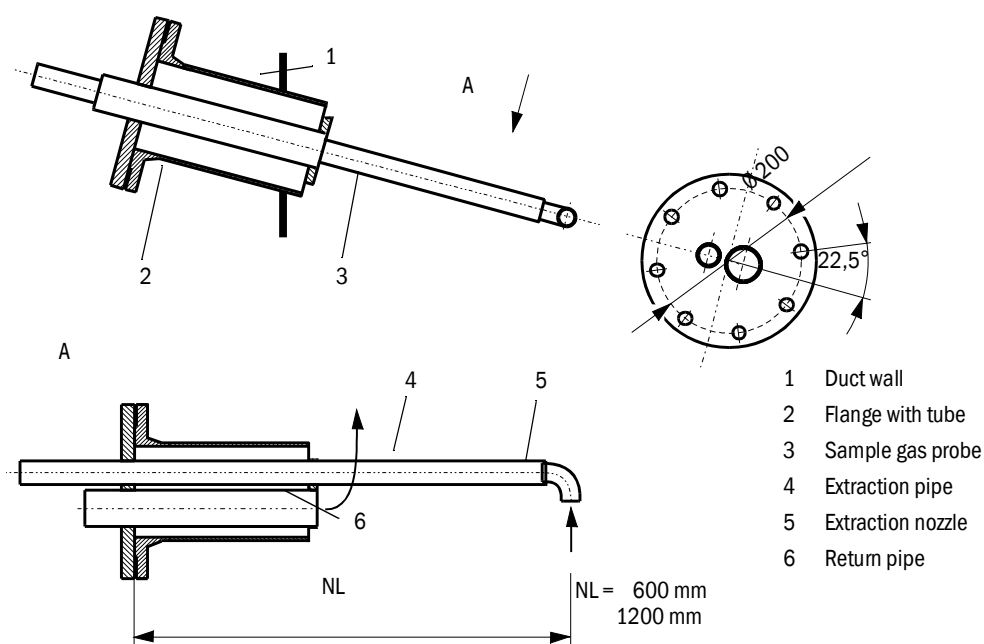
2.3.1 Sample gas probe

The sample gas probe serves to extract and return the partial gas flow, It is fixed on a flange with tube (see “Flange with tube”, page 18) to be fitted onsite on the gas duct.

The probes are available as standard in two nominal lengths (NL) and materials PVDF (for gas temperatures < 120 °C) and Hastelloy.

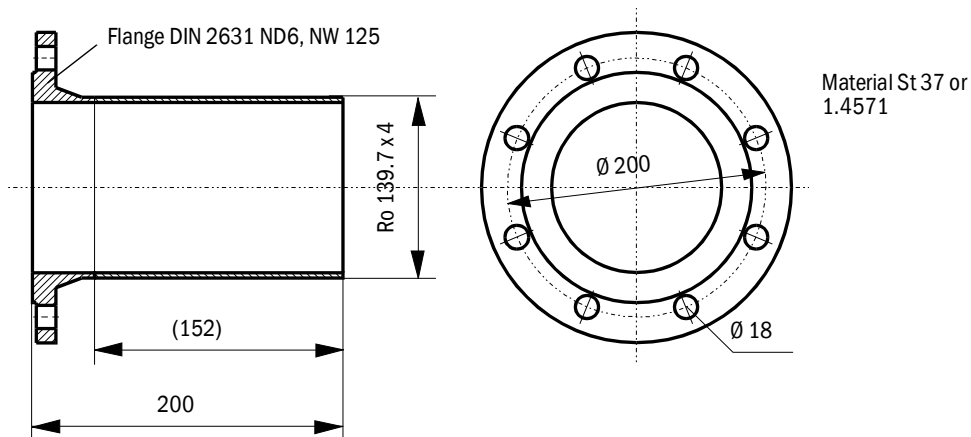
Exchangeable extraction nozzles with nominal diameters DN14, DN18 and DN23 are delivered for flow adjustment (see “Isokinetic behavior”, page 14).

Fig. 6: Sample gas probe



2.3.2 Flange with tube

Fig. 7: Flange with tube



If required, the flange with tube can also be supplied with other dimensions and materials.

2.3.3 Extraction and return hoses

Sample gas probe and control unit are connected with flexible hoses with NW32 for gas extraction and NW 50 for gas return.

Standard length is approx. 1.2 m.

In most cases, an active heating (option) is not required (available as an option). It is recommended to use an extraction hose with insulation for use outside with very low ambient temperatures and longer hoses.

Such an insulation (silicone foam hose) can be retrofitted onsite.

Recommendation:

Ambient temperature	Extraction hose
< -20°C	with active heating
-20 .. +20°C	with insulation

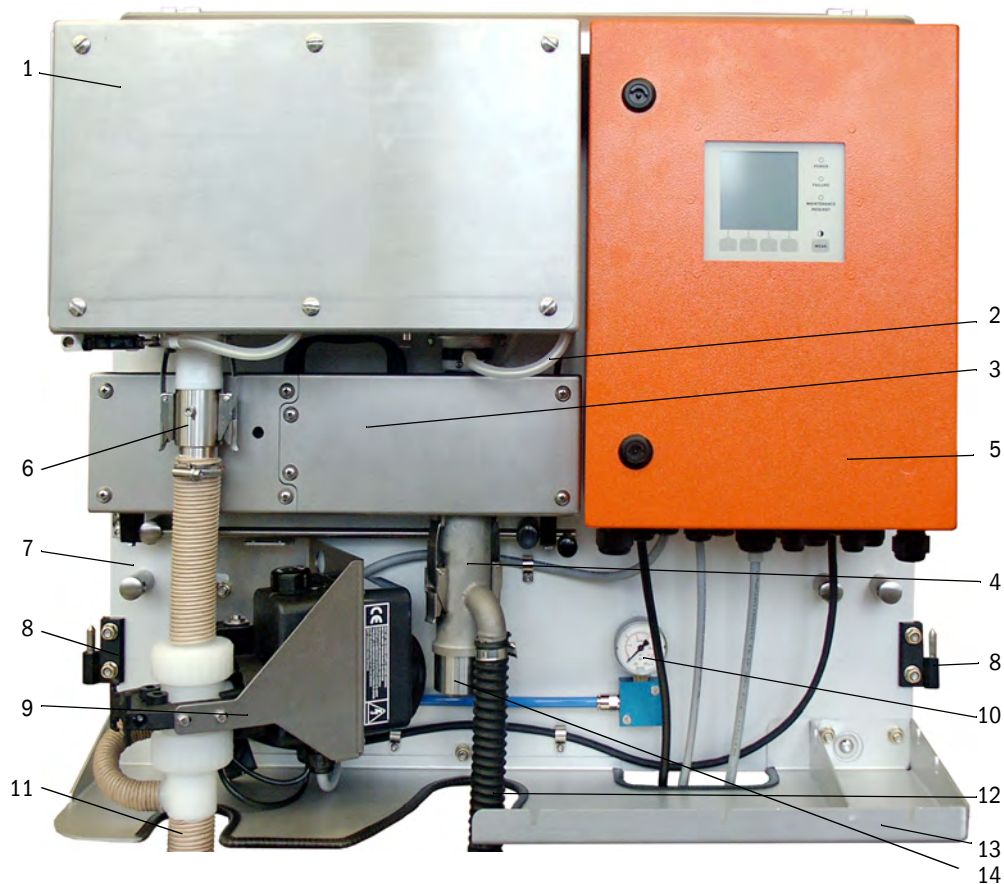
Longer hoses have a higher maintenance effort (removing deposits/cakings) and a higher cooling-off of suctioned partial gas flow as well as pressure loss and thus are only allowed to be used in exceptions and after checking the operating conditions.

2.3.4 Measuring and control unit

The measuring and control unit comprises the following components fitted on a base plate (7):

- Thermo cyclone (1) for overheating the sample gas with temperature sensor (2) to regulate the sample gas temperature,
- Measuring sensor (3) with sender and receiver electronics, and measuring cell to transport the partial gas flow through the optical measuring volume of the sender beam
- Ejector (4) for transporting the suctioned partial gas flow,
- Control unit (5).

Fig. 8: Measuring and control unit (without weatherproof cover, with backpurge option and cover at the bottom)



- | | |
|---|---|
| 6 Adapter for extraction hose (standard)/ to connect the back-purge unit option | 11 Extraction hose |
| 8 Hinge for weatherproof cover | 12 Hose from the ejector to the blower |
| 9 Backpurge unit option | 13 Work surface.Cover at the bottom (option). |
| 10 Pressure gauge - Compressed air display (only for option "Backpurge unit") | 14 Return hose connection |

The sample gas flow is monitored with a differential pressure sensor between thermo cyclone output and measuring cell input.

The application-dependent plant and device parameters can be set via the operating program SOPAS ET (see ["Setting standard parameters", page 53](#)). Depending on the function, three individual software modules are used ("FWE200DH" for system functions, "DH SP200" for measuring functions and "MCU" for input and output functions). The parameters are stored reliably even in the case of a power failure.

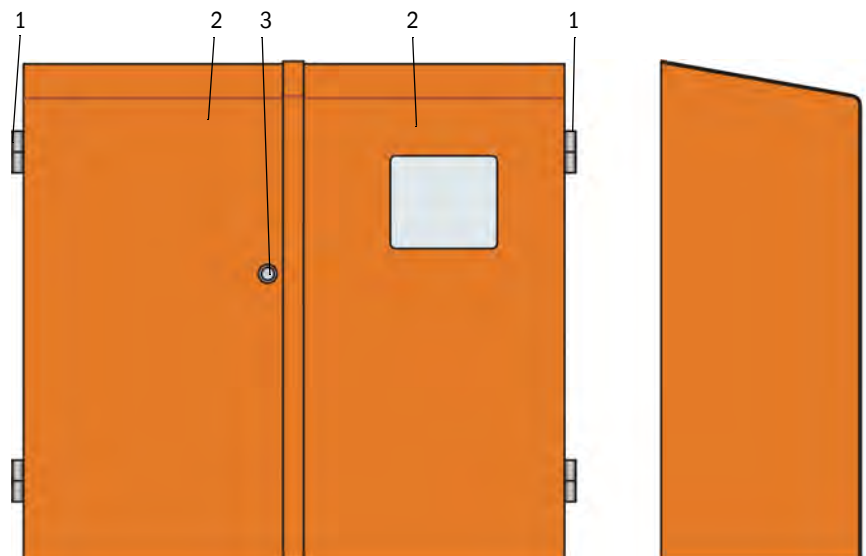
When in operation, the measuring and control unit is covered by a two-piece hood that serves as weather protection at the same time for outdoor installations. Both parts (2) are hung on hinges (1) on the base plate, can be swiveled away sideways and locked together with lock (3).

Weatherproof cover for FWE200DH

When in operation, the measuring and control unit is covered by a two-piece hood that also serves as weather protection for outdoor installations.

The cover can be omitted for use in rooms.

Fig. 9: Weatherproof cover for FWE200DH



Type code

The respective version of the measuring and control unit is marked by a type code:

Parameter	Version	Type code			
		FWE200DH-	X	X	X
Backpurge unit option	Without		N		
	With		B		
Heated extraction hose option	Without			N	
	With			H	
Optional Interface module	Modbus TCP				J
	Ethernet type 1				E
	Profibus DP				P

2.3.4.1 Thermo cyclone

The thermo cyclone comprises a housing with insulation, a swirl chamber with inlet and outlet connections and 2 heating bands to overheat the partial gas flow. The inlet connection is fitted tangentially, creating a swirl flow in the swirl chamber. A PTFE nozzle in the inlet connection accelerates the flow. The swirl chamber can be accessed easily for inspection and possible cleaning after opening a cover.

Temperature sensors attached to the heating bands measure the temperatures which are monitored by the microprocessor control in the control unit.

Additional built-in temperature fuses switch the heating bands off at temperatures above approx. 425 °C. This effectively prevents damage to the thermo cyclone through overheating even during a possible electronics failure.

A temperature sensor is fitted on the thermo cyclone outlet and serves as encoder for regulating the sample gas temperature.

2.3.4.2 Measuring sensor

The measuring sensor consists of two modules fitted in one stainless steel housing:

- Electronics unit (1) with the optical and electronic subassemblies to send and receive laser beam (2) as well as signal processing and evaluation.
- Measuring cell (3) with receiver optics (4), light trap (5) and nozzle to transport the sample gas flow.

The electronics unit is connected to the control unit via connection cable for signal transmission and power supply (24 V DC).

Fig. 10: Measuring sensor open

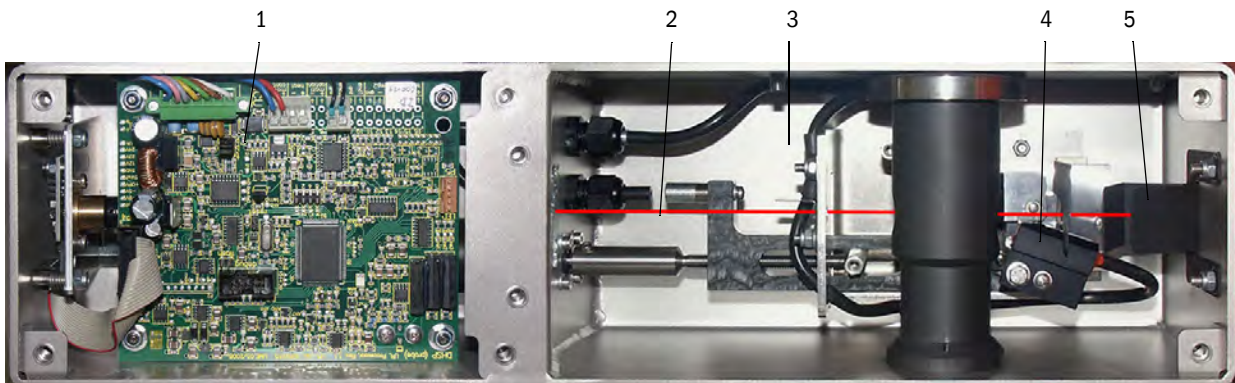
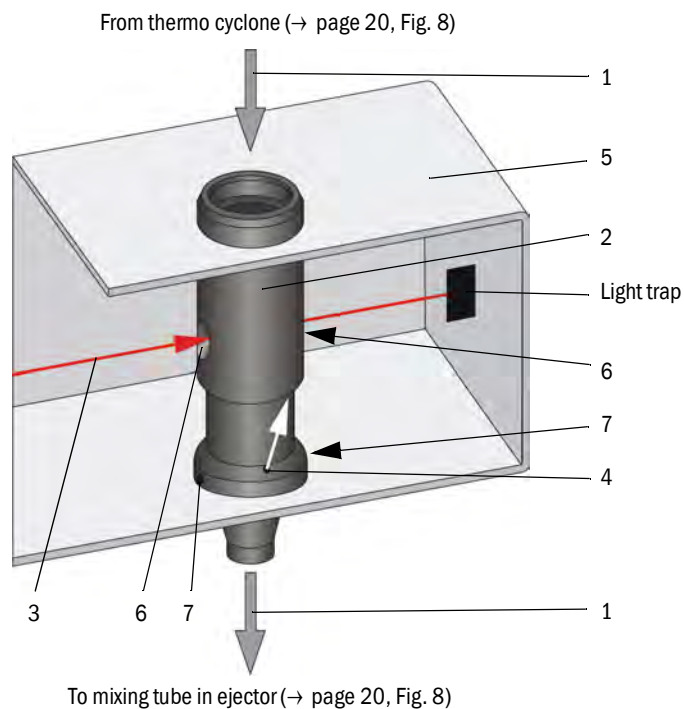


Fig. 11: Sample gas and purge air feed



Sample gas (1) from the thermo cyclone flows down through measuring tube (2) vertically through laser beam (3). The active measuring volume is within the measuring tube so that all particles of the dry sample gas flowing through are captured by the laser beam. The scattered light signal measured by the receiver therefore represents the dust content in the partial gas flow.

Clean air is blown into measuring cell (3) through small opening (4) in the measuring tube and then transported further via measuring openings (6) with the sample gas. The purge air amount is very low in relation to the sample gas flow so that no mixing with the measuring volume occurs and the purge air has no effect on measuring behavior.

Condensate that may occur due to condensation effects can flow out through 2 openings (7) in the nozzle in the sample gas flow (is drawn away by the partial vacuum).

2.3.4.3 Control unit

The control unit has the following functions:

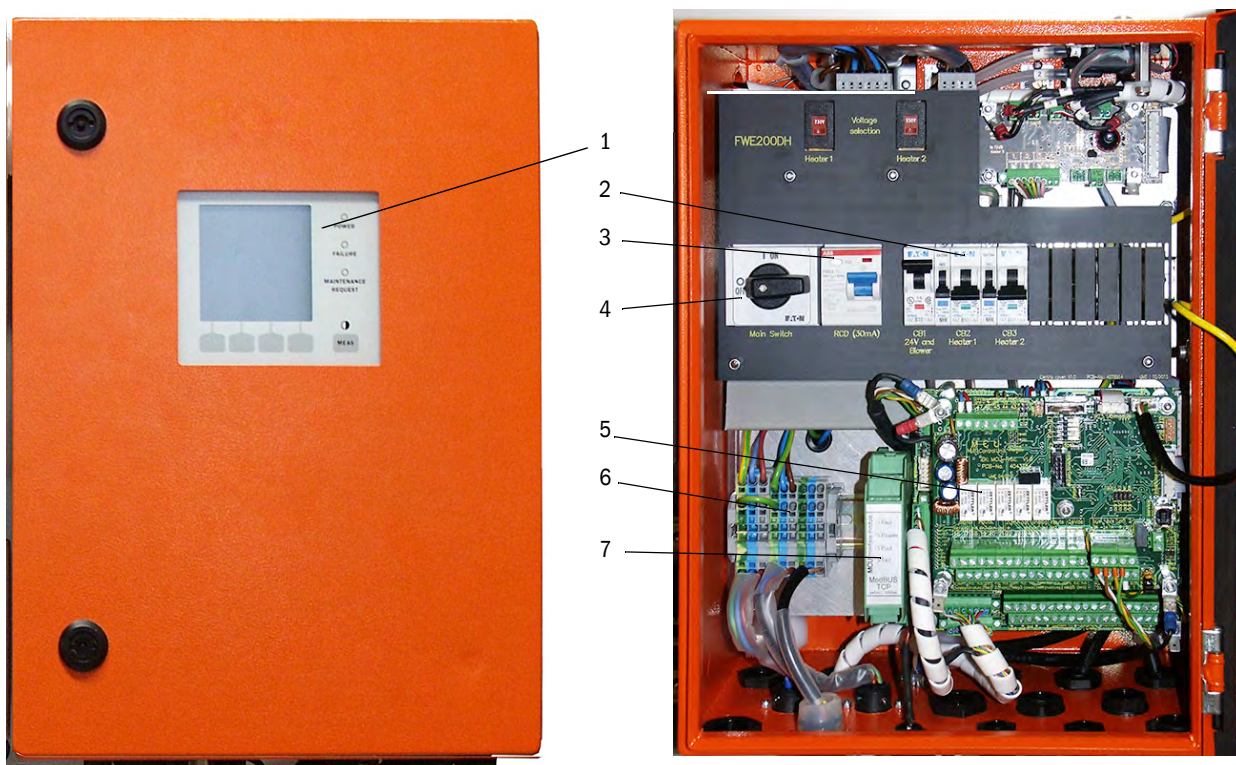
- Starting and stopping the FWE200DH
- Temperature control and monitoring for thermo cyclone heating
- Sample gas flow control
- Monitoring and controlling gas feed (switching blower unit on/off)
- Recording and evaluating status signals
- Controlling data traffic and processing data of the measuring sensor connected via the RS485 interface and system control
- Signal output via analog output (measured value) and relay outputs (device status)
- Signal input via analog and digital inputs
- Power supply for the connected measuring sensor via 24 V switch-mode power supply with wide range input
- Communication with higher level control systems via optional modules

Apart from the control electronics, the control unit also contains the connection elements for thermo cyclone, measuring sensor and blower unit, as well as for analog and status signals.

Measured values and status messages are output on an LC-Display. It also allows configuring basic functions.

The control unit is fitted in a steel sheet enclosure.

Fig. 12: Control unit



- 1 Display module
- 2 Fuses
- 3 FI circuit breaker
- 4 Main switch

- 5 Processor boards for system control ("FWE200DH") and data recording/processing and signal input/output ("MCU")
- 6 Terminal block for power supply
- 7 Interface Module

Standard interfaces

- Analog outputs
3 outputs 0/2/4...22 mA (electrically isolated, active, min. 12-bit resolution) for output of scattered light intensity (corresponds to dust concentration not calibrated), dust concentration calibrated and dust concentration scaled
- Analog inputs
6 inputs 0...20 mA (without electric isolation, min. 12-bit resolution) for connecting external sensors for measuring gas temperature, pressure and humidity and O₂ content for calculating scaled dust concentration values
- Relay outputs
9 changeover contacts 48 V, 1 A to output status signals operation/malfunction, maintenance, function check, maintenance request, limit value
- Digital inputs
8 inputs to connect potential-free contacts for starting the function check, setting maintenance mode, purge air monitoring, triggering backpurging (when installed see “Back-purge unit”, page 27) and activating the second calibration function (option, see “Remote unit”, page 28)
- Communication
 - USB 1.1 and RS232 (on terminals) for measured value inquiries, setting parameters and software updates.
 - Interface module Modbus TCP for communication with higher-level control system

LC-Display

Functions

- Display measured values and status information

Type		Display
LED	Power (green)	Power supply OK
	Failure (red)	Function fault
	Maintenance request (yellow)	Maintenance request
LC-Display	Graphic display (main screen)	2 measured values as bars (e.g., dust concentration or scattered light intensity and sample gas temperature or differential pressure), selection as shown on “Using SOPAS ET to modify display settings”, page 84
	Text display	8 diagnosis values (see “LC-Display menu structure”, page 81)

Fig 13

LC-Display with graphic (left) and text display (center and right) (example)



- Control buttons for basic configuration

Button	Function
Meas	<ul style="list-style-type: none"> • Toggle between text and graphic display • Display the contrast setting (after 2.5 s)
Arrows	Select next/previous measured value page
Diag	Display alarm or error messages
Menu	Display main menu and selection of submenus

After the measuring system has been switched on, the start phase of the FWE200DH is shown on the LC-Display during the warming up time (see [“Starting the FWE200DH”, page 48](#)).

2.3.4.4 Extended calibration function

The following regression functions to calibrate dust concentration measurement are implemented in the FWE200DH as standard (see [“Scattered light measuring principle”, page 14](#), see [“Calibration for dust concentration measurement”, page 63](#)):

- Polynomial: $c = cc2 \cdot SI^2 + cc1 \cdot SI + cc0$
- Exponential: $c = cc2 \cdot e^{(cc1 \cdot SI)} + cc0$
- Logarithmic: $c = cc2 \cdot \ln(cc1 \cdot SI) + cc0$
- Power: $c = cc2 \cdot SI^{cc1} + cc0$

Two of them can be used individually (selection and configuration, see [“Calibration for dust concentration measurement”, page 63](#)).

Digital input DI5 can be used to toggle between the two calibration functions selected. Apart from that, single values can be output during the function check (see [“Automatic function check”, page 15](#)).

Digital input	Function
DI5	Toggle between calibration function 1 and calibration function 2
DI6	Output the last contamination value determined on the analog output
DI7	Output the last control value determined on the analog output
DI8	Output the last zero value determined on the analog output

Relay output	Function
6	Status signal for output of last contamination value
7	Status signal for output of last control value
8	Status signal for output of last zero value
9	Not used

Optional Interface module

The standard built-in Modbus TCP module can be swapped for an Interface module for Profibus DP V0 or Ethernet (type 1) (see [“Device check accessories”, page 111](#)).

The module is installed on a top hat rail and connected to the “MCU” processor board with a corresponding cable.



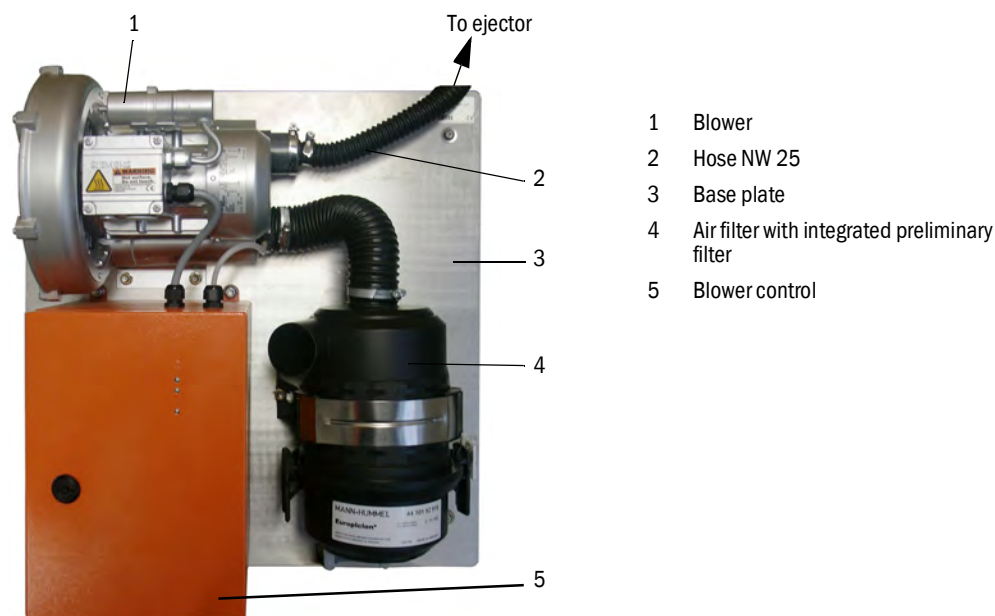
Profibus DP-V0 to transfer via RS485 according to DIN 19245 Part 3 as well as IEC 61158.

2.3.5 Blower unit

The blower unit serves to feed the sample gas into the measuring and control unit via the ejector. Air connection to the ejector is made via a flexible NW 25 hose. At the same time, a partial flow is delivered from the ejector to the measuring cell to keep the optical components clean.

The blower control with frequency converter controls the engine speed and thus the blower capacity for an optimal sample gas flow in the specified nominal range.

Fig. 14: Blower unit



A weatherproof cover is available for use outdoors (see “Weatherproof cover for blower unit”, page 111).

2.3.6 Options

2.3.6.1 Backpurge unit

Subassembly (see “Measuring and control unit (without weatherproof cover, with back-purge option and cover at the bottom)”, page 20) for backpurge of sampling line (hose and sample gas probe), consisting of:

- Solenoid valve to connect instrument air
- Ball valve in the sampling line to close off the thermo cyclone during the purge process.

Backpurging is started automatically during the function check. In addition, a purge process can be triggered manually by closing digital input DI4 with an external switch.

The measuring system is in “Maintenance” mode during the purge process. The purge process is displayed on the LC-Display.

This option is released with a codeword when retrofitted later (included in scope of delivery).



On request, the backpurge option can also be delivered for connecting water as purge medium.

2.3.6.2 Heated extraction hose

In special applications (e.g. very low gas temperature and high gas humidity, very low ambient temperatures, limitation of heating temperatures), it might be necessary to additionally heat the sampling line, see “Extraction and return hoses”, page 19). The standard extraction hose used can be replaced with a ready-made hose with heating. The measuring and control unit must then be specially adapted (type code see “Measuring and control unit”, page 19).

The silicone foam hose for insulation can also be fitted over the present sampling line afterwards.

An additional temperature sensor monitors the gas temperature at the thermo cyclone inlet with this option (Pos. 3, see “Measuring and control unit (without weatherproof cover, with backpurge option and cover at the bottom)”, page 20).

2.3.6.3 Remote unit

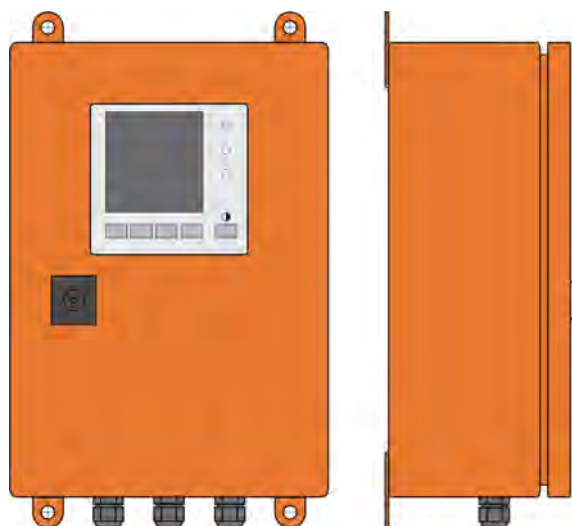
Module with LC-Display to display measured values and status, data inquiry and configuration. A cable to be installed onsite then serves to connect to the system technology (RS485) in the control unit.

Following wire cross-sections are required depending on the distance to the measuring and control unit:

Max. cable length in m	Wire cross-section in mm ²
120	0.14
250	0.25
500	0.5
1000	1.0

The remote unit with integrated power supply unit for separate power supply can be delivered as an option (recommended for larger distances to the measuring and control unit).

Fig. 15: Remote unit



2.3.6.4 *Cover at the bottom*

This subassembly serves as additional protection of the measuring system at low ambient temperatures. It is installed on the base plate of the measuring and control unit and closes the weatherproof cover at the bottom.

Fig. 16: Cover at the bottom



2.3.6.5 *Test equipment for linearity test*

A linearity test can serve to check the correct measurement function (see Service Manual). In this case, filter glasses with defined transmission values are positioned in the beam path and the values compared against those measured by the measuring system. Compliance within the allowed tolerance means the measuring system is working correctly. The filter glasses with holder required for the check are deliverable including a carrying case.

2.4 SOPAS ET (PC program)

SOPAS ET is a SICK software for easy operation and configuration of the FWE200DH.

SOPAS ET runs on a Laptop/PC, which is connected to the FWE200DH via an USB line or Ethernet interface (option).

The menu structure simplifies changing settings. Further functions are also available (e.g., data storage, graphic displays).

SOPAS ET is delivered on the product CD.

3 Assembly and installation

3.1 Project planning

The following Table provides an overview of the project planning work necessary as prerequisite for trouble-free assembly and subsequent device functionality. You can use this Table as a Checklist and check off the completed steps.

Task	Requirements	Work step	<input checked="" type="checkbox"/>	
Determine the measuring and installation locations for the device components	Inlet and outlet paths according to DIN EN 13284-1 (inlet at least 5x hydraulic diameter d_h , outlet at least 3x d_h ; distance to stack opening at least 5x d_h)	For round and square ducts: d_h = duct diameter For rectangular ducts: d_h = 4x cross-section divided by circumference	<ul style="list-style-type: none"> - Follow specifications for new equipment - Select best possible location for existing equipment; - For too short inlet/outlet paths: Inlet path > outlet path 	<input type="checkbox"/>
	<ul style="list-style-type: none"> - Uniform flow distribution - Representative dust distribution 	Whenever possible, no deflections, cross-section variations, feed and drain lines, flaps or fittings in the area of the inlet and outlet paths	If conditions cannot be ensured, define flow profile according to DIN EN 13284-1 and select best possible location	<input type="checkbox"/>
	Sample gas probe installation position	Installation angle to horizontal 15°; vertical fitting is also possible for horizontal or slanted ducts	Select best possible location	<input type="checkbox"/>
	Accessibility, accident prevention	The device components must be easily and safely accessible	Provide platforms or pedestals as required	<input type="checkbox"/>
	Installation free of vibrations	Acceleration < 1 g	Avoid/reduce vibrations through adequate measures	<input type="checkbox"/>
	Ambient conditions	Limit values according to Technical Data (see "Technical Data", page 104)	If necessary, enclose device components	<input type="checkbox"/>
	Intake air for blower unit	Whenever possible, low amount of dust, no oil, moisture or corrosive gases	Select best possible location for air intake Determine required purge air hose length	<input type="checkbox"/>
Select device components	Internal duct diameter, insulation, wall thickness	Nominal length and material of sample gas probe	Select suitable components as described in see "Technical Data", page 104	<input type="checkbox"/>
	Gas temperature			<input type="checkbox"/>
	Supply voltage, internal duct pressure	Type of measuring and control unit and blower unit		<input type="checkbox"/>
Plan calibration openings	Access	Easy and safe	Provide platforms or pedestals as required	<input type="checkbox"/>
	Distances to measuring level	No mutual interference of calibration probe and FWE200DH	Plan sufficient distance between measuring and calibration level (approx. 500 mm)	<input type="checkbox"/>
Plan the voltage supply	Operating voltage, power requirements	According to Technical Data (see "Technical Data", page 104)	Plan adequate cable cross-sections and fuses	<input type="checkbox"/>



NOTE:

- ▶ Consider the weights of these components when planning brackets and strength of fitting locations for measuring and control unit and blower unit.

3.2 Assembly

Carry out all assembly work onsite. This includes:

- ▶ Fitting the flange with tube
- ▶ Installing the measuring and control unit
- ▶ Installing the blower unit



WARNING:

- ▶ Observe the relevant safety regulations as well as the safety notices in Section 1 during all assembly work.
- ▶ Only carry out assembly work on equipment with hazard potential (hot or aggressive gases, higher internal duct pressure) when the equipment is at a standstill.
- ▶ Take suitable protection measures against possible local hazards or hazards arising from the equipment.

Auxiliary material

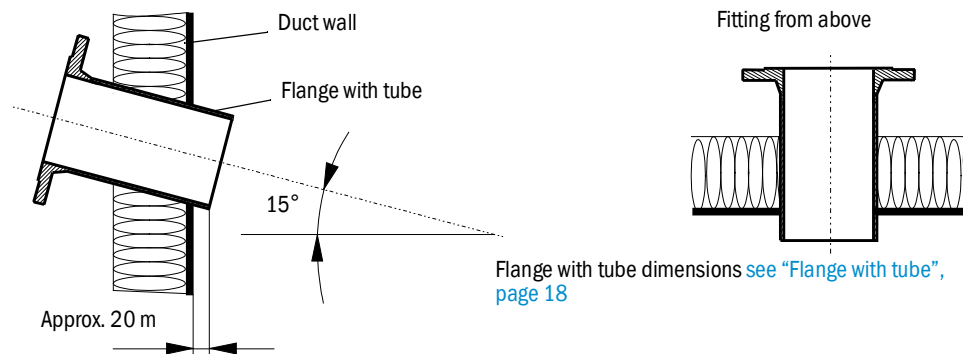
- Silicone grease (for O-rings for e.g. inlet nozzle, mixing tube ejector and Teflon parts in the measuring cell and intermediate nozzle above)

3.2.1 Fitting the flange with tube

The flange must be fitted so that any condensate occurring can flow back into the duct (see “Fitting the flange with tube”, page 32). Ensure the sample gas probe is aligned as shown in see “Sample gas probe alignment”, page 33.

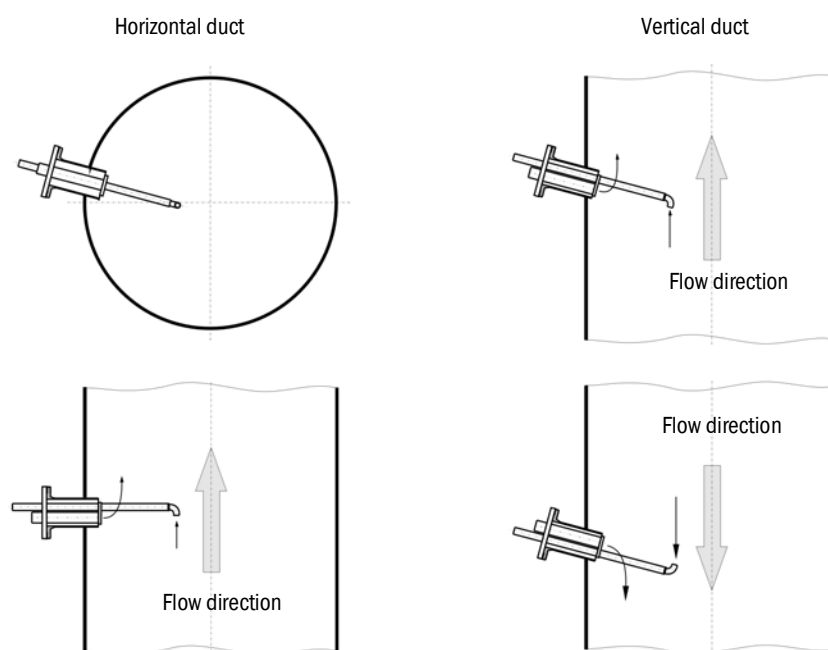
vertical fitting is also possible for horizontal or slanted ducts.

Fig. 17: Fitting the flange with tube



If none of the flanges with tube in the scope of delivery (see “Flange with tube”, page 107) should or could be used (e.g., on GRP ducts), these must be provided onsite under consideration of the probe dimensions (see “Sample gas probe”, page 107 and see “Flange with tube”, page 107).

Fig. 18: Sample gas probe alignment

**Work to be performed**

- ▶ Measure the fitting location and mark the installation location.
- ▶ Remove insulation (when fitted)
- ▶ Cut a suitable opening in the duct wall depending on the installation position; bore large enough holes in brick or concrete stacks (pipe diameter flange tube, see “Flange with tube”, page 18).

**NOTE:**

- ▶ Do not let separated pieces fall into the duct.

- ▶ Insert the flange with tube in the opening and weld it (steel ducts).



- For brick or concrete ducts, weld the flange with pipe onto the anchor plate when necessary and fasten it on the duct.
- Use junction plates as well on ducts with thin walls.

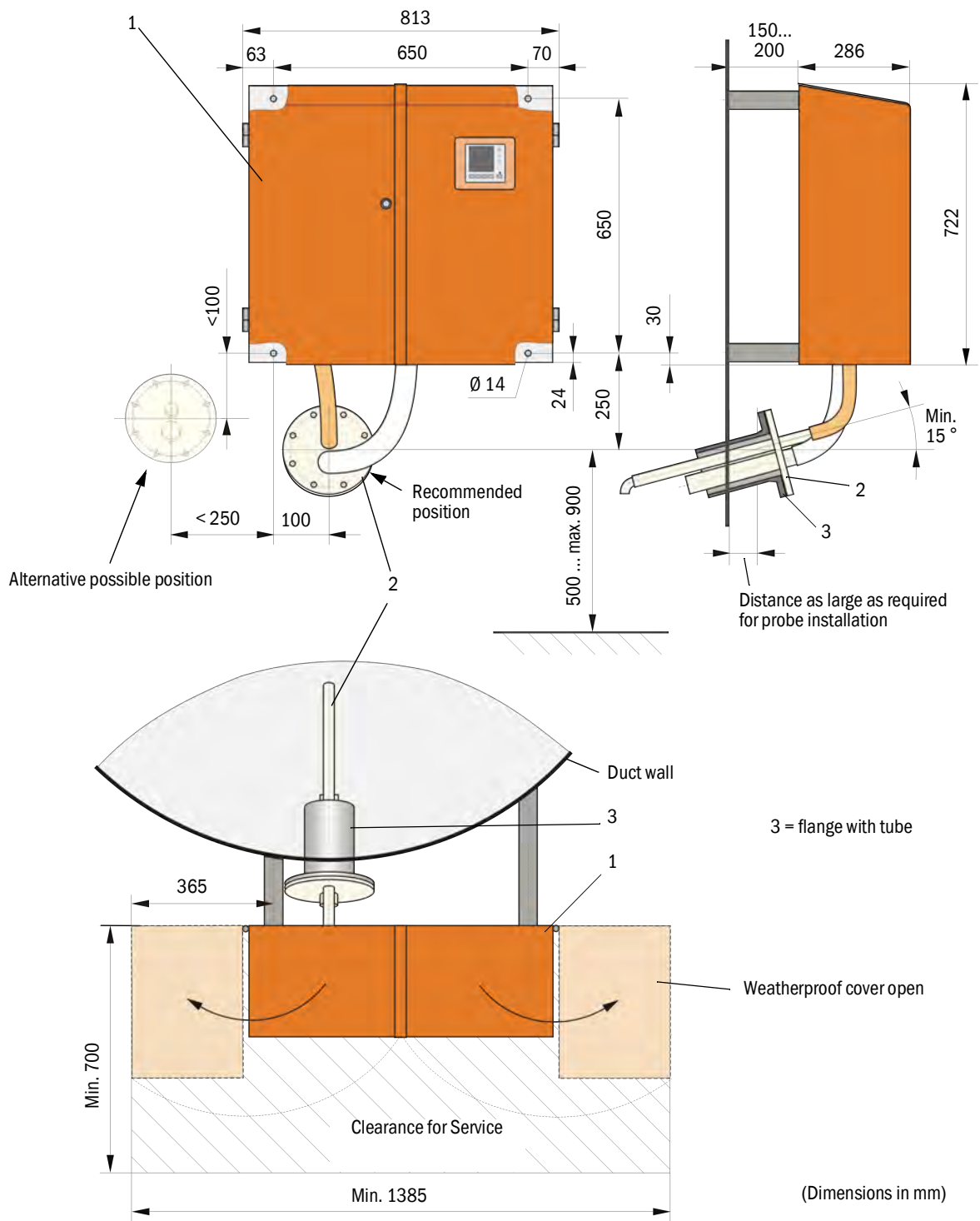
- ▶ Close off the flange opening after fitting to prevent gas escaping.

3.2.2 Installing the measuring and control unit

Consider the following points when selecting the installation location:

- Measuring and control unit (1) must be fitted on a level, vertical base at an easily accessible, protected location with dimensions according to Fig. “Assembly dimensions”.
- Maintain the distances to sample gas probe (2).
- The fitting location must be vibration free.
- Ambient temperatures must be within the permissible range (see “Technical Data”, page 104), take possible radiant heat into consideration.
- Suitable hoisting gear and sufficient clearance are required for transporting and fitting the measuring and control unit (weight see “Technical Data”, page 104).

Fig. 19: Assembly dimensions



Work to be performed

- ▶ Prepare and fit fastening points according to see “Assembly dimensions”, page 34.
- ▶ Fit the measuring and control unit.



The measuring and control unit can also be fitted on an optionally deliverable frame (see “Frame”, page 110)

Weatherproof cover for blower unit

The weatherproof cover (see “Weatherproof cover for blower unit”, page 111) comprises a cover and locking set.

Installation:

- ▶ Fit the locking pins from the locking set on the base plate.
- ▶ Put the weatherproof cover on from above.
- ▶ Insert the holding catches into the counterpieces from the side, twist and lock in.

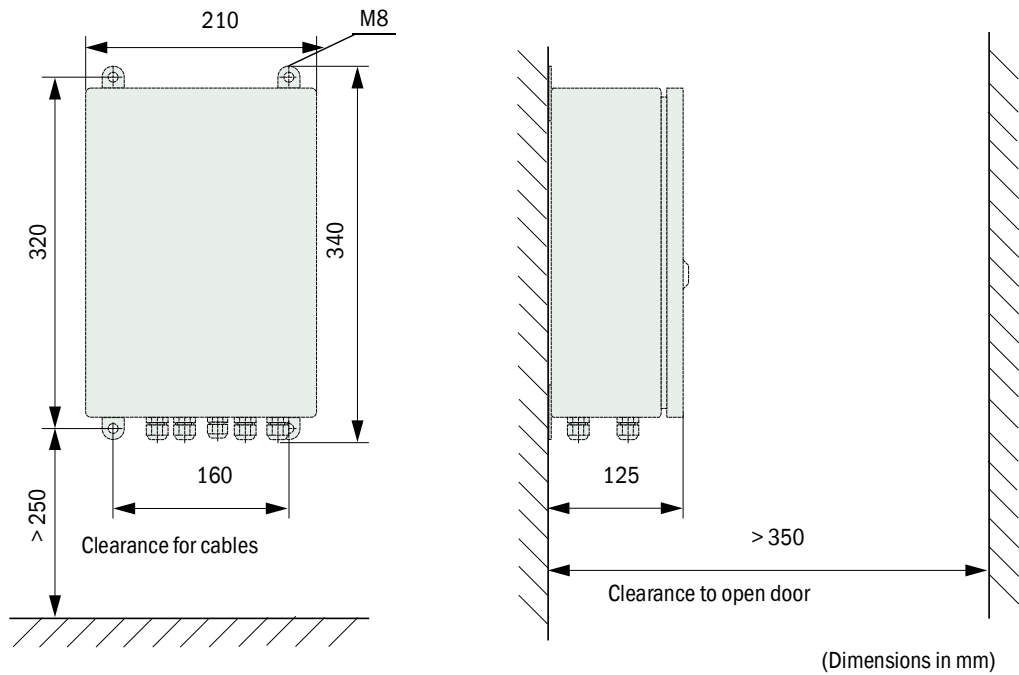
3.2.4 Installing the remote unit option

Install the remote unit in an easily accessible, protected location (see “Remote unit assembly dimensions”, page 36). Observe the following points during installation:

- Maintain the ambient temperature according to the Technical Data; take possible radiant heat into consideration (shield when necessary).
- Protect against direct sunlight.
- Whenever possible, choose an installation location with minimum vibrations; dampen any vibrations when necessary.
- Leave enough clearance for cables and opening the door.

Assembly dimensions

Fig. 21: Remote unit assembly dimensions



The MCU remote unit can be fitted up to 1000 m away from the measuring and control unit. We therefore recommend fitting the remote unit in a control room (measuring station or similar) to ensure free access. This considerably simplifies communication with the measuring system in order to set parameters or to locate malfunction or error causes.

It is advantageous to provide weather protection (tin roof or similar), to be made onsite, for use outdoors.

3.3 Installation

**WARNING:**

- ▶ Observe the relevant safety regulations as well as the safety notices in Section 1 during all installation work.
- ▶ Take suitable protection measures against possible local hazards or hazards arising from the equipment.

**NOTE:**

- ▶ During installation, it must be possible to switch the power supply to the FWE200DH off using a power isolating switch/circuit breaker in accordance with EN61010-1.
- ▶ After completion of the work or for test purposes, the power supply may only be activated again by the personnel who carried out the work and complying with the valid safety regulations.

3.3.1 General information

Prerequisites

The assembly work described in „[Assembly](#)“ must have been carried out before starting installation.

For the power supply to the FWE200DH, a one-phase main supply voltage

- 230 V AC 50/60 Hz with fuse min. 10 A or
- 115 V AC 50/60 Hz with fuse min. 15 A

must be available.

Installation work

Carry out all installation work onsite unless otherwise explicitly agreed with Endress+Hauser or authorized representatives. This work involves:

- Laying power supply and signal cables.
- Installing switches and mains fuses.
- Connecting the blower unit to the corresponding terminals in the control unit of the measuring and control unit.
- Connecting the cables for analog and status signals as well as digital inputs to the terminals of the I/O board in the control unit.
- Connecting the measuring and control unit to the main supply voltage.

**NOTE:**

- ▶ Only use cables specified for temperatures up to 75 °C (EN 61010-1:2011 5.1.8 Connection Boxes of Field Devices).
- ▶ The control unit can reach a temperature > 60 °C due to self-heating at maximum ambient temperature.
- ▶ Plan adequate line cross-sections (see [“Technical Data”, page 104](#)).
- ▶ Before connecting the components, check that the present power voltage/frequency matches the delivered version of measuring unit, control unit and blower unit.

3.3.2 Connecting the control unit

- ▶ Check whether toggles (1) for heater voltage are set to the supply voltage present at the installation location; if not, switch accordingly.

Fig. 22: Switch for supply voltage in the measuring and control unit

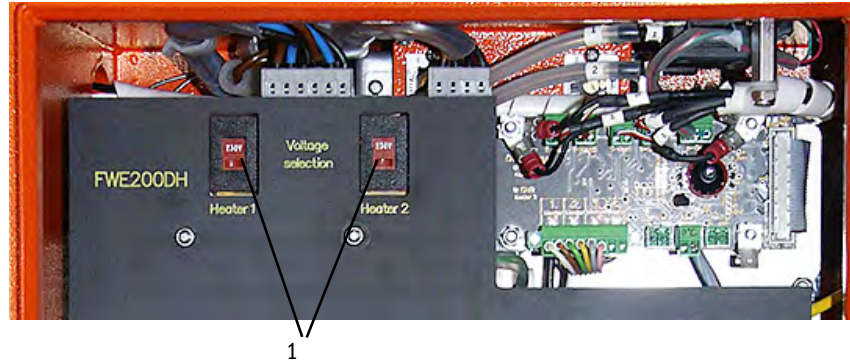
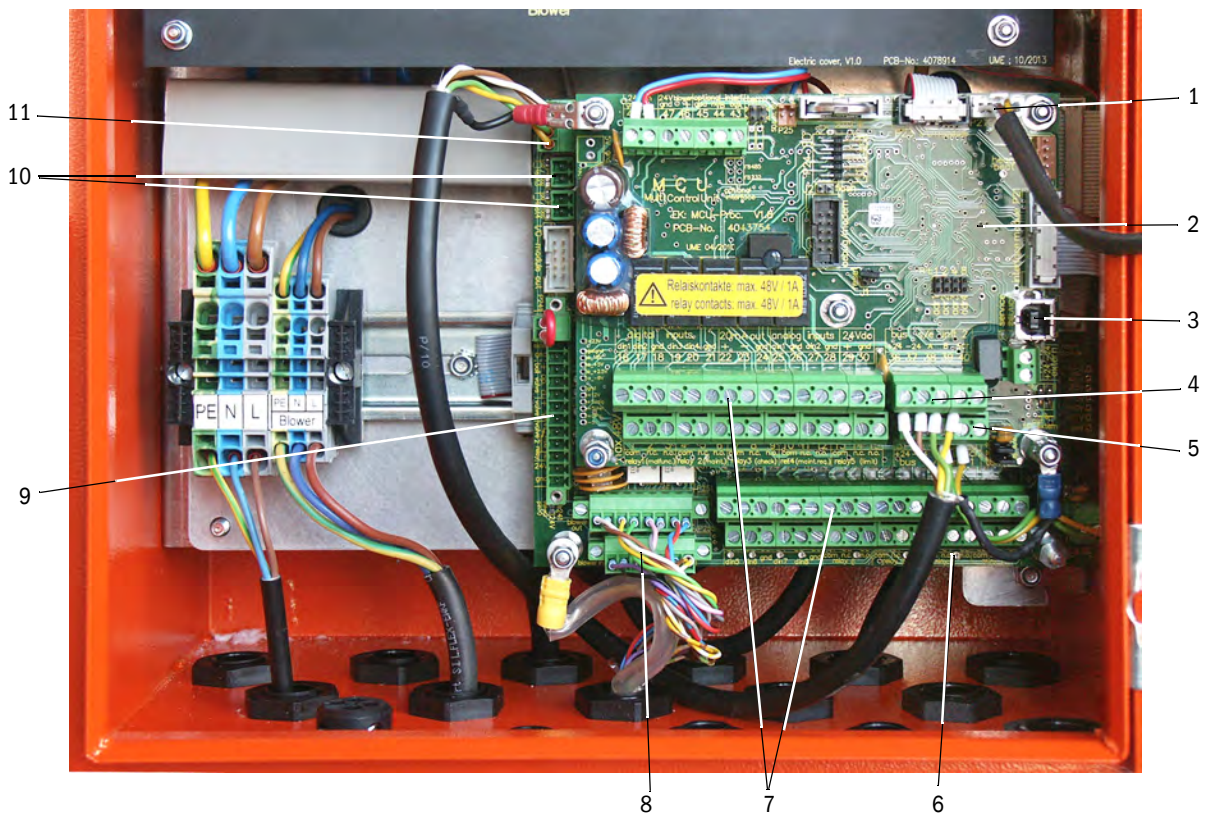


Fig. 23: Control unit connections

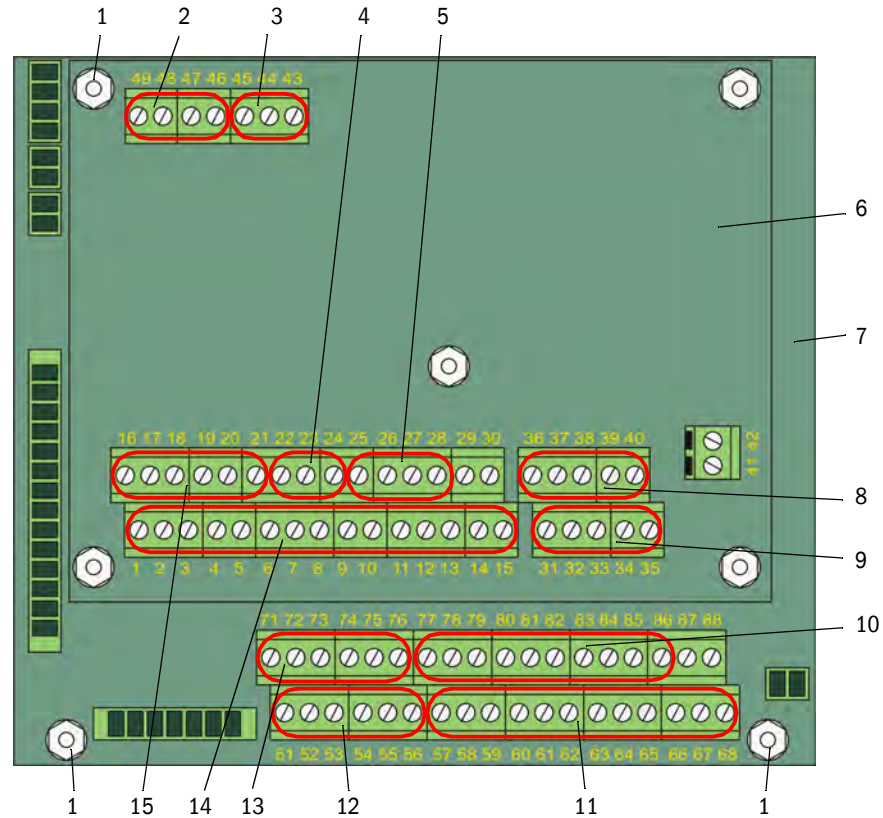


- | | |
|---|--|
| 1 Connection for Display module | 6 System control processor board (FWE200DH) |
| 2 Processor board for data recording/processing and signal input/output (MCU) | 7 Connections for signal inputs and outputs |
| 3 USB plug connector | 8 Connections for blower control cable |
| 4 Connections for measuring sensor (DHSP200) | 9 Connections for backpurge option |
| 5 Connections for system control processor board | 10 Connection for external temperature sensors |
| | 11 Connection for remote unit |

3.3.2.1 Connecting cables for digital, analog and status signals

- ▶ Connect outputs for digital, analog and status signals using suitable cables (e.g., LiYCY 4x2x0.5 mm²) according to Fig. “Connections for processor boards” and the following Table.

Fig. 24: Connections for processor boards



- | | |
|---|--|
| <ul style="list-style-type: none"> 1 Connection for cable shielding 2 Supply voltage 24 V DC 3 RS232 4 Connection for analog output A01 5 Connections for analog inputs AI1 and AI2 6 Processor board for data recording/processing and signal input/output (MCU) 7 System control processor board (FWE200DH) 8 Connections for measuring sensor (DHSP200) (connected at the factory) | <ul style="list-style-type: none"> 9 Connections for system control processor board (FWE200DH) (connected at the factory) 10 Connections for analog inputs AI3 to AI6 11 Connections for relays 6 to 9 (with the extended calibration function option installed) → p. 28, §2.3.6.3) 12 Connections for digital inputs D15 to D18 (with the extended calibration function option installed) → p. 28, §2.3.6.3) 13 Connections for analog outputs A02 and A03 14 Connections for relays 1 to 5 15 Connections for digital inputs DI1 to DI4 |
|---|--|

Connections on processor board for data recording/processing and signal input/output (MCU)

Terminal No.	Connection	Function
1	COM	Output relay 1 (operation/malfunction)
2	n.c. ¹⁾	
3	n.o. ²⁾	
4	COM	Output relay 2 (maintenance)
5	n.c. ¹⁾	
6	n.o. ²⁾	
7	COM	Output relay 3 (function check)
8	n.c. ¹⁾	
9	n.o. ²⁾	
10	COM	Output relay 4 (maintenance request)
11	n.c. ¹⁾	
12	n.o. ²⁾	
13	COM	Output relay 5 (limit value)
14	n.c. ¹⁾	
15	n.o. ²⁾	
16	d in1	Digital input DI1 (start function check)
17	d in2	Digital input DI2 (set maintenance mode)
18	gnd	Ground for DI1 and DI2 (usable as shield connection for signal cable)
19	d in3	Digital input DI3 (purge air monitoring)
20	d in4	Digital input DI4 (triggering backpurge option when installed)
21	gnd	Ground for DI3 and DI4 (usable as shield connection for signal cable)
22	+	Analog output AO1
23	-	
24	gnd	
25	a in1	Analog input AI1
26	gnd	
27	a in2	Analog input AI2
28	gnd	

1): Closed in currentless condition (normal closed)

2): Open in currentless condition (normal open)

Connections on processor board for system control (FWE200DH)

Terminal No.	Connection	Function
51	d in5	Digital input DI5 (calibration function switchover)
52	d in6	Digital input DI6 (output contamination value on AO)
53	gnd	Ground for DI5 and DI6
54	d in7	Digital input DI6 (output control value on AO)
55	d in8	Digital input DI8 (output zero value on AO)
56	gnd	Ground for DI7 and DI8 (usable as shield connection for signal cable)
57	COM	Output relay 6 for output of last contamination value
58	n.c. ¹⁾	
59	n.o. ²⁾	
60	COM	Output relay 7 for output of last control value
61	n.c. ¹⁾	
62	n.o. ²⁾	
63	COM	Output relay 8 for output of last zero value
64	n.c. ¹⁾	
65	n.o. ²⁾	
66	COM	Not used
67	n.c. ¹⁾	
68	n.o. ²⁾	
71	+	Analog output AO2
72	-	
73	gnd	Ground (usable as shield connection for signal cable)
74	+	Analog output AO3
75	-	
76	gnd	Ground (usable as shield connection for signal cable)
77	+	Analog input AI3
78	-	
79	gnd	Ground for AI3 and AI4 (usable as shield connection for signal cable)
80	+	Analog input AI4
81	-	
82	+	Analog input AI5
83	-	
84	gnd	Ground for AI5 and AI6 (usable as shield connection for signal cable)
85	+	Analog input AI6
86	-	
87	+	24 V DC for external power supply (max. approx. 500 mA)
88	-	

1): Closed in currentless condition (normal closed)

2): Open in currentless condition (normal open)

3.3.2.2 Connecting the blower unit and supply voltage

- ▶ Check whether toggle (1) for voltage supply is set to the supply voltage present at the installation location; if not, switch accordingly.

Fig 25 Switch for supply voltage in the blower unit

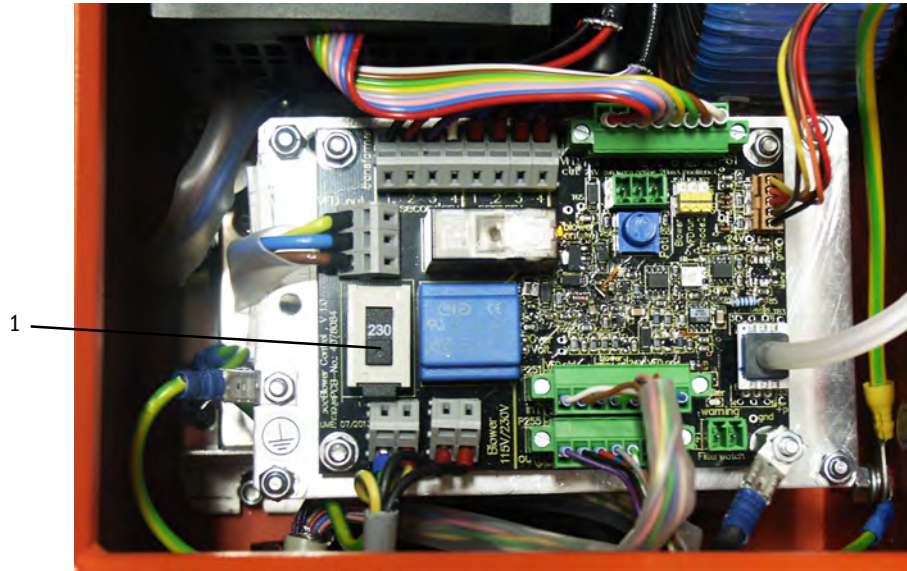
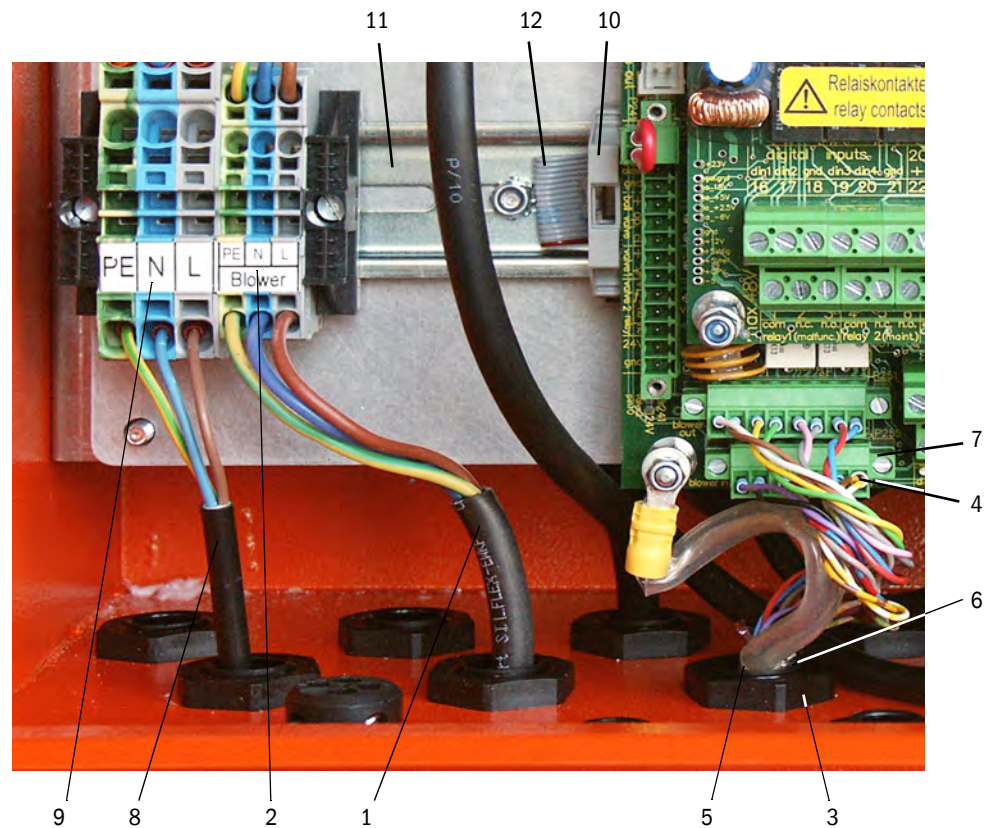


Fig. 26: Connecting the blower unit and supply voltage



- ▶ Connect the mains cable of blower unit (1) to corresponding terminals (2) in the control unit.
- ▶ Unscrew nut (3) from the PG screw fitting (belongs to control cable).
- ▶ Push plug-in connector (4) with control cable (5) through the opening in the control unit (closed in Fig. “Connecting the blower unit and supply voltage” through PG screw fitting (6)), insert the PG screw fitting through the opening and screw together with the nut and plug the plug-in connector on connection (7) on the processor board.
- ▶ Connect the suitable 3-wire mains cable (3) with sufficient cross-section from the onsite power supply to the corresponding terminals (9) in the control unit.
- ▶ Close off unused cable openings with dummy plugs.

**WARNING:**

- ▶ Be sure to check the wiring before switching the supply voltage on.
- ▶ Only modify wiring when disconnected from the power supply and potential-free.

3.3.3 Fitting and connecting the Interface module option

- ▶ Loosen the fuse for ribbon cable (10) (see “Connecting the blower unit and supply voltage”, page 43) on top hat rail (11) and plug the plug-in connector of ribbon cable (12) on the Interface module (see “Measuring system”, page 111).
- ▶ Push the onsite network cable through a free PG screw fitting, connect to the Interface module and plug the Interface module onto the top hat rail.

3.3.4 Installing the backpurge option (only necessary when ordered separately)

Fit the backpurge subassembly onto the measuring and control unit

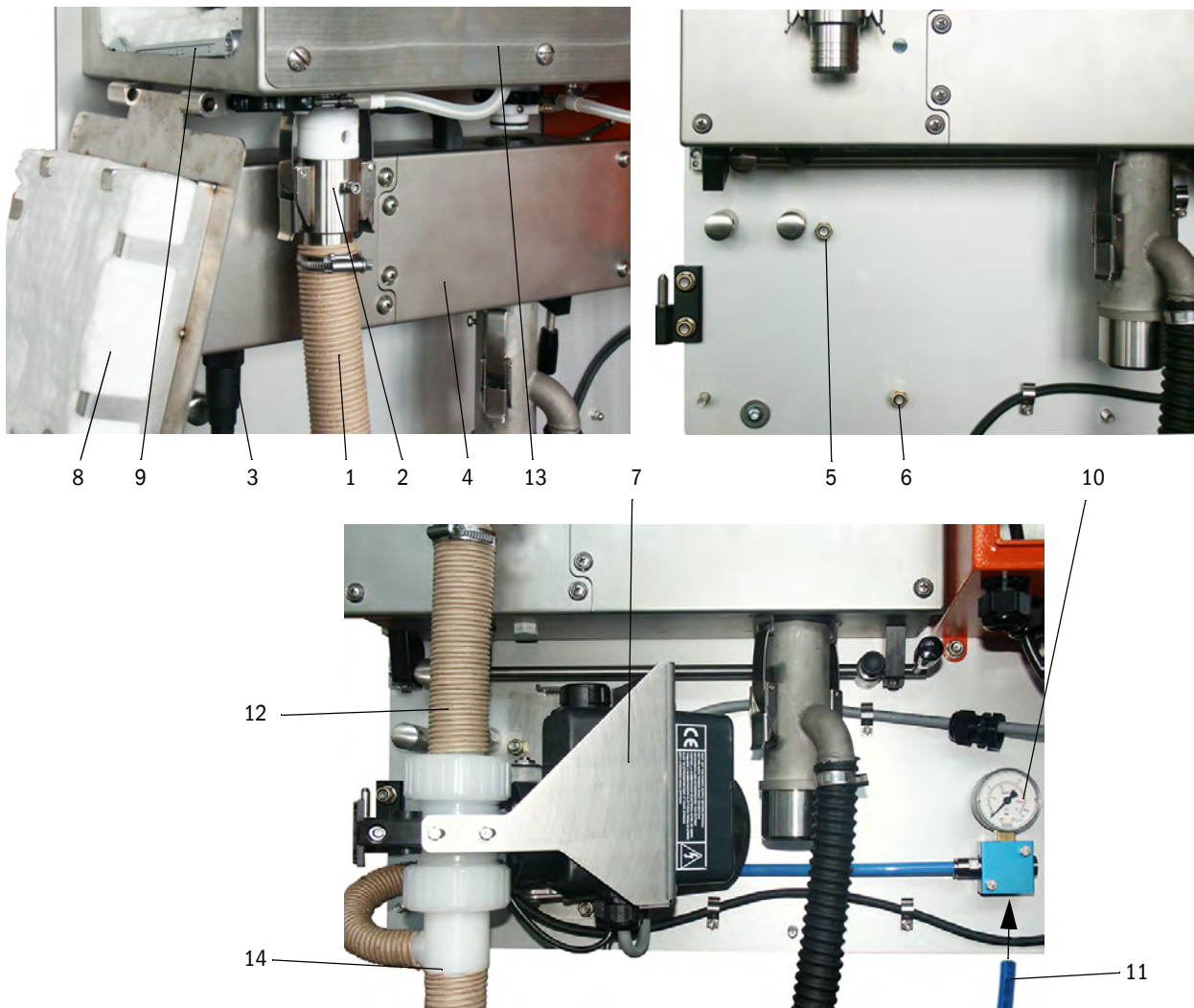
- ▶ Disconnect extraction hose (1) from connection of adapter (2), take the adapter off and loosen connection cable (3) to the control unit from measuring sensor (4).
- ▶ Loosen top fastening nut (5) and remove lower nut (6), position backpurge subassembly (7) on the bolts on the base plate and fasten with the nuts.



The SW13 jaw wrench (9) located behind the flap of thermo cyclone (8) can be used to loosen/tighten the nuts.

- ▶ Fasten pressure monitor (10) on the base plate and connect onsite compressed air hose (11) to the pressure sensor.
- ▶ Connect hose piece (12) from the ball valve to the connection of adapter (2) and attach the adapter on thermo cyclone (13) again.
- ▶ Connect extraction hose (1) to connection (14) of the backpurge subassembly.
- ▶ Connect connection cable (3) to the control unit on measuring sensor (4) again.

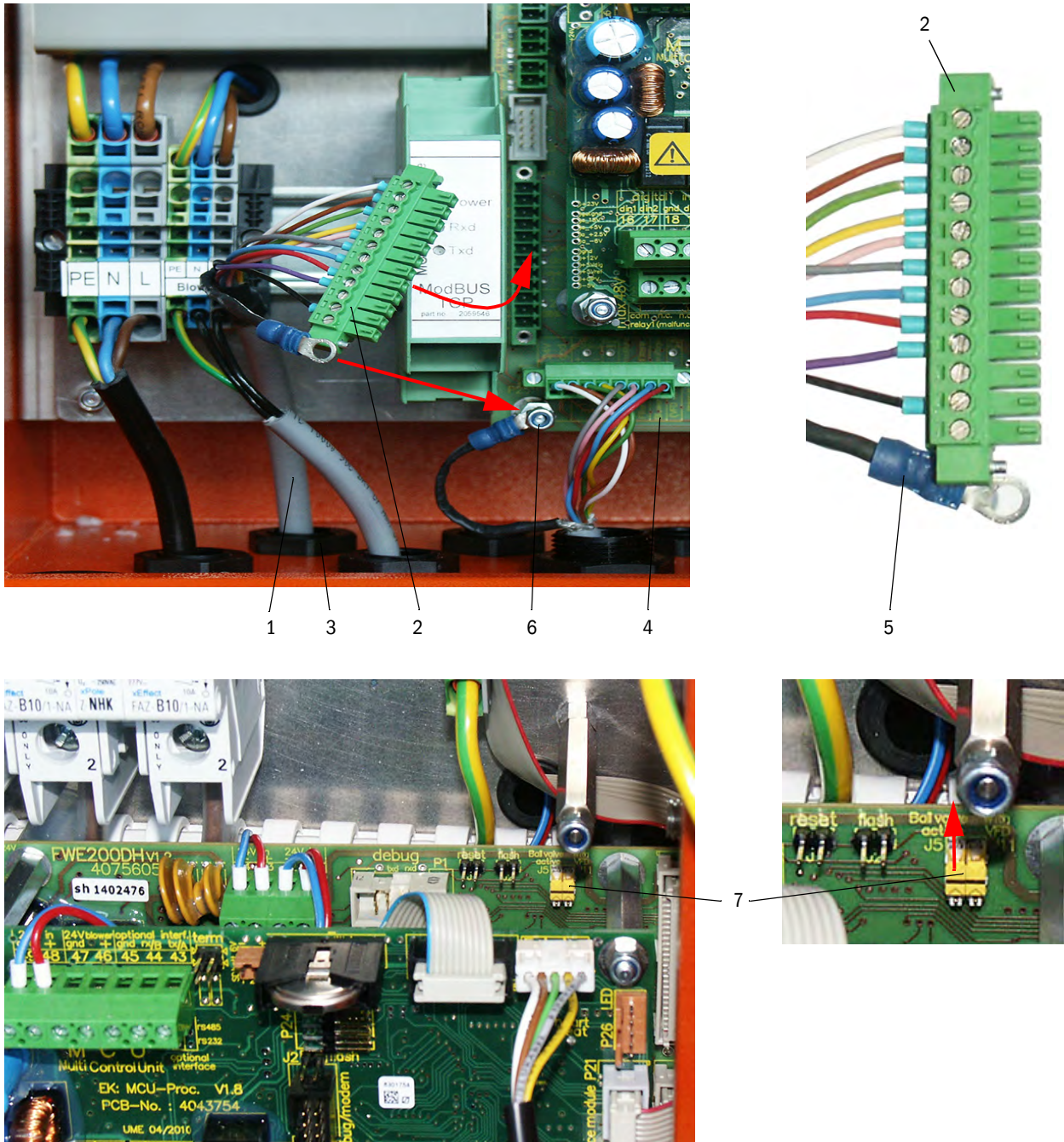
Fig. 27: Fitting the backpurge subassembly onto the measuring and control unit



Connecting backpurge option

- ▶ Loosen the wires of connection cable (1) on plug-in connector (2), pull the cable through one of the rear PG screw fittings (3) and connect the wires, color correct, to the plug-in connector again.
- ▶ Plug the plug-in connector onto the system control processor board (4) and cable shoe (5) on with separator bolt (6).
- ▶ Switch actuation switch (7) to the upper position.

Fig. 28: Connecting option backpurge

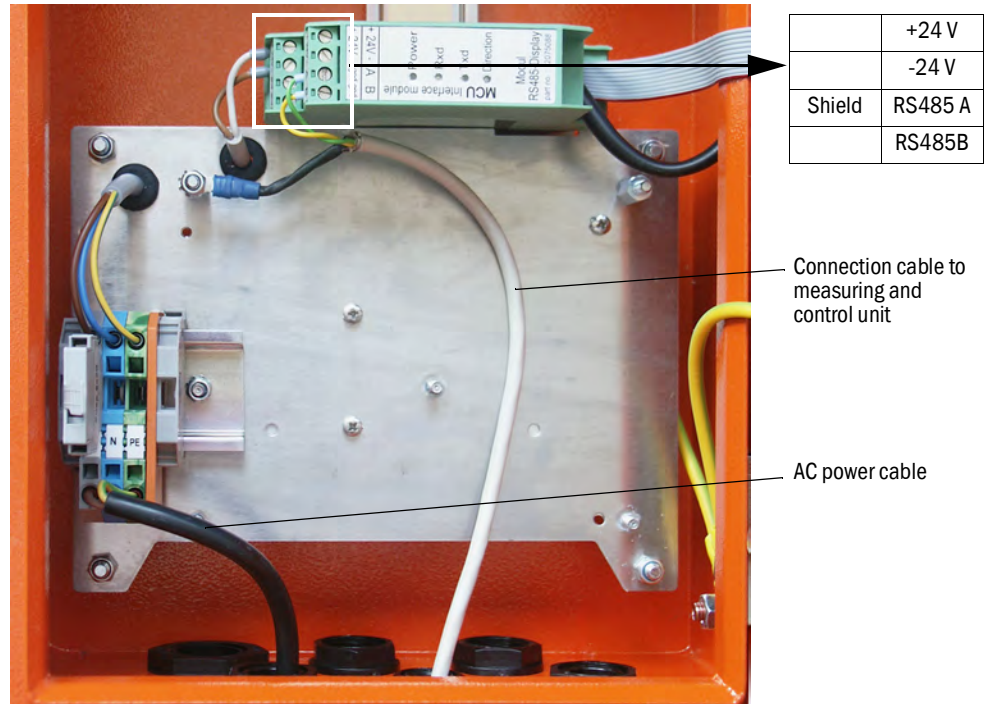


3.3.5 Connecting the remote unit option

Version without power supply unit

- ▶ Connect the connection cable to the measuring and control unit (4-wire, twisted pair, with shield) to the connections in the control unit (see “Control unit connections”, page 38) and the module of the remote unit.

Fig. 29: Connections in the remote unit (version with integrated wide-range power pack)



Version with integrated wide-range power pack:

- ▶ Connect the 2-wire cable (twisted pair, with shield) to the connections for RS485 A/B and shield in the control and remote unit.
- ▶ Connect the 3-wire mains cable with sufficient cross-section to the onsite power supply and the corresponding terminals in the remote unit.



NOTE:

- ▶ During installation, it must be possible to switch the power supply off using a power isolating switch/circuit breaker in accordance with EN 61010-1.
- ▶ After completion of the work or for test purposes, the power supply may only be activated again by the personnel who carried out the work and complying with the valid safety regulations.

4 Start-up and configuration

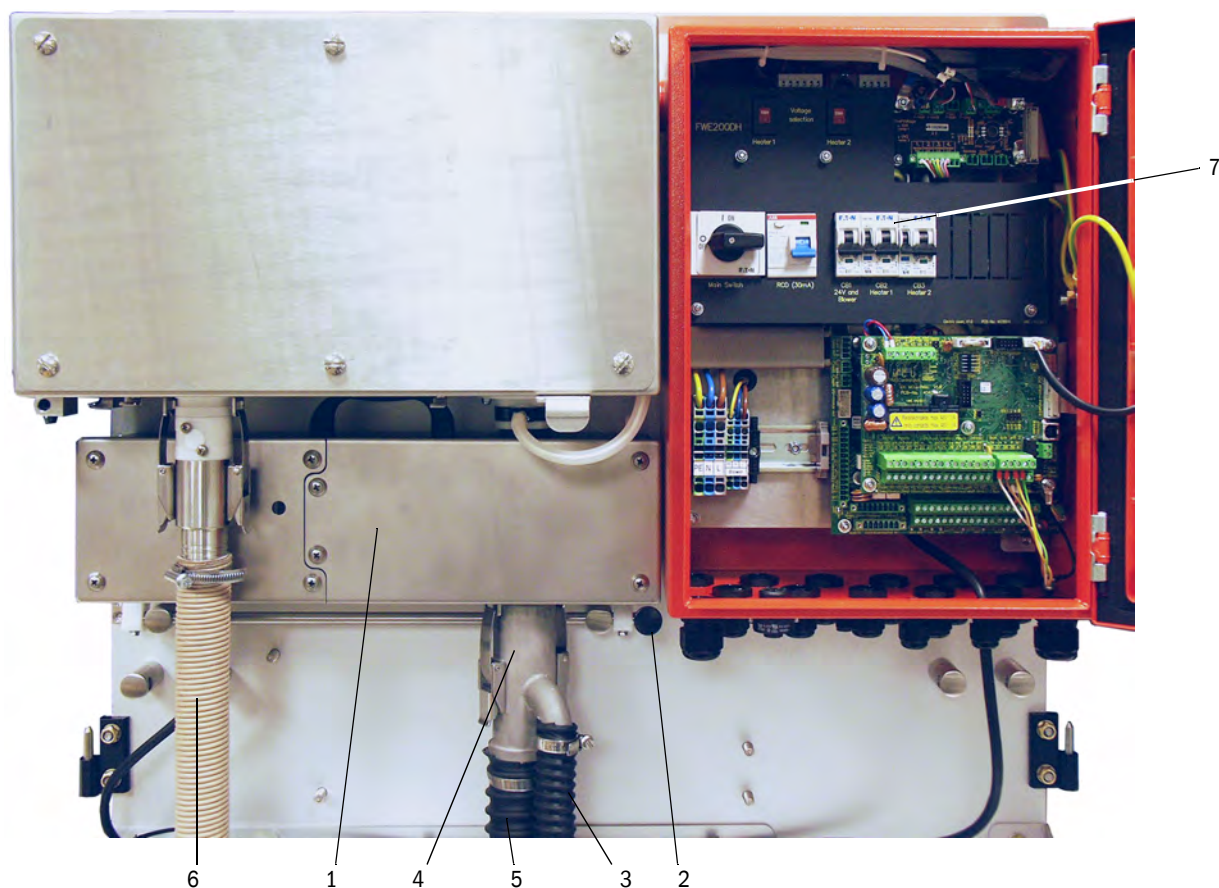
4.1 Putting the FWE200DH into operation

Prerequisite for performing the work described in the following is completion of the assembly and installation of measuring unit, control unit and blower unit according to Section 3.

4.1.1 Preparatory work

- ▶ Check that measuring sensor (1) is in the measuring position (safety lever (2) must be in the upper position, see “Measuring and control unit”, page 47) and is locked.
- ▶ Push the NW 25 flexible hose (3) (belongs to the blower unit) onto the connection on ejector (4) and secure with a hose clip.
- ▶ Push the NW 50 hose (5) for gas return (scope of delivery) over the connections on the ejector and sample gas probe and secure with hose clips.
- ▶ Connect the NW 32 hose (6) for gas extraction to the connections of the thermo cyclone and sample gas probe.
- ▶ Open the door of the control cabinet door of the measuring and control unit and check that all fuses (7) are switched on (if not, switch on).

Fig. 30: Measuring and control unit

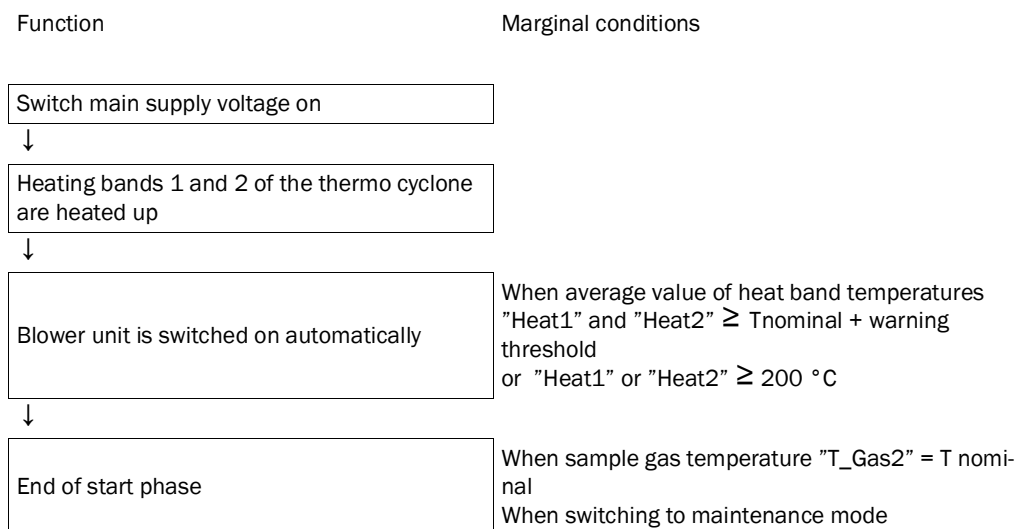


- ▶ Check whether the toggles for heater voltage (see “Switch for supply voltage in the measuring and control unit”, page 38) and power supply of the blower unit (see “Switch for supply voltage in the blower unit”, page 42) are set to the supply voltage present at the installation location; if not, switch accordingly.
- ▶ Switch the main switch on.

4.1.2 Starting the FWE200DH

The start phase of the FWE200DH starts when the main supply voltage is switched on.

The start process runs as follows:



The current measured values are displayed on the LC-Display of the control unit (see "LC-Display with graphic (left) and text display (center and right) (example)", page 25, see "Using SOPAS ET to modify display settings", page 84.) The start phase is signaled with "Initialization" instead of "Operation".

Relay 4 (maintenance) is active during the start phase. Any malfunctions possibly present are not reported to relay 1 (operation/malfunction) during this time.

The start phase finishes when the sample gas temperature reaches the set nominal value for the first time (average duration approx. 30 min). If this value is not reached (e.g. through too high gas humidity/too low gas temperature in the duct), the error "Heating up phase" is displayed in the LC display after 1 h (see "Measuring system", page 100).

After completion of the start phase, warning and malfunction messages are displayed on the LC display (except when tolerance ranges for the sample gas temperature are exceeded [standard values for warning = Tnominal - 10 K and Tnominal +30 K; standard value for malfunction = Tnominal - 30 K]) and output on relay 1.

The blower unit is switched off when:

- The gas temperature sinks below the malfunction threshold value
- The average value of the temperatures from heating bands 1 and 2 sinks below 80 °C
- For certain device malfunctions (see Service Manual for details).

4.1.3 Fitting the sample gas probe

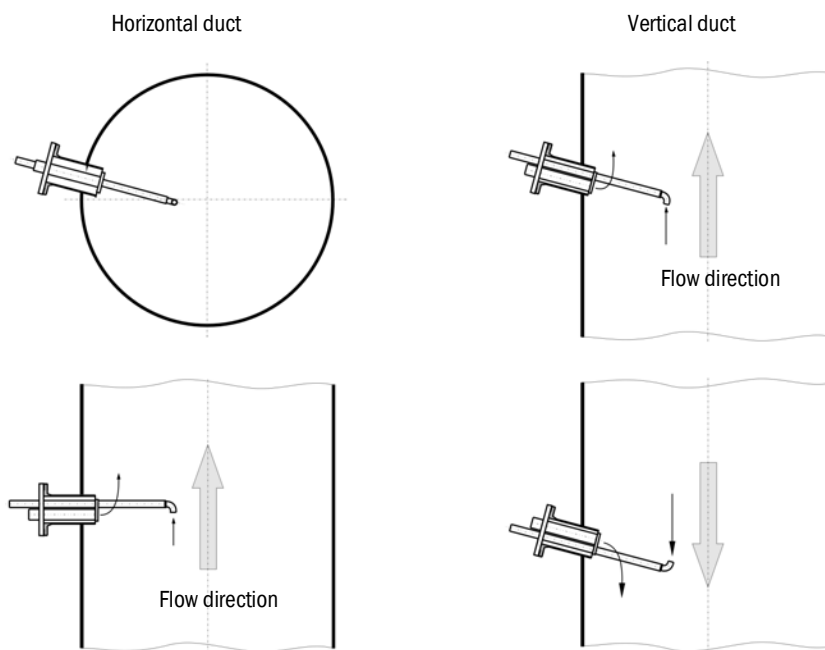


WARNING: Danger from exhaust gas

- ▶ Only fit the sample gas probe on equipment with hazard potential (hot or aggressive gases, higher internal duct pressure) when the equipment is at a standstill.
- ▶ Take suitable protection measures against possible local hazards or hazards arising from the equipment.

- ▶ Check whether the suitable extraction nozzle according to the Table in “[Isokinetic behavior](#)”, page 14 is screwed in on the sampling pipe; if not, correct accordingly.
- ▶ Insert the sample gas probe in the flange with tube according to [Fig. “Sample gas probe alignment”](#) and fasten. The extraction opening of the probe must show in the flow direction (arrow on the probe flange with marking “Flow Direction”).

Fig. 31: Sample gas probe alignment



4.2 Basics

4.2.1 General information

Prerequisite for work described in the following is completion of the assembly and installation as described in Section 3.

Start-up and parameter setting comprise:

- Fitting and connecting the sender/receiver unit,
- Customizing parameter settings according to the respective requirements.

To achieve exact measurement, the measuring system must first be calibrated using a gravimetric comparison measurement (see [“Setting standard parameters”, page 53](#)) before being used for continuous measurement of dust content.

The operating and parameter program SOPAS ET is provided to set the parameters. The menu structure simplifies changing settings. Further functions are also available (e.g., data storage, graphic displays).

4.3 Install SOPAS ET

- Install SOPAS ET on a laptop/PC.
- Start SOPAS ET.
- Follow the installation information of SOPAS ET.

4.3.0.1 Password for SOPAS ET menus

Certain device functions are first accessible after a password has been entered.

User level	Access to
0 "Operator"	Displays measured values and system states
1 "Authorized Operator"	Displays, inquiries and parameters required for start-up or adjustment to customer-specific demands and diagnosis
2 "Official"	
3 "Service"	Displays, inquiries as well as all parameters required for service tasks (e.g., diagnosis and clearance of possible malfunctions)

4.3.1 Connection to the device via USB line

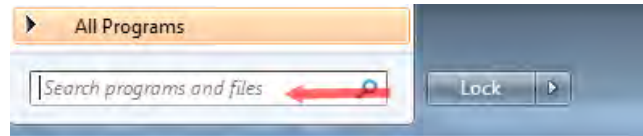
Recommended procedure:

- 1 Connect the USB line to the MCU control unit and the laptop/PC.
- 2 Switch the device on.
- 3 Start SOPAS ET.
- 4 "Search settings"
- 5 "Device family oriented search"
- 6 Click the desired MCU.
- 7 Make settings:
 - Ethernet communication (is always selected)
 - USB communication (is always selected)
 - Serial communication: Select
- 8 Do not enter an IP address.
- 9 A list of COM ports appears. Enter COM port of the DUSTHUNTER.
If you don't know the COM port: see [“Finding the DUSTHUNTER COM port”, page 51](#)
- 10 Assign a name for this search.
- 11 "Finish"

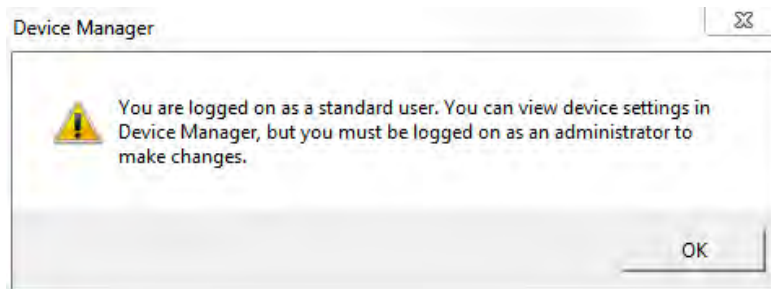
4.3.1.1 Finding the DUSTHUNTER COM port

If you do not know the COM port: Use the Windows Device Manager to find the COM port (no administrator rights are needed).

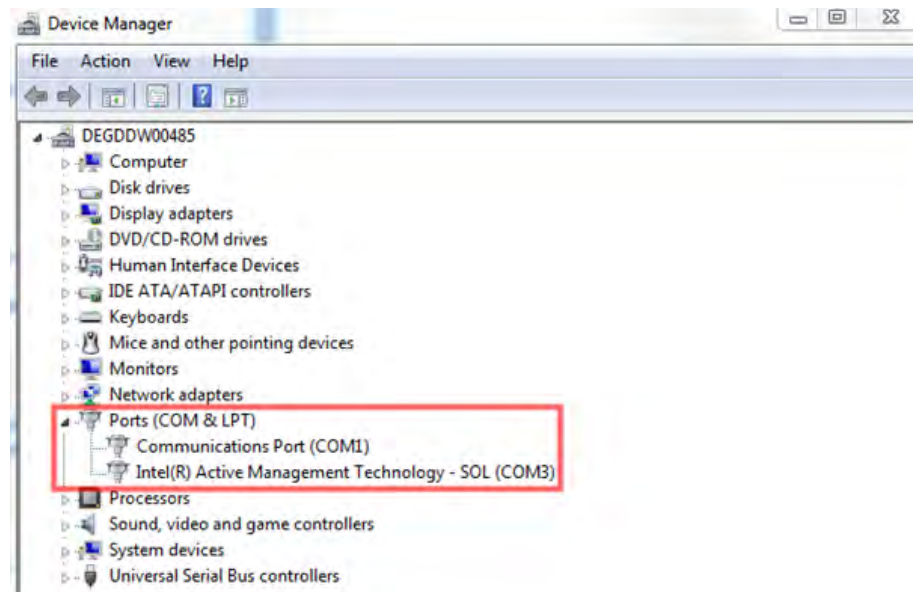
- 1 Disconnect the connection of the DUSTHUNTER and your laptop/PC.
- 2 Input: `devmgmt.msc`



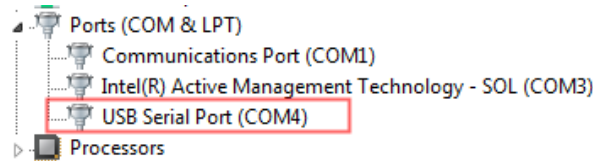
3 This message is shown:



- 4 "OK"
- 5 The Device Manager opens.
See: "Ports (COM & LPT)"



6 Connect the MCU with the laptop/PC.
A new COM port is shown.



Use this COM port for communication.

4.3.2 Connection to the device via Ethernet (option)



To connect to the measuring system via Ethernet, the Ethernet interface module must be installed on the MCU (see [“Device check accessories”, page 111](#)) and the parameters set.

Recommended procedure:

- 1 MCU must be switched off.
- 2 Connect the MCU to the network.
- 3 Connect the laptop/PC to the same network.
- 4 Switch the MCU on.
- 5 Start SOPAS ET
- 6 "Search settings"
- 7 "Device family oriented search"
- 8 Click the desired MCU
- 9 Make settings:
 - Ethernet communication (is always selected)
 - USB communication (is always selected)
 - Serial communication : *Do not* select
- 10 Enter IP address
IP address: see [“Setting the Ethernet module parameters”, page 78](#)
- 11 Do not select a COM port
- 12 Assign a name for this search
- 13 "Finish"

4.4 Setting standard parameters

4.4.1 Factory settings

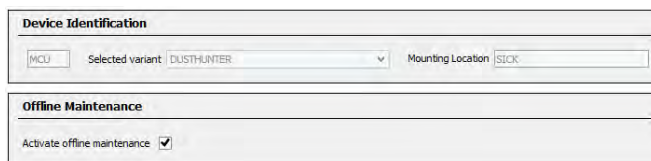
Parameter		Value	
Sample gas temperature	Nominal value	160 °C	
	Value for warning	< 150 °C and > 180 °C	
	Value for malfunction	130 °C	
Differential pressure (flow monitoring)		0.8 hPa	
Function check		Every 8 h; control value output (90 s each) to standard analog output	
Analog output (AO)	Live zero (LZ)	4 mA	
	Upper measuring range value (MBE)	20 mA	
	Current during maintenance	0.5 mA	
	Current by malfunction	21 mA (optional 1 mA)	
Response time		60 s for all measured variables	
Measured variable	Output on AO	Value at LZ	Value at MBE
Dust concentration	1	0 mg/m ³	200 mg/m ³
Scattered light intensity	2	0	200
Regression function 1		Function type polynomial	
Coefficients set (only for dust concentration)		0.00 / 1.00 / 0.00	
Regression function 2		Function type polynomial	
Coefficients set (only for dust concentration)		0.00 / 1.00 / 0.00	

The steps required to modify these settings are described in the following Sections. Prerequisite: The device data are located in the "Project Tree" window, the level 1 password has been entered and "Maintenance" mode set.

4.4.2 Setting "Maintenance" mode

- ▶ In SOPAS ET: Change to the "Maintenance/Maintenance" directory in the respective device file, activate the checkbox "Activate offline maintenance" in the window.

Fig. 32: SOPAS ET menu: MCU/Maintenance/Maintenance



The screenshot shows a software interface with two main sections. The top section is titled "Device Identification" and contains three input fields: "MCU" with a dropdown arrow, "Selected variant" with the text "DUSTHUNTER" and a dropdown arrow, and "Mounting Location" with the text "SICK". The bottom section is titled "Offline Maintenance" and contains a single checkbox labeled "Activate offline maintenance" which is checked.



"Maintenance" mode can also be set using the buttons on the LC-Display of the control unit (see ["Menu structure"](#), page 81) or by connecting an external maintenance switch to the terminals for Dig In2 (17, 18) in the control unit (see ["Connecting the control unit"](#), page 38).

4.4.3 Changing function parameters

Select device file "FWE200DH" to change temperature and pressure settings and switch to directory "Configuration / Application Parameter".

Fig. 33: SOPAS ET menu: FWE200DH/Configuration/Application parameters (example)

4.4.3.1 Change temperature settings

In certain cases, it can be necessary to change the nominal value for sample gas temperature (e.g., for acid dew point temperature > 160 °C) and/or heater temperature(s)). To do this, enter the desired values in the respective windows in the group "Temperature settings" (see "SOPAS ET menu: FWE200DH/Configuration/Application parameters (example)", page 55).

4.4.3.2 Define limit value for the flow rate

The differential pressure measured between the thermo cyclone and measuring cell can be used for flow monitoring. Entering a limit value triggers a message when underflow. This helps to prevent that the flow rate (e.g. resulting from deposits in the gas path) sinks below the value needed for proper device function by starting maintenance measures in time.

The FWE200DH outputs the following messages:

Message	Monitoring value	Signals
Warning	Differential pressure measured less than 1.5 times the limit value (generated device-internal)	<ul style="list-style-type: none"> "Warning Eductor air/flow" displayed on LC-Display "Warning" relay triggers
Malfunction	Differential pressure measured less than limit value	<ul style="list-style-type: none"> "Malfunction Eductor air/flow" displayed on LC-Display Relay "Malfunction" triggers



- The flow is not monitored when the blower is not in operation, i.e., there are no warning or malfunction messages.
- Monitoring is active during the start phase (until the sample gas has reached the nominal temperature or max. 1 hour after the start) when a limit value has been entered. When the flow is too low, this is only displayed on the LC-Display. The warning or malfunction relays do not trigger because the maintenance relay is still active during the start phase.
- The hysteresis for the limit value is 10%.

For setting, enter a value in window "Limit pGas" in group "Flow settings" (see "SOPAS ET menu: FWE200DH/Configuration/Application parameters (example)", page 55) corresponding to approx. 33% of the differential pressure shown on the LC-Display after flow adjustment according to "Basics", page 50. The gas path must be free from deposits in this case.

Recommendation:

- average differential pressure 1.5 - 2.0 hPa: limit value 0.7 hPa
- average differential pressure 2.0 - 2.5 hPa: limit value 0.8 hPa
- average differential pressure 2.5 - 3.0 hPa: limit value 0.9 hPa

4.4.3.3 Set the suction

The following steps are necessary to adapt the suction to the equipment conditions:

- ▶ Check the gas path for deposits, clean when necessary.
- ▶ Set the frequency in group "Flow setting" (see "SOPAS ET menu: FWE200DH/Configuration/Application parameters (example)", page 55) using the slider so that the value displayed in window "Flow" is within the recommended range.



The flow can be set to the lower value of the recommended range for very low gas temperatures and/or high gas wetness and/or low ambient temperatures.

4.4.4 Setting the function check

To change the values set at the factory (see “Factory settings”, page 53), select device file “MCU” and switch to directory “Adjustment / Function Check - Automatic”. The interval time, control value output on the analog output and the start timepoint for automatic function check can be changed here.

Fig. 34: SOPAS ET menu: MCU/Adjustment/Function check automatic (example for settings)

The screenshot shows the SOPAS ET configuration interface. It is divided into three main sections:

- Device Identification:** Includes a dropdown for 'MCU', a 'Selected variant' dropdown set to 'FWE200DH', and a 'Mounting Location' dropdown set to 'NS EMV'.
- Function Check:** Contains an input field for 'Output duration of function control value' set to '90 s'. Below it is a dropdown menu for 'Function check interval' which is currently open, showing options: 4 hours, 6 hours, 8 hours (highlighted), 12 hours, 18 hours, 24 hours, 2 days, and 3 days.
- Function Check Start Time:** Features two input fields for 'Hour' (set to 8) and 'Minute' (set to 0).

Entry field	Parameter	Remark
Output duration of function control value	Value in seconds	Output duration of control values.
Function check interval	Time between two check cycles	see “Automatic function check”, page 15
Function Check Start Time	Hours	Defining a start timepoint in hours and minutes.
	Minutes	

+i The last value measured is output during control value determination (see “Function check output on a plotter”, page 16).

4.4.5 Setting the analog output parameters

Select the "Configuration / IO Configuration / Output Parameters" directory to set the analog outputs.

+i

- Default values see "Factory settings", page 53
- In order to output the dust concentration under standard conditions ("Conc. s.c." (SL)), set the parameters for the analog outputs according to „Setting the analog input parameters“.


Fig. 35: SOPAS ET menu: MCU/Configuration/IO configuration/Output parameters

The screenshot shows the configuration interface for the analog outputs. It is divided into several sections:

- Device Identification:** Shows the selected variant as 'FWE200DH' and the mounting location as 'HG ENV'.
- Analog Outputs - General Configuration:** Includes settings for 'Output Error current' (set to 'yes'), 'Error Current' (set to '21 mA'), 'Current in maintenance' (set to 'Measured value'), and 'Maintenance current' (set to '0.5 mA').
- Analog Output 1 Parameter:** Includes 'Value on analog output 1' (set to 'Conc. a.c. (SL)'), 'Live zero' (set to '4mA'), 'Output checkcycle results on the AO' (checked), and 'Write absolute value' (unchecked).
- Analog Output 1 Scaling:** Includes 'Range low' (set to '0.00 mg/m³') and 'Range high' (set to '200.00 mg/m³').
- Limiting Value:** Includes 'Limit value' (set to 'Conc. a.c. (SL)'), 'Hysteresis type' (set to 'Absolute'), and 'Switch out' (set to 'Over Limit').
- Limit Switch Parameters:** Includes 'Limit value' (set to '50.00 mg/m³') and 'Hysteresis' (set to '5.00 mg/m³').

Field	Parameter	Remark	
Analog Outputs - General Configuration	Output Error current	Yes	Error current is output.
		No	Error current is not output.
	Error Current	Value < Live Zero (LZ) or > 20 mA	mA value to be output in "Malfunction" state (error case) (size depends on connected evaluation system).
		User value	A value to be defined is output during "Maintenance"
		Last value measured	The value measured last is output during "Maintenance"
	Current in maintenance	Measured value output	The current measured value is output during "Maintenance".
Maintenance current	Whenever possible, value ≠ LZ	mA value to be output in "Maintenance" state	

Field		Parameter	Remark	
Analog Output 1 Parameter	Value on analog output 1	Conc. a.c. (SL)	Dust concentration in operating state (based on scattered light intensity)	The selected measured variables are output on the analog output.
		Conc.s.c.dry O2 corr. (SL)	Dust concentration under standard conditions (based on scattered light intensity)	
		SL	Scattered light intensity	
		T_Gas2	Sample gas temperature	
		p_Gas	Differential pressure	
		T_Heater 1	Temperature heater 1	
		T_Heater 2	Temperature heater 2	
		T_Heater 3	Temperature heater 3	
		T_Heater 4	Temperature heater 4	
		Live zero	Zero point (0, 2 or 4 mA)	
Output check-cycle results on the AO	Inactive	Control values (see "Automatic function check", page 15) are not output on the analog output .		
	Active	Control values are output on the analog output .		
Write absolute value	Inactive	Positive and negative measured values are differentiated.		
	Active	The amount of the measured value is output.		
Analog Output 1 Scaling	Range low	Lower measuring range limit	Physical value at live zero	
	Range high	Upper measuring range limit	Physical value at 20 mA	
Limiting value	Limit value	Conc. a.c. (SL)	Dust concentration in operating state (based on scattered light intensity)	Select the measured variable for which a limit value is to be monitored.
		Conc.s.c.dry O2 corr. (SL)	Dust concentration under standard conditions (based on scattered light intensity)	
		SL	Scattered light intensity	
		T_Gas2	Sample gas temperature	
		p_Gas	Differential pressure	
		T_Heater 1	Temperature heater 1	
		T_Heater 2	Temperature heater 2	
		T_Heater 3	Temperature heater 3	
		T_Heater 4	Temperature heater 4	
		Hysteresis type	Percent Absolute	
Switch at	Over Limit	Define the switching direction		
	Underflow			
Limit Switch Parameters	Limit value	Value	The limit value relay switches when the entered value is exceeded or underflown.	
	Hysteresis	Value	Define a tolerance for resetting the limit value relay	

 Set the parameters for "Analog Output 2(3) Parameter" and "Analog Output 2(3) Scaling" in the same manner as for "Analog Output 1 Parameter" and "Analog Output 1 Scaling".

4.4.6 Setting the analog input parameters

Select the "Configuration / IO Configuration / Input Parameters" directory to set the analog inputs.

Fig. 36: SOPAS ET menu: MCU/Configuration/IO configuration/Input parameter

The screenshot shows a configuration interface for the FWE200DH device. At the top, there is a 'Device Identification' section with fields for 'MCU', 'Selected variant' (FWE200DH), and 'Mounting Location' (NS EMV). Below this are four columns of configuration options:

- Temperature Source:** Radio buttons for 'Constant Value' (selected) and 'Analog Input 1'. Below is a 'Constant Temperature' field with a fixed value of 0.00 and a unit selector set to °C.
- Pressure Source:** Radio buttons for 'Constant Value' (selected) and 'Analog Input 2'. Below is a 'Constant Pressure' field with a fixed value of 1013.25 and a unit of mbar.
- Moisture Source:** Radio buttons for 'Constant Value' (selected) and 'Analog Input 3'. Below is a 'Constant Moisture' field with a fixed value of 0.00 and a unit of %.
- Oxygen Source:** Radio buttons for 'Constant Value' (selected) and 'Analog Input 4'. Below is a 'Constant Oxygen' field with a fixed value of 6.00 and a unit of %.

Field	Parameter	Remark
Temperature Source	Constant Value	A fixed value is used to calculate the scaled value. This parameter opens the "Constant Temperature" field to enter the scaling value in °C or K.
	Analog Input 1	The value from an external sensor connected to analog input 1 (standard scope of delivery) is used to calculate the scaled value. This parameter opens the "Analog input 1 - Temperature" field to set the lower and upper range limit values and the Live Zero value.
Pressure Source	Constant Value	A fixed value is used to calculate the scaled value. This parameter opens the "Constant Pressure" field to enter the scaling value in mbar (= hPa).
	Analog Input 2	The value from an external sensor connected to analog input 2 (standard scope of delivery) is used to calculate the scaled value. This parameter opens the "Analog input 2 - Pressure" field to set the lower and upper range limit values and the Live Zero value.
Moisture Source	Constant Value	A fixed value is used to calculate the scaled value. This parameter opens the "Constant Moisture" field to enter the scaling value in %.
	Analog Input 3	The value from an external sensor connected to analog input 3 (optional module required) is used to calculate the scaled value. This parameter opens the "Analog input 3 - Moisture" field to set the lower and upper range limit values and the Live Zero value.
Oxygen Source	Constant Value	A fixed value is used to calculate the scaled value. This parameter opens the "Constant Oxygen" field to enter the scaling value in %.
	Analog Input 4	The value from an external sensor connected to analog input 4 (optional module required) is used to calculate the scaled value. This parameter opens the "Analog input 4 - Oxygen" field to set the lower and upper range limit values and the Live Zero value.

4.4.7 Setting the response time

Select the "Parameters / Value Damping" directory to set the damping time.

Fig. 37: SOPAS ET menu: MCU/Parameters/Value Damping

Device Identification		
MCU	Selected variant: FWE200DH	Mounting Location: NS EMV
Value Damping Time		
Damping time for Sensor 1: 60 sec		

Field	Parameter	Remark
Damping time Sensor 1	Value in s	Response time for the selected measured variable (see "Response time", page 15) Setting range 1 ... 600 s

4.4.8 Defining regression coefficients

To change the values set at the factory (see [“Factory settings”, page 53](#)), select device file “DH SP200” and switch to directory “Configuration / Application Parameters”.

Fig. 38: SOPAS ET menu: DH SP200/Configuration/Application parameter

Device identification

DH SP200

Calibration coefficients for calculation of concentration with scattered light

Function typ calibration function 1

cc2 cc1 cc0

Conz = cc2 * SL² + cc1 * SL + cc0

Calibration coefficients for calculation of concentration with scattered light

Function typ calibration function 2

cc2 cc1 cc0

Conz = cc2 * SL² + cc1 * SL + cc0

Two different functions, independent of each other, can be selected and configured in the windows “Calibration coefficients for calculation of concentration with scattered light” for calibrating dust concentration measurement (see [“Calibration for dust concentration measurement”, page 63](#)).

4.4.9 Calibration for dust concentration measurement



NOTE:

- The steps described here serve to avoid input errors. Carrying out comparison measurements demands special knowledge that cannot be described in detail here.
- The calculation of regression coefficients cc_2 , cc_1 and cc_0 from coefficients K_2 , K_1 and K_0 are only valid for the polynomial function. The coefficients of other function types (extended calibration function option) have to be calculated separately.

For exact dust concentration measurement, the relation between the primary measured variable scattered light intensity and the actual dust concentration in the duct must be established. To do this, the dust concentration must be determined based through a gravimetric comparison measurement according to DIN EN 13284-1 and set in relation to the scattered light values measured at the same time by the measuring system.

Steps to be carried out

- ▶ Select device file "MCU", enter the level 1 password (see "Setting standard parameters", page 53) and set the measuring system to "Maintenance" mode (see "Setting "Maintenance" mode", page 54).
- ▶ Select the "Configuration / IO Configuration / Output Parameter" directory (see "SOPAS ET menu: MCU/Configuration/IO configuration/Output parameters", page 58) and assign the "Scattered light intensity" measured variable to one of the three analog outputs available.
- ▶ Estimate the measuring range required for the dust concentration in operational state and enter this in the "Analog output 1 (2/3) Scaling" field assigned to the selected analog output assigned to the scattered light intensity.
- ▶ Deactivate "Maintenance" mode.
- ▶ Carry out the gravimetric comparison measurement in accordance with DIN EN 13284-1.
- ▶ Determine regression coefficients from the mA values of the analog output for "Scattered light intensity" and the actual dust concentrations measured gravimetrically.

$$c = K_2 \cdot I_{\text{out}}^2 + K_1 \cdot I_{\text{out}} + K_0 \quad (1)$$

c : Dust concentration in mg/m^3
 K_2, K_1, K_0 : Regression coefficients of the function $c = f(I_{\text{out}})$
 I_{out} : Current output value in mA

$$I_{\text{out}} = LZ + SI \cdot \frac{20\text{mA} - LZ}{MBE} \quad (2)$$

SI : Measured scattered light intensity
 LZ : Live zero
 MBE : Defined upper range limit (value entered for 20 mA; normally 2.5 x fixed limit value)

► Enter the regression coefficients

There are two options:

- Direct input of K2, K1, K0 in a measured value computer



NOTE:

In this case, the regression coefficients set in the sender/receiver unit and the measuring range set in the MCU may not be changed anymore. On the optional LC Display (when used), the dust concentration is displayed as uncalibrated value in mg/m³.



NOTE:

In this case, the regression coefficients set in the sender/receiver unit and the measuring range set in the MCU (option) may not be changed anymore. The dust concentration is displayed in mg/m³ on the LC display of the MCU (option) as an uncalibrated value.

- Use of the regression function of the measuring system (use without measured value computer).

In this case, the correlation to the scattered light intensity has to be determined. To do this, calculate the regression coefficients cc2, cc1, cc0 to be entered in the measuring system from K2, K1, K0.

$$c = cc2 \cdot SL^2 + cc1 \cdot SI + cc0 \quad (3)$$

Using (2) in (1), the result is:

$$c = K2 \cdot \left(LZ + SI \cdot \frac{20mA - LZ}{MBE} \right)^2 + K1 \cdot \left(LZ + SI \cdot \frac{20mA - LZ}{MBE} \right) + K0$$

Using (3), the result is:

$$\begin{aligned} cc0 &= K2 \cdot LZ^2 + K1 \cdot LZ + K0 \\ cc1 &= (2 \cdot K2 \cdot LZ + K1) \cdot \left(\frac{20mA - LZ}{MBE} \right) \\ cc2 &= K2 \cdot \left(\frac{20mA - LZ}{MBE} \right)^2 \end{aligned}$$

Now enter the regression coefficients cc2, cc1 and cc0 determined in directory "Parameters/Application parameters" (see "SOPAS ET menu: DH SP200/Configuration/Application parameter", page 62, see "Calibration for dust concentration measurement", page 63) (set sender/receiver unit to maintenance mode and enter password level 1; set the sender/receiver unit to "Measurement" mode again).




This method allows changing the parameters for the selected measuring range as desired.

4.4.10 Data backup

All parameters relevant for the collecting, processing and input/output of measured values as well as current measured values can be saved in SOPAS ET and printed. This allows easy reentering of set device parameters as needed or registering device data and states for diagnostic purposes.

The following options are available:

- Saving as a project
Not only device parameters but also data logs can be saved.
- Saving as a device file
Saved parameters can be processed without a device connected and transferred to the device again later.

 Description, see SOPAS ET help menu and DUSTHUNTER Service Manual.

- Saving as a protocol
Device data and parameters are registered in the Parameter protocol.
A Diagnosis protocol can be created for analysis of the device function and recognition of possible malfunctions.

Parameter protocol example

Fig. 39: Parameter protocol DH SP200 (example)

Dusthunter - Parameter protocol	
Type of device: DH SP200	
<i>Mounting location:</i>	
<i>Sensor 1</i>	
<hr/>	
Device information	Factory calibration settings
<i>Device version</i>	Gains
<i>Firmware version</i>	AN0-AN1 10.2000
<i>Serial number</i>	Relais 1 5.7100
<i>Identity number</i>	Relais 2 31.4000
<i>Hardware version</i>	Relais 3 700.0000
<i>Firmware bootloader</i>	Offsets
	AN0 0.000610
	Relais 1 0.000160
	Relais 2 0.000015
	Relais 3 0.000002
Installation parameter	Scattered light
<i>Bus adress</i>	cc2 0.0000
<i>Measurement laser temperature</i>	cc1 2.1572
Calibration coefficient for calculation of concentration	cc0 0.0000
<i>Code for second calibration function</i>	Current laser
Calibration function 1	cc2 0.0000
<i>Function type</i>	cc1 30.3000
cc2 0.0000	cc0 0.0000
cc1 1.0000	Device temperature
cc0 0.0000	cc2 0.0000
Calibration function 2	cc1 100.0000
<i>Function type</i>	cc0 -275.1500
Not used	Current motor
cc2 0.0000	cc2 0.0000
cc1 1.0000	cc1 2000.0000
cc0 0.0000	cc0 -19.5000
Device parameter	Power supply
Factory settings	cc2 0.0000
<i>Response time Sensor</i>	cc1 10.8000
1.0 s	cc0 0.0000
<i>Response time diagnosis values</i>	
10.0 s	

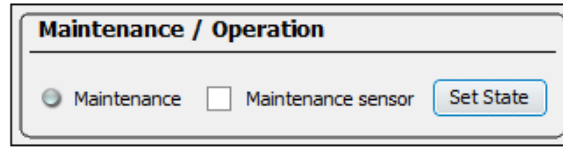
Fig. 40: Parameter protocol FWE200DH (example)

Dusthunter - Parameter protocol	
Type of device: FWE200DH	
<i>Mounting location:</i>	
<i>Sensor 3</i>	
<hr/>	
Device information	Factory calibration settings
<i>Device version</i>	T Heater1
<i>Firmware version</i>	cc2 1.9522
<i>Serial number</i>	cc1 76.2318
<i>Identity number</i>	cc0 -31.3333
<i>Hardware version</i>	T Heater2
<i>Firmware bootloade r</i>	cc2 1.9522
	cc1 76.2318
	cc0 -31.3333
Configuration	T Gas1
<i>VFD hardware activation</i>	cc2 1.9522
<i>Zeropoint valve hardware activation</i>	cc1 76.2318
<i>Ball valve hardware activation</i>	cc0 -31.3333
<i>Ball valve code</i>	T Gas2
<i>Heater3</i>	cc2 1.9522
<i>Heater4</i>	cc1 76.2318
<i>T Gas1</i>	cc0 -31.3333
<i>Analog input (0...20mA)</i>	T Reservation
	cc2 1.9522
	cc1 76.2318
	cc0 -31.3333
Installation parameter	pGas
<i>Set temperature measure gas</i>	cc2 0.0000
<i>Limit temperature Heater1</i>	cc1 3.5000
<i>Limit temperature Heater2</i>	cc0 -0.8500
<i>Limit pGas</i>	pBaro
<i>Set frequency(0%...100%)</i>	cc2 0.0000
<i>Frequency VFD</i>	cc1 144.0000
<i>Flow</i>	cc0 633.0000
<i>Code for option ball valve</i>	T Case
	cc2 0.0000
	cc1 100.0000
	cc0 -275.1500
Device parameter	T Heater3
<i>Leistungsstellwert Notbetrieb</i>	cc2 1.9522
<i>Ansprechzeit Messwerte</i>	cc1 76.2318
Heater1	cc0 -31.3333
<i>Activation</i>	T Heater4
<i>Maximal temperature</i>	cc2 1.9522
<i>Fix value activation</i>	cc1 76.2318
<i>Fix value</i>	cc0 -31.3333
<i>Maximal power</i>	U I/O-Modul
Heater2	cc2 0.0000
<i>Activation</i>	cc1 1.0000
<i>Maximal temperature</i>	cc0 0.0000
<i>Fix value activation</i>	U_12V
<i>Fix value</i>	cc2 0.0000
<i>Maximal power</i>	cc1 5.7000
Heater3	cc0 0.0000
<i>Activation</i>	U_24V
Heater4	cc2 0.0000
<i>Activation</i>	cc1 11.1000
Control measure gas	cc0 0.0000
<i>Control value for heater1 and heater2</i>	Blower voltage
<i>Set temperature</i>	cc2 0.0000
<i>Lower error limit</i>	cc1 110.0000
<i>Lower warn limit</i>	cc0 0.0000
<i>Upper warn limit</i>	Analog input (20mA)
<i>Upper error limit</i>	cc2 0.0000
<i>Maximal control limit</i>	cc1 5.0000
Constants flow calculation	cc0 0.0000
<i>Air pressure</i>	Analog output (VFD)
<i>Density</i>	cc2 0.0000
<i>Orifice plate</i>	cc1 0.0000
Settings probe purge	cc0 0.0000
<i>Valve 1 open</i>	cc2 0.0000
<i>Wait time for switch valves</i>	cc1 172.6500
<i>Valve 2 open</i>	cc0 0.0000
<i>Wait time finishing probe purge</i>	

4.4.11 Starting measuring operation

Set the measuring system to "Measurement" mode after entering/modifying parameters. To do so, stop "Maintenance" mode: Click checkmark "Maintenance sensor" off.

Fig. 41: SOPAS ET menu: MCU/Maintenance/Maintenance



Standard start-up is now completed.

4.5 Setting the Interface module parameters

The measuring system is delivered with an Interface module Modbus TCP as standard. When desired, it can be swapped for an Interface module for Profibus DP V0 or Ethernet (type 1) (see “[Device check accessories](#)”, page 111).



GSD file and measured value assignment are available for the Profibus DP module on request.

4.5.1 Modbus TCP module



For detailed information concerning communication via Modbus, see the “Modbus Organization” (www.modbus.org) documents, for example:

- MODBUS Messaging on TCP/IP Implementation Guide
- MODBUS APPLICATION PROTOCOL SPECIFICATION
- MODBUS over serial line specification and implementation guide

The register assignment is supplied as separate document with the Modbus module.

4.5.1.1 Check MCU settings

- ▶ Connect the MCU to the SOPAS ET program, select device file “MCU”, enter the level 1 password (see “[Setting standard parameters](#)”, page 53) and set the measuring system to “Maintenance” mode (see “[Setting “Maintenance” mode](#)”, page 54).
- ▶ Switch to directory “Configuration / System Configuration” and check that the module type in field “Interface Module / Interface Module” is set to “RS485”.

Fig. 42: SOPAS ET menu: MCU/Configuration/System configuration

Device Identification		
MCU	Selected variant: FWE200DH	Mounting Location: NS EMV
Interface Module		
Interface Module: RS 485		
Current Time / Date		
Date/Time: 26 Aug 2016 13:42:55		
Adjust Date/Time		
Day: 1	Month: 1	Year: 2007
Hour: 0	Minute: 0	Second: 0
<input type="button" value="Set date / time"/> <input checked="" type="radio"/> Date / Time set <input type="radio"/> Invalid value		
System Time Synchronization		
Date / Time: Friday, August 26, 2016 1:42:53 PM CEST <input type="button" value="Synchronize"/>		
Settings for service interface		
Protocol selection: CoLa-B	Modbus Address: 1	Serial service port baudrate: 57600
Use RTS/CTS lines: <input type="checkbox"/>		

- ▶ Switch to directory "Configuration / I/O Configuration / Interface Module" directory and check that the interface is set according to [Fig. "SOPAS ET menu: MCU/Configuration/IO configuration/Interface module"](#) in the "RS 485 Interface Parameter" field.

Fig. 43: SOPAS ET menu: *MCU/Configuration/IO configuration/Interface module*

The screenshot displays two configuration panels. The top panel, titled "Expansion module information", contains a "Module type" dropdown menu set to "RS 485" and a "Reset module" button with the text "When this button is clicked, the connection will be reseted". The bottom panel, titled "RS 485 Interface Parameter", contains three fields: "Protocol selection" set to "Modbus ASCII", "Modbus Address" set to "1", and "Baudrate" set to "57600".

4.5.1.2 *Installing the configuration program*

A separate configuration program has to be installed to set the customer's requirements.

+i Administrator rights are required to install software.

System requirements

- Operating system: MS-Windows XP or higher
- Program NET Framework 4.0
- Program Windows Installer 3.1

Installing the configuration program

- ▶ Connect the laptop/PC with the internet and enter "ftp://ftp.lantronix.com/pub/DeviceInstaller/Lantronix/4.3/".
- ▶ Download the current configuration program.

Fig. 44: *Downloading the configuration program*

FTP Listing of /pub/DeviceInstaller/Lantronix/4.3/ at ftp.lantronix.com

Parent Directory

Oct 31 2012 00:00	Directory	4.3.0.7	
Mar 28 2013 18:12	Directory	4.3.0.8	←

Parent Directory

Mar 28 2013 17:07	Directory	Help	
Mar 28 2013 17:10	Directory	Installers	
Mar 28 2013 19:15	651201	Lantronix.plbx	
Mar 28 2013 19:15	16652	Release.txt	

Parent Directory

Mar 28 2013 17:08	Directory	CD	
Mar 28 2013 17:09	Directory	Download	
Mar 28 2013 17:10	Directory	Download Web	
Mar 28 2013 19:18	1276	Readme.txt	
Mar 28 2013 17:11	Directory	SingleInstallFiles	

Parent Directory

Mar 28 2013 19:18	102033144	setup_di_x86x64cd_4.3.0.8.exe	←
Mar 28 2013 19:18	42018552	setup_di_x86x64dl_4.3.0.8.exe	←

It is possible that

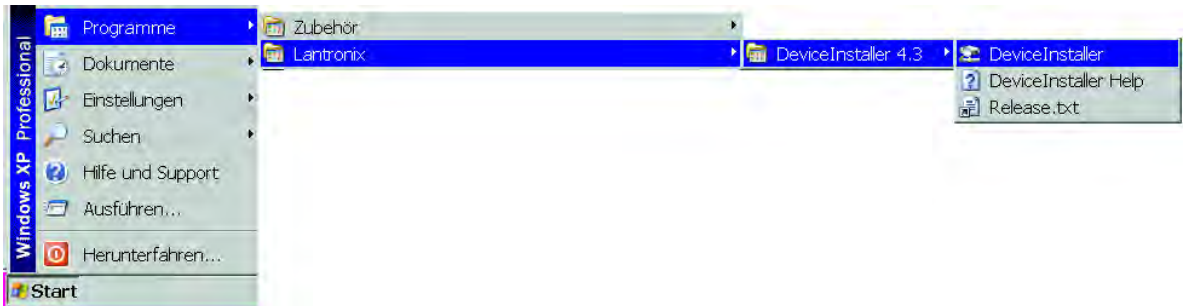
Select when the system requirements are not fulfilled (file size 99 MB)

Select when the system requirements are fulfilled (file size 41 MB)

4.5.1.3 Integrating the Modbus module in the network

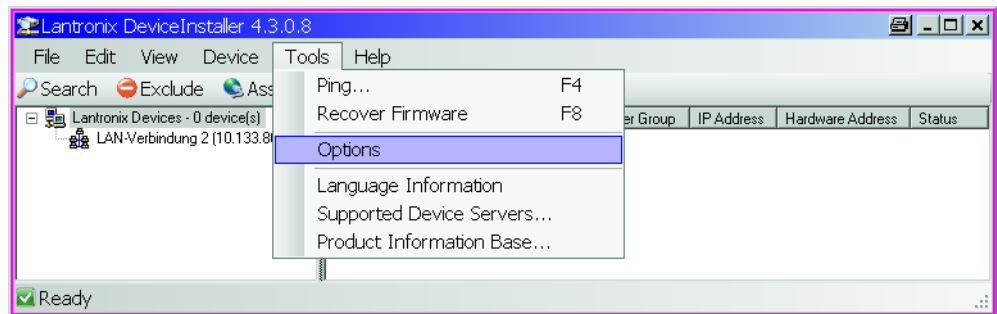
- ▶ Start the "DeviceInstaller" program.

Fig. 45: Starting the "DeviceInstaller"



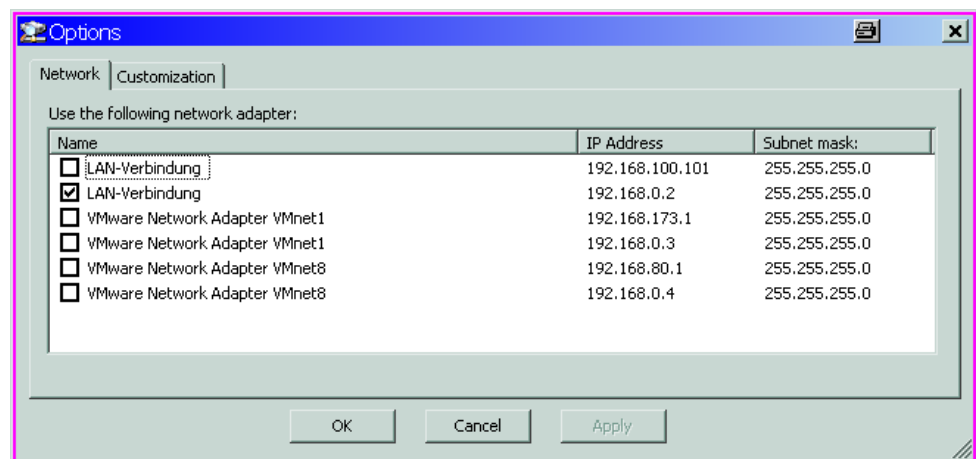
- ▶ Wait for a few seconds while the program is searching for installed components.
- ▶ Select the "Tools/Options" menu.

Fig. 46: "Tools/Options" menu



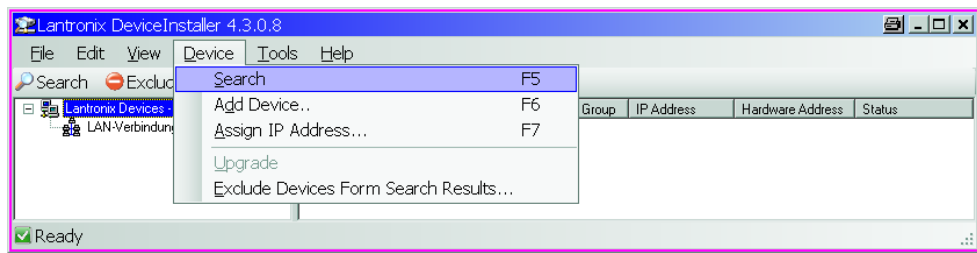
- ▶ If several networks are available, select the network interface with which the Modbus module is connected.

Fig. 47: Network connection(s) (example)



- ▶ Select the "Device/Search" menu and search for the Modbus module.

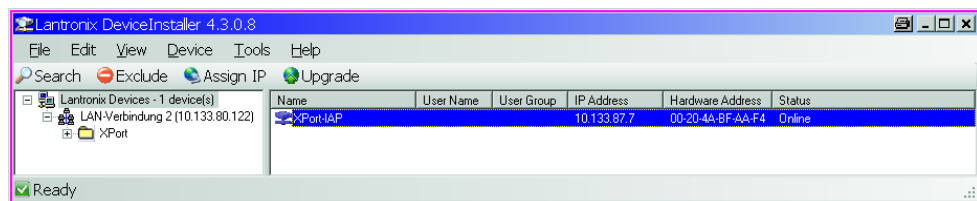
Fig. 48: Searching for connected components



If no module has been found, check the network connection and search again.

- ▶ Select the found module.

Fig. 49: Selecting the module

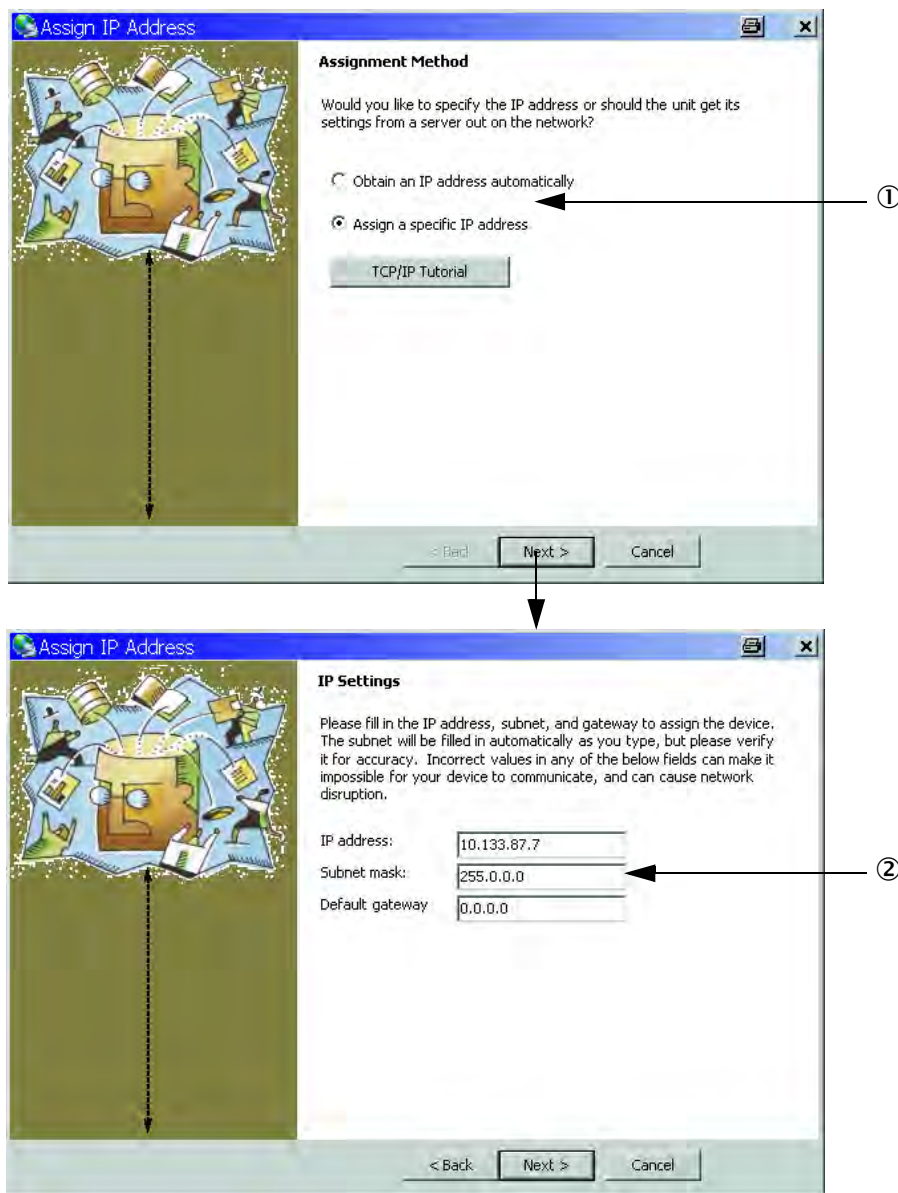


NOTICE:

Select the module only in the right window, not in the tree structure on the left.

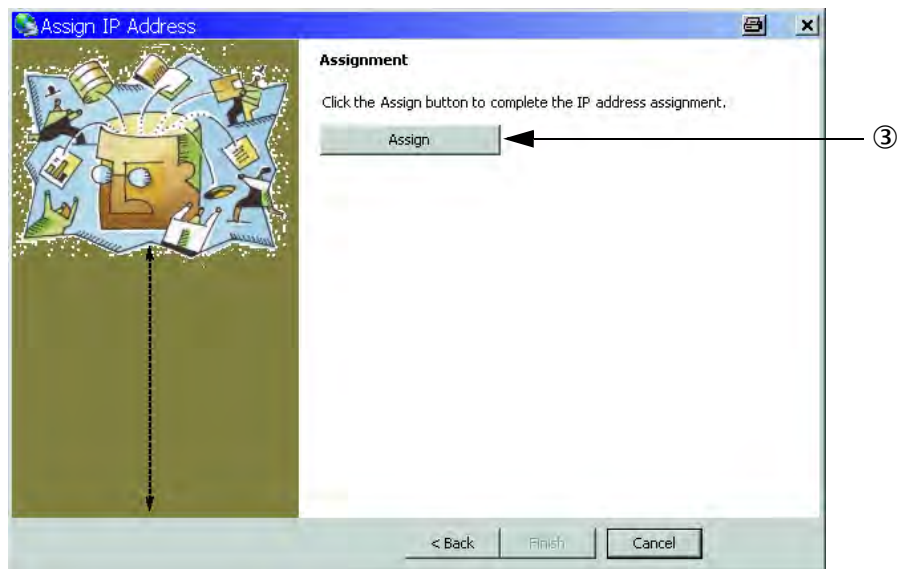
- ▶ Click the "Assign IP" menu and perform the following steps.

Fig. 50: Network assignment (address information is exemplary)



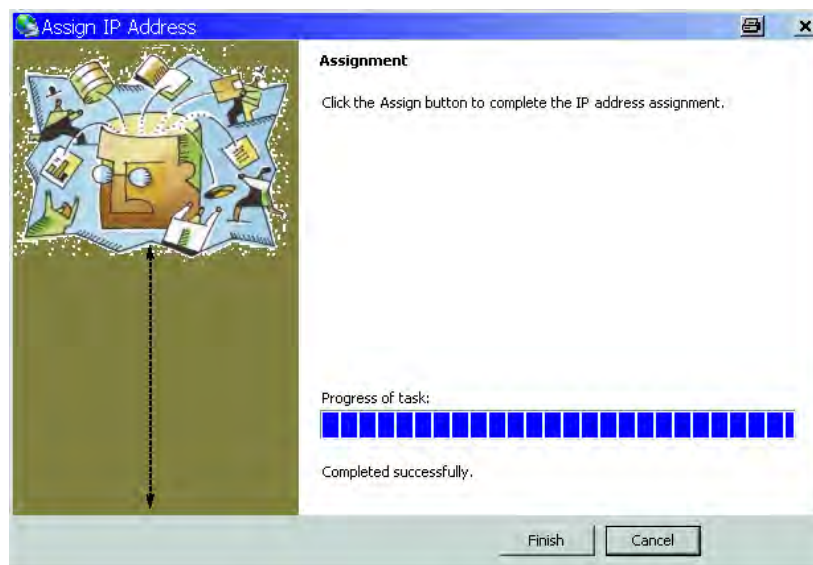
Step	Remark
1	Select the respective setting depending on the desired address assignment (automatic or manual assignment)
2	Manual assignment: Enter the required network connection data here.

Fig. 51: Defining the address settings



- ▶ Complete the assignment, then wait while the module is being configured and then click "Finish".

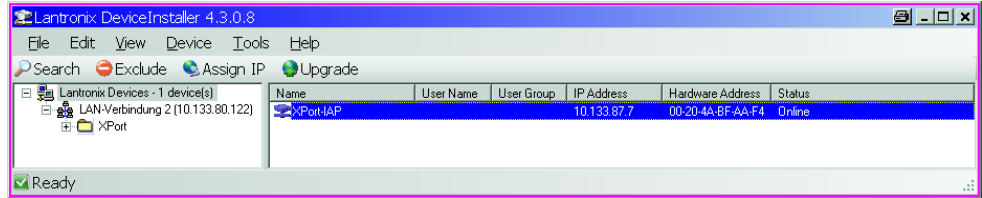
Fig. 52: Completing the assignment



4.5.1.4 Configuring the Modbus module

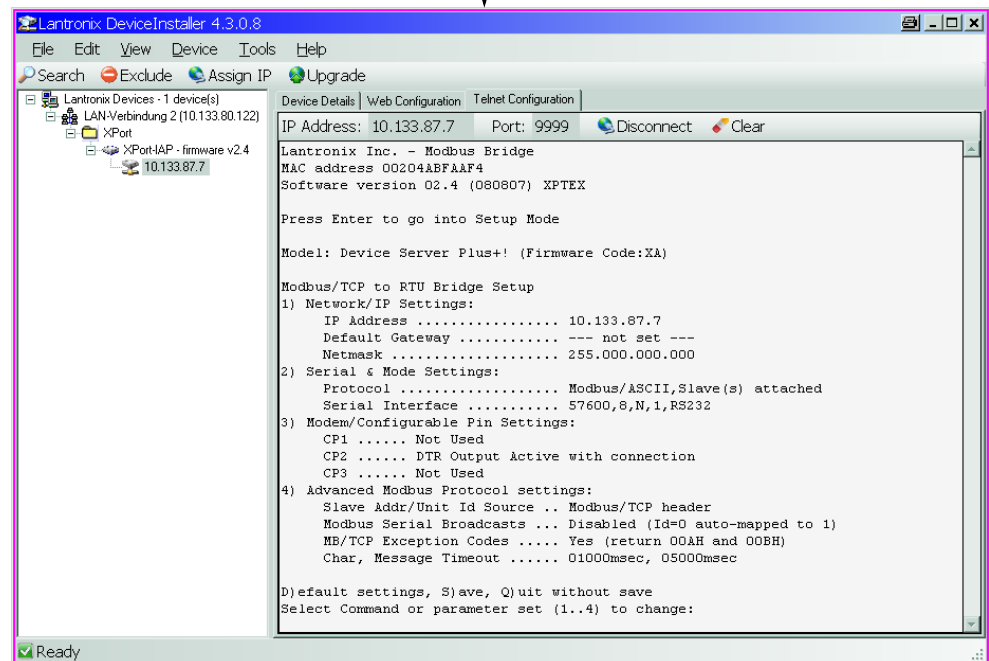
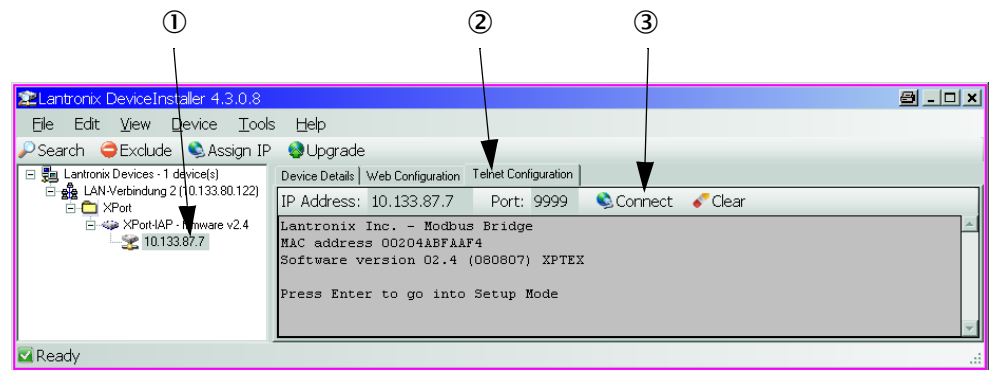
- ▶ After confirming the address assignment with "Finish", the following window is displayed:

Fig. 53: "Telnet Configuration"



- ▶ Perform steps (1) to (3) in succession and confirm with <Enter>.

Fig. 54: "Telnet Configuration"



- Define the serial and Modbus settings with the following entries.

Fig. 55: Serial and Modbus settings

The figure illustrates the configuration process through four sequential screenshots of the Upgrade web interface. Each screenshot shows the 'Telnet Configuration' tab with various settings and a command prompt for user input.

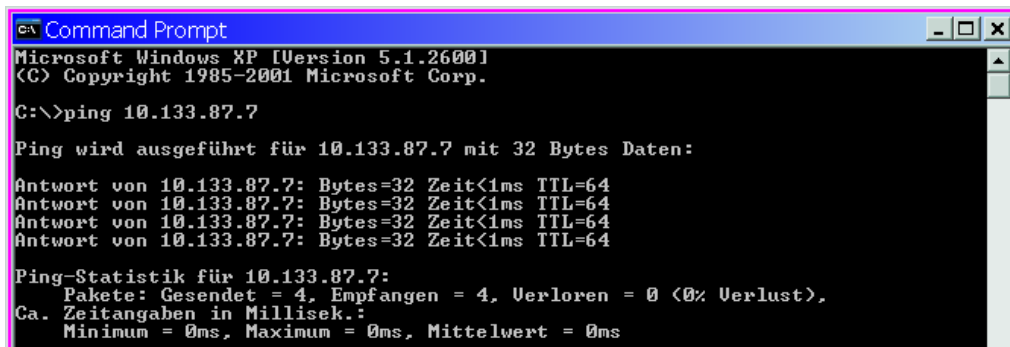
- First Screenshot:** Shows the initial configuration screen. The 'Attached Device' is set to 'Slave' (1). The 'Serial Protocol' is 'Modbus/RTU' (1). The 'Interface Type' is 'RS485+2-wire' (3). The command prompt shows 'Enter serial parameters (57600,8,N,1)'. Annotations indicate pressing '2' to confirm the device type, '1' to confirm the protocol, '3' to confirm the interface type, and '57600,8,N,1' to enter the serial parameters.
- Second Screenshot:** Shows the 'CP1 Function' set to 'RS485 Enable' (4). The 'Invert RS485 Output Enable' is set to 'N'. The 'CP2 Function' is set to 'RS485 Output Enable' (1). The 'CP3 Function' is set to 'Diagnostic LED Output' (1). Annotations indicate pressing '3' to confirm the CP1 function, '4' to confirm the CP2 function, and '1' to confirm the CP3 function.
- Third Screenshot:** Shows the 'Modem/Configurable Pin Settings' and 'Advanced Modbus Protocol settings'. The 'Advanced Modbus Protocol settings' include 'Slave Addr/Unit Id Source' as 'Modbus/TCP header', 'Modbus Serial Broadcasts' as 'Disabled', and 'MB/TCP Exception Codes' as 'Yes'. The command prompt shows 'Default settings, S)ave, Q)uit without save'. An annotation indicates pressing 'S' to save the settings.
- Fourth Screenshot:** Shows the final configuration screen. The 'Connect' button is now visible. The 'Advanced Modbus Protocol settings' are confirmed. The command prompt shows 'Parameters saved, Restarting ...'. An annotation indicates pressing 'S' to save the settings.

The Modbus module TCP is now configured.

4.5.1.5 Checking the functional capability

- ▶ Enter 'ping' followed by the IP address under "Command Prompt" ("Start → Programs → Accessories") and check the module reply.

Fig. 56: Correct reply from Modbus module



```
Command Prompt
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\>ping 10.133.87.7

Ping wird ausgeführt für 10.133.87.7 mit 32 Bytes Daten:

Antwort von 10.133.87.7: Bytes=32 Zeit<1ms TTL=64
Antwort von 10.133.87.7: Bytes=32 Zeit<1ms TTL=64
Antwort von 10.133.87.7: Bytes=32 Zeit<1ms TTL=64
Antwort von 10.133.87.7: Bytes=32 Zeit<1ms TTL=64

Ping-Statistik für 10.133.87.7:
    Pakete: Gesendet = 4, Empfangen = 4, Verloren = 0 (0% Verlust),
    Ca. Zeitangaben in Millisek.:
    Minimum = 0ms, Maximum = 0ms, Mittelwert = 0ms
```

4.5.2 Setting the Ethernet module parameters



NOTICE:

The risk of undesired access to the measuring system is inherent when communicating via Ethernet.

- ▶ Operate the measuring system only behind suitable protection (e.g., Firewall).



The configuration of interface module Ethernet type 2 (see “[Device check accessories](#)”, page 111) is not possible with program SOPAS ET. A special software with description is supplied with the program

Default setting: 192.168.0.10

If required, a specified IP address is set.

To change the settings:

- ▶ Select directory “Configuration / I/O Configuration / Interface Module”.
- ▶ Set the desired network configuration and click button “Restart” in the “Interface module information” field.

Fig. 57: SOPAS ET menu: MCU/Configuration/IO configuration/Interface module

Expansion module information

Module type: ▾

When this button is clicked, the connection will be reset

Ethernet Interface Configuration

IP Address:

Subnet mask:

Gateway:

TCP port:

4.6 Activating the backpurge option

This option must be activated with a codeword when retrofitted. The following steps are then required:

- ▶ Select the "FWE200DH" device file, set the measuring system to "Maintenance" mode and enter the level 1 password.
- ▶ Enter the delivered code word in the "Parameters/Application parameters" directory in the "Enable code for option ball valve" field.
- ▶ Change to "Diagnosis / Device info" directory and check in the "Configuration / check states" field whether the "Ball valve hardware activated" display is active (if not, activate according to see "Installing the backpurge option (only necessary when ordered separately)", page 44).

Fig. 58: SOPAS ET menu: FWE200DH/Configuration/Application parameters (example)

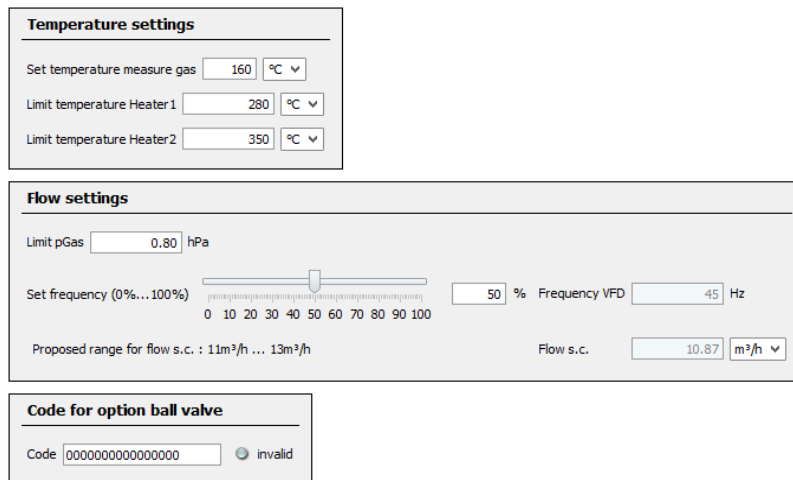
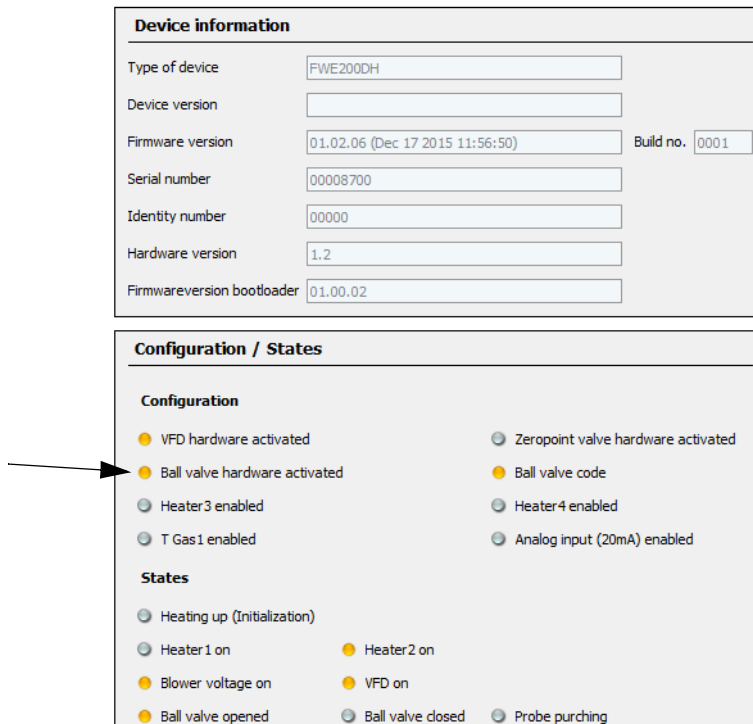


Fig. 59: SOPAS ET menu: FWE200DH/Diagnosis/Device Info

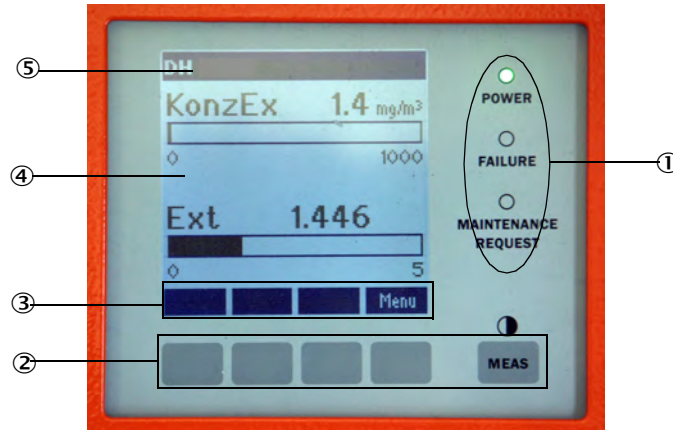


4.7 Operating/setting parameters via the LC-Display

4.7.1 General information on use

The display and operating interface of the LC-Display contains the functional elements shown in [Fig. "LC-Display functional elements"](#).

Fig. 60: LC-Display functional elements



- ① Status LED
- ② Control buttons
- ③ Current button function
- ④ Display field
- ⑤ Status bar

Button functions

The function shown depends on the menu currently selected. Only the function shown in the button is available.

Button	Function
Diag	Display diagnostic information (warnings and errors during a start using the Main menu, sensor information during a start using the Diagnostics menu see "LC-Display menu structure", page 81)
Back	Switch to higher level menu
Arrow ↑	Scroll up
Arrow ↓	Scroll down
Enter	Execution of the action selected with an arrow button (switch to a submenu, confirm parameter selected during parameter setting)
Start	Start an action
Save	Store a changed parameter
Meas	Toggle between text and graphic display Display the contrast setting (after 2.5 s)

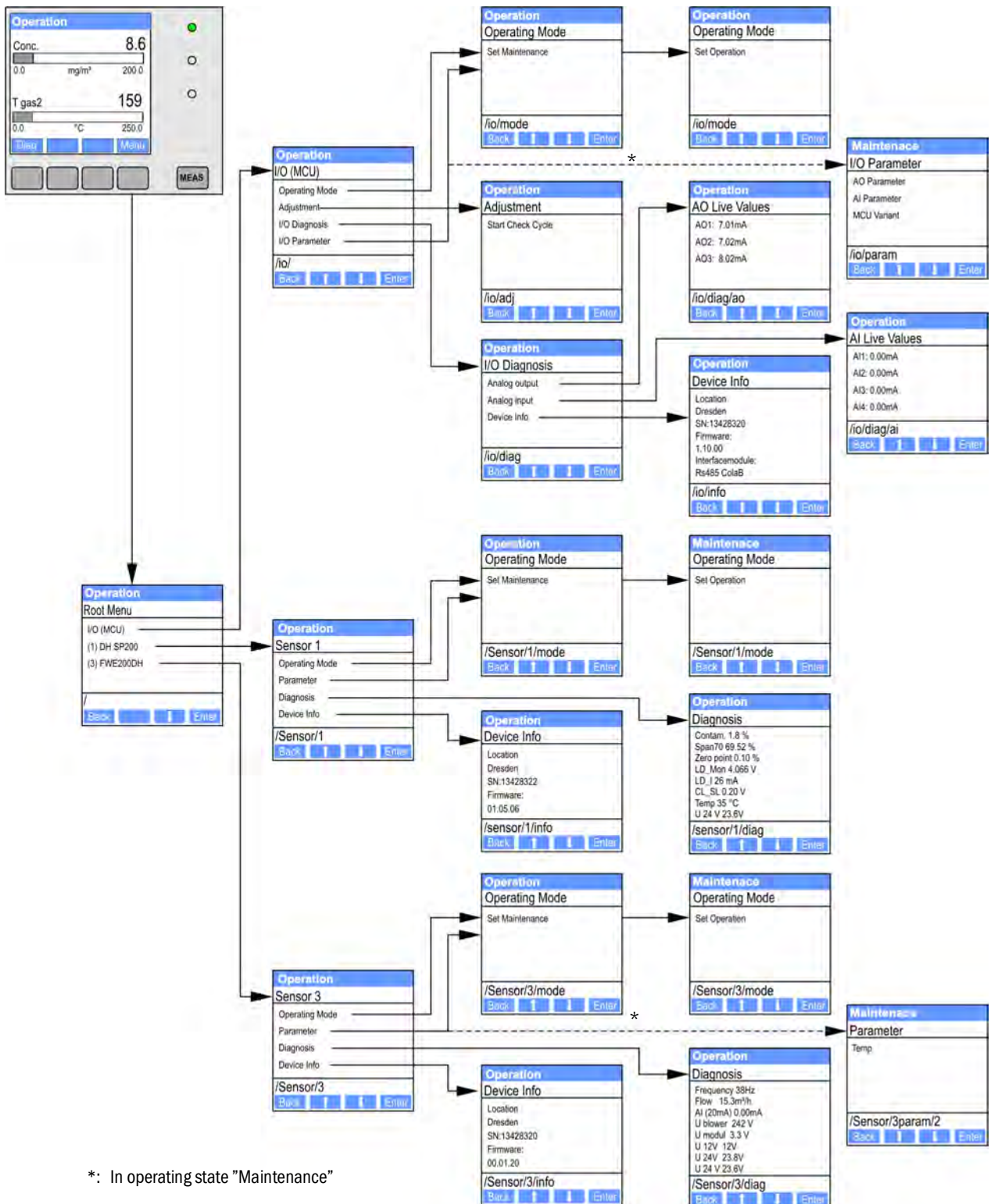
4.7.2 Password and user levels

Certain device functions are first accessible after a password has been entered.

User level	Access to
0 Operator	Displays measured values and system states. No password required.
1 Authorized operator	Displays, inquiries and parameters required for start-up or adjustment to customer-specific demands and diagnosis Preset password: 1234

4.7.3 Menu structure

Fig. 61: LC-Display menu structure

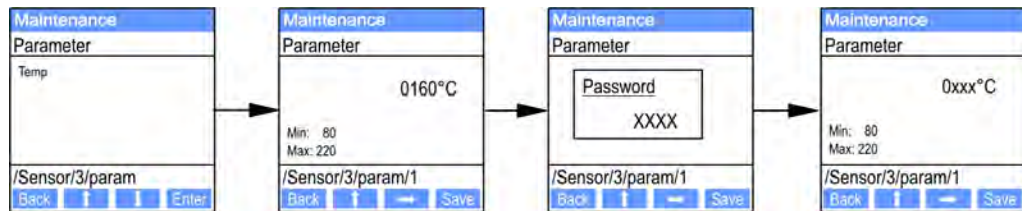


4.7.4 Setting parameters

4.7.4.1 Sample gas temperature

- ▶ Set the system control (FWE200DH) to "Maintenance" (see "LC-Display menu structure", page 81) and activate submenu "Parameter".
- ▶ Choose the parameter to be entered and enter the default password "1234".
- ▶ Set the calculated coefficients (see "Setting standard parameters", page 53) using the "^" and/or "→" buttons and write to the device with "Save" (confirm twice).

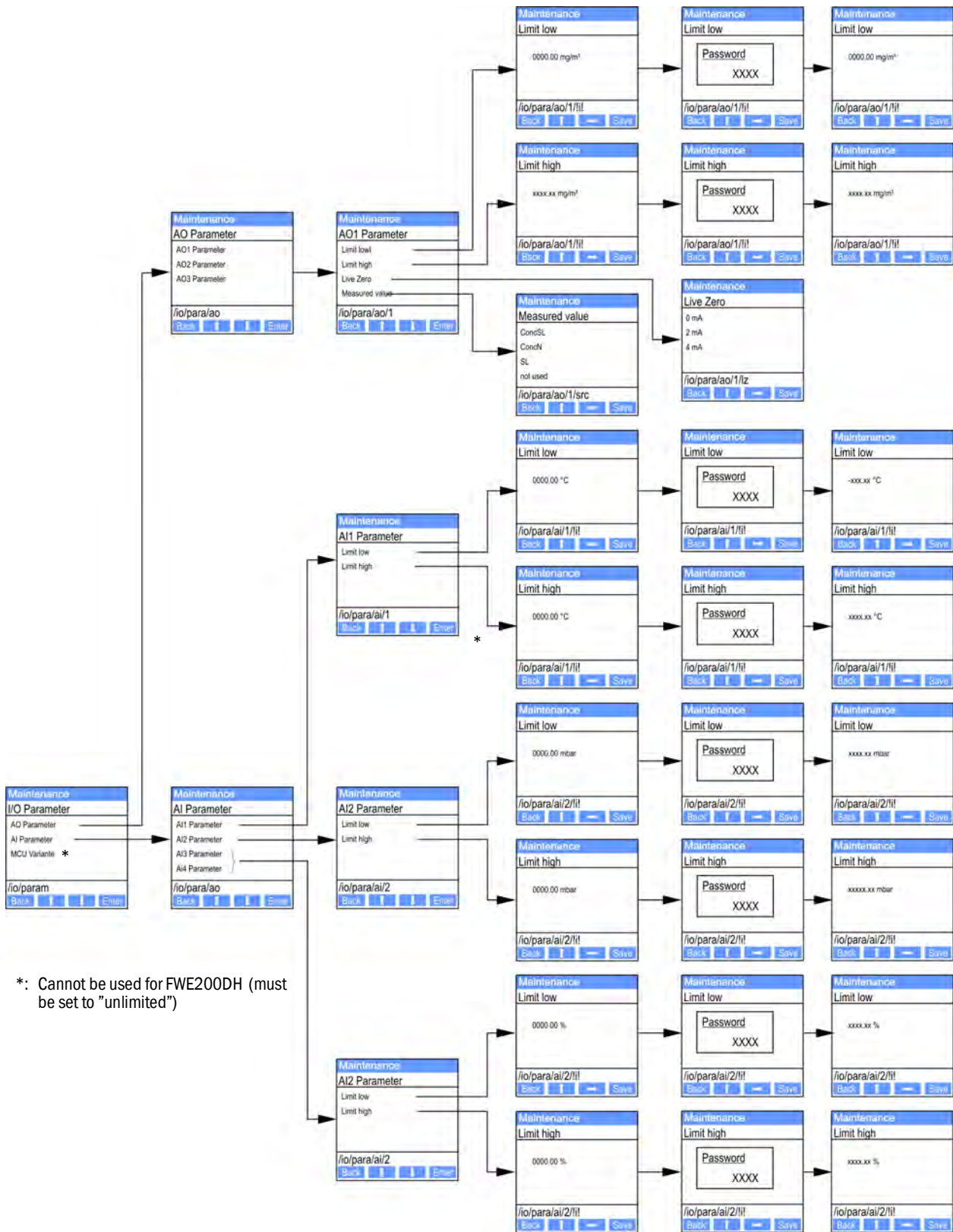
Fig. 62: Changing the sample gas temperature



4.7.4.2 Analog outputs / inputs

- ▶ Set the control unit (MCU) to "Maintenance" (see "LC-Display menu structure", page 81) and activate submenu "I/O Parameter".
- ▶ Select the desired parameter and enter the default password "1234" using the "^" (scrolls from 0 to 9) and/or "→" (moves the cursor to the right) buttons.
- ▶ Select the desired value using the "^" and/or "→" buttons and write it to the device with "Save" (confirm 2x).

Fig. 63: Menu structure for parameter settings analog outputs / inputs



*: Cannot be used for FWE200DH (must be set to "unlimited")

4.7.5 Using SOPAS ET to modify display settings

To modify factory settings, connect SOPAS ET with "MCU" (see "Connection to the device via USB line", page 50), enter password level 1 and select the "Parameter settings/Display settings" directory.

Fig. 64: SOPAS ET menu: MCU/Configuration/Display settings

The screenshot shows the SOPAS ET configuration interface with the following sections:

- Device Identification:** MCU (selected), Selected variant: DUSTHUNTER, Mounting Location: SICK.
- Common Display Settings:** Display language: English, Display Unit System: metric.
- Overview Screen Settings:** A table of 8 bars. Bar 1 is set to Sensor 1, while Bars 2-8 are set to Not Used. Each bar has a Value field (Value 1), a Use AO scaling checkbox, and Range low/Range high input fields (set to -100 and 1000).
- Measured Value Description:**
 - Dusthunter 5:** Value 1 = not used, Value 2 = Concentration a.c. (SL), Value 3 = not used, Value 4 = not used, Value 5 = not used, Value 6 = not used, Value 7 = Scattered Light, Value 8 = not used.
 - Calculated values (MCU):** Value 1 = Concentration s.c. dry O2 corr. (SL), Value 2 = not used, Value 3 = not used, Value 4 = not used, Value 5 = Temperature, Value 6 = Pressure, Value 7 = Moisture, Value 8 = Oxygen.
- Security settings:** Authorized operator: 1234, Idle time: 30 Minutes.

Window	Entry field	Description
Common display settings	Display language	Language version shown on the LC-Display
	Display Unit System	Unit of measurement system used in displays
Overview Screen Settings	Bars 1 to 8	Sensor address for the first measured value bar in the graphic display
	Meas. value	Measured value index for the respective measured value bar
	Use AO scaling	When activated, the measured value bar is scaled to the associated analog output. If not activated, define the limit values separately
	Range low	Values for separate scaling of the measured value bar independent of the analog output
	Range high	

The measured value assignment is listed in the bottom field.

5 Maintenance

5.1 General information

5.1.1 Maintenance intervals

The plant operator must specify the maintenance intervals. The period depends on existing operating parameters such as gas temperature and humidity, dust content and state, how the plant is run and ambient conditions. Therefore only general recommendations can be made here (basic maintenance).

During the practical function check for receiving the QAL 1 certification, the TÜV determined a minimum maintenance interval of 3 months (extended maintenance).

The work performed by the operator has to be documented in a Maintenance Manual. The following maintenance work is recommended:

Kind of maintenance	Work to be performed
Basic maintenance	Visual inspection
	Check/clean jets in inlet nozzles of the thermo cyclone
	Check/clean the ejector
	Check/clean the suction nozzle
Extended maintenance	Check/clean the intermediate nozzle
	Check/clean the sample gas probe
	Check /clean the extraction and return hoses
	Check/clean the swirl chamber (in the thermo cyclone)
	Check/clean optical interfaces in the scattered light sensor DHSP200
	Check/clean the filter element of the blower unit

5.1.2 Maintenance contract

Scheduled maintenance work can be carried out by the equipment operator. Only qualified personnel according to Section 1 should be allowed to do the work. If requested, all maintenance activities can also be performed by Endress+Hauser Service or an authorized Service partner. Endress+Hauser offers cost-effective maintenance and repair contracts. Endress+Hauser carries out all maintenance and repair work within the framework of these agreements. Any repairs will be made by specialists onsite whenever possible.

5.1.3 Auxiliary means required

- Water
- Cleaning cloths (lint-free)
- Optics cloth, cotton swabs
- Jaw wrench, SW 7, 8, 13 and 19
- Allen key, SW 7
- Silicone grease (for O-rings for e.g. inlet nozzle, mixing tube ejector and Teflon parts in the measuring cell and intermediate nozzle above)
- Screwdriver with crosshead (middle size) and slot screwdriver (small).

5.1.4 Setting "Maintenance" mode

Take the following steps to set the measuring system to "Maintenance" mode before starting maintenance work.

- ▶ Connect the measuring system to the laptop/PC using the USB cable and start SOPAS ET.
- ▶ Connect with the MCU (see ["Connection to the device via USB line"](#), page 50).
- ▶ Enter the level 1 password (see ["Password and user levels"](#), page 80)
- ▶ Set the measuring system to "Maintenance" mode: select "Sensor maintenance")

Fig. 65: SOPAS ET menu: MCU/Maintenance/Maintenance mode

The screenshot shows two sections of the SOPAS ET menu. The top section, titled 'Device Identification', contains a 'MCU' dropdown menu, a 'Selected variant' dropdown menu with 'DUSTHUNTER' selected, and a 'Mounting Location' dropdown menu with 'SECK' selected. The bottom section, titled 'Offline Maintenance', contains a checkbox labeled 'Activate offline maintenance' which is checked.



- "Maintenance" mode can also be set using the buttons on the LC-Display of the control unit (see ["Menu structure"](#), page 81) or by connecting an external maintenance switch to the terminals for Dig In2 (17, 18) in the control unit see ["Connecting the control unit"](#), page 38).
- An automatic functional check is carried out during "Maintenance".
- The value set for "Maintenance" is output on the analog output (see ["Setting the analog output parameters"](#), page 58). This is also applicable when a malfunction is present (signaled on relay output).
- When "Maintenance" mode is only set using SOPAS ET, this state is reset after a voltage failure. The measuring system switches automatically to "Measurement" after the operating voltage is switched on again.

Resume measuring operation after completing the work (deactivate the "Maintenance on/off" checkbox in the "Maintenance / Operation" window and click "Set State").

5.2 Maintenance work



NOTE:

- During performance of maintenance work, it must be possible to switch the power supply to the FWE200DH off using a power isolating switch/circuit breaker in accordance with EN61010-1.
- After completion of the work or for test purposes, the power supply may only be activated again by the personnel who carried out the work and complying with the valid safety regulations.



WARNING: Hazard through chemical compounds

Acids or bases can be created when deposits are dissolved when cleaning gas-carrying parts (hoses, nozzles etc.) with water.

- ▶ Take suitable protective measures and use suitable protection devices.
- ▶ Observe the relevant safety regulations as well as the safety notices (see “Responsibility of user”, page 9) during all work.

5.2.1 Preparatory work

- ▶ Remove the sample gas probe and close off the assembly opening with a blind flange.



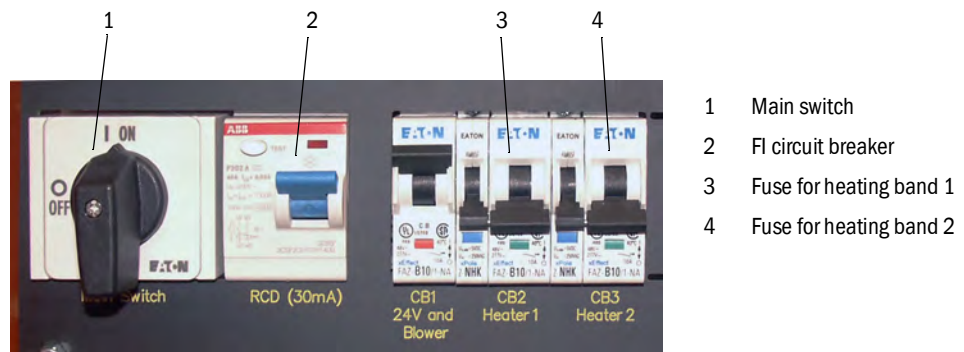
WARNING: Hazard through gas and hot parts

Hot and/or aggressive gases can escape when removing and fitting the sample gas probe as well as gas-carrying parts.

- ▶ Take suitable protective measures and use suitable protection devices.
- ▶ Observe the relevant safety regulations as well as the safety notices (see “Responsibility of user”, page 9) during all work.
- ▶ Only remove or fit the sample gas probe on equipment with hazard potential (higher internal duct pressure, hot or aggressive gases) when the equipment is at a standstill.

- ▶ Switch off the fuses for heating bands 1 and 2 in the control unit.
The blower unit is switched off when the average value of both heating temperatures is below the warning limit of the nominal temperature (default: 160°C - 10K = 150°C), at the latest for temperatures < 80°C.
- ▶ Switch the main switch in the control unit off and wait until hot parts have cooled down sufficiently.

Fig. 66: Main switch and fuses in the control unit



- 1 Main switch
- 2 FI circuit breaker
- 3 Fuse for heating band 1
- 4 Fuse for heating band 2

5.2.2 Visual inspection

- ▶ Check all hose connections for firm seat and leak tightness.
- ▶ Check the flow using the differential pressure (must be selected as measured value for display on the LC-Display [see “SOPAS ET menu: MCU/Configuration/Display settings”, page 84](#)).
The value must be in the range 1 to 4 mbar when the blower is running.
If this is not the case:
 - ▶ Check all gas-carrying parts for deposits and clean when necessary (see following Section).
- ▶ Check the running noise of the blower (must be within the usual frequency spectrum); increases in the noise level can indicate a blower failure.
 - ▶ Put the measuring system out of operation ([see “Putting the measuring system out of operation”, page 96](#)) and then check the blower unit.

5.2.3 Cleaning the inlet nozzles on the thermo cyclone

- ▶ Loosen hose clip (1) and pull extraction hose (2) off the connection of adapter (3).
- ▶ Carefully loosen quick-release clamps (4) of the adapter and take the adapter off.
- ▶ Pull jet (5) out of the adapter and remove O-ring (6)
- ▶ Pull inlet nozzle (8) out of the thermo cyclone and remove O-rings (7).



The inlet nozzle may sit very tight.

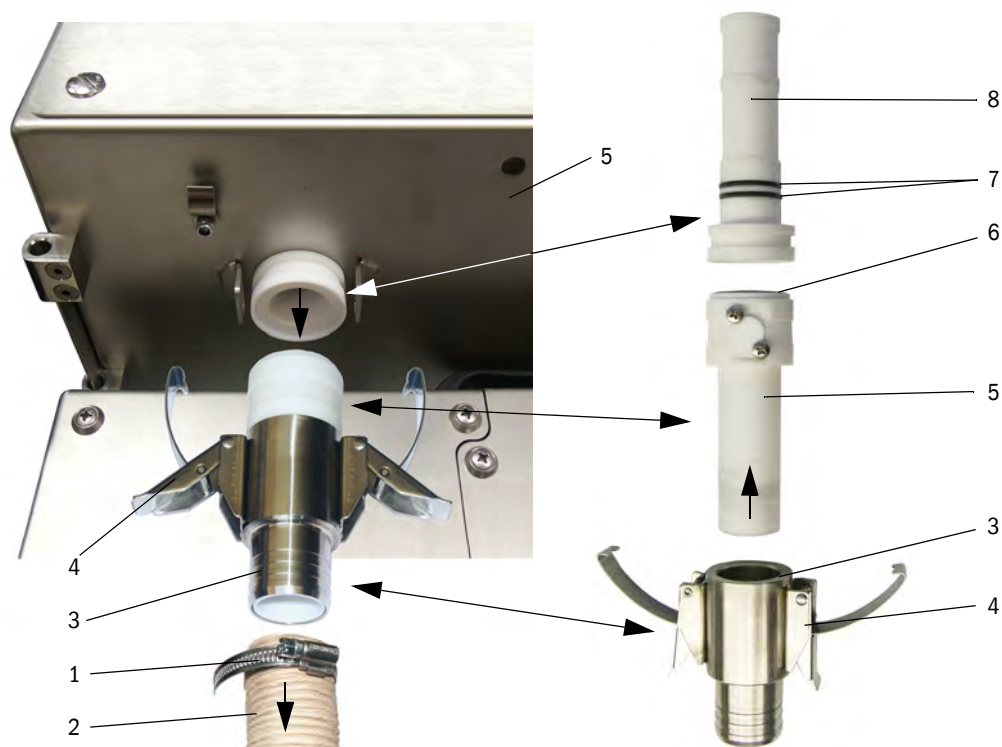
- ▶ Clean the nozzles and O-rings with water.
Carefully remove solid deposits (when present) with suitable tools without damaging the nozzles.
Fit new nozzles and/or O-rings when these are worn or damaged.
- ▶ Refit the O-rings and grease the two on the inlet nozzle with high-vacuum grease, insert the nozzles, fit and fasten the adapter.



Position the adapter centered on the inlet nozzle and tighten both quick-release clamps at the same time.

- ▶ Push the extraction hose onto the adapter connection and fasten with a hose clip.
- ▶ Fit the sample gas probe.
- ▶ If switched off, switch the fuses for the heating bands on and start the FWE200DH.

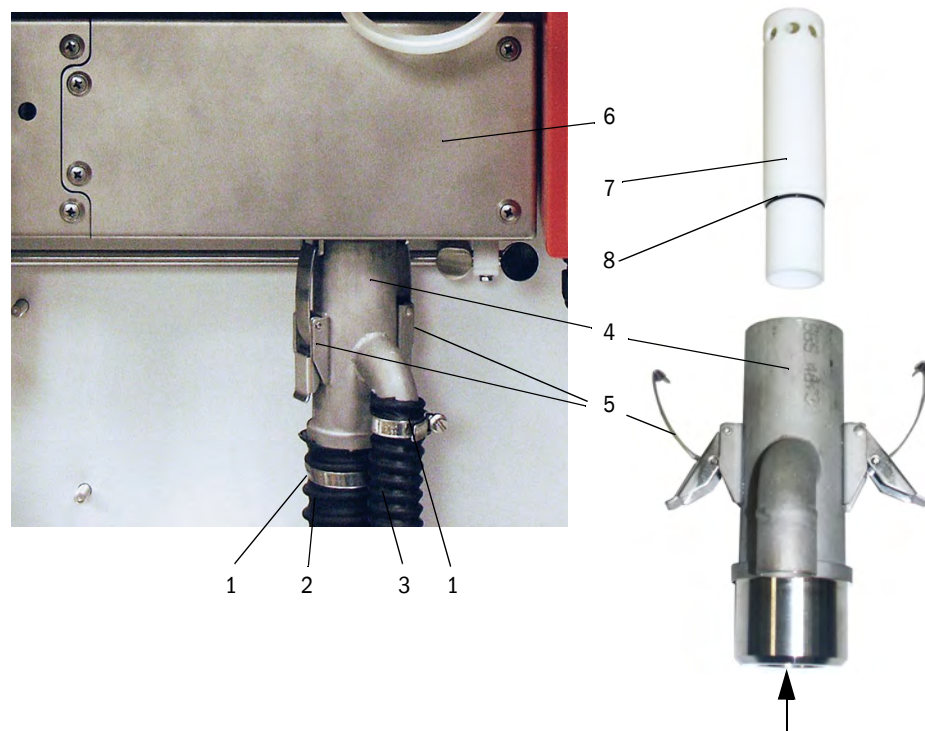
Fig. 67: Inlet nozzles



5.2.4 Cleaning the ejector

- ▶ Loosen hose clips (1) of return hose (2) and the hose to blower unit (3) on ejector (4) and take the hoses off.
- ▶ Loosen quick-release clamps (5) on measuring cell (6) and take the ejector off.
- ▶ Press mixing tube (7) out of ejector housing (8).
- ▶ Clean the mixing tube, O-ring and ejector housing with water.
- ▶ Check parts for wear or damage and replace with new parts when necessary.
- ▶ Reassemble the ejector in reverse sequence and fit on the measuring cell.
- ▶ Connect the hoses and secure with hose clips.
- ▶ Fit the sample gas probe.
- ▶ If switched off, switch the fuses for the heating bands on and start the FWE200DH.

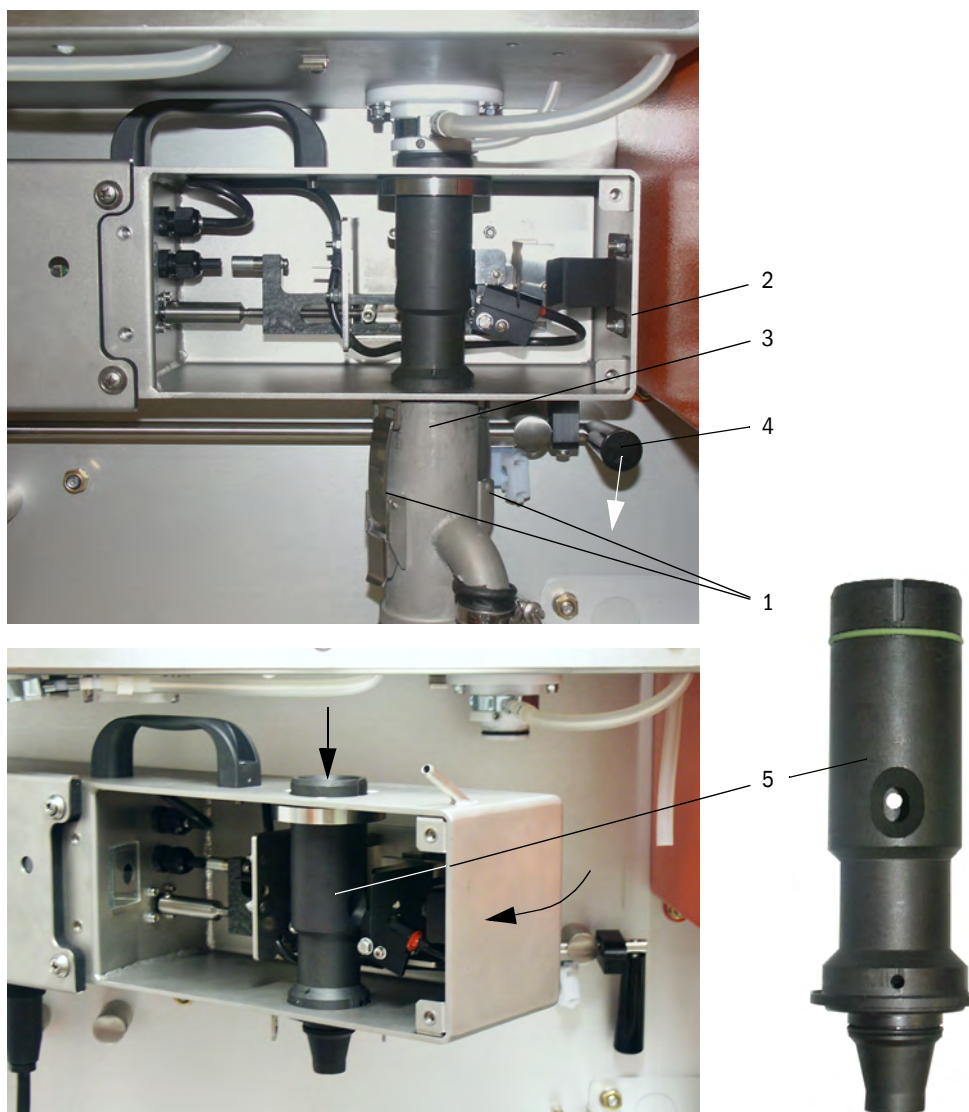
Fig. 68: Ejector



5.2.5 Cleaning the suction nozzle

- ▶ Loosen quick-release clamps (1) on measuring cell (2) and take the ejector (3) off.
- ▶ Push lever (4) that locks the measuring sensor down and swivel the measuring sensor out to the left.
- ▶ Press suction nozzle (5) downwards (e.g., with a light tap with the ball of the hand), remove and clean it with water.
- ▶ Grease the O-rings with silicone grease.
- ▶ Fit and fasten the ejector.
- ▶ Reassemble and lock the measuring sensor.
- ▶ Fit the sample gas probe.
- ▶ If switched off, switch the fuses for the heating bands on and start the FWE200DH.

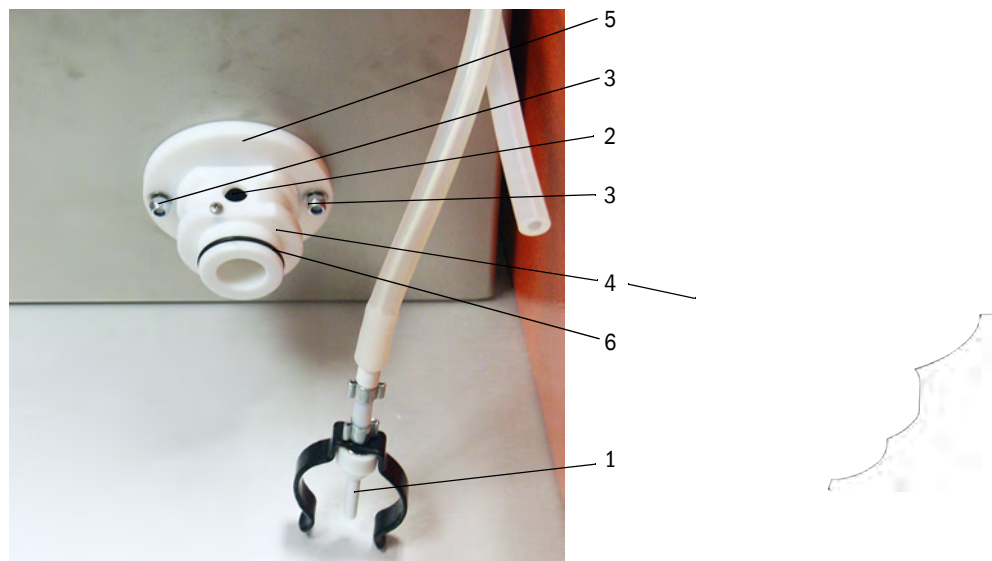
Fig. 69: Cleaning the suction nozzle



5.2.6 Cleaning the intermediate nozzle

- ▶ Pull the hose for differential pressure measurement of the connection (see “Cleaning the suction nozzle”, page 91).
- ▶ Push the lever that locks the measuring sensor down and swivel the measuring sensor out to the left.
- ▶ Pull sample gas cooler (1) out of hole (2)
- ▶ Loosen fastening nut (3), turn intermediate nozzle (4), take it out of holder (5) and clean with water.
- ▶ Check O-ring (6) and replace when necessary.
- ▶ Grease the O-rings with silicone grease.
- ▶ Refit the intermediate nozzle, swivel the measuring sensor back in and lock.
- ▶ Fit the sample gas probe.
- ▶ If switched off, switch the fuses for the heating bands on and start the FWE200DH.

Fig. 70: Cleaning the intermediate nozzle



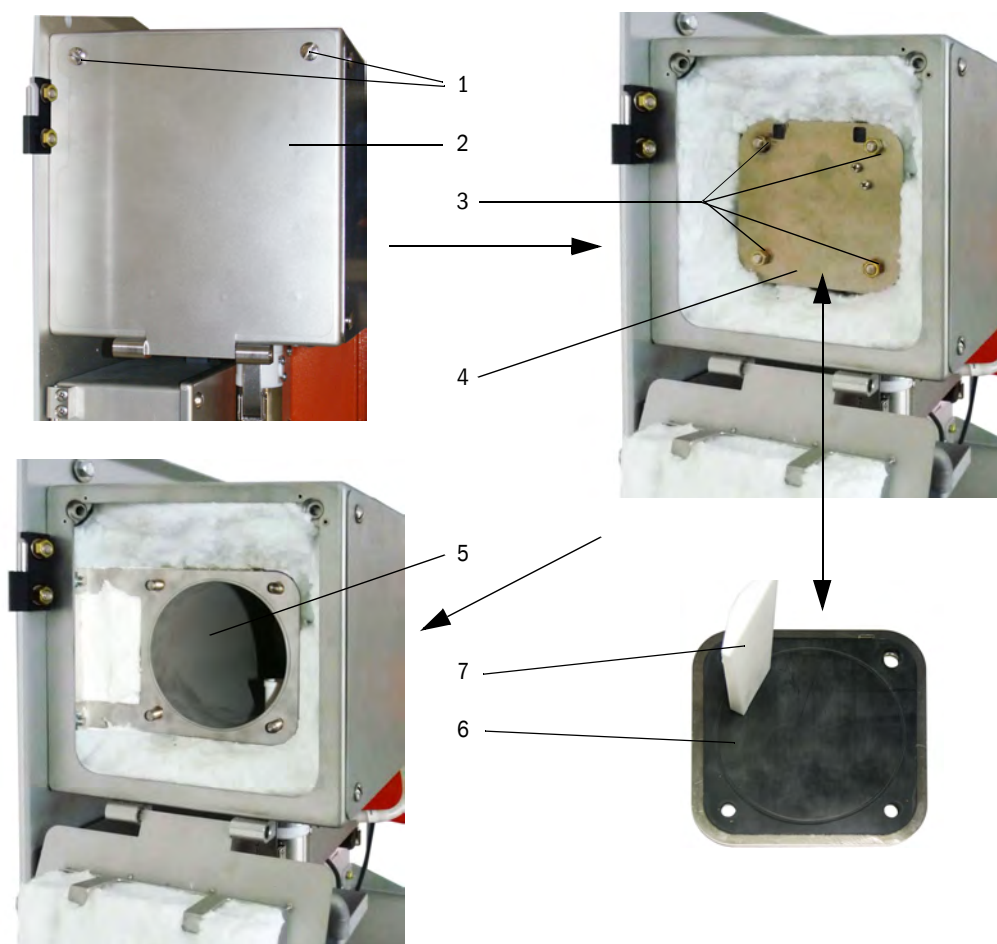
5.2.7 Clean the sample gas probe, extraction and return hose

- ▶ Loosen the hose clips on both ends of the extraction and return hoses and pull the hoses off.
- ▶ Clean the hoses and sample gas probe with water.
Replace worn or defective hoses with new ones (extraction hose Part No. 5313673, return hose Part No. 5328761).
- ▶ Connect the hoses and secure with hose clips.
- ▶ Fit the sample gas probe.
- ▶ If switched off, switch the fuses for the heating bands on and start the FWE200DH.

5.2.8 Cleaning the swirl chamber

- ▶ Loosen fastening locks (1) of cover (2) and fold cover down.
- ▶ Loosen fastening nuts (3) of cover (4) of swirl chamber (5) and take the cover with seal (6) off.
- ▶ Clean the swirl chamber inside with water.
Carefully remove any deposits with suitable tools. Replace the swirl chamber with heavy wear or damage with a new one (see Service Manual).
- ▶ Check the seal and baffle plate (7) and replace when necessary.
- ▶ Reassemble the thermo cyclone.
- ▶ Fit the sample gas probe.
- ▶ If switched off, switch the fuses for the heating bands on and start the FWE200DH.

Fig. 71: Cleaning the swirl chamber

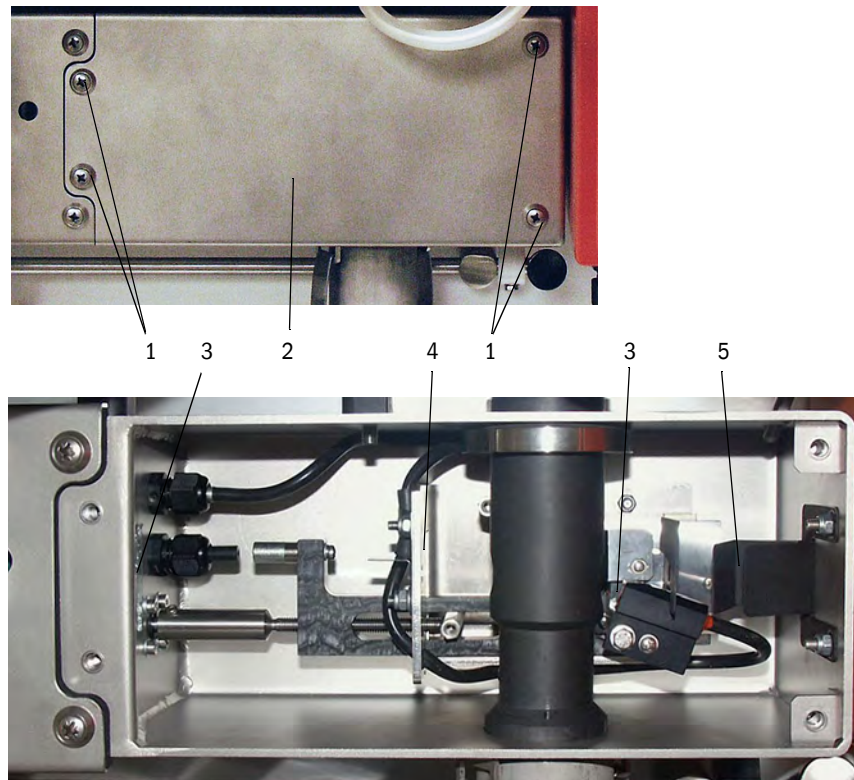


5.2.9 Cleaning optical interfaces

Clean the optical surfaces when deposits can be seen or before contamination reaches the maximum allowable contamination (limit value 30% for warning, 40% for malfunction). The current contamination value can be read out on the LC-Display or in SOPAS ET.

- ▶ Loosen fastening screws (1) for cover (2) of the measuring cell and take the cover off.
- ▶ Carefully clean glass surfaces (3) and apertures (4) with cotton swabs, and also clean light trap (5) when necessary.

Fig. 72: Cleaning optical interfaces



Higher contamination values (above approx. 10%) which cannot be reduced even by cleaning several times indicate wear of the optical surfaces. Values up to approx. 10% do not however have any influence on measuring behavior and precision.

- ▶ Check the seal for the cover and replace when necessary.
- ▶ Fit the sample gas probe.
- ▶ If switched off, switch the fuses for the heating bands on and start the FWE200DH.

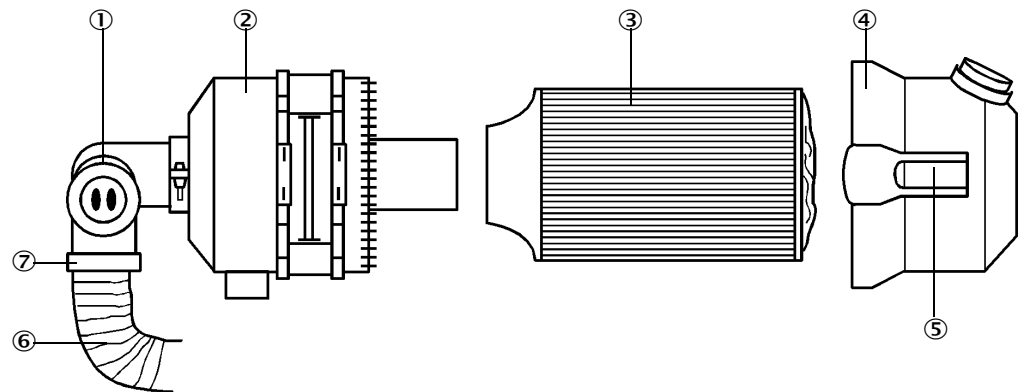
5.2.10 Checking / replacing the filter element of the blower unit

Depending on the degree of contamination of the suctioned ambient air, the filter element has to be checked for contamination in intervals determined by the operator. Replace the filter element when:

- Severe contamination (deposits on the filter surface) is visible.
- The purge air volume is reduced considerably as compared to operation with a new filter.

Work to be performed

Fig. 73: Replacing the filter element



- | | |
|------------------------|----------------------|
| ① Low-pressure monitor | ⑤ Quick-release lock |
| ② Filter housing | ⑥ Purge air hose |
| ③ Filter element | ⑦ Strap retainer |
| ④ Filter housing cover | |

- ▶ Switch the blower off for a short time.
- ▶ Clean outside of filter housing (2).
- ▶ Loosen strap retainer (7) and clamp purge air hose (6) to a clean location.



NOTICE:

- ▶ Place the end of the hose in a safe place so that foreign objects cannot be sucked in (this will cause irreparable damage to the blower), but do not close the end of the hose! During this time, the purge air entering the purge air connection pieces is unfiltered.

- ▶ Press snap locks (5) together and take off filter housing cover (4).
- ▶ Remove filter element (3) with twisting-pulling movements.
- ▶ Clean the inside of the filter housing and the filter housing cover with a cloth and brush.



NOTICE:

- ▶ For wet cleaning, use only a water-soaked cloth and then dry the parts well.

- ▶ Insert the new filter element with twisting-pressing movements.
Spare part :Filter element Micro-Topoelement C11 100, Part No. 5306091
- ▶ Mount the filter housing cover, ensuring that it is aligned correctly with the housing, and snap the snap locks into place.
- ▶ Reconnect the purge air hose on the filter outlet using the hose clamp.
- ▶ Switch the blower on again.

5.3 Putting the measuring system out of operation

The FWE200DH should remain in operation during short equipment standstills. For longer standstills (as from approx. 1 week), we recommend putting the FWE200DH out of operation.

**NOTE:**

Put the FWE200DH out of operation immediately should the blower unit fail.

**WARNING: Hazard through gas and hot parts**

- ▶ Observe the relevant safety regulations as well as the safety notices in Section 1 during all disassembly work.
 - ▶ Take suitable protection measures against possible local hazards or hazards arising from the equipment.
 - ▶ Secure switches that should not be switched on again for safety reasons with signs and safeguards to prevent unintentional switching.
-

Work to be performed

- ▶ Take the sample gas probe out of the gas duct.
-

**WARNING: Hazard through gas and hot parts**

- ▶ Only remove the sample gas probe on equipment with hazard potential (hot or aggressive gases, higher internal duct pressure) when the equipment is at a standstill.
-

- ▶ Close off the assembly opening with a blind flange.
- ▶ Loosen the hose connections on the sample gas probe.
- ▶ Switch the main switch off.
- ▶ After all hot parts have cooled down, remove the measuring and control unit and blower unit, and store all components in a clean, dry location.
- ▶ Use suitable auxiliary means to protect the plug-in connectors against dirt and moisture.

6 Troubleshooting and error handling

6.1 General information

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



Warning messages do not imply a malfunction of the measuring system. The current measured value continues to be output on the analog output.



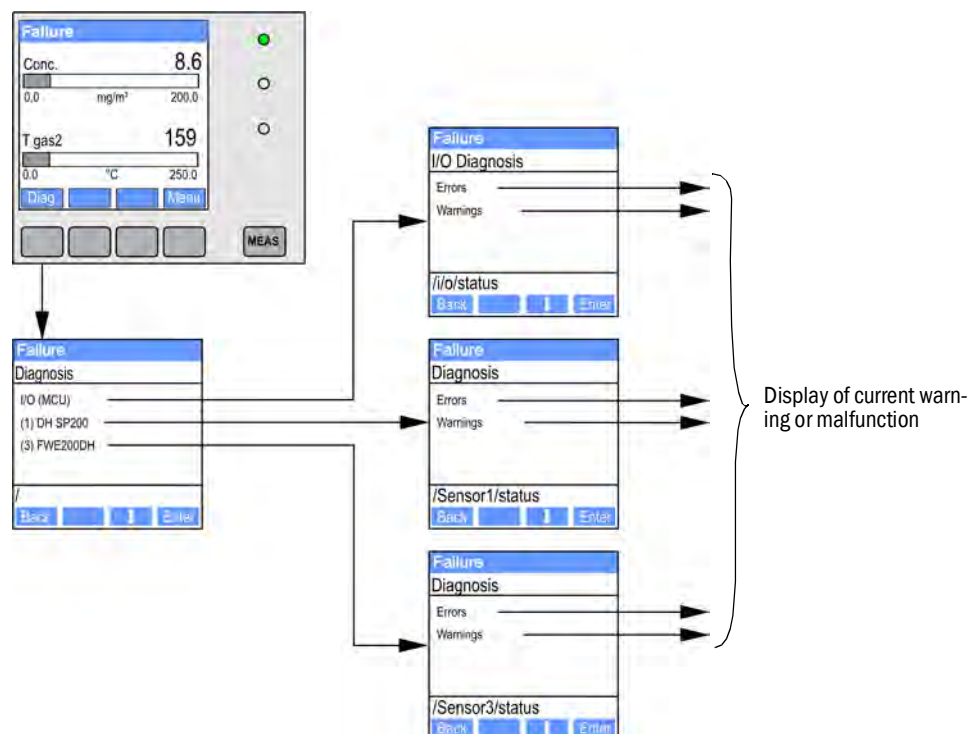
See the Service Manual for a detailed description of messages and options for clearance.

6.1.1 Display of warning and malfunction messages

Warnings or device malfunctions are signaled by:

- Status relays (see “Connecting cables for digital, analog and status signals”, page 39).
- LC-Display of the measuring and control unit
 “Maintenance request” or “Malfunction” displayed in the status line (see “General information on use”, page 80). In addition, the respective LED goes on (“MAINTENANCE REQUEST” for warnings, “FAILURE” for errors).
 After pressing the button “Diag”, possible causes are shown as short information in the menu “Diagnosis” after selecting the device (“DH SP200”, “FWE200DH”, “MCU”).

Fig 74 Display on the LC-Display



- In SOPAS ET
 The “Diagnosis / Error messages/warnings” directory provides detailed information on the current device state.

6.1.2 Malfunctions

Symptom	Possible cause	Action
No display on the LCD	<ul style="list-style-type: none"> ● Main switch and/or fuses switched off ● Main supply voltage missing ● Defective fuse ● Cable to LC-Display not connected or damaged ● Defective subassemblies 	<ul style="list-style-type: none"> ▶ Check voltage supply. ▶ Check connection cable. ▶ Exchange fuse. ▶ Contact Endress+Hauser Service.
Analog output on Live Zero	<ul style="list-style-type: none"> ● Device set to "Maintenance" mode ● Device has function fault(s) 	<ul style="list-style-type: none"> ▶ Check device status. ▶ Measuring range selected too large. ▶ Contact Endress+Hauser Service.

6.2 Warning and error messages in SOPAS ET

To display, connect the measuring system to SOPAS ET and start the device file "DH SP200"; FWE200DH" or "MCU".

Move the mouse to the respective message to display more details on the significance of individual messages in a separate window. Click on the display to view a short description of possible causes and clearance for certain messages as "Context help".

Select "Actual" or "Saved" in the "Error selection" or "Warnings selection" window to view current or previous warning and malfunction messages recorded in error memory.

6.2.1 Measuring sensor

Fig. 75: SOPAS ET menu: SP200/Diagnosis/Error messages - Warnings

Device identification

DH SP200 Sensor 1

Errors

Error selection : Actual

EEPROM CRC sum parameter Version Parameter CRC sum factory settings
 Version Factory settings Threshold value Span test Monitor signal
 Contamination Overflow measured value Motor current
 Zero point Laser current to high
 Power supply (24V) < 18V Power supply (24V) > 30V

Reset of saved errors

Warnings

Selection Warnings : Actual

Reference value Contamination Contamination invalid Default factory parameter
 Laser current to high
 Power supply (24V) to low Power supply (24V) to high

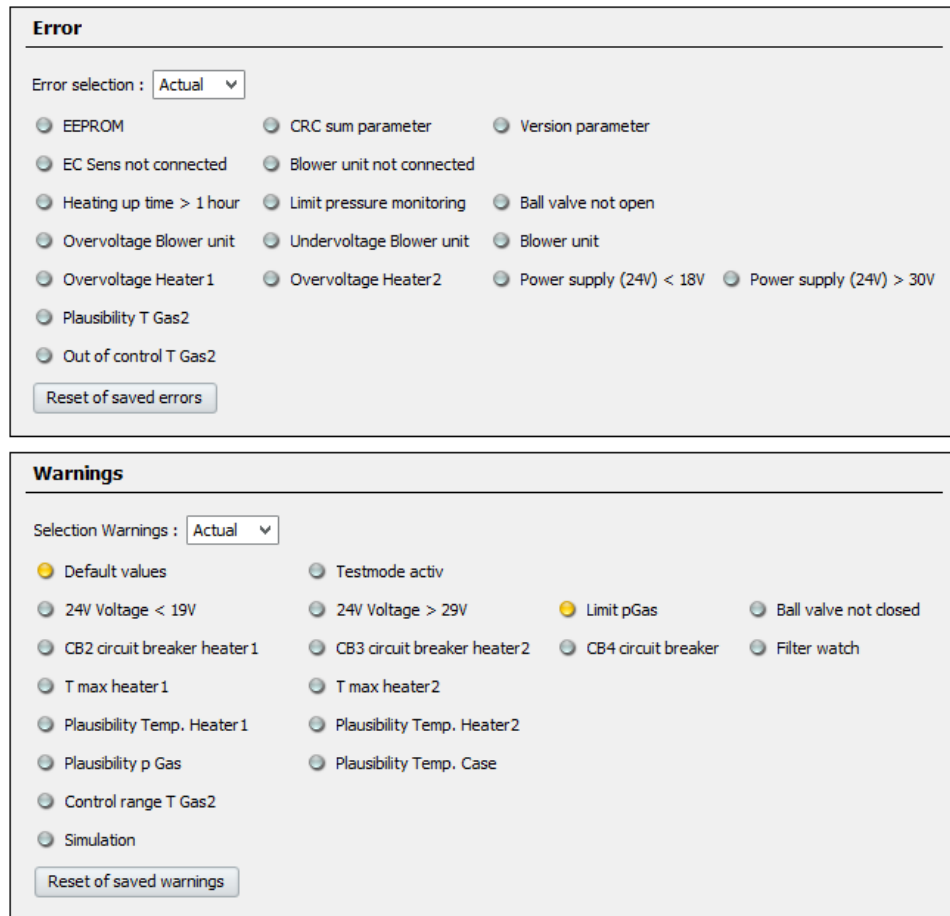
Reset of saved warnings

Malfunctions listed below can probably be cleared onsite.

Message	Description	Possible cause	Action
Contamination	Received light intensity is lower than the allowed limit (see "Technical Data", page 104)	<ul style="list-style-type: none"> Deposits on the optical interfaces Unclean purge air 	<ul style="list-style-type: none"> Clean optical surfaces (see "Cleaning optical interfaces", page 94). Check purge air filter (see "Checking / replacing the filter element of the blower unit", page 95) Contact Endress+Hauser Service.
	Deviation from setpoint value > ±2%.	Sudden change of measuring conditions during control value determination	<ul style="list-style-type: none"> Repeat the function check. Contact Endress+Hauser Service.

6.2.2 Measuring system

Fig. 76: SOPAS ET menu: FWE200DH/Diagnosis/Error messages - Warnings



Malfunctions listed below can probably be cleared onsite.

Warning messages

Message	Description/possible cause	Action
Default value set	Measuring system set to delivery parameters	▶ Set the parameters of the measuring system according to the requirements.
Test operation activated	Automatic heating control and blower control are deactivated.	▶ Set the system to Measuring Mode.
CB2 fuse, heater 1 CB3 fuse, heater 2	Limit value is exceeded.	▶ Clean gas paths (see "Maintenance work", page 87). ▶ Check/correct configuration (see "Define limit value for the flow rate", page 55). ▶ Contact Endress+Hauser Service.

Malfunction messages

Message	Description/possible cause	Action
Blower unit not connected	Blower unit is not connected or not correctly connected (see “Connecting the blower unit and supply voltage” , page 42).	<ul style="list-style-type: none"> ▶ Check and correct connection. ▶ Contact Endress+Hauser Service.
Heating up phase > 1 hour	Nominal value of sample gas temperature is not reached (sample gas temperature is too high in relation to gas humidity and gas temperature).	<ul style="list-style-type: none"> ▶ Reduce the nominal value of the sample gas temperature. ▶ Check application conditions
Limit value pressure monitoring	Limit value underflown.	<ul style="list-style-type: none"> ▶ Clean gas paths (see “Maintenance work”, page 87). ▶ Check/correct parameter settings(see “Define limit value for the flow rate”, page 55). ▶ Contact Endress+Hauser Service.

6.2.3 Control unit

Fig. 77: SOPAS ET menu: MCU/Diagnosis/ Error messages - Warnings

Device Identification

MCU Selected variant Mounting Location

System Status MCU

Operation
 Malfunction
 Maintenance Request
 Maintenance
 Function Check

Configuration Errors

AO configuration
 AI configuration
 DO configuration
 DI configuration
 Sensor configuration
 Interface Module
 MMC/SD card
 Application selection
 "Limit and status" not possible
 Pressure transmitter type not supported
 Error current and LZ overlaps
 Option emergency air not possible

Errors

EEPROM
 I/O range error
 I²C module
 Firmware CRC
 AI NAMUR
 Power supply 5V
 Power supply 12V
 Power supply(24V) <21V
 Power supply(24V) >30V
 Transducer temperature too high - emergency air activated
 Key module not available
 Key module too old
 Failure from device on DI3
 Failure from device on DI4
 Loss of purge air

Warnings

Factory settings
 No sensor found
 Testmode enabled
 Interfacemodule Inactive
 RTC
 I²C module
 Power supply(24V) <22V
 Power supply(24V) >29V
 Flash memory
 Warning from device on DI3
 Warning from device on DI4

Malfunctions listed below can probably be cleared onsite.

Warning messages

Message	Description	Possible cause	Action
No sensor found	Measuring sensor and/or system control has not been recognized	<ul style="list-style-type: none"> • Communication problems on RS485 line • Supply voltage problems 	<ul style="list-style-type: none"> ▶ Check system settings. ▶ Check connection cable. ▶ Check voltage supply. ▶ Contact Endress+Hauser Service.
Testmode enabled	MCU in "Test" mode.		<ul style="list-style-type: none"> ▶ Deactivate "System Test" mode ("Maintenance" directory)
Interface module inactive	Interface module not configured		<ul style="list-style-type: none"> ▶ Configure the interface module (see "Setting the Ethernet module parameters", page 78).

Malfunction messages

Message	Description	Possible cause	Action
I/O range exceeded/underflow	The analog output/input current range is outside the specified range.	<ul style="list-style-type: none"> • Measured value above set range • Configuration error • Load does not match specification 	<ul style="list-style-type: none"> ▶ Check input/output range values with multimeter. ▶ Contact Endress+Hauser Service.

Configuration error

Message	Description	Possible cause	Action
AO configuration	Number of available and configured analog outputs not identical.	<ul style="list-style-type: none"> • AO not configured • Connection error • Module failure 	<ul style="list-style-type: none"> ▶ Check configuration (see "Setting the analog output parameters", page 58). ▶ Contact Endress+Hauser Service.
AI configuration	Number of available and configured analog inputs not identical.	<ul style="list-style-type: none"> • AI not configured • Connection error • Module failure 	<ul style="list-style-type: none"> ▶ Check configuration (see "Setting the analog input parameters", page 60). ▶ Contact Endress+Hauser Service.
DO configuration	Not relevant for FWE200DH		
DI configuration			
Sensor configuration	Number of available sensors does not match the number of sensors connected.	<ul style="list-style-type: none"> • Sensor failure • Communication problems on RS485 line 	<ul style="list-style-type: none"> ▶ Check measuring sensor/system control. ▶ Check connection cable. ▶ Contact Endress+Hauser Service.
Interface Module	No communication via Interface module	<ul style="list-style-type: none"> • Module not configured • Connection error • Module failure 	<ul style="list-style-type: none"> ▶ Check configuration (see "Setting the Ethernet module parameters", page 78). ▶ Contact Endress+Hauser Service.

7 Specifications

7.1 Technical Data

Measuring Parameters	
Measured variable	Scattered light intensity Dust concentration output in mg/m ³ after gravimetric comparison measurement
Measuring range (freely adjustable)	Smallest range: 0 ... 5 mg/m ³ Largest range: 200 mg/m ³ higher on request, in-between freely configurable
Measuring precision	±2% of upper measuring range value
Reaction time	0.1 ... 600 s; Freely selectable
Application Data	
Gas temperature in the duct	Max. 120 °C for PVDF probes Max. 220 °C for Hastelloy probes (higher on request)
Gas temperature in the measuring cell	Adjustable (max. 160°C)
Internal duct pressure	± 20 hPa
Gas wetness	Max. 10 g water per m ³ (weight share 1%) as fluid share without water vapor (higher on request)
Gas velocity	5 ... 30 m/s (others on request)
Ambient temperature	-20 ... +50°C -20 ... +45°C Otherwise enclosure is required Intake temperature for purge air Extended ranges on request
Function Check	
Automatic self-test	Linearity, drift, aging, contamination Contamination limit values: From 30% for warning; from 40% for malfunction
Manual linearity check	Using a reference filter (test equipment for linearity test)
Displays	
LC-Display on control cabinet	Displays measured values and system states
Output Signals	
Analog outputs	3 outputs 0/2/4 ... 22 mA, max. load 750 Ω; electrically isolated;
Relay outputs	5 potential-free outputs (changeover contacts) for status signals; contact load 48 V, 1 A; Others on request
Input signals	
Analog inputs	6 inputs 0 ... 20 mA (standard, without electrical isolation); precision ± 0.1 mA
Digital inputs	8 inputs for connecting potential-free contacts (see “Connecting cables for digital, analog and status signals” , page 39)
Communication Interfaces	
USB 1.1	For measured value inquiries and software updates per PC/laptop using the operating program
RS485	For connecting the remote unit option
Interface module	For communication with higher-level control systems, Modbus TCP as standard Alternately Profibus DP, Ethernet
Power Supply	
Voltage supply	115 / 230 V AC, 50 / 60Hz
Power consumption	Typ. 0.8 ... 1 kW, max. 1.7 kW (standard version without optional heated extraction hose)
Dimensions (W x H x D), Weight	
Measuring and control unit	approx. 820 x 730 x 300 mm; approx. 65 kg
Sample gas probe	Length 730 mm (NL 600 mm); 1330 mm (NL 1200 mm); max. 15 kg
Blower unit	550 mm x 550 mm x 258 mm; with weatherproof cover 605 mm x 550 mm x 350 mm; approx. 16 kg

Miscellaneous	
Protection class	IP 54 (electronic housing IP 65)
Laser	Laser class 1 in operating state, laser class 2 in open state; power < 1 mW; White light, wavelength between 640 nm and 660 nm
Blower feed amount	approx. 15 ... 20 m ³ /h (standard state)

Compliances

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

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

Applied EN standards:

- EN 61010-1, Safety requirements for electrical equipment for measurement, control and laboratory use
- EN 61326, Electrical equipment for measurement technology, control technology and laboratory use - EMC requirements
- EN 14181, Emissions from stationary sources

Electrical protection

- Insulation: Protection class 1 according to EN 61010-1.
- Insulation coordination: Measuring category II in accordance with EN61010-1.
- Contamination: The device operates safely in an environment up to contamination level 2 according to EN 61010-1 (usual, non-conductive contamination and temporary conductivity by occasional moisture condensation).
- Electrical power: The wiring system to the power source of the system must be installed and fused according to the relevant regulations.

Approvals

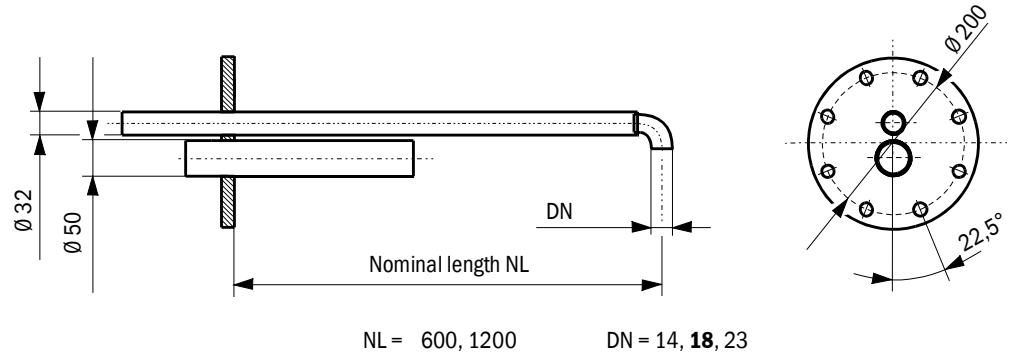
The measuring system is performance-tested according to EN 15267.

7.2 Dimensions, Part Nos.

All dimensions in mm.

7.2.1 Sample gas probe

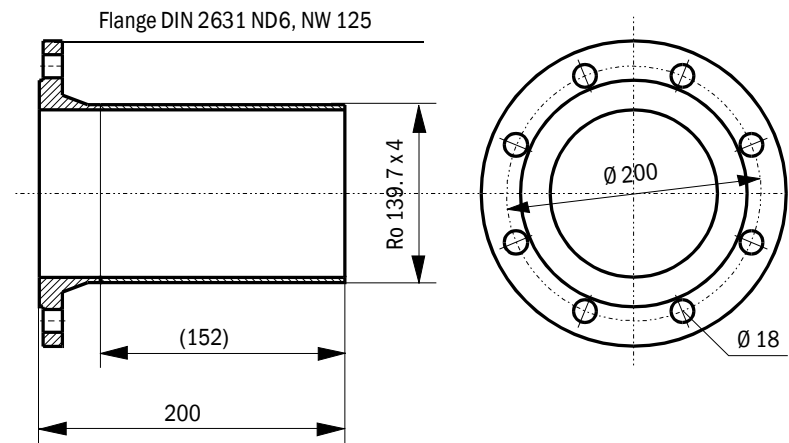
Fig. 78: Sample gas probe



Designation	Part No
Sample gas probe NL 600 PVDF	2074811
Sample gas probe NL1200 PVDF	2075029
Sample gas probe NL 600 Hastelloy	2075038
Sample gas probe NL1200 Hastelloy	2075039

7.2.2 Flange with tube

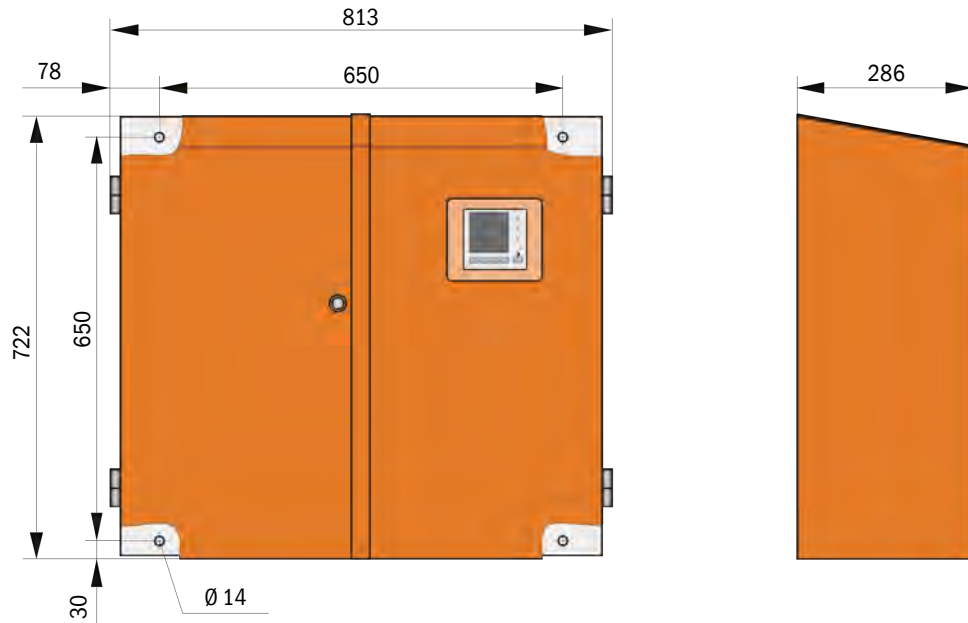
Fig. 79: Flange with tube



Designation	Material	Part No
Flange with tube D139ST200	St37	7047616
Flange with tube D139SS200	1.4571	7047641

7.2.3 Measuring and control unit

Fig. 80: Measuring and control unit



Designation	Part No
Measuring and control unit FWE200DH-NNJ	1066190
Measuring and control unit FWE200DH-NNE	1068441
Measuring and control unit FWE200DH-NNP	1069950
Measuring and control unit FWE200DH-BNJ	1068461
Measuring and control unit FWE200DH-BNE	1069591
Measuring and control unit FWE200DH-BNP	1069592
Measuring and control unit FWE200DH-NHJ	1069593
Measuring and control unit FWE200DH-NHE	1069594
Measuring and control unit FWE200DH-NHP	1069595
Measuring and control unit FWE200DH-BHJ	1069596
Measuring and control unit FWE200DH-BHE	1069597
Measuring and control unit FWE200DH-BHP	1069598

Type code: [see "Type code", page 21](#)

7.2.4 Blower unit

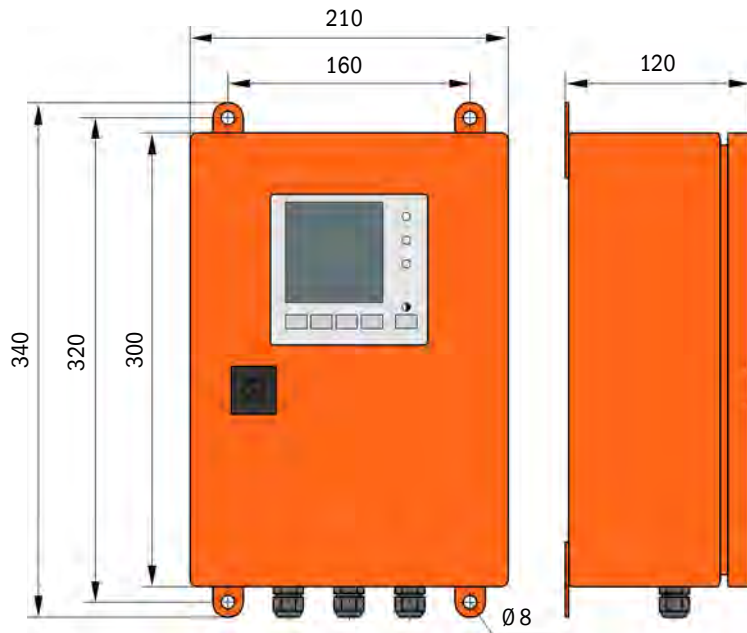
Blower unit

Designation	Part No
Blower unit with blower 2BH1100, filter, purge air hose length 10 m	1067951

7.3 Options

7.3.1 Remote unit

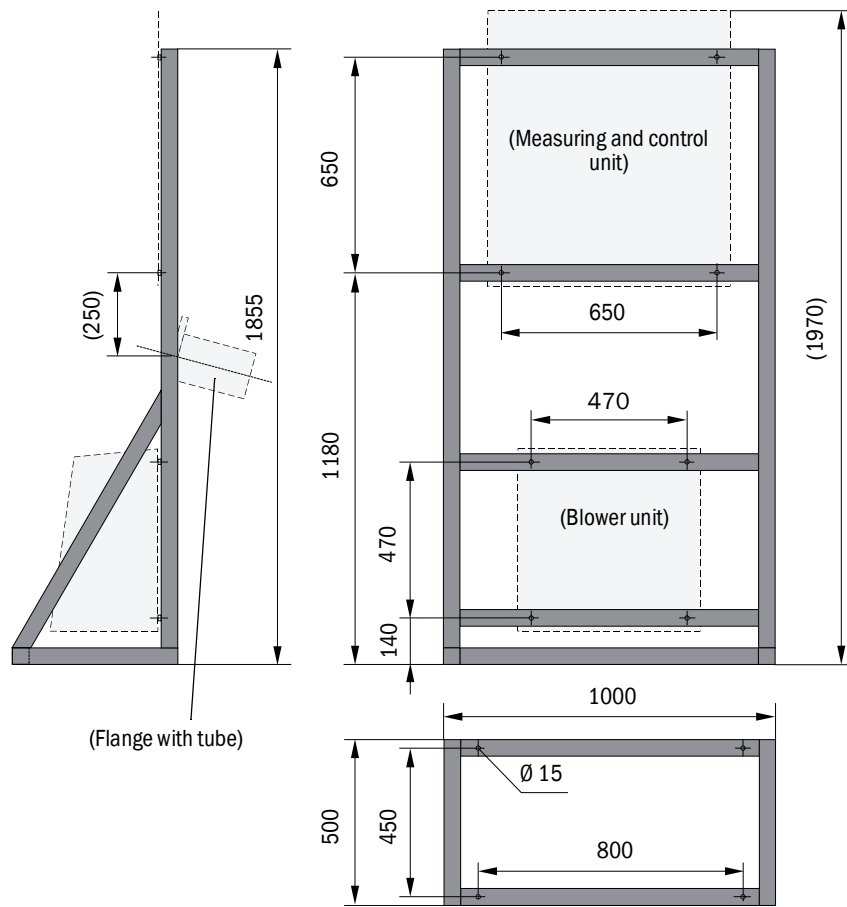
Fig. 81: Remote unit



Designation	Part No
Remote unit	2075567
Remote unit with integrated wide-range power pack	2075568

7.3.2 Frame

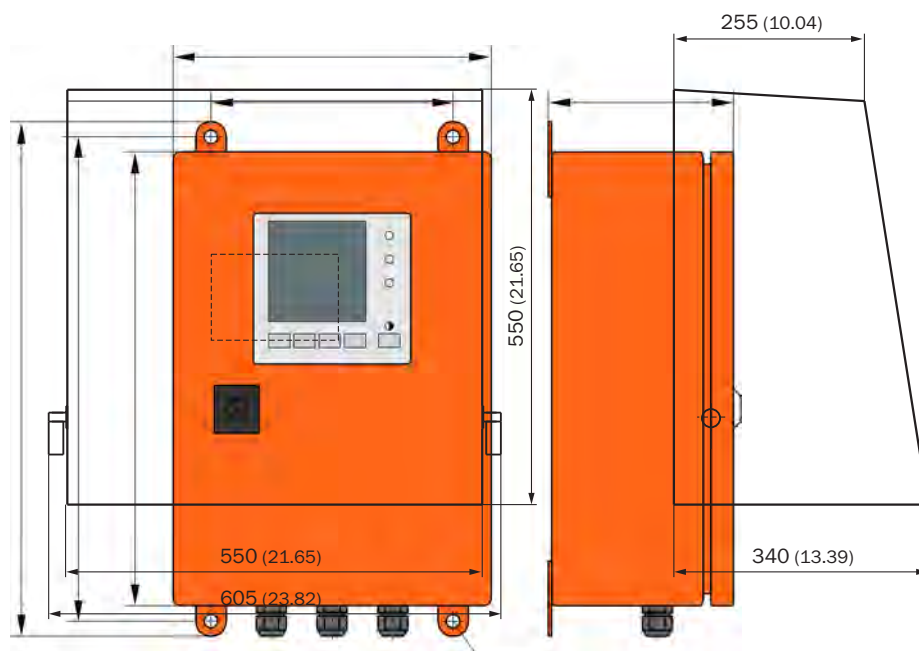
Fig. 82: Frame



Designation	Part No
Frame	7047617

7.3.3 Weatherproof cover for blower unit

Fig. 83: Weatherproof cover for blower unit



Designation	Part No
Weatherproof cover for purge air unit	5306108

7.3.4 Measuring system

Designation	Part No
Backpurge unit option	2073682
Cover at the bottom	2074595
Option, heated extraction hose, length 4 m (3 m heated)	2075575

7.3.5 Interface module

Designation	Part No
Interface module, Profibus module DP V0	2040961
Interface module, Ethernet type 1	2040965

7.3.6 Device check accessories

Designation	Part No
Test equipment for linearity test FWE200DH	2072204

7.4 Consumable parts for 2-years operation**7.4.1 Measuring sensor**

Designation	Number	Part No
Optics cloth	4	4003353

7.4.2 Blower unit

Designation	Number	Part No
Filter element, Europiclon 3000 l/min	4	5306090

8 Annex

8.1 Standard settings FWE200DH

The protocols for parameter settings when delivered (factory settings, [see “Factory settings”, page 53](#)) are part of the system documentation delivered with the measuring system and are therefore not described separately in these Operating Instructions.

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