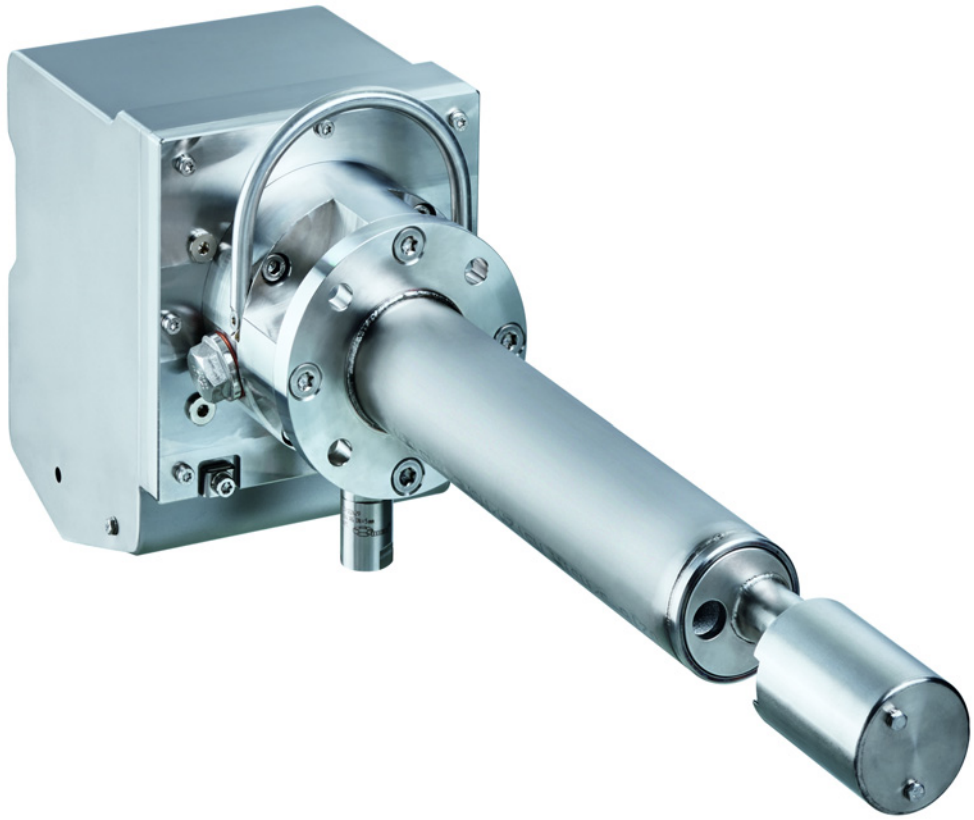
Operating Instructions
DUSTHUNTER SP100 Ex-3K

Scattered Light Dust Measuring Device



Endress+Hauser
People for Process Automation

Described product

DUSTHUNTER SP100 Ex-3K

Version for potentially explosive atmospheres:
Zone 2 (gas / device category 3G) and Zone 22 (dust / device 3D)

Manufacturer

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

Legal information

Original document

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

Contents

1 About this document

1.1 Function of this document

These Operating Instructions describe:

- Device components
- Installation
- Operation
- Maintenance tasks necessary for safe operation

1.2 Scope of application

These Operating Instructions apply exclusively to the measuring system described in the product identification (see “Product identification”, page 20).

The Operating Instructions are not applicable for other Endress+Hauser measuring devices.

The standards mentioned in the Operating Instructions must be observed in their currently valid version.

1.3 Target groups

This Manual is intended for persons who install, operate and maintain the device.

Operation

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

Installation and maintenance

Installation and maintenance may only be carried out by trained specialists familiar with the installation conditions.

Observe the information at the beginning of the respective Sections.

1.4 Further information

Observe the enclosed data medium for the product, as well as other supplied documents.

1.5 Symbols and document conventions

1.5.1 Warning symbols

Table 1: Warning symbols

Symbol	Significance
	Hazard (general)
	Hazard by voltage
	Hazard by laser radiation
	Hazard in potentially explosive atmospheres
	Hazard for environment and organisms

1.5.2 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 less severe or minor injuries.

NOTICE

Hazard which *could* result in property damage.

Note

Hints.

1.5.3 Information symbols

Table 2: Information symbols

Symbol	Significance
	Important technical information for this product
	Important information on electric or electronic functions
	Information on product condition with regard to protection against explosions (general)
	Information on product condition with regard to Explosion Protection Directive ATEX 2014/34/EU
	Additional information and explanations

1.6 Data integrity

Endress+Hauser uses standardized data interfaces, such as standard IP technology, in its products. The focus here is on product availability and features.

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

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

2 For your safety

2.1 Basic safety information

Work on the device

NOTICE:

Risk for system safety through work on the device not described in these Operating Instructions

Work on the device not described in the Operating Instructions or associated documents can lead to unsafe operation of the measuring system and thus endanger equipment safety.

- Only carry out the work described in these Operating Instructions and the corresponding documents on the device.

WARNING:

Injury risk through incorrect lifting and carrying of device components

Due to the weight of individual device components, carelessness and mishandling during transport can lead to injuries.

- Consider the device component's weight before lifting.
- Observe the regulations for protective clothing (e.g., safety shoes, non-slip gloves).
- To carry the device components safely, use handles or reach under the component.
- Do not use protruding parts on device components for carrying.
- Call in further persons as assistants as required.
- Use a hoist or transport equipment as an option.
- Pay attention to the transport safety.
- Clear obstacles that could cause falls and collisions out of the way.

Hazards through hot or aggressive gases and high pressure

The DUSTHUNTER SP100 Ex-3K sender/receiver unit is fitted directly on the gas-carrying duct. On systems with a low hazard potential, installation or removal can be carried out during system operation when the applicable regulations and safety provisions of the system are observed, and necessary and appropriate protective measures are taken.

WARNING:

Health hazard due to sample gas and sample gas residues

When working on the sender/receiver unit, leaking gas paths can cause sample gas dangerous to health to escape from the duct and contaminate the enclosure.

- In systems with gases detrimental to health, high pressure, high operating temperatures or risk of explosions, the sender/receiver unit fitted on the duct may only be installed or removed when the system is at a standstill.
- When removing the sender/receiver unit from the duct, the sample gas supply must be interrupted and the opening in the duct closed with a blind flange. The purge gas supply remains.
- Before opening the gas paths: Take suitable safety measures (e.g., stop sample gas feed, purge gas paths with inert gas, protective clothing).
- Skin or eye contact with contaminated parts:
  - Observe the instructions of the respective Safety Data Sheet.
  - Consult a doctor.
- Remove sample gas residues: Purge all parts carrying sample gas with inert gas for a sufficiently long time.
- Remove solid and liquid residues.

WARNING:

Risk of burns due to hot sample gases and components

Risk of skin burns through contact with hot sample gases and hot components

- In systems with high temperatures, work on the duct or hot assemblies should only be carried out when the system is shut down.
- Keep fitted valves and seals closed until cooled down.
- Allow enclosure parts or surfaces involved to cool down before touching.

When work is necessary on hot assemblies:

- Before opening gas paths or touching surfaces: Take suitable protective measures (e.g. personal protective equipment).
- Use heat-resistant tools.
- Keep disassembled hot components away from electrical components and cables. Allow to cool down at a protected place.

WARNING:

Hazard through escaping gas or bursting components due to overpressure in the system

High process pressure can damage components and lead to personal injury through bursting components or escaping gas.

- Only use components designed for the process pressure in the application (see “Technical data”, page 117).
- Only carry out installation and maintenance of the device when the system is switched off.

NOTICE:

Danger to operational safety at high temperatures

The device can be damaged by high temperatures. The operator must take suitable measures to ensure the enclosure temperature does not exceed 70 °C.

- Avoid direct sunlight. If necessary, take measures to protect against the weather.
- If necessary, insulate hot surfaces at the installation location to prevent temperature penetration.

NOTICE:

Danger to operational safety in the event of visible damage

Operating the measuring system with visible damage can further damage the measuring system or make it a source of danger.

- Check the components of the measuring system for external damage after each transport.
- If there is visible damage, do not put the measuring system into operation but send it in for repair (see “Return delivery”, page 116).

Hazards through electrical equipment

WARNING:
Hazard through electric shock
There is a risk of electric shock when working on system components with the power supply switched on.
- ▶ Before starting work on the measuring device, ensure the power supply can be switched off using a power isolating switch or circuit breaker in accordance with the applicable standard.
- ▶ Make sure the power isolating switch is easily accessible.
- ▶ An additional disconnecting device is mandatory when the power isolating switch is difficult to access or cannot be accessed when connecting the equipment after installation.
- ▶ Switch off the power supply before carrying out any work on the measuring device.
- ▶ After completion of the work or for calibration, the power supply may only be activated again by authorized personnel complying with the applicable safety regulations.

Hazards through laser beam

WARNING:
Hazard by laser radiation
Laser class 2 device.
- ▶ Never look directly into the beam path.
- ▶ Do not point the laser beam at persons.
- ▶ Avoid laser beam reflections.
- ▶ Observe the valid national regulations for laser protection.

Hazards through explosive or combustible gases and dust

WARNING:
Risk of explosion from escaping gas
There is a risk of explosion due to escaping gases when the sender/receiver unit is pulled out of the duct or the maximum process pressure is exceeded.
- ▶ Only fit or remove device components when the system is shut down.
- ▶ Observe the maximum permissible process pressure (see “Technical data”, page 117), safe operation of the measuring system is not possible when this value is exceeded.

CAUTION:
Risk of explosion through incorrect or missing potential equalization.
Incorrectly connected potential bonding can generate charges which represent a possible source of ignition in a potentially explosive atmosphere.
- ▶ Connect potential equalization to all planned points.
- ▶ Ensure the potential equalization is connected during all work on the device described in the Operating Instructions.

DANGER:
Risk of explosion when opening the MCUDH Ex-3K control unit
The MCUDH Ex-3K control unit must not be opened in an Ex-atmosphere until 3 minutes after switching off the power supply, so that the residual energy in the capacitors can dissipate.
- ▶ First open the MCUDH Ex-3K control unit in an Ex-atmosphere after the waiting period.
- ▶ Take suitable precautions and measures to prevent dust from entering the control unit enclosure when the enclosure door is open.

DANGER:
Risk of explosion when opening the sender/receiver unit enclosure
Opening the DUSTHUNTER SP100 Ex-3K sender/receiver unit housing cancels the explosion protection, the device can then be an ignition source.
- ▶ The DUSTHUNTER SP100 Ex-3K sender/receiver unit enclosure may only be opened by Endress+Hauser Service.
- ▶ If the DUSTHUNTER SP100 Ex-3K sender/receiver unit enclosure has been opened, take the device out of operation immediately and contact Endress+Hauser Service.

Also observe the notes on operation in potentially explosive atmospheres (see “Operation in potentially explosive atmosphere”, page 34).

2.2 Warning information on the device

2.2.1 Information on the sender/receiver unit

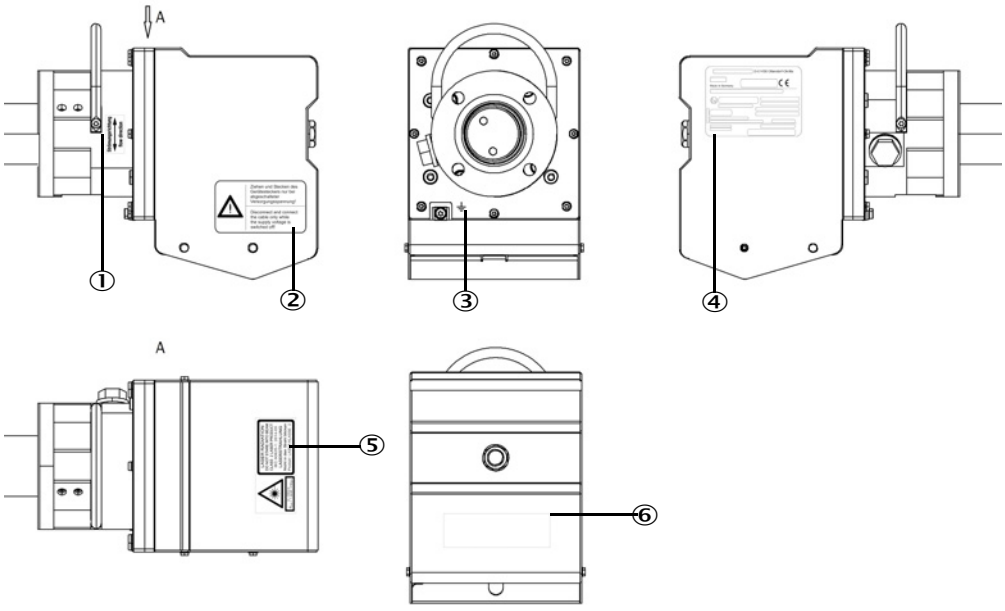


Fig. 1: Information on the DUSTHUNTER SP100 Ex-3K sender/receiver unit

Table 3: Significance of the information on the DUSTHUNTER SP100 Ex-3K sender/receiver unit

No.	Note
1	Information on aligning the device according to the flow direction in the duct (see “Adapting the sender/receiver unit to the duct geometry”, page 65)
2	Warning: Only unplug and plug the connector plug when the supply voltage is switched off
3	Information on the connection point of the potential equalization
4	Type plate for clear identification of the device
5	Warning: Laser class 2, do not look into the beam
6	Manufacturer logo

2.2.2 Information on the MCUDH Ex-3K control unit

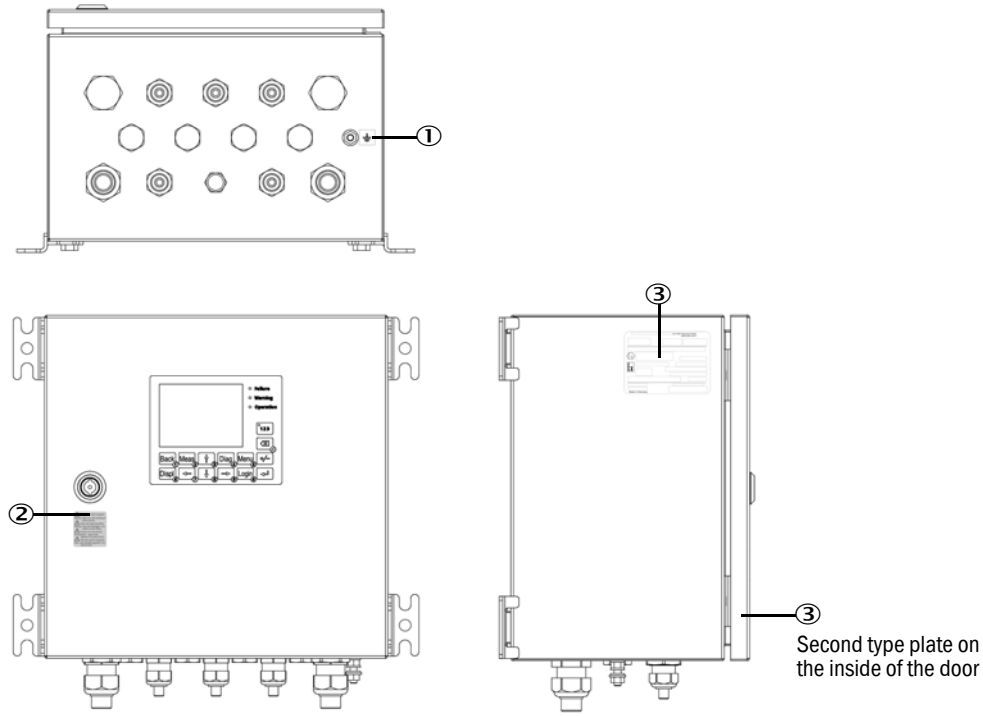


Fig. 2: Information on the MCUDH Ex-3K control unit - external

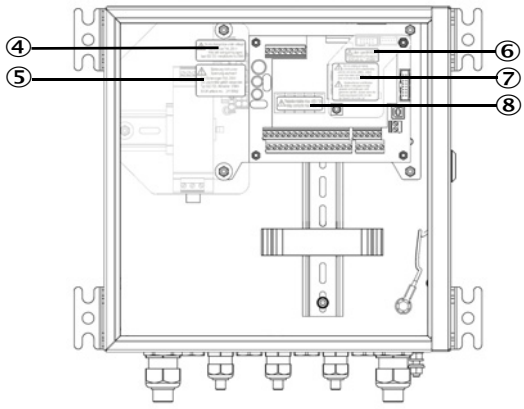


Fig. 3: Information on the MCUDH Ex-3K control unit - internal

Table 4: Significance of the information on the MCUDH Ex-3K control unit

No.	Note
1	Information on the connection point of the potential equalization
2	Warning: Do not open the door of the MCUDH Ex-3K control unit until 3 minutes after switching off the power supply
3	Type plates for clear identification of the device
4	Information on the specifications of the fuses
5	Warning: Do not remove or replace the fuse while the power is on
6	Specifications regarding the button cell used
7	Warning: Do not disconnect or change connectors and modules while these are live
8	Information on the specifications of the relay contacts

2.3 Intended use

Purpose of the system

The measuring system (see “Product description”, page 20) is designed as intended for use in industrial technical systems for continuous measurement of the dust load in gas flows. The device is used for both emission and process measurement and is intended for use in potentially explosive gas or dust atmospheres.

Correct use

- The device should only be used 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, inspection, transport and storage.
- No components may be removed, added or changed on and in the device unless described and specified in the official manufacturer information. Otherwise
  - the device could become dangerous
  - any warranty by the manufacturer becomes void.

Sender/receiver unit restrictions of use

The sender/receiver unit complies with ATEX category 3G and 3D (Zone 2 and 22) and is only to be used in corresponding areas (see “Application illustration DUSTHUNTER SP100 Ex-3K”, page 35).

The device identification is as follows:

DHSP-TxxxxEX3K

Ex II 3G Ex nR op is IIC T6 Gc

Ex II 3D Ex tc op is IIIC T85 °C Dc

Control unit restrictions of use

The MCUDH control unit complies with ATEX category 3G and 3D and is only to be used in corresponding areas (see “Application illustration DUSTHUNTER SP100 Ex-3K”, page 35).

The device identification of the version with power supply unit is as follows:

MCUDH-NSxx

Ex II 3G Ex ec nA nC IIC T4 Gc

Ex II 3D Ex tc IIIC T85 °C Dc

The device identification of the version without power supply unit is as follows:

MCUDH-N2xx

Ex II 3G Ex ec IIC T4 Gc

Ex II 3D Ex tc IIIC T85 °C Dc

NOTE:

Observe explosion protection regulations:

- Installation, transport, commissioning, maintenance and testing may only be carried out by experienced personnel who have knowledge of the rules and regulations for potentially explosive areas. In particular, this applies to:
  - Ignition protection types and applicable standards
  - Installation regulations and zone classification

2.4 Responsibility of user

Avoiding damage

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

- The maintenance personnel responsible can reach the site immediately, and at any time.
- 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.

Procedure for unsafe operating conditions

If the device is or could be in an unsafe state:

- Disconnect the device from the power voltage and signal voltage.
- Put the device out of operation.
- Secure the device against unallowed or unintentional start-up.

For further information, see “Recognizing the safe operating state”, page 66.

Protection devices

According to the respective hazard potential:

- Suitable protective devices must be available.
- Personal safety equipment must be available in sufficient quantities.
- Personal safety equipment must used by the personnel.

Purge gas

The purge gas supply serves to protect device-internal optical surfaces and internal parts against hot or aggressive gases. If explosion protection permits, the purge gas supply should remain switched on when the plant is shut down. If the purge gas supply fails, the optical assemblies can be severely damaged in a short time (see “Purge gas supply”, page 30). There is a possible risk of flammable gases escaping, posing an explosion hazard.

The user must ensure that:

- The purge gas supply operates safely and without interruption, as far as explosion protection permits.
- A correct connection between the lines and connections is ensured and regularly checked.
- Suitable material (preferably metal) is used for the purge gas line and plug connections are avoided wherever possible.
- Failure of the purge gas supply is immediately detected (e.g., by using pressure monitors).
- If the purge gas supply fails, the sender/receiver unit is removed from the duct and the duct opening is covered taking explosion protection into account (e.g. with a blind flange, see “Fastening technology”, page 129).

Preventive measures for operating safety

The user must ensure that:

- A failure of the measuring system does not cause incorrect measurements and damage and does not lead to unsafe operating conditions.
- The specified maintenance and inspection tasks are carried out regularly by qualified, experienced personnel.

Correct project planning

- Basis of this Manual is the delivery of the device according to the preceding project planning and the relevant delivery state of the device (see delivered System Documentation).
  ▶ Contact Endress+Hauser Service if you are not sure whether the device corresponds to the state defined during project planning or to the delivered system documentation.

Special local conditions

In addition to the information in these Operating Instructions, follow all local laws, technical rules and company-internal operating directives applicable wherever the device is installed.

Read the Operating Instructions

▶ Read and observe these Operating Instructions.
▶ Observe all safety information.
▶ If there is something you do not understand: Contact Endress+Hauser Service.

Retention of documents

These Operating Instructions must be:

▶ Available for reference.
▶ Passed on to new owners.

3 Product description

3.1 Product identification

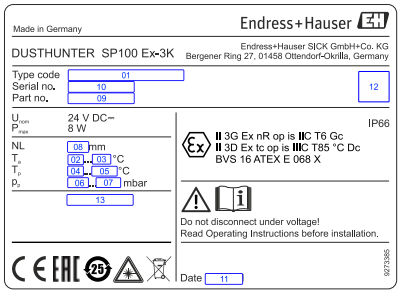
The measuring system comprises the components sender/receiver unit and control unit. The characteristics of the sender/receiver unit determine the practical applicability, therefore the designation of the sender/receiver unit is the same as that of the measuring system.

Table 5: Product identification

Measuring system	**DUSTHUNTER SP100 Ex-3K**
Manufacturer	Endress+Hauser SICK GmbH+Co. KG Bergener Ring 27 · D-01458 Ottendorf-Okrilla · Germany
Components: Sender/receiver unit	**DUSTHUNTER SP100 Ex-3K**
Device version	Version for potentially explosive atmospheres, zones 2/22
Type plate	Sender/receiver unit: On right side
Components: Control unit	**MCUDH Ex-3K**
Device version	Version for potentially explosive atmospheres, zones 2/22
Type plates	Control unit: on the left side and inside cover
Components: Control unit	**MCU**
Device version	Conventional version
Type plates	Control unit: on the left side and inside cover

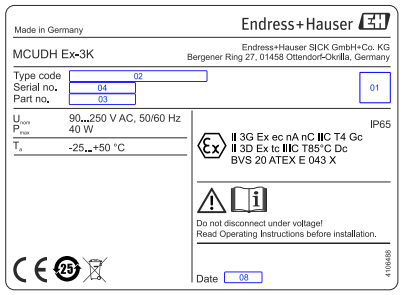
Type plates

The type plate serves correct device identification. If the device is suitable for use in potentially explosive atmospheres, possible areas of application are also listed there based on the explosion protection types.



No.	Variable
01	Type code
02, 03	Ambient temperature
04, 05	Gas temperature.
06, 07	Gas pressure
08	Nominal length
09	Part number
10	Serial number
11	Date of manufacture
12	Data Matrix Code

Fig. 4: Type plate, sender/receiver unit



No.	Variable
01	Data Matrix Code
02	Type code
03	Part No.
04	Serial number
05	Date of manufacture

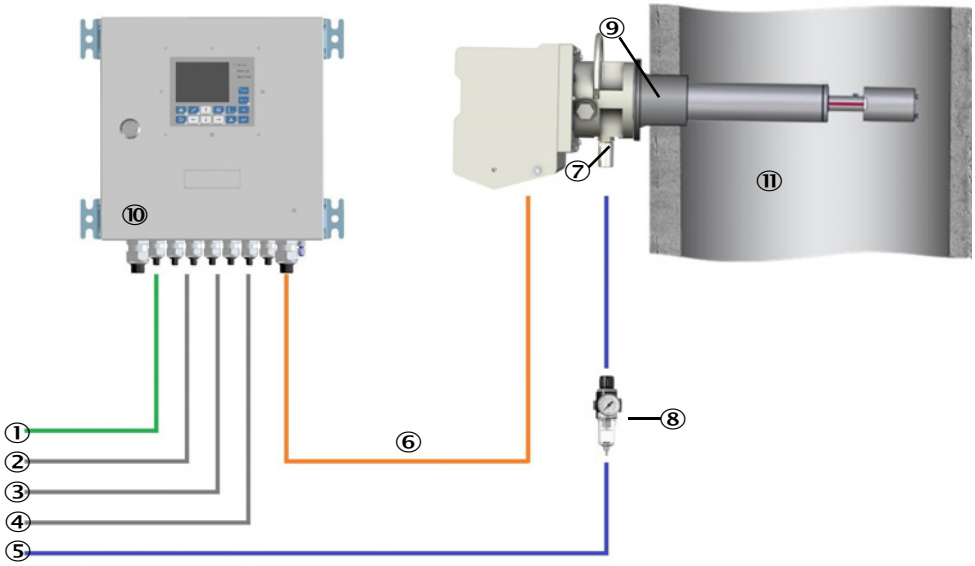
Fig. 5: Type plate, MCUDH control unit (example shows variant with power supply unit)

The MCUDH control unit without power supply unit has other values than those shown here in the example, see the Technical data (see “Technical data”, page 117).

3.2 Product characteristics

- The measuring system serves continuous measurement of dust particle concentrations in exhaust gas and exhaust air plants.
- The sender/receiver unit is an in-situ measuring device which means measuring is done directly in the gas carrying duct.
- The DUSTHUNTER SP100 Ex-3K sender/receiver unit is certified for use in potentially explosive atmospheres in zones 2 and 22.
- The MCUDH Ex-3K control unit is certified for use in potentially explosive atmospheres in zones 2 and 22.
- Measuring principle: Scattered light (forwards)

3.3 Layout and function



① Power supply (on-site)
② Signal cable, RS485 Service interface
③ RS485 signal cable from integrated Interface module (optional)
④ I/O signal cable
⑤ Instrument air (on-site)
⑥ Connecting cable
⑦ Non-return valve G¼ inch (incl. fitted reducer nozzle in connection thread)
⑧ Pressure reducer / flow meter (recommended on site, as necessary a particle filter in front of it)
⑨ Flange with tube
⑩ MCUDH Ex-3K control unit (as example)
⑪ Duct

Fig. 6: DUSTHUNTER SP100 Ex-3K layout with MCUDH Ex-3K control unit

- The selection of individual components is the responsibility of the operator of the measuring system (for further information, see “Selecting the control unit”, page 40).

3.3.1 Functional principle

The measuring system works according to the principle of scattered light measurement (forward scattering). The laser used illuminates a measurement volume, and the scattered light intensity of illuminated particles is detected by the receiver.

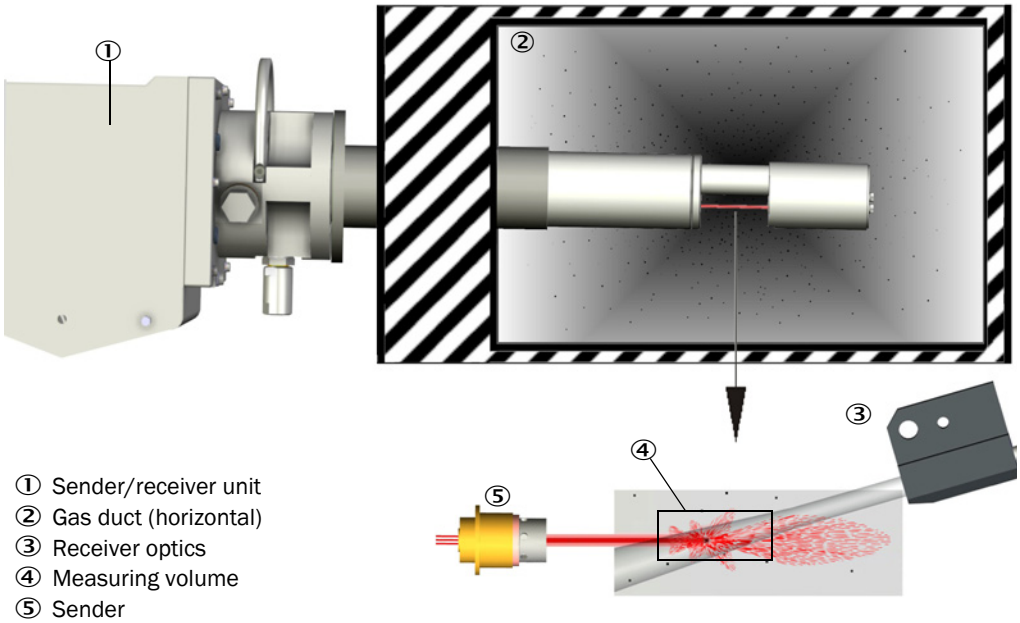
The measurement volume is defined by the overlap of the transmitted beam and the field of view of the receiver optics.

The measured scattered light intensity is proportional to the dust concentration. However, the scattered light intensity depends not only on the number and size of the particles, but also on their optical properties.

Therefore, the sender/receiver unit must be calibrated using a gravimetric comparison measurement for an exact determination of the dust concentration (see “Gravimetric comparison measurement / calibration”, page 77).

To maintain the measuring function, a permanent gas flow (purge gas) keeps the optics free from dust particles as well as condensate.

Determining the dust concentration



① Sender/receiver unit
② Gas duct (horizontal)
③ Receiver optics
④ Measuring volume
⑤ Sender

Fig. 7: Measuring principle

3.3.2 Protection concept

Protection concept for the sender/receiver unit

The mechanical construction of the DUSTHUNTER SP100 Ex-3K is intended for use in potentially explosive atmospheres of category 3G and 3D (Ex-Zones 2/22).

The enclosure is dust-tight and the surface temperature limited. Thus the device corresponds to ignition protection type “t” (protection by enclosure).

In addition, ignition protection type “nR” (restricted breathing) is used. This ignition protection type restricts explosive gases penetrating into the electronics enclosure.

The device uses a laser to perform its measuring task. To avoid ignition of a potentially explosive gas mixture by optical radiation, the Laser module meets the criteria of the type of protection inherently safe optical radiation (op is) according to EN60079-28.

Control unit protection concept

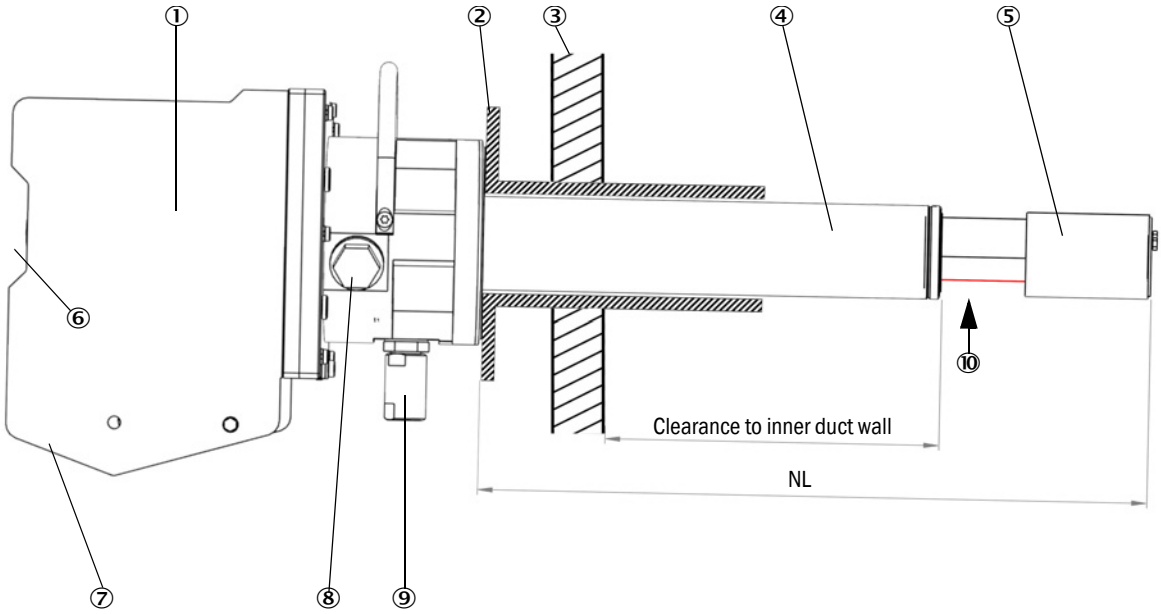
The MCUDH Ex-3K control unit is intended for use in potentially explosive atmospheres of category 3G and 3D (Ex-Zones 2/22).

Ignition protection types “ec” (increased safety) and “t” (protection by enclosure) are used. In addition, ignition protection types “nA” and “nC” are used on the versions with integrated power supply unit.

3.3.3 DUSTHUNTER SP100 Ex-3K sender/receiver unit

The sender/receiver unit comprises two main subassemblies:

- Electronics unit
  The assembly contains the optical and electronic subassemblies for sending the laser beam and receiving the scattered light.
- Measuring probe
  The measuring probe is available in different versions and nominal lengths as well as for various gas temperature ranges and defines the device variant (see “Selecting the sender/receiver unit”, page 38).



①	Electronic housing	⑤	Hood (end piece protective tube)	⑧	Cleaning opening for sender optics
②	Flange with tube		Probe head with receiver optics	⑨	Non-return valve G¼“
③	Duct wall	⑥	Sight glass		(High temperature variant G½“)
④	Protective tube	⑦	Connecting cable connection	⑩	Measuring volume

Fig. 8: DHSP-T2VxxEX-3K sender/receiver unit

NOTE:

Clearance to inner duct wall

The clearance between internal duct wall and sender/receiver unit measuring volume should be at least 100 mm. For the high-temperature version, the clearance should be between minimum 100 mm and maximum 140 mm so that the measuring device does not protrude too far into the duct and only a limited surface is exposed to the hot sample gas.

Sender/receiver unit type code

A type code identifies the special version of the sender/receiver unit:

Sender/receiver unit type code (extract): DHSP-T 2 V 1 X EX3K T6

Maximum permissible gas temperature
- 2: 220 °C (standard version)
- 4: 400 °C (high-temperature version)

Probe / protective tube material (incl. hood)
- V: High-alloy stainless steel
- H: Hastelloy®
- M: Probe Hastelloy® / protective tube high-alloy stainless steel
- K: High-alloy stainless steel, coated with CrC/NiCr (chrome carbide)
- W: High-alloy stainless steel, coated with WC/Co/Cr (tungsten carbide)

Measuring probe nominal length (NL)
- 1: 435 mm
- 2: 735 mm
- X: Special length

Flange version
- 1: Reference circle k100
- X: Special version

Explosion protection approval
- EX3K: Marking of gas and dust zones 2/22

Maximum surface temperature
- T6: 85 °C

3.3.4 MCUDH Ex-3K control unit

The control unit serves as user interface for the DUSTHUNTER SP100 Ex-3K sender/ receiver unit, prepares and outputs the measured values and also performs control and monitoring functions.

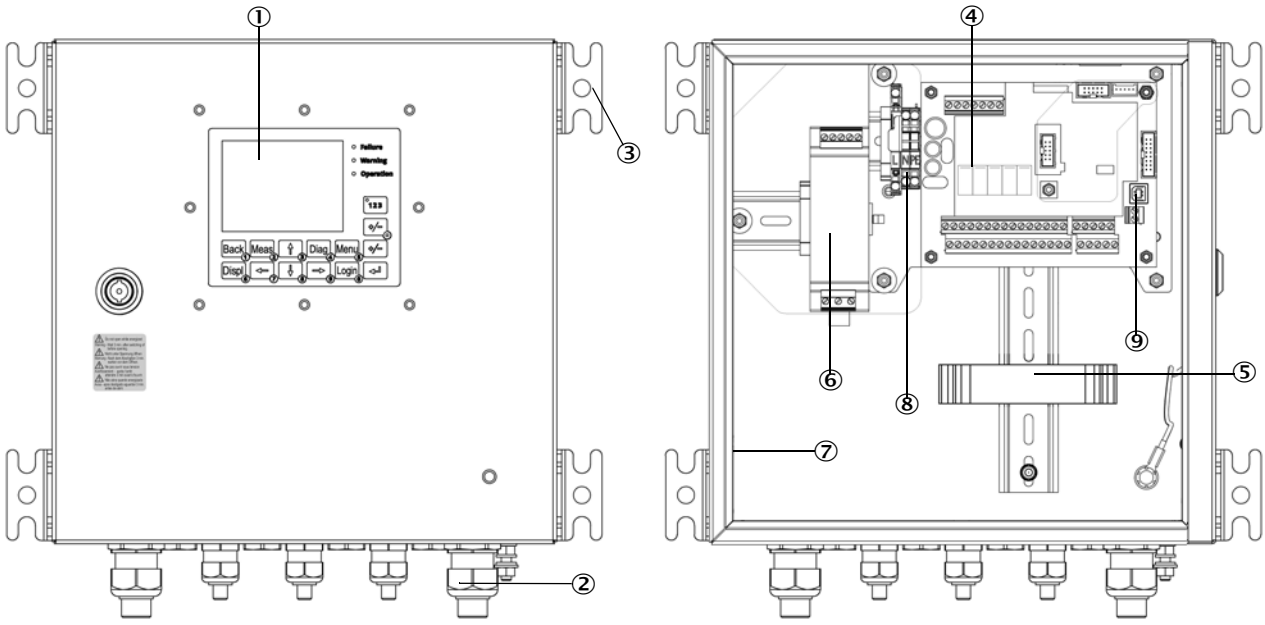
In detail, the control unit takes over the following tasks, for example:

- Sender/receiver unit power supply.
- Output of measured values, computed data and operating states
- Communication with the peripheral equipment
- Output of error messages and other status signals.
- Control of automatic test functions and access during service (diagnosis)

The device parameters can be set via the RS485 Service interface using a computer and an operating program. The parameters are stored reliably even in the case of a power failure.

WARNING:
Explosion hazard when using the USB Service interface in Ex-Zone
Operation of the USB connector can cause an explosion.
- ▶ Using the USB service interface in a potentially explosive atmosphere is prohibited.
- ▶ If required, set up an alternative RS485 Service interface that is routed out of the potentially explosive atmosphere (see “Interfaces”, page 36).

Use the control unit according to the intended area of application (see “Application illustration DUSTHUNTER SP100 Ex-3K”, page 35).



① Display module
② Cable glands (2×M25; 5×M20)
③ Fastening brackets
④ Processor board
⑤ Interface module (option)
⑥ Power supply unit (not for 24 V DC variant)
⑦ Enclosure
⑧ Connection terminal, voltage supply input 24 V DC / 90...250 V AC (various versions)
⑨ USB Service interface (operation prohibited)

Fig. 9: MCUDH Ex-3K control unit (version with power supply unit)

MCUDH Ex-3K type code

A type code identifies the special version of the control unit:

MCUDH Ex-3K control unit type code (extract): MCUDH -N 2 Y D N 0 0 0 0 0 M N 0 E

Integrated purge gas supply
- N: Not present

Voltage supply
- S: 90...250 V EX
- 2 24 V DC

Enclosure variants
- Y: Wall enclosure, middle, 300×300×220, stainless steel

Display module
- D: Present

Other options
- N: Not present

Analog input module (0/4...20 mA; 2 inputs per module)
- 0 Not present

Analog output module (0/4...20 mA; 2 outputs per module)
- 0 Not present

Digital input module (4 inputs per module)
- 0 Not present

Digital output module W (48 V DC 5 A; 2 changeover contacts per module)
- 0 Not present

Digital output module W (48 V DC 0.5 A; 2 changeover contacts per module)
- 0 Not present

Interface module
- N: Not present
- M: RS485 Interface module for transmission from Modbus® ASCII/RTU or CoLa-B

Special features
- N: None
- S: Special solution

Explosion protection certification
- O: ATEX zones 2/22:

Software
- E: Emission

3.3.5 Conventional MCU control unit

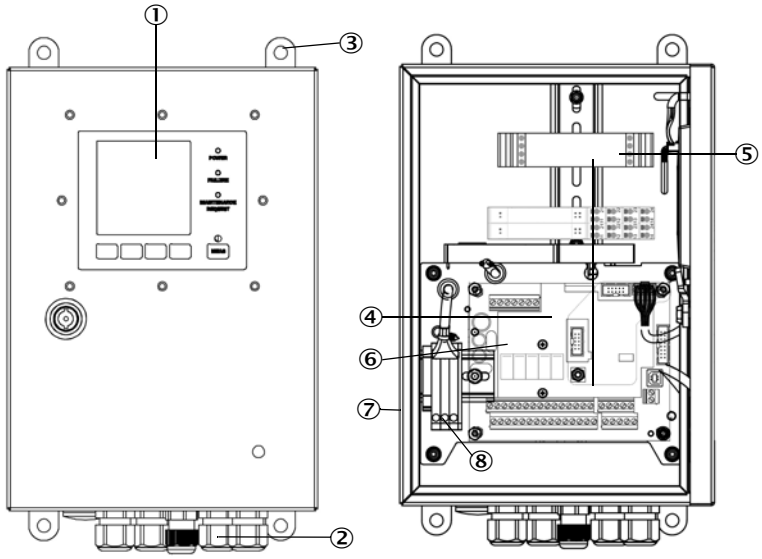
The control unit serves as user interface for the DUSTHUNTER SP100 Ex-3K sender/ receiver unit, prepares and outputs the measured values and also performs control and monitoring functions.

In detail, the control unit takes over the following tasks, for example:

- Sender/receiver unit power supply.
- Output of measured values, computed data and operating states
- Communication with the peripheral equipment
- Output of error messages and other status signals.
- Control of automatic test functions and access during service (diagnosis)

The device parameters can be set via the RS485 Service interface using a computer and an operating program. The parameters are stored reliably even in the case of a power failure.

The control unit is only to be used outside potentially explosive atmospheres (see “Application illustration DUSTHUNTER SP100 Ex-3K”, page 35).



① Display module
② Cable glands (1×M16; 4×M20)
③ Fastening brackets
④ Processor board
⑤ Interface module (option)
⑥ Power supply unit (under the processor board)
⑦ Enclosure
⑧ Connection terminal, voltage supply input

Fig. 10: MCU control unit

MCU type code

A type code identifies the special version of the control unit:

MCU control unit type code (extract): MCU - N W O D N 0 0 0 0 0 N N N E

Purge gas supply
- N: Not present

Voltage supply
- W: 90...250 V AC
- 2 24 V DC

Enclosure variants
- O: Wall enclosure, compact, orange, stainless steel

Display module
- D: Present

Other options
- N: Not present

Analog input module (0/4...20 mA; 2 inputs per module)
- 0 Not present

Analog output module (0/4...20 mA; 2 outputs per module)
- 0 Not present

Digital input module (4 inputs per module)
- 0 Not present

Digital output module W (48 V DC 5 A; 2 changeover contacts per module)
- 0 Not present

Digital output module W (48 V DC 0.5 A; 2 changeover contacts per module)
- 0 Not present

Interface module
- N: Not present
- M: Interface module RS 485 (Modbus® ASCII/RTU)
- J: Interface module Ethernet (Modbus® TCP)
- V: Ethernet Interface module (CoLa-B)

Special features
- N: None
- S: Special solution

Explosion protection certification
- N: None

Software
- E: Emission

3.3.6 Flange with tube

The flange with tube is attached directly to the gas duct of the measuring point and is used to mount the sender/receiver unit.

3.3.7 Purge gas supply

The sender/receiver unit must be purged with purge gas available on-site. Purging protects the optoelectronic components from contamination and excessive gas temperatures. Take into consideration that purge gas consumption is higher in the high-temperature version (see “Purge gas supply”, page 44).

The manufacturer recommends the use of a pressure reducer to adjust and control the purge gas volume because an undersupply or failure of the purge gas supply can lead to equipment damage. The device is supplied with a nozzle to stabilize the amount of purge gas.

WARNING:
Risk of explosion through purge gas failure
Explosive gases may escape in case of purge gas failure.
- The sender/receiver unit must be disconnected immediately from the power supply when a purge gas failure occurs.
- To avoid damage to the device, the sender/receiver unit must be removed from the duct, but only if this does not create a risk of explosion or danger to employees.

NOTICE:
Device damage possible in case of purge gas failure
During operation longer than 15 minutes without purge gas supply, there is a risk that components relevant to ignition protection (seals and adhesives) may lose their sealing function or fatigue strength completely or partially. If the device has been operated without a purge gas supply, the device should be returned to the factory for testing.

Non-return valve

Should the purge gas supply fail, the non-return valve protects the sender/receiver unit against higher temperatures and sample gas for a short time (dependent on the application, at least 15 minutes).

Purge gas hose (antistatic)

The purge gas hose is used to supply purge gas to the sender/receiver unit. On the device side, the purge gas hose is connected to the G¼" non-return valve (high-temperature version G½“).

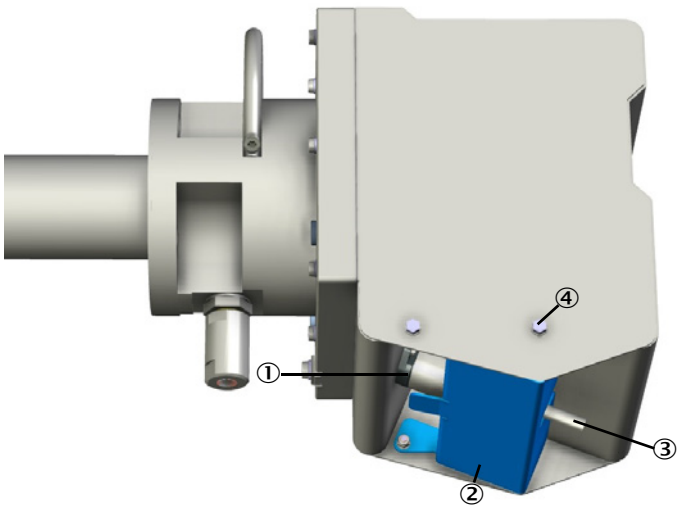
The operator must ensure a suitable and uninterrupted purge gas supply (see “Purge gas supply”, page 44), including a suitable purge gas hose.

Due to the risk of explosion in the event of electrostatic discharge, it is mandatory to provide a purge gas hose made of a material that prevents static charging.

3.3.8 Connecting cable and plug protection bracket

The plug of the connection between control unit and sender/receiver unit must be secured with a plug protection bracket to protect against accidental disconnection of the plug after connection to the DUSTHUNTER SP100 Ex-3K.

For this purpose, swing open the plug protection bracket before connecting, loosen the locking screw beforehand. After connecting the connecting cable, swing back the plug protection bracket and fasten it with the locking screw.



① Connection socket
② Plug protection guard
③ Connecting cable
④ Securing screw

Fig. 11: Connection, connecting cable with plug protection guard

3.3.9 Weather protection hood

When mounting the sender/receiver unit outdoors, a weather protection hood is strongly recommended to protect against the weather (see “Weather protection hood”, page 129). The available weather protection hood is suitable for use in potentially explosive atmospheres.

Fig. 12: Weather protection hood for potentially explosive atmospheres

DANGER:
Risk of explosion through incorrect or missing potential equalization for the weather protection hood
Incorrectly connected potential bonding can generate charges which represent a possible source of ignition in a potentially explosive atmosphere.
- ▶ Connect the weather protection hood at both points provided (bolts for fastening inside on base plate and hood).

3.3.10 Function check

A function check can be triggered at fixed intervals to automatically check the function (check cycle) of the measuring system. The start time for the automatic function check begins when the device is switched on.

Any unallowed deviations from normal behavior that may occur during the function check are signaled as errors. A function check triggered manually can help localize possible error causes should a device malfunction occur (see “Setting the function check”, page 73).

① : Determination of control values (contamination, span, zero point)
A swiveling movement moves the scattered light receiver from the measuring position to the control position and back. In this phase, the last current measured value is always recorded. In the control position, the measured values for contamination as well as the values for zero point and 70% value (span) are determined.
Duration: typically approx. 40 s ... 60 s

②: Contamination value output
The contamination value is mapped on the analog output between Live Zero and 20 mA. 0% contamination corresponds to Live Zero. 40% contamination (disturbance limit) corresponds to 20 mA.

③: The 70% control value (span value) is mapped on the analog output between Live Zero and 20 mA.

④: The 0% control value (zero point value) is mapped on the analog output between Live Zero and 20 mA (see “Factory settings”, page 73).

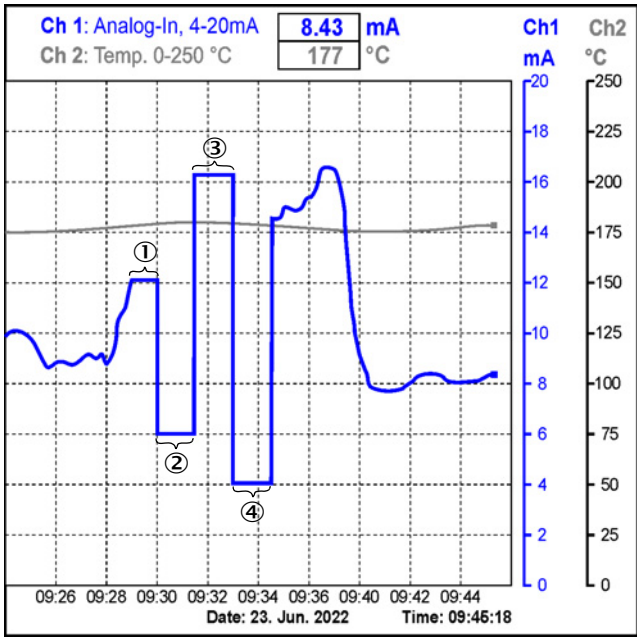


Fig. 13: Output of the function check (example graphic)

- The analog output must be activated to output control values on the analog output (see “Setting the analog outputs parameters”, page 74).
- 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.
- A corresponding message is displayed on the control unit display during the function check.
- A function check is not started automatically when the measuring system is in “Maintenance” mode.
- If the cycle interval is changed, a check cycle 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.

Cycle restriction

The measuring system contains wearing parts which are stressed by device functions and must be replaced after a certain number of traverses in order to permanently guarantee the ignition protection of the system. A warning message is generated after 12,000 function check cycles (see “Setting the function check”, page 73) and an error message after 15,000 cycles. The sender/receiver unit should be sent in for factory inspection before reaching 15,000 cycles for replacement of wear and tear parts.

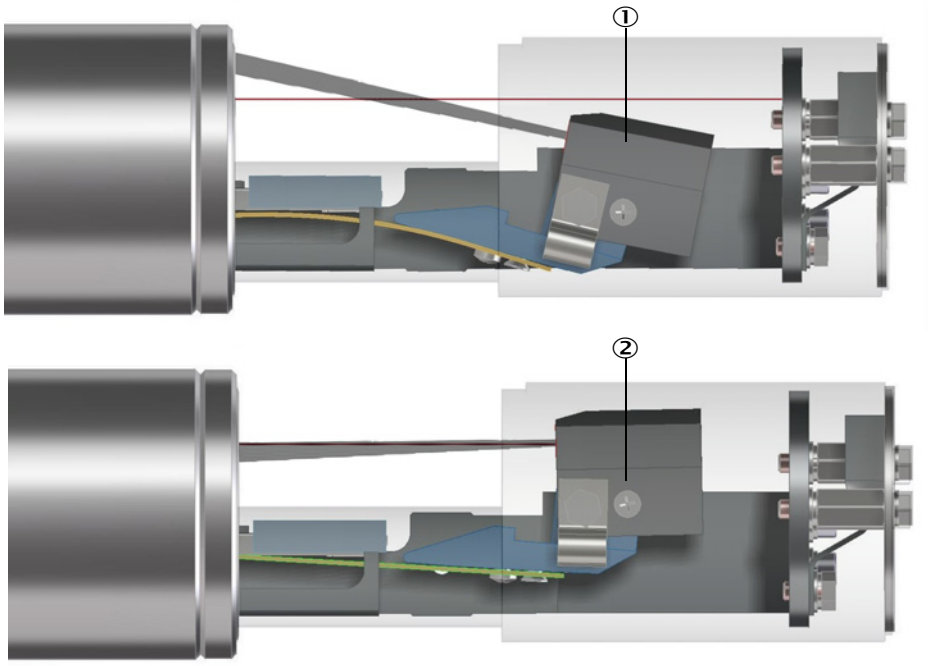
Contamination measurement

The receiving optics are swiveled to a control position for the function check measurements and the transmission is measured (see “Contamination and control value measurement”, page 33). The measured value determined and the reference value (defined as factory setting) are used to calculate a correction factor. This fully compensates any contamination that occurs.

For contamination values < 40%, a value between “Live Zero” and 20 mA proportional to the contamination is output on the analog output and status “Malfunction” and the error current set are output on the analog output (see “Setting the analog outputs parameters”, page 74).

Control value measurement (span test)

Sender beam intensity changes between 70 and 100% during control value determination. The brightness of the light signal in the measuring circuit (“measuring signal”) is compared with the brightness in an independent internal reference channel (“monitor signal”). The measuring system generates an error signal for deviations greater than ±2%. The error message is cleared again when the next functional check runs successfully.



① Receiver optics in measuring position
② Receiver optics in control position (function check)

Fig. 14: Contamination and control value measurement

Zero point 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 message is generated when the “zero point” is outside the specified range.

3.4 Explosion protection in accordance with ATEX

3.4.1 Operation in potentially explosive atmosphere

DUSTHUNTER SP100 Ex-3K sender/receiver unit

The marking of the electrical explosion-proof device is:
ATEX II 3G Ex nR op is IIC T6 Gc / ATEX II 3D Ex tc op is IIIC T85 °C Dc

- The marking is on the type plate
- Type Examination Certificate: BVS 16 ATEX E 068 X
  Letter “X” after the certificate number indicates the following special condition for safe use of the device:
  – The thermal insulation is an explosion protection measure to be subjected to special examination for media temperatures higher than the surface temperature allowed by the selected temperature class. Observe the following during this examination:
    – Parts of the device surface that can be subjected to prohibited high temperatures due to the media temperatures must be included in the insulation or the heat conduction must be prevented.
    – It must be ensured that the surface temperature of the enclosure remains below 70 °C. In nominal operation, the internal heating of the device can be up to 2 K.
  – It must be ensured that the dust measuring device is permanently supplied with purge gas.

MCUDH Ex-3K control unit

The marking of the electrical explosion-proof device depends on the device selection (see “Technical data”, page 117).

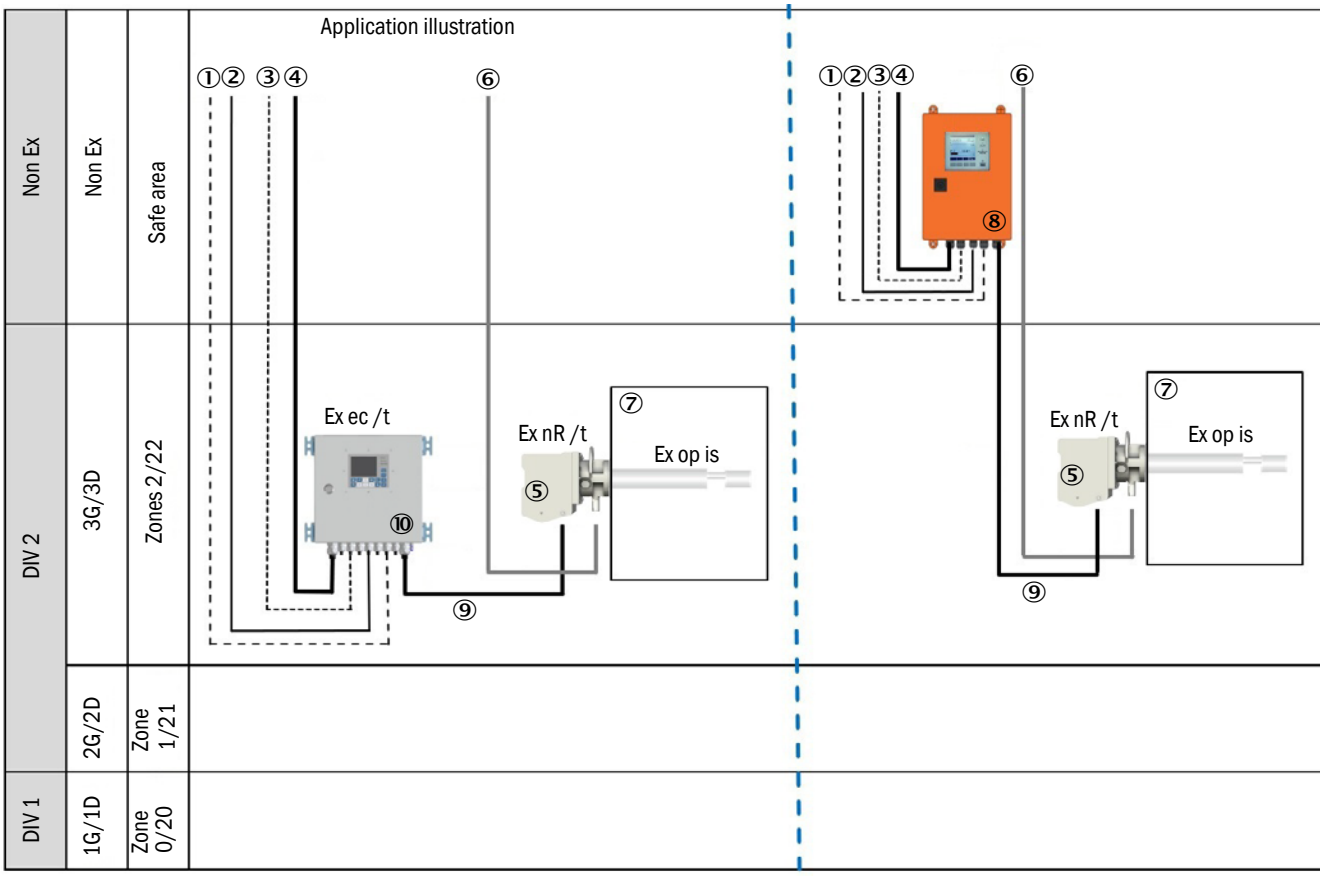
- The marking is on the type plate
- Type Examination Certificate: BVS 20 ATEX E 043 X
  Letter “X” after the certificate number indicates the following special condition for safe use of the device:
  – Only operate the device with a maximum degree of contamination of 2.
  – It must be ensured that the transient protection is set to a value not exceeding 140% of the measured peak voltage on the supply terminals of the device.

DANGER:
Risk of explosion through incorrect operation
Risk of explosion when regulations on explosion protection are not observed during operation.

- ▶ Only use the measuring system in potentially explosive atmospheres according to the device identification (see “Intended use”, page 17).
- ▶ Only use the measuring system within the temperature limits as specified in these Operating Instructions as well as on the type plate.
  The specified values must not be exceeded even for brief periods.
- ▶ The use of the measuring system with hybrid mixtures (mixture of combustible gases or vapors with dust) must be evaluated according to the situation being considered, e.g. regarding concentrations, energy and temperature limits.
- ▶ The measuring system must not be operated with dust deposits thicker than 5 mm on the electronics housing.
- ▶ Dust deposits must be removed regularly and properly.

3.5 Application illustration DUSTHUNTER SP100 Ex-3K

In the Figure, the left columns show the classification of potentially explosive atmospheres according to internationally relevant guidelines. The Figure shows, on the left side, the possible constellation for use of the DUSTHUNTER SP100 Ex-3K with the MCUDH Ex-3K control unit, and, on the right side, the possible constellation of the DUSTHUNTER SP100 Ex-3K with the conventional MCU control unit that may only be used in safe areas without explosion hazards.



① RS485 Service interface
② Cable for measured value transmission
③ Data interface (when using optional Interface module)
④ Voltage supply
⑤ DUSTHUNTER SP100 Ex-3K (sender/receiver unit for zones 2/22)
⑥ Purge gas hose (antistatic)
⑦ Measuring channel
⑧ Conventional MCU control unit
⑨ Control unit connecting cable to the sender/receiver unit
⑩ MCUDH Ex-3K (control unit for zones 2/22)

Fig. 15: Application illustration with application variants DUSTHUNTER SP100 Ex-3K

3.6 Interfaces

Communication between sender/receiver unit and control unit

As standard, each sender/receiver unit is connected to a control unit via the connecting cable.

Data transfer to the MCUDH Ex-3K control unit and the power supply (24 V DC) from the MCUDH Ex-3K control unit run via a 4-lead shielded cable with plug-in connector.

The MCUDH Ex-3K USB interface may only be used outside the potentially explosive atmosphere because opening the control unit while it is live is not permitted in the potentially explosive atmosphere. Alternatively, an RS485 Service interface is connected to terminals 43 and 44 (see “Connection plan”, page 54). A cable (up to 1,000 m) can be routed from the terminals out of the potentially explosive atmosphere. The service interface via RS485 and the USB interface cannot be operated at the same time.

3.6.1 Standard interfaces of the MCUDH Ex-3K control unit

Table 6: Standard interfaces of the MCUDH Ex-3K control unit

Analog output	1 output 0/2/4...22 mA (electrically isolated; active; resolution 10 bits) to output: Scattered light intensity (corresponds to the uncalibrated dust concentration), calibrated dust concentration, scaled dust concentration.
Analog inputs	2 inputs 0...20 mA (standard; without electric isolation; resolution 10 bits).
Relay outputs	5 changeover contacts (48 V, 1 A) to output status signals: Operation/malfunction; maintenance; function check; maintenance request; limit value.
Digital inputs	4 inputs to connect potential-free contacts (e.g. to connect a maintenance switch, trigger a function check or further actions).
Communication	USB 1.1 (use only outside the potentially explosive atmosphere). RS485 Service interface (on connection terminal) for measured value inquiry, configuration and updates. Internal RS485 interface for communication between sender/receiver unit and control unit.

Optional interface for the MCUDH Ex-3K control unit

To extend the functional scope of the MCUDH Ex-3K control unit, see “Options for MCUDH Ex-3K control unit”, page 130.

- Interface module
  Only the module approved for use in potentially explosive atmospheres (Part No. 2048958) may be integrated in the control unit.
  The module serves to transmit measured values, system status and service information to higher-level control systems via Modbus® ASCII/RTU or CoLa-B (SOPAS ET protocol) and is connected to the processor board via a ribbon cable.
  An RS485 signal cable can be connected to the module, which can be routed out of the potentially explosive atmosphere. The RS485 signal cable can be converted to Ethernet, outside the potentially explosive atmosphere, using the following interface modules: Ethernet Service or Modbus® TCP (separate modules with their own 24 V supply).
- Remote Display 100
  The Remote Display 100 in connection with the MCUDH Ex-3K control unit offers identical functions for operation outside the potentially explosive atmosphere.
  Distance to the device: Observe the minimum cable cross-section (24 V DC variant: Max. 15 A, min. 20 V on the display).
  The MCUDH Ex-3K display and the Remote Display 100 are locked against each other, both devices cannot be operated at the same time.

3.6.2 Standard interfaces of the MCU control unit

Table 7: Standard interfaces of the MCU control unit

Analog output	1 output 0/2/4...22 mA (electrically isolated; active; resolution 10 bits) to output: Scattered light intensity (corresponds to the uncalibrated dust concentration), calibrated dust concentration, scaled dust concentration.
Analog inputs	2 inputs 0...20 mA (standard; without electric isolation; resolution 10 bits).
Relay outputs	5 changeover contacts (48 V, 1 A) to output status signals: Operation/malfunction Maintenance Function check Maintenance request Limit value.
Digital inputs	4 inputs to connect potential-free contacts (e.g. to connect a maintenance switch, trigger a function check or further actions).
Communication	USB 1.1. RS485 interface for communication between sender/receiver unit and control unit.

Optional interfaces of the conventional MCU control unit

Additional options can be integrated to extend the functional scope of the MCU control unit (see “Options for MCU control unit”, page 130).

- Various Interface modules
- Analog and digital input/output modules

3.6.3 SOPAS ET user interface

SOPAS ET is a SICK software for easy operation and configuration of DUSTHUNTER measuring devices. Further functions are also available (e.g., data storage, graphic displays).

SOPAS ET runs on a computer connected via an interface to the control unit of the DUSTHUNTER measuring system (see “SOPAS ET”, page 67).

SOPAS ET is included on the enclosed data medium.

4 Project planning

4.1 Device configuration

The device components required for a measuring system depend on the respective application conditions. The following Section can help you with your selection.

4.1.1 Selecting the sender/receiver unit

Selection of the appropriate sender/receiver unit depends on:

- The gas temperature (max. 220 °C or max. 400 °C - DHSP-T2xx / DHSP-T4xx),
- The wall thickness and thickness of the thermal insulation of the duct (nominal length 435 mm or 735 mm - DHSP-Txx1 / DHSP-Txx2),
- Composition and temperature of the sample gas (*see "Sender/receiver unit material", page 38*).

- Select the nominal length of the sender/receiver unit so that the measuring volume has an adequate clearance to the internal duct wall.
  - Standard version clearance: At least 100 mm.
  - High-temperature version clearance: Between 100 mm and 140 mm so that the measuring probe does not protrude too far into the duct and therefore only a smaller surface area is exposed to the hot sample gas.
- The selected nominal length of the sender/receiver unit should only be as long as necessary, the measuring volume (see "DHSP-T2VxxEX-3K sender/receiver unit", page 24) need not be in the middle of the duct.
- Observe the maximum process pressure (see "Technical data", page 117). Safe operation of the measuring system is not possible when this exceeds the maximum pressure specified for the sender/receiver unit.

The standard material of the sender/receiver unit is a high-alloy stainless steel (1.4571), which is used when the sample gas can be considered non-corrosive or low-corrosive. This is the case when the following substance concentrations are not exceeded:

HCl:	10 mg/m³	SO_2:	800 mg/m³
HF:	10 mg/m³	SO_3:	300 mg/m³
NO_x:	1000 mg/m³	Data depend on application	

If the substance concentrations are exceeded, higher-quality material or coatings that counteract corrosion should be used:

Table 8: Sender/receiver unit material

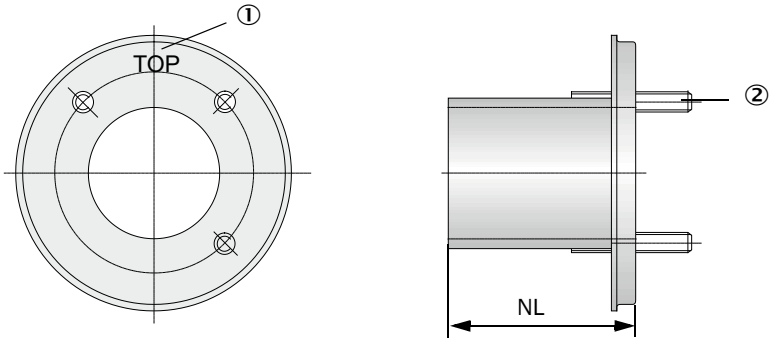
Material	Type code	Application area
Probe, protective tube and hood made of high-alloy stainless steel	DHSP-TxVx	Usable for low corrosive gases
Probe and protective tube made of Hastelloy, Hood made of high-alloy stainless steel with chromium carbide coating	DHSP-TxHx	Usable for corrosive gases
Probe made of Hastelloy, Protective tube and hood made of high-alloy stainless steel	DHSP-TxMx	Usable for corrosive gases (protective tube and hood as wearing parts)
Chromium carbide coating on surfaces of probe, protective tube and hood with sample gas contact	DHSP-TxKx	Usable for corrosive gases with NaOH, NaCl and H_2SO_4 contents, lower hardness (Mohs 8.5) than tungsten carbide, advantageous for highly fluctuating gas temperatures
Tungsten carbide coating on surfaces of probe, protective tube and hood with sample gas contact	DHSP-TxWx	Usable for corrosive gases with HCl and H_2SO_4 contents. Greater hardness (Mohs 9.5) than chromium carbide, suitable for abrasive particles entrained in the sample gas and high gas velocities

4.1.2 Selecting the flange with tube

The selection of a suitable flange with tube depends on the wall thickness and insulation of the duct wall, the nominal length of the selected sender/receiver unit and the sample gas temperature. Standard flanges are available and flanges with a fourth bolt together with an optional 3.1 Material Certificate (see “Flange with tube”, page 123). The material pairing of the duct and the tube should also be taken into account when a welded connection between the flange with tube and duct is planned.

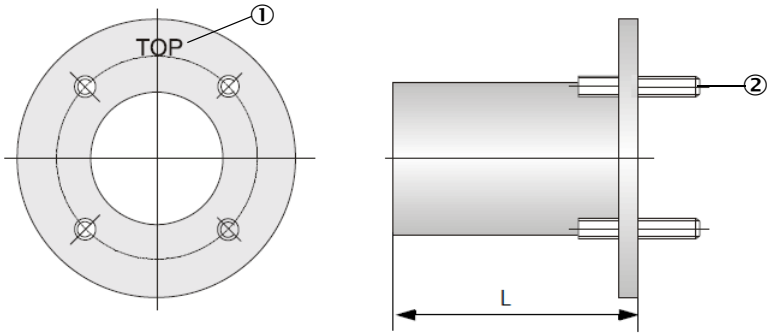
Table 9: Flange with tube, nominal length overview

Gas temperature	Nominal length of sender/receiver unit		
	435 mm	735 mm	
< 150 °C	130, 240	130, 240, 500	Nominal length of flange with tube (mm)
> 150 °C	240	500	



① Marking for fitting
② Fixing bolts

Fig. 16: Standard flange with tube



① Marking for fitting
② Fixing bolts

Fig. 17: Flange with tube (4 bolts)

- For a material and order number overview see “Flange with tube”, page 123.

4.1.3 Selecting the control unit

When selecting the control unit, it must always be clarified whether an explosion-proof version is necessary or whether the control unit can also be installed outside the potentially explosive atmosphere (see “Application illustration DUSTHUNTER SP100 Ex-3K”, page 35). Please note that additional precautions for explosion protection must be observed when connecting the control unit in the potentially explosive atmosphere.

Selecting the MCUDH Ex-3K control unit

Selection of the MCUDH Ex-3K control unit depends on the power supply type and the optional Interface module (see “Interfaces”, page 36). The control units are suitable for operation in potentially explosive zones 2/22.

Table 10: Selection Table for MCUDH Ex-3K control unit

Power supply unit	Interface module	Type designation
Without power supply unit (external 24 V DC)	No Interface module	MCUDH-N2YDN00000NNOE
Wide range 95...250 V EX		MCUDH-NSYDN00000NNOE
Without power supply unit (external 24 V DC)	RS485 (enables connecting optional Interface modules outside the potentially explosive atmosphere)	MCUDH-N2YDN00000MNOE
Wide range 95...250 V EX		MCUDH-NSYDN00000MNOE

- The ambient temperature ranges of the two power supply variants differ significantly, refer to the Technical Data “MCUDH Ex-3K control unit (Zones 2/22)”, page 120.

Selecting a conventional MCU control unit

Selection depends on the type of power supply and the optional Interface modules (see “Interfaces”, page 36). The conventional control units are not suitable for operation in potentially explosive atmospheres.

Table 11: Selection Table for MCU control unit

Power supply unit	Interface module	Type designation
Without power supply unit (external 24 V DC)	No Interface module	MCU-N2ONN00000NNNE (o. LCD) MCU-N2ODN01000NNNE (+2 AO)
Wide range 95...250 V AC		MCU-NWODN00000NNNE MCU-NWODN01000NNNE (+2 AO)
	Ethernet / COLA-B	MCU-NWODN00000BNNE MCU-NWODN01000BNNE (+2 AO)
	RS485/Modbus® ASCII/RTU	MCU-NWODN00000MNNE MCU-NWODN01000MNNE (+2 AO)
	Ethernet Modbus® TCP	MCU-NWODN00000JNNE MCU-NWODN01000JNNE (+2 AO)
	RS485/Modbus® ASCII/RTU Ethernet COLA-B Service	MCU-NWODW01000DNNE (+2 AO) 2 Interface modules
	PROFIBUS / RS485 Ethernet COLA-B Service	MCU-NWODW01000FNNE 2 Interface modules
Further MCU control unit variants available on request		

4.2 Installation location

4.2.1 Project planning for measuring channel

Electrical connection

Ensure the device can be switched off with a power isolating switch or circuit breaker in accordance with EN 61010-1, this power isolating device must be provided on-site. The potential equalization cable of the sender/receiver unit at the measuring point must be flexible enough to allow the cable to remain connected both when the sender/receiver unit is removed and installed.

Determining the measuring point

The operator is responsible for determining the measuring point. Observe the regulations of the local authorities for official measurements. Furthermore, it is important to ensure an uninterrupted supply of purge gas and to maintain sufficient space for installing and subsequent fitting and removing the sender/receiver unit.

Required thermal insulation

If the gas temperatures in the duct are higher than the permissible operating temperature of the measuring system, the thermal insulation represents an explosion protection measure that must be tested separately. Observe the following during this examination:

- Apart from the duct surface, other parts (e.g. device components) that can be subjected to prohibited high temperatures through thermal conduction are to be included in the thermal insulation or the thermal conduction prevented.
- The operator must ensure that suitable insulation reduces the heat radiation sufficiently so that the enclosure temperature remains below 70 °C and therefore below the temperature for the temperature protection class. The operator must take into consideration that the device-internal warming can be up to 2 K. It may be necessary to shade the device in climate zones with high temperatures and intensive sunlight.
- The maximum ambient temperature of 60 °C must be observed during project planning and operation (see “Technical data”, page 117).

Miscellaneous.

- The operator must ensure that the dust measuring device is permanently supplied with purge gas.
- The operator is responsible for the tightness of the purge gas line between the device, connecting pieces and flange and for monitoring the tightness.
- Ensure sufficient ventilation at the installation site.
- The operator must ensure that no hot process gas can escape when the sender/receiver unit is removed from the duct and that there is no risk of explosion.

4.2.2 Space requirements for system components

Sender/receiver unit space requirements

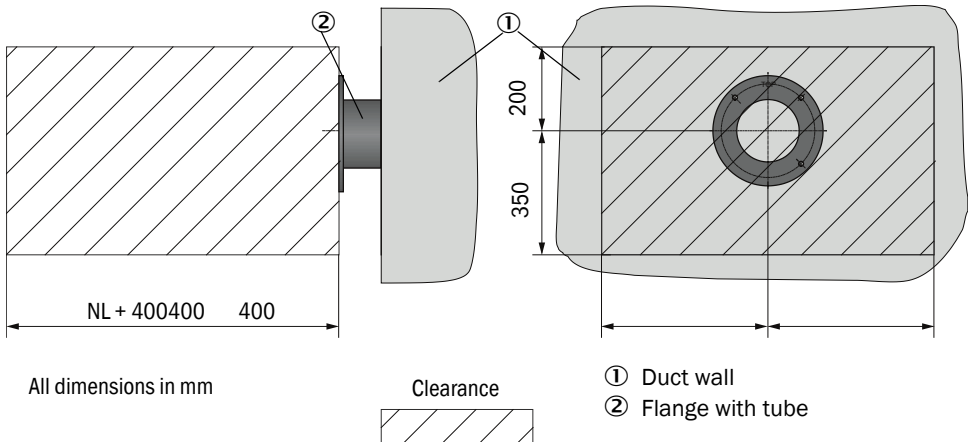


Fig. 18: Sender/receiver unit clearance

When determining the installation location of the sender/receiver unit, make sure the device is aligned with the flow direction in the duct (see “Adapting the sender/receiver unit to the duct geometry”, page 65).

MCUDH Ex-3K control unit space requirements

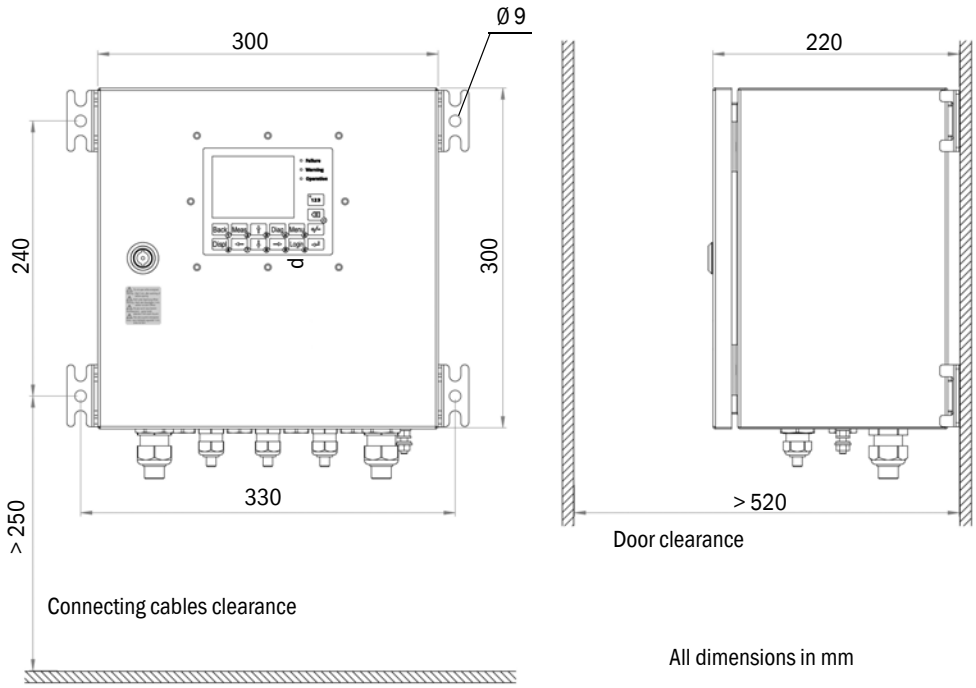


Fig. 19: MCUDH Ex-3K control unit clearance

MCU control unit space requirements

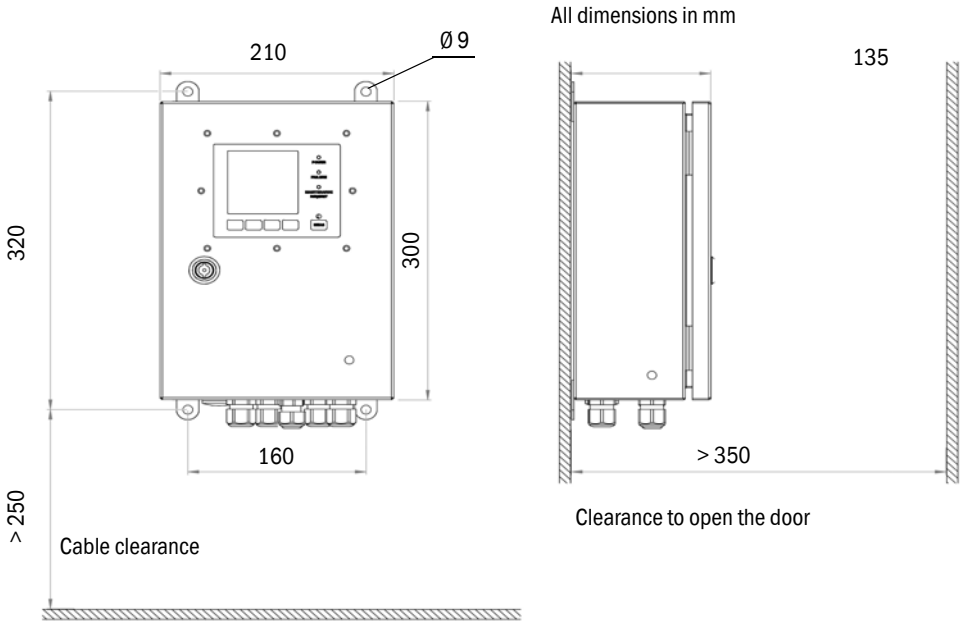


Fig. 20: Clearance for MCU control unit and Remote Display 100

Space requirements for the Remote Display 100

The space requirement of the Remote Display 100 corresponds to that of the MCU control unit.

4.2.3 Purge gas supply

The sender/receiver unit must be permanently supplied with purge gas during operation in order to keep the optical surfaces clean and to cool the measuring probe (at high gas temperatures). The purge gas (e.g. air, nitrogen) must be available on-site with an overpressure of 1...5 $bar_{(rel.)}$. The SP100Ex-3K sender/receiver unit is delivered with a purge gas orifice ② with diameter 2 mm or 3 mm, depending on the purge gas requirement.

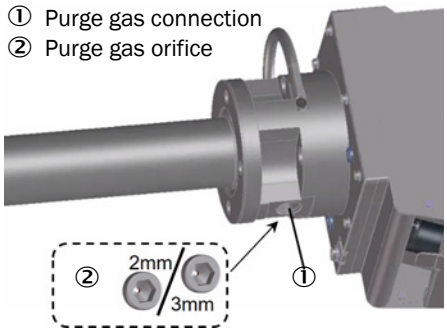


Fig. 21: Purge gas orifice

Purge gas requirement

For DUSTHUNTER SP100 Ex-3K Standard version: 3...5 m³/h

– Normally requires the 2 mm purge gas orifice to stabilize the volume flow.

For DUSTHUNTER SP100 Ex-3K High temperature version: 18...20 m³/h

– Normally requires the 3 mm purge gas orifice to stabilize the volume flow.

Depending on the required purge gas volume, the corresponding purge gas orifice ② is screwed into the purge gas connection ① above the non-return valve ③. The non-return valve has a G¼" female thread on the standard unit (G½" on the high-temperature version), where the purge gas line ⑤ is to be connected with a corresponding adapter ④. The purge gas line must be made of antistatic material to avoid electrical discharge. Filter regulator ⑥ serves to set the required purge gas pressure to feed the desired purge gas volume (see “Purge gas pressure diagram”).

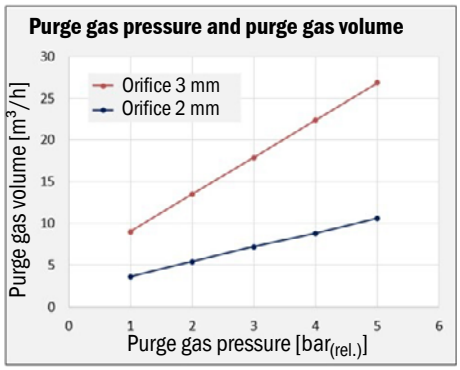
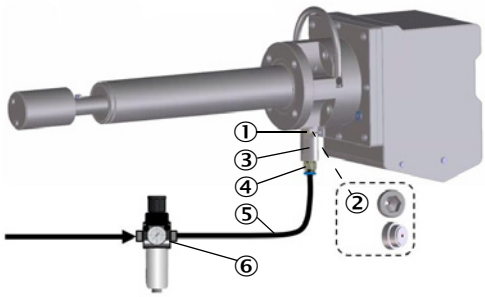


Fig. 22: Purge gas pressure diagram



① Purge gas connection
② Purge gas orifice
③ Non-return valve
④ Adapter
⑤ Purge gas line
⑥ Filter regulator
⑦ Pressure gauge

Fig. 23: Standard connection, purge gas supply

The Figure above “Standard connection, purge gas supply” shows that the length of the purge gas line ⑤ between filter regulator ⑥ and adapter ④ is at most 5 m and the inside diameter is at least 10 mm.

When the length of the purge gas line ⑤ is more than 5 m or the internal diameter of the line is less than 10 mm, considerable pressure losses can be expected between filter controller ⑥ and adapter ④. In this case, an additional pressure gauge ⑦ (observe local explosion protection specifications) must be connected directly upstream of the adapter for correct adjustment of the purge gas volume, at least during commissioning. The purge gas pressure relevant for the setting can be read there (see "Checking purge gas pressure").

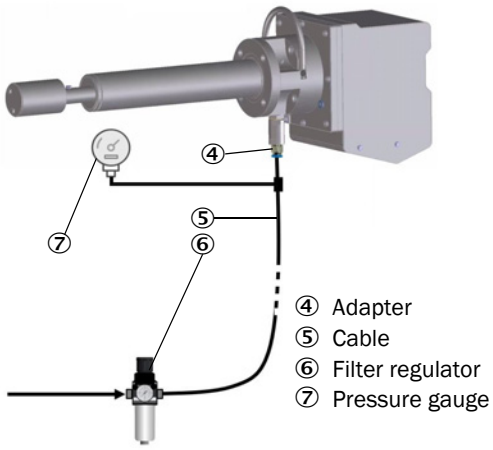


Fig. 24: Checking purge gas pressure

Compressed air requirement

The following Table can serve the user as a planning and orientation aid for the design of the compressed air network. It shows the required supplied compressed air volume (m^3/h) at different pressure ratios to achieve the desired purge gas demand. The values in the Table have been calculated without taking duct pressure and purge gas temperature into account.

Table 12: Compressed air requirement

	Pressure of the supplied compressed air [$bar_{(rel.)}$]				
	1 $bar_{(rel.)}$	2 $bar_{(rel.)}$	3 $bar_{(rel.)}$	4 $bar_{(rel.)}$	5 $bar_{(rel.)}$
Purge gas requirement	Required compressed air volume [m^3/h]				
3 m^3/h	1.5	1.0	0.8	0.6	0.5
5 m^3/h	2.5	1.7	1.3	1.0	0.8
18 m^3/h	9.0	6.0	4.5	3.6	3.0
20 m^3/h	10.0	6.7	5.0	4.0	3.3

Purge gas quality

In addition to cooling the measuring probe, the supplied purge gas is mainly used to keep the optical surfaces clean. The purge gas should be dry and free of dust and oil. The cleaner the purge gas, the less the optical surfaces become dirty. The maintenance cycle can thus be extended.

4.2.4 Project checklist

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

Table 13: Project checklist

Task	Requirements	Work step	☑
Determine measuring and installation locations for device components	Inlet and outlet piping in accordance with DIN EN 13284-1 – Inlet at least 5 × d_h (hydraulic diameter) – Outlet at least 3 x d_h – Clearance from stack opening at least 5 × d_h For round and square ducts: d_h = duct diameter For rectangular ducts: d_h = 4 × A (surface) ÷ U (circumference)	Follow specifications for new systems Select best possible location for existing systems. For too short inlet/outlet paths: Inlet path > outlet path	☐
	Homogeneous flow, 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 in accordance with DIN EN 13284 and select best possible location.	☐
	Sender/receiver unit fitting location and alignment – No perpendicular mounting on horizontal or sloping ducts, max. deviation of measuring axis from horizontal 45°, provide for min. 1° slope (condensate drainage) – Observe alignment to flow direction (see “Adapting the sender/receiver unit to the duct geometry”, page 65)	Select best possible location Provide information on duct direction.	☐
	Accessibility, accident prevention – Device components must be safely accessible	Provide platforms or pedestals as required.	☐
	Mounting with as little vibration as possible – Acceleration < 1 g	Reduce strong vibrations through adequate measures.	☐
	Ambient conditions – Limit values according to Technical Data (see “Technical data”, page 117)	For outdoor installation, provide weather protection (see “Weather protection hood”, page 31), enclose or insulate components.	☐
	Consider lines and hoses at the installation site (see “Fastening technology”, page 129)	Observe line and hose lengths. Select the best possible location, potential equalization cable must allow removing the sender/receiver from the duct when connected.	☐
	Observe the application illustration (see “Application illustration DUSTHUNTER SP100 Ex-3K”, page 35) with regard to the installation locations.		
Purge gas Determine type and quantity	Suitable purge gas in compliance with application-specific requirements for explosion protection. – Dry, dust-free and oil-free, non-corrosive	Provide purge gas supply. Work steps, see “Purge gas supply”, page 44.	☐
Select device components: Measuring device	Nominal length of sender/receiver unit and flange with pipe according to duct diameter, duct wall thickness with insulation	Select components according to configuration (see *“Selecting the sender/receiver unit”, page 38*); If necessary, plan additional measures for mounting flange with tube (see *“Fitting the flange with tube”, page 49*).	☐
	Sender/receiver unit type (up to 220 °C or up to 400 °C) depending on maximum possible gas temperature in duct		
	Measuring probe material depending on gas composition in the duct – For corrosive gases, measuring probe coated with chromium carbide, tungsten carbide or made of Hastelloy®.		
Select control unit	Power supply and communication options based on the intended system integration	Select components according to the Configuration Table (see *“Selecting the control unit”, page 40*).	☐
Plan calibration openings	Easy and safe access, no mutual interference of calibration probe and measuring system	Provide platforms or pedestals as required. Plan sufficient clearance between measuring and calibration level (approx. 500 mm)	☐
Plan the voltage supply	Supply voltage and power requirements according to Technical Data (see “Technical data”, page 117)	Plan adequate cable cross-sections and fuses	☐

5 Transport and storage

NOTICE:

Sensitive components

The probe head of the sender/receiver unit of the DUSTHUNTER SP100 Ex-3K contains sensitive components and must therefore be handled carefully:

- Protect the probe head from strong vibrations.
- Do not load the probe head.
- Take safety precautions when transporting the device.
- Check the components for visible damage after each transport.

5.1 Transport

Observe the following during device transport:

- Protect the device openings of the sender/receiver unit from weather influences and dust.
- Pack all components for transport in such a way that shocks cannot damage the components.
- Close off open electrical connections dust-tight.
- The ambient conditions specified in the Technical Data must also be observed when transporting the measuring system (see “Technical data”, page 117).
- Observe explosion protection regulations, e.g. do not bring packaging material into the potentially explosive atmosphere.

5.2 Storage

Observe the following during device storage:

- Process media residues can be hazardous to health.
- Close off open electrical connections dust-tight.
- Protect the device openings of the sender/receiver unit from weather influences and dust.
- Store all components of the measuring device in a ventilated, dry, clean area.
- The ambient conditions specified in the Technical Data must also be observed when storing the measuring system (see “Technical data”, page 117).

6 Mounting

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

- ▶ Fitting the flange with tube.
- ▶ Installing the control unit (with the cable bushings pointing downwards).

6.1 Mounting information

6.1.1 Proper mounting

CAUTION:
Danger during mounting
Improper mounting can lead to injuries.
- ▶ Observe the relevant safety regulations as well as safety notices during all mounting work.
- ▶ Only carry out mounting workon systems with hazard potential (hot or aggressive gases, higher internal duct pressure) when the system is at a standstill.
- ▶ Take protective measures against local or plant-related hazards.

WARNING:
Risk of injury through inadequate fastening of the device
Inadequate fastening can cause the device or device components to become detached from the installation site and injure people if they fall down.
- ▶ Consider the device weight specifications when planning the fitting supports.
- ▶ Take possible vibration loads into account when choosing the fixtures.
- ▶ Before starting mounting, check the condition and load-bearing capacity at the installation location.

6.2 Preparing the measuring point

The operator is responsible for preparing the measuring point. Basis for determining the measuring point:

- Preceding project planning
- Regulations of local authorities

Responsibility of the operator:

- Determining the measuring point, carrying out any necessary structural changes
- Determining the suitable purge gas
- Ensuring uninterrupted purge gas supply

6.3 Scope of delivery

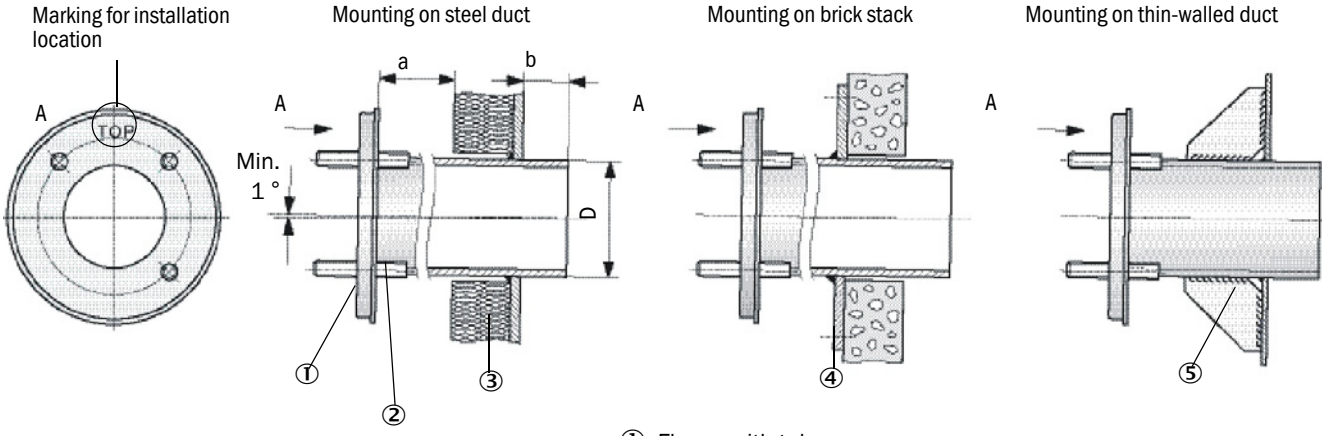
Check the scope of delivery according to the order confirmation.

6.4 Installation sequence

Installation is carried out according to the sequence in this Section, the sender/receiver unit is not installed until commissioning.

NOTICE:
Device damage due to premature installation of the measuring device on the gas duct
Unsuitable conditions in the measuring duct can cause damage to the measuring system, making it impossible to use it as intended.
- ▶ The sender/receiver unit is first positioned in the duct during commissioning (see “Fitting and connecting the sender/receiver unit”, page 65).

6.4.1 Fitting the flange with tube



Nominal length of sender/receiver unit	D
435 mm, 735 mm	Ø 76

Fig. 25: Fitting the flange with tube (shown for standard version)

- Dimension a must be large enough so that a weather protection hood can be fitted easily when necessary (approx. 40 mm).
- Dimension b must be as large as possible under consideration of dimension a.

NOTE:

The tube length must suit the planned sender/receiver unit depending on the relation between gas temperature and nominal length (see “Selecting the flange with tube”, page 39).

▶ Do not shorten tubes.

Work to be performed

1 Measure the fitting location and mark the installation location, ensure sufficient clearance to fit and remove the sender/receiver unit (see “Sender/receiver unit space requirements”, page 42).
2 Remove thermal insulation (when fitted).
3 Cut suitable openings in the duct wall; bore large enough holes in brick or concrete stacks (flange tube diameter).

NOTE:

▶ Do not let separated pieces fall into the duct.

4 Insert the flange with tube in the opening slanting slightly downwards (1 to 3 °) so that the “Top” marking points upwards and any condensate that may collect in the duct can drain off.
5 Weld the flange with tube on using an anchor plate for brick or concrete stacks, insert junction plates for thin-walled ducts.
6 Close off the flange opening with a blind flange after fitting (see “Fastening technology”, page 129) to prevent gas escaping.

6.4.2 Fitting the MCUDH Ex-3K control unit

Fit the MCU or MCUDH Ex-3K control unit in a protected location that is easily accessible (see “Space requirements for system components”, page 42). Observe the following points during fitting:

- The MCUDH Ex-3K control unit may only be used in the potentially explosive atmosphere in accordance with the specifications (see “Application illustration DUSTHUNTER SP100 Ex-3K”, page 35).
- Maintain the ambient temperature range in accordance with the Technical Data under consideration of possible radiant heat (shield when necessary).
- Protect against direct sunlight.
- The control unit must be firmly mounted on a suitable wall or rack, with the cable bushings pointing downwards.
- Whenever possible, choose an installation location with minimum vibrations; dampen any vibrations when necessary.
- Provide sufficient clearance for cables and opening the door.
- When opening the enclosure door, take suitable precautions to prevent dust from entering.

The maximum cable length between the sender/receiver unit and the control unit depends, among other things, on the internal resistance of the cable. When using suitable connecting cables (see “Information on connecting cables”, page 55), the maximum distance for signal transmission (RS485 interface) is 1000 m. For the power supply (separate, on-site or by the control unit), the minimum operating voltage of at least 20 V (at maximum current consumption - see Technical Data “DHSP100 Ex-3K sender/receiver unit”, page 122) must be observed.

For outdoor installation, it is recommended for the customer to provide a weather protection hood.

6.4.3 Fitting the optional Remote Display 100

The optional Remote Display 100 must be fitted in an easily accessible and protected location (see “Space requirements for system components”, page 42). Observe the following points during fitting:

- Maintain the ambient temperature range in accordance with the Technical Data under consideration of possible radiant heat (shield when necessary).
- Protect against direct sunlight.
- The Remote Display 100 must be firmly mounted on a suitable wall or rack, with the cable bushings pointing downwards.
- Whenever possible, choose an installation location with minimum vibrations; dampen any vibrations when necessary.
- Provide sufficient clearance for cables and opening the door.
- When opening the enclosure door, take suitable precautions to prevent dust from entering.

The maximum distance between the Remote Display 100 and the MCUDH Ex-3K, when using suitable connection cables (see “Information on connecting cables”, page 55) depends on the local conditions (observe minimum cable cross-section (24 V DC variant: max. 0.15 A, min. 20 V on Remote Display)).

For outdoor installation, it is recommended for the customer to provide a weather protection hood.

6.4.4 High-temperature version

High-temperature version
- Fitting on a steel duct, brick stack and on a thin-walled duct is the same as for the standard version.

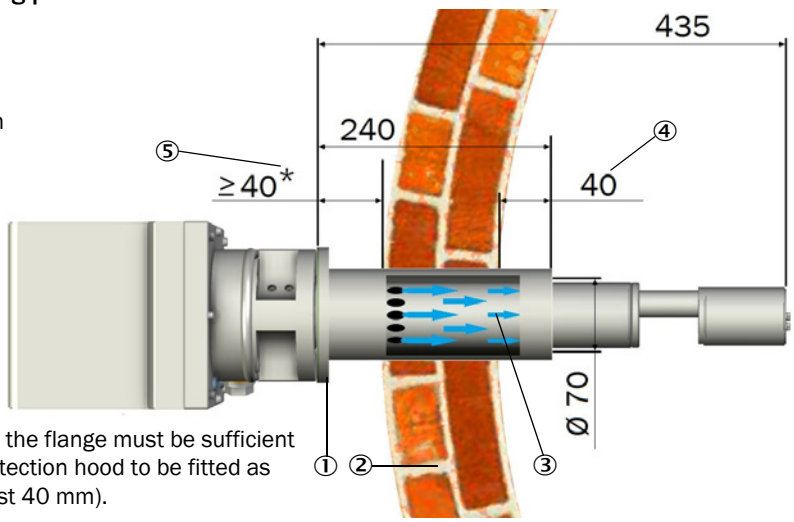
NOTICE:

High-temperature version

Fitting with a flange tube with wrong tube diameter can cause temperature damage on the sender/receiver unit.
- ▶ The flange inner diameter must be 70 mm otherwise correct purging is not possible.
- ▶ Only fit the measuring probe in the duct as far as necessary (see ④ measure 40 mm) to avoid temperature damage.

Fitting the measuring probe NL 435 mm

① Flange with tube
② Duct wall
③ Purge gas
④ Maximum 40 mm

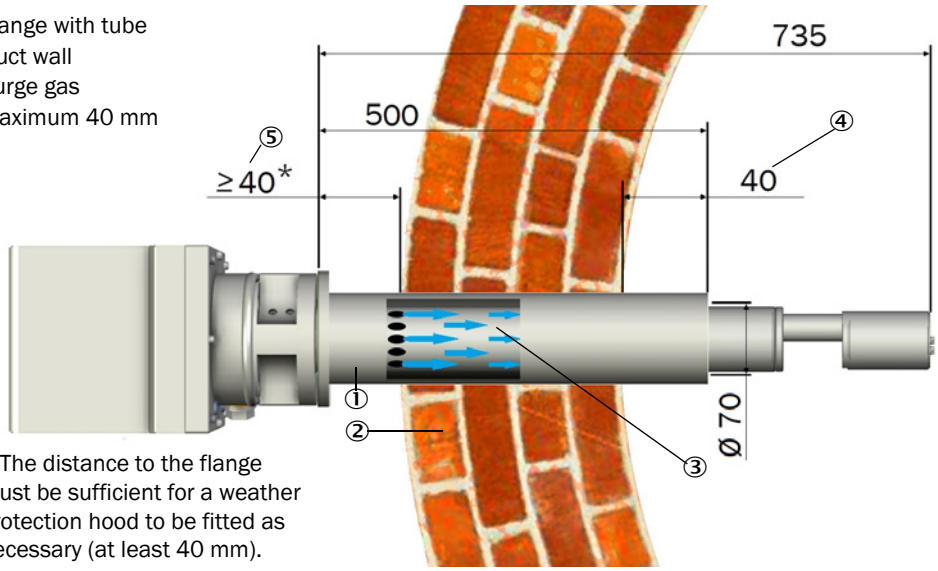


⑤ * The distance to the flange must be sufficient for a weather protection hood to be fitted as necessary (at least 40 mm).

Fig. 26: Fitting the flange with tube (all dimensions in mm)
Shown (view from above) for high-temperature version, nominal length 435 mm

Fitting the measuring probe NL 735 mm

① Flange with tube
② Duct wall
③ Purge gas
④ Maximum 40 mm



⑤ * The distance to the flange must be sufficient for a weather protection hood to be fitted as necessary (at least 40 mm).

Fig. 27: Fitting the flange with tube (all dimensions in mm)
Shown (view from above) for high-temperature version, nominal length 735 mm

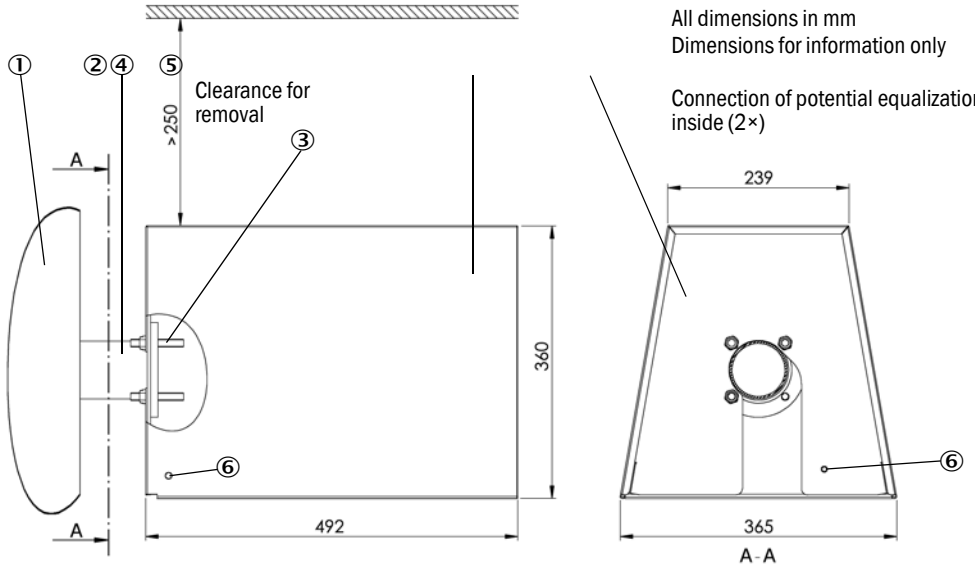
6.4.5 Fitting the weather protection hood

This weather protection hood serves to protect the sender/receiver unit. It comprises a base plate and a protective hood.

A special weather protection hood is available for potentially explosive atmospheres. It is made of high-alloy steel, is uncoated to prevent static charging and has contact screws for potential equalization. Other compatible weather protection hoods must not be used in potentially explosive atmospheres (see “Weather protection hood”, page 129).

Fitting:

1 Push base plate ⑤ onto the flange with tube ②, slot onto threaded bolts ③ of the duct-side surface of the flange plate and screw on (see “Fitting the weather protection hood for the sender/receiver unit”, page 52).
2 Connect potential equalization to the base plate of the hood.



① Duct
② Flange with tube
③ Threaded bolts
④ Weather protection hood
⑤ Base plate
⑥ Potential equalization connection

Fig. 28: Fitting the weather protection hood for the sender/receiver unit

7 Electrical installation

NOTE:
Check device suitability before installation.
- ▶ Before installation, check that the type code and type plate match the intended application.

All mounting work previously described must be completed (as far as applicable) before starting installation work.

Carry out all installation work on-site unless otherwise explicitly agreed with Endress+Hauser or authorized representatives. This includes laying and connecting the power supply and signal cables, installing switches and power fuses, and connecting the purge gas supply.

- Plan adequate cable cross-sections (see “Information on connecting cables”, page 55).
- Cable ends with plugs to connect the sender/receiver unit must have sufficient free length.
- The potential equalization cable of the sender/receiver unit must be flexible enough to allow the sender/receiver to be removed from the duct with the potential equalization connected.

7.1 Electrical installation safety information

WARNING:
Endangerment of electrical safety during installation and maintenance work when the power supply is not switched off.
An accident can occur during installation and maintenance work when the power supply to the device and cables is not switched off using a power isolating switch or circuit breaker.
- ▶ Before starting work on the device, ensure the power supply can be switched off using a power isolating switch or circuit breaker.
- ▶ Make sure the power isolating switch is easily accessible.
- ▶ An additional disconnecting device is mandatory when the power isolating switch cannot be accessed or only with difficulty after installation.
- ▶ The power supply may only be activated again after the work, or for test purposes, by personnel carrying out the work under consideration of valid safety regulations.

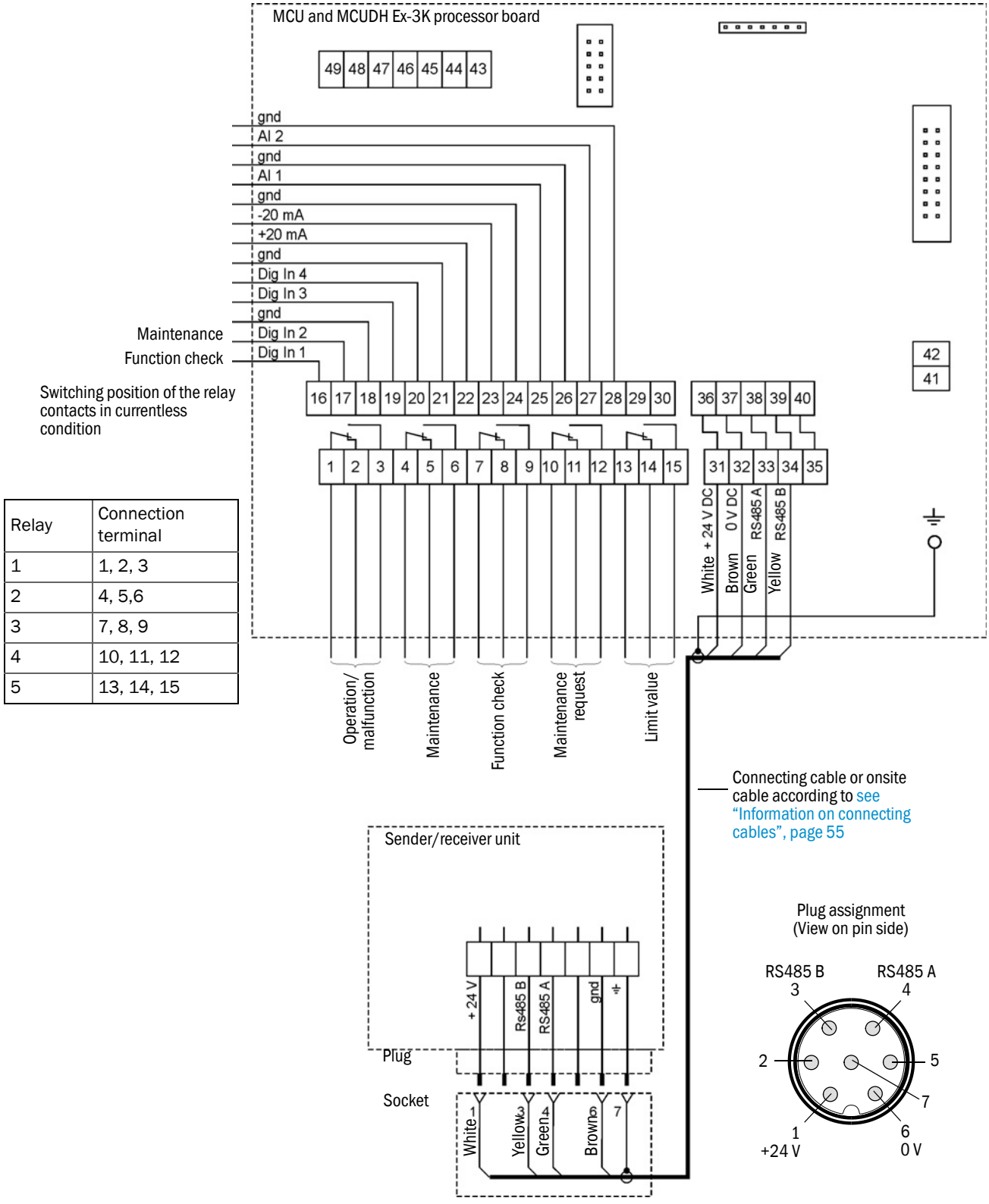
7.2 Connection overview

Pay attention to zone separation when installing and connecting device components (see “Application illustration DUSTHUNTER SP100 Ex-3K”, page 35).

Connecting is done in three main steps:

1 Before connection work, establish potential equalization of devices to be connected.
2 Before commissioning: Make the connections for the device components, other than the sender/receiver unit.
3 During commissioning: Establish the connections still required on the sender/receiver unit at the measuring point.

7.2.1 Connection plan



Relay	Connection terminal
1	1, 2, 3
2	4, 5,6
3	7, 8, 9
4	10, 11, 12
5	13, 14, 15

Fig. 29: Connection plan

7.3 Information on connecting cables

DANGER:
Risk of explosion through unsuitable screw fittings and electric cables

- ▶ Use only suitable cables (according to valid standard) with matching outside diameter.
- ▶ Protect cables against electrostatic charges.
- ▶ Only open those cable glands to be used for the installation. Keep the screw plugs.
- ▶ Refit the original blind cap when a cable gland has to be closed again (see "MCUDH Ex-3K cable glands", page 58).

Requirements for connecting cables outside the potentially explosive atmosphere

For the signal cables with low voltage limits, only use shielded cables with twisted pairs (e.g., UNITRONIC LiYCY (TP) Li2YCY 2 x 2 x 0.5 mm^2 from LAPPKabel; 1 pair of wires for RS 485, 1 pair of wires for power supply; not suitable for underground laying). Cables with other designations but equivalent construction and comparable or higher electrical properties are permissible.

Requirements for connecting cables within the potentially explosive atmosphere

- The documentation for zone division according EN 60079-10 must be available.
- The cables to be used must be checked for suitability for the application area.
- After installation, an initial test of the device and the system according to EN 60079-17 must be performed.
- Potential equalization and cable connections must fulfill the requirements according to EN 60079-14.
- Cables which are especially endangered by thermal, mechanical or chemical stress, must be protected, e.g., by laying in protective tubes open at both ends.
- For cables not protected against smoldering, the fire behavior must be verified according to IEC 60332-1.
- The cross-section of each individual wire must not be smaller than 0.5 mm^2.
- When selecting the cables, the respective clamping range of the cable duct described here must be observed. If you need more than one cable duct or cable ducts with different diameters, a set can be found in the spare parts (see "Spare parts, control unit", page 128).
- The inserted cables must be routed to the designated connection terminals by the shortest possible route and fixed inside the enclosure in order to maintain the air and creepage distances of the existing circuits.
- Cable glands for the potentially explosive atmosphere must be suitable for the intended cable type (e.g., cables with or without shield).
- Protect the wire ends with connector sleeves against fraying.
- Replace unused cable glands with the enclosed Ex-d sealing plugs.
- Unused wires must be connected with a ground cable (ground potential) or secured so that a short circuit with other conductive parts is excluded.
- Torque for tightening the cable glands
  - with sealing plugs: 5 Nm,
  - with inserted cable: 10 Nm (M20) or 12 Nm (M25).

7.4 Connecting the sender/receiver unit

Connecting the sender/receiver unit is covered in the Section on the control unit, the sender/receiver unit is first positioned in the duct during commissioning (see “Fitting and connecting the sender/receiver unit”, page 65).

7.5 Connecting the control unit

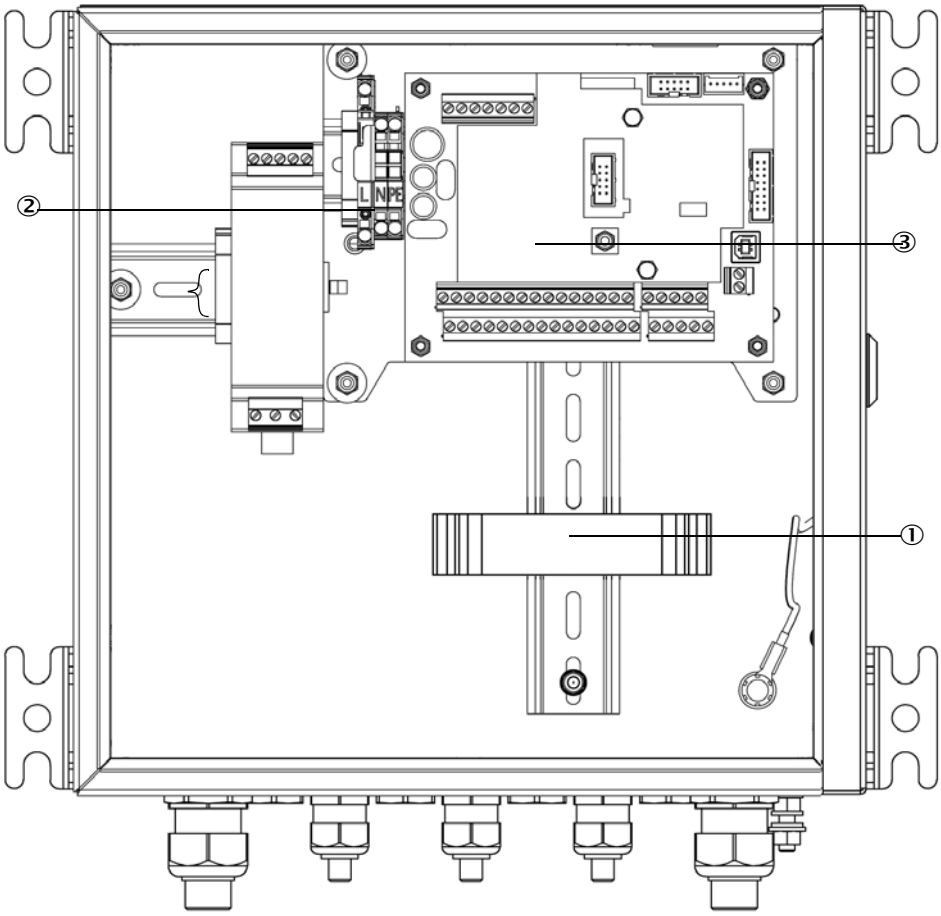
DANGER:

Risk of explosion through incorrect or missing potential equalization when working on the measuring system

Static charge can lead to explosions.

- ▶ Connect the potential equalization as first task during installation and as last task during disassembly.

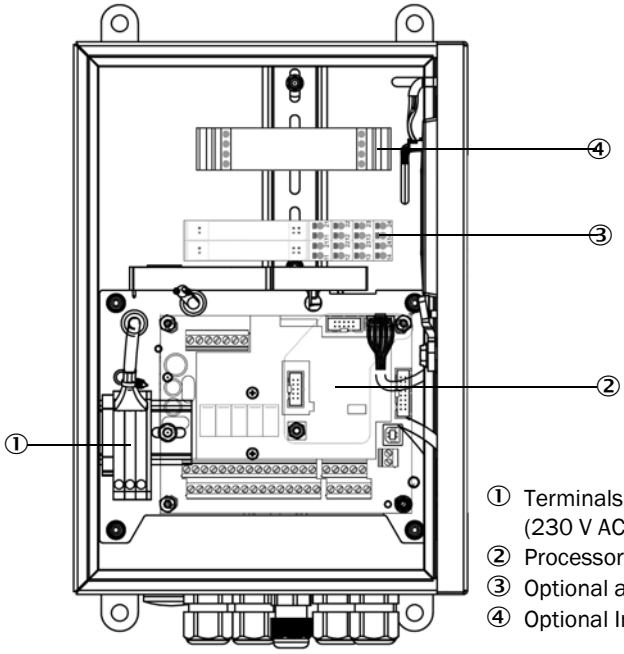
7.5.1 MCUDH Ex-3K control unit components



① Option, Interface module RS485 Modbus® ASCII/RTU
② Terminals for power connection
(230 V AC / 24 V DC depending on type)
③ Processor board

Fig. 30: MCUDH Ex-3K control unit component layout

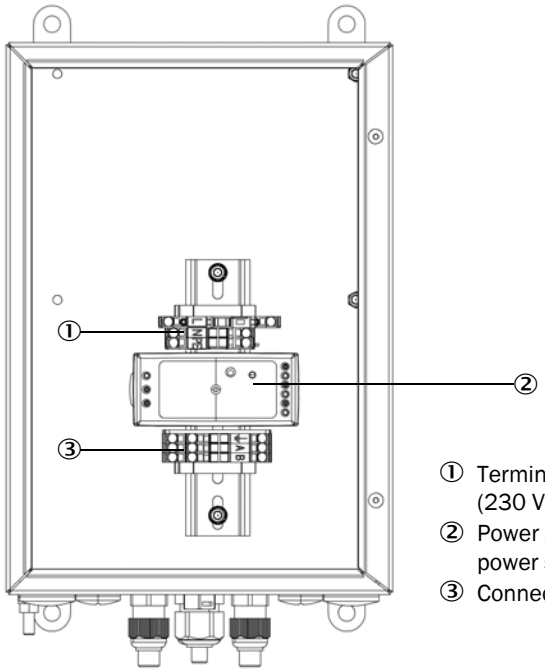
7.5.2 MCU control unit components



① Terminals for power connection
(230 V AC / 24 V DC depending on type)
② Processor board
③ Optional analog / digital connection modules
④ Optional Interface module

Fig. 31: MCU component layout

7.5.3 Remote Display 100 components



① Terminals for power connection
(230 V AC / 24 V DC depending on type)
② Power supply unit (only for version with mains power supply 230 V AC)
③ Connection terminals RS485 signal cable

Fig. 32: Layout of components of optional Remote Display 100

7.5.4 Work to be done

- Connect the connecting cable: see “Connection plan”, page 54.
- Connect cables for status signals (operation/malfunction, maintenance, function check, maintenance request, limit value), analog output, analog and digital inputs according to requirements (see “Connection plan”, page 54 and see “MCHDH communication options”, page 61).
- Connect the power cable to connection terminals (230 V AC: L1, N, PE / 24 V DC: +24V, GND, PE) of the control unit (see “Connecting the control unit”, page 56).

Close off unused cable glands with blind cap.

NOTE:
If more connecting cables are to be used than initially planned, a set with cable glands is available for the MCUDH Ex-3K control unit (see “Spare parts, control unit”, page 128).

NOTICE:
Faulty wiring can damage the measuring system
- Be sure to check the potential equalization of the devices and the wiring before switching the supply voltage on.
- Only modify wiring when disconnected from the power supply and potential-free.

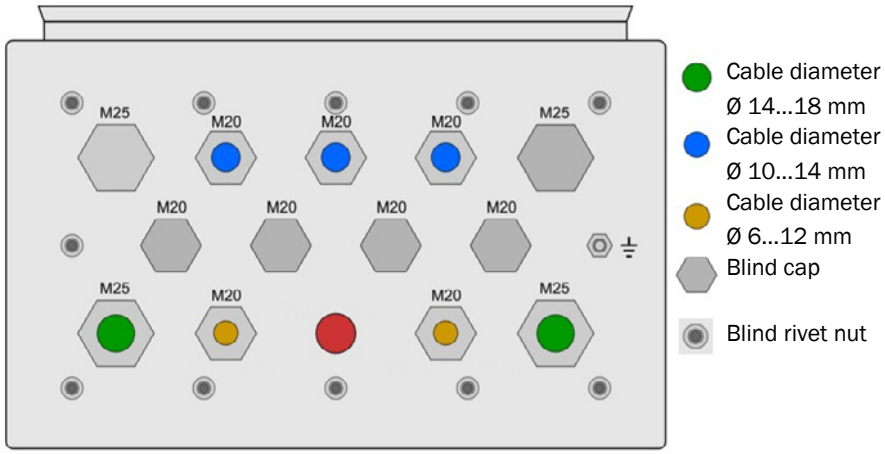
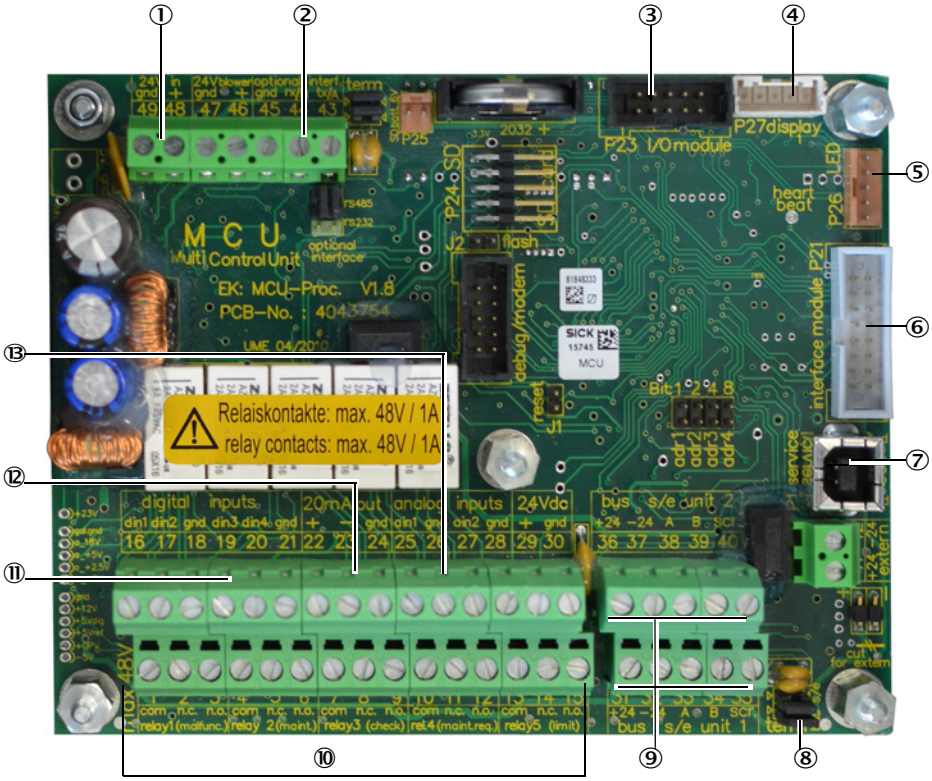


Fig. 33: MCUDH Ex-3K cable glands

7.5.5 Processor boards connections of control units

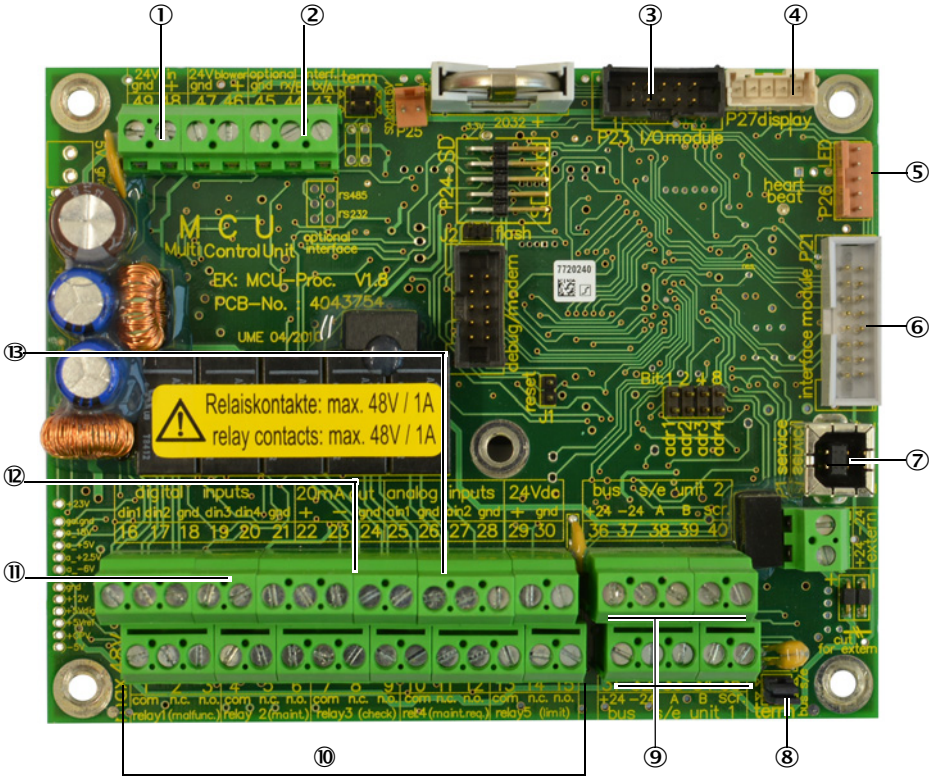
MCUDH Ex-3K processor board connections



① Supply voltage 24 V DC
② Service interface RS485 for SOPAS communication
③ Connection for option I/O module - use not permitted for MCUDH Ex-3K
④ Connection for Display module
⑤ Connection for LED - use not permitted for MCUDH Ex-3K
⑥ Connection for option Interface module
⑦ USB plug connector (see “MCUDH Ex-3K control unit”, page 26)
⑧ Jumper for termination of the bus system (necessary)
⑨ Connections for sender/ receiver units
⑩ Connections for relays 1 to 5
⑪ Connections for digital inputs 1 to 4
⑫ Connection for analog output
⑬ Connections for analog inputs 1 and 2

Fig. 34: MCUDH Ex-3K processor board connections

MCU processor board connections



① Supply voltage 24 V DC
② Not used
③ Connection for option I/O module
④ Connection for Display module
⑤ Connection for LED
⑥ Connection for option Interface module
⑦ USB plug connector
⑧ Jumper for termination of the bus system (necessary)
⑨ Connections for sender/ receiver units
⑩ Connections for relays 1 to 5
⑪ Connections for digital inputs 1 to 4
⑫ Connection for analog output
⑬ Connections for analog inputs 1 and 2

Fig. 35: MCU processor board connections

7.5.6 Connecting cable to control unit

The connecting cable has a 7-pole plug which may only be connected to the DUSTHUNTER SP100 Ex-3K when currentless. The connector plug is inserted into the socket when the plug protection guard is opened and the plug-side safety gland is screwed onto the socket. Then fasten the plug protection guard (see “Connecting cable and plug protection bracket”, page 31). The following Figure shows the connector plug pin assignment.

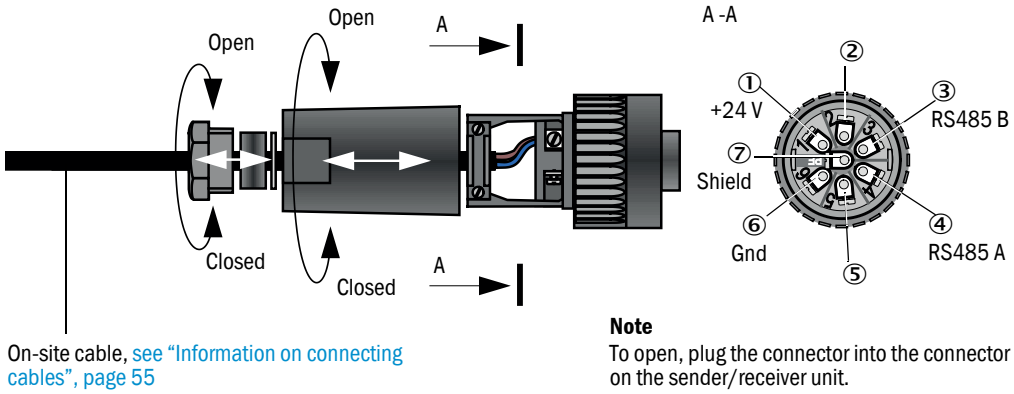


Fig. 36: Connecting the plug connector to the on-site cable

7.6 Installing the purge gas supply

WARNING:
Risk of explosion through electrostatic charges
▶ An antistatic purge gas hose must be used within the potentially explosive atmosphere.

For the requirements on the purge gas to be provided on-site, see “Purge gas supply”, page 44.

7.7 Connecting Remote Display 100

The Remote Display 100 is not suitable for use in potentially explosive atmospheres and should only used together with the MCUDH Ex-3K.

The data cable available on-site and, as necessary, the power supply, must be routed out of the potentially explosive atmosphere and thus meet extended requirements, see “Requirements for connecting cables within the potentially explosive atmosphere”, page 55. The cables are to be led from below and fastened before the cable bushings in case of tensile stress.

Further information, see “Remote Display 100 components”, page 57.

7.7.1 Connecting to the MCUDH Ex-3K control unit

The electrical connection of the Remote Display 100 largely corresponds to the connection of the sender/receiver unit (see “Connection plan”, page 54), the connection terminals used here deviate from this.

- Electrical connection of the Remote Display 100 24 (without own power supply unit):
  - 24 V supply: Connection terminals 36 and 37
  - Communication: Connection terminals 38 and 39
- Electrical connection of Remote Display 100 (with own power supply unit):
  - Communication: Connection terminals 38 and 39

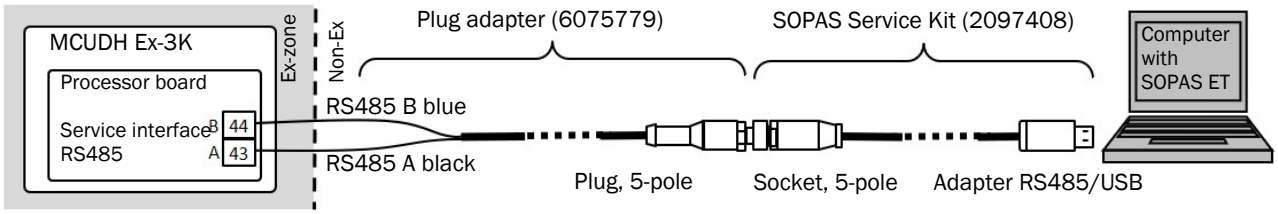
7.8 MCHDH communication options

There are two options to communicate with the MCUDH Ex-3K for configuring and exchanging data via the Service interface (option 1) or via the optional Interface module (option 2).

Option 1 (Service interface)

Communication via the RS485 Service interface available on terminals 43 and 44 of the MCUDH Ex-3K processor board. The Service interface only transmits the protocol CoLa-B, which is used by the SOPAS ET operating program. The Service interface operates with the parameters: 57,600 baud, 8 data bits, 1 stop bit, semi-duplex. The connection can be implemented via two variants:

Option 1



Option 2

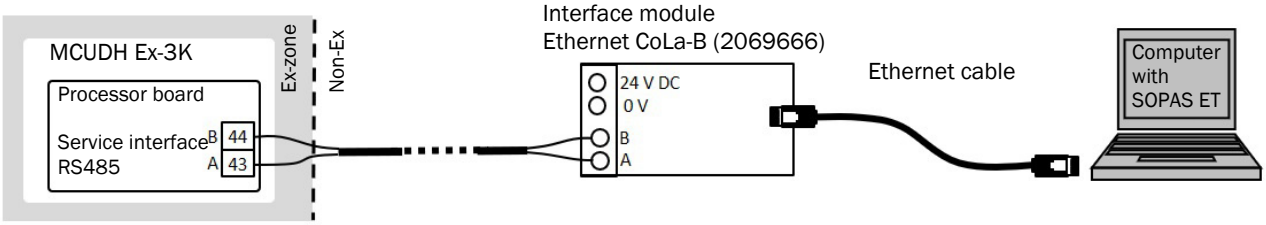


Fig. 37: Communication variant 1 - options 1 and 2

- Option 1 shown here has no galvanic isolation between MCUDH and computer and is therefore not suitable for continuous operation.

NOTICE:

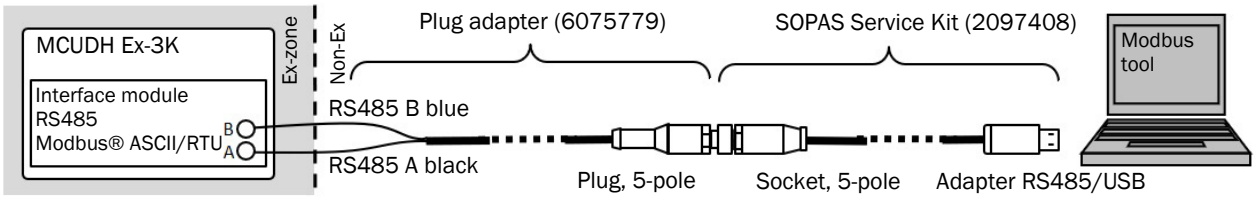
There is a risk of unwanted access to the measuring system when communicating via Ethernet.

▶ Only operate the measuring system behind a suitable protective barrier (e.g. firewall).

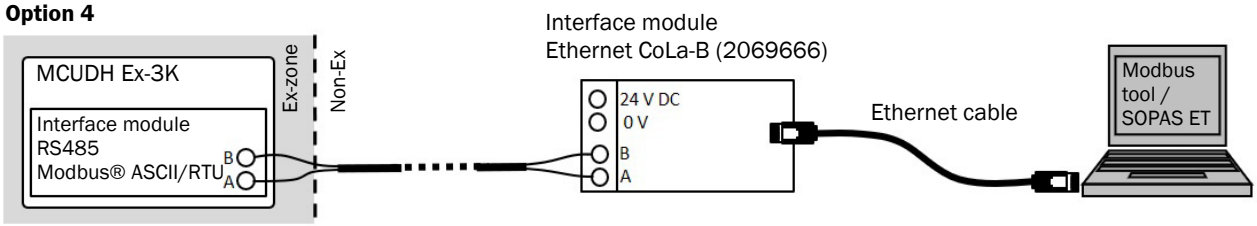
Option 2 (optional Interface module)

Communication via the optional RS485 Modbus® ASCII/RTU Interface module plugged onto the top-hat rail of the MCUDH Ex-3K. The module is connected to the MCUDH Ex-3K processor board via ribbon cable. Then select in SOPAS ET in which communication type this module is to be used (CoLa-B, Modbus ASCII, Modbus RTU) (see “Connection MCUDH Ex-3K via RS485 Ethernet”, page 68). The RS485 connection is led out of the potentially explosive atmosphere via a two-wire cable - shielded and twisted pair (see “Requirements for connecting cables within the potentially explosive atmosphere”, page 55), then used directly or via Interface modules in the following manner:

Option 3



Option 4



Option 5

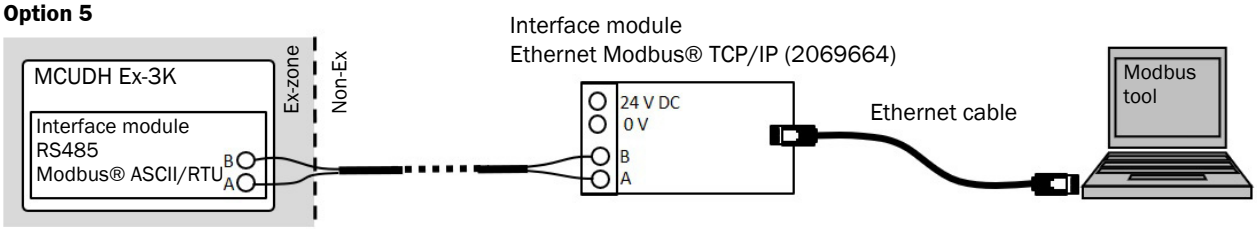


Fig. 38: Communication variant 2 - options 3, 4 and 5

- Option 3 shown here has no galvanic isolation between MCUDH and computer and is therefore not suitable for continuous operation.

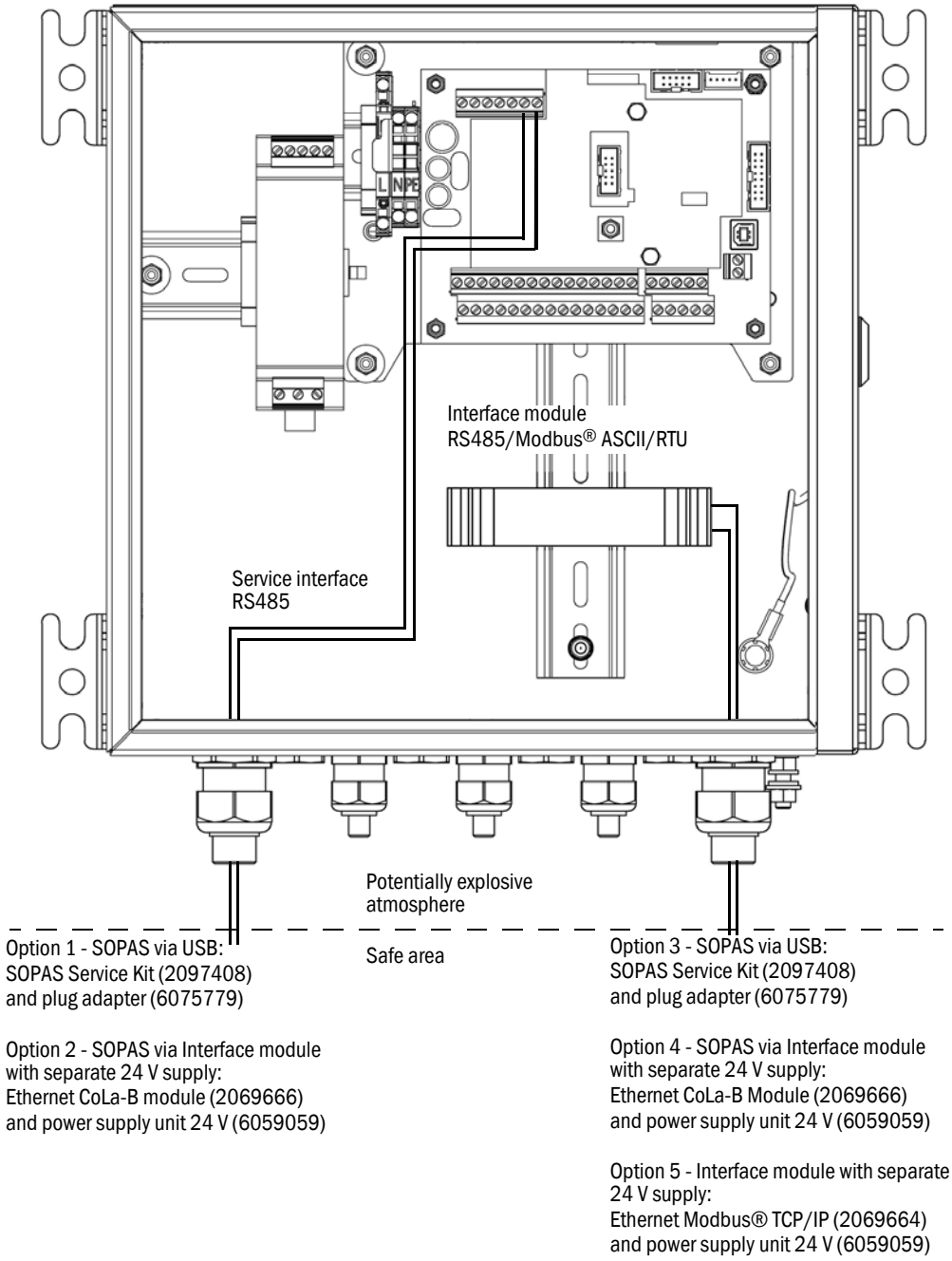


Fig. 39: MCUDH Ex-3K interface options

8 Commissioning

8.1 Safety information on commissioning

NOTICE:
Device damage possible due to an unprofessionally executed electrical installation.
▶ The manufacturer recommends having the initial commissioning carried out by Endress+Hauser Service.

The explosion protection regulations must be observed during commissioning:

- Do not remove, add or change any components on the sender/receiver unit unless described and specified in the official manufacturer information, otherwise the approval for use in potentially explosive atmospheres becomes void.
- Follow the sequence of the commissioning procedure described in this Section.
- Adhere to the prescribed maintenance intervals (see “Maintenance plan”, page 90).
- Do not insert or remove the power supply plug on the sender/receiver unit when under voltage.
- System components without explosion protection marking must not be used in potentially explosive atmospheres.
- Potentially explosive atmosphere:
  - Observe transport regulations, e.g. no transport of packaging materials in the potentially explosive atmosphere.
  - Do not carry out any mounting work or commissioning in the potentially explosive atmosphere.
    Commissioning, decommissioning and cleaning may only be performed when it is verified that no explosive media are present (verification by gas detector).
  - Only specified work on the device described in the following Sections may be performed.
  - Only use trained personnel in the potentially explosive atmosphere.
  - Only use tools suitable for the potentially explosive atmosphere.
  - Observe behavior rules to prevent sparks.
  - Only work that does not affect ignition protection is allowed.

8.2 Requirements for commissioning

The following requirements must be met before starting commissioning:

- All specifications are met in accordance with the project planning.
- All the work in the Mounting Section has been completed and checked.
- Electrical installation is completed and checked.
- Measuring point has been checked for free access without problems or hazards.
- Have the “DHSP100EX3K Commissioning, Service and Repair Checklist” (Part No. 4115621) available, document activities and then archive.
  The Checklist can be found on the product data medium, alternatively please contact Endress+Hauser Service.

8.3 Inserting and switching on

8.3.1 Adapting the sender/receiver unit to the duct geometry

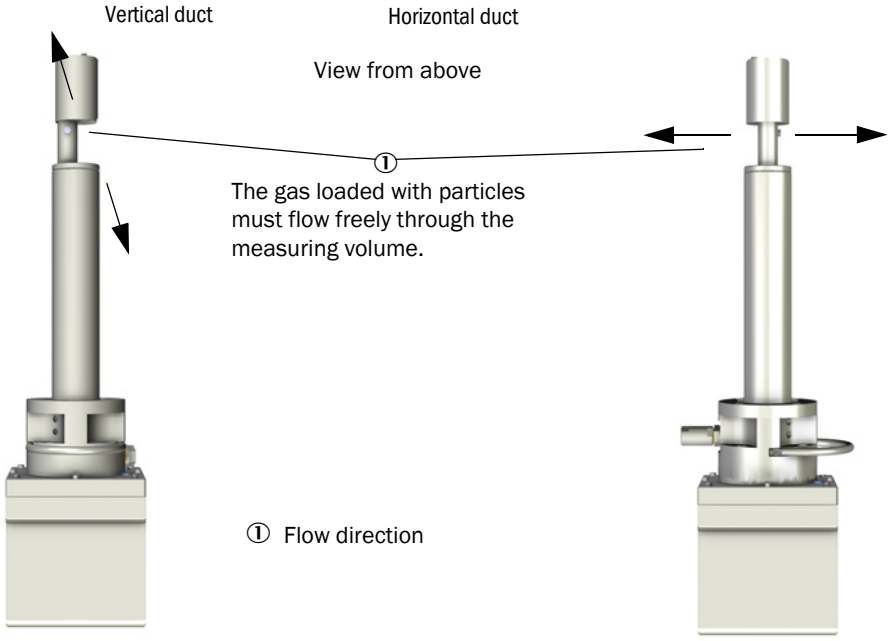


Fig. 40: Measuring probe alignment

The sender/receiver unit is delivered for vertical fitting as standard when the duct direction (horizontal or vertical) is not specified in the order. Rotate the sender/receiver unit 90° when fitting on a horizontal duct. This task may only be carried out by trained personnel, please contact Endress+Hauser Service for this purpose.

8.3.2 Fitting and connecting the sender/receiver unit

WARNING:
Risk of poisoning by exhaust gases
When installing the sender/receiver unit in systems in plants with a potential hazard, toxic or aggressive gases or dusts may escape and cause injury through inhalation or contact.
- ▶ In case of potential danger, only install the sender/receiver unit on the duct when the system is at a standstill.

The sender/receiver unit is already connected to the purge gas supply (see “Installing the purge gas supply”, page 60) and connected to the control unit (see “MCU processor board connections”, page 59) with the connecting cable, the steps for insertion in the duct now follow:

1 Connect a flexible potential equalization cable that allows the sender/receiver unit to be removed from the duct when connected.
2 Activate the purge gas supply.
3 Push the sender/receiver unit with the correct alignment (see “Adapting the sender/receiver unit to the duct geometry”, page 65) into the flange with tube. Do not forget the seal and fasten it with the assembly kit (see “Fastening technology”, page 129). Make sure the probe head is not damaged during fitting.
4 Switch the supply voltage on.

8.4 Recognizing the safe operating state

The system is in proper operation when:

- A system check has been carried out according to the Maintenance plan before commissioning and in running operation.
- The green status indicator on the control unit lights up and operating status “Operation or Power” (MCUDH Ex or MCU) is shown on the display.

Recognizing malfunctions

At this stage of commissioning, a display of the malfunctions can only be seen on the control unit. Any deviation from normal operation must be regarded as a serious indication of a functional impairment or unsafe operating state. These are, amongst others:

- Indication of malfunctions on the LC display
- The red LED lights up (error / malfunction)
- Implausible measurement results
- Increased power consumption
- Increased system components temperature
- Triggering of monitoring devices
- Smells or smoke emission

Electrical connection

Ensure the device can be switched off with a power isolating switch or circuit breaker in accordance with EN 61010-1.

9 Configuring

9.1 Prerequisites

Prerequisite for the work described in the following is completion of mounting, electrical installation and commissioning as described in Sections 6, 7 and 8.

9.2 SOPAS ET

9.2.1 Install SOPAS ET

- Install SOPAS ET on a computer (see “SOPAS ET user interface”, page 37).
- Start SOPAS ET.
- Follow the SOPAS ET installation instructions.

9.2.2 Password for SOPAS ET

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

Table 14: SOPAS ET user levels

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

9.2.3 Changing the password for SOPAS ET menus

To change the password for a user level, the operator must be logged in to SOPAS ET at the appropriate level. To do this, start SOPAS ET and add a connected device to the project. Open the device window by double-clicking on the connected device and log in to the user level for which the password is to be changed. In the command bar, a menu is named after the connected device, click “Passwort ändern” (Change password) in this pull-down menu.

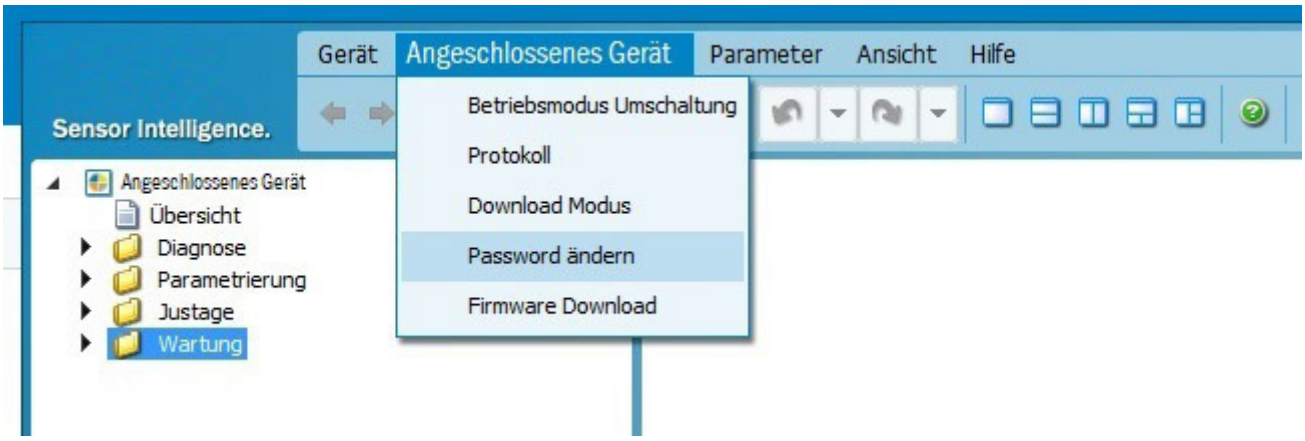


Fig. 41: SOPAS ET menu: Pull-down menu for the connected device

9.3 Connecting to the MCUDH Ex-3K control unit

9.3.1 Connection via RS485 Service interface to USB

Recommended procedure:

1 Establish electrical connections (see “MCHDH communication options”, page 61 Option 1).
2 Switch control unit on.
3 Start SOPAS ET.
4 Select “Search settings”.
5 “Device family oriented search”
6 Click MCU control unit.
7 Make the settings:
  – Serial communication: Click
  – Do not specify IP addresses.
8 A list of virtual COM ports is displayed.
  Activate the DUSTHUNTER COM port.
  If you do not know the COM port: see “Finding the DUSTHUNTER COM port”, page 81.
9 Enter a name for this search if you want to save it.
10 Click “Finish”.

9.3.2 Connection MCUDH Ex-3K via RS485 Ethernet

Recommended procedure:

1 Establish electrical connections (see “MCHDH communication options”, page 61 - Option 2, 4 or 5).
2 Configure the Ethernet module using the manufacturer software and note the IP address, port and network.
3 Connect the laptop/PC with the Ethernet module.
4 Connect the switched off control unit to the network cable (LAN).
5 Switch control unit on.
6 Start SOPAS ET.
7 “Search settings”
8 “Search by interface”
9 Make the settings:
  – Ethernet communication (activate)
10 Enter the noted IP address of the Interface module.
11 Enter a name for this search if you want to save it.
12 Click “Finish”.

9.3.3 Connecting a separate Ethernet Interface module

The optional integrated Interface module of the MCUDH Ex-3K control unit allows to connect further optional Ethernet interface modules via a RS485 connecting cable (see “Options for MCUDH Ex-3K control unit”, page 130).

Starting from the RS485 output of the internal Interface module, a cable is required from here to outside the potentially explosive atmosphere, where the Ethernet module is then connected (see “MCUDH Ex-3K interface options”, page 63).

For such a connection, the separate Ethernet module must be set to the same IPv4 network address used in the network in which the Ethernet connection is connected. The documentation supplied with the optional Ethernet module contains the necessary information. No software updates are possible via the Ethernet interface, these must be carried out via the Service interface (see “MCUDH Ex-3K interface options”, page 63).

9.3.4 Configuring the RS485 Modbus ASCII/RTU Interface module

If a control unit model that already contains the optional RS485 / Modbus® ASCII/RTU Interface module from the factory is selected, this is already preconfigured. Configuring is necessary when the module is subsequently integrated. The USB service interface must not be used inside the potentially explosive atmosphere, therefore configuring must be carried out outside this area. The following steps are then necessary:

1 Select device file “MCU”, set the measuring system to “Maintenance” mode
2 Enter the Level 1 password (see “Password for SOPAS ET”, page 67).
3 Switch to the “Configuration / System Configuration” directory.
The field “Installed Interface Module” shows the installed Interface module. This module must be selected because only an RS485 connection is possible for the explosion-proof MCUDH Ex-3K control unit.
4 Installed Interface module: Select RS485.

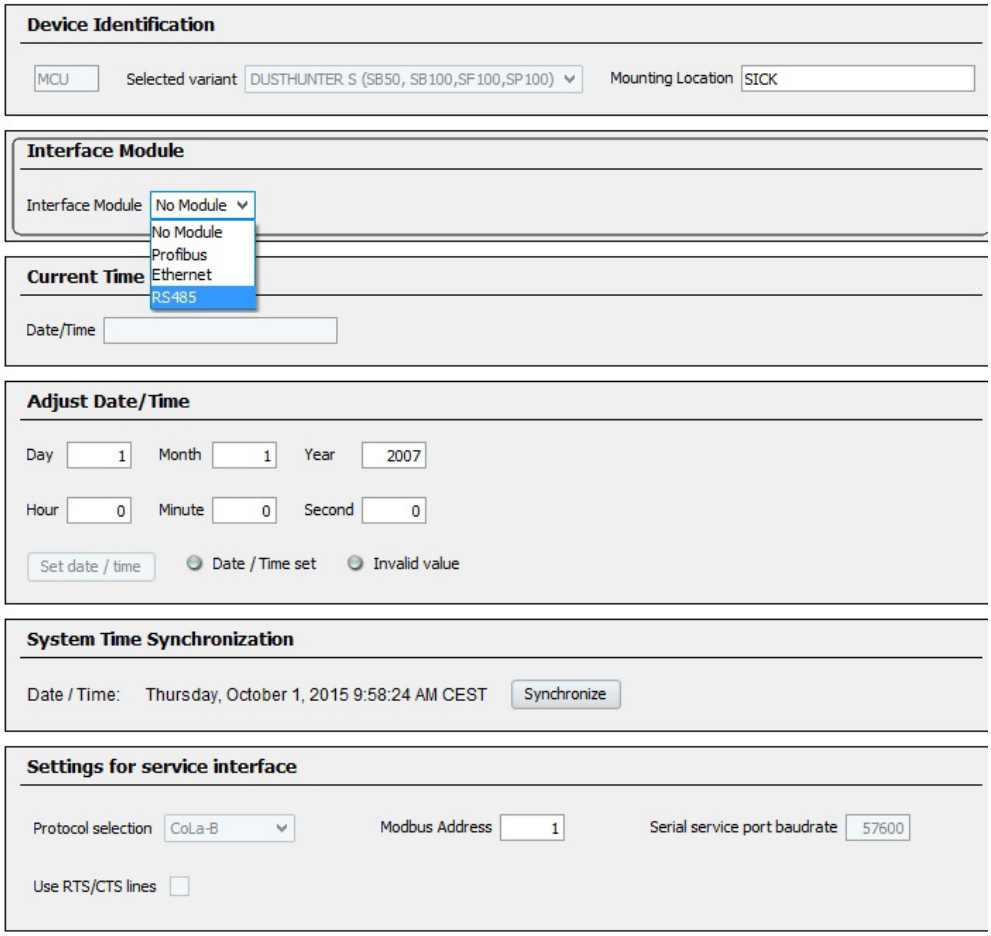


Fig. 42: SOPAS ET menu: MCU/Configuration/System Configuration

5 Configure the Interface module according to requirements.
Nothing else has to be configured on the RS485 module.

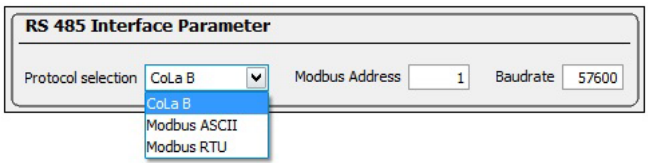


Fig. 43: SOPAS ET menu: MCU/IO Configuration/Interface module

9.4 Connecting to the MCU control unit

9.4.1 Connection to the MCU via Ethernet

Recommended procedure:

1 MCU must be switched off.
2 Connect the MCVU to the network (network cable to Interface module).
3 Connect laptop/computer to the same network.
4 Switch MCU on.
5 Start SOPAS ET.
6 “Search settings”
7 “Device family oriented search”
8 Click desired MCU.
9 Make the settings:
  – Activate Ethernet communication
10 Enter IP address
  IP address: see “Configuring the MCU control unit Ethernet module”, page 71
11 Do not click any COM port.
12 Assign a name for this search.
13 Click “Finish”.

9.4.2 Configuring the Interface module of the MCU control unit

The following steps are necessary to select and set the optionally available Interface modules PROFIBUS DP, Modbus® TCP and Ethernet Type 1:

1 Select device file “MCU”, set the measuring system to “Maintenance” mode
2 Enter the Level 1 password (see “Password for SOPAS ET”, page 67).
3 Switch to the “Configuration / System Configuration” directory.
4 The field “Installed Interface Module” shows the installed Interface module.
5 Configure the Interface module according to requirements.

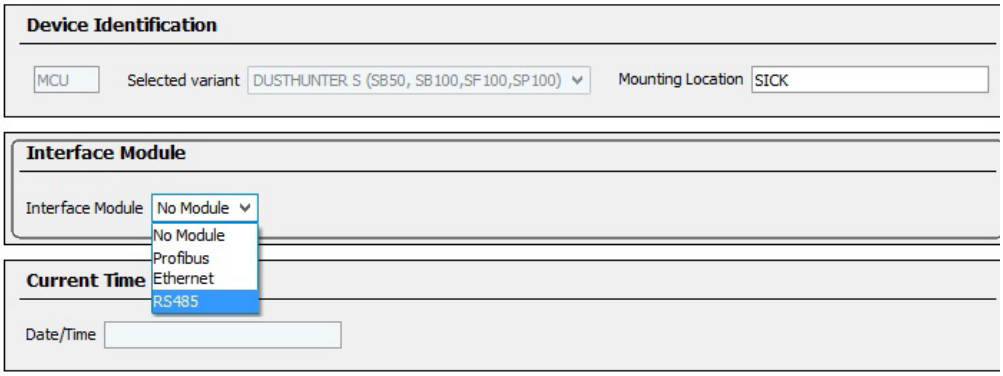


Fig. 44: SOPAS ET menu: MCU/Configuration/System Configuration

NOTICE:
There is a risk of unwanted access to the measuring system when communicating via Ethernet.
▶ Only operate the measuring system behind a suitable protective barrier (e.g. firewall).

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

9.4.3 Configuring the MCU control unit Ethernet module

Standard setting: 192.168.0.10

A default IP address is set if desired.

To change the settings:

- ▶ Switch to directory “Parameterization / IO Configuration / Interface module”.
- ▶ Set the desired network configuration and press the “Reset module” button in the “Expansion Module Information” field.

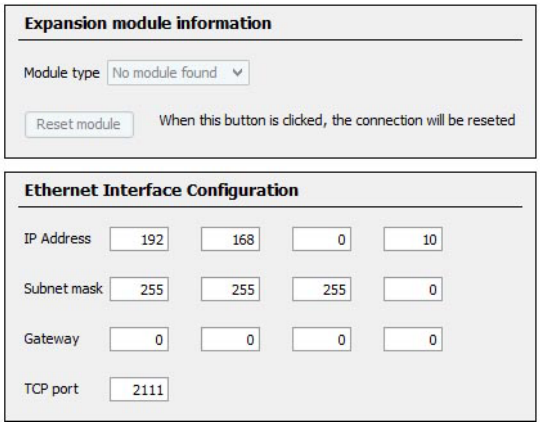


Fig. 45: SOPAS ET menu: MCU/Configuration/IO Configuration/Interface module

9.5 System configuration

9.5.1 Application parameters

Assign the sender/receiver unit to the measuring location

The sender/receiver unit can be assigned explicitly to the respective measuring location. The following steps are then necessary:

1 Start the SOPAS ET program and connect to the measuring system (see “SOPAS ET”, page 67).
2 Select device file “DH SP100” and move it to the “Project Tree” window.

> The respective device version connected is displayed automatically

3 Enter password level 1.
4 Set the sender/receiver unit to the “Maintenance” state: Check the box and click the corresponding button.

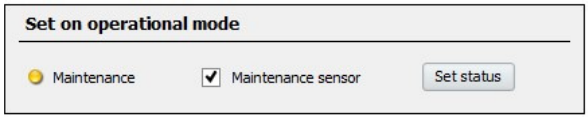


Fig. 46: SOPAS ET menu: DH SP100/Maintenance/Maintenance

5 Select the “Configuration / Application Parameters” directory and enter the desired data in the “Mounting location” entry field under “Device Identification”.

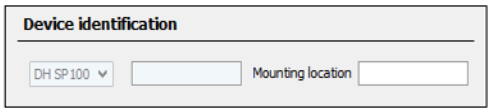


Fig. 47: SOPAS ET menu: DH SP100/Configuration/Application parameters (top window)

9.5.2 Assigning the control unit to the sender/receiver unit

The sender/receiver unit must be connected to the control unit.

The control unit must be set to the sender/receiver unit to be connected. A malfunction is reported in case of a mismatch. Assignment must be made after installation when the setting is not possible at the factory (e.g., when several devices are delivered at the same time or when the device is swapped later). The following steps are then necessary:

1 Connect the measuring system to the SOPAS ET program.
2 Enter the Level 1 password (see “Password for SOPAS ET”, page 67).
3 Set the sender/receiver unit to “Maintenance”: Click “Maintenance sensor”.

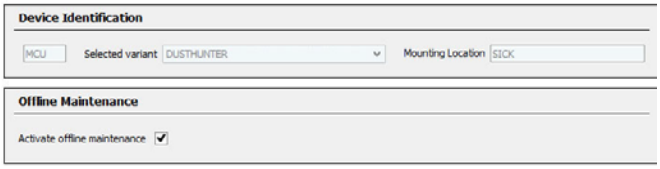


Fig. 48: SOPAS ET menu: MCU/Maintenance/Maintenance

4 Switch to the “Configuration / Application selection” directory.
5 The basic type of the sender/receiver unit connected is displayed in the “Connected variant” window (field “Application selection”). Click “Save selection” to assign to the control unit.

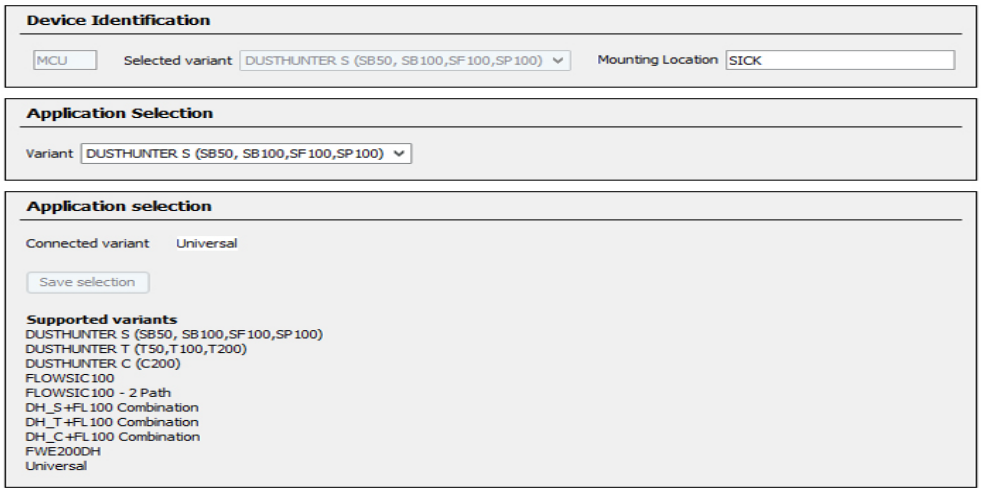


Fig. 49: SOPAS ET menu: MCU/Configuration/Application selection

9.5.3 Factory settings

Table 15: Factory settings

Parameter		Value	
Function check		Every 8 h; output of control values (every 90 s) on standard analog output	
Analog output (AO) [mA]	Live Zero (LZ)	4	
	Measuring range end value (MBE)	20	
	Current during maintenance	0,5	
	Current by malfunction	21 (optional 1)	
Response time		60 seconds for all measured variables	
Measured variable	Output on AO	Value at LZ	Value at MBE
Dust concentration [mg/m³]	1	0	200
Scattered light intensity	2		
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. For this purpose, the devices must be connected in SOPAS ET (see “SOPAS ET”, page 67), the Level 1 password set and the “Maintenance” mode set.

9.5.4 Setting the function check

Interval time, control value output on the analog output and the starting timepoint for automatic function check can be modified in the “Adjustment / Function Check - Automatic” directory.

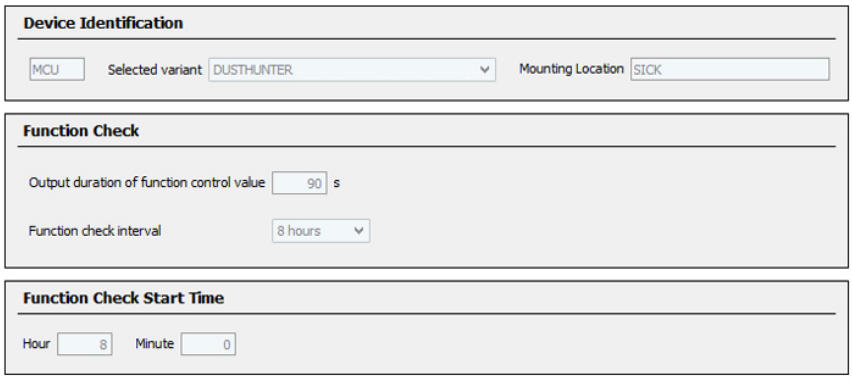


Fig. 50: SOPAS ET menu: MCU/Adjustment/Function Check - Automatic (example)

Standard values: see “Factory settings”, page 73

Table 16: Function check setting options

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 “Function check”, page 32
Function Check Start Time	Hour	Defining a start timepoint in hours and minutes.
	Minute	

The value measured last is output during control value determination (see “Function check”, page 32).

9.5.5 Setting the analog outputs parameters

- Standard values see “Factory settings”, page 73
- In order to output the dust concentration under standard conditions (“Conc. s.c.” (Ext)), set the parameters for the analog outputs according to see “Setting the analog inputs parameters”, page 76.

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

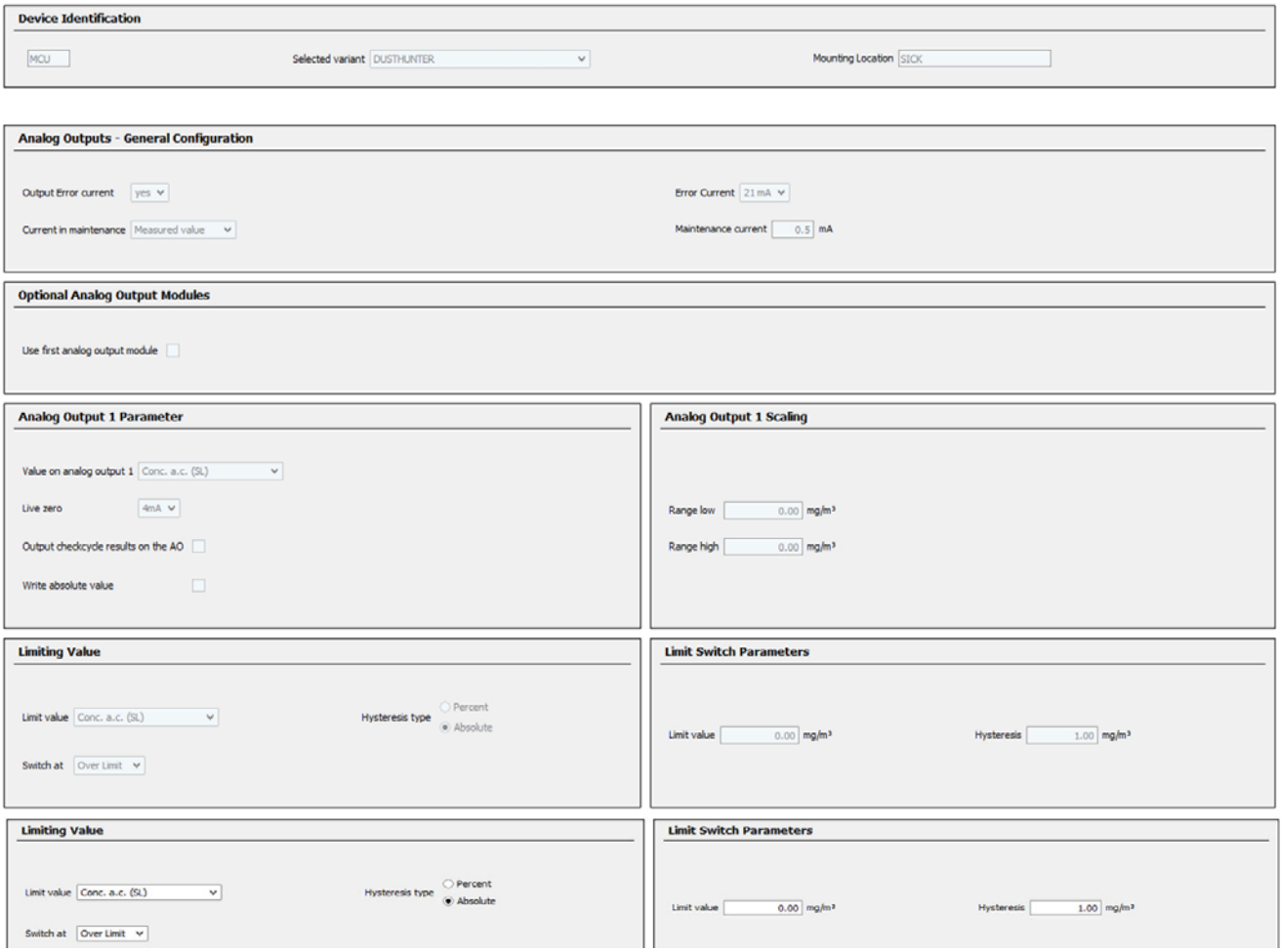


Fig. 51: SOPAS ET menu: MCU/Configuration/IO Configuration/Output Parameters

Table 17: Analog outputs

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).	
	Current in maintenance	User defined value	A value to be defined is output during “Maintenance”.	
		Last measured value	The value measured last is output during “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.	
Optional Analog Output Modules	Use first analog output module	Inactive	Not permitted for DUSTHUNTER SP100 Ex-3K (results in error, because AO 2 and AO 3 are available by default).	
		Active	Opens the fields to set parameters for AO 2 and AO 3 (standard for DUSTHUNTER SP100 Ex-3K).	
Analog Output 1 Parameter	Value on analog output 1	Concentration a.c. (SI)	Dust concentration in operating state (based on scattered light intensity).	The selected measured variables are output on the analog output.
		Concentration s.c.dry O2 corr. (SI)	Dust concentration under standard conditions (based on scattered light intensity).	
		SI	Scattered light intensity.	
	Live zero	Zero point (0, 2 or 4 mA)	Select 2 or 4 mA to ensure being able to differentiate between measured value and switched off device or interrupted current loop.	
	Output check cycle results on the AO	Inactive	Control values (see “Function check”, page 32) 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	Measured value	Concentration a.c. (SL)	Dust concentration in operating state (based on scattered light intensity).	Select the measured variable for which a limit value is monitored.
		Concentration s.c.dry O2 corr. (SL)	Dust concentration under standard conditions (based on scattered light intensity).	
		SL	Scattered light intensity.	
	Hysteresis type	Percent	Assignment of the value entered in the “Hysteresis value” field as relative or absolute value of defined limit value.	
		Absolute		
	Switch at	Value exceeded	Define the switching direction.	
		Underflow		
Switch Parameters	Limit value	Value	The limit value relay switches when the entered value is overflown or underflown.	
	Hysteresis	Value	Defines a tolerance for resetting the limit value relay.	

9.5.6 Setting the analog inputs parameters

Select the “Configuration / I/O Configuration / Input Parameters DUSTHUNTER” directory to set the analog inputs.

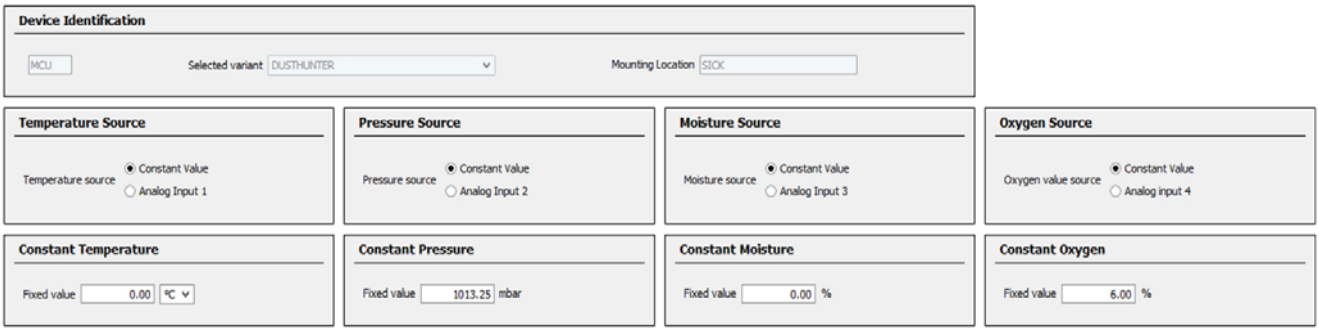


Fig. 52: SOPAS ET menu: MCU/Configuration/IO Configuration/Input Parameters

Table 18: Analog inputs

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 (° F for imperial units) 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.

9.5.7 Setting the response time

Select the “Configuration / Value Damping” directory to set the damping time (response time).

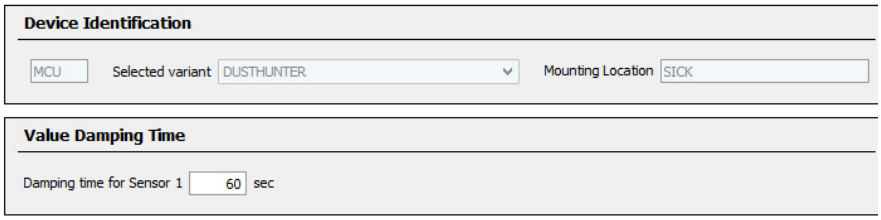


Fig. 53: SOPAS ET menu: MCU/Configuration/Value Damping

Erratic increases in measured values can be “calmed” with the damping time, a longer damping time reduces output signal fluctuations.

Table 19: Damping time

Field	Parameter	Remark
Damping time Sensor 1	Value in s	Damping time for the measured variable Setting range 1 ... 600 s

9.5.8 Gravimetric comparison measurement / calibration

DHSP100 Ex-3K uses the optical principle of scattered light measurement. The primary measurand is the scattered light intensity (SI or SL). It is proportional to the dust concentration, but is not only dependent on the number and size of the particles, but also on their optical properties.

To be able to output the dust concentration in mg/m^3, the DHSP100 Ex-3K measuring system must be calibrated by gravimetric comparison measurements. During calibration, a calibration curve is determined that establishes the relationship between scattered light intensity and dust concentration. The calibration curve is a polynomial function defined by its coefficients cc0, cc1 and cc2.

The procedure for gravimetric comparison measurements and the creation of a calibration curve (determination of the coefficients cc0, cc1 and cc2) is described in detail in DIN EN 13284-1 and DIN EN 13284-2.

NOTE:
Gravimetric comparison measurements and the creation of the calibration function require special equipment and knowledge. In most cases, this work is carried out by accredited measuring institutes.

Via SOPAS ET, the determined coefficients can be entered as parameters of the stored polynomial function. If this is done, the dust concentration can be output in mg/m^3 (a.c.).

The conversion of scattered light to dust concentration by means of a calibration curve can also be performed in a downstream emission measurement computer. In this case, the coefficients cc0, cc1 and cc2 in the DHSP100 Ex-3K remain at the default values 0, 1, 0.

The coefficients calculated for the calibration curve are entered in the emission value calculator in order to now calculate the dust concentrations there.

Entering the calibration coefficients into the DHSP100 Ex-3K

1 Start SOPAS ET and connect it with the MCU and DHSP100 Ex-3K.
2 Select the device file “DHSP100” and set DHSP100 Ex3K to “Maintenance”.
3 Enter the Level 1 password (see “Password for SOPAS ET”, page 67).
4 In the menu: “Configuration / Application Parameters”, enter the coefficients cc0, cc1, cc2. Depending on the operating mode of the exhaust gas system, it may be necessary to temporarily use a second calibration function.
The coefficients for this are entered accordingly in the lower field.

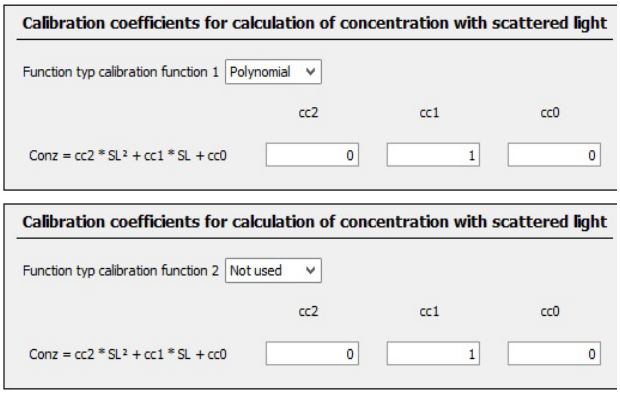


Fig. 54: SOPAS ET-Menu: SP100/Configuration/Application parameters

5 The second calibration function is activated via digital input DI4 of the MCU. For this purpose, the “DI4 function” must be set to “Send status to sensors” in the SOPAS ET menu “Configuration / I/O Configuration / Input Parameters”. (Password level 2 required).

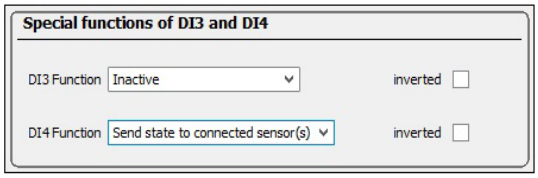


Fig. 55: SOPAS ET-Menu: MCU/Configuration/ I/O Configuration/Input Parameters

6 After entering the coefficients, set the DHSP100 Ex-3K back to the “Measurement” operating state.

9.5.9 Changing display settings

To change factory settings, connect SOPAS ET to the control unit (see “Connecting the control unit”, page 56), enter the level 1 password and select the “Configuration/Display Settings” directory.

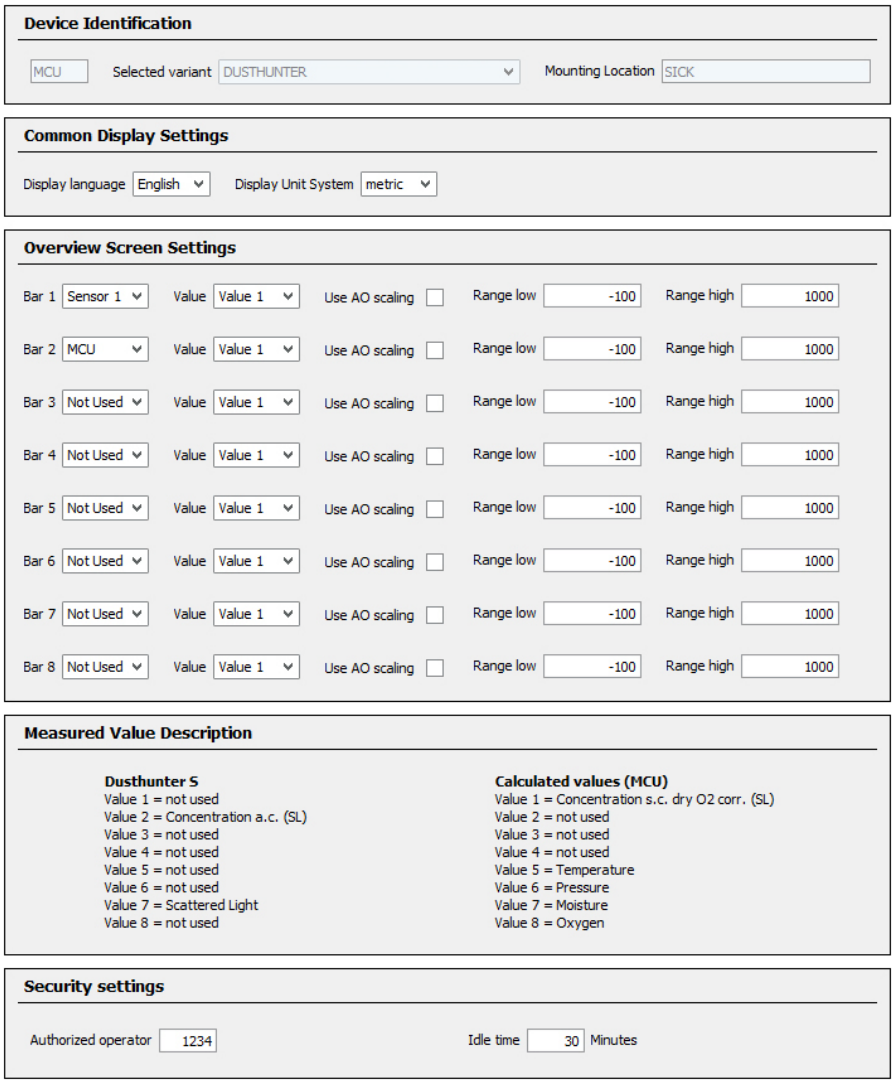


Fig. 56: SOPAS ET menu: MCU/Configuration/Display Settings

Table 20: Display settings

Window	Entry field	Significance
Common Display Settings	Display language	Language version shown on the LC display
	Display Unit System	Unit of measurement used in LC display
Overview Screen Settings	Bars 1 to 8	Number of the measured value for the measured value bar of the graphic display.
	Measured 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 this selection field is not activated, define the limit values separately.
	Range low	Values for the separate scaling of the measured value bar, independent of the analog output.
	Range high	
Security Settings	Authorized operator	Password input for the Display menu operating level “Authorized Operator” (Default: 1234).
	Idle time	Time until user level “Authorized Operator” is automatically switched off again.

Settings overview screen

Table 21: Assignment of the measured values in the control unit

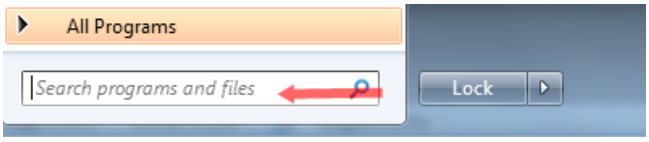
Measured value	Assignment
Value 1 - Sensor	Not used
Value 2 - Sensor	Concentration a.c. (SI)
Value 3 - Sensor	Not used
Value 4 - Sensor	Not used
Value 5 - Sensor	Not used
Value 6 - Sensor	Not used
Value 7 - Sensor	Scattered light
Value 8 - Sensor	Not used
Value 1 - Control unit (MCU)	Concentration s.c. dry O2 corr. (SI)

9.6 Finding the DUSTHUNTER COM port

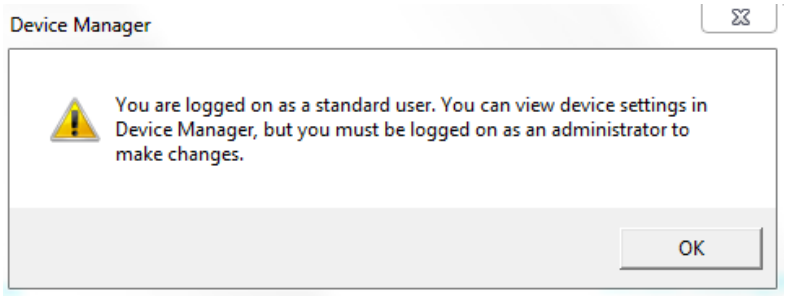
If the COM port is not known:

The COM port can be found with the Device manager (Administrator rights are not required).

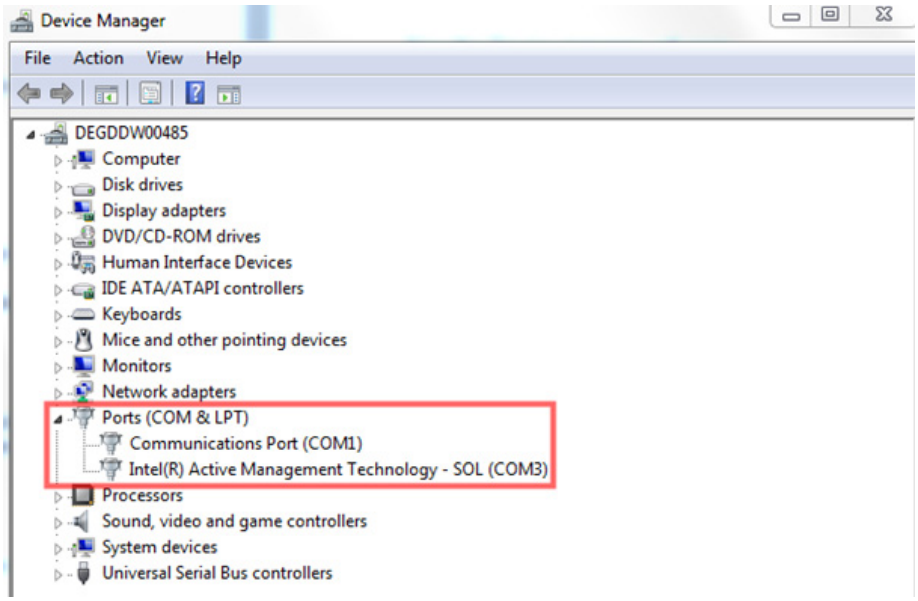
1 Disconnect the connection of the DUSTHUNTER and your PC.
2 Input: *devmgmt.msc*



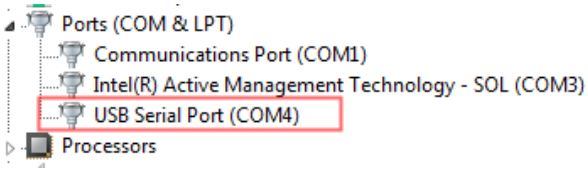
3 This message is shown:



4 “OK”
5 The Device Manager opens.
See: “Ports (COM and LPT)”



6 Connect the control unit with the computer.
A new COM port is shown.



7 Use this COM port for communication.

10 Operation

10.1 Operating concept

The control unit of the measuring system has an LC display, buttons for operation and status LEDs. Alternatively, the control unit can be connected to an external device and operated using the SOPAS ET software (see “SOPAS ET”, page 67).

- Many menus and functions can also be used via the display.
- The menus and functions are called up using the buttons.
- Status LEDs on the display indicate the current operating status.

NOTE:
The display can also be operated in the potentially explosive atmosphere.

10.2 User groups

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

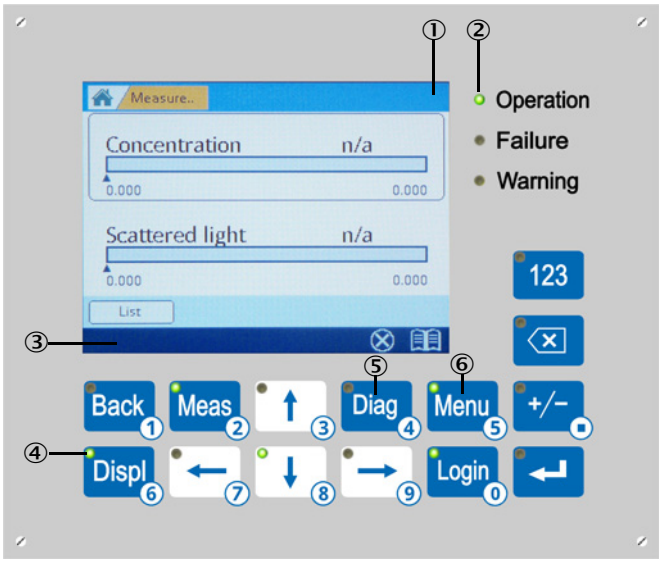
Table 22: User groups on the control unit

User group		Access to
0	Operator	Displays measured values and system states No password required.
1	Authorized operator	Displays, inquiries as well as parameters required for commissioning or adjustment to customer-specific demands and diagnosis (preset password: 1234).

10.2.1 Changing the password for user groups

The password for the user groups on the control unit can be changed in the display settings in SOPAS ET (see “Changing display settings”, page 79).

10.3 MCUDH Ex-3K displays and operating elements



① Display field
② Status LED
③ Status bar
④ Active buttons
⑤ Overview of warning messages Button: “Diag”
⑥ Configuration menu Button: “Menu”

Fig. 57: Function elements, LC display, MCUDH Ex-3K control unit

10.4 MCUDH Ex-3K control unit buttons

The function shown depends on the menu currently selected. All buttons that can be selected for the respective menu are indicated by an illuminated LED.

Table 23: MCUDH Ex-3K control unit buttons

Button	Name	Function
Login 0	Login button	Displays the login.
Back 1	Back button	Returns to the previous display.
Meas 2	Measured value button	Displays current measured values.
↑ 3	Arrow up button	Navigates through menu items.
Diag 4	Diagnostics button	Displays warnings and malfunctions.
Menu 5	Menu button	Calls up the Settings menu.
Displ 6	Display button	Calls up the display settings.
← 7	Arrow left button	Navigates through menu items.
↓ 8	Arrow down button	Navigates through menu items.
→ 9	Arrow right button	Navigates through menu items.
123	Number button	Activates the numeric function of the buttons.
⌫	Delete button	Deletes entries character by character.
+/-	Plus-minus button	Sets plus or minus.
↵	Confirmation button	Confirms the entry.

10.5 MCU control unit displays and operating elements

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

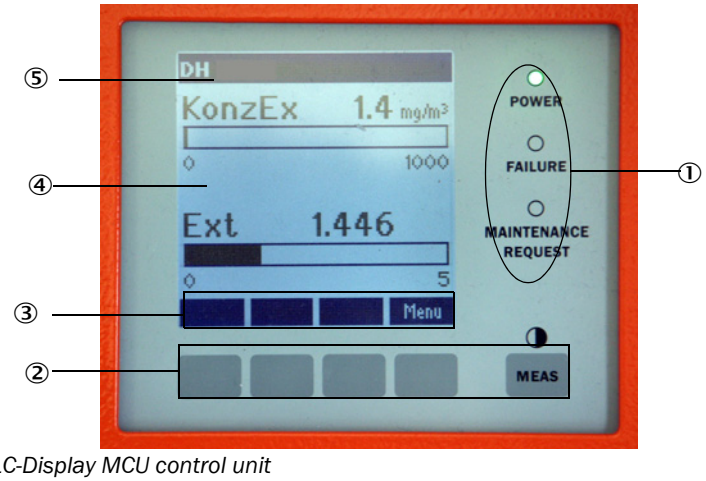


Fig. 58: Functional elements LC-Display MCU control unit

11 Menus

11.1 MCU and MCUDH Ex-3K control units menu structure

The menu structure of the control units is divided into the functions for configuration (“Menu“ button) and an overview of the warning and error messages (“Diagnostics” button). The respective functions can be selected directly via the buttons (depending on the version of the control unit, see “MCUDH Ex-3K displays and operating elements”, page 82 or see “MCU control unit displays and operating elements”, page 83).

11.1.1 Configuration (Menu)

Menu level	Designation	Explanation
1	I/O (MCU)	Control unit settings
1.1	Operating mode	Setting the maintenance mode or operating mode of the control unit
1.1.1		Set Maintenance / Set Operation
1.2	Adjustment	Start check cycle
1.2.1		Start check cycle
1.3	I/O Diagnosis	AO / AI / Device info
1.3.1	Analog output	Display current signal values n
1.3.2	Analog input	Display current signal values
1.3.3	Device Info	Control unit information text
1.4	I/O Parameter	Analog interfaces, set to sensor type
		(Requires maintenance mode condition)
1.4.1	AO Parameter	Selection of analog output
	The parameterization of the analog interfaces is identical, therefore the submenu for analog input and analog output is only listed once each.	
	The identical number of the submenu and interface is marked with “x”.	
1.4.1.x	AO x	End values, Live Zero, measured value source
1.4.1.x.1	Limit low	Set limit low in mg/m³ (password required)
1.4.1.x.2	Limit high	Set limit high in mg/m³ (password required)
1.4.1.x.3	Live Zero	Set zero point for 0/2/4 mA signal strength
1.4.1.x.4	Measured value	Assign a measured value source to interface AO x :
	ConcA_SL *ConcN* *SL*	*Dust concentration in operating condition* *Dust concentration in standard condition* *Scattered light intensity*
1.4.2	AI Parameter	Analog input selection
1.4.2.x	AI x	Assign end values (temperature and pressure)
1.4.2.x.1	Limit low	Set limit low in °C / hPa (password required)
1.4.2.x.2	Limit high	Set limit high in °C / hPa (password required)

1.4.3	Variant	Assigning the sensor type (usually assigned ex works) *This assignment is only necessary when the system has been changed. All compatible sensor types are displayed for selection.*
2	Sensor	Settings on measuring device
2.1	Operating mode	Set the maintenance mode or operating mode of the sensor
2.2	Parameter	Set regression coefficients (see “Gravimetric comparison measurement / calibration”, page 77) (Requires maintenance mode condition)
2.2.1	Coeff	Set Coefficient set 0-3 (see “Assigning the control unit to the sender/receiver unit”, page 72)
2.2.2	cc2	Set regression coefficients (password required)
2.2.3	cc1	Set regression coefficients (password required)
2.2.4	cc0	Set regression coefficients (password required)
2.3	Diagnosis	Display diagnosis values
2.4	Device info	Display sensor information

11.1.2 Warning and error messages (Diagnosis)

Menu level	Designation	Explanation
1	I/O (MCU)	Display MCU(FDH Ex) error and warning messages
1.1	Error	Display MCU(DH Ex) error messages
1.2	Warnings	Display MCU(DH Ex) warning messages
2	Sensor	Display sensor error and warning messages
2.1	Error	Display sensor error messages
2.2	Warnings	Display sensor warning messages

11.2 Configuring on the control unit display

Some configuration options can also be set directly on the control unit display. Some important functions are explained here in more detail as examples. The numbers behind the submenus refer to the numbering of the menus in the previous subsections.

11.2.1 Configuring analog outputs and inputs of the control unit

1 Set the control unit to “Maintenance” (1.1) and activate submenu “I/O Parameter” (1.4).
2 Select the setting of the “Analog output parameters” (1.4.1) or the “Analog input parameters” (1.4.2) and enter the password (see “User groups”, page 82) using the control fields.
3 Set the desired value using the operating fields. Press “Save” to save in the device.

11.2.2 Assigning the control unit to the sender/receiver unit

1 Set the control unit to “Maintenance” (1.1) and activate submenu “I/O Parameter” (1.4).
2 Select the setting of the “MCU variant” (1.4.3) and choose the type “DUSTHUNTER S”.
3 Enter the password (see “User groups”, page 82) using the operating fields and save the selected type with “Saved”.

11.2.3 Entering the regression coefficients

1 Set the sender/receiver unit to “Maintenance” (2.1) and activate submenu “I/O Parameter” (2.2).
2 Select the desired parameter and enter the password (see “User groups”, page 82) with the operating fields.
3 Enter the determined coefficient (see “Gravimetric comparison measurement / calibration”, page 77) with the operating fields and save to the device with “Save”.

12 Maintenance

Have the “DHSP100EX3K Commissioning, Service and Repair Checklist” (Part No. 4115621) available during maintenance, document activities and then archive.
The Checklist can be found on the product data medium, alternatively please contact Endress+Hauser Service.

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

- ▶ Connect the control unit with the computer. Start SOPAS ET.
- ▶ Connect to the MCU(DH-Ex3K) (see “Connecting the control unit”, page 56).
- ▶ Enter the Level 1 password (see “Password for SOPAS ET”, page 67).
- ▶ Set the sender/receiver unit to “Maintenance”: Click “Maintenance sensor”.

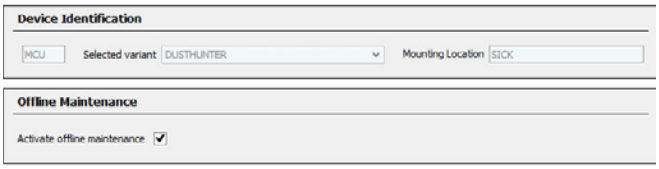


Fig. 59: SOPAS ET menu: MCU/Maintenance/Maintenance

Resuming measuring operation

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

- Maintenance” mode can also be set using the buttons on the optional control unit LC display (see “Menus”, page 84) or by connecting an external maintenance switch to the terminals for Dig In2 (17, 18) in the MCUDH Ex-3K and MCU control units (see “Processor boards connections of control units”, page 59).
- An automatic functional check is not carried out during “Maintenance”.
- The value set for “Maintenance” is output on the analog output (see “Setting the analog outputs parameters”, page 74). This is also applicable when a malfunction is present (signaled on relay output).
- The “Maintenance” mode is reset when there is a voltage failure. In this case, the measuring system switches automatically to “Measurement” after the supply voltage is switched on again. If “Maintenance” mode is set via the external maintenance switch (see top item), the mode is also maintained when there is a voltage failure.

12.1 Safety information

WARNING:
Risk of explosion during maintenance work
Risk of explosion during maintenance work in the potentially explosive atmosphere.
- ▶ Maintenance work must only be carried out outside the potentially explosive atmosphere.
- ▶ Only remove the sender/receiver unit from the duct when the surface temperature cannot be an ignition source.
- ▶ If necessary, use a gas detector to verify the explosion hazard.

DANGER:
Risk of explosion when using spare or expendable parts not approved for the potentially explosive atmosphere
All spare and wear parts are tested by Endress+Hauser for use in the potentially explosive atmosphere. The use of other spare and expendable parts will invalidate the claim against Endress+Hauser because the ignition protection cannot be guaranteed.
- ▶ Use only original spare parts and expendable parts from Endress+Hauser.

WARNING:
Health hazards through dangerous process residues
The device may be contaminated by dangerous process residues.
- ▶ If process gas that is harmful to health is used, purge the unit thoroughly with purge gas, as necessary clean it with water and suitable agents.

12.2 Data backup

12.2.1 Data backup in SOPAS ET

All parameters relevant for recording, 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

- 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.

Example for Parameter protocol

Dusthunter - Parameter protocol

Type of device: DH SP100
Mounting location: DHSP100-Ex3K
Sensor 1 - DHSP100-Ex3K

Device information

Device version	
Firmware version	01.08.00
Serial number	00008700
Identity number	03665
Hardware version	1.1
Firmware bootloader	01.00.02

Installation parameter

Bus adress	1
Measurement laser temperature	inactiv
Calibration coefficient for calculation of concentration	
Coefficient set	Polynomial
Set 0	
cc2	0.0010
cc1	1.0040
cc0	0.0200
Set 1 (fix)	
cc2	0.0000
cc1	0.5000
cc0	0.0000
Set 2 (fix)	
cc2	0.0000
cc1	2.0000
cc0	0.0000
Set 3 (fix)	
cc2	0.0000
cc1	3.0000
cc0	0.0000

Device parameter

Factory settings		
Response time Sensor	1.0	s
Response time diagnosis values	10.0	s

Factory calibration settings

Gains	
AN0-AN1	10.2000
Relais 1	5.7200
Relais 2	31.3000
Relais 3	863.0000
Offsets	
AN0	0.000250
Relais 1	0.000600
Relais 2	0.000180
Relais 3	0.000020
Scattered light	
cc2	0.0000
cc1	1.0000
cc0	0.0000
Current laser	
cc2	0.0000
cc1	30.3000
cc0	0.0000
Device temperature	
cc2	0.0000
cc1	100.0000
cc0	-275.1500
Current motor	
cc2	0.0000
cc1	2000.0000
cc0	-19.5000
Power supply	
cc2	0.0000
cc1	10.8000
cc0	0.0000

Fig. 60: Parameter protocol DUSTHUNTER SP100-Ex3K

12.3 Maintenance plan

Maintenance intervals

The equipment operator must specify the maintenance intervals. The period depends on existing operating parameters such as dust content and state, gas temperature, how the equipment is run and ambient conditions.

The work to be performed in each case and its execution must be documented by the operator in a Maintenance Manual and the “DHSP100EX3K Commissioning, Service and Repair Checklist” (Part No. 4115621) and filed with the verification documents for the device. The Checklist can be found on the product data medium, alternatively please contact Endress+Hauser Service.

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 desired, Endress+Hauser Service or authorized Service support centers can carry out all maintenance work. Any repairs will be made by specialists on-site, whenever possible.

12.4 Consumables and spare parts

Consumables and spare parts for the measuring system are listed in the Spare parts Section (see “Spare parts”, page 127).

To facilitate device maintenance, Endress+Hauser offers a set of spare and wear and tear parts. In addition to the required wear and tear parts for 5 years, this set contains a selection of small parts that may only be replaced with original parts if lost (see “Spare parts DUSTHUNTER SP100 Ex-3K”, page 128).

12.5 Maintenance on the sender/receiver unit

Information on sender/receiver maintenance

- Commissioning and decommissioning, maintenance and cleaning may only be performed after verification that no explosive gases are present (verification by gas detector).
- Check the potential equalization for corrosion, other damage and secure contacts.
- Check cables for damage and strain relief.
- Check that the locking parts of the device are firmly locked (laser adjustment opening, cleaning opening, purge gas connection, hood, plug, sight glass).
- There is a risk of explosion when pulling the sender/receiver unit out from the duct due to the hot surface of the measuring probe and possibly escaping combustible gases. Ensure the probe is either cold or the temperature thus significantly below ignition temperature or no risk of explosion is present when removing the sender/receiver unit from the duct.
- Hot, aggressive or ignitable gas can escape when opening gas paths. Exercise particular caution and take the necessary safety precautions.

NOTICE:

Improper maintenance can lead to device damage

- ▶ Do not interrupt the purge gas supply.
- ▶ Eliminate maintenance requirements reported by the measuring system in a timely manner.

Clean the outside of the sender/receiver unit in regular intervals. Remove deposits with water or mechanically using suitable auxiliary means.

Clean the optical surfaces when deposits can be seen or, at the latest, when the limit values are reached (30% for warning, 40% for malfunction).

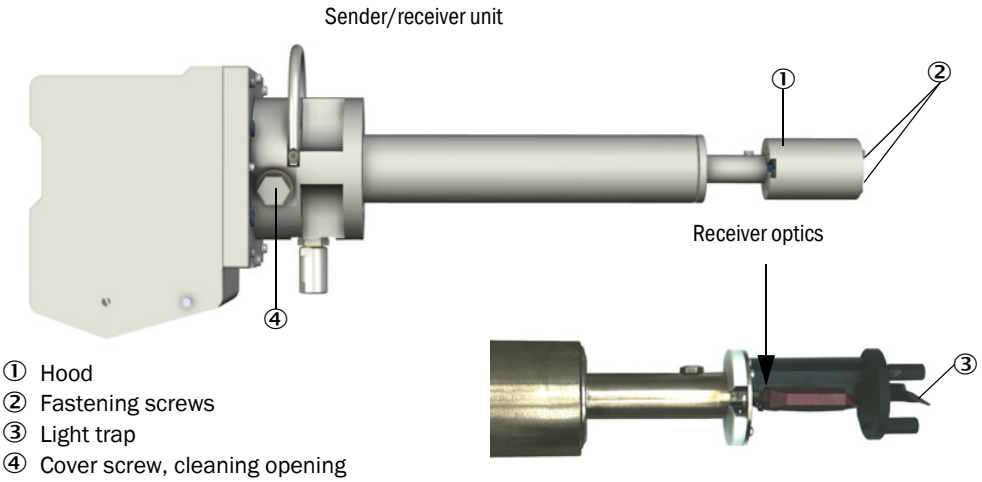
Minor contamination values can occur permanently and are negligible.

If contamination on the glass surfaces cannot be removed with the optics cloth, clean the glass surfaces with soap suds or a suitable cleaning agent (see “Consumable parts, SP100 Ex-3K sender/receiver unit”, page 127) and then dry.

WARNING:
Hazard through gas and hot parts
When cleaning the sender/receiver unit, toxic gases which can lead to poisoning can escape and hot parts can cause burns.
- Dismantle the sender/receiver unit from the duct for cleaning and then fit it back on again.
- Only carry out mounting work on systems with hazard potential (higher internal duct pressure, hot, aggressive, explosive gases or dusts) when the system is at a standstill.
- Take suitable protection measures against local or plant-specific hazards.

12.5.1 Cleaning the optics of the sender/receiver unit

- Remove the sender/receiver unit from the duct.
- Close off the flange with tube with a blind flange (see “Fastening technology”, page 129).
- Unscrew cover screw ④ from the cleaning opening for the sender optics (see “Replacing the seal in the cleaning opening”, page 96, steps 1 to 3).
- Loosen fastening screws ② for hood ① and remove hood.
- Clean the optics carefully and, as necessary, light trap ③ as well.



① Hood
② Fastening screws
③ Light trap
④ Cover screw, cleaning opening

Fig. 61: Cleaning the optical surfaces

12.5.2 Checking the contamination value

▶ Start the function check. To do this, select device file “MCU” and move it to window “Project Tree”. Switch to directory “Adjustment / Function Check - Manual”. Click “Start Manual Function Check”.

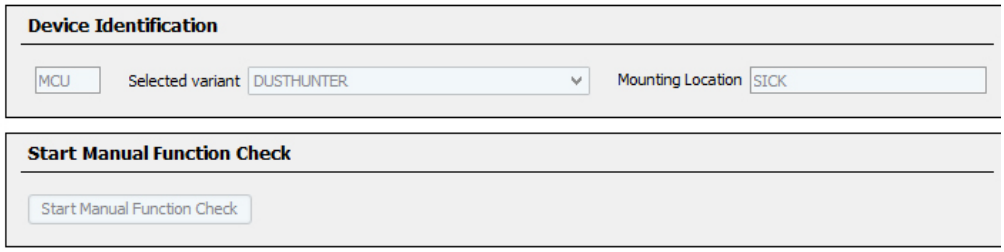


Fig. 62: SOPAS ET menu: MCU/Adjustment/Function Check - Manual

> The function check can also be started via the LC display on the MCU(DH Ex) (see “Menus”, page 84).

▶ Select the “DH SP100” device file in the “Project Tree” window, select the “Diagnosis / Check values” directory and check the contamination value.

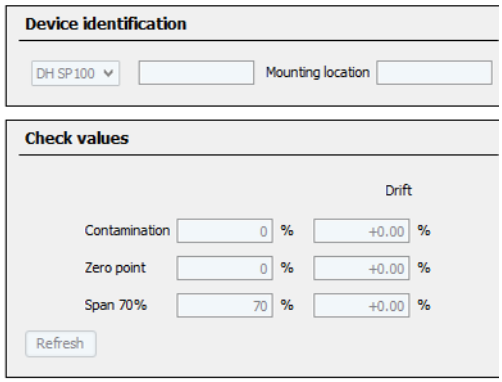


Fig. 63: SOPAS ET menu: DH SP100/Diagnosis/Check values

▶ When the measured values for contamination, zero point and span are within the allowed ranges, save them to the device by clicking the “Refresh” button (“Check values” field); if not, repeat cleaning and check the contamination value again by triggering a renewed function check.

> - The contamination value can also be displayed on the LC display of the MCU(DH Ex) (initiate a function check and switch to the “SP100/Diagnosis” menu, see “Menus”, page 84).
> - The device is probably defective when the contamination value does not sink below the warning value (30%) despite several cleaning processes → contact Endress+Hauser Service.

▶ Reassemble the sender/receiver unit. Remove the cover from the flange with tube (blind flange). Fit the sender/receiver unit on the duct.

▶ Resume measuring operation (see “Resuming measuring operation”, page 87).

12.5.3 Non-return valve

Make a visual check of the non-return valve at each service interval. Flushing can be performed if cleaning is required. Replace the non-return valve with a spare part when it no longer functions (see “Spare parts DUSTHUNTER SP100 Ex-3K”, page 128) (see “Exchanging the non-return valve”, page 100).

12.5.4 Test equipment for linearity test

Measurement linearity can be checked using a linearity test. In this case, filter glasses with defined optical damping (transmission) 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 as a set including documentation and a carrying case (see “Device check accessories”, page 130). The measuring function is checked by the function check and the linearity test.

12.5.5 Power supply without control unit

Due to the regulations for explosion protection, some maintenance activities must not be carried out in the potentially explosive atmosphere; the sender/receiver unit must be dismantled and transported out of the potentially explosive atmosphere for this purpose. Observe the safety instructions in Section 2 and at the beginning of this Section before carrying out the activities. If a power supply is required for the work, laboratory power supplies and fixed-voltage power supplies (e.g. plug-in power supply 24 V DC, 1 A as shown in the following figure) are suitable, for other accessories see “Options for MCUDH Ex-3K control unit”, page 130.

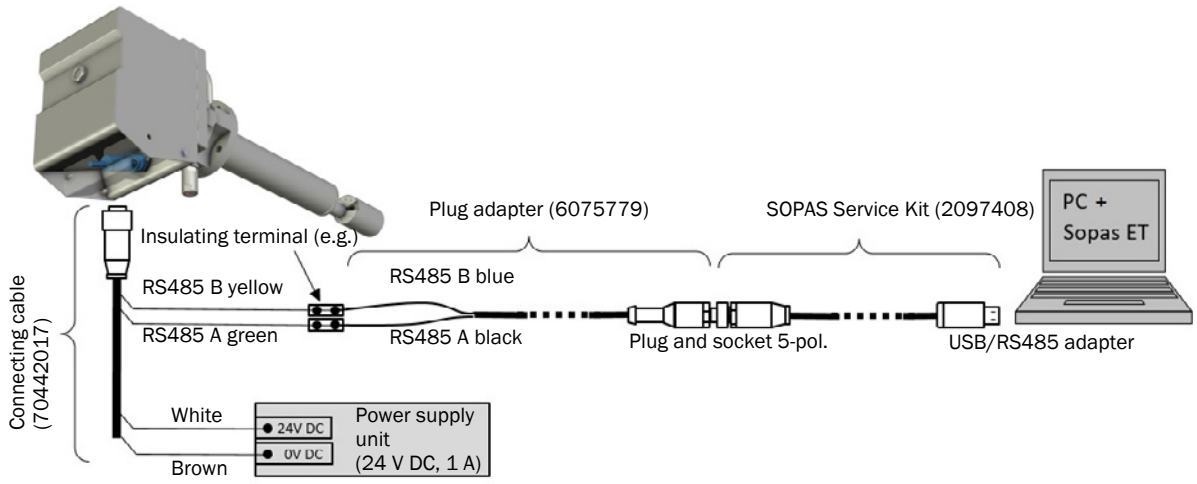
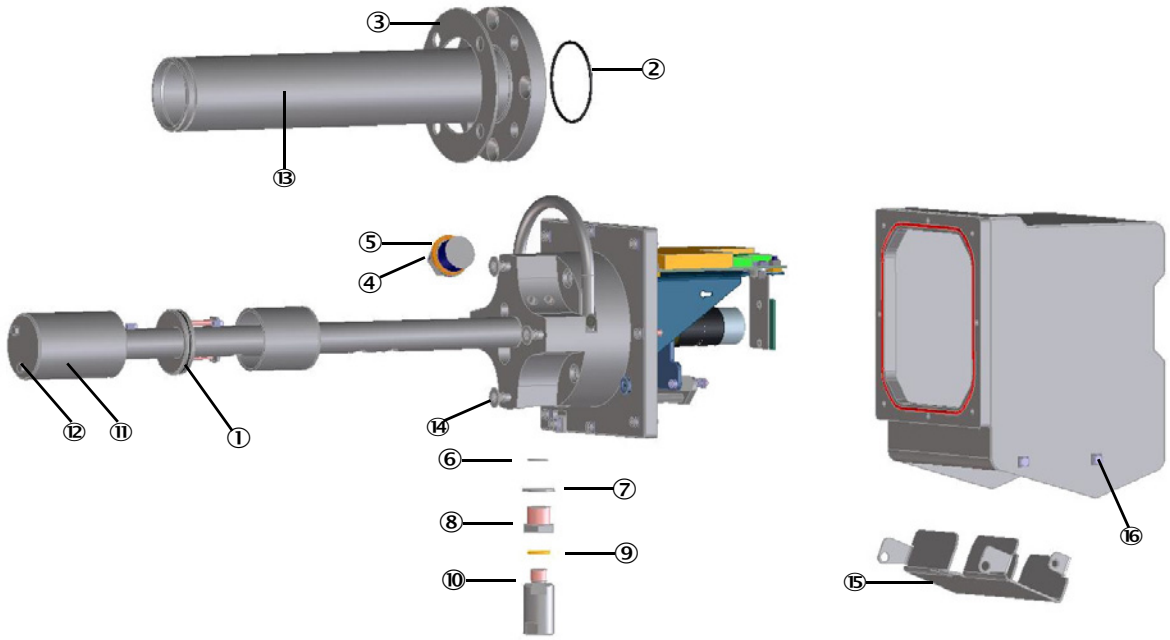


Fig. 64: Voltage supply for sender/receiver unit without the control unit

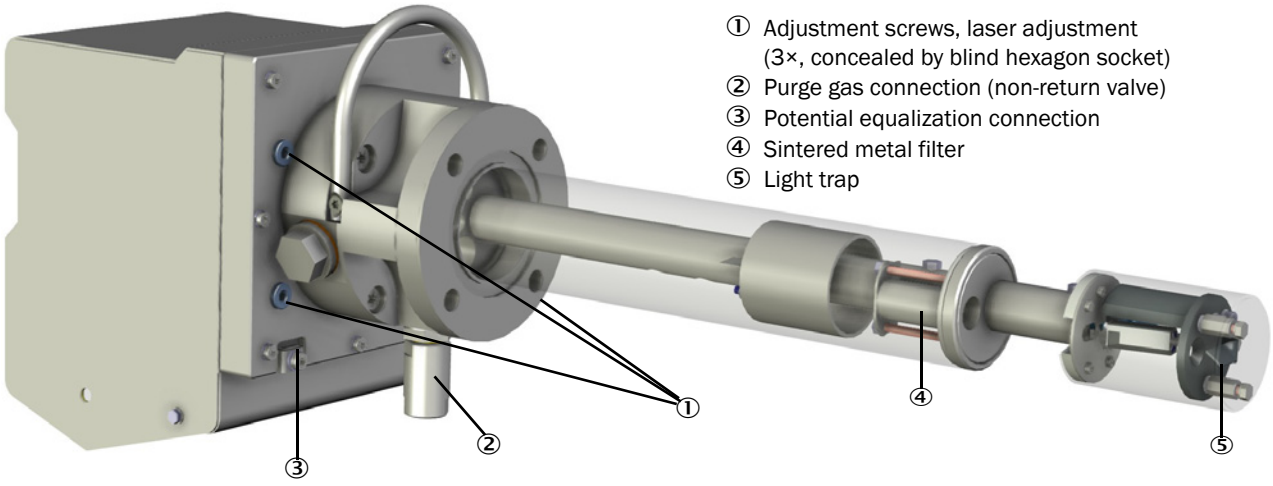
12.6 Maintenance work on the sender/receiver unit

Device views for sender/receiver unit



① O-ring, protection tube, top
② O-ring, protection tube, bottom
③ Flat seal, flange
④ Screw, cleaning opening
⑤ Seal, cleaning opening
⑥ Reducing nozzle
⑦ Flat seal, reduction piece
⑧ Reduction piece (not for HT variant)
⑨ Flat seal, non-return valve
⑩ Non-return valve
⑪ Hood
⑫ Hood screw and spring washer (2×)
⑬ Protective tube
⑭ Protective tube screw (4×)
⑮ Plug protection bracket (secures the device connection)
⑮ Safety screw, plug protection guard

Fig. 65: Device view 1



① Adjustment screws, laser adjustment (3×, concealed by blind hexagon socket)
② Purge gas connection (non-return valve)
③ Potential equalization connection
④ Sintered metal filter
⑤ Light trap

Fig. 66: Device view 2

For an overview of available spare parts, see “Spare parts DUSTHUNTER SP100 Ex-3K”, page 128.

12.6.1 Checking laser alignment

To be done: As required.

Requirement: Test must be performed outside the potentially explosive atmosphere.

24 V DC power supply must be available outside the potentially explosive atmosphere (see “Power supply without control unit”, page 93).

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Loosen the flange screws. Remove the sender/receiver unit from the duct. Allow to cool down, as necessary.
3 Disconnect the purge gas supply and remove the purge gas hose.
4 Disconnect the potential equalization cable.
5 Disconnect the connection plug, for this purpose release the plug protection guard (see “Connecting cable and plug protection bracket”, page 31).
6 Transport the sender/receiver unit out of the potentially explosive atmosphere.
7 Place the enclosure rear side of the sender/receiver unit on a flat surface.
8 Loosen both screws (see Fig. 65, page 94 ⑪) (SW 7) of the hood (see Fig. 65 ⑩) and remove the hood.
9 Connect and switch the sender/receiver unit power supply on.
10 As shown in the following Figure, check the alignment before the light trap with a finger, the laser must be exactly in the middle (max. excentricity 1 mm).
11 If the alignment is not centered but the laser is still visible on the receiver, the alignment must be adjusted (see “Setting the laser alignment”, page 111), if, on the other hand, the laser is no longer visible, another check must be performed (see “Checking the laser beam for free passage”, page 112).
12 If the laser alignment is correct, disconnect the sender/receiver unit from the power supply.
13 Fit the cover and tighten the screws (2 Nm).
14 Bring the sender/receiver unit to the measuring location and connect the potential equalization.
15 Fit the purge gas hose and switch on the purge gas supply.
16 Fit the sender/receiver unit on the duct flange (torque 20 Nm).
17 Insert the connector plug and secure with the plug protection guard (see “Connecting cable and plug protection bracket”, page 31).
18 Put the complete device back into operation (switch voltage on, wait for the check cycle to complete or start it manually, check the measured and status values).

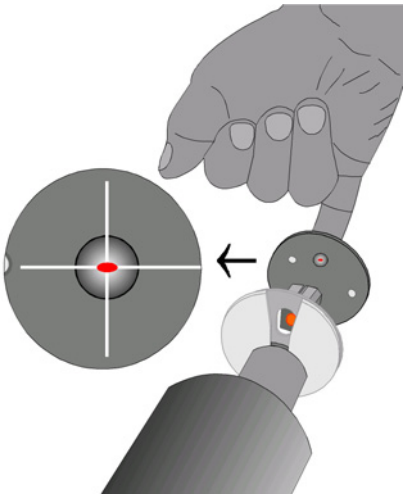


Fig. 67: Checking laser alignment

12.6.2 Replacing the protection tube O-ring

Replacement criterion: In case of damage.

Requirement: Replacement can be performed in the potentially explosive atmosphere when the absence of an explosion hazard can be verified with a gas detector before and during the maintenance activity.

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Loosen the flange screws. Remove the sender/receiver unit from the duct. Allow to cool down, when necessary.
3 Disconnect the potential equalization cable, as necessary.
4 Place the enclosure rear side of the sender/receiver unit on a flat surface.
5 Interrupt purge gas supply.
6 Loosen both screws (see Fig. 65, page 94 ⑪) (SW 7) of the hood (see Fig. 65 ⑩) and remove the hood.
7 Loosen the four protection tube screws (see Fig. 65 ⑬). Remove the protection tube by turning it slightly upwards.
8 Position a suitable tool (e.g. small screwdriver) under the “top” O-ring (see Fig. 65 ①). Remove this from the groove and place the new O-ring in the groove.
9 Position a suitable tool (e.g. small screwdriver) under the “bottom” O-ring (see Fig. 65 ②). Remove this from the groove and place the new O-ring in the groove.
10 Refit the probe protection tube. Fasten with the four protection tube screws (torque 15 Nm). After fitting the protection tube, the laser alignment must be checked (see “Checking laser alignment”, page 95).
11 Replace the hood and fasten it again with the screws (torque 2 Nm)
12 Switch on the purge gas supply.
13 Connect the potential equalization cable.
14 Fit the sender/receiver unit on the duct flange (torque 20 Nm).
15 Put the complete device back into operation (switch voltage on, wait for the check cycle to complete or start it manually, check the measured and status values).

12.6.3 Replacing the seal in the cleaning opening

Replacement criterion: As required (manufacturer recommendation).

Requirement: Replacement can be performed in the potentially explosive atmosphere when the absence of an explosion hazard can be verified with a gas detector before and during the maintenance activity.

Work steps:

1 Using an Allen key (SW 24). unscrew screw (see Fig. 65, page 94 ④) on the cleaning opening in an anti-clockwise direction (caution: Hot, aggressive and explosive gases may escape; the measuring probe may be hot).
2 Replace old sealing ring (see Fig. 65 ⑤) with a new one.
3 Retighten the screw (torque 70 Nm).

12.6.4 Replacing the sinter filter

Replacement criterion: Every 2 years (manufacturer's recommendation).

Requirement: Replacement can be performed in the potentially explosive atmosphere when the absence of an explosion hazard can be verified with a gas detector before and during the maintenance activity.

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Unscrew the flange screws and remove the sender/receiver unit from the duct (caution: hot, aggressive and explosive gases may escape; the measuring probe may be hot) and allow it to cool down as necessary.
3 Disconnect the potential equalization cable, as necessary.
4 Place the enclosure rear side of the sender/receiver unit on a flat surface.
5 Switch off purge gas supply, as necessary.
6 Loosen both screws (see Fig. 65, page 94 ⑪) (SW 7) of the hood (see Fig. 65 ⑩). Remove the hood.
7 Loosen the four protection tube screws (see Fig. 65 ⑬). Turn the protection tube lightly and pull it off upwards.
8 Loosen the two fixing screws and exchange the sinter filter (see Fig. 66, page 94 ④). Make sure the laser beam passes through the center of the hole in the retaining plate when adjusted correctly.
9 Slightly tighten the fixing screws again.
10 Visually inspect O-rings (see Fig. 65 ①,②) at this opportunity and replace if there is any visible wear or damage (see “Replacing the protection tube O-ring”, page 96).
11 Refit the probe protection tube. Fasten with the four protection tube screws (torque 15 Nm). After fitting the protection tube, the laser alignment must be checked (see “Checking laser alignment”, page 95).
12 Fit the hood and fasten it with the two screws (torque 2 Nm).
13 Switch on the purge gas supply.
14 Connect the potential equalization cable.
15 Fit the sender/receiver unit on the duct flange (torque 20 Nm).
16 Put the complete device back into operation (switch voltage on, wait for the check cycle to complete or start it manually, check the measured and status values).

12.6.5 Replacing the flange seal

Replacement criterion: Every 2 years (manufacturer's recommendation).

Requirement: Replacement can be performed in the potentially explosive atmosphere when the absence of an explosion hazard can be verified with a gas detector before and during the maintenance activity.

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Loosen the flange screws, remove the sender/receiver unit from the duct and allow it to cool down, as necessary.
3 Replace the old flange seal with a new one (see Fig. 65, page 94 ④).
4 Fit the sender/receiver unit back on the duct flange (torque 20 Nm).
5 Put the complete device back into operation (switch voltage on, wait for the check cycle to complete or start it manually, check the measured and status values).

12.6.6 Replacing the potential equalization screw

Replacement criterion: In case of damage.

Requirement: Replacement can be performed in the potentially explosive atmosphere when the absence of an explosion hazard can be verified with a gas detector before and during the maintenance activity.

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 If necessary, loosen the flange screws and remove the sender/receiver unit from the duct and allow it to cool down, as necessary.
3 Disconnect the potential equalization cable.
4 Loosen potential equalization screw (see Fig. 66, page 94 ③) and replace all parts of the set with new ones.
5 Connect the potential equalization cable.
6 Fit the sender/receiver unit back on the duct flange (torque 20 Nm).
7 Put the complete device back into operation (switch voltage on, wait for the check cycle to complete or start it manually, check the measured and status values).

12.6.7 Replacing the protection tube

Replacement criterion: In case of damage.

Requirement: Replacement can be performed in the potentially explosive atmosphere when the absence of an explosion hazard can be verified with a gas detector before and during the maintenance activity.

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Loosen the flange screws. Remove the sender/receiver unit from the duct. Allow to cool down, as necessary.
3 Disconnect the potential equalization cable, as necessary.
4 Place the enclosure rear side of the sender/receiver unit on a flat surface.
5 Switch off purge gas supply, as necessary.
6 Loosen both screws (see Fig. 65, page 94 ⑪) (SW 7) of the hood (see Fig. 65 ⑩). Remove the hood.
7 Loosen the four protection tube screws (see Fig. 65 ⑬). Remove the protection tube by turning it slightly upwards.
8 Visually inspect O-rings (see Fig. 65 ①,②) at this opportunity and replace if there is any visible wear or damage (see “Replacing the protection tube O-ring”, page 96).
9 Fit a new probe protection tube. Fasten with the four protection tube screws (torque 15 Nm). After fitting the protection tube, the laser alignment must be checked (see “Checking laser alignment”, page 95).
10 Fit the hood and fasten it with both two screws (torque 2 Nm).
11 Switch on the purge gas supply.
12 Connect the potential equalization cable.
13 Fit the sender/receiver unit on the duct flange (torque 20 Nm).
14 Put the complete device back into operation (switch voltage on, wait for the check cycle to complete or start it manually, check the measured and status values).

12.6.8 Replacing the hood

Replacement criterion: In case of damage.

Requirement: Replacement can be performed in the potentially explosive atmosphere when the absence of an explosion hazard can be verified with a gas detector before and during the maintenance activity.

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Loosen the flange screws. Remove the sender/receiver unit from the duct. Allow to cool down, as necessary.
3 Disconnect the potential equalization cable, as necessary.
4 Place the enclosure rear side of the sender/receiver unit on a flat surface.
5 Switch off purge gas supply, as necessary.
6 Loosen both screws (see Fig. 65, page 94 ⑪) (SW 7) of the hood (see Fig. 65 ⑩). Remove the hood.
7 Fit the new hood and fasten it again with the two screws (torque 2 Nm)
8 Switch on the purge gas supply.
9 Connect the potential equalization cable.
10 Fit the sender/receiver unit on the duct flange (torque 20 Nm).
11 Put the complete device back into operation (switch voltage on, wait for the check cycle to complete or start it manually, check the measured and status values).

12.6.9 Replacing the copper seal of the non-return valve

Replacement criterion: In case of damage.

Requirement: Replacement can be performed in the potentially explosive atmosphere when the absence of an explosion hazard can be verified with a gas detector before and during the maintenance activity.

Note: Depending on the on-site conditions, the seals can be replaced without removing the sender/receiver unit from the duct. In this case, work steps 2, 3, 4, 11 and 12 are not necessary.

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Unscrew the four flange screws and remove the sender/receiver unit from the duct (caution: hot, aggressive and explosive gases may escape; the measuring probe may be hot) and allow it to cool down as necessary.
3 Disconnect the potential equalization cable, as necessary.
4 Place the enclosure rear side of the sender/receiver unit on a flat surface.
5 Interrupt purge gas supply.
6 Detach the purge gas hose from the non-return valve.
7 Unscrew the non-return valve with a wrench (SW 22), then unscrew the reduction piece when fitted (SW 24, not fitted on the high temperature version) and separate these components.
8 Screw reduction piece (see Fig. 65, page 94 ⑦) back in with new seal (see Fig. 65 ⑥) and, whilst centering the sealing ring at the same time, tighten with 30 Nm.
9 Screw in the non-return valve (see Fig. 65 ⑨) with a new seal (see Fig. 65 ⑧) and tighten with 20 Nm, and then check the tightness of the compressed air connection.
10 Fit the purge gas hose and switch on the purge gas supply.
11 Connect the potential equalization cable.
12 Fit the sender/receiver unit on the duct flange (torque 20 Nm).
13 Put the complete device back into operation (switch voltage on, wait for the check cycle to complete or start it manually, check the measured and status values).

12.6.10 Exchanging the non-return valve

Replacement criterion:	In case of damage or when needed.
Requirement:	Replacement can be performed in the potentially explosive atmosphere when the absence of an explosion hazard can be verified with a gas detector before and during the maintenance activity.
Note	Depending on the on-site conditions, the seals can be replaced without removing the sender/receiver unit from the duct. In this case, work steps 2, 3, 4, 10 and 11 are not necessary.

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Unscrew the four flange screws and remove the sender/receiver unit from the duct (caution: hot, aggressive and explosive gases may escape; the measuring probe may be hot) and allow it to cool down as necessary.
3 Disconnect the potential equalization cable, as necessary.
4 Place the enclosure rear side of the sender/receiver unit on a flat surface.
5 Interrupt purge gas supply.
6 Detach the purge air hose from the non-return valve.
7 Unscrew the non-return valve (SW 22) while retaining the reduction piece with a wrench when necessary (SW 24, not fitted on the high temperature variant).
8 When appropriate, check the installed reducing nozzle for free passage and corrosion, clean if dirty.
9 Screw in the new non-return valve (see Fig. 65, page 94 ⑨) with new seal (see Fig. 65 ⑧) and tighten with 20 Nm, then check the tightness of the compressed air connection.
10 Fit the purge gas hose and switch on the purge gas supply.
11 Connect the potential equalization cable.
12 Fit the sender/receiver unit on the duct flange (torque 20 Nm).
13 Put the complete device back into operation (switch voltage on, wait for the check cycle to complete or start it manually, check the measured and status values).

12.7 Maintenance tasks for MCUDH Ex-3K control unit

12.7.1 Replacing the button cell in the control unit

WARNING:
Risk of explosion when using an unspecified button cell
There is a risk of explosion when a different type of button cell is used.
- ▶ Only use button cell type BR1632A with adapter ring (see “Consumable parts, MCUDH Ex-3K / MCU control unit”, page 128).

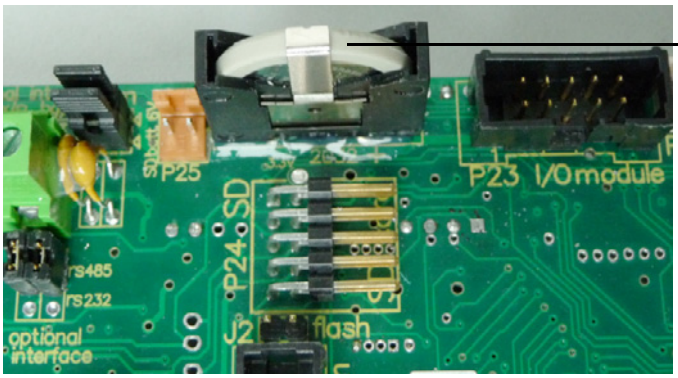
Replacement criterion: Every 3 years (manufacturer's recommendation) or when cell voltage <2.5 V).

Requirement: Replacement can be performed in the potentially explosive atmosphere when the absence of an explosion hazard can be verified with a gas detector before and during the maintenance activity.

Take suitable measures to prevent dust from entering the control unit enclosure when the door is open.

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Make sure that the environment allows the door of the control unit to be opened and open it after the waiting time has elapsed.
3 Remove the old button cell on the circuit board. Insert a new button cell with adapter ring ① into the holder. Observe the installation direction of the button cell. The circuit board is marked accordingly at this point.
4 Close the control unit door again.
5 Put the complete device back into operation (switch on voltage and check measured and status values, set date and time).



① Button cell of the MCUDH Ex-3K control unit

Fig. 68: Replacing the MCUDH Ex-3K button cell

12.7.2 Replacing the MCUDH Ex-3K power supply unit

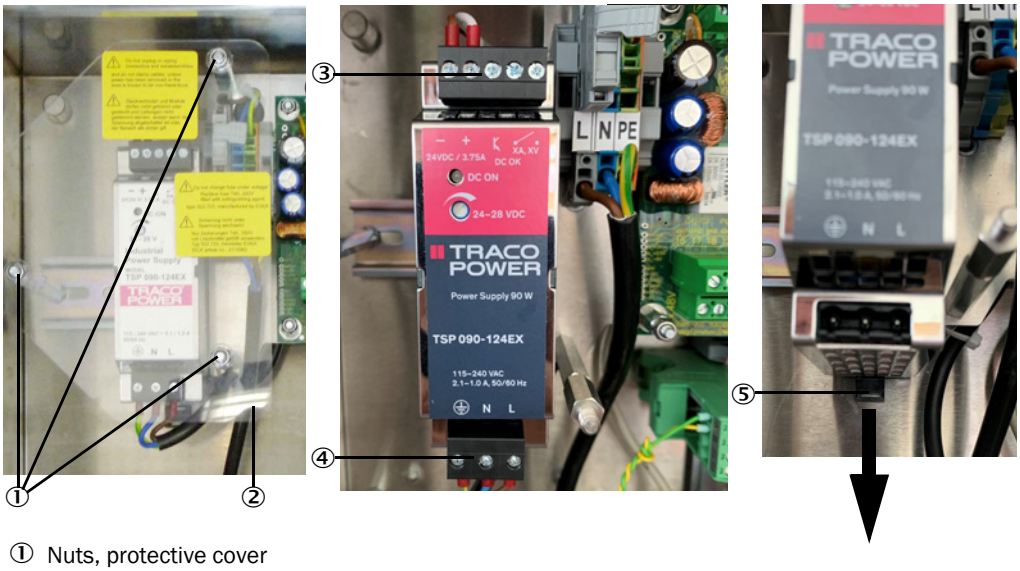
Replacement criterion: In case of damage.

Requirement: Replacement can be performed in the potentially explosive atmosphere when the absence of an explosion hazard can be verified with a gas detector before and during the maintenance activity.

Take suitable measures to prevent dust from entering the control unit enclosure when the door is open.

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Make sure that the environment allows the door of the control unit to be opened and open it after the waiting time has elapsed.
3 Open the MCUDH Ex-3K with the control cabinet key.
4 Loosen three nuts (①) and remove transparent protective cover (②).
5 Disconnect power plug (③) and DC plug (④) from the power supply unit.
6 Use a screwdriver to unlock hat rail lock ⑤ of the power supply unit (pull the black plastic latch downwards) and remove the power supply unit from the hat rail.
7 Plug the new power supply unit onto the hat rail.
8 Connect power plug (③) and DC plug (④) to the power supply unit.
9 Place protective cover ② on the three stud bolts and fasten it again with nuts ①.
10 Lock the MCUDH Ex-3K with the control cabinet key.
11 Put the complete device back into operation (switch on voltage and check measured and status values).



① Nuts, protective cover
② Protective cover (transparent)
③ DC plug
④ Power plug
⑤ Hat rail lock

Fig. 69: Replacing the MCUDH Ex-3K power supply unit

12.7.3 Replacing the RS485 Interface module

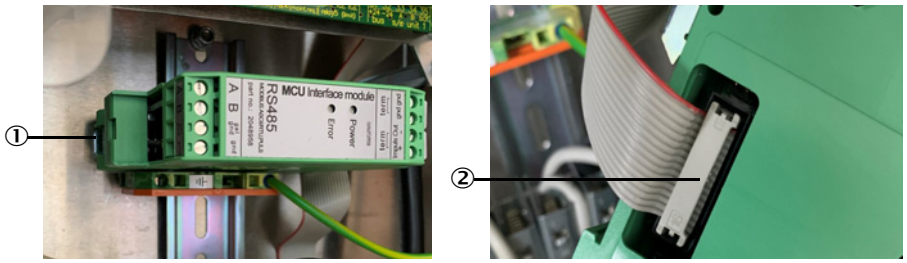
Replacement criterion: In case of damage.

Requirement: Replacement can be performed in the potentially explosive atmosphere when the absence of an explosion hazard can be verified with a gas detector before and during the maintenance activity.

Take suitable measures to prevent dust from entering the control unit enclosure when the door is open.

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Make sure that the environment allows the door of the control unit to be opened and open it after the waiting time has elapsed.
3 Open the MCUDH Ex-3K with the control cabinet key.
4 Disconnect the plug connectors of the connecting cables on the Interface module.
5 Use a screwdriver to unlock hat rail lock (①) of the power supply unit and remove the module. Note how the ribbon cable is laid on the module.
6 Disconnect ribbon cable connector (②).
7 Connect ribbon cable connector (②) to the new Interface module.
8 Plug the new power supply unit onto the hat rail.
9 Connect the connecting cables to the new module.
10 Lock the MCUDH Ex-3K with the control cabinet key.
11 Put the complete device back into operation (switch on voltage and check measured and status values, check communication with the swapped module).



① Hat rail lock
② Ribbon cable connector

Fig. 70: Replacing the MCUDH Ex-3K Interface module

12.8 MCU control unit maintenance work

12.8.1 Replacing the button cell in the control unit

Replacement criterion: Every 3 years (manufacturer's recommendation) or when cell voltage <2.5 V).

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Open the MCU with the control cabinet key.
3 Remove the old button cell. Insert new button cell ① into the holder. Observe the installation direction of the button cell. The board is marked accordingly.
4 Put the complete device back into operation (switch on voltage and check measured and status values, set date and time).

① Button cell of the MCU control unit

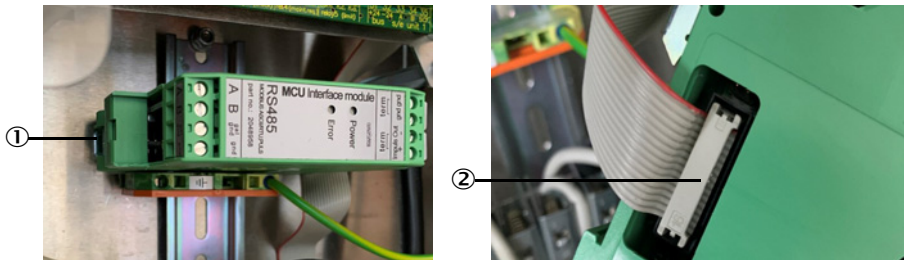
Fig. 71: Replacing the MCU button cell

12.8.2 Replacing the Interface module

Replacement criterion: In case of damage.

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Open the MCU with the control cabinet key.
3 Loosen the connecting cables on the Interface module.
4 Use a screwdriver to unlock hat rail lock (①) of the power supply unit and remove the module. Note how the ribbon cable is laid.
5 Disconnect ribbon cable connector (②).
6 Connect ribbon cable connector (②) to the new Interface module.
7 Plug the new power supply unit onto the hat rail.
8 Connect the connecting cables to the new module.
9 Lock the MCU with the control cabinet key.
10 Put the complete device back into operation (switch on voltage and check measured and status values).



① Hat rail lock
② Ribbon cable connector

Fig. 72: Replacing the MCU Interface module

13 Troubleshooting

13.1 Safety information

WARNING:
Danger to health from gas and hot parts when working on the unit
When clearing malfunctions on the sender/receiver unit, toxic gases which can lead to poisoning,can escape and hot parts can cause burns.
- ▶ For work on the device, remove the sender/receiver unit from the duct and fit it back on after the work is completed.
- ▶ Observe the relevant safety regulations as well as the safety notices (see “Responsibility of user”, page 18) during all work.
- ▶ Only carry out mounting work on systems with hazard potential (higher internal duct pressure, hot, aggressive, explosive gases or dusts) when the system is at a standstill.

WARNING:
Risk of explosion due to removal of hot parts from the duct
There is a risk of explosion when pulling the sender/receiver unit out from the duct due to the hot surface of the measuring probe and possibly escaping hot gases.
- ▶ Take suitable protection measures against local or plant-specific hazards.

WARNING:
There is a risk of explosion when the enclosure is opened in a potentially explosive environment
- ▶ The sender/receiver unit enclosure may only be opened by Endress+Hauser Service.

13.2 Monitoring and diagnostic system

The device has an integrated system that continually checks the operating state of the sender/receiver unit and the control unit.

Messages for the two system components are categorized into fault messages and warning messages depending on the anticipated effects:

Significance of warning messages

- Measuring results are not (yet) directly influenced by a deviating system state.
- Evaluation and, as necessary, elimination of the causes are required promptly to avoid subsequent faults or device damage.

Significance of malfunction messages

- Measuring operation can no longer be guaranteed.
- The measured values are no longer to be used.

The individual warnings of the sender/receiver unit and the control unit are combined as a collective warning and all faults are combined into a collective fault. The collective warning or collective fault is output via status LED, status relay and status indications in displays.

Detailed information on the current device status is provided by the “Diagnostics / Error messages / Warnings” directories of the sender/receiver unit and the MCU control unit. To display, connect the measuring system to SOPAS ET and start the corresponding device file.

Move the mouse to the respective message to display more details on the significance of individual messages in a separate window. Clicking on the display shows a short description of possible causes and corrections under “Help” (see “Warning and malfunction messages in SOPAS ET”, page 108).

Warning messages are output, for example, 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.

13.3 Status display LED and display

Warning or error messages are output as follows:

- The respective relay on the control unit triggers (see “Connection overview”, page 53).
- “Maintenance requ.” or “Failure” is displayed in the status bar of the LC display of the control unit (see “Operation”, page 82). In addition, the respective LED goes on (“WARNING” for warnings, “FAILURE” for malfunctions).
  After pressing the “Diag” button, possible causes are shown as short information in the menu “Diagnosis” after selecting the device (e.g. “MCU control unit” or “DH SP100 Ex”).

Status display significance

Next to the display of the control unit, LEDs indicate the operating states of the device.

Table 24: *MCUDH Ex-3K control unit operating state*

LED	Color	Significance
Operation	Green	Device in operation
Failure	Red	Malfunction - operating state: Malfunction
Warning	Yellow	Warning message

Table 25: *MCU control unit operating state*

LED	Color	Significance
Power	Green	Device switched on
Failure	Red	Malfunction - operating state: Malfunction
Maintenance request	Yellow	Warning message

13.4 Sender/receiver unit malfunctions

13.4.1 Malfunctions

Table 26: Sender/receiver unit malfunctions

Malfunction	Possible cause	Action
• No laser beam	• No supply voltage • Connecting cable not connected correctly or defective • Defective plug connector	▶ Check plug connectors and cables. ▶ Contact Endress+Hauser Service.

13.4.2 Warning and malfunction messages

Malfunctions listed below can probably be cleared on-site.

Table 27: Sender/receiver unit malfunctions that can be cleared

Message	Significance	Possible cause	Action
Contamination	Contamination of optical surfaces too high (see "Technical data", page 117).	• Deposits on the optical surfaces • Unclean purge gas • Incorrect laser alignment	▶ Clean optical surfaces (see "Maintenance on the sender/receiver unit", page 90). ▶ Check laser alignment (see "Checking laser alignment", page 95). ▶ Contact Endress+Hauser Service.
Span test, Zero point	Deviation from nominal value > ±2%.	• Sudden change of measuring conditions during control value determination • Laser control defective	▶ Repeat the functional check. ▶ Contact Endress+Hauser Service.
Threshold value	Laser light not found during check cycle	• Deposits on the optical surfaces • Incorrect laser alignment • Laser defective	▶ Cleaning optical surfaces. ▶ Checking laser alignment. ▶ Contact Endress+Hauser Service.

Warning and malfunction messages in SOPAS ET

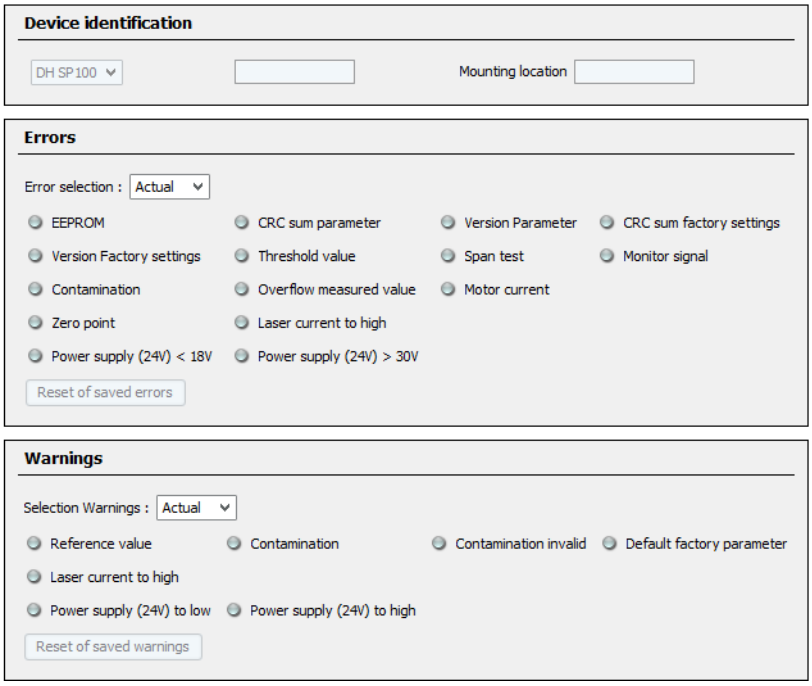


Fig. 73: SOPAS ET menu: DH SP100/Diagnosis/Error messages/Warnings

Current warning or error messages, or earlier messages stored in the error memory, can be shown by selecting “actual” or “memory” in the “Selection” window.

- Display of error or warning: With LED symbol.
- Description of error or warning: In the description field of SOPAS ET.

13.5 Control unit malfunctions

13.5.1 Malfunctions

Table 28: Control unit malfunctions

Malfunction	Possible cause	Action
No display on the LC display	• No supply voltage • Connecting cable to display not connected or damaged • Defective fuse	▶ Check voltage supply. ▶ Check connecting cable. ▶ Replace fuse. ▶ Contact Endress+Hauser Service.

13.5.2 Warning and malfunction messages

Malfunctions listed below can probably be cleared on-site.

Table 29: Control unit malfunctions that can be cleared

Message	Significance	Possible cause	Action
AO configuration	The number of available and configured analog outputs is not identical.	• No parameters set for AO • Connection error • Module failure	▶ Check configuration (see “Setting the analog outputs parameters”, page 74). ▶ Contact Endress+Hauser Service.
AI configuration	Number of available and configured analog inputs not identical.	• No parameters set for AI • Connection error • Module failure	▶ Check configuration (see “Setting the analog inputs parameters”, page 76). ▶ Contact Endress+Hauser Service.
Interface module	No communication via the Interface module.	• No parameters set for module • Connection error • Module failure	▶ Check configuration (see “Connecting to the MCUDH Ex-3K control unit”, page 68) or (see “Connecting to the MCU control unit”, page 70). ▶ Contact Endress+Hauser Service.
No sensor found	Sender/receiver unit not recognized	• Communication problems on RS485 cable • Supply voltage problems	▶ Check system settings. ▶ Check connecting cable. ▶ Check voltage supply. ▶ Contact Endress+Hauser Service.
Variant configuration error	MCU setting does not match the connected sensor.	• Sensor type has been changed	▶ Correct application settings (see “Assigning the control unit to the sender/receiver unit”, page 72).
Test mode enabled	MCU(DH Ex) in Test mode.	• Test mode	▶ Deactivate “System Test” mode (“Maintenance” directory)

Warning and malfunction messages in SOPAS ET

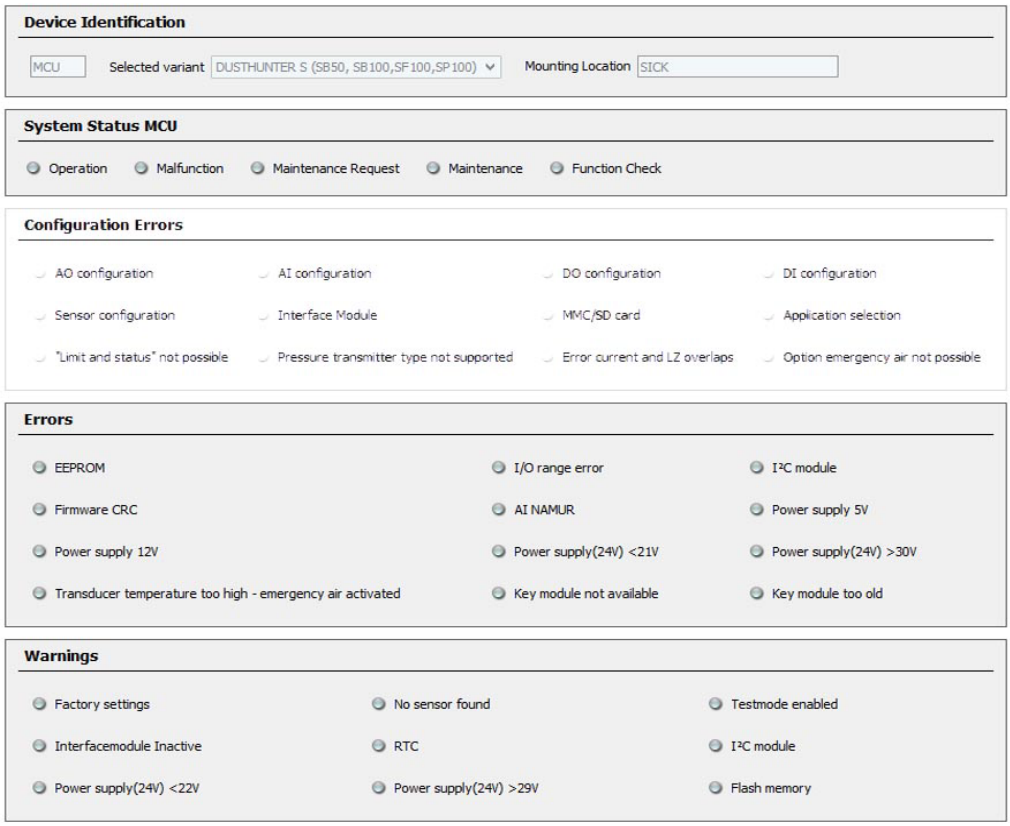


Fig. 74: SOPAS ET menu: MCU/Diagnosis/Error messages/Warnings

- Display of error or warning: With LED symbol.
- Description of error or warning: In the description field of SOPAS ET.

13.6 Sender/receiver unit troubleshooting measures

13.6.1 Setting the laser alignment

In case the laser is no longer correctly aligned when checking the laser alignment (see “Checking laser alignment”, page 95), adjust the laser alignment anew.

Criterion: Laser still visible on receiver but not correctly aligned.

Requirement: Setting must be performed outside the potentially explosive atmosphere.

24 V DC power supply must be available outside the potentially explosive atmosphere (see “Power supply without control unit”, page 93).

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Unscrew the four flange screws and remove the sender/receiver unit from the duct (caution: hot, aggressive and explosive gases may escape; the measuring probe may be hot) and allow it to cool down as necessary.
3 Disconnect the purge gas supply and remove the purge gas hose.
4 Disconnect the potential equalization cable.
5 Disconnect the connection plug, for this purpose release the plug protection guard (see “Connecting cable and plug protection bracket”, page 31).
6 Move the sender/receiver unit out of the potentially explosive atmosphere into a safe area.
7 Place the enclosure rear side of the sender/receiver unit on a flat surface.
8 Loosen both screws (see Fig. 65, page 94 ⑪) (SW 7) of the hood (see Fig. 65 ⑩) and remove the hood.
9 Unscrew the three blanking plugs (see Fig. 66, page 94 ①) with an Allen key (SW 5) to gain access to the adjustment screws.
This temporarily disables an explosion protection function of the device!
10 Carry out a visual inspection of the O-rings of the blanking plugs on this opportunity; replace them if there is any visible wear or damage.
11 Connect and switch the sender/receiver unit power supply on.
12 Tighten or loosen the laser alignment hexagon adjustment screws (SW3) (see Fig. 66 ①), check the alignment in between (see “Checking laser alignment”, page 95), until the alignment is correct.
13 Replace and tighten the dummy plugs (torque 7 Nm).
This work restores the explosion protection function and must be carried out with special care!
14 Disconnect power supply.
15 Fit the cover and tighten the screws (torque 2 Nm).
16 Bring the sender/receiver unit to the measuring location.
17 Connect the potential equalization cable.
18 Fit the purge gas hose and switch on the purge gas supply.
19 Fit the sender/receiver unit on the duct flange (torque 20 Nm).
20 Insert the connector plug and secure with the plug protection guard (see “Connecting cable and plug protection bracket”, page 31).
21 Put the complete device back into operation (switch voltage on, wait for the check cycle to complete or start it manually, check the measured and status values).

13.6.2 Checking the laser beam for free passage

The laser beam must pass centrically through the aperture plate, readjust the aperture plate when this is not the case with a correctly adjusted laser.

Criterion: Laser no longer visible on the receiver.

Requirement: Checking and setting the aperture plate can be carried out in the potentially explosive atmosphere when the purge gas supply and potential equalization remain connected and the absence of a potentially explosive atmosphere has been verified with a gas warning device.

Work steps:

1 Disconnect the entire device (control unit and sender/receiver unit) from the power supply.
2 Loosen the flange screws. Remove the sender/receiver unit from the duct. Allow to cool down, as necessary.
3 Disconnect the potential equalization cable, as necessary.
4 Place the enclosure rear side of the sender/receiver unit on a flat surface.
5 Loosen both screws (see Fig. 65, page 94 ⑪) (SW 7) of the hood (see Fig. 65 ⑩).
6 Remove the hood.
7 Loosen the four protection tube screws (see Fig. 65 ⑬). Remove the protection tube by turning it slightly upwards.
8 Visually inspect O-rings (see Fig. 65 ①,②) at this opportunity and replace if there is any visible wear or damage (see “Replacing the protection tube O-ring”, page 96).
9 Check the beam transmission as shown in the Figure (see “Checking the beam path”, page 112).
10 Readjust the aperture plate when necessary.
11 Remove existing deposits in the beam path on the aperture opening, the sintered metal filter and on the outlet openings of the purge gas.
12 Fit the probe protection tube and tighten again with the four screws (torque 15 Nm). After fitting the protection tube, the laser alignment must be checked (see “Checking laser alignment”, page 95).
13 Replace the cover and fasten it again (torque 2 Nm).
14 Switch on the purge gas supply.
15 Connect the potential equalization cable.
16 Fit the sender/receiver unit on the duct flange (torque 20 Nm).
17 Put the complete device back into operation (switch voltage on, wait for the check cycle to complete or start it manually, check the measured and status values).

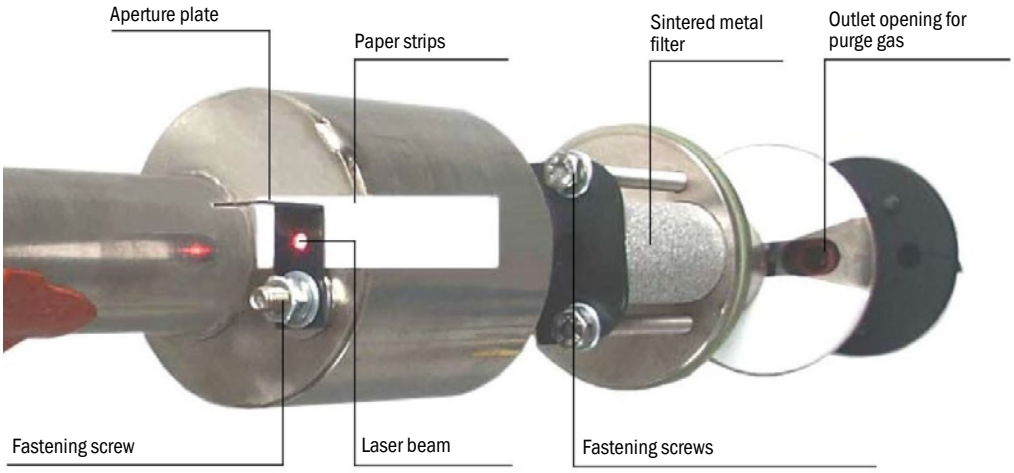
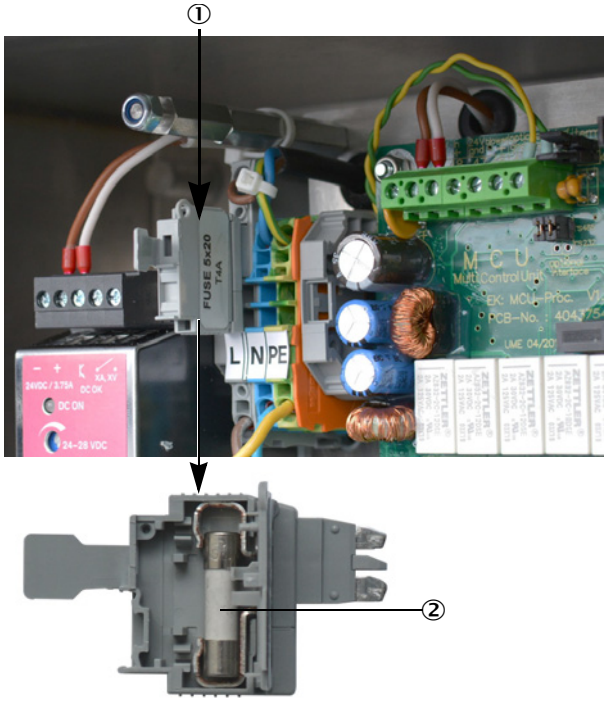


Fig. 75: Checking the beam path

13.7 MCUDH Ex-3K control unit troubleshooting measures

13.7.1 Replacing the fuse

1 Disconnect the control unit from the power supply and observe the waiting time before opening the door.
2 Take suitable precautions to prevent dust from entering the enclosure.
3 Open the control unit door.
4 Remove the transparent fuse cover.
5 Remove fuse holder (1) and open.
6 Replace defective fuse (2) (see “Other accessories”, page 130).
7 Close and attach the fuse holder.
8 Reattach the transparent fuse cover.
9 Close the door. Switch the power supply on again.



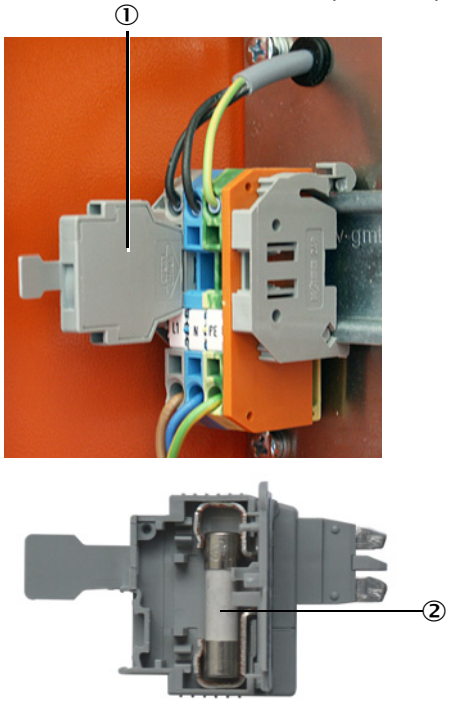
① Fuse holder
② Fuse

Fig. 76: Replacing the MCUDH Ex-3K fuse (shown with fuse cover removed)

13.8 MCU control unit troubleshooting measures

13.8.1 Replacing the fuse

1 Disconnect the control unit from the power supply.
2 Take suitable precautions to prevent dust from entering the enclosure.
3 Open the control unit door. Remove fuse holder (1) and open.
4 Replace defective fuse (2) (see “Other accessories”, page 130).
5 Close and attach the fuse holder.
6 Close the door. Switch the power supply on again.



① Fuse holder
② Fuse

Fig. 77: Replacing the MCU fuse (shown with fuse cover removed)

13.9 Sending in devices

Information on sending a device to the factory for inspection or repair, see “Return delivery”, page 116.

14 Decommissioning

14.1 Switch-off states

The measuring system must be decommissioned:

- Immediately when the purge gas supply fails.
- When the system is to be put out of operation for a longer period of time (as from approx. 1 week).

NOTICE:
Purge gas supply
An interruption in the purge gas supply to a duct-mounted sender/receiver unit can damage the device.
▶ Never switch off or interrupt the purge gas supply when the sender/receiver unit is fitted on the duct.

Information on transport and storage of the device components: see “Transport and storage”, page 47.

14.2 Switching off and dismantling

WARNING:
Connect potential equalization when working on the measuring system
Static charge can lead to explosions.
▶ Connect the potential equalization as first task during mounting and as last task during disassembly.

Work to be performed

▶ Disconnect the connecting cable to the control unit.
▶ Dismantle the sender/receiver unit from the duct.

WARNING:
Danger to health through gas and hot parts when the device is removed from the duct
▶ Only remove the sender/receiver unit on systems with hazard potential (higher internal duct pressure, hot, aggressive, explosive gases/dusts) when the system is at a standstill.
▶ Take suitable protection measures against local or plant-specific hazards.
▶ Secure switches that should not be switched on again for safety reasons with signs and safeguards to prevent unintentional switching.

▶ Close off flanged pipe with blind flange (see “Fastening technology”, page 129).
▶ Interrupt purge gas supply.
▶ Disconnect the control unit from the supply voltage.
▶ Disconnect the potential equalization.

14.3 Return delivery

Before shipping:

- Contact your local Endress+Hauser representative. The addresses are on the back cover of the Operating Instructions.
- The Endress+Hauser representative can advise you whether the defective device can be repaired locally or whether it would more advantageous for you to return the device for repair.
- Observe the following when returning the device to Endress+Hauser:
  - Repair flat rates.
  - Arrangements for packaging and transport (see “Transport and storage”, page 47).
  - Replacement devices or putting the device back into operation by Endress+Hauser Service.

Preparatory work

- Clean all device components. Remove any residues that are potentially hazardous to health.
- Complete the Return Form.
- Observe the transport instructions (see “Transport”, page 47).

14.4 Disposal

The metal parts of the devices can be disposed of as industrial scrap.

NOTICE:
Disposal
- Observe relevant local conditions for disposal of industrial waste.

WARNING:
Disposal of subassemblies containing residual substances harmful to the environment
The following subassemblies could contain substances that have to be disposed of separately:
- Electronics: Condensers, circuit boards, batteries.
- Display: Liquid contained in the LC display.
- All parts in contact with the sample gas can be contaminated with harmful substances.
- Observe relevant valid local conditions for disposal.

15 Technical data

System DUSTHUNTER SP100EX3K (Zones 2/22)

Table 30: Technical data, complete system

Measured variable	Scattered light intensity (dust concentration output in mg/m³ after gravimetric comparison measurement)
Measuring principle	Scattered light measurement (forward dispersion)
Measuring range (freely adjustable) Dust concentration	0 ... 5 mg / m³ /0 ... 5,000 mg/m³ Higher measuring ranges (up to 100,000 mg/m³) on request
Certified measuring ranges Dust concentration	0...7.5 mg/m³ (additional measuring ranges 0...10, 0...15, 0...50, 0...100, 0...200, 0...500 mg/m³)
Response time (t90) (freely adjustable)	1 ... 600 seconds
Precision	≤2% from measuring range end value
Altitude	0 ... 2000 m
Compliances	Approved for systems requiring approval: 2001/80 /EC (13. BImSchV) 2000/76/EC (17. BImSchV) 27. BImSchV TI-Air EN 15267 EN 14181 2010/75/EU 2014/34/EU 2014/30/EU U.S. EPA PS-11 compliant
Electrical safety	CE
Control functions	Automatic self-test (linearity, contamination, drift, aging) Contamination limits: At 30% warning, at 40% malfunction Manual linearity test with test fixture

DHSP-TxxxxEx-3K sender/receiver unit (Zones 2/22)

Table 31: Technical data, sender/receiver unit DUSTHUNTER SP100 Ex-3K

Ambient temperature	-40 °C ... +60 °C
Air humidity	<95%, non-condensing
Temperature process gas Standard version DHSP-T2xxxxEx3K High temperature version DHSP-T4xxxxEx3K	 -40 °C ... +220 °C -40 °C ... +400 °C
Pressure process gas With instrument air (from customer)	 -100...+100 hPa (rel. (Δ ambient pressure to gas duct pressure)(1 hPa = 1 mbar))
Process gas moisture	<95%, non-condensing
Internal duct diameter	≥ 0.25 m
Explosion protection approvals ATEX	 II 3G Ex nR op is IIC T6 Gc II 3D Ex tc op is IIIC T85°C Dc
Protection class	IP66
Weight Nominal length 435 mm Nominal length 735 mm	 ≤ 14.2 kg ≤ 15.2 kg
Spectral range	640 nm ... 660 nm Laser class 2, power <1 mW
Power supply Voltage Power consumption Max. current consumption	 24 V / 19... 29 V ≤ 8 W (maximum power consumption during normal operation) ≤ 800 mA (briefly during function check)
Protection class:	Protection class III (protection class according to DIN EN 61140)

Connecting cable with connector plug

Table 32: Technical data, connecting cable

Temperature range Movable Fixed installation	 -5 °C ... +70 °C -40 °C ... +80 °C Do not move the cable unnecessarily at temperatures below -5°C
Minimum bending radius Movable Fixed installation	 15 × cable diameter 6 × cable diameter At temperatures below -5°C, maintain a minimum bending radius > 30 cm
Available lengths	5 m / 10 m / 25 m / 50 m / 100 m Other lengths on request
Cable type	Lappkabel Unitronic Li2YCY v (TP) 2×2×0.5 mm^2
Burning behavior	Flame-retardant acc. to IEC 60332-1-2

Conventional MCU control unit

Table 33: Technical data, MCU control unit

Description	Unit to control system components, and evaluate and output the data you provide
Ambient temperature	-40 °C ... +60 °C
Air humidity	<95%, non-condensing
Protection class	IP65
Analog outputs	1 output 0/2/4 ... 20 mA, max. load 750 Ω Galvanically isolated
Analog inputs	2 inputs 0...20 mA, measuring resistance 110 Ω Not galvanically isolated
Digital outputs	5 relay contacts: 48 V, 1 A Potential-free; for status signals
Digital inputs	4 contacts, wiring recommended with floating contacts
Interface module Type of field bus integration	Various modules available (Ethernet, Modbus® TCP/IP,Profibus etc.)
Ethernet Option 1 Option 2	Ethernet CoLa-B Ethernet Modbus® TCP
Display	LC display Status LED: “Power”, “Failure” and “Warning”
Operation	Via display or SOPAS ET software
Dimension (W×H×D)	300 mm 210 mm 135 mm
Weight	≤ 5.3 kg
Power supply Version with power supply unit MCU NWxxx Version without power supply unit MCU-N2xxx	 90...250 V (AC) (wide range power supply / frequency 47...63 Hz) 24 V (DC) (external supply)
Power consumption Version with power supply unit MCU-NWxxx Version without power supply unit MCU-N2xxx	 Max. 40 W, typically 8...15 W Max. 35 W, typically 6...12 W
Protection class: Version with power supply unit MCU-NWxxx Version without power supply unit MCU-N2xxx	Protection class according to DIN EN 61140 Protection class I Protection class III

MCUDH Ex-3K control unit (Zones 2/22)

Table 34: Technical data, MCUDH Ex-3K control unit

Description	Unit to control system components, and evaluate and output the data you provide
Ambient temperature Version with power supply unit MCUDH Ex-3K NSxxx Version without power supply unit MCUDH Ex-3K N2xxx	 -25 °C ... +50 °C -40 °C ... +60 °C
Air humidity	<95%, non-condensing
Explosion protection approvals Version with power supply unit MCUDH Ex-3K NSxxx Version without power supply unit MCUDH Ex-3K N2xxx	 II 3G Ex ec nA nC IIC T4 Gc II 3D Ex tc IIIC T85 °C Dc II 3G Ex ec IIC T4 Gc II 3D Ex tc IIIC T85 °C Dc
Protection class	IP65
Analog outputs	1 output 0/2/4 ... 20 mA, 750 Ω Galvanically isolated
Analog inputs	2 inputs 0...20 mA, measuring resistance 110 Ω Not galvanically isolated
Digital outputs	5 relay contacts: 48 V, 1 A Potential-free; for status signals
Digital inputs	4 contacts, recommended wiring with floating contacts
Modbus® Type of field bus integration	 RTU RS-485 (via optional Interface module; only one module per MCU possible)
Ethernet Option 1 Option 2	 Ethernet CoLa-B (remote, outside the potentially explosive atmosphere) Ethernet Modbus® TCP (remote, outside the potentially explosive atmosphere)
Display	LC display Status LED: “Operation”, “Failure” and “Warning”
Operation	Via display or SOPAS ET software
Dimension (W×H×D)	300 mm 300 mm 220 mm
Weight	≤ 8.8 kg
Power supply Version with power supply unit MCUDH Ex-3K NSxxx Version without power supply unit MCUDH Ex-3K N2xxx	 90...250 V (AC) (wide range power supply / frequency 47...63 Hz) 24 V (DC) (external supply)
Power consumption Version with power supply unit MCUDH Ex-3K NSxxx Version without power supply unit MCUDH Ex-3K N2xxx	 Max. 30 W, typically 6...10 W Max. 30 W, typically 5...7 W
Protection class: Version with power supply unit MCUDH Ex-3K NSxxx Version without power supply unit MCUDH Ex-3K N2xxx	Protection class according to DIN EN 61140 Protection class I Protection class III

Remote Display 100

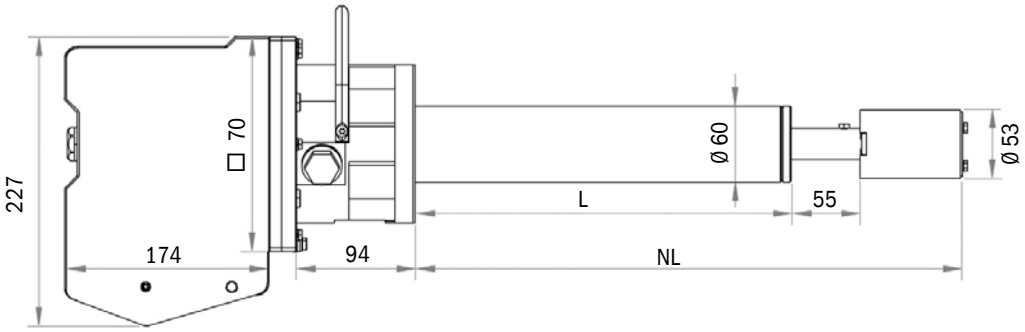
Table 35: Technical data, Remote Display 100

Description	Unit for remote control of the MCUDH control unit
Ambient temperature	-40 °C ... +60 °C
Air humidity	<95%, non-condensing
Protection class	IP65
Display	LC display (colour) Status LED: “Operation”, Failure and “Warning”
Operation	Via display or SOPAS ET software
Dimension (W×H×D)	300 mm x 210 mm x 135 mm
Weight	≤ 3.8 kg
Power supply Version with power supply unit Version without power supply unit	90...250 V (AC) (wide range power supply / frequency 47...63 Hz) 20...28 V (DC) (from MCUDH/MCU or provided on-site)
Power consumption Version with power supply unit Version without power supply unit	 Max. 8 W Max. 4 W
Protection class: Version with power supply unit Version without power supply unit	Protection class according to DIN EN 61140 Protection class I Protection class III

15.1 Dimensional drawings and part numbers

All measures are specified in mm.

15.1.1 DHSP100 Ex-3K sender/receiver unit



NL	L
435	300
735	600

Fig. 78: Sender/receiver unit dimensions

Table 36: Part numbers, sender/receiver unit

Name	Part No.
Sender/receiver unit DHSP-T2V11EX3KT6	1091010
Sender/receiver unit DHSP-T2H11EX3KT6	1091014
Sender/receiver unit DHSP-T4V11EX3KT6	1091012
Sender/receiver unit DHSP-T4H11EX3KT6	1119195
Sender/receiver unit DHSP-T2V21EX3KT6	1091011
Sender/receiver unit DHSP-T2H21EX3KT6	1119194
Sender/receiver unit DHSP-T4V21EX3KT6	1091013
Sender/receiver unit DHSP-T4H21EX3KT6	1119196

Further information, see “Sender/receiver unit type code”, page 25.

15.1.2 Flange with tube

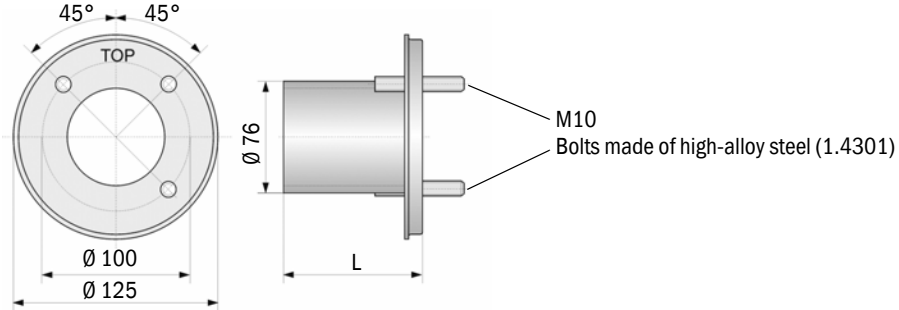


Fig. 79: Dimensions, standard flange with tube

Table 37: Part numbers, standard flange with tube

Name	Part No.	Usage on
Material, flange and tube: 1.0254 (unalloyed structural steel)		
Flange with tube, Øi 70 mm, L 130 mm	2017845	DHSP-Txx1, DHSP-Txx2
Flange with tube, Øi 70 mm, L 240 mm	2017847	
Flange with tube, Øi 70 mm, L 500 mm	2017849	DHSP-Txx2
Material, flange and tube: 1.4571 (high-alloy steel)		
Flange with tube, Øi 70 mm, L 130 mm	2017846	DHSP-Txx1, DHSP-Txx2
Flange with tube, Øi 70 mm, L 240 mm	2017848	
Flange with tube, Øi 70 mm, L 500 mm	2017850	DHSP-Txx2

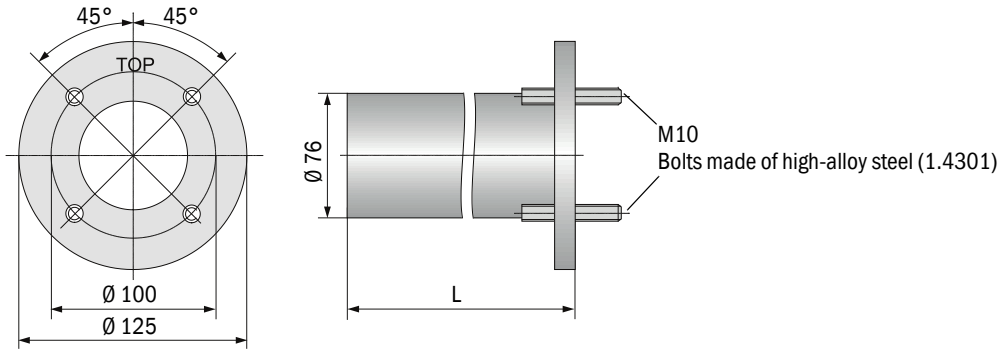
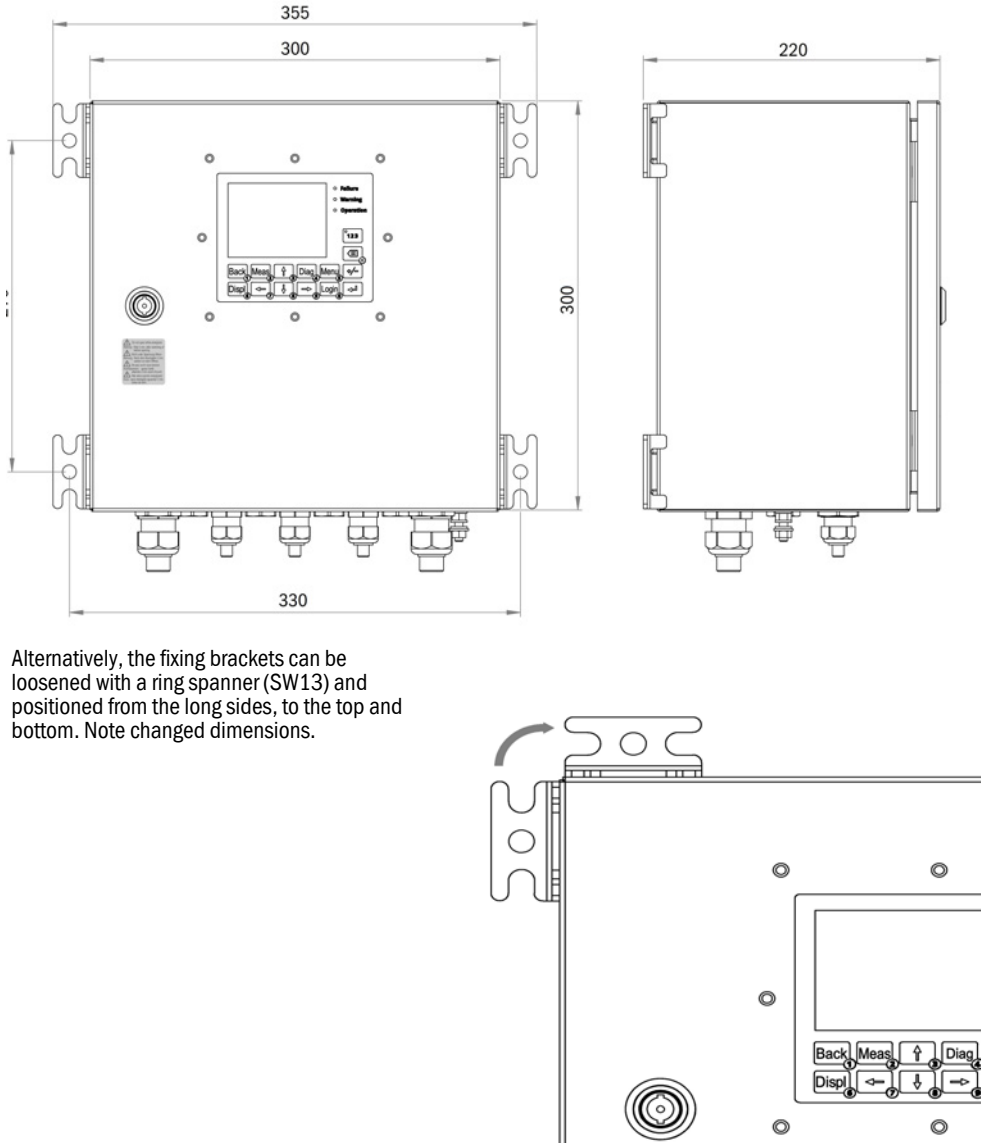


Fig. 80: Dimensions, flange with tube (4 bolts)

Table 38: Part numbers, flange with tube (4 bolts)

Name	Part No.	Usage on
Material flange: 1.4571 (high-alloy steel); material tube: 1.0254 (unalloyed structural steel)		
Flange with tube, Øi 70 mm, L 130 mm	2115419	DHSP-Txx1, DHSP-Txx2
Flange with tube, Øi 70 mm, L 240 mm	2115420	
Flange with tube, Øi 70 mm, L 500 mm	2115421	DHSP-Txx2
Material, flange and tube: 1.4571 (high-alloy steel), with 3.1 Material Certificate		
Flange with tube, Øi 70 mm, L 130 mm, with 3.1 Material Certificate	2115404	DHSP-Txx1, DHSP-Txx2
Flange with tube, Øi 70 mm, L 240 mm, with 3.1 Material Certificate	2115417	
Flange with tube, Øi 70 mm, L 500 mm, with 3.1 Material Certificate	2115418	DHSP-Txx2

15.1.3 MCUDH Ex-3K control unit



Alternatively, the fixing brackets can be loosened with a ring spanner (SW13) and positioned from the long sides, to the top and bottom. Note changed dimensions.

Fig. 81: MCUDH Ex-3K control unit dimensions

Table 39: Part numbers, MCUDH Ex-3K control unit

Name	Part No.
MCUDH Ex-3K NSYDN00000MNOE control unit in wall enclosure, supply voltage 115/230 V AC, without integrated purge gas supply, with display, with integrated Interface module RS485 Modbus® ASCII/RTU	1106647
MCUDH Ex-3K NSYDN00000NNOE control unit in wall enclosure, supply voltage 115/230 V AC, without integrated purge gas supply, with display, without integrated Interface module	1109325
MCUDH Ex-3K N2YDN00000MNOE control unit in wall enclosure, supply voltage 24 V DC, without integrated purge gas supply, with display, with integrated Interface module RS485 Modbus® ASCII/RTU	1109326
MCUDH Ex-3K N2YDN00000NNOE control unit in wall enclosure, supply voltage 24 V DC, without integrated purge gas supply, with display, without integrated Interface module	1109327

15.1.4 MCU control unit

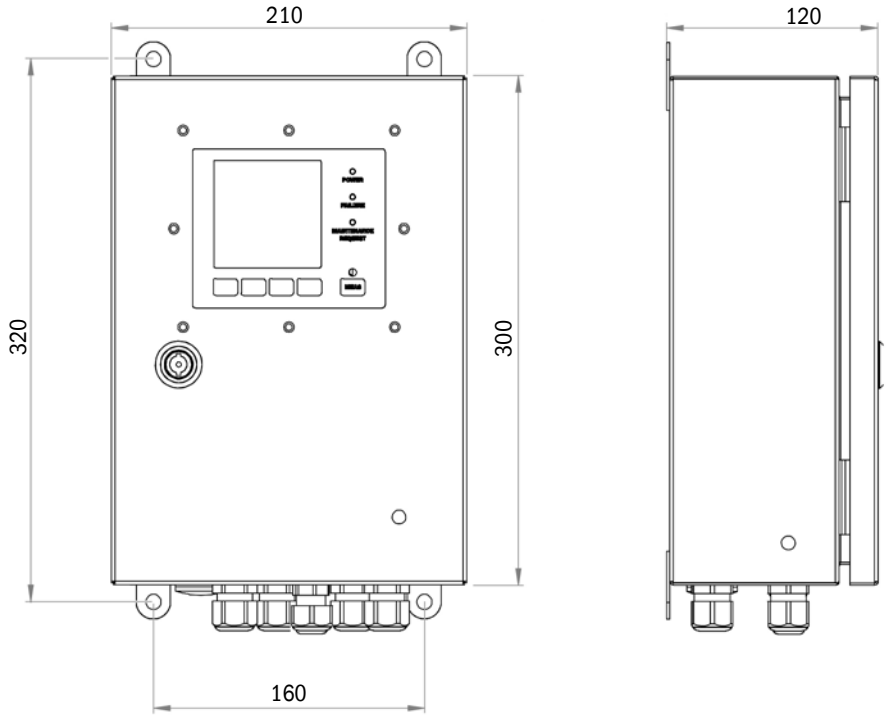


Fig. 82: Dimensions, MCU-N control unit

Table 40: Part numbers, MCU control unit

Name	Part No.
MCU-N2ONN00000NNNE control unit (without LC-Display) - with 1 analog and 5 relay outputs - with 4 digital and 2 analog inputs - supply voltage 24 V DC	1080505
MCU-NWODN00000NNNE control unit - with 1 analog and 5 relay outputs - with 4 digital and 2 analog inputs - supply voltage 90...250 V AC	1080506
MCU-N2ODN01000NNNE control unit - with 3 analog and 5 relay outputs - with 4 digital and 2 analog inputs - supply voltage 24 V DC	1045003
MCU-NWODN01000NNNE control unit - with 3 analog and 5 relay outputs - with 4 digital and 2 analog inputs - supply voltage 90...250 V AC	1045001
MCU-NWODN00000BNNE control unit - with 1 analog and 5 relay outputs - with 4 digital and 2 analog inputs - supply voltage 90...250 V AC - 1 Ethernet Interface module, COLA-B	1080507
MCU-NWODN00000MNNE control unit - with 1 analog and 5 relay outputs - with 4 digital and 2 analog inputs - supply voltage 90...250 V AC - 1 Interface module Modbus® ASCII/RTU	1081996
MCU-NWODN01000JNNE control unit - with 3 analog and 5 relay outputs - with 4 digital and 2 analog inputs - supply voltage 90...250 V AC - 1 Interface module Modbus® TCP/IP	1064639
MCU-NWODN01000ENNE control unit - with 3 analog and 5 relay outputs - with 4 digital and 2 analog inputs - supply voltage 90...250 V AC - 1 Ethernet, CoLa-B Interface module	1047195
MCU-NWODW01000DNNE control unit - with 3 analog and 5 relay outputs - with 4 digital and 2 analog inputs - supply voltage 90...250 V AC - 1 Interface module Modbus® ASCII/RTU - 1 Ethernet, CoLa-B, Service Interface module	1082232
MCU-NWODW00000FNNE control unit - with 1 analog and 5 relay outputs - with 4 digital and 2 analog inputs - supply voltage 90...250 V AC - 1 Interface module PROFIBUS, RS485 - 1 Ethernet, CoLa-B, Service Interface module	1084573

16 Spare parts

Only spare and consumable parts from Endress+Hauser may be used.

16.1 Consumable parts

16.1.1 Consumable parts DUSTHUNTER SP100 Ex-3K

Spare and consumable parts set

Table 41: Spare and consumable parts set, SP100 Ex-3K sender/receiver unit

Name	Part No.
Spare and consumable parts set DUSTHUNTER SP100 Ex-3K	2120587

The components contained in the set are listed in the following Table with their quantity and a recommendation for the replacement interval. For a description of the work necessary for replacement, see “Maintenance work on the sender/receiver unit”, page 94.

Table 42: Contents, spare and consumable parts set, SP100 Ex-3K sender/receiver unit

Name	Number	Replacement interval
O-ring, protection tube, top	3	In case of damage
O-ring, protection tube, bottom	3	In case of damage
Flat seal, flange	3	Every 2 years
Screw, cleaning opening	1	In case of damage
Seal, cleaning opening	3	In case of damage
Seal, reducer	3	In case of damage
Reducer	1	In case of damage
Seal, non-return valve	3	In case of damage
Screws and spring washers, hood	4	In case of damage
Screws, protective tube	4	In case of damage
Safety screw, plug protection guard	2	In case of damage
Sinter filter	3	Every 2 years
Screws, potential equalization	4	In case of damage
O-rings, lock, laser adjustment screws	3	In case of damage

Consumable parts to be purchased separately

Table 43: Consumable parts, SP100 Ex-3K sender/receiver unit

Name	Part No.
Flange seal k100	7047036
Sinter filter	7047714
Optics cloth	4003353
Optics cleaning set with accessories (1×30 ml spray bottle, optics cloth, bellows, brush, cleaning cloths)	5343133
Optics cleaning set (2×60 ml spray bottle, optics cloth)	5340076

16.1.2 Consumable parts, MCUDH Ex-3K / MCU control unit

Table 44: Consumable parts, MCUDH Ex-3K / MCU control unit

Name	Part No.
Button cell, BR1632A for MCUDH Ex-3K	2114601
Button cell for conventional MCU	2085319

DANGER:
Explosion hazard when using non-specified button cells
When using the MCUDH Ex-3K control unit in a potentially explosive atmosphere, only the button cell specified for this purpose may be used.
▶ Only use the button cell battery Part No. 2114601 (type BR1632A).

16.2 Spare parts

16.2.1 Spare parts DUSTHUNTER SP100 Ex-3K

Table 45: Spare parts, SP100 Ex-3K sender/receiver unit

Name	Part No.
Protection tube NL 435 mm 3.1 (high-alloy stainless steel (1.4571))	4103878
Protection tube NL 735 mm 3.1 (high-alloy stainless steel (1.4571))	4103880
Hood 3.1 (high-alloy stainless steel (1.4571))	4093574
Set, 3 blanking plugs laser adjustment (hexagon socket)	2089355
Non-return valve, G¼ inch (standard version)	5320060
Non-return valve G½ inch (high temperature version)	5343453
O-ring, protection tube, top	5329376
O-ring, protection tube, bottom	5314122

16.2.2 Spare parts, control unit

Table 46: Spare parts, control unit MCUDH Ex-3K / MCU / Remote Display

Name	Part No.
Set, cable glands, MCUDH Ex-3K (2× M20 (6...12 mm); 2× M20 (10...14 mm); 2× M25 (14...18 mm)	2115594
Fuse sets T 4 A 250 V (suitable for MCUDH Ex-3K control unit and Remote Display 100 with power supply (mains voltage))	2115062
Fuse sets, T 2 A 250 V (suitable for MCU control unit)	2054541
Fuse sets T 0 A 63 (suitable for Remote Display 100 without power supply (24 V))	2128510

17 Accessories

17.1 Weather protection hood

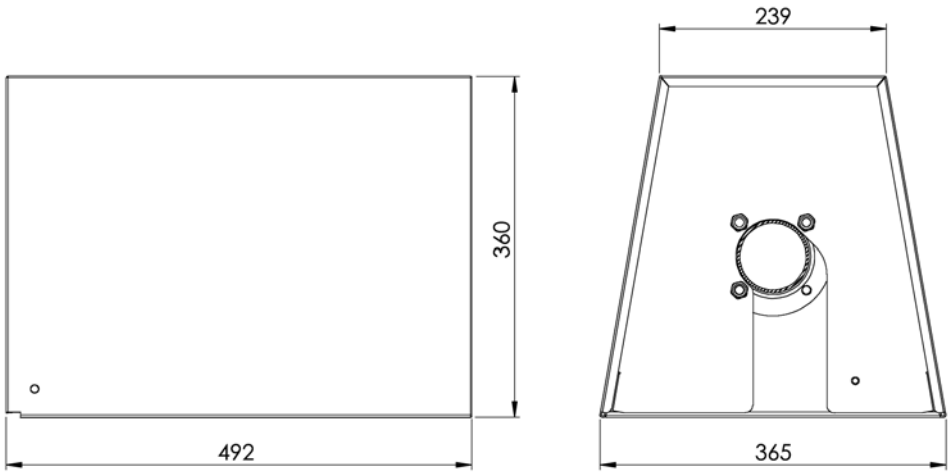


Fig. 83: Weather protection hood for the sender/receiver unit (dimensions in mm)

Table 47: Part number, weather protection hood

Name	Part No.
Weather protection hood for sender/receiver unit with NL up to 735 mm, for the potentially explosive atmosphere	2108971

17.2 Connection technology

17.2.1 Sender/receiver - control unit cable

Name	Part No.
Connecting cable, length 5 m	2102782
Connecting cable, length 10 m	2102783
Connecting cable, length 25 m	2102784
Connecting cable, length 50 m	2102785
Connecting cable, length 100 m	2102786
Cable for the potentially explosive atmosphere, Lappkabel Li2YCYv (TP) - other lengths on request	

17.3 Fastening technology

Table 48: Part numbers, assembly parts

Name	Part No.
Assembly kit for flange - fastening material (for sender/receiver unit with NL 435 mm and 735 mm)	2018184
Blind flange for temporary closure of the flange with tube (without seal)	4108524

17.4 Optional accessories

17.4.1 Options for MCUDH Ex-3K control unit

The Interface module Modbus® ASCII/RTU is a retrofit option when an MCUDH Ex-3K without integrated module was ordered. The optional Ethernet and Modbus® TCP/IP of the MCUDH Ex-3K Interface modules must not be used in the potentially explosive atmosphere.

To use this option, the RS485 Interface module (Part No. 2048958) must be installed in the MCUDH Ex-3K. Between the MCUDH Ex-3K and an Interface module installed outside the potentially explosive atmosphere, a signal cable is required for the RS485 connection that is suitable for use in the potentially explosive atmosphere (see “MCHDH communication options”, page 61).

Table 49: Part numbers, optional accessory, MCUDH Ex-3K control unit

Name	Part No.
Interface module RS485 / Modbus® ASCII/RTU	2048958
Interface module Ethernet / CoLa-B (as remote separate module for communication with MCUDH Ex-3K)	2069666
Interface module Ethernet / Modbus® TCP/IP (as remote separate module for communication with MCUDH Ex-3K)	2069664
Remote Display 100 without power supply unit (24 V DC)	2117058
Remote Display 100 with power supply unit (90...250 V AC)	2117059
SOPAS Service Kit (adapter cable USB-RS485)	2097408
Plug adapter for SOPAS Service Kit	6075779
Power supply unit 24 V DC to supply optional remote Interface modules (rail power supply unit for TS35, type Meanwell MDR-60-24)	6059059
Connecting cable with plug for connection outside the Ex-zone (5 m)	7042017

17.4.2 Options for MCU control unit

Table 50: Part numbers, optional accessories, MCU control unit

Name	Part No.
Interface module Ethernet / CoLa-B for SOPAS ET,	2072693
Interface module Ethernet / Modbus® TCP/IP	2069664
Interface module RS485 / Modbus® ASCII/RTU	2048958
Interface module RS485 / PROFIBUS	2048920
Service Interface module Ethernet / CoLa-B (only applicable as second module for optional use of the local Service interface via Ethernet)	2069667
Analog input module, 2 channels, 0/4 mA ... 22 mA, 100 Ω,	2034656
Analog input module, 2 channels, 0/4 mA ... 22 mA, 500 Ω,	2034657
Digital output module, 4 channels, as NO contact, 48 V AC/DC, 0.5 A	2034661
Digital output module, 2 channels, as changeover contact, 48 V AC/DC, 5 A or 30 V AC/DC, 2 A	2034659

17.5 Other accessories

17.5.1 Device check accessories

Table 51: Part numbers, device check

Name	Part No.
DHSP control filter set for linearity check (in case)	2049045

18 Annex

18.1 Compliances

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

- EU directive: 2014/30/EU (EMC)
- EU directive: 2011/65/EU (RoHS)
- EU directive: 2014/34/EU (ATEX)

Applied EN standards:

- EN 60529, Degrees of protection provided by enclosures (IP code)
- EN 61010-1 Safety requirements for electrical equipment
- EN 61000-6-2 Electromagnetic compatibility
- EN 61326, Electrical equipment for measurement, control and laboratory use - EMC requirements
- EN 50581, Guideline for the implementation of RoHS
- EN 14181, Stationary source emissions - Quality assurance of automated measuring systems
- EN IEC 60079-00:2018-07 (DHSP100 Ex-3K and MCUDH Ex-3K)
- EN IEC 60079-07:2015-12/A1:2018-01 (MCUDH Ex-3K)
- EN IEC 60079-15:2010-05 (DHSP100 Ex-3K and MCUDH Ex-3K with power supply unit)
- EN 60079-28:2015-09 (DHSP100 Ex-3K)
- EN 60079-31:2014-07 (MCUDH Ex-3K)

18.2 Electrical protection

- Control unit MCUDH Ex-3K with power supply unit: Protection class I acc. to EN 61010-1
  Control unit MCUDH Ex-3K without power supply unit: Protection class III acc. to EN 61010-1
  Control unit MCU with power supply unit: Protection class I acc. to EN 61010-1
  Control unit MCU without power supply unit: Protection class III acc. to EN 61010-1
- Insulation coordination: Overvoltage category II acc. to 60664-1
- Degree of contamination (inside device/enclosure):
  - The device operates safely in an environment up to contamination degree 2 according to EN 61010-1 (usual, not conductive contamination and temporary conductivity by occasional moisture condensation).
- Electrical energy:
  - The wiring network to the power voltage supply of the system must be installed and fused according to the relevant regulations.

18.3 Approvals

Approvals

The DUSTHUNTER SP100 Ex-3K is performance-tested according to EN 15267 and may be used for continuous emission monitoring in systems requiring approval according to EU Directives.

18.4 Licenses

Exclusion of liability

The firmware for this device has been developed using Open Source Software. Any changes to the Open Source components are in the general responsibility of the user. All warranty claims are excluded in this case.

The following exclusion of liability applies to the GPL components in relation to the rights holders: This program is distributed in the hope that it will be of use, but with no guarantee of this; neither is there any implied guarantee of marketability or suitability for a particular purpose. See GNU (General Public License) for details. With regard to the other Open Source components, we draw attention to the liability disclaimers of the copyright holders in the license texts on the data medium delivered.

Software licenses

In this product, Endress+Hauser uses unchanged and, as far is necessary and in compliance with relevant license conditions, changed Open Source Software.

The firmware of this device is therefore subject to the copyrights listed on the data medium delivered. Please refer to the data medium delivered for a complete list of the Open Source programs used as well as the relevant license conditions.

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