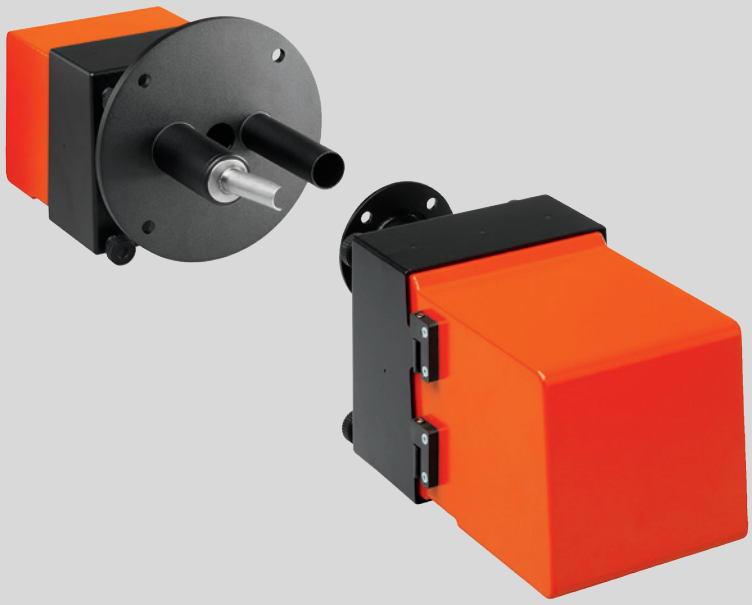
OPERATING INSTRUCTIONS

DUSTHUNTER C200

Dust Concentration Monitor

Installation, Operation, Maintenance

SICK
Sensor Intelligence.



Described Product
Product name: DUSTHUNTER C200

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Legal Information

Original document
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CE

Contents

1 Important Information

1.1 Main hazards

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

The optical subassemblies are fitted directly on the gas-carrying duct. On equipment with low hazard potential (no danger to health, ambient pressure, low temperatures), the installation or removal can be performed while the equipment is in operation providing the valid regulations and equipment safety notices are observed and suitable protective measures are taken.

WARNING: Danger from exhaust gas

- On equipment with gases detrimental to health, high pressure or high temperatures, the sender/receiver units and reflector components fitted on the duct may only be installed/removed when the equipment is at a standstill.

1.1.2 Hazards through electrical equipment

WARNING: Danger through power voltage

The DUSTHUNTER C200 measuring system is classified as electrical.

- Disconnect power supply lines before working on power connections or parts carrying power voltage.
- Refit any contact protection removed before switching the power voltage back on again.

1.1.3 Hazards through laser beam

WARNING: Hazards through laser beam

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

1.2 Symbols and document conventions

1.2.1 Warning Symbols

Symbol	Significance
	Hazard (general)
	Hazard by voltage

1.2.2 Warning levels and signal words

DANGER
Risk or hazardous situation which *will* result in severe personal injury or death.
WARNING
Risk or hazardous situation which *could* result in severe personal injury or death.
CAUTION
Hazard or unsafe practice which *could* result in less severe or minor injuries.
NOTICE
Hazard which *could* result in property damage.

1.2.3 Information symbols

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

1.3 Intended use

Purpose of the device

The DUSTHUNTER C200 measuring system only serves continuous measurement of dust concentrations in exhaust gas and exhaust air plants.

Correct use

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

Restrictions of use

- The DUSTHUNTER C200 measuring system is not approved for use in potentially explosive atmospheres.

1.4 Responsibility of user

1.4.1 General information

Designated users

The measuring system DUSTHUNTER C200 may only be installed and operated by skilled technicians who, based on their technical training and knowledge as well as knowledge of the relevant regulations, can assess the tasks given and recognize the hazards involved.

Special local conditions

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

Retention of documents

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

1.4.2 Safety information and protective measures

Protection devices

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

Behavior during purge air failure

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

NOTE:
When no fail-safe shutters are fitted:
The user must ensure that:
- The purge air supply runs reliably and continuously
- Failure of the purge air supply is immediately detected (e.g., by using pressure monitors)
- Optical subassemblies are removed from the duct if the purge air supply fails and the duct opening is closed off (e.g. with a flange cover).

Preventive measures for operating safety

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

Recognizing malfunctions

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

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

Avoiding damage

NOTE:

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

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

Electrical connection

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

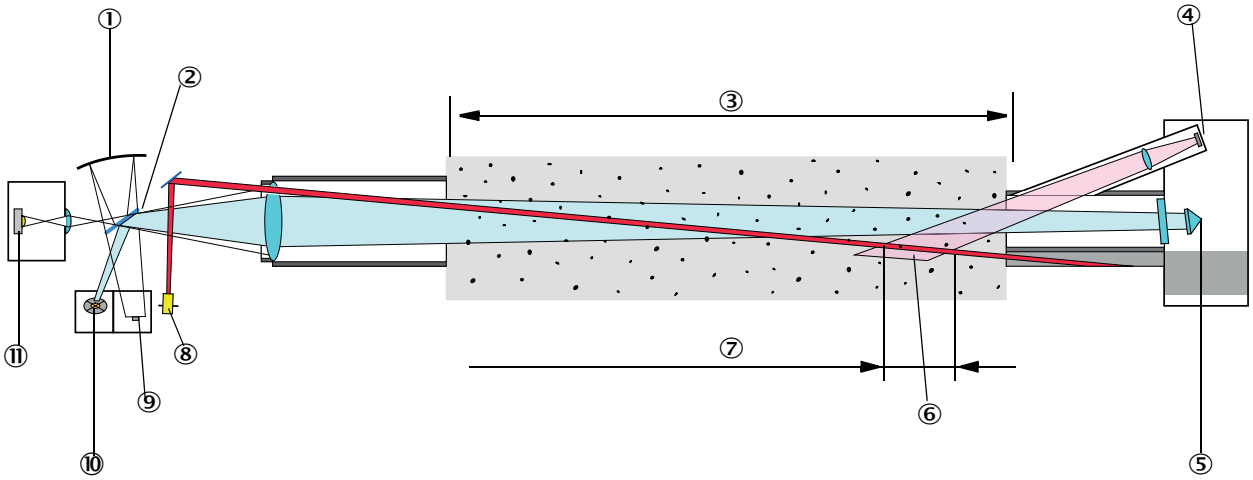
2 Product Description

2.1 Measuring principle, measured variables

2.1.1 Functional principle

The DUSTHUNTER C200 measuring system operates as transmissometer with double beam path and as scattered light measuring device with forward dispersion.

Fig. 1: Measuring principle with transmission and scattered light measurement with forward dispersion



① Concave mirror
② Beam splitter
③ Active measuring path Transmission measurement
④ Scattered light receiver
⑤ Reflector
⑥ Active measuring volume Scattered light measurement
⑦ Effective active measuring path Scattered light measurement
⑧ Laser diode
⑨ Monitor receiver
⑩ Measurement receiver (4-quadrant element)
⑪ LED

2.1.1.1 *Transmission measurement*

A high performance LED sends light in the visible range (white light, wavelength approx. 450 to 700 nm) through the active measuring path containing particles to the reflector where it is bounced back to the receiver. A highly sensitive measurement receiver accepts the signal weakened by particles, amplifies the signal electrically and feeds it to the measuring channel of a microprocessor as central part of the measuring, control and evaluation electronics.

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

Measured variables

The measuring system uses transmission (T) as primary optical measured variable. The other measured variables opacity (O), relative opacity (ROPA), extinction (E) and dust concentration (c) are derived from this variable.

Transmission, opacity, relative opacity:

$$T = N \bullet \frac{I_{meas}}{I_{mon}}$$

$$O = 1 - T$$

$$ROPA = 1 - e^{E \bullet \frac{D_{Do}}{2 \bullet D_{meas}}}$$

N = scaling constant
I_{meas} = light received
I_{mon} = monitor signal
D_{Do} = stack diameter at the top end
D_{meas} = active measuring path

Transmission, opacity and relative opacity are usually specified in percent.
Extinction:

$$E = \log\left(\frac{1}{T}\right)$$

Dust concentration:

Based on the Beer-Lambert law, the dust concentration is derived from the extinction as follows:

$$c = \frac{2,31 \bullet E}{k \bullet L} = K \bullet E$$

k= extinction constant
L = 2x active measuring path (due to double beam path)

Extinction is directly proportional to dust concentration for constant particle size and uniform dust distribution.

Particle size, dust density and dust distribution during differing load states influence transmission and extinction values and therefore the measuring system must be calibrated using a gravimetric comparison measurement for exact dust concentration measurement. The calibration coefficient determined can be entered directly in the measuring system as

$c = cc2 \cdot E^2 + cc1 \cdot E + cc0$

(Entry see “Calibration for dust concentration measurement”, page 76; standard factory setting: cc2 = 0, cc1 = 1, cc0 = 0).

2.1.1.2 *Scattered light measurement*

A laser diode beams the dust particles in the gas flow with modulated light in the visual range (wavelength approx. 650 nm). A highly sensitive receiver registers the light scattered by the particles, amplifies the light electrically and feeds it to the measuring channel of a microprocessor as central part of the measuring, control and evaluation electronics. The measuring volume in the gas duct is defined through the intersection of the sender beam sent and the receive aperture.

In the same manner as for transmission measurement, continuous monitoring of the sender output registers smallest changes in brightness of the light beam sent which then serves to determine the measurement signal.

Determining the dust concentration

Measured scattered light intensity (SI) is proportional to dust concentration (c). Scattered light intensity not only depends on the number and size of particles but also on the optical characteristics of the particles and therefore the measuring system must be calibrated using a gravimetric comparison measurement for exact dust concentration measurement. The calibration coefficients determined can be entered directly in the measuring system as

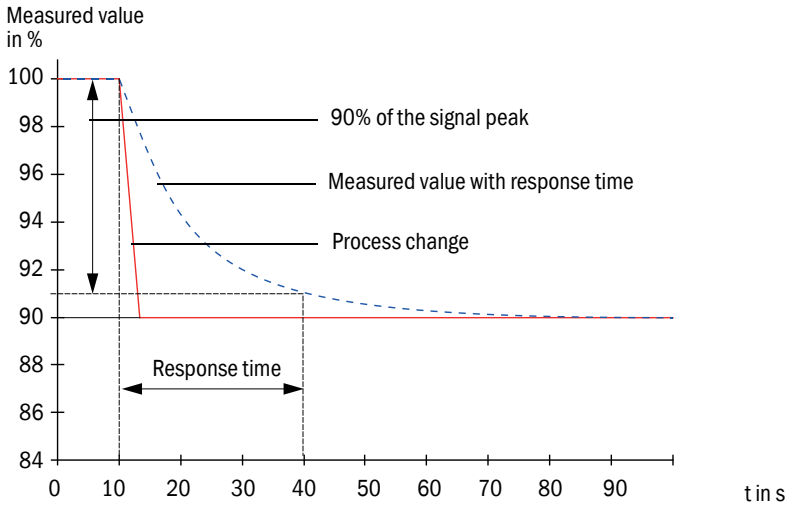
$c = cc2 \cdot SI^2 + cc1 \cdot SI + cc0$

(Entry see “Calibration for dust concentration measurement”, page 76; standard factory setting: cc2 = 0, cc1 = 1, cc0 = 0).

2.1.2 Response time

The response time is the time required to attain 90% of the signal peak after a sudden change in the measurement signal. It can be set anywhere between 1 and 600 s. As the response time increases, transient measured value fluctuations and interruptions are damped stronger and stronger which “smoothes out” the output signal.

Fig. 2: Response time



2.1.3 Function check

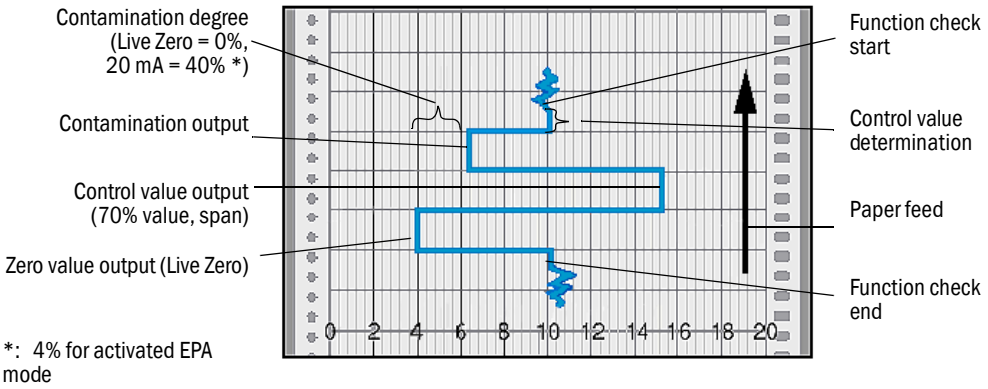
A function check can be triggered at fixed intervals as from a definable starting timepoint for an automatic function check of the measuring system. The setting can be made using the SOPAS ET operating program (see “Determining the function check”, page 70). Any unallowed deviations from normal behavior that may occur are signaled as errors. A function check triggered manually can help localize possible error causes should a device malfunction occur.

Further information → Service Manual

The function check comprises:

- Approx. 65 s measurement of contamination on optical interfaces, zero and control value
  The measuring time depends on the increase in contamination value (change > 0.5% → measurement is repeated up to 2 times → measuring time increases).
- Every 90 s (standard value), output of values determined (duration parameter can be modified, see “Determining the function check”, page 70).

Fig. 3: Function check output on a plotter



- The analog output must be activated to output control values on the analog output (see “Setting the analog outputs parameters”, page 71).
- 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.
- During a function check, relay 3 is activated (see “MCU processor board connections”, page 48) and the green LED in the control window of the sender/receiver unit flashes (see “Sender/receiver unit”, page 18).
- A function check is not started automatically when the measuring system is in “Maintenance” mode.
- “Function control” is displayed on the LC-Display of the MCU control unit during the function check.
- If the start timepoint or cycle interval are 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.

Zero value measurement

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

Control value measurement (Span test)

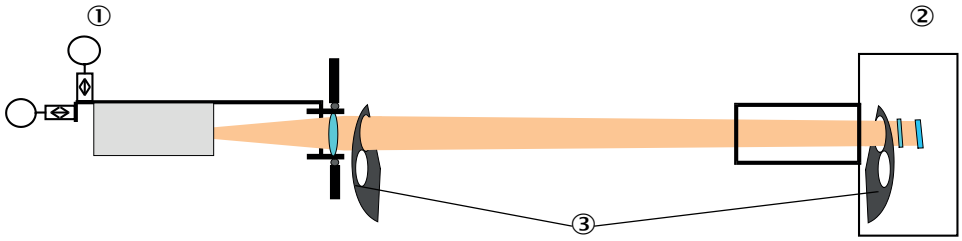
Sender beam intensity changes between 70 and 100% during control value determination. The light intensity received is compared against the standard value (70%). The measuring system generates an error signal for deviations greater than ±2%. The error message is cleared again when the next function check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

For scattered light measurement, the value calculated theoretically (70%) is output for very low dust concentrations (< approx. 1 mg/m^3).

Contamination measurement

The glass panes positioned in the sender beam during normal measurement are swiveled away during contamination determination (staggered for sender/receiver unit and reflector/scattered light receiver). The contamination value is determined from the values measured thereby and the reference values determined during every scaling process (see “Scaling the measuring system for transmission measurement”, page 63). The regular measured values are reduced by the contamination value which fully compensates any contamination that occurred.

Fig. 4: Contamination measurement principle (on both sides)



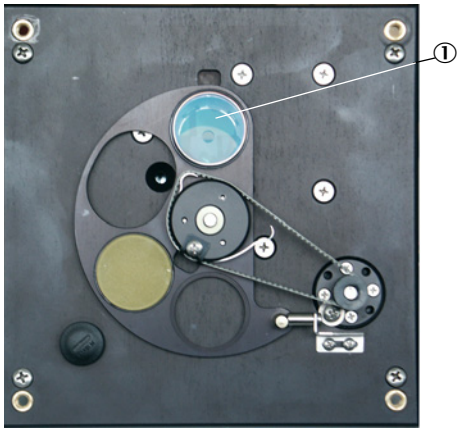
① Sender/receiver unit
② Reflector
③ Pivoted shutter

A value between live zero and 20 mA which is proportional to the contamination is output on the analog output for contamination values < 40% (standard setting); when this value is exceeded, the “Failure” status is output (on the analog output the set error current; see “Factory settings”, page 69, see “Setting the analog outputs parameters”, page 71)

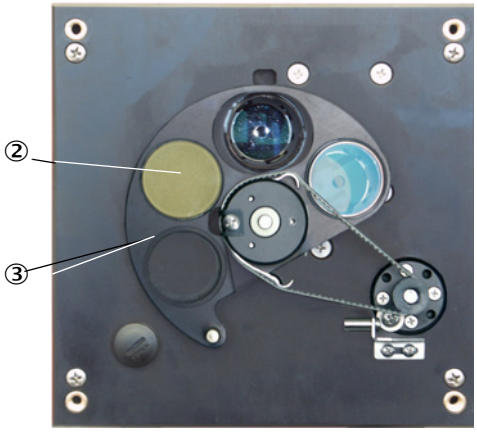
- The contamination limit value can be freely configured when the measuring system is operated according to the European standard (see “Entering application-specific parameters”, page 64).
- The contamination limit value for “Warning” is always 10% below the value for “Failure”.
- In operation according to the EPA standard, the contamination limit value for “Warning” is set fixed to 3% and the value for “Failure” to 4%.

Fig. 5: Pivoted shutter settings on the sender/receiver unit

Measuring position



Contamination measurement



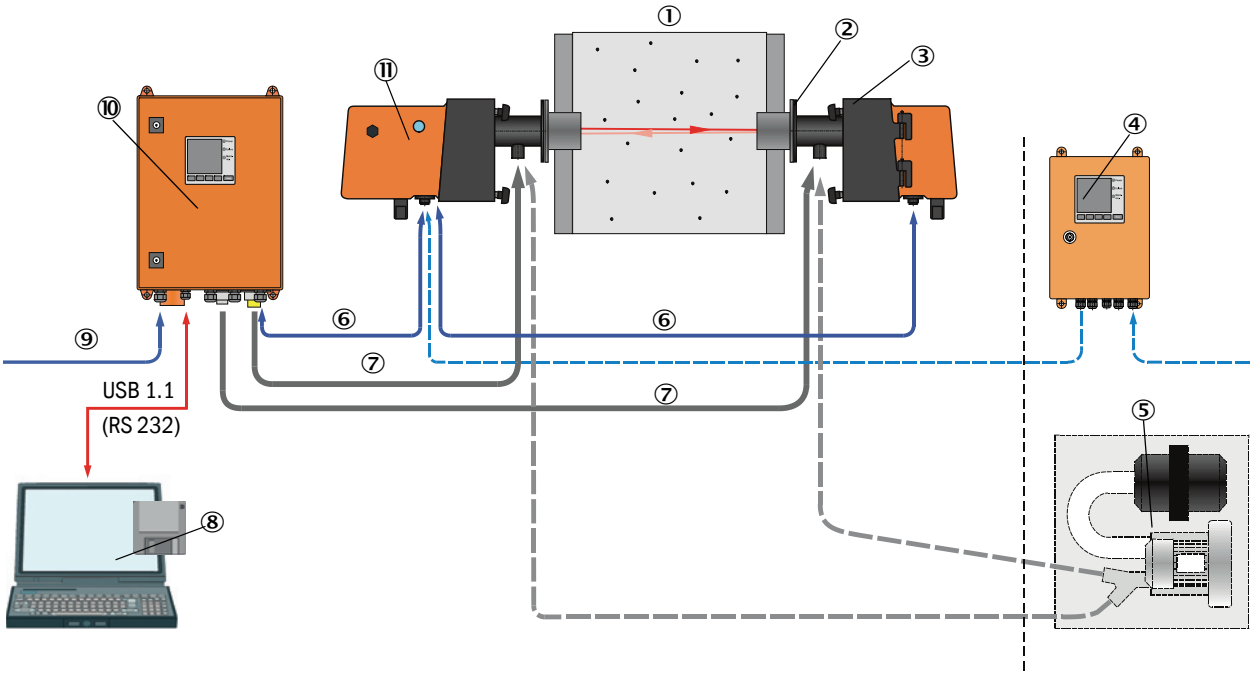
① Glass pane
② Control reflector (only on the sender side)
③ Pivoted shutter

2.2 Device components

Measuring system DUSTHUNTER C200 comprises as standard the components:

- Sender/receiver unit DHC-T
- Connection line to connect the sender/receiver unit to the MCU control unit (lengths 5 m, 10 m)
- Reflector/scattered light receiver DHC-R
- Connection line to connect the reflector/scattered light receiver to the sender/receiver unit (lengths 5 m, 10 m, 20 m)
- Flange with tube
- MCU control unit
  to control, evaluate and output the data of the sender/receiver unit connected via the RS485 interface
  - With integrated purge air supply, for internal duct pressure -50 ... +2 hPa
  - Without purge air supply, therefore additionally required:
- Optional external purge air unit, for internal duct pressure -50 ... +30 hPa
- Purge air hose for supply by MCU control unit-P

Fig. 6: Device components DUSTHUNTER C200



① Duct
② Flange with tube
③ Reflector/scattered light receiver
④ MCU-N (without purge air supply) (option)
⑤ External purge air unit (option)
⑥ Connection cable
⑦ Purge air hose
⑧ Operating and parameter program SOPAS ET
⑨ Power supply
⑩ MCU-P (with purge air supply)
⑪ Sender/receiver unit

Communication between sender/receiver unit and MCU control unit

As standard, each sender/receiver unit is connected to an MCU control unit via the connection line.

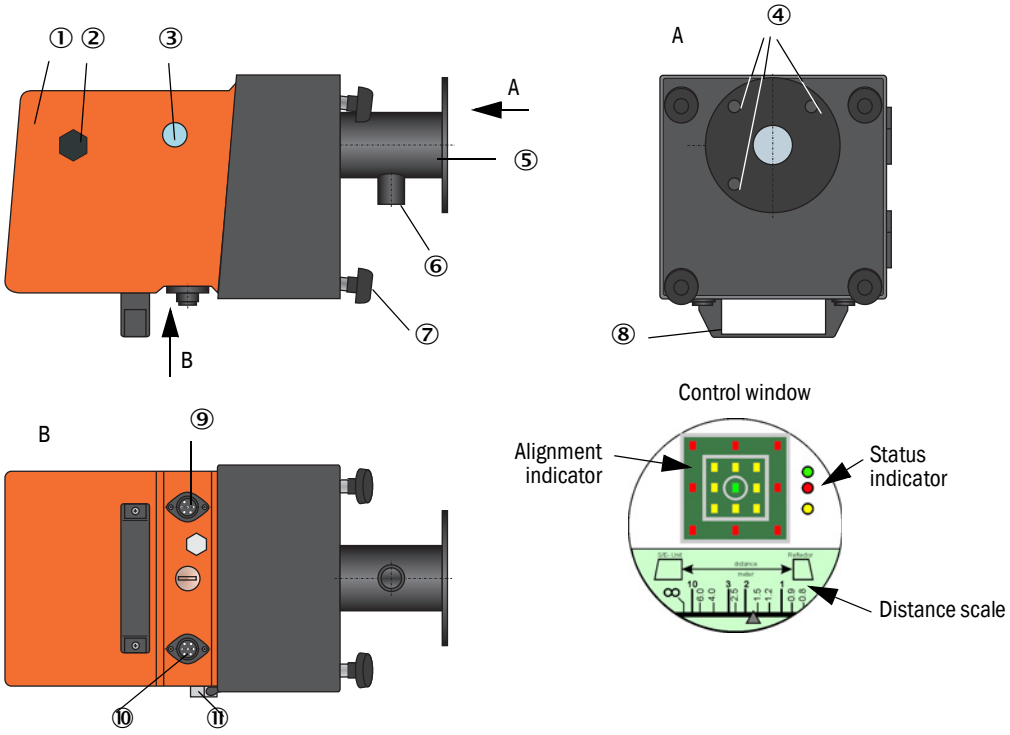
2.2.1 Sender/receiver unit

The sender/receiver unit contains the optical and electronic subassemblies to send and receive the reflected light beam of the transmission measurement as well as to process and evaluate the signals. Swivel mechanisms are also fitted for contamination measurement and self-alignment (see “Pivoted shutter settings on the sender/receiver unit”, page 16 and see “Self-alignment principle design”, page 19).

Data transfer to and power supply (24 V DC) from the MCU control unit run via a shielded line with 4 wires and plug connector. Clean air to cool the device and keep the optical surfaces clean is fed via a purge air connection.

The sender/receiver unit is fastened to the duct with a flange with tube (see “Device components”, page 17).

Fig. 7: Sender/receiver unit DHC-T for transmission and scattered light measurement



① Enclosure with electronics (swivel-mounted)
② Cover screw for laser adjustment
③ Control window
④ Mounting holes
⑤ Flange
⑥ Purge air connection
⑦ Knurled screw
⑧ Handle
⑨ Connection for connection line to reflector/ scattered light receiver
⑩ Connection of connection line to MCU
⑪ Hinge

The alignment of the optical axes as well as the current device state (operation = green LED, failure = red LED, maintenance request = yellow LED) are shown at the control window.

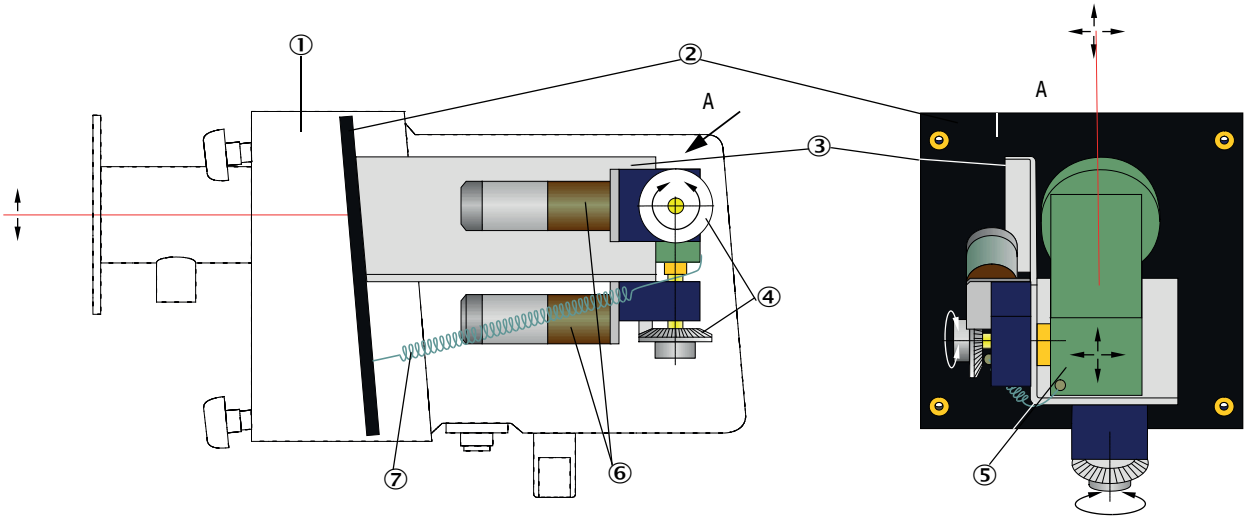
The enclosure with fitted sender/receiver unit can be swiveled to the side after the knurled screws have been loosened. Optics, electronics and mechanical components can then be easily accessed for maintenance work.

The laser beam can be readjusted to different duct diameters after loosening the cover screw.

How self-alignment works

The sender module can be moved horizontally and vertically using motors and bevel gears so that the sender light beam can be adjusted by approximately 2° in all directions. Tracking is performed using the measurement signal on the 4 quadrants of the measurement receiver. This allows automatic compensation of optical axis misalignment caused by, for example, distortion of duct walls due to temperature fluctuations.

Fig. 8: Self-alignment principle design



① Sender/receiver unit
② Base plate
③ Retaining bracket
④ Bevel gear
⑤ Sender module
⑥ Drive
⑦ Tension spring

2.2.2 Reflector/scattered light receiver

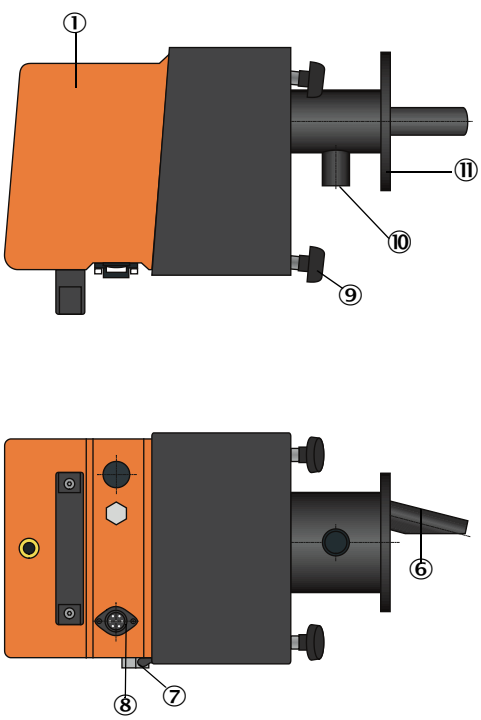
For transmission measurement, this component contains a reflector to reflect the sender light beam back to the receiver in the sender/receiver unit and a scattered light receiver with a light trap. Two versions are available to adapt to different internal duct diameters. A type code identifies the versions:

Reflector/scattered light receiver: DHC-Rx

Measuring path:

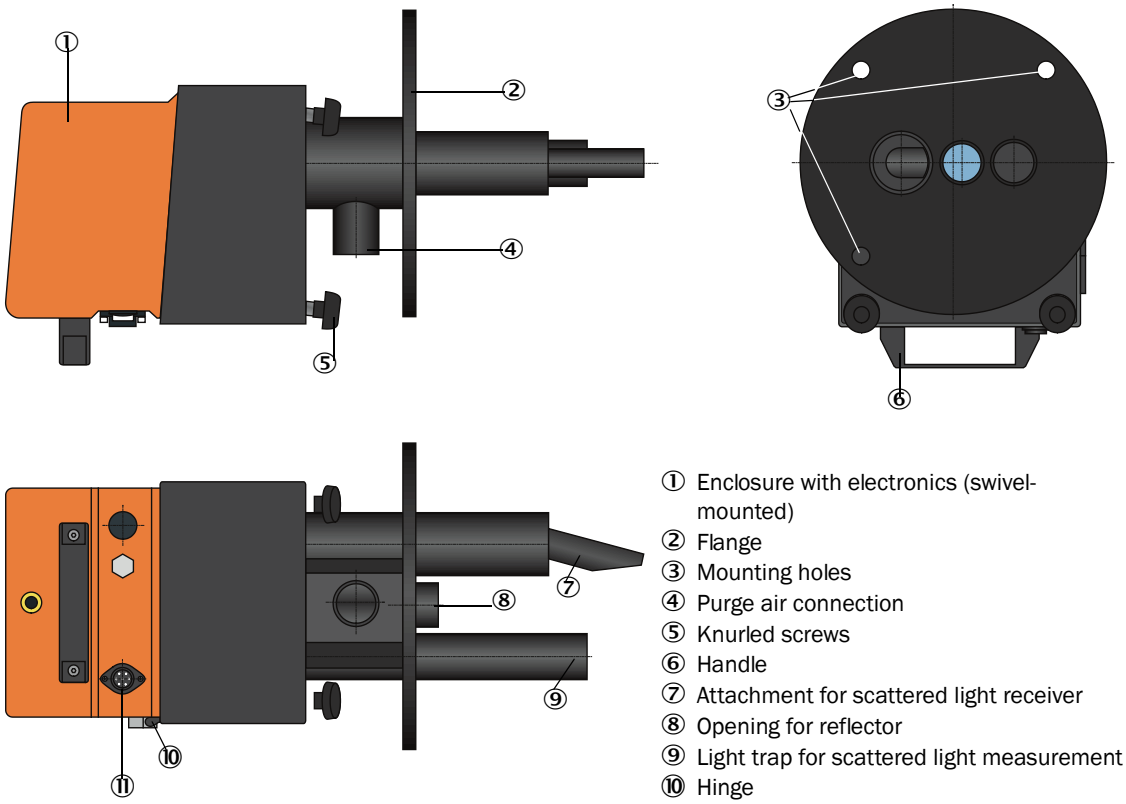
- 0: Short (0.5 ... 3 m)
- 1: Long (2.5 ... 8 m)

Fig. 9: Reflector/scattered light receiver for short measuring paths



① Enclosure with electronics (swivel-mounted)
② Mounting holes
③ Light trap
④ Opening for reflector
⑤ Handle
⑥ Attachment for scattered light receiver
⑦ Hinge
⑧ Connection for sender unit
⑨ Knurled screw
⑩ Purge air connection
⑪ Flange

Fig. 10: Reflector/scattered light receiver for long measuring paths

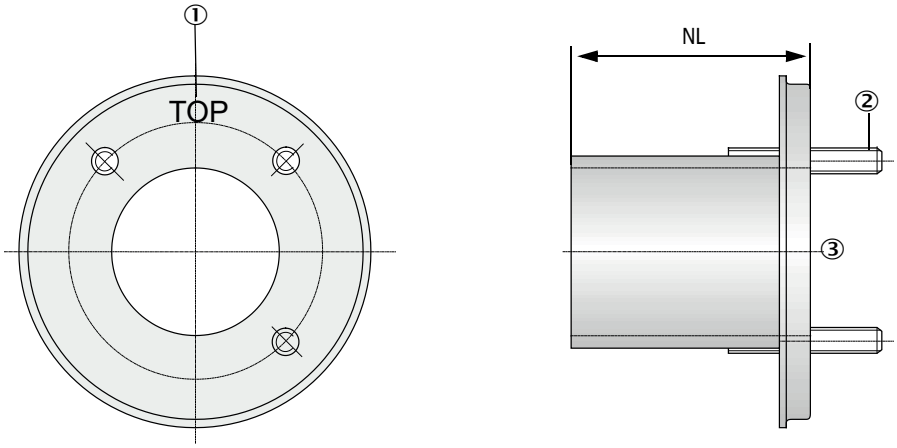


① Enclosure with electronics (swivel-mounted)
② Flange
③ Mounting holes
④ Purge air connection
⑤ Knurled screws
⑥ Handle
⑦ Attachment for scattered light receiver
⑧ Opening for reflector
⑨ Light trap for scattered light measurement
⑩ Hinge
⑪ Connection for sender unit

2.2.3 Flange with tube

The flange with tube is available in different steel grades and dimensions (see “Flange with tube”, page 117). Selection depends on the wall and isolation thickness of the duct wall (→ nominal length) and the duct material.

Fig. 11: Flange with tube



① Marking for assembly position
② Securing bolt
③ Material St 37 or 1.4571

2.2.4 MCU control unit

Control unit MCU has the following functions:

- Control of the data traffic and processing of the sender/receiver unit data connected via the RS485 interface
- Signal output via analog output (measured value) and relay outputs (device status)
- Signal input via analog and digital inputs
- Power supply for the connected measuring unit via 24 V switch-mode power supply with wide range input
- Communication with higher level control systems via optional modules

Equipment and device parameters can be set easily and conveniently via a USB interface using a PC and a user-friendly operating program. The parameters are stored reliably even in the case of a power failure.

Control unit MCU has a sheet steel enclosure as standard.

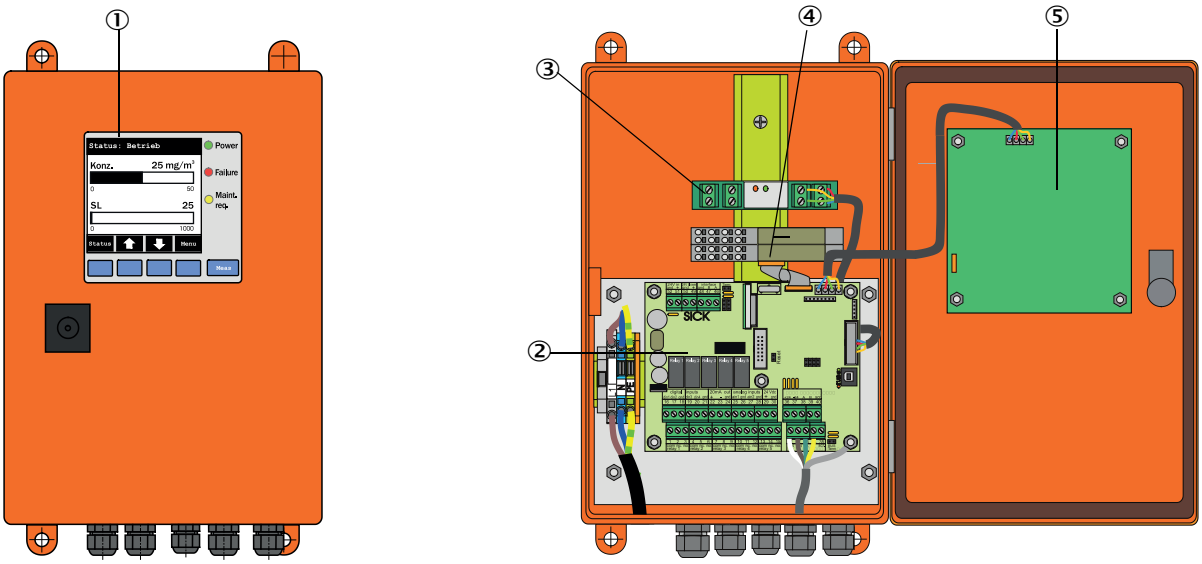
2.2.4.1 *Standard interfaces*

Analog output	Analog inputs	Relay outputs	Digital inputs	Communication
3 outputs 0/2/4...22 mA (electrically isolated, active) to output: • Dust concentration ext. a.c. • Dust concentration ext. s.c. • Dust concentration SI. a.c. • Dust concentration SI. s.c. • Scattered light • Opacity • Extinction • Transmission • Relative opacity Resolution 10 bits	2 inputs 0...20 mA (standard; without electric isolation); resolution 10 bits	5 changeover contacts (48 V, 1 A) to output status signals: • Operation/failure • Maintenance • Function check • Maintenance request • Limit value	4 inputs to connect potential-free contacts (e.g., to connect a maintenance switch or trigger a function check)	• USB 1.1 and RS232 (on terminals) for measured value inquiries, setting parameters and software updates. • RS485 for sensor connection

2.2.4.2 *Versions*

- Control unit MCU-N without purge air supply

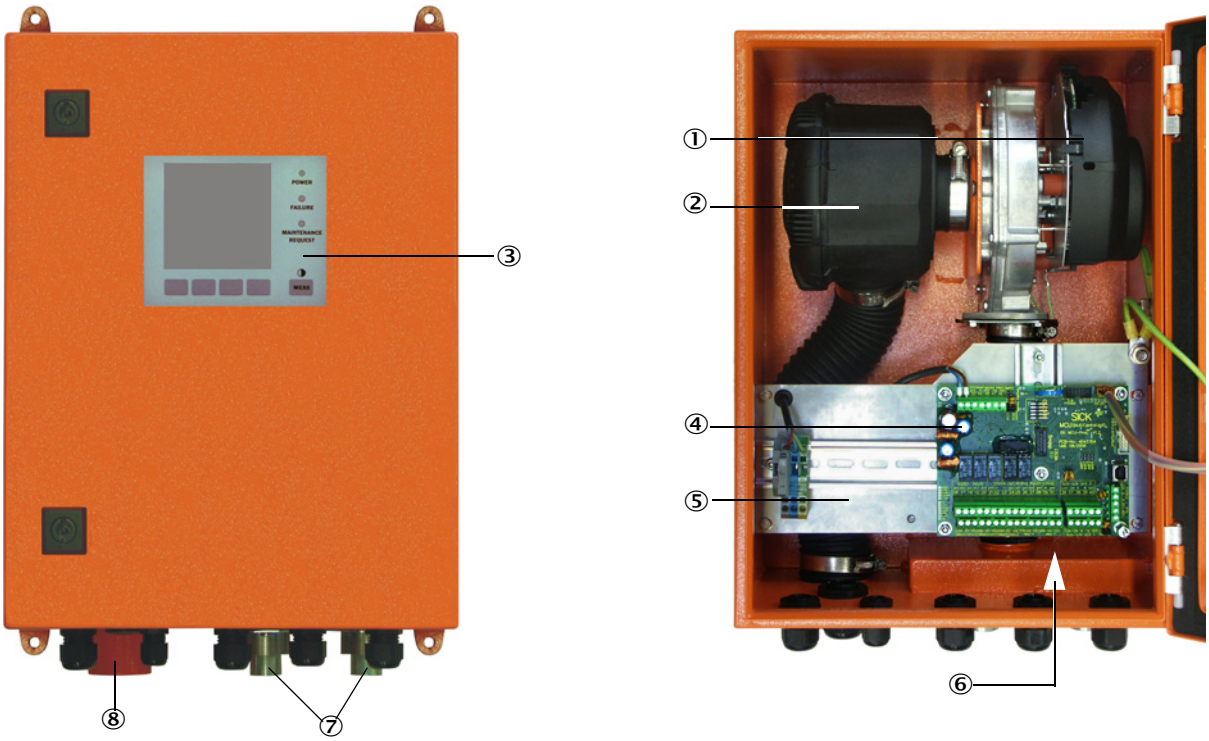
Fig. 12: Control unit MCU-N with options



① Display module (option)
② Processor board
③ Interface module (option)
④ I/O module (option)
⑤ Display module (option)

- MCU-P control unit with integrated purge air supply

Fig. 13: MCU-P control unit with integrated purge air supply



① Purge air blower
② Air filter
③ Optional Display module
④ Processor board
⑤ Installation plate
⑥ Power supply unit (on back of installation plate)
⑦ Purge air connection
⑧ Purge air inlet

The purge air hose (standard lengths 5 and 10 m (see “Purge air supply”, page 122)) is a separate part of the measuring system and must be ordered separately.

2.2.4.3 *Type code*

The following type code defines the various configuration options in the same manner as for the sender/receiver unit and reflector/scattered light receiver:

Type code MCU control unit: MCU-X X O D N X 1 0 0 0 N N N E

Integrated purge air supply
- N: Without (no)
- P: With (purged)

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

Enclosure variants
- O: Wall enclosure, SICK, orange

Display module
- D: With

Other options
- N: Without

Analog input option (plug-in module; 0/4...20 mA; 2 inputs per module)
- 0: Without
- n: With, n = 1

Analog output option (plug-in module; 0/4...20 mA; 2 outputs per module)
- n: With, n = 1

Digital input option (plug-in module; 4 inputs per module)
- 0: Without

Digital output power option (plug-in module; 48 V DC, 5 A; 2 changeovers per module)
- 0: Without

Digital output low power option (plug-in module; 48 V DC, 0.5 A; 4 make contact elements per module)
- 0: Without

Optional Interface module
- N: Without
- E: Ethernet type 1, COLA-B
- P: Profibus
- E: Ethernet type 2, COLA-B

Special versions
- N: No special features

EX certification
- N: Without EX certification

Software
- E: Emission measurement

2.2.4.4 *Modules*

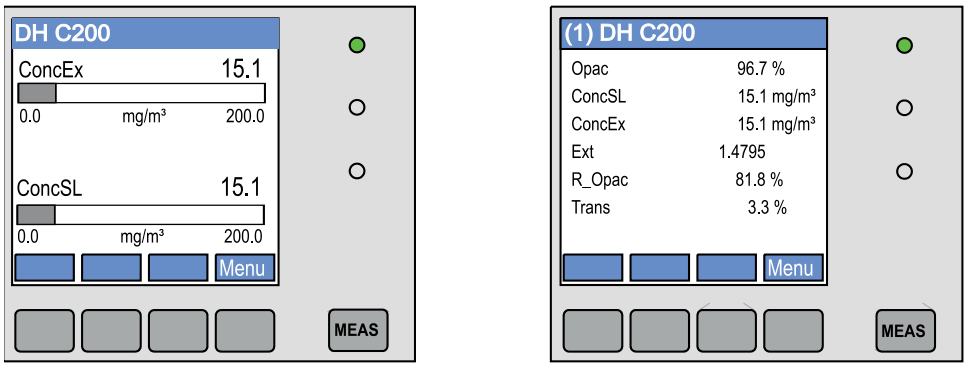
1 Display module
Module to display measured values and status information and for configuration during start-up, selection via operating buttons.

a) Displays

Type		Display
LED	Power (green)	Voltage supply OK
	Failure (red)	Function fault
	Maintenance request (yellow)	Maintenance request
LC-Display	Graphic display (main screen)	• Dust concentration • Transmission • Opacity • Extinction • Scattered light intensity
	Text display	Two measured values (see graphic display) and 8 diagnosis values (see “LC-Display menu structure”, page 85)

The graphic display shows two main measured values of a connected sender/receiver unit selected at the factory or calculated values from the MCU (e.g., scaled dust concentration) as bar charts. Alternatively, up to 8 single measured values of a sender/receiver unit can be displayed (toggle with “Meas” button).

Fig. 14: LC-Display with graphic (left) and text (right) display)



b) Control buttons

Button	Function
Meas	• Toggle between text and graphic display • Display the contrast setting (after 2.5 s)
Arrows	Select next/previous measured value page
Diag	Display alarm or fault message
Menu	Display of main menu and selection of submenus

2 I/O module

Apart from the standard analog output, the DUSTHUNTER C200 has an Analog module with two outputs 0/4 ... 22 mA (max. load 500 Ω) integrated to output further measured variables. The module is plugged onto a module carrier connected to the processor board with a special line.

Options

1 1x analog input module with two inputs 0/4 ... 22 mA (see “Options for MCU control unit”, page 123) to read-in values from external sensors (gas temperature, internal duct pressure, moisture, O_2) to calculate the dust concentration in standard state.
An additional module carrier docked to the existing ones is required for this option.
2 Module to pass on measured values, system status and service information to higher level control systems, optionally for Profibus DP V0, Modbus TCP or Ethernet (type 1 or type 2), to plug onto a hat rail (see “Options for MCU control unit”, page 123).
A corresponding line serves to connect the module to the processor board.

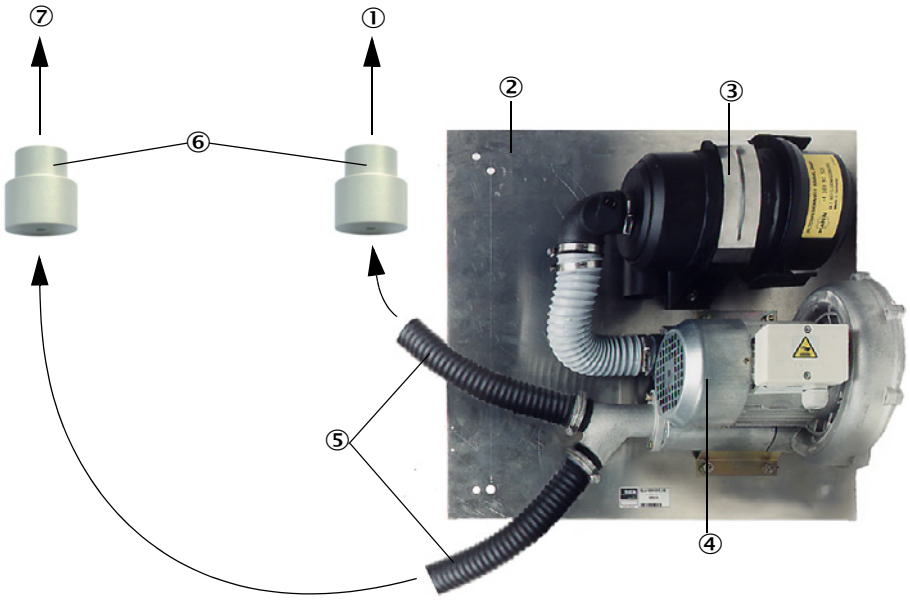
> Profibus DP-V0 for transfer via RS485 according to DIN 19245 Part 3 as well as IEC 61158.

3 MCU remote control unit
The MCU remote control unit has identical functions to the MCU display near the device, however, it can be installed further away.
– Operating function the same as the MCU display
– Distance to the device:
  - MCU remote control unit without separate power supply unit: Max. 100 m
  - MCU remote control unit with own power supply unit: Max. 1000 m
– The MCU and the MCU remote control unit are interlocked (it is not possible to operate both MCUs at the same time).

2.2.5 Optional external purge air unit

The MCU control unit with integrated purge air supply cannot be used when the internal duct pressure is greater than +2 hPa or when using the DHC-R1 reflector/scattered light receiver for long measuring paths. Use the optional external purge air unit in this case. It has a powerful blower and can be used for excess pressure in the duct up to 30 hPa. The scope of delivery includes a purge air hose with 40 mm nominal diameter (length 5 m or 10 m).

Fig. 15: Optional external purge air unit with adapter



① To purge air connection of reflector/scattered light receiver
② Base plate
③ Air filter
④ Blower (standard type 2BH13)
⑤ Purge air hose
⑥ Adapter 40-25
⑦ To purge air connection of sender/receiver unit

A weatherproof cover is available for use outdoors (see “Weatherproof covers”, page 121).

2.2.6 Installation accessories (to be ordered separately)

2.2.6.1 *Purge air supply*

Component	Supply by MCU-P control unit			Purge air supply by optional external purge air unit		
	for send/ receiver unit	for reflector/ Scattered light receiver		for send/ receiver unit	for reflector/ Scattered light receiver	
		DHC-R0	DHC-R1		DHC-R0	DHC-R1
Purge air hose DN25	1x	1x	-	-		
Purge air hose DN40	-		1x	1x	1x	1x
Adapter 40-25	-			1x	1x	-

Purge air hoses can have different lengths.

2.2.6.2 *Connection line*

One line each is required for connection of the sender/receiver unit to the MCU and the reflector/scattered light receiver to the sender/receiver unit. The respective lengths are 5 or 10 m (for the connection of reflector/scattered light receiver - sender/receiver unit also 20 m).

2.2.6.3 *Weatherproof covers*

Weatherproof covers are available for sender/receiver units and reflectors used outdoors (see “Weatherproof covers”, page 121).

2.2.7 Device check accessories

2.2.7.1 *Test equipment for linearity test*

A linearity test can serve to check the correct measurement function (see Service Manual). In this case, filter glasses with defined transmission values are positioned in the beam path and the values compared against those measured by the DUSTHUNTER C200. Compliance within the allowed tolerance means the measuring system is working correctly. The filter glasses with holder required for the check are deliverable including a carrying case.

2.2.7.2 *Adjusting stands for scaling*

Adjusting stands are available to check transmission measurement in smoke-free measuring paths (see “Preparatory work”, page 58) and are fitted with a sender/receiver unit and reflector in a defined distance from each other and aligned so that the optical axes match (see “Focussing the sender light beam for transmission measurement”, page 60). The transmission value determined is set as 100% and serves as standard for measurement in the path containing dust.

2.2.7.3 *Zero tube for scaling*

The measuring system can also be scaled using a tube with a defined length instead of the adjusting stand (see “Preparatory work”, page 58). Assembling and aligning the sender/receiver unit and reflector in a dust-free path are then easier and more precise. We especially recommend this option when a dust-free environment cannot be guaranteed for scaling.

The zero tube is closed off with end flaps when not in use so that no dust can penetrate the tube.

2.3 Device configuration

The device components required for a measuring system depend on the respective application conditions. The following Table should serve to assist you in your selection.

Sender/receiver unit, reflector/scattered light receiver, flange with tube

> **NOTE:**
> The reflector/scattered light receiver may not project from the flange tube. The maximum possible wall and insulation thickness is therefore limited to the values stated in the Table.

Distance flange - flange	Maximum wall and insulation thickness	Sender/ receiver unit	Reflector/ scattered light receiver	Flange with tube		Line for reflector/scattered light receiver
				Sender/receiver unit	Reflector/scattered light receiver	
0.5 ... 3 m	40 mm	DHC-T	DHC-R0	Flange with tube k100 NL 130/240/500 mm	Flange with tube k100 NL 110 mm	x
2.5 ... 8 m	270 mm		DHC-R1		Flange with tube k225 NL 350 mm	

Voltage and purge air supply

Internal duct pressure	Distance MCU - sender/receiver unit or reflector/scattered light receiver	Connection and supply components	
		Purge air	Voltage
up to +2 hPa	max. 3 m	MCU-P + purge air hose DN 25 (on sender/receiver unit and reflector/scattered light receiver DHC-R0) or purge air hose DN 40 (on reflector/scattered light receiver DHC-R1)	
> +2 hPa		Optional external purge air unit + adapter 40-25 (on sender/receiver unit)	MCU-N

2.4 SOPAS ET (PC program)

SOPAS ET is a SICK Software for easy operation and configuration of the DUSTHUNTER.

SOPAS ET runs on a laptop/PC connected to the DUSTHUNTER via a USB line or Ethernet interface (option).

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

SOPAS ET is delivered on the product CD. Alternatively, you can download SOPAS ET free of charge from the SICK homepage (“Downloads”).

3 Assembly and Installation

3.1 Project planning

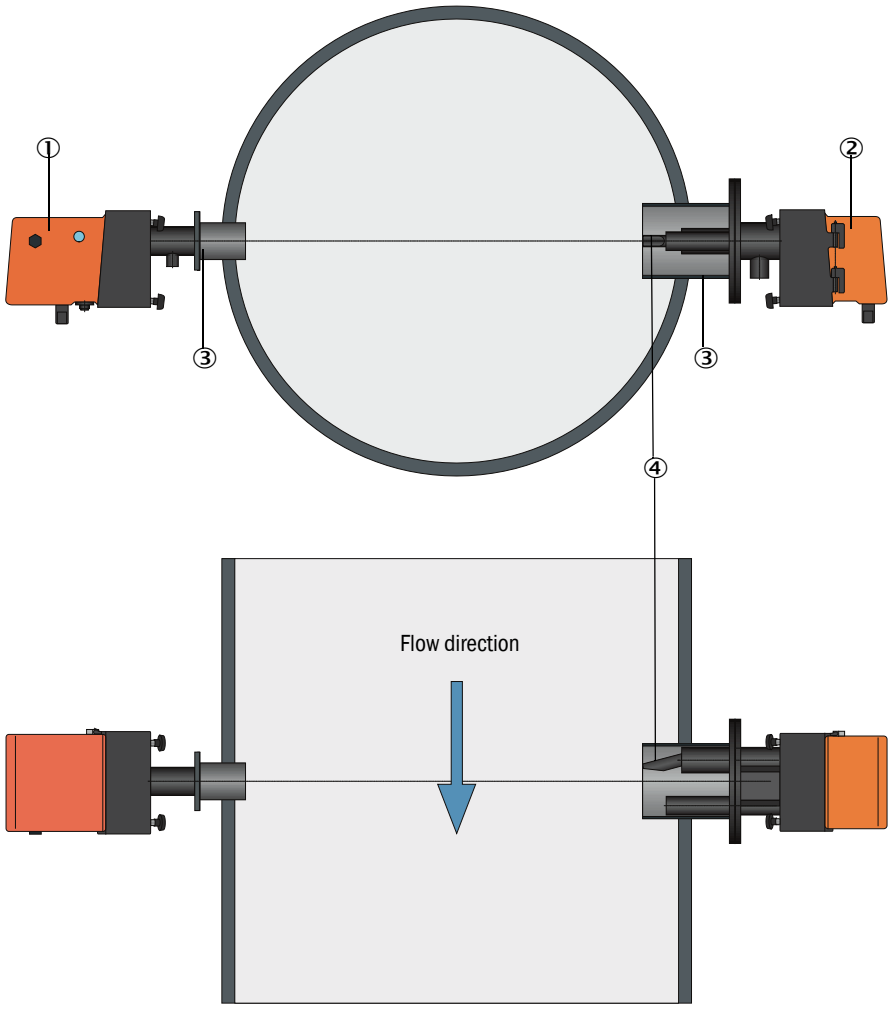
The following Table provides an overview of the project planning work necessary as prerequisite for trouble-free assembly and subsequent device functionality. You can use this Table as a Checklist and check off the completed steps.

Task	Requirements		Work step	✓
Determine the measuring and installation locations for the device components	Inlet and outlet paths according to DIN EN 13284-1 (inlet at least 5x hydraulic diameter d_h, outlet at least 3x d_h; distance to stack opening at least 5x d_h)	For round and square ducts: d_h = duct diameter For rectangular ducts: d_h = 4x cross-section divided by circumference	• Follow specifications for new equipment • Select best possible location for existing equipment; • For too short inlet/outlet paths: Inlet path > outlet path	☐
	Homogeneous flow distribution Representative dust distribution	Whenever possible, no deflections, cross-section variations, feed and drain lines, flaps or fittings in the area of the inlet and outlet paths	If conditions cannot be ensured, define flow profile according to DIN EN 13284-1 and select best possible location	☐
	Assembly position for sender/receiver unit and reflector/scattered light receiver	Do not fit vertically on horizontal or slanted ducts; max. measuring axis angle to horizontal 45°	Select best possible location	☐
	Accessibility, accident prevention	The device components must be easily and safely accessible	Provide platforms or pedestals as required	☐
	Installation free of vibrations	Acceleration < 1 g	Eliminate/reduce vibrations through suitable measures	☐
	Ambient conditions	Limit values according to Technical Data	If necessary: • Provide weatherproof covers/sun protection • Enclose or lag device components	☐
Select the purge air supply	Sufficient primary purge air pressure depending on internal duct pressure	Up to +2 hPa, MCU control unit with integrated purge air supply Above +2 hPa to +30 hPa, optional external purge air unit	Select supply type	☐
	Clean intake air	Whenever possible, low amount of dust, no oil, moisture or corrosive gases	• Select best possible location for air intake • Determine required purge air hose length	☐
Select device components	Active measuring path, duct wall thickness with isolation	Sender/receiver unit, reflector/scattered light receiver, flange with tube	• Select components according to the Configuration Table (see “Device configuration”, page 31); • If necessary, plan additional measures to fit the flange with tube (see “Fitting the flange with tube”, page 35)	☐
	Internal duct pressure	Type of purge air supply		
	Fitting locations	Line and purge air hose lengths		
Plan calibration openings	Access	Easy and safe	Provide platforms or pedestals as required	☐
	Distances to measuring level	No mutual interference between calibration probe and measuring system	Plan sufficient distance between measuring and calibration level (approx. 500 mm)	☐
Plan the voltage supply	Operating voltage, power requirements	According to Technical Data (see “Technical Data”, page 111)	Plan adequate line cross-sections and fuses	☐

3.1.1 Fitting sender/receiver unit and reflector/scattered light receiver to horizontal lines

To prevent particles flowing into the tube (1) of the scattered light receiver and thus contaminating the optics, sender/receiver unit (2) and reflector/scattered light receiver (3) must be fitted in accordance with Fig. “Fitting of sender/receiver unit and reflector/scattered light receiver to horizontal lines (representation for large active measuring paths)”. The flanges with tube (4) must be welded on accordingly.

Fig. 16: Fitting of sender/receiver unit and reflector/scattered light receiver to horizontal lines (representation for large active measuring paths)



① Sender/receiver unit
② Reflector/scattered light receiver
③ Flange with tube
④ Tube

3.2 Assembly

Carry out all assembly work onsite. This includes:

- Fitting the flange with tube
- Fitting the MCU control unit,
- Fitting the optional external purge air unit.

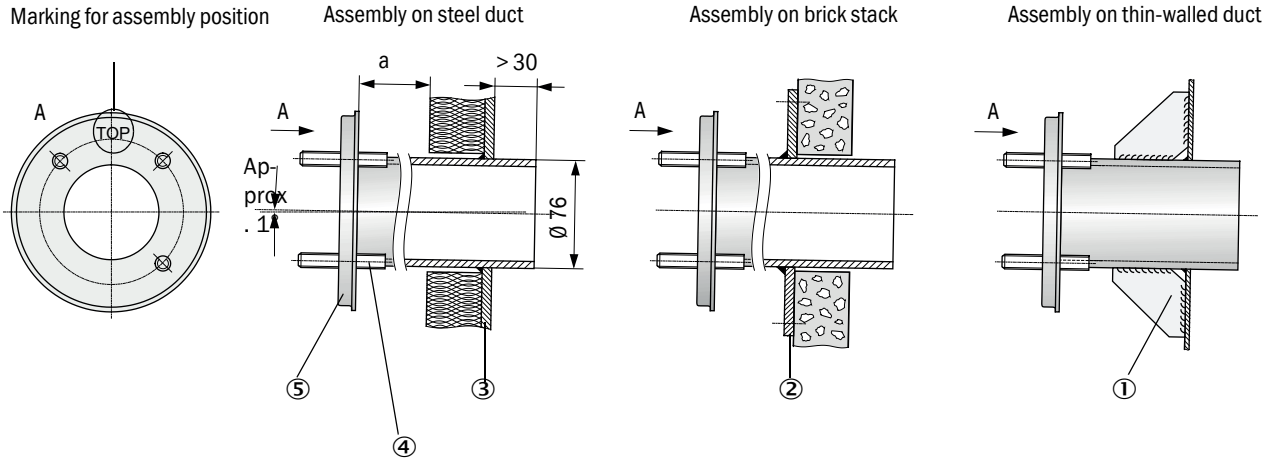
WARNING:

- Observe the relevant safety regulations as well as the safety notices during all work: see “Important Information”, page 7
- Consider the equipment weight specifications when planning the mounting brackets.
- Only carry out assembly work on equipment with hazard potential (hot or aggressive gases, higher internal duct pressure) when the equipment is at a standstill.
- Take suitable protection measures against possible local hazards or hazards arising from the equipment.

All dimensions specified in this Section are shown in mm.

3.2.1 Fitting the flange with tube

Fig. 17: Fitting the flanges with tube



① Junction plate
② Anchor plate
③ Duct wall
④ Fixing bolt for weatherproof cover
⑤ Flange with tube

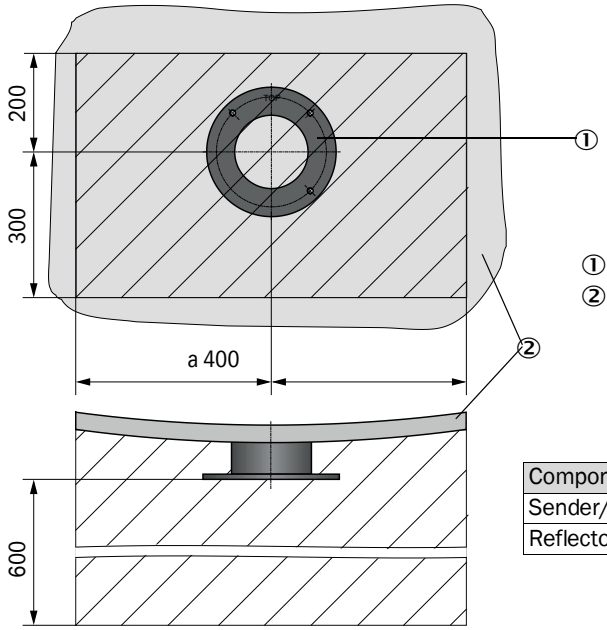
Component	D
Sender/receiver unit DHC-T	Ø 76
Reflector/scattered light receiver DHC-R0	
Scattered light receiver DHC-R1	Ø 159

Dimension a must be large enough so that a weatherproof cover can be fitted easily when necessary (approx. 40 mm).

Work to be performed

- Measure the fitting location and mark the assembly location.
  Leave enough clearance around the flange with tube to fit the sender/receiver unit and reflector.

Fig. 18: Clearance for sender/receiver unit and reflector/scattered light receiver (dimensions in mm)



Component	a
Sender/receiver unit	400
Reflector/scattered light receiver	350

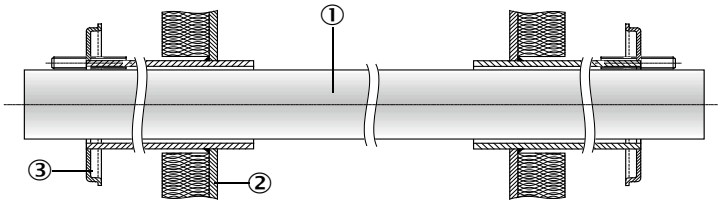
- Remove insulation (when fitted)
- Cut suitable openings in the duct wall; bore large enough holes in brick or concrete stacks (flange tube diameter (see “Flange with tube”, page 117))

NOTE:
- Do not let separated pieces fall into the duct.

- Insert the flange with tube in the opening so that the “Top” marking points upwards.
- Align the flanges with tube roughly to each other and weld on with a few welding spots (on the anchor plate for brick or concrete stacks, insert junction plates for thin-walled ducts).
- Use a suitable tube (for narrower ducts) or the adjusting device from SICK to align the flange tubes to each other exactly after welding; axes deviation to each other max. ± 1°.

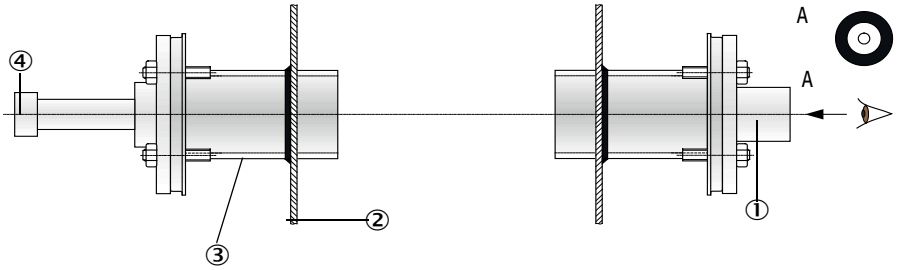
Fig. 19: Aligning the flanges with tube

Aligning with auxiliary tube



Aligning with adjusting device

(see “Options for MCU control unit”, page 123; also available on loan)



① Auxiliary tube
② Duct wall
③ Flange with tube
④ Light source

Use the target optics to align the flange so that the light spot of the lamp appears in the center of the target optics.

- ▶ Finally, weld the flange tubes tight all-round and, at the same time, check for exact alignment and correct when necessary. When using the adjusting device, assemble?? both the flange plate with light source and the flange plate with target optics before welding the second flange tube.
- ▶ Close off the flange opening after fitting to prevent gas escaping.

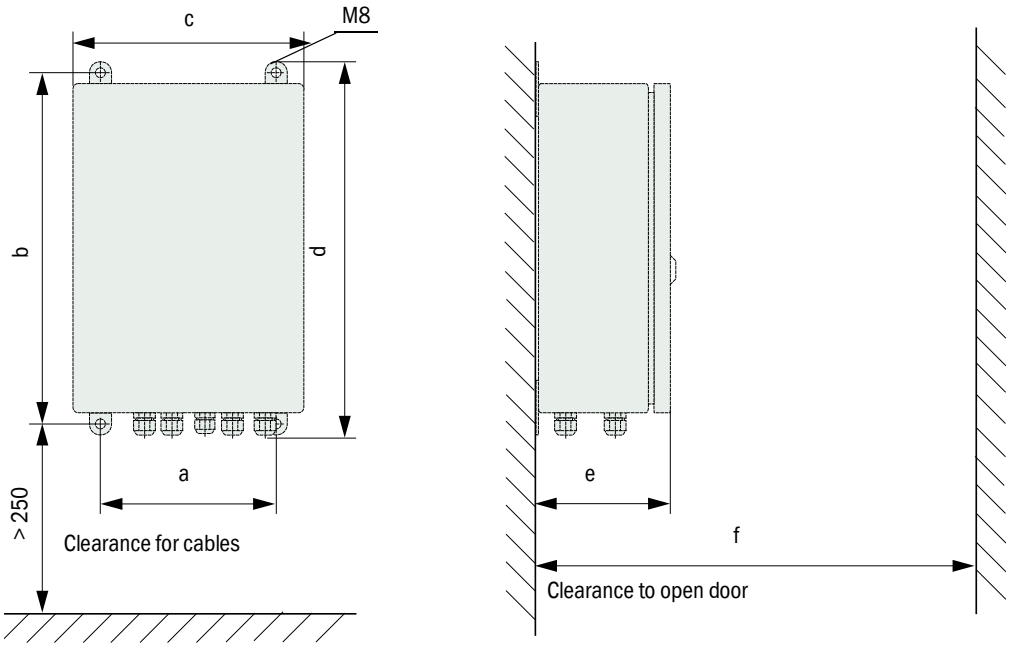
3.2.2 Fitting the MCU control unit

Fit the MCU control unit in a protected location that is easily accessible (see “MCU assembly dimensions”, page 38). Observe the following points during fitting:

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

Assembly dimensions

Fig. 20: MCU assembly dimensions



Dimension	Control unit type	
	MCU-N	MCU-P
a	160	260
b	320	420
c	210	300
d	340	440
e	125	220
f	> 350	> 540

MCU-N:
Control unit without purge air supply
MCU-P:
Control unit with purge air supply
(see “MCU control unit”, page 23)

Using a suitable line (see “General information, prerequisites”, page 44), the MCU-N control unit (without integrated purge air supply) can be located up to 1000 m away from the sender/receiver unit.

We therefore recommend fitting the MCU in a control room (measuring station or similar) to ensure free access to the MCU. This considerably simplifies communication with the measuring system in order to set parameters or to locate malfunction or error causes.

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

Requirements when using the MCU-P control unit

The following is applicable in addition to the general specifications:

- Install the MCU-P control unit at a location with clean air whenever possible. The air intake temperature must correspond to specifications in the Technical data (see “Technical Data”, page 111). In unfavorable conditions, lay an air intake hose to a location with better conditions.
- The purge air hoses to the sender/receiver unit and reflector/scattered light receiver should be as short as possible.
- Whenever possible, lay the purge air hoses so that no water can collect.
- We recommend using the optional external purge air unit when the sender/receiver unit and reflector are more than 10 m away from the MCU control unit.

3.2.3 Fitting the optional external purge air unit

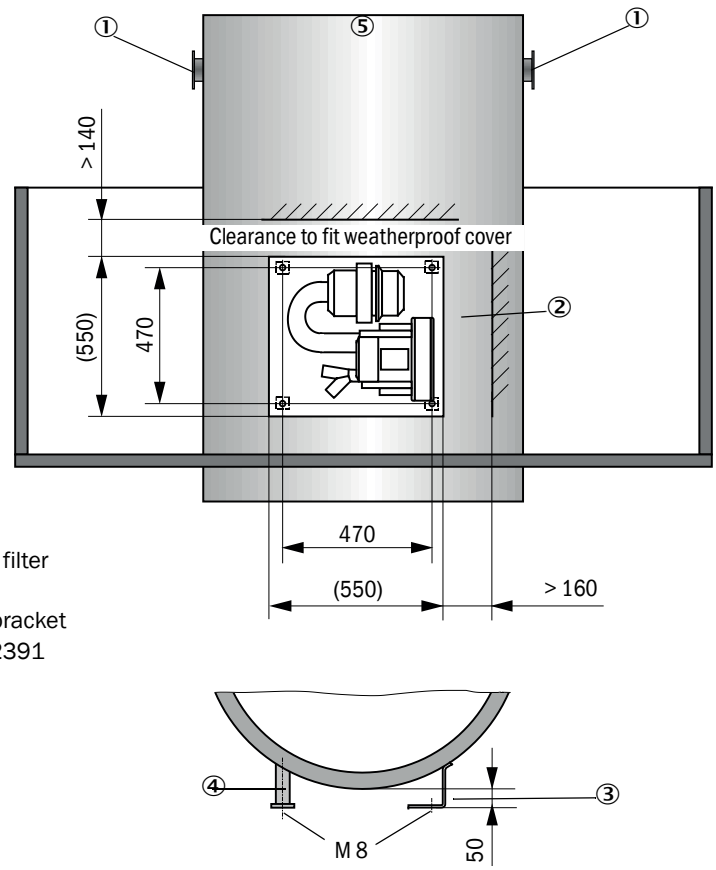
Consider the following points when selecting the assembly location:

- Install the purge air unit at a location with clean air whenever possible. The air intake temperature must correspond to specifications in the Technical data (see “Technical Data”, page 111). In unfavorable conditions, lay an air intake hose or pipe to a location with better conditions.
- The fitting location must be easily accessible and meet all safety regulations.
- Install the purge air unit only as far as necessary below the flange with tube for the sender/receiver unit and reflector/scattered light receiver so that the purge air hoses can be laid downwards (avoids water collecting).
- Provide sufficient clearance to exchange the filter element.
- Provide sufficient space to attach and remove the weatherproof cover when installing the purge air unit outdoors see “Purge air unit layout and assembly dimensions (dimensions in mm)”, page 41).

3.2.4 Assembly work

- ▶ Prepare holder (see “Purge air unit layout and assembly dimensions (dimensions in mm)”, page 41).
- ▶ Fasten purge air unit with 4 M8 screws.
- ▶ Check whether the filter element is fitted in the filter housing otherwise fit when necessary.

Fig. 21: Purge air unit layout and assembly dimensions (dimensions in mm)



① Flange with tube
② Clearance to exchange filter element
③ Alternative: Mounting bracket
④ Steel pipe 50 x 5 DIN 2391
⑤ Duct

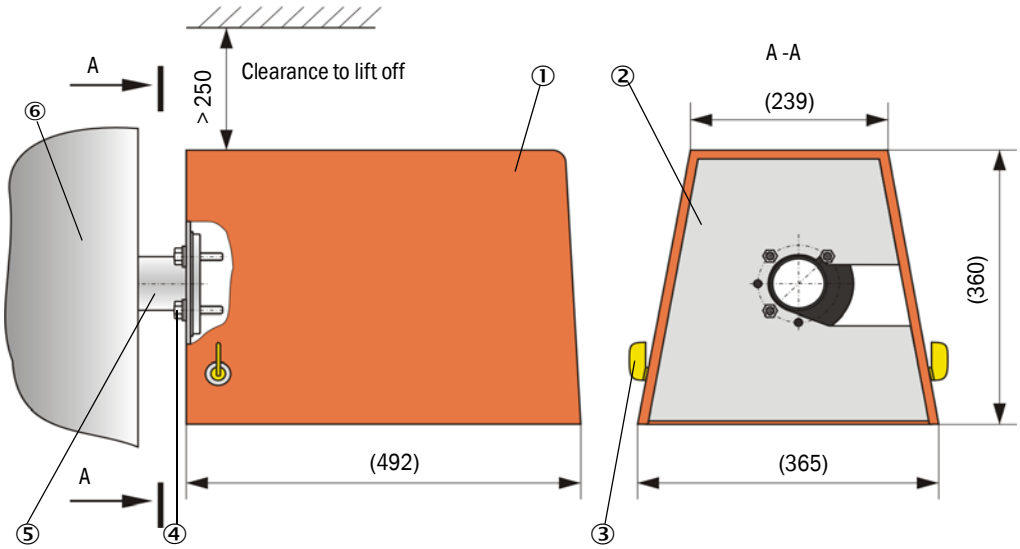
3.2.5 Fitting the weatherproof cover

Weatherproof cover for analyzer

Assembly

- Push the base plate (2) sideways on the flange with tube (5), slot onto the threaded bolts (4) of the duct-side surface of the flange plate and screw tight (see “Fitting the weatherproof cover for analyzer (dimensions in mm)”, page 42).
- Put the cover (1) on from above.
- Insert the side holding catches (3) into the counterpieces, twist and lock in.

Fig. 22: Fitting the weatherproof cover for analyzer (dimensions in mm)



① Cover
② Base plate
③ Side holding catches
④ Threaded bolts
⑤ Flange with tube
⑥ Duct

Weatherproof cover for external purge air unit

The weatherproof cover (see “Weatherproof covers”, page 121) comprises a cover and locking set.

Assembly:

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

3.3 Electrical installation

3.3.1 Electrical safety

WARNING:
- Observe the relevant safety regulations as well as the safety notices in see “Important Information”, page 7 during all installation work.
- Take suitable protection measures against possible local hazards or hazards arising from the equipment.

3.3.1.1 *Properly installed power isolating switches*

WARNING:
Endangerment of electrical safety during installation and maintenance work when the power supply is not switched off.
An electrical accident can occur during installation and maintenance work when the power supply to the device or lines is not switched off using a power isolating switch/circuit breaker.
- Before starting work on the device, ensure the power supply can be switched off using a power isolating switch/circuit breaker in accordance with DIN EN 61010.
- Make sure the power isolating switch is easily accessible.
- An additional disconnecting device is mandatory when the power 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.

3.3.1.2 *Lines with correct rating*

WARNING:
Endangerment of electrical safety through power line with incorrect rating.
Electrical accidents can occur when the specifications for replacement of a removable power line have not been adequately observed.
- Always observe the exact specifications in the Operating Instructions (Technical Data Section) when replacing a removable power line.

3.3.1.3 *Grounding the devices*

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

3.3.1.4 *Responsibility for system safety*

WARNING:
Responsibility for the safety of a system.
- The person setting the system up is responsible for the safety of the system in which the device is integrated.

3.3.2 General information, prerequisites

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

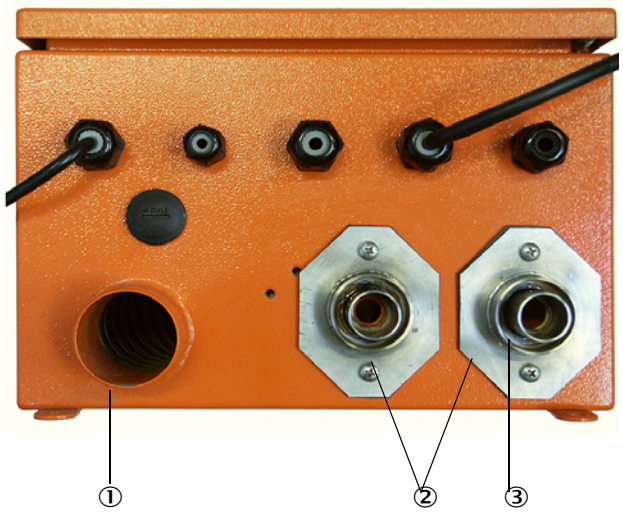
Carry out all installation work onsite unless otherwise explicitly agreed with SICK or authorized representatives. This includes laying and connecting the power supply and signal lines, installing switches and power fuses and connecting the purge air supply.

- Plan adequate line cross-sections (see “Technical Data”, page 111).
- Line ends with plugs to connect the sender/receiver unit must have sufficient free length.

3.3.3 Installing the purge air supply

- ▶ Lay the purge air hoses with shortest paths and free of bends, shorten as required.
- ▶ Maintain sufficient distance from hot duct walls.

Fig. 23: Underside of MCU-P



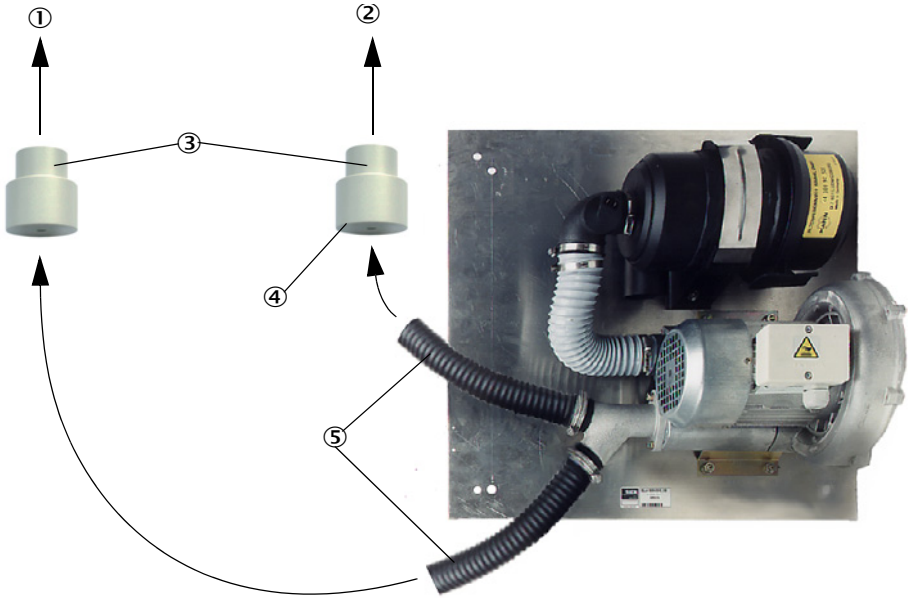
① Purge air inlet
② Purge air outlet DN 25 for sender/receiver unit and reflector/scattered light receiver DHC-R0
③ Purge air outlet DN 40 for reflector/scattered light receiver DHC-R1

3.3.3.1 *Optional external purge air unit*

Connect the purge air hose

Connect the purge air hose DN 40 mm and secure with hose clamps D32-52.

Fig. 24: Optional external purge air unit connection



① To purge air connection of sender/receiver unit
② To purge air connection of reflector
③ Adapter 40 - 25
④ Not required for scattered light receiver DHC-R1
⑤ Purge air hose

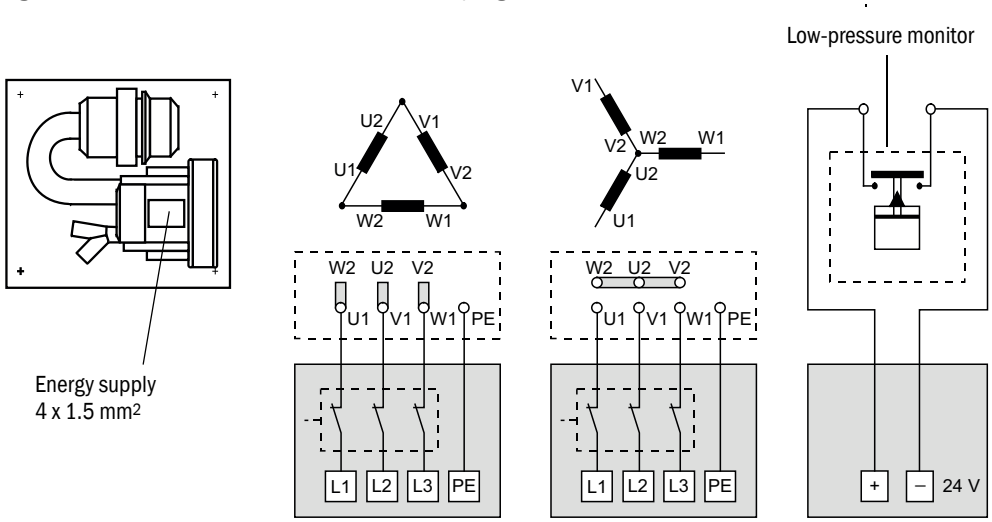
Electrical connection

- Compare power voltage and frequency with the specifications on the type plate on the purge air motor.

CAUTION:
- Only connect when these match!

- Connect the power supply line to the purge air motor terminals (refer to the supplementary sheet on the purge air motor and lid of the motor terminal box for terminal allocation).

Fig. 25: Electrical connection of the external purge air unit



- Connect protective conductor to terminal.
- Set motor circuit breakers according to the blower connection data (see Technical Data for purge air unit) to a value 10% above the rated current.

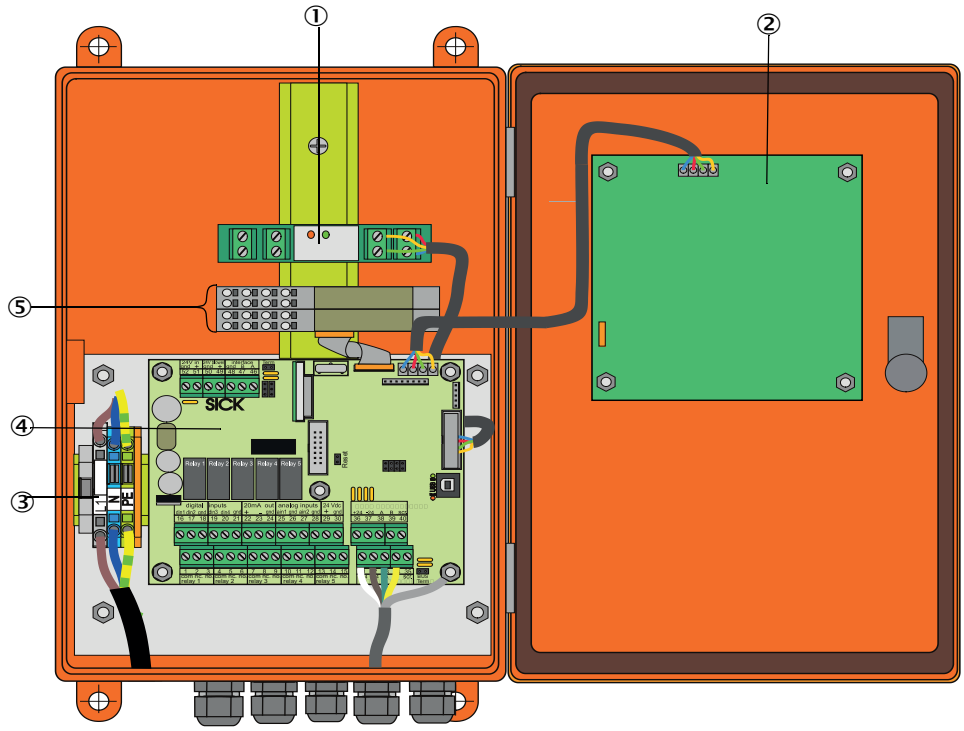
NOTE:
In case of doubt or when using a special motor version, the operating instructions supplied with the motor have priority over any other information.

- Check the function and running direction of the blower (purge air flow direction must match the arrows on the inlet and outlet openings on the blower). For wrong direction on 3-phase motors: Swap power connections L1 and L2.
- Connect the pressure controller (option) to monitor purge air feed.

NOTE:
- Use a fail-safe power supply (standby unit, rails with redundant supply)
- Fuse the purge air unit separate from the other system components. The fuse type must match the rated current (see technical details of purge air unit). Fuse each phase separately.
  Use circuit breakers to prevent phase failures on one side.

3.3.4 Connecting the MCU control unit

Fig. 26: Component layout in the MCU (without purge air supply, with options)



① Optional Interface module
② Optional Display module
③ Terminals for power connection
④ Processor board
⑤ Optional I/O modules

3.3.4.1 *Work to be done*

- Connect the connection line: see “Standard connection”, page 50.

> If an onsite line is to be used, it must be connected to a suitable 7-pole socket (see “Plug connector connection to onsite line”, page 49; SICK Part No.: 7045569).

- Connect lines for status signals (operation/failure, maintenance, function check, maintenance request, limit value), analog output, analog and digital inputs according to requirements (see “Standard connection”, page 50, p. 53, Fig. 31 and Fig. “Terminal assignment of analog input module”; only use shielded lines with twisted pairs).

NOTICE:

- Only use shielded lines with twisted pairs (e.g., UNITRONIC LiYCY (TP) 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).

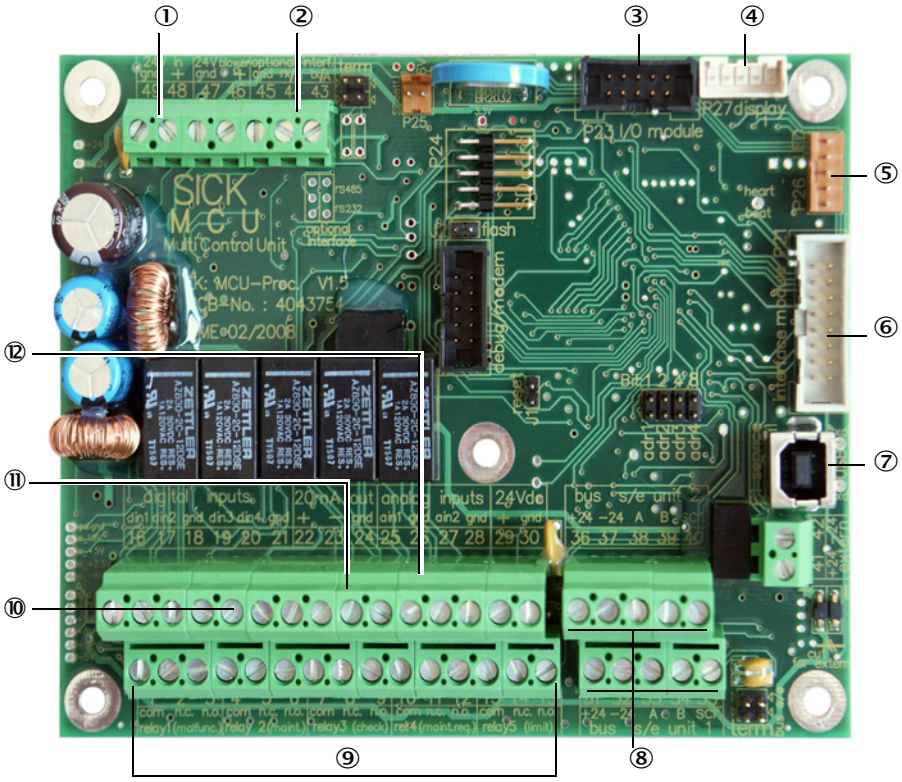
- Connect power line to terminals L1, N, PE of the MCU (see “Component layout in the MCU (without purge air supply, with options)”, page 47).
- Close off unused line openings with dummy plugs.

WARNING:

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

3.3.4.2 *MCU processor board connections*

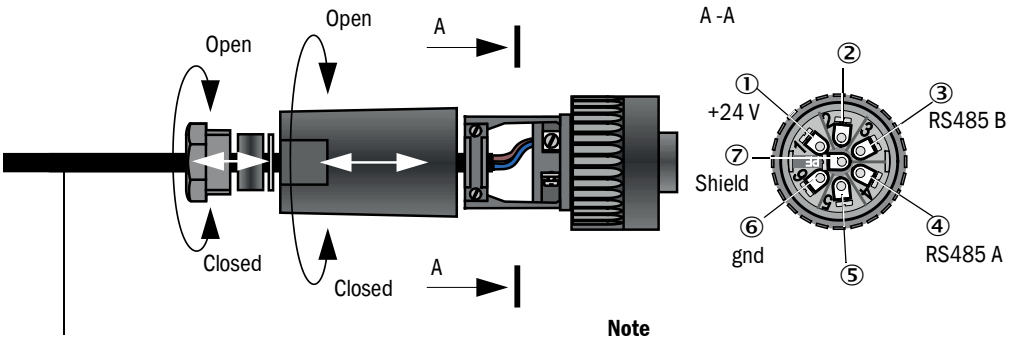
Fig. 27: MCU processor board connections



① Supply voltage 24 V DC
② RS232
③ Connection for optional I/O module
④ Connection for Display module
⑤ Connection for LEDs
⑥ Connection for optional Interface module
⑦ USB plug connector
⑧ Connections for sender/ receiver units
⑨ Connections for relays 1 to 5
⑩ Connections for digital inputs 1 to 4
⑪ Connection for analog output
⑫ Connections for analog inputs 1 and 2

3.3.4.3 *Connection of connection line to MCU*

Fig. 28: Plug connector connection to onsite line

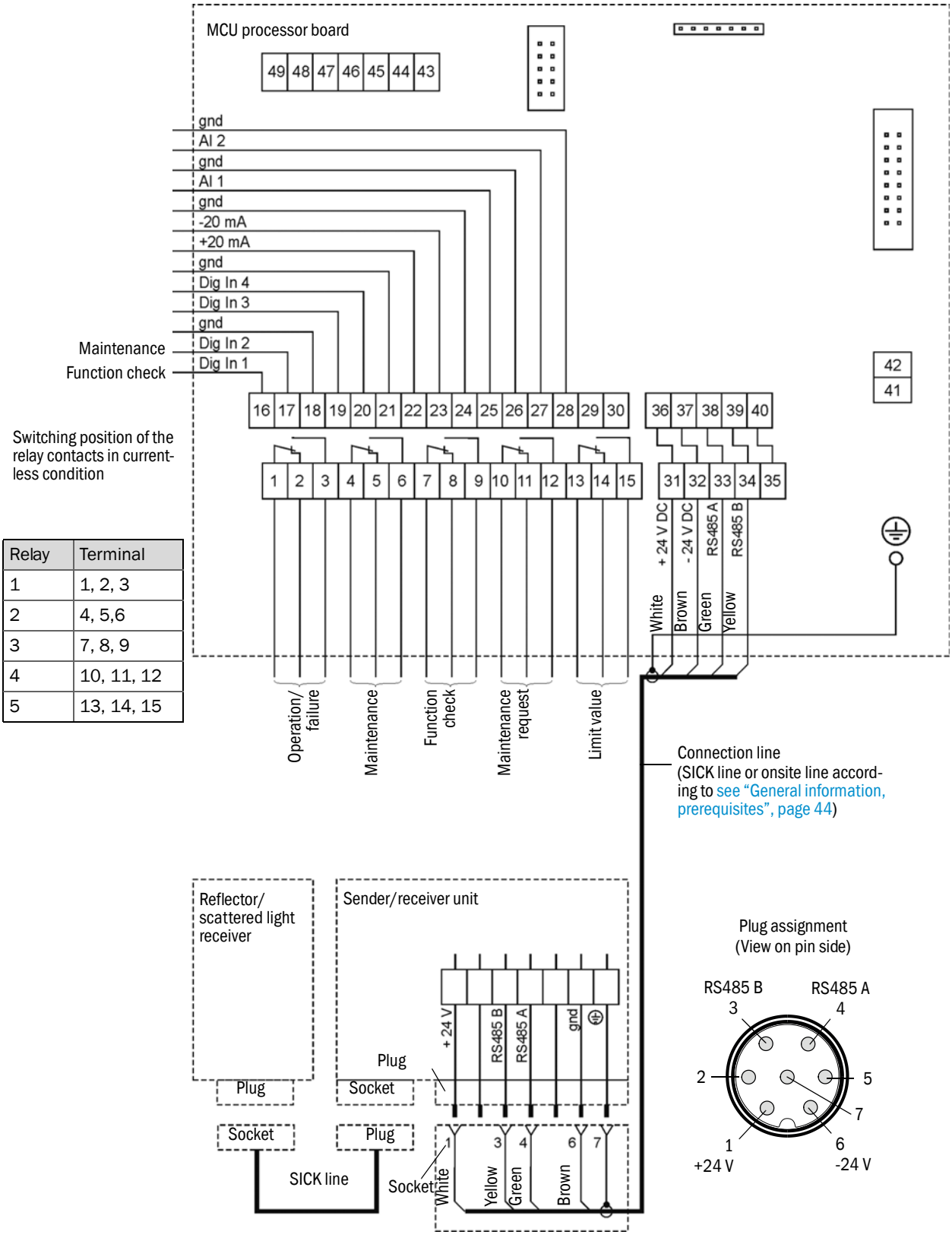


Cable provided by customer according to page 44, §3.3.2

Note
To open, connect the plug connector to the plug on the sender/receiver unit.

3.3.4.4 *Standard connection*

Fig. 29: Standard connection



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

3.3.5 Connecting the scattered light receiver

Connect the cable belonging to this component (see “Line from sender/receiver unit to reflector/scattered light receiver”, page 122) to the sender/receiver unit and reflector/ scattered light receiver and screw tight.

3.3.6 Connecting the MCU remote control unit

3.3.6.1 *Connection to the MCU control unit*

Electrical connection see “Standard connection”, page 50

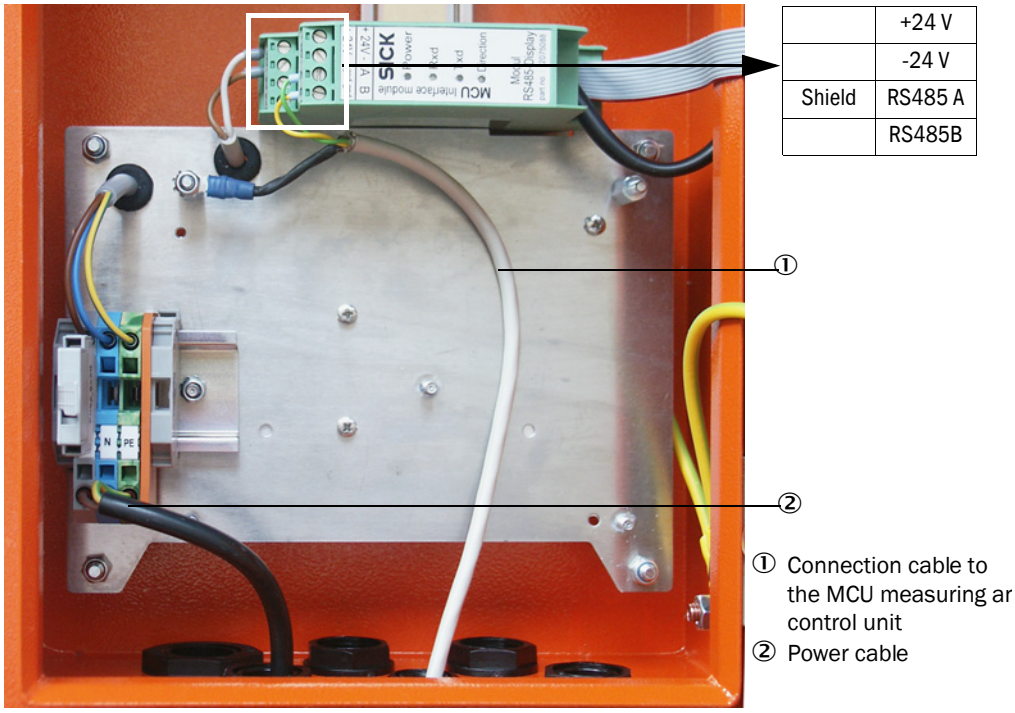
- Electrical connection of the MCU remote control unit without an own power supply unit:
  - 24V supply: Terminals 36 and 37 (or equivalent)
  - Signals: Terminals 38 and 39 (or equivalent)
- Electrical connection of the MCU remote control unit with an own power supply unit:
  - Signals: Terminals 38 and 39 (or equivalent)

3.3.6.2 *Connection to the MCU remote control unit*

Version without power supply unit

- Connect the connection cable to the measuring and control unit (4-wire, twisted pair, with shield) to the connections in the control unit and the module of the remote unit.

Fig. 30: Connections in the remote control unit (version with integrated wide-range power pack)



Version with integrated wide-range power pack:

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

NOTICE:

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

3.3.7 Fitting the interface and I/O module (option)

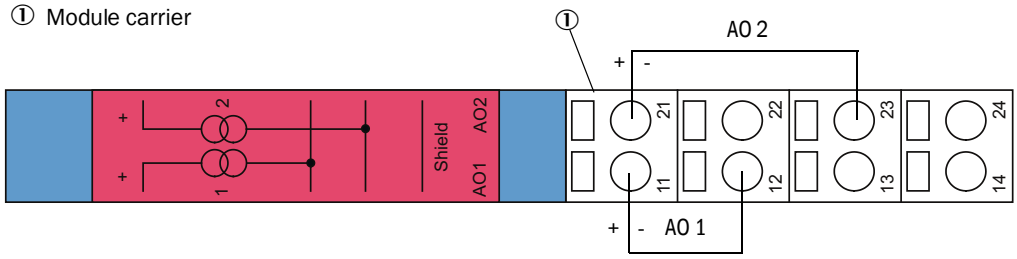
Plug Interface modules and module carriers for I/O modules onto the hat rail in the MCU (see “Component layout in the MCU (without purge air supply, with options)”, page 47) and connect to the associated connection on the processor board with the line with plug connector (see “MCU processor board connections”, page 48). Then plug the I/O modules on the module carriers.

Connect the Interface modules using the customer provided network line to the local network. Use the terminals on the module carrier to connect I/O modules.

Terminal assignment of AO module

Fig. 31: Terminal assignment of analog output module

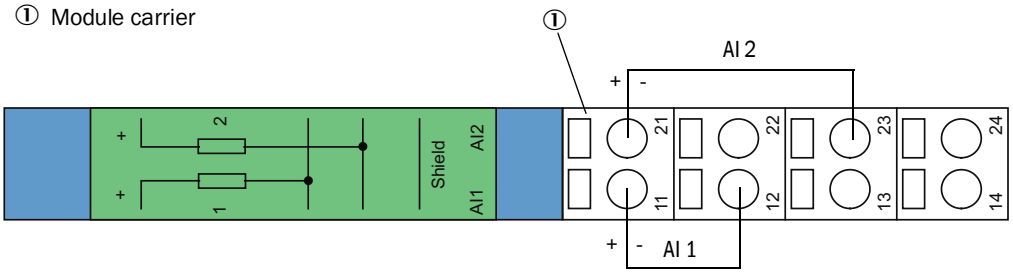
① Module carrier



Terminal assignment of AI module

Fig. 32: Terminal assignment of analog input module

① Module carrier



4 Start-up and Parameter Settings

4.1 Basics

4.1.1 General information

Assembly and installation must have been completed according to Section 3 before starting the work described in the following.

Start-up and parameter setting comprise:

- Setting the measuring system to the duct dimensions
- Fitting and connecting sender/receiver unit and reflector/scattered light receiver,
- Customizing parameter settings according to the respective requirements.

To achieve exact measurement, the measuring system must first be calibrated using a gravimetric comparison measurement (see “Calibration for dust concentration measurement”, page 76) before being used for continuous measurement of dust content.

4.1.2 Installing SOPAS ET

- Install SOPAS ET on a laptop/PC.
- Start SOPAS ET.
- Following the installation instructions of SOPAS ET.

4.1.2.1 *Password for SOPAS ET menus*

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

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

4.1.3 Connection to the device via USB line

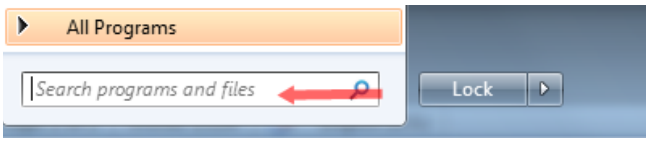
Recommended procedure:

1 Connect the USB line to the MCU control unit (see “MCU processor board connections”, page 48) and the laptop/PC.
2 Switch the device on.
3 Start SOPAS ET.
4 “Search settings”
5 “Device family oriented search”
6 Click the desired MCU.
7 Make the settings:
  – Ethernet communication (always clicked)
  – USB communication (always clicked)
  – Serial communication: Click
8 Do not specify IP addresses.
9 A list of COM ports is shown.
  Specify the COM port of the DUSTHUNTER.
  If you do not know the COM port: see “Finding the DUSTHUNTER COM port”, page 55
10 Assign a name for this search.
11 “Finish”

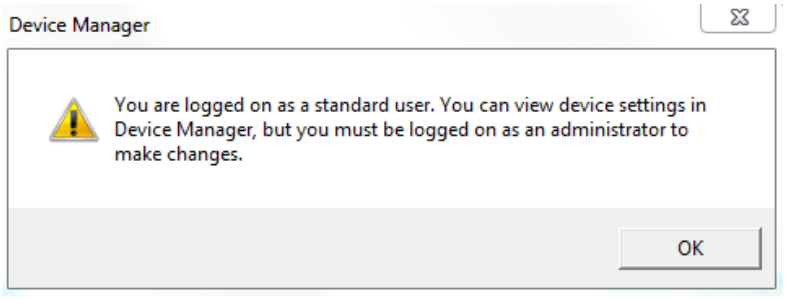
4.1.3.1 *Finding the DUSTHUNTER COM port*

If you do not know your COM port: You can find the COM port with the Windows Device Manager (Administrator rights are not required).

1 Disconnect the DUSTHUNTER from your laptop/PC.
2 Input: *devmgmt.msc*

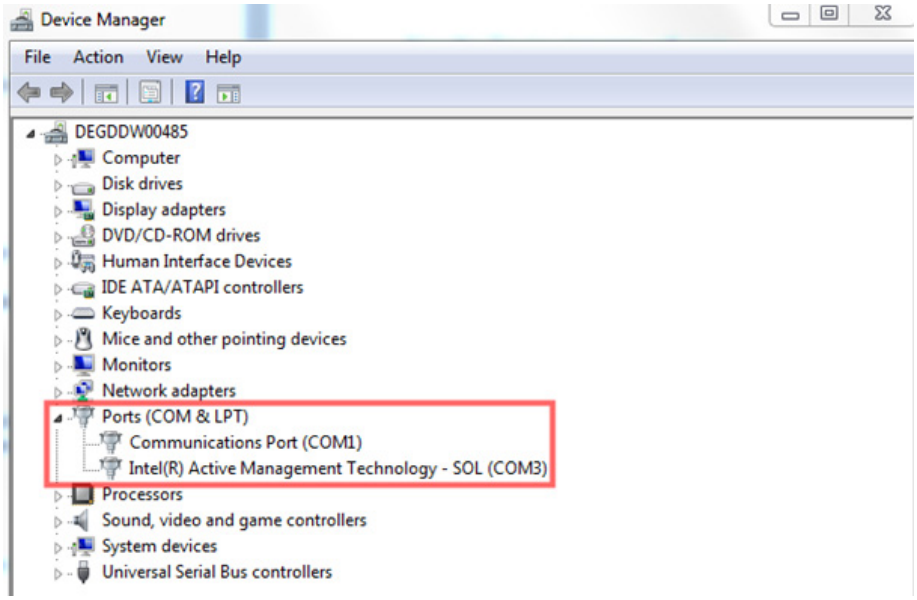


3 This message is shown:

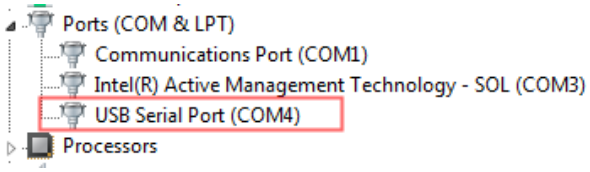


4 “OK”

5 The Device Manager opens.
See: “Ports (COM & LPT)”



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



Use this COM port for communication.

4.1.4 Connection to the device via Ethernet (option)

The Ethernet interface module (see “Options for MCU control unit”, page 123) must be installed in the MCU (see “Fitting the interface and I/O module (option)”, page 53) and configured (see “Setting the Ethernet module parameters”, page 83) to connect to the measuring system via Ethernet.

Recommended procedure:

1 The MCU must be switched off.
2 Connect the MCU with the network.
3 Connect the PC to the same network.
4 Switch the MCU on.
5 Start SOPAS ET.
6 “Search settings”
7 “Device family oriented search”
8 Click the desired MCU
9 Make the settings:
  – Ethernet communication (always clicked)
  – USB communication (always clicked)
  – Serial communication: Do *not* click
10 Specify the IP addresses
  IP address: see “Setting the Ethernet module parameters”, page 83
11 Do not click a COM port
12 Assign a name for this search
13 “Finish”

4.2 Application-specific settings

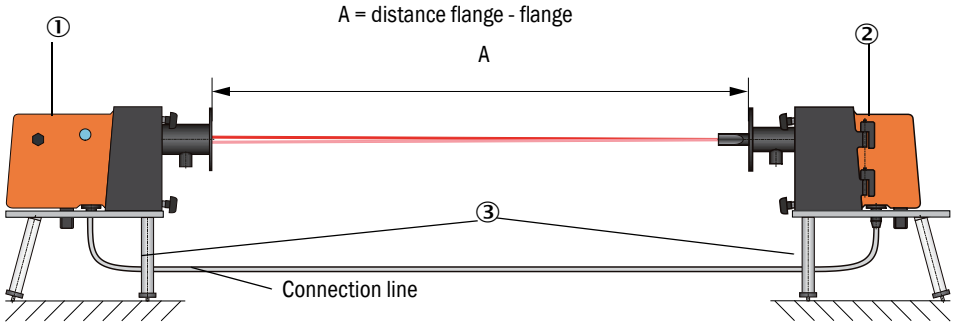
The measuring system must first be set to the respective internal duct diameter to ensure correct measurement. The following steps are then necessary:

Measuring principle	Work step	Aim
Transmission measurement	Focussing the sender light beam	The light spot on the reflector must lie within the optical active reflection surface under consideration of the active measuring path and the swivel angle allowed.
	Scaling the measuring system to a path free of particles	Influences on measuring results specific to the device and dependent on the distance must be eliminated. The path free from particles must be identical to the active measuring path (distances between the optical interfaces of the sender/receiver unit and reflector/scattered light receiver must be the same).
Scattered light measurement	Adjusting the laser beam	The laser beam must always be aligned to the light trap on the reflector/scattered light receiver.

4.2.1 Preparatory work

▶ Assemble the measuring system away from the measuring location at a dark place with as little dust as possible where voltage supply is available.
There are two options:
– Using the optional adjusting stand (see “Miscellaneous”, page 123)

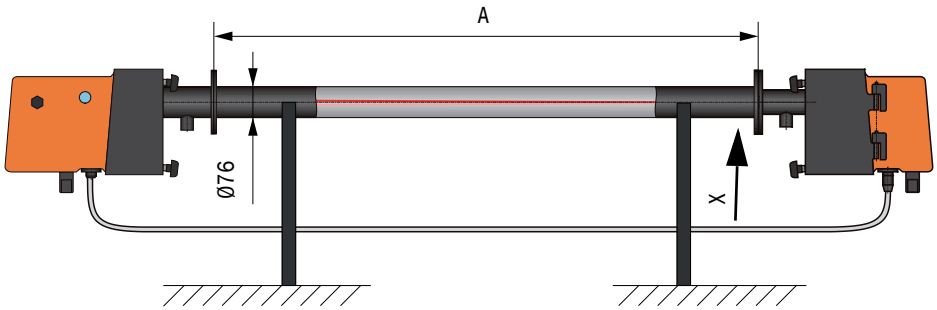
Fig. 33: Assembly on a dust-free path with adjusting stands



① Sender/receiver unit
② Reflector/scattered light receiver
③ Adjusting stand

– Onsite installation of a “zero tube”.
The tube must fit on the flange tubes and have little reflection inside.

Fig. 34: Assembly on a dust-free path with zero tube

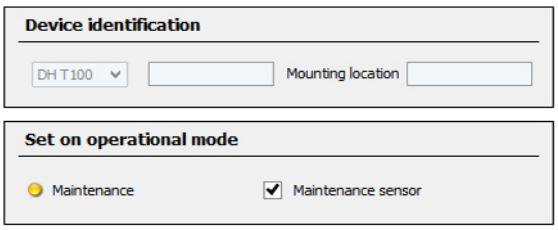


① Sender/receiver unit
② Reflector/scattered light receiver
③ Adjusting stand

X: Dimensions between flange and tube according to the type of reflector/scattered light receiver (see “Reflector/scattered light receiver”, page 115, see “Flange with tube”, page 117)

- Using the associated connection lines, connect the sender/receiver unit to the MCU and the reflector/scattered light unit to the sender/receiver unit.
- Connect the MCU to the supply voltage.
- Start the SOPAS ET program and connect to the measuring system (see “Connection to the device via USB line”, page 55).
- Enter the Level 1 password (see “Password and operating levels”, page 84).
- Set the sender/receiver unit to “Maintenance”: Click “Maintenance sensor”.

Fig. 35: SOPAS ET menu: DH C200/Maintenance/Maintenance

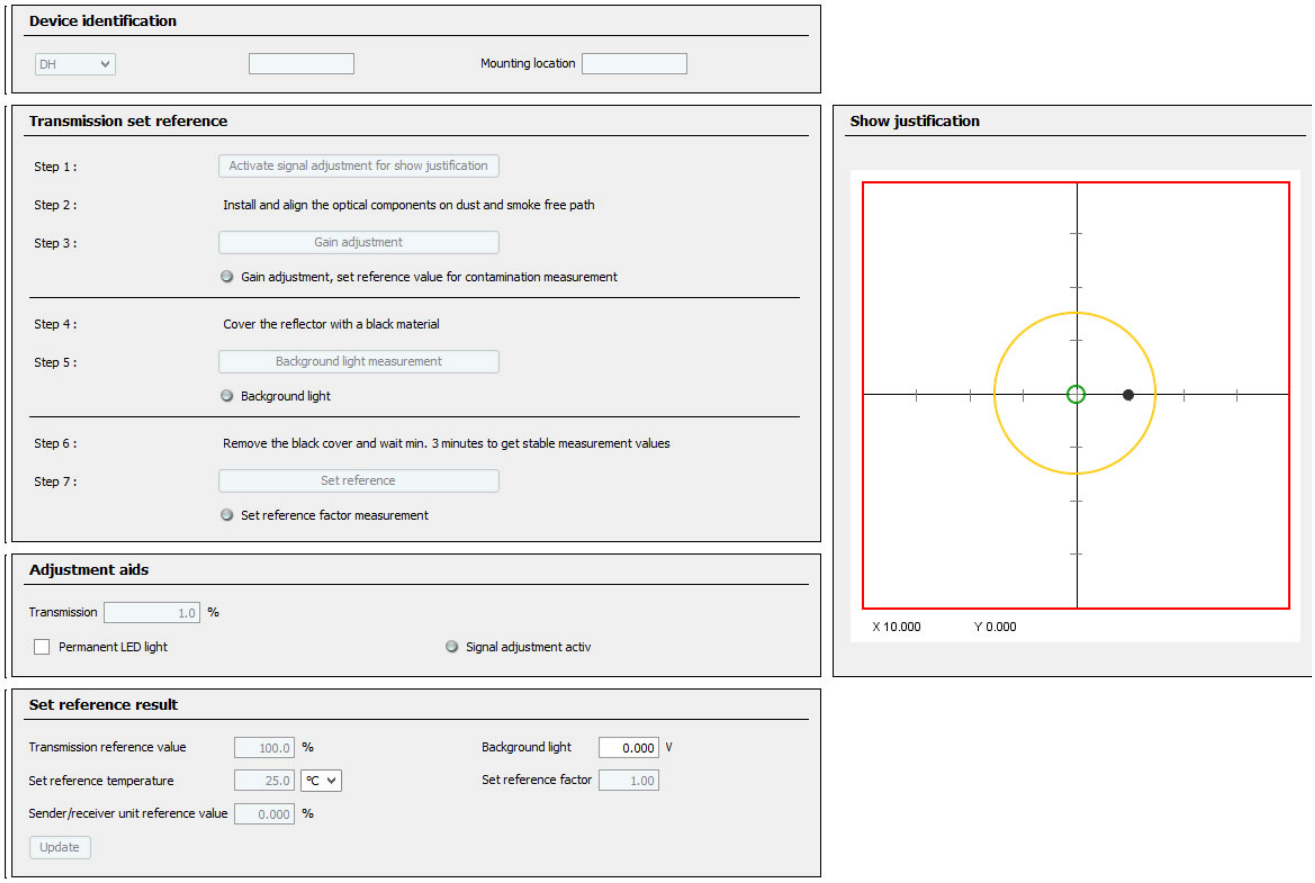


- Clean the optical surfaces on sender/receiver unit and reflector (see “Maintenance on the sender/receiver unit”, page 94 and see “Maintenance on the reflector”, page 98).
- Wait approx. 30 min before starting the following work (measuring system must have reached operating temperature).

4.2.2 Focussing the sender light beam for transmission measurement

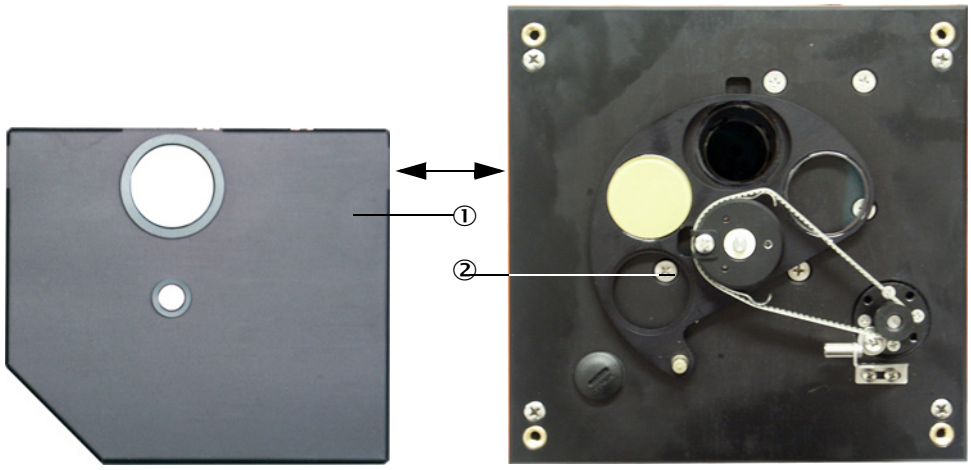
- Select the “Adjustment / Manual Adjustment / Transmission set reference” directory and activate the “Permanent LED light” checkbox in the “Adjustment aids” field.

Fig. 36: SOPAS ET menu: DH C200/Adjustment/Manual Adjustment/Transmission set reference



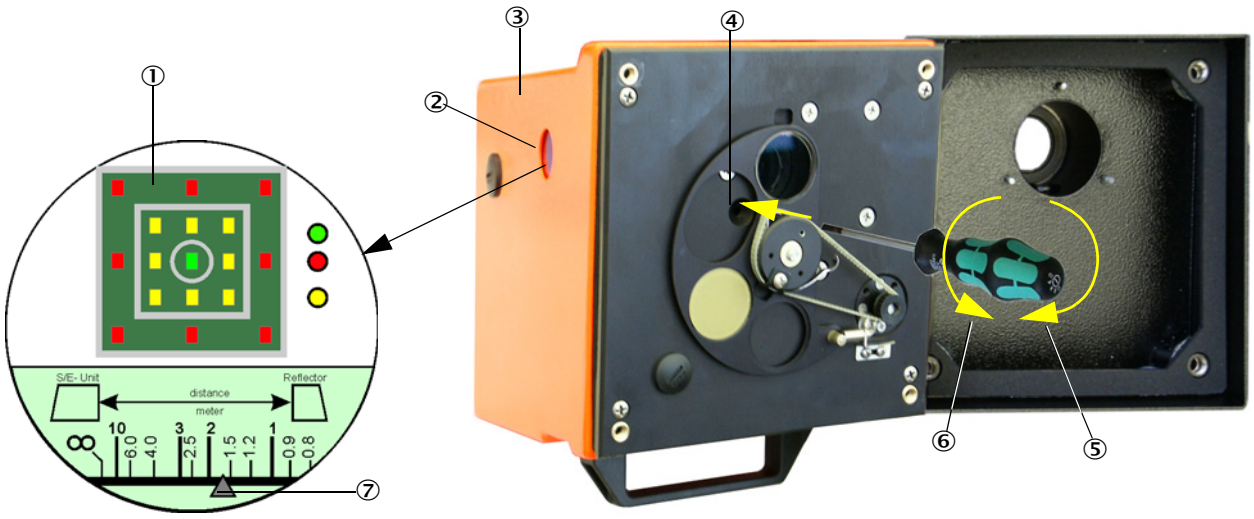
- Loosen the knurled screws (see “Sender/receiver unit DHC-T for transmission and scattered light measurement”, page 18), swivel the electronics unit to the side and remove pivoted shutter cover (1).

Fig. 37: Cover screw for focussing opening



- Insert the screw driver in the focussing opening and set the adjustment screw so that the scale pointer in the control window points to the distance between the optical surfaces of the sender/receiver unit and the reflector/scattered light receiver (= distance of the front panels).
  Active measuring path 0.5 ... 3 m:distance = dimension A + 343 mm
  Active measuring path 2.5 ... 8 m:distance = dimension A + 348 mm
  (see “Assembly on a dust-free path with adjusting stands”, page 58)

Fig. 38: Focussing the sender light beam



① 4-quadrant display
② Control window
③ Electronics unit
④ Focussing opening
⑤ Reduce active measuring path
⑥ Increase active measuring path
⑦ Scale

The scale illumination lights when the measuring system is switched to “Maintenance” or up to 10 min after device reboot.

- Screw the cover for the focussing opening on again, swivel the electronics unit back and lock with the knurled screws.
- Click the “Mechanical centring” button (step 1‘) in directory “Adjustment / Manual Adjustment / Transmission set reference” (see “SOPAS ET menu: DH C200/Adjustment/Manual Adjustment/Transmission set reference”, page 60).
- Align the optical axes of the sender unit and the scattered light receiver to each other. Align the sender/receiver unit so that the sender spot lies on the middle of the opening for the reflector (see “Reflector/scattered light receiver for short measuring paths”, page 20). Align the reflector/scattered light receiver so that sender spot (1) can be seen in the circular marking in the middle of the control window (2) on the back of the enclosure (3).

Fig. 39: Sender spot on the back of the enclosure of the reflector/scattered light receiver

① Sender spot
② Control window
③ Back of enclosure

▶ Deactivate the “Permanent LED light” checkbox (see “SOPAS ET menu: DH C200/Adjustment/Manual Adjustment/Transmission set reference”, page 60).
  – in the “Adjustment / Manual Adjustment / Transmission set reference” directory (see “SOPAS ET menu: DH C200/Adjustment/Manual Adjustment/Transmission set reference”, page 60), the sender spot (black circular area in the “Show justification” window) is inside the green circle.

A non-exact alignment is signaled by lighting of the LED in the 4-quadrant display in the control window in the following manner:

LED lights	Misalignment of the light spot on the reflector
Green and yellow	Deviation max. approx. 0.1 ° in the shown direction; measured values are valid
Yellow	Deviation max. approx. 0.1 to 0.3 ° in the shown direction; measured values are valid
Yellow and red	Deviation approx. 0.3 ° to 0.4 ° in the shown direction; measured values are valid; possibly larger swivel error than listed in the technical data
Red	Deviation > approx. 0.4 ° in the shown direction; measured values are valid; possibly larger swivel error than listed in the technical data
Red LED lights as a circle	Deviation > approx. 0.5 °or transmission < approx. 10%; dust concentration too high or measuring system incorrectly scaled, self-alignment no longer possible

Only rough alignment is necessary because an internal self-alignment is fitted. Click the “Optical centering” button in the “Adjustment / Manual Adjustment / Transmission set reference” directory to start automatic fine adjustment (see “SOPAS ET menu: DH C200/Configuration/Application parameter (example)”, page 64).

The measuring system must then be scaled after focussing has completed.

NOTE:
The measuring system must be scaled again after every focus change.

4.2.3 Scaling the measuring system for transmission measurement

NOTE:
The optical surfaces must be clean (clean if necessary before performing the following steps; see “Maintenance on the sender/receiver unit and reflector/scattered light receiver”, page 94).

- Process successively the steps shown in field “Transmission set reference” in directory “Adjustment / Manual adjustment / Transmission set reference” (see “SOPAS ET menu: DH C200/Adjustment/Manual Adjustment/Transmission set reference”, page 60). While the steps are processed, the associated indicator lights yellow.
- Check whether the value 100% is displayed in window “Transmission reference value” (see “SOPAS ET menu: DH C200/Adjustment/Manual Adjustment/Transmission set reference”, page 60) after this process is completed. When the deviations (< approx. 1%) are small, click the “Set reference” button, when the deviations are large, repeat setting of reference.

The values shown in field “Set reference result” in window “Sender/receiver unit reference value” and “Reflector reference value” must not exceed 8% (otherwise there could be a device defect → contact SICK Customer Service).

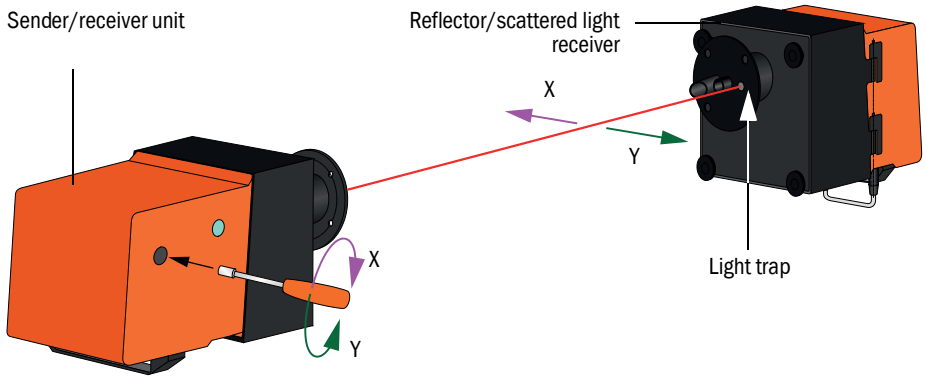
4.2.4 Adjusting the laser beam for scattered light measurement

- Take off the sender/receiver unit cover and use an SW 7 socket wrench to set the adjusting nut so that the laser beam disappears in the light trap on the reflector/scattered light receiver.

NOTE:
Do not change the alignment of sender/receiver unit and reflector/scattered light receiver.

The sender/receiver unit and the reflector/scattered light receiver must be connected via the connection line, otherwise no laser beam is visible.

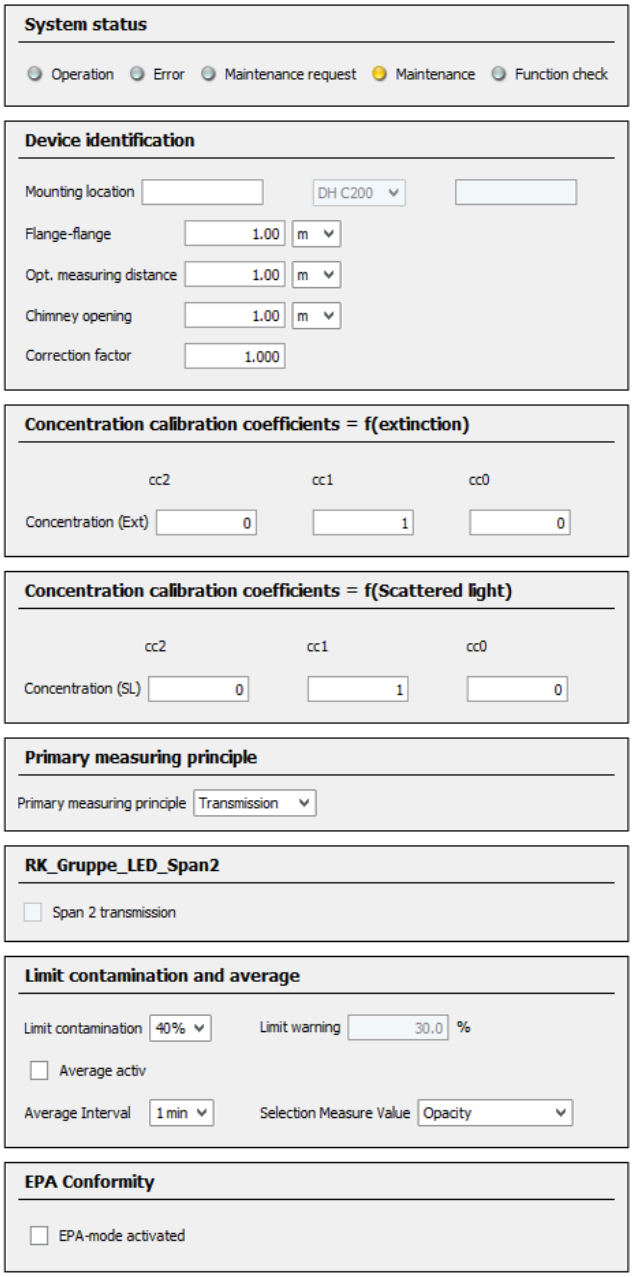
Fig. 40: Aligning the laser beam to the light trap



- Put the cover back on.

4.2.5 Entering application-specific parameters

Fig. 41: SOPAS ET menu: DH C200/Configuration/Application parameter (example)



Group	Input window	Parameter	Remark	
Device identification	Mounting location	Name of the measuring location	Assignment of measuring system to the respective measuring location	
	Flange - flange	Flange distance measured on the duct	For registration (e.g. repeated reference setting on a dust-free path)	
	Opt. measuring distance	Active measuring path	Input required for calculation of relative opacity	
	Chimney opening	Chimney diameter at top end		
	Correction factor	Value	Adaption of relative opacity to geometric dimensions of channel	
Concentration calibration coeffecients = f (extinction)	cc2	Quadratic coefficient	Input of regression coefficients determined on extinction basis for measurement of the dust concentration in mg/m³ (see “Calibrating dust concentration measurement based on extinction”, page 76).	
	cc1	Linear coefficient		
	cc0	Absolute coefficient		
Concentration calibration coeffecients = f (Scattered light)	cc2	Quadratic coefficient	Input of regression coefficients determined on scattered light basis for measurement of the dust concentration in mg/m³ (see “Calibrating dust concentration measurement based on scattered light measurement”, page 78).	
	cc1	Linear coefficient		
	cc0	Absolute coefficient		
Primary measuring principle	Primary measuring principle	Transmission	Determination of light source (LED for 'Transmission‘, laser for 'Scattered light‘) for determination of the check values during the function check	
		Scattered light		
RK_Gruppe_LED_ Span2	Span2 transmission	Activated	The second control value is compared with the reference value during the function check.	Activation and input of reference value possible only when the “EPA Conformity” is activated
		Deactivated	The second control value is not used.	
	Reference value	Transmission value in %	Input of a second control value for the function check (see “Function check”, page 14)	
Limit contamination and average	Limit contamination	Value in %	Determination of a limit value, optionally 40% (default value), 20%, 10%, 6%, 4% When checkbox “EPA Conformity” is activated, limit value 4% is firmly assigned.	
	Limit warning	75% of limit value	Automatic determination depending on the entered limit value	
	Average active	Activated	When the checkbox is activated, an average is created from the values measured in the determined average interval.	
		Deactivated		
	Average Interval	Interval time 1/2/3/4/5/6min	Selection of interval time (6 min for use according to EPA standard)	
	Selection Measure Value	Measured variable	Selection of measured variable whose values are to be averaged	
EPA Conformity	EPA-mode active	Activated	For use according to EPA standard	
		Deactivated	No use according to EPA standard	

+i After deactivation of the EPA conformity, limit contamination and limit warning are reset to standard values (40% or 30%).

4.3 Sender/receiver unit and reflector/scattered light receiver

After completion of the tasks described above, the sender/receiver unit and the reflector/scattered light receiver must be removed from the adjusting stands or zero tube and taken to the measuring location.

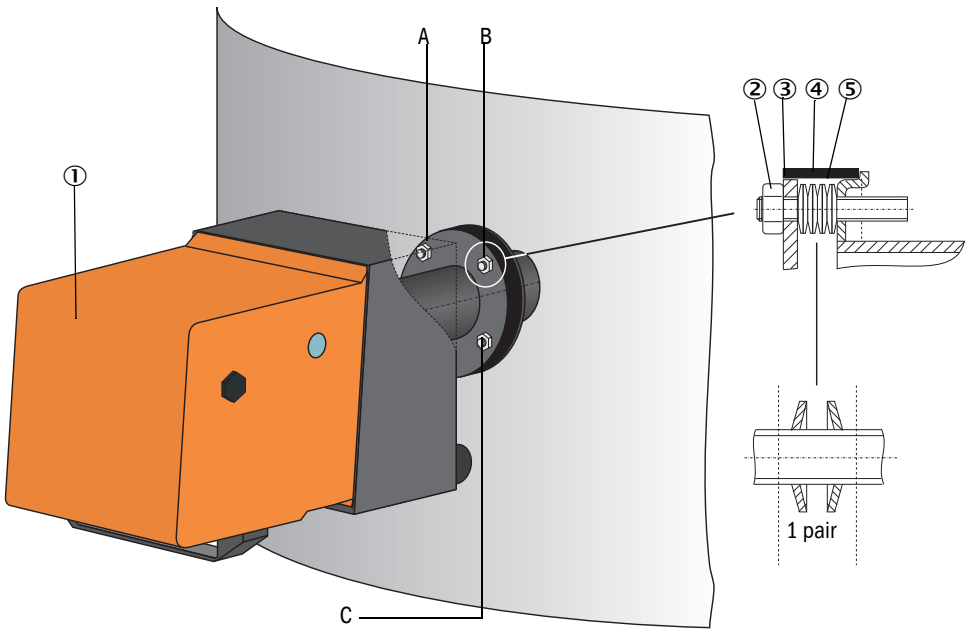
4.3.1 Connecting the scattered light receiver

- ▶ Check whether the purge air supply is available (the flow direction must be correct and the purge air hoses fitted tight on the connections).
- ▶ For purge air supply via the MCU-P control unit or external purge air supply, push the purge air hose on the connections of the sender/receiver unit and the reflector and secure with hose clamps.

4.3.2 Fitting and connecting on the duct

- ▶ Attach the sender/receiver unit and reflector/scattered light receiver to the flange with tube and secure with the associated assembly kit (see “Assembly parts”, page 122), tighten the self-locking nuts as tight as possible.

Fig. 42: Fitting the sender/receiver unit / reflector on the duct



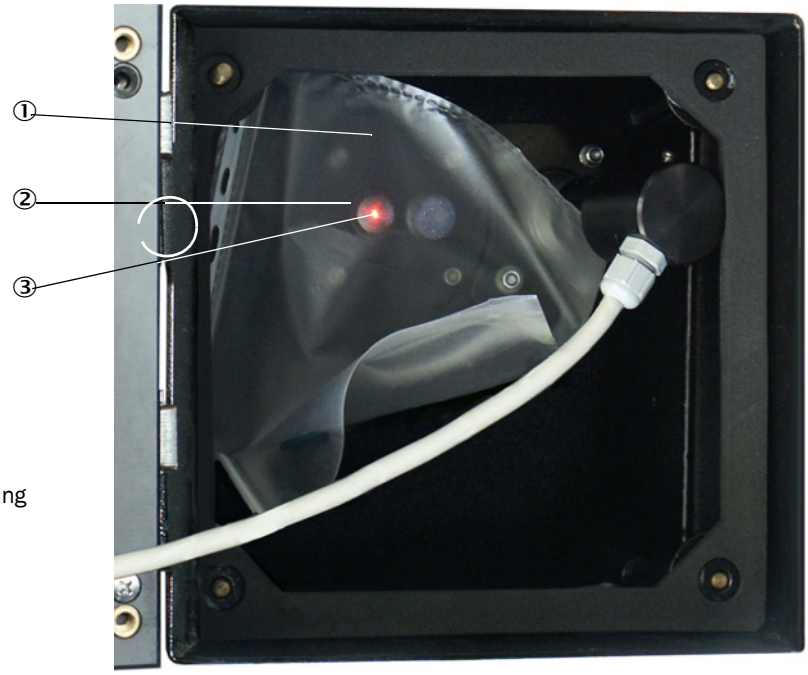
① Sender/receiver unit
② Self-locking nut
③ Spherical washer
④ Sealing tape
⑤ Cup springs (4 pairs); only with fastening set for sender/receiver unit
A Horizontal alignment
B Fixing point
C Vertical alignment

- Connect the connection line MCU - sender/receiver unit and sender/receiver unit - reflector/scattered light receiver to the respective plug connector (see “Sender/receiver unit DHC-T for transmission and scattered light measurement”, page 18, see “Self-alignment principle design”, page 19 and see “Reflector/scattered light receiver for short measuring paths”, page 20) and screw tight.
- Start the SOPAS ET program and connect to the measuring system, select the device file “DH C200” and move the “Project tree” window.
- Enter the level 1 password and set the sender/receiver unit to the “Maintenance” state.
- Click the “Mechanical centring” button (step 1‘) in directory “Adjustment / Manual Adjustment / Transmission set reference” (see “SOPAS ET menu: DH C200/Adjustment/ Manual Adjustment/Transmission set reference”, page 60)
- Align the optical axes of sender/receiver unit and reflector/scattered light receiver according to see “Fitting the sender/receiver unit / reflector on the duct”, page 66 so that the sender spot is in the center of the control window on the enclosure rear of the reflector/scattered light receiver (see “Sender spot on the back of the enclosure of the reflector/scattered light receiver”, page 62).
- Check that the laser beam disappears into the light trap on the reflector/scattered light receiver. To do this, loosen the knurled screws, swivel the enclosure to the side, hold a transparent foil (1) over the light opening (2) and check whether the laser beam (3) can be seen in the center of the opening.

WARNING: Hazards when looking at the laser beam

- Never look directly into the laser beam.

Fig. 43: Laser beam in light trap opening



① Transparent foil
② Light trap opening
③ Laser beam

- Readjust the laser beam according to see “Aligning the laser beam to the light trap”, page 63 when this is not the case.

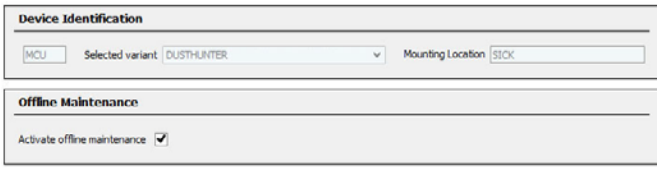
4.4 Setting standard parameters

4.4.1 Assigning the MCU to the sender/receiver unit

The MCU 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 MCU is swapped later). The following steps are then necessary:

- Connect the measuring system to the SOPAS ET program.
- Enter the Level 1 password (see “Password and operating levels”, page 84).
- Set the sender/receiver unit to “Maintenance”: Click “Maintenance sensor”.

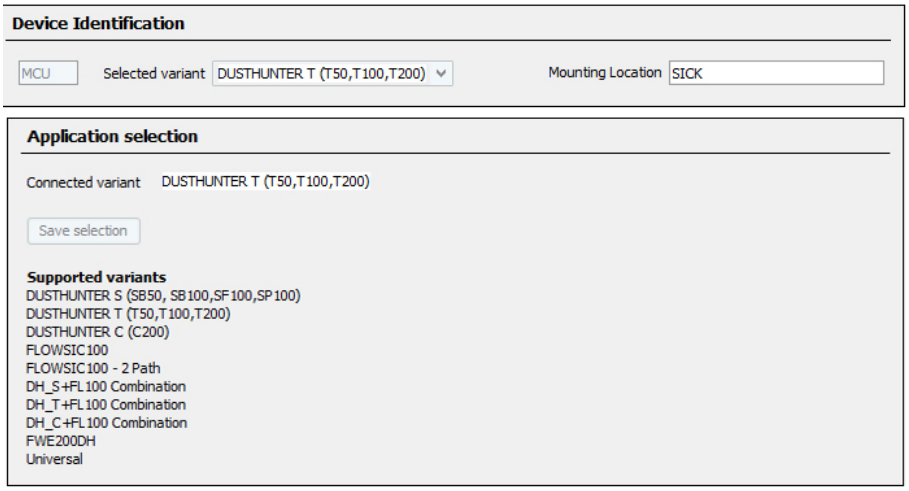
Fig. 44: SOPAS ET menu: MCU/Maintenance/Maintenance



- Change to the “Configuration / Application selection” directory (see “SOPAS ET menu: MCU/Configuration/Application selection”, page 68).
- 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 MCU.

> The sender/receiver unit must be connected to the MCU.

Fig. 45: SOPAS ET menu: MCU/Configuration/Application selection



4.4.2 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	
	Upper measuring range value (MBE)		20	
	Current during maintenance		0.5	
	Current by malfunction		21 (optional 1)	
Response time			60 s for all measured variables	
Measured variable		Output on AO	Value at LZ	Value at MBE
Opacity [%]		1	0	100
Dust concentration a.c. ext [mg/m^3]		2	0	200
Dust concentration a.c. SI [mg/m^3]		3	0	200
Coefficients set (for dust concentration ext)			0.00 / 1.00 / 0.00	
Coefficients set (for dust concentration SI)			0.00 / 1.00 / 0.00	

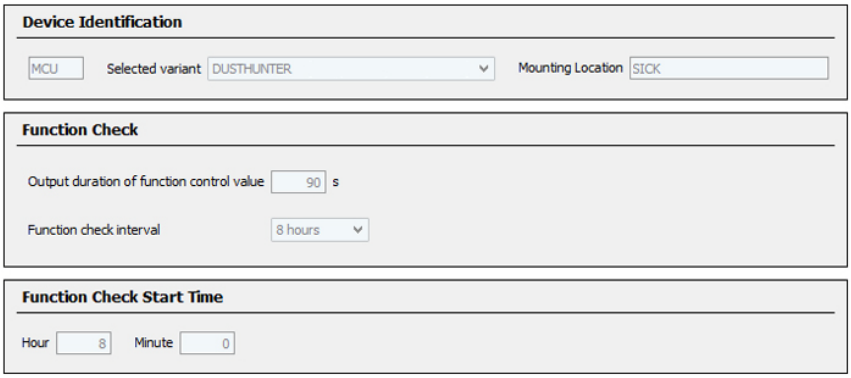
The steps required to modify these settings are described in the following Sections. For this purpose, the devices must be connected in SOPAS ET (see “Connection to the device via USB line”, page 55), the Level 1 password set and the “Maintenance” mode set.

4.4.3 Determining 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.

Default values see “Factory settings”, page 69

Fig. 46: SOPAS ET menu: MCU/Adjustment/Function Check - Automatic (example)



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 14
Function Check Start Time	Hour	Defining a start timepoint in hours and minutes.
	Minute	

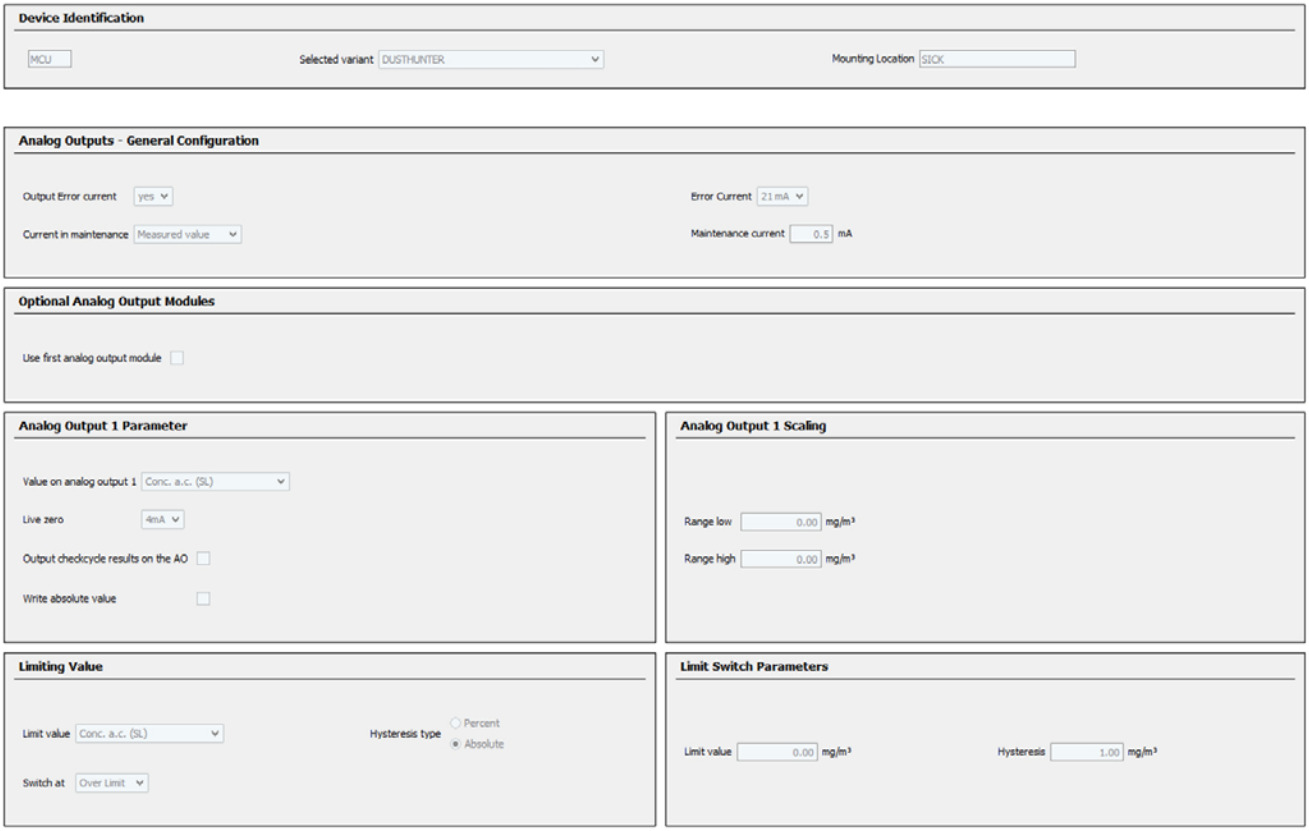
The value measured last is output during control value determination (see “Function check output on a plotter”, page 14).

4.4.4 Setting the analog outputs parameters

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

- Default values see “Factory settings”, page 69
- 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 74.

Fig. 47: SOPAS ET menu: MCU/Configuration/IO configuration/Output Parameters



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”
		Value measured last	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

Field		Parameter	Remark	
Optional Analog Output Modules	Use first analog output module	Inactive	Not permitted for DUSTHUNTER C200 (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 on DUSTHUNTER C200)	
Analog Output 1 Parameter	Value on analog output 1	Conc. a.c. (SI)	Dust concentration under operating (actual) conditions (based on scattered light intensity)	The selected measured variables are output on the analog output.
		Conc. s.c. (SI)	Dust concentration under standard conditions (based on scattered light intensity)	
		Opacity		
		Extinction		
		Transmission		
		SI	Scattered light intensity	
		Rel. opacity	Relative opacity	
		Conc. a.c. (ext)	Dust concentration under operating (actual) conditions (based on extinction)	
		Conc. s.c. (ext)	Dust concentration under standard conditions (based on extinction)	
	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 checkcycle results on the AO	Inactive	Control values (see “Function check”, page 14) are not output on the analog output.	
		Active	Control values are output on the analog output (the “Output control values at AO” checkbox in the “Adjustment / Function Check - Automatic” directory must be activated).	
	Write absolute value	Inactive	Positive and negative measured values are differentiated.	
		Active	The amount of the measured value is output (not relevant for DUSTHUNTER C200).	
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	

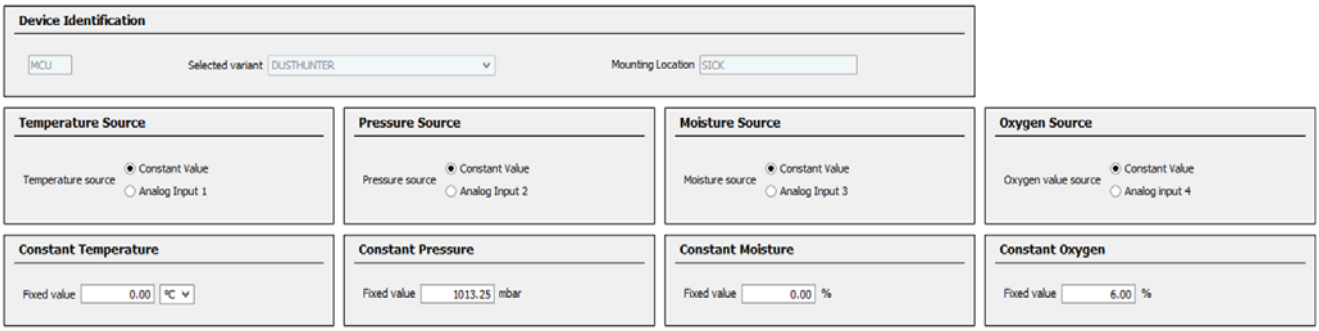
Field		Parameter	Remark	
Limiting Value	Limit value	Concentration a.c. (SI)	Dust concentration under operating (actual) conditions (based on scattered light intensity)	Select the measured variable for which a limit value is to be monitored.
		Concentration s.c. (SI)	Dust concentration under standard conditions (based on scattered light intensity)	
		Opacity		
		Extinction		
		Transmission		
		Scattered light intensity	Scattered light intensity	
		Rel. opacity	Relative opacity	
		Concentration a.c. (ext)	Dust concentration under operating (actual) conditions (based on extinction)	
		Concentration s.c. (ext)	Dust concentration under standard conditions (based on extinction)	
	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		
Limit Switch Parameters	Limit value	Value	The limit value relay switches when the value entered is overflown or underflown.	
	Hysteresis	Value	Define a tolerance for resetting the limit value relay	

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

4.4.5 Setting the analog inputs parameters

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

Fig. 48: SOPAS ET menu: MCU/Configuration/IO configuration/Input Parameters

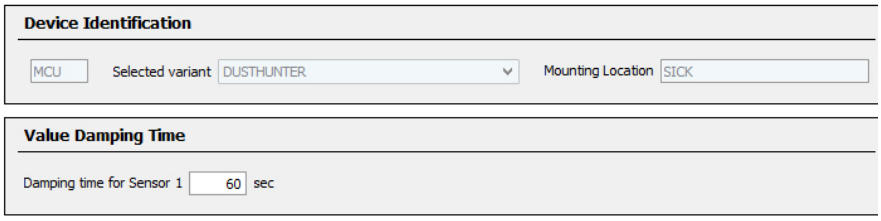


Field	Parameter	Remark
Temperature Source	Constant Value	A fixed value is used to calculate the scaled value. This parameter opens the “Temperature Constant” field to enter the scaling value in °C (° F for imperial units) or K.
	Analog Input 1	The value from an external sensor connected to analog input 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.

4.4.6 Setting the response time

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

Fig. 49: SOPAS ET menu: MCU/Configuration/Value Damping



Field	Parameter	Remark
Damping time for Sensor 1	Value in s	Response time for the selected measured variable (see “Response time”, page 13) Setting range 1 ... 600 s

4.4.7 Calibration for dust concentration measurement

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

NOTE:
Carrying out a gravimetric comparison measurement demands special knowledge that cannot be described in detail here.

Steps to be carried out

4.4.7.1 *Calibrating dust concentration measurement based on extinction*

- Select device file “MCU”, set the measuring system to “Maintenance” mode
- Enter the Level 1 password (see “Password and operating levels”, page 84).
- Select the “Configuration / IO Configuration / Output Parameters” directory (see “SOPAS ET menu: MCU/Configuration/IO configuration/Output Parameters”, page 71) and assign the “Extinction” measured variable to an analog output.
- Estimate the measuring range required for the dust concentration in operational state and enter this in the “Analog Output 1 *(2/3)* Scaling” field assigned to the selected analog output for output of the extinction.
- Deactivate “Maintenance” mode.
- Carry out the gravimetric comparison measurement according to DIN EN 13284-1.
- Determine regression coefficients from the mA values of the analog output for “Scattered light intensity” and the actual dust concentrations measured gravimetrically.

$$c = K2 \cdot I_{out}^{\,2} + K1 \cdot I_{out} + K0 \qquad (1)$$

c:	Dust concentration in mg/m³
K2, K1, K0:	Regression coefficients of the function $c = f(I_{out})$
I_{out}:	Current output value in mA

$$I_{out} = LZ + Ext \cdot \frac{20mA - LZ}{MBE} \qquad (2)$$

Ext:	Measured extinction
LZ:	Live Zero
MBE:	Defined upper range limit value (value entered for 20 mA; normally 2.5 x fixed limit value)

- Enter the regression coefficients
  There are two options:
  – Direct input of K2, K1, K0 in a measured value computer.

NOTICE:
After calibration, the regression coefficients set in the sender/receiver unit and the measuring range set in the MCU may not be changed anymore.
On the LC-Display (option), the dust concentration is shown in mg/m³ as uncalibrated value.

– Use the regression function of the measuring system (use without measured value computer). In this case, the correlation to the extinction has to be determined. To do this, calculate the regression coefficients cc2, cc1 and cc0 to be entered in the measuring system from K2, K1, K0.

$$c = cc2 \cdot Ext^2 + cc1 \cdot Ext + cc0 \qquad (3)$$

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

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

Using (3), the result is as follows:

$$cc0 = K2 \cdot LZ^2 + K1 \cdot LZ + K0$$

$$cc1 = (2 \cdot K2 \cdot LZ + K1) \cdot \left(\frac{20mA - LZ}{MBE}\right)$$

$$cc2 = K2 \cdot \left(\frac{20mA - LZ}{MBE}\right)^2$$

Now enter the regression coefficients cc2, cc1 and cc0 determined in directory “Configuration/Application parameters” (see “SOPAS ET menu: DH C200/Configuration/Application parameter (example)”, page 64) (set sender/receiver unit to “Maintenance” state and enter the Level 1 password. Reset the sender/receiver unit back to “Measurement” state afterwards.)

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

4.4.7.2 *Calibrating dust concentration measurement based on scattered light measurement*

- Select device file “MCU”, set the measuring system to “Maintenance” mode
- Enter the Level 1 password (see “Password and operating levels”, page 84).
- Select the “Configuration / IO Configuration / Output Parameters DUSTHUNTER” directory (see “SOPAS ET menu: MCU/Configuration/IO configuration/Output Parameters”, page 71) and assign the “SI” (scattered light intensity) measured variable to an analog output.
- Estimate the measuring range required for the dust concentration in operational state and enter this in the “Analog Output 1 *(2/3)* Scaling” field assigned to the selected analog output assigned to the scattered light intensity.
- Select the “Configuration / Application Parameter” directory see “SOPAS ET menu: DH C200/Configuration/Application parameter (example)”, page 64) and then select “Scattered light” in the “Primary measuring principle” field.
- Deactivate “Maintenance” mode.
- Carry out the gravimetric comparison measurement according to DIN EN 13284-1.
- Determine regression coefficients from the mA values of the analog output for “Scattered light intensity” and the actual dust concentrations measured gravimetrically.

$$c = K2 \cdot I_{out}^{\,2} + K1 \cdot I_{out} + K0 \qquad (1)$$

c:	Dust concentration in mg/m³
K2, K1, K0:	Regression coefficients of the function $c = f(I_{out})$
I_{out}:	Current output value in mA

$$I_{out} = LZ + SL \cdot \frac{20mA - LZ}{MBE} \qquad (2)$$

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

► Enter the regression coefficients

There are two options:

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

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

– Use the regression function of the measuring system (use without measured value computer).
In this case, the correlation to the scattered light intensity has to be determined. To do this, calculate the regression coefficients cc2, cc1, cc0 to be entered in the measuring system from K2, K1, K0.

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

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

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

Using (3), the result is as follows:

$$cc0 = K2 \cdot LZ^2 + K1 \cdot LZ + K0$$

$$cc1 = (2 \cdot K2 \cdot LZ + K1) \cdot \left(\frac{20mA - LZ}{MBE}\right)$$

$$cc2 = K2 \cdot \left(\frac{20mA - LZ}{MBE}\right)^2$$

Now enter the regression coefficients cc2, cc1 and cc0 determined in directory “Configuration/Application parameters“ (see “SOPAS ET menu: DH C200/Configuration/Application parameter (example)”, page 64) (set sender/receiver unit to “Maintenance” state and enter the Level 1 password. Reset the sender/receiver unit back to “Measurement” state afterwards).

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

4.4.8 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 and DUSTHUNTER Service Manual.

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

Parameter protocol example

Fig. 50: DUSTHUNTER C200 Parameter protocol (example)

Dusthunter - Parameter protocol

Type of device: DH C200
Mounting location:

Device information

Device version S/R-unit	
Firmware version S/R-unit	
Serial number S/R-unit	00008700
Identity number S/R-unit	00000
Hardware version S/R-unit	1.2
Firmware bootloader S/R-unit	V00.99.15
Firmware version reflector	00000000
Serial number reflector	00000000
Idendity number reflector	00000
Hardware version reflector	1.1
Firmware bootloader reflector	V00.99.15

Installation parameter

Bus address	1
Flange-flange	1.00m
Opt. measuring distance	1.00m
Chimney opening	1.00m
Correction factor	1.000
Primary measuring principle	Transmission
Concentration calibration coefficients = f(Scattered light)	
cc2	0.0000
cc1	1.0000
cc0	0.0000
Concentration calibration coefficients = f(Extinction)	
cc2	0.0000
cc1	1.0000
cc0	0.0000
Limit contamination warning	30.0%
Limit contamination fault	40.0%
Average	inaktiv
Average Interval	1 min
Selection Measure Value	Opacity
EPA-mode	inaktiv

Device parameter

Factory settings	
Automatic self adjustment	activ
Automatic self adjustment interval	30 min
Automatic self adjustment limit	0.1
Response time sensor	1.0s
Response time diagnosis values	10.0s
Delay ADC-trigger LED	38µs
Delay ADC-trigger Laser	35µs
Response time contamination	5
Pivoted shutter at S/R-unit in contamination measurement position	51
Pivoted shutter at S/R-unit in check point measurement position	102
Pivoted shutter at reflector in contamination measurement position	51
Pivoted shutter at S/R-unit in back light measurement position	102
Refl. Gain AN0-AN1	10.0
Refl. Gain Relais 1	5.7
Refl. Gain Relais 2	27.0

Factory calibration settings

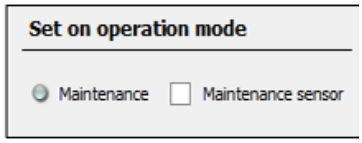
Scattered light (MUF)	
cc2	0.0000
cc1	1.0000
cc0	0.0000
Current laser	
cc2	0.0000
cc1	30.3000
cc0	0.0000
Device temperature	
cc2	0.0000
cc1	100.0000
cc0	-275.1500
Power supply	
cc2	0.0000
cc1	11.0000
cc0	0.0000
Temp. correction transmission	
cc2	0.0000
cc1	0.0000
cc0	0.0000

4.4.9 Starting measurement mode

Set the measuring system to “Measurement” mode after entering/modifying parameters.

To do so, cancel “Maintenance”: Deselect “Maintenance sensor”.

Fig. 51: SOPAS ET menu: MCU/Maintenance/Maintenance



Standard start-up is now completed.

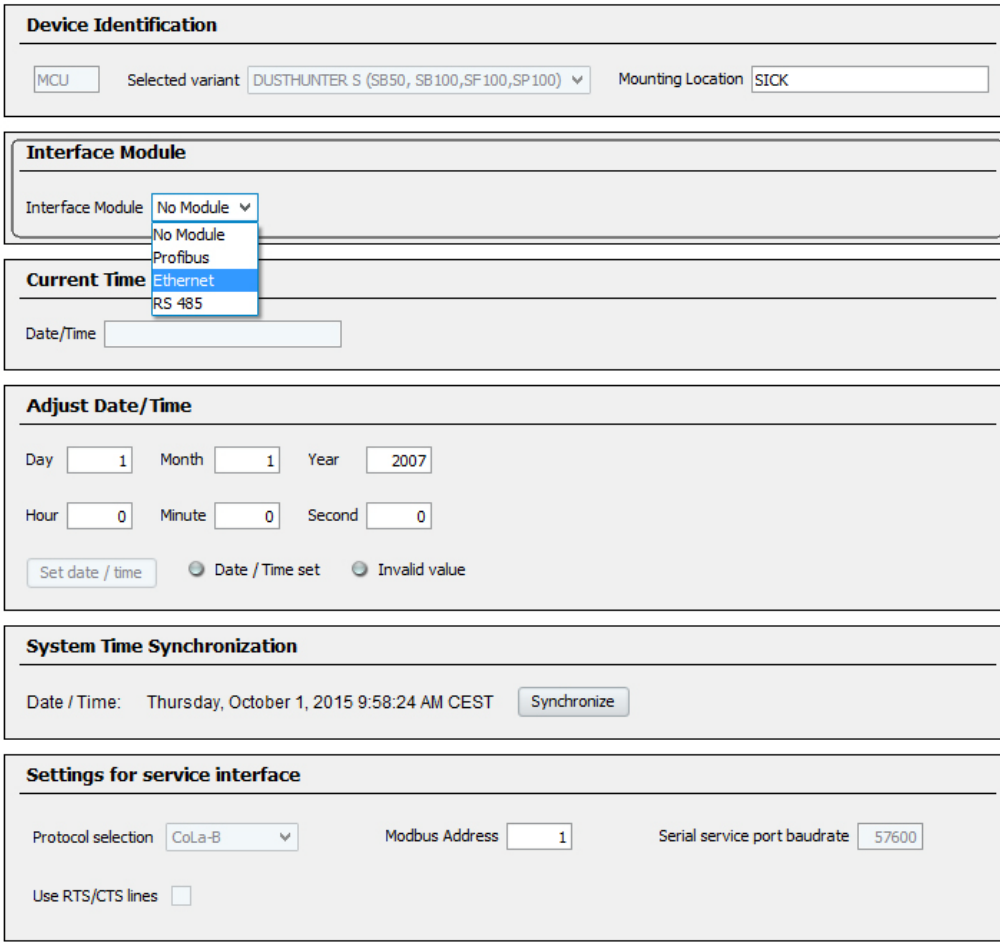
4.5 Setting the Interface module parameters

4.5.1 General information

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
- Enter the Level 1 password (see “Password and operating levels”, page 84).
- Switch to the “Configuration / System Configuration” directory.
  The installed interface module is displayed in the field “Interface Module”.
- Configure the Interface module according to requirements.

Fig. 52: SOPAS ET menu: MCU/Configuration/System Configuration



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

4.5.2 Setting the Ethernet module parameters

NOTICE:
The risk of undesired access to the measuring system is inherent when communicating via Ethernet.
- ▶ Operate the measuring system only behind suitable protection (e.g., Firewall).

The configuration of interface module Ethernet type 2 (see “Options for MCU control unit”, page 123) is not possible with program SOPAS ET. A special software with description is supplied with the program.

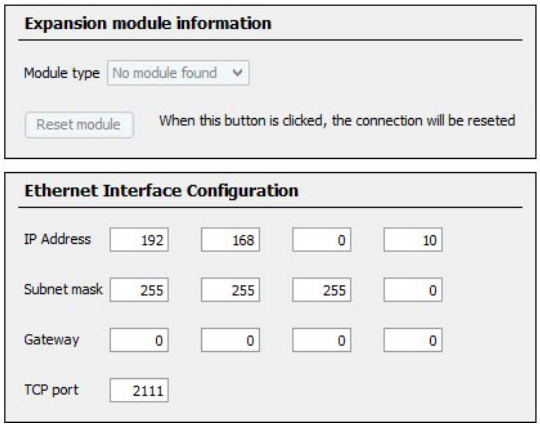
Standard setting: 192.168.0.10

A predefined IP address is set on request.

To change the settings:

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

Fig. 53: SOPAS ET menu: MCU/Configuration/IO configuration/Interface Module



4.6 Operating/setting parameters via the optional LC-Display

4.6.1 General information on use

The display and operating interface of the LC-Display contains the functional elements shown in Fig. “LC-Display functional elements”.

Fig. 54: LC-Display functional elements

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

Button functions

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

Button	Function
Diag	Display diagnostic information (warnings and errors during a start using the Main menu, sensor information during a start using the Diagnostics menu)
Back	Switch to higher level menu
Arrow ↑	Scroll up
Arrow ↓	Scroll down
Enter	Execution of the action selected with an arrow button (switch to a submenu, confirm parameter selected during parameter setting)
Start	Start an action
Save	Store a changed parameter
Meas	Switch from main measured values to measured sensor values Display the contrast setting (after 2.5 s)

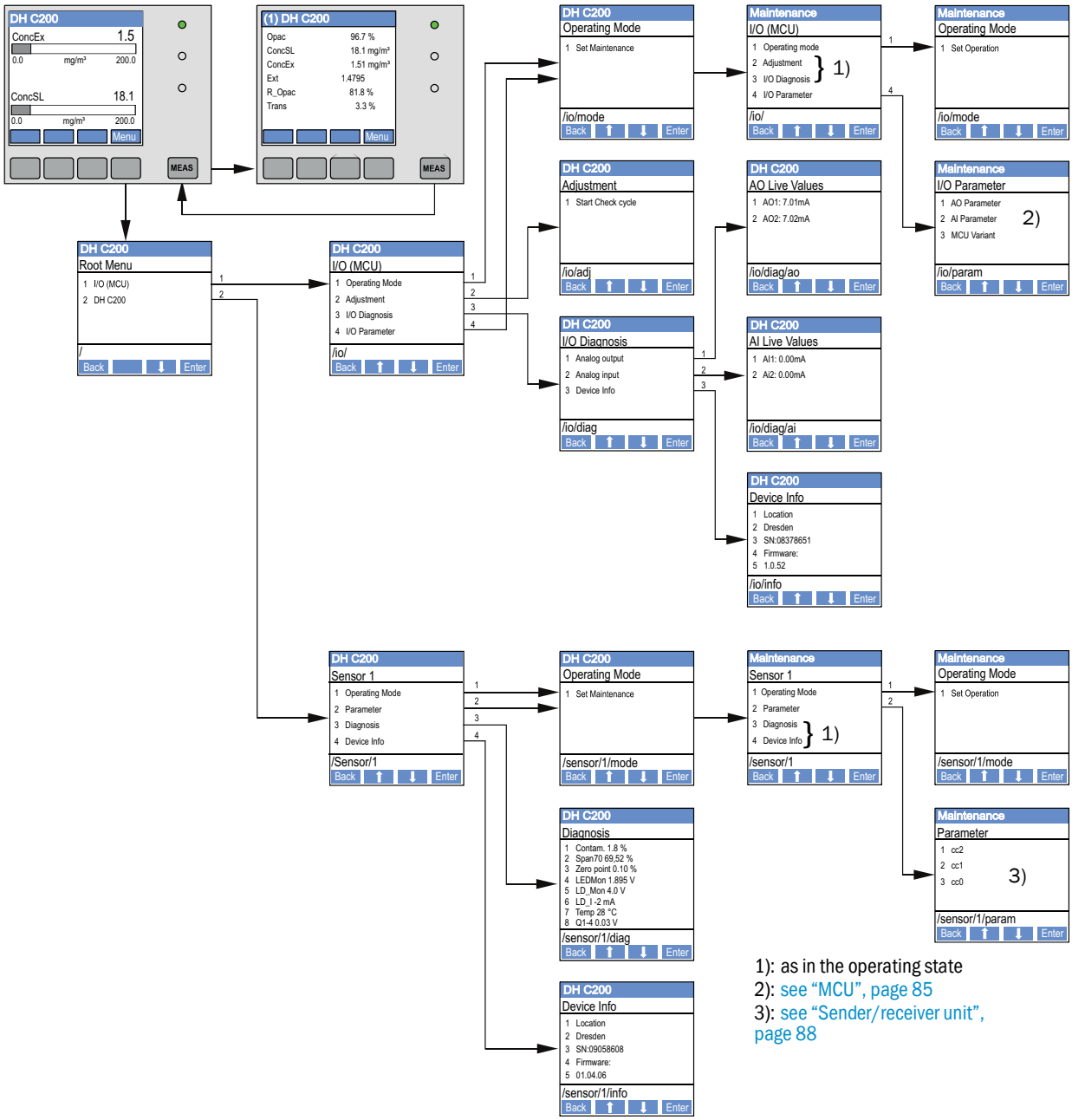
4.6.2 Password and operating levels

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

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

4.6.3 Menu structure

Fig. 55: LC-Display menu structure



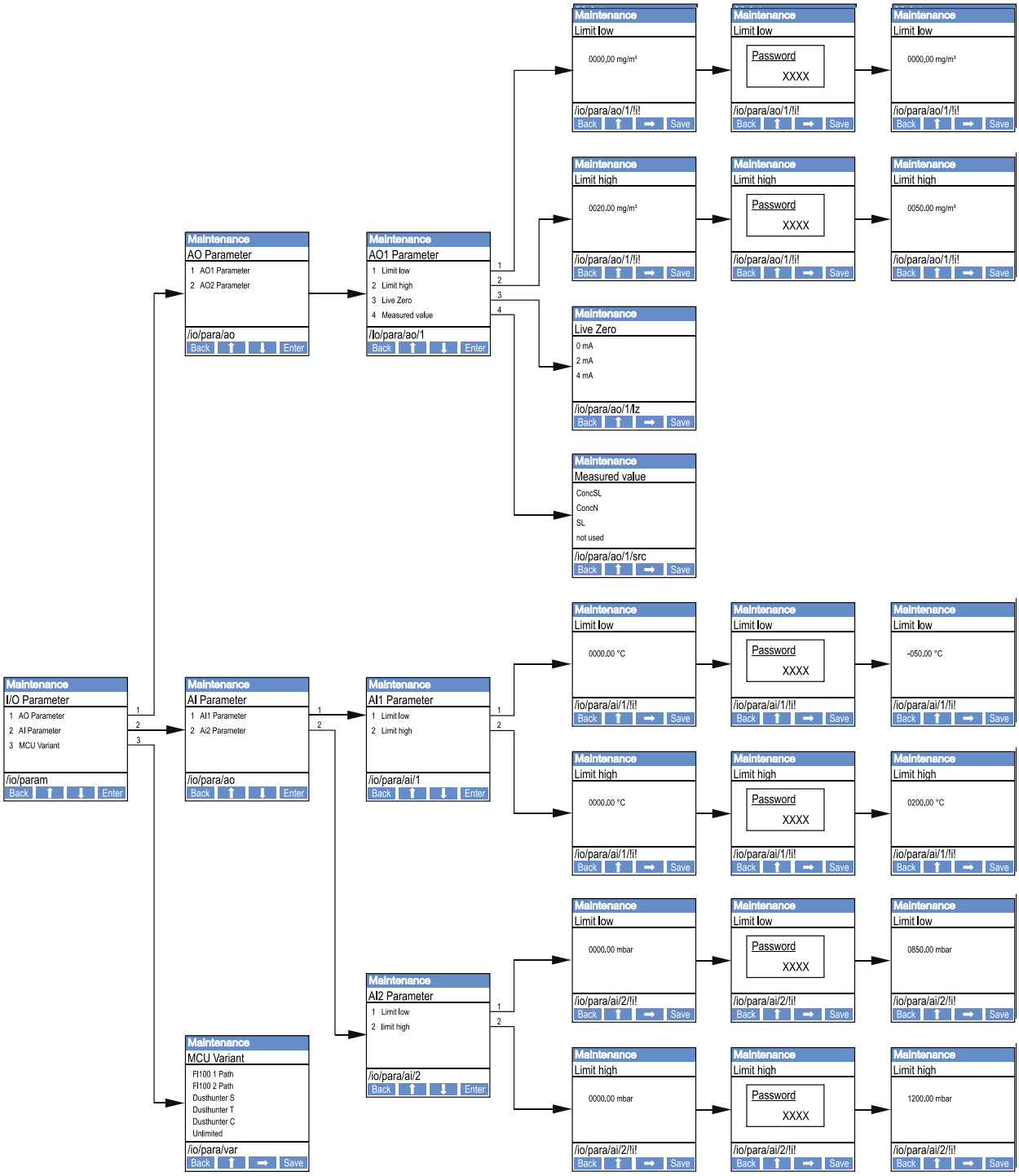
4.6.4 Parameter setting

4.6.4.1 *MCU*

Analog outputs / inputs

- ▶ Set the MCU to “Maintenance” mode and select the “I/O Parameter” submenu.
- ▶ Select the desired parameter and enter the default password “1234” using the “^” (scrolls from 0 to 9) and/or “→” (moves the cursor to the right) buttons.
- ▶ Select the desired value using the “^” and/or “→” buttons and write it to the device with “Save” (confirm 2x).

Fig. 56: Menu structure for configuring analog outputs/inputs and setting the MCU variant



Setting the MCU variant

The following steps are required to set the MCU for the DUSTHUNTER C200 sender/receiver unit to be connected (see “Assigning the MCU to the sender/receiver unit”, page 68):

- Set the MCU to “Maintenance” mode, select the “MCU Variant” submenu and select the type “DUSTHUNTER C”.

▶ Enter the default password and store the type with “Save” (confirm twice).

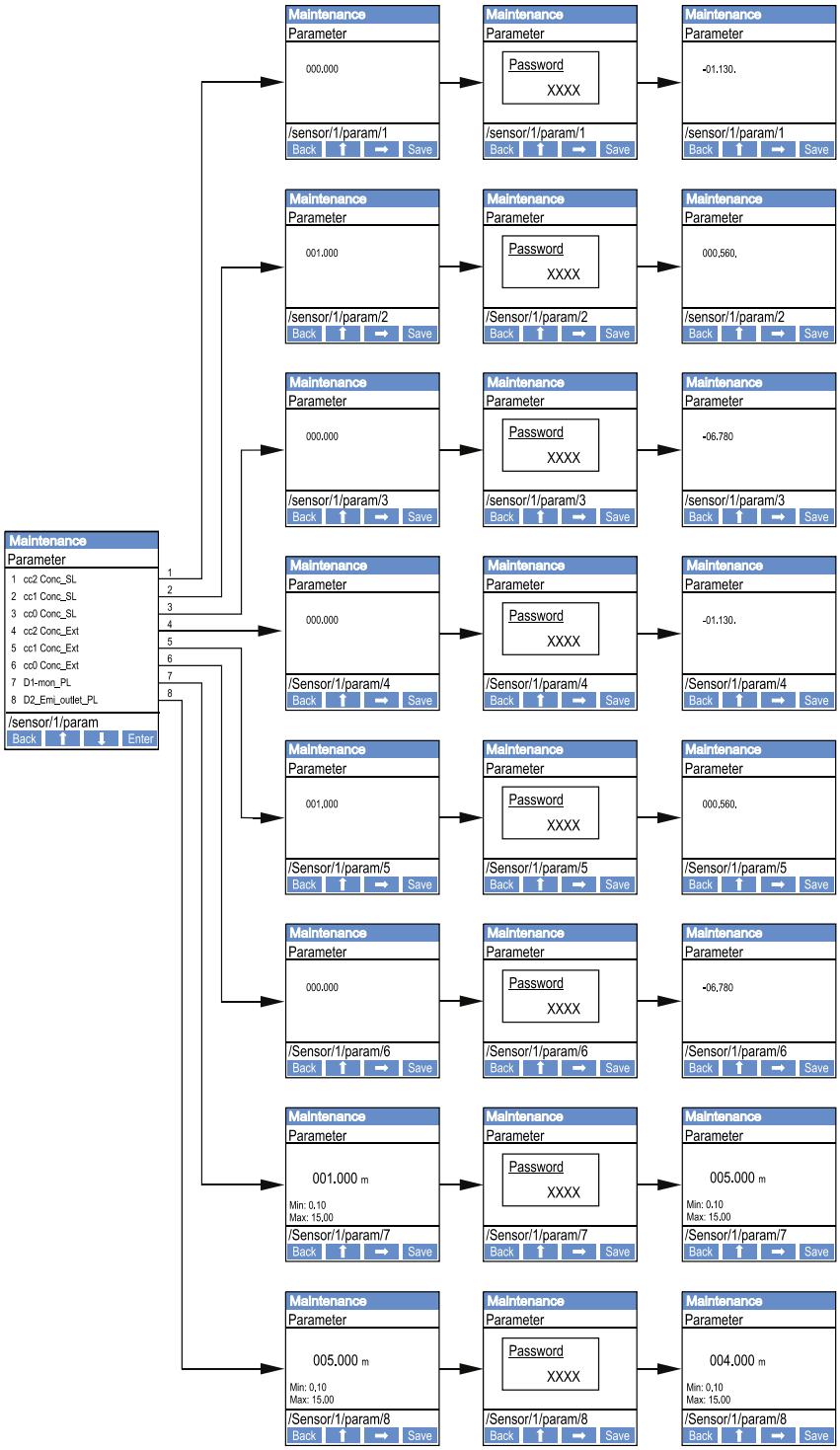
The other selection options have no significance here.

4.6.4.2 *Sender/receiver unit*

The following steps are required to enter the regression coefficients:

- Set the sender/receiver unit to “Maintenance” and select the “Parameter” submenu.
- Select the desired parameter and enter the password (see “Password and operating levels”, page 84).
- Set the calculated coefficients (see “Calibration for dust concentration measurement”, page 76) using the “^” and/or “→” buttons and write to the device with “Save” (confirm twice).

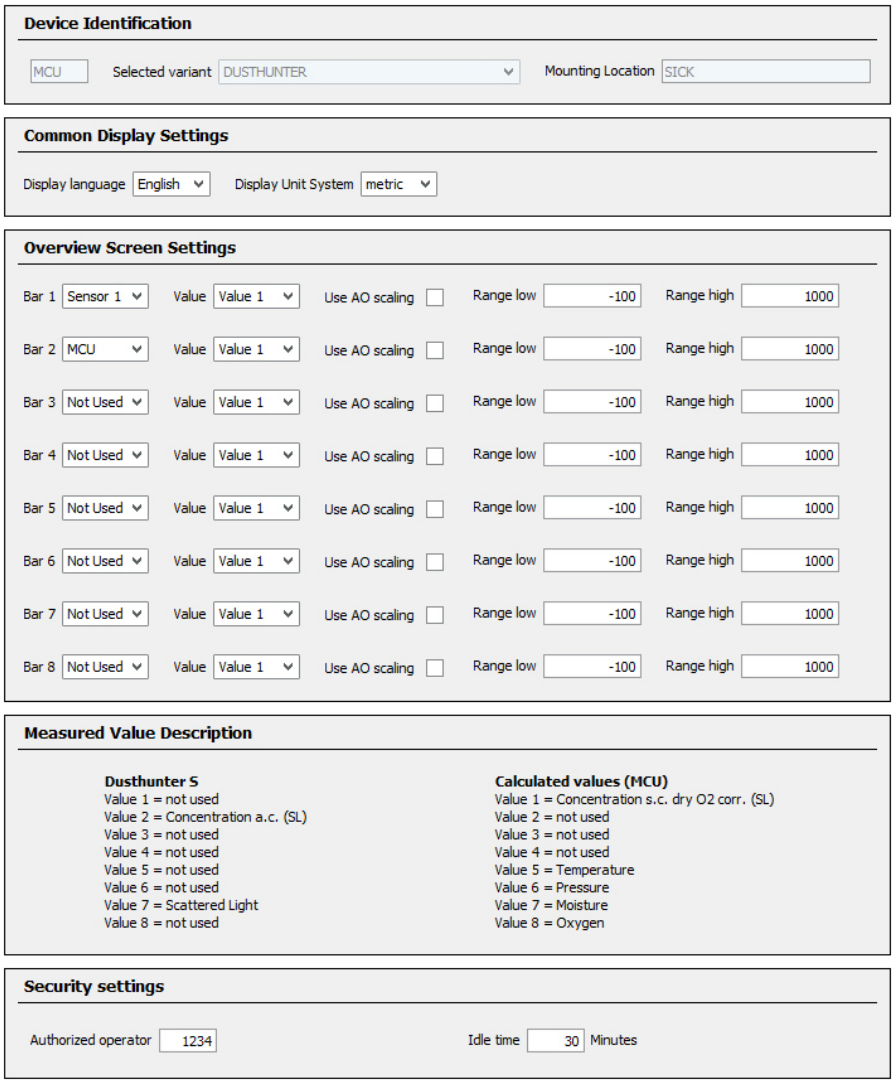
Fig. 57: Entering the regression coefficients



4.6.5 Using SOPAS ET to modify display settings

To modify the factory settings, connect SOPAS ET with the “MCU” (see “Connection to the device via USB line”, page 55), enter the Level 1 password and select the “Configuration / Display Settings” directory.

Fig. 58: SOPAS ET menu: MCU/Configuration/Display Settings



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

Measured value assignment

MCU measured value	Sender/receiver unit measured value
Value 1	Opacity
Value 2	Concentration a.c. (SI)
Value 3	Concentration a.c. (ext)
Value 4	Extinction
Value 5	Rel. opacity
Value 6	Transmission
Value 7	Scattered light
Value 8	Not used
MCU Value 1	Concentration s.c. (SI)
MCU Value 2	Concentration s.c. (ext)

5 Maintenance

5.1 General

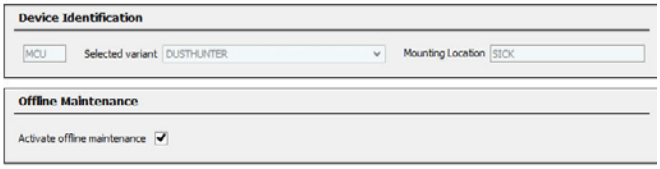
The maintenance work to be carried out consists of:

- Cleaning work (see “Maintenance on the sender/receiver unit and reflector/scattered light receiver”, page 94),
- Securing the purge air supply function (see “Cleaning the optical interfaces on the reflector”, page 98),
- Checking/correcting the alignment of the optical axes of sender/receiver unit and reflector (see “Focussing the sender light beam for transmission measurement”, page 60).

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

▶ Connect the MCU to the laptop/PC using the USB line and start program SOPAS ET.
▶ Connect with the MCU (see “Connection to the device via USB line”, page 55).
▶ Enter the Level 1 password (see “Password and operating levels”, page 84).
▶ Set the sender/receiver unit to “Maintenance”: Click “Maintenance sensor”)

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



WARNING:
Observe the relevant safety regulations as well as the safety notices (see “Responsibility of user”, page 9) during all work.

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 display on the MCU (see “Menu structure”, page 85) when the LC-Display option is present or by connecting an external maintenance switch to the terminals for Dig In2 (17, 18) in the MCU (see “Connecting the MCU control unit”, page 47).
- An automatic function check is not carried out during “Maintenance”.
- The control window on the rear of the reflector/scattered light receiver (see “Sender spot on the back of the enclosure of the reflector/scattered light receiver”, page 62) is lit for better inspection of the optical alignment in the “Maintenance” mode.
- The value set for “Maintenance” is output on the analog output (see “Setting the analog outputs parameters”, page 71). 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 operating voltage is switched on again.

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. Therefore only general recommendations can be made here. Normally, the maintenance intervals are about 4 weeks during the initial period and can be steadily incremented to up to a year depending on the respective conditions.

The equipment operator must specify the specific work to be carried out and its performance in a Maintenance Manual.

Maintenance contract

Scheduled maintenance work can be carried out by the equipment operator. Only qualified personnel according to Section 1 should be allowed to do the work. If requested, all maintenance activities can also be performed by SICK Service or an authorized Service partner. Any repairs will be made by specialists onsite whenever possible.

Auxiliary means required

- Brush, cleaning cloth, cotton swabs
- Water
- Replacement air filter, preliminary filter (for suction)

5.2 Maintenance on the sender/receiver unit and reflector/scattered light receiver

NOTE:

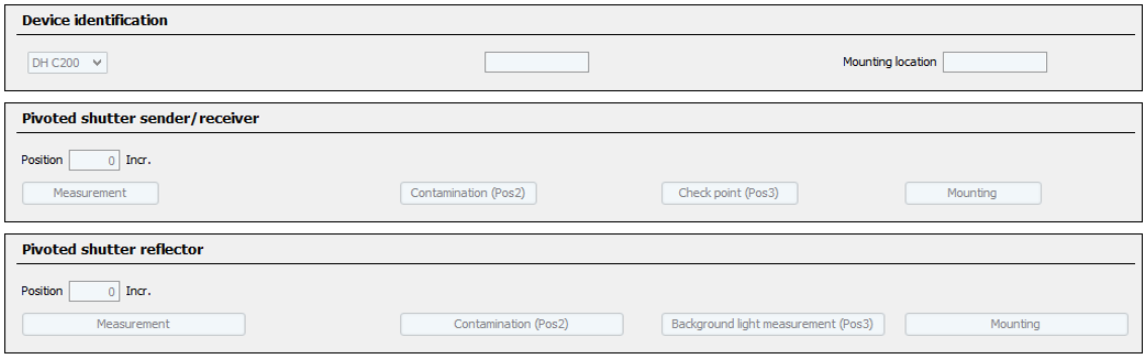
- Do not damage any device parts during maintenance work.
- Do not interrupt the purge air supply.

Clean the outside of the sender/receiver unit and reflector/scattered light receiver in regular intervals. Remove deposits with water or mechanically using suitable auxiliary means (30% for warning, 40% for failure).

5.2.1 Maintenance on the sender/receiver unit

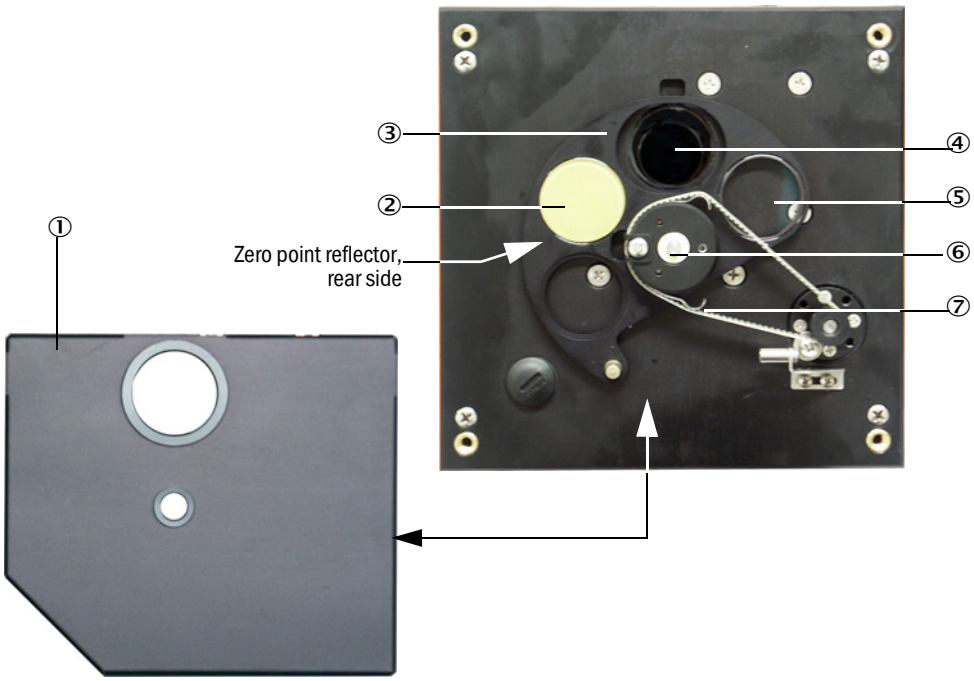
- Enter the level 1 password and set the sender/receiver unit to the “Maintenance” state see “SOPAS ET menu: DH C200/Maintenance/Maintenance”, page 59).
- Loosen the knurled screws and swivel the enclosure to the side.
- Check mounting flange and purge air connections for contamination and clean when necessary.
- Close the mounting flange with cover (see “Miscellaneous”, page 123).
- Switch to the “Adjustment / Manual adjustment / Motor control” directory and click “Mounting” under “Pivoted shutter sender/receiver”.
  The pivoted shutter then moves to the cleaning position.

Fig. 60: SOPAS ET menu: DH C200/Adjustment/Manual Adjustment/Motor control



- Remove pivoted shutter cover (1), press tension spring (7) together and take pivoted shutter (3) off axis (6).
- Carefully clean glass pane (5) (both sides), zero point reflector (2) and sender optics (4) with an optics cloth.

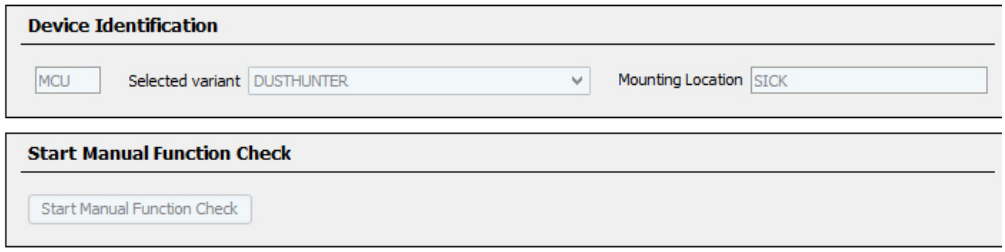
Fig. 61: Cleaning the optical interfaces on the sender/receiver unit



① Pivoted shutter cover
② Zero point reflector
③ Pivoted shutter
④ Sender optics
⑤ Glass pane (both sides)
⑥ Axis
⑦ Tension spring

- ▶ Lay the toothed belt on the drive axis, press the tension spring together and push pivoted shutter back onto the axis.
- ▶ To start the function check, connect to file “MCU”, select subdirectory “Adjustment / Manual function check” and actuate “Start Manual Function Check”.

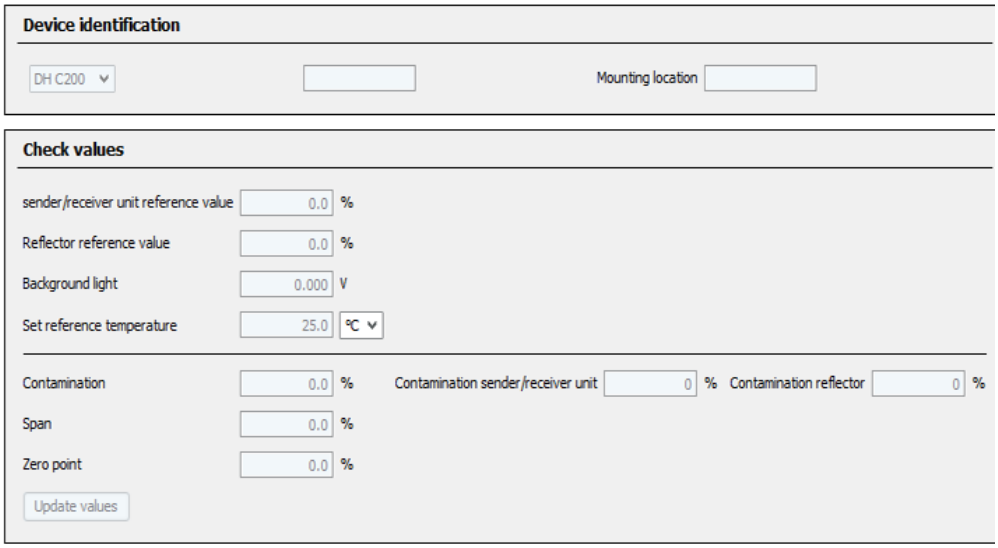
Fig. 62: SOPAS ET menu: MCU/Adjustment/Function Check - Manual



The function check can also be triggered via the LC-Display on the MCU (see “Menu structure”, page 85).

- ▶ Connect with the DH C200 device file, select the “Diagnosis / Check values” directory and check the contamination value.

Fig. 63: SOPAS ET menu: DH C200/Diagnosis/Check values



- If 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 (initiate a function check and select the “C200/Diagnosis” menu, see “Menu structure”, page 85).
  - If the contamination value does not sink below the value for warning in spite of several cleaning processes, the device is probably defective → contact SICK Service.
  - If the contamination value becomes negative after cleaning (e.g. because of scaling with contaminated optics), the measuring system must be rescaled (see “Scaling the measuring system for transmission measurement”, page 63).

- Put the pivoted shutter cover back on, remove the cover from the assembly flange, swivel the enclosure back in and lock with the knurled screws.
- Move the pivoted shutter back into the measuring position. To do this, click the “Measurement” button in the “Adjustment / Manual adjustment / Motor control” directory (see “SOPAS ET menu: DH C200/Adjustment/Manual Adjustment/Motor control”, page 94).
- Resume Measuring mode.

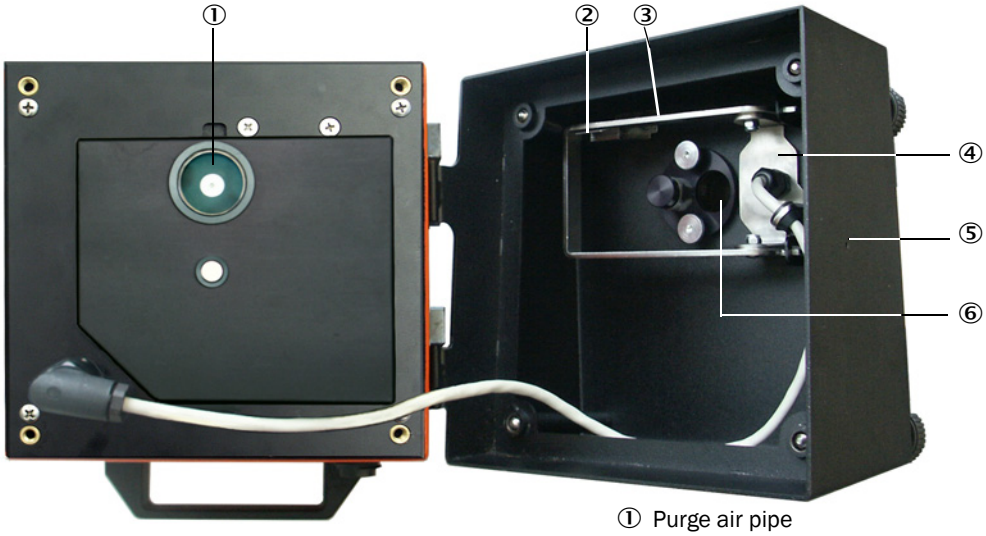
5.2.2 Performing maintenance on the reflector/scattered light receiver

- Set the measuring system to “Maintenance” (see “General”, page 92), loosen the knurled screws and swivel the enclosure to the side.

Maintenance on the scattered light receiver

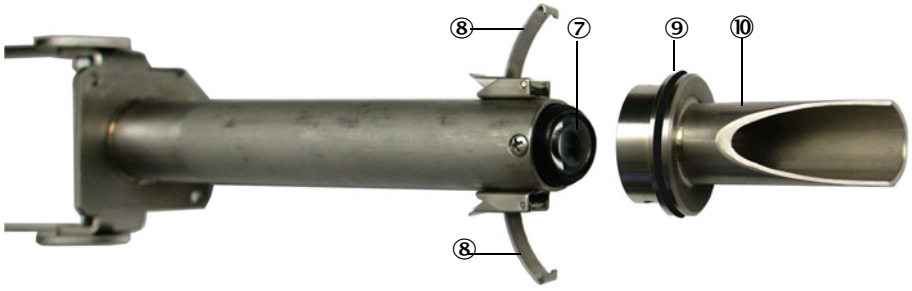
- Push spring (2) to the side, pull bracket (3) to the front and pull scattered light receiver optics (4) out of the tube.
- Close mounting flange (5) with cover (see “Miscellaneous”, page 123).
- Open tensioners (8) on the reflector/scattered light receiver for long active measuring paths and take attachment (10) off.
- Carefully clean lens of the scattered light receive optics (7) with an optics cloth.
- Check purge air pipe (1), light trap (6) and O-ring (9) for deposits and clean, if required.

Fig. 64: Cleaning the optical interfaces



Scattered light receiver for short active measuring paths

Scattered light receiver for long active measuring paths

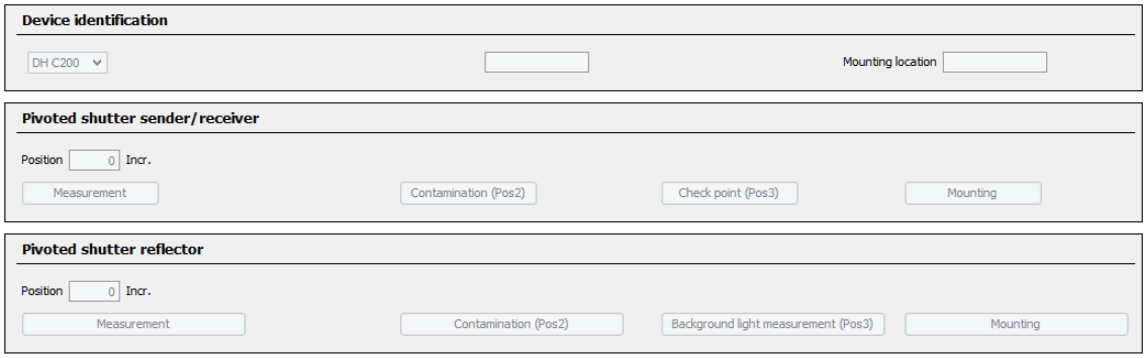


① Purge air pipe
② Spring
③ Bracket
④ Scattered light receiver optics
⑤ Mounting flange
⑥ Light trap
⑦ Scattered light receiver optics
⑧ Tensioner
⑨ O-ring
⑩ Attachment

5.2.3 Maintenance on the reflector

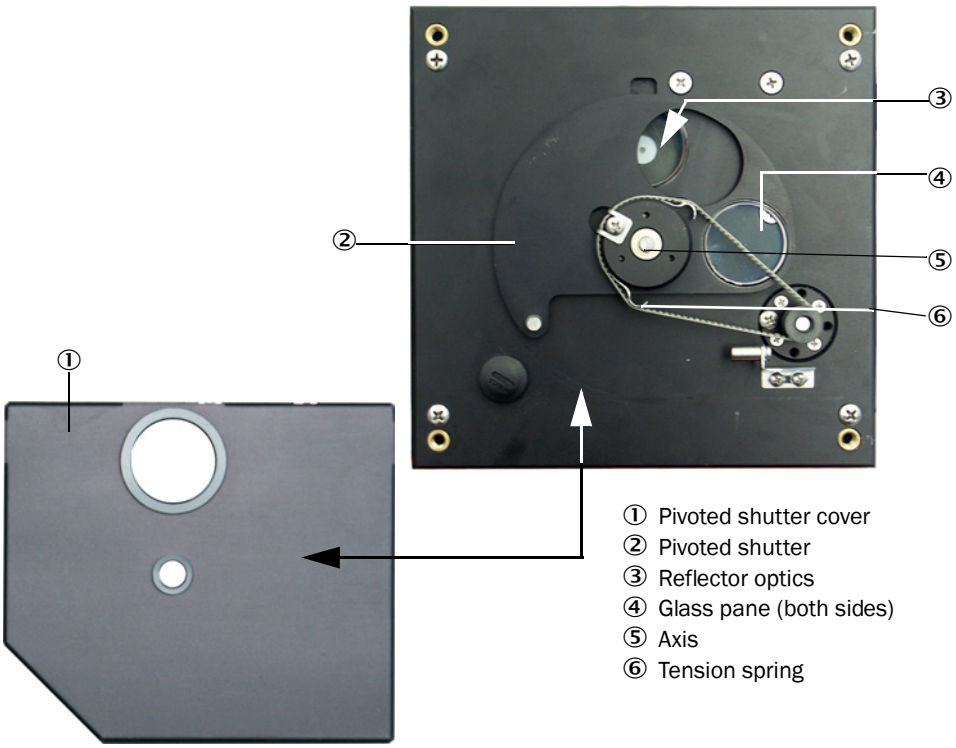
- Click the “Mounting” button in menu “DH C200/Adjustment/Manual Adjustment/Motor control” under position Pivoted shutter reflector see “SOPAS ET menu: DH C200/Adjustment/Manual Adjustment/Motor control”, page 98).
  The pivoted shutter then moves to the cleaning position.

Fig. 65: SOPAS ET menu: DH C200/Adjustment/Manual Adjustment/Motor control



- Remove pivoted shutter cover (1), loosen tension spring (6) and take pivoted shutter (2) off axis (5).
- Carefully clean glass pane (4) (both sides) and reflector optics (3) with an optics cloth.

Fig. 66: Cleaning the optical interfaces on the reflector



- Lay the toothed belt on the drive axis, push pivoted shutter back onto the axis and reinstall the tension spring.

- Trigger the function check (select the “Adjustment / Function Check - Manual” subdirectory in the “MCU“ device file and click “Start Manual Function Check”; see “SOPAS ET menu: MCU/Adjustment/Function Check - Manual”, page 95).
- Check the contamination value (see “Maintenance on the sender/receiver unit and reflector/scattered light receiver”, page 94, see “SOPAS ET menu: DH C200/Diagnosis/Check values”, page 96).
- If 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.
- Put the pivoted shutter cover back on, remove the cover from the assembly flange, re-install and fasten the scattered light receiver optics.
- Swivel the enclosure back again and lock with the knurled screws.
- Move the pivoted shutter back into the measuring position. To do this, click the “Measurement” button under “Pivoted shutter reflector” in the “Adjustment / Manual adjustment / Motor control” directory (see “SOPAS ET menu: DH C200/Adjustment/Manual Adjustment/Motor control”, page 94).
- Resume Measuring mode.

5.3 Maintenance on the purge air supply

Maintenance work to be carried out:

- Inspecting the entire purge air supply
- Cleaning the filter housing
- Replacing the filter element, if necessary.

The dust load and wear on the filter element depend on the degree of contamination of the intake ambient air. It is therefore not possible to specify precise time intervals for these tasks. We recommend inspecting the purge air supply at short intervals (approx. 2 weeks) and then optimizing maintenance intervals over a longer period of operation.

NOTE:

Irregular or insufficient maintenance of the purge air supply can cause it to fail and thus cause severe damage to the sender/receiver unit.

- ▶ Always ensure purge air supply when the optical components sender/receiver unit and reflector/scattered light receiver are fitted on the duct.
- ▶ Disassemble the connected components before exchanging damaged purge air hoses (see “Shutdown”, page 103).

Inspection

- ▶ Check the running noise of the blower at regular intervals; increases in the noise level can indicate a blower failure.
- ▶ Check that all hoses are secure and free of damage.
- ▶ Check the filter element for contamination.
- ▶ Exchange the filter element when:
  - Severe contamination (deposits on the filter surface) is visible
  - The purge air volume is reduced considerably as compared to operation with a new filter.

The purge air supply does not have to be switched off to clean the filter housing or to replace the filter element, i.e. the components can remain on the duct.

5.3.1 Control unit MCU with integrated purge air supply

Cleaning or replacing the filter element

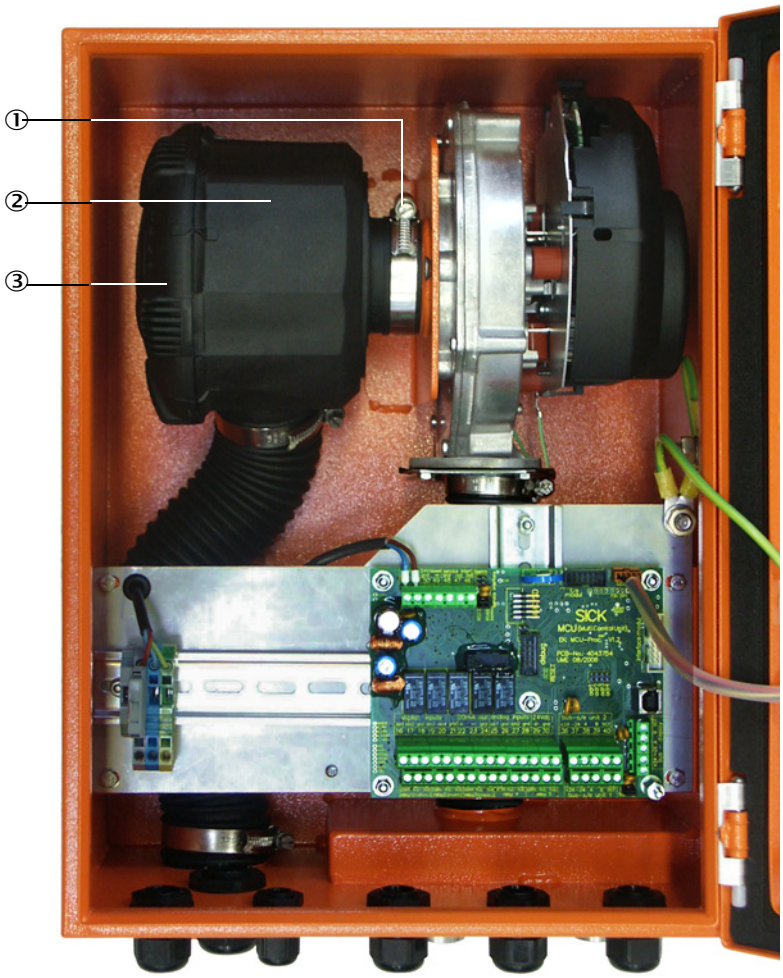
- ▶ Open the door of the MCU with the appropriate key.
- ▶ Loosen strap retainer (1) on the filter outlet and pull filter housing (2) off the connection piece.
- ▶ Remove the filter housing.
- ▶ Rotate filter housing cover (3) in the “OPEN” arrow direction and remove the cover.
- ▶ Take out the filter element and replace with a new element.
- ▶ Clean the inside of the filter housing and the filter housing cover with a cloth and brush.

NOTICE:

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

- ▶ Insert new filter element.
  Spare part: Filter element C1140, Part No. 7047560
- ▶ Mount the cover on the filter housing cover and rotate opposite to the direction of the arrow until it clicks into place.
- ▶ Reinstall the filter housing in the control unit.

Fig. 67: Exchanging the filter element for the control unit with purge air supply



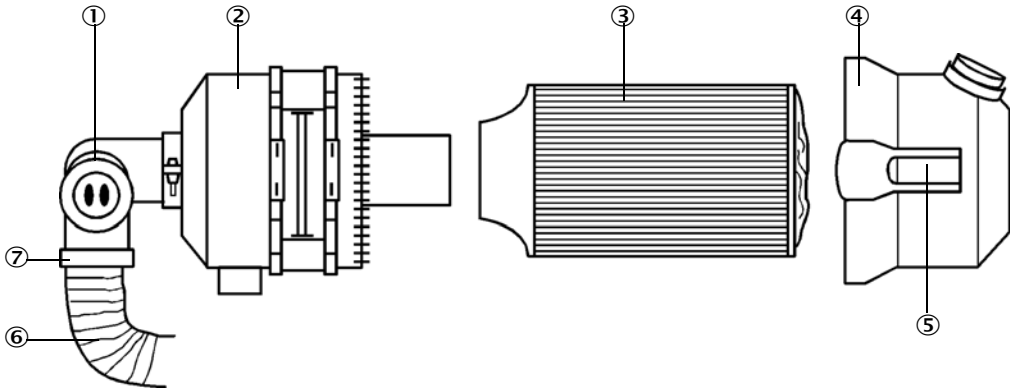
① Strap retainer
② Filter housing
③ Filter housing cover

5.3.2 Optional external purge air unit

NOTICE:
The purge air unit must be serviced at the latest when the low-pressure monitor (7) at the filter outlet triggers (see “Replacing the filter element”, page 102).

Replacing the filter element

Fig. 68: Replacing the filter element



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

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

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

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

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

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

5.4 Shutdown

The measuring system must be shut down:

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

NOTICE:
Never switch off or interrupt the purge air supply when the sender/receiver unit and reflector/scattered light receiver are fitted on the duct.

Work to be performed

- ▶ Loosen the connection line to the MCU.
- ▶ Dismantle the sender/receiver unit and reflector/scattered light receiver from the duct.

WARNING: Hazard through gas and hot parts
- ▶ Observe the relevant safety regulations as well as the safety notices in Section 1 during all disassembly work.
- ▶ Only remove the sender/receiver unit and reflector/scattered light receiver on equipment with hazard potential (higher internal duct pressure, hot or aggressive gases) when the equipment is at a standstill.
- ▶ Take suitable protection measures against possible local hazards or hazards arising from the equipment.
- ▶ Secure switches that should not be switched on again for safety reasons with signs and safeguards to prevent unintentional switching.

- ▶ Close off the flange with tube with a blind plug.
- ▶ Switch off the purge air supply
- ▶ Loosen the hose clamps and pull the purge air hose off the connections and secure the hose ends against dirt and moisture
- ▶ Disconnect the MCU control unit from the supply voltage.

Storage

- ▶ Store dismantled device parts in a clean, dry location.
- ▶ Use suitable auxiliary means to protect the connection line plug connectors against dirt and moisture.
- ▶ Secure purge air hoses against penetration by dirt and moisture.

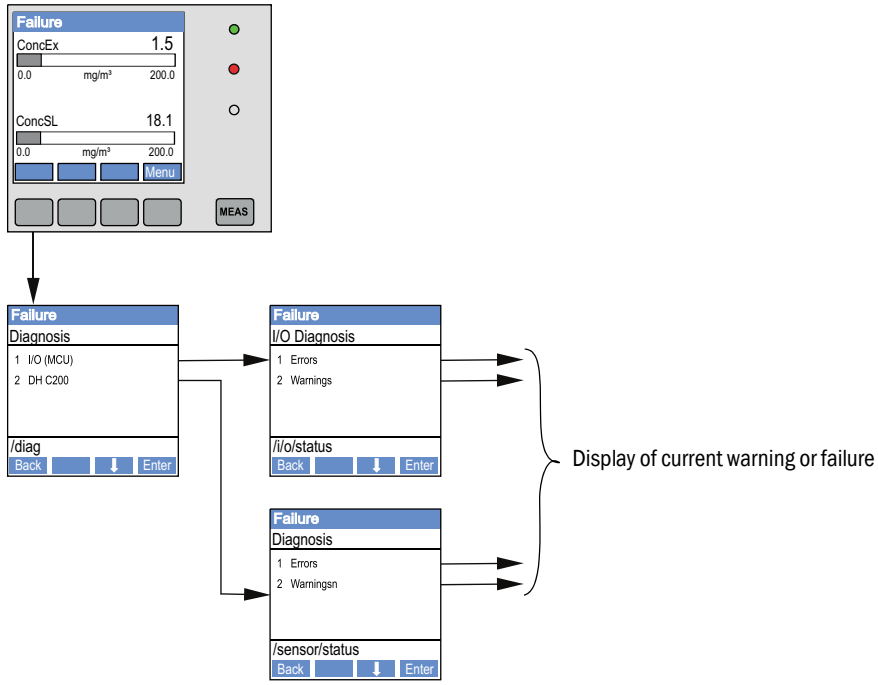
6 Troubleshooting

6.1 General

Warning or error messages are output as follows:

- On the MCU, the respective relay is switched on (see “Standard connection”, page 50).
- Maintenance requ.” or “Failure” is displayed in the status bar of the LC-Display. In addition, the respective LED goes on (“MAINTENANCE REQUEST” for warnings, “FAILURE” for errors).
  After pressing the button “Diag”, possible causes are shown as short information in the menu “Diagnosis” after selecting the device (“MCU” or “DH C200”).

Figure 69 Display on the LC-Display



“Diagnosis / Error messages/warnings” provides detailed information on the current device state. To display, connect the measuring system to SOPAS ET and start the device file “DH C200” or “MCU”.

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 error messages in SOPAS ET”, page 105).

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

	Warning messages do not imply a malfunction of the measuring system. The current measured value continues to be output on the analog output.
	See the Service Manual for a detailed description of messages and options for clearance.

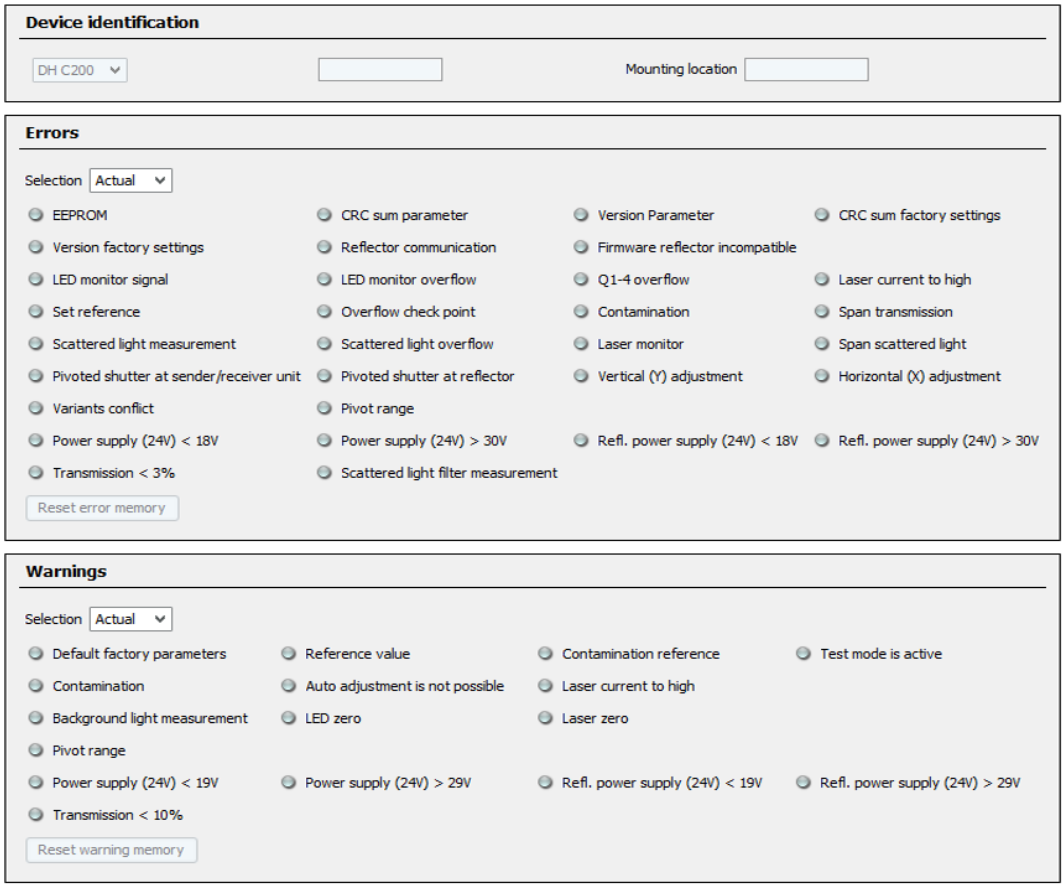
6.2 Sender/receiver unit

Malfunctions

Symptom	Possible cause	Action
• LEDs of the sender/receiver are not on • No sender light beam	• No supply voltage • Connection line not connected correctly or defective • Defective plug connector	▶ Check plug connectors and lines. ▶ Contact SICK Customer Service.

Warning and error messages in SOPAS ET

Fig. 70: SOPAS ET menu: DH C200/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 “Error selection” or “Warnings selection” window.

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

Malfunctions listed below can probably be cleared onsite.

Message	Significance	Possible cause	Action
Reflector communication	No connection between sender/receiver unit and reflector	• Connection line not connected or not connected correctly • Defective connection line • Defective reflector/scattered light receiver • RS485 interface of the sender unit defective	▸ Check the connection line ▸ Contact SICK Customer Service.
LED monitor overflow	Overmodulation of the monitor channel during scaling	Incorrect alignment of the optical axes of sender/receiver unit and reflector	▸ Check/correct alignment. ▸ Repeat scaling
Q1-4 overflow	Group signal of quadrant measurement too high	• Measuring system not scaled • Changed alignment of optical axes • Reduced active measuring path	▸ Scale measuring system. ▸ Check/correct alignment. ▸ Contact SICK Customer Service.
Set reference	Scaling not possible	Measurement or monitor signal too low (contamination, incorrect alignment)	▸ Check/correct alignment. ▸ Clean the optical surfaces (see “Maintenance on the sender/receiver unit and reflector/scattered light receiver”, page 94).
Contamination	Contamination value is higher than the permitted limit value (see “Technical Data”, page 111)	• Deposits on the optical interfaces • Unclean purge air	▸ Clean the optical surfaces (see “Maintenance on the sender/receiver unit and reflector/scattered light receiver”, page 94). ▸ Check purge air filter (see “Cleaning the optical interfaces on the reflector”, page 98). ▸ Contact SICK Customer Service.
Power supply (24 V) < 18 V Power supply (24 V) < 19 V	Supply voltage too low	• Line provided by customer does not match the specification (see “Connecting the MCU control unit”, page 47) • Voltage loss on the connection line (core cross-section too low in relation to the line length)	▸ Check the connection line ▸ Contact SICK Customer Service.

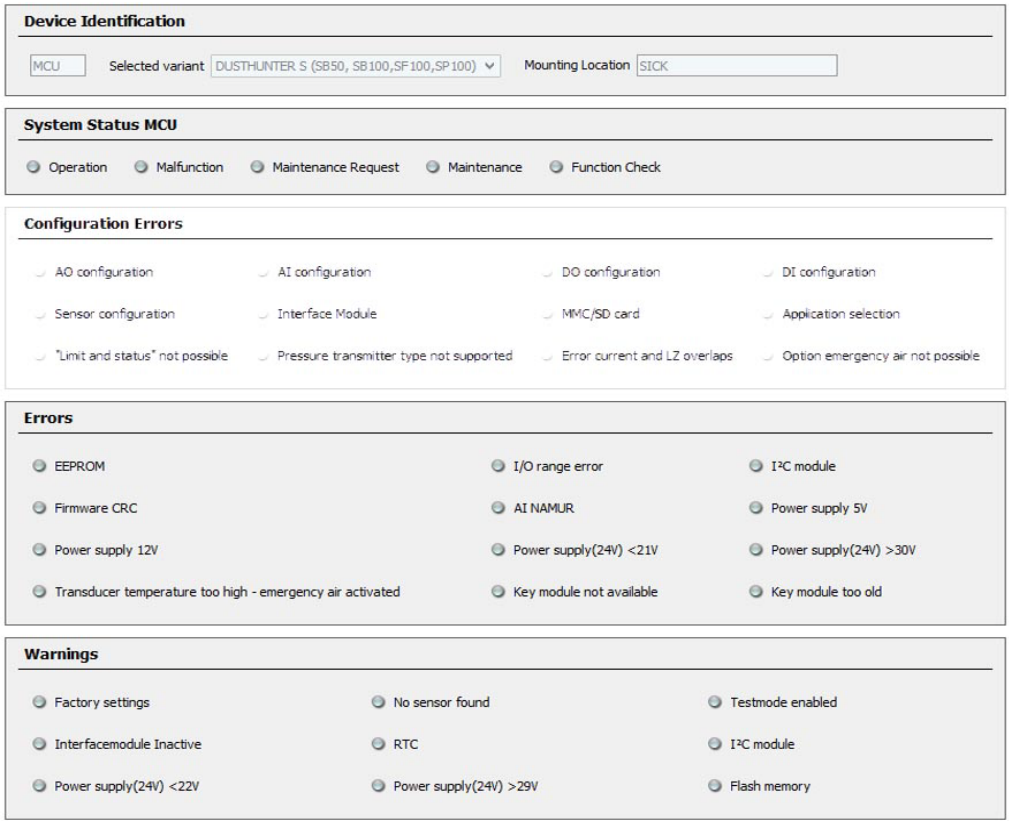
6.3 MCU control unit

6.3.1 Malfunctions

Symptom	Possible cause	Action
No display on the LCD	• No supply voltage • Connection line to LC-Display not connected or damaged • Defective fuse	▶ Check voltage supply. ▶ Check the connection line ▶ Exchange fuse. ▶ Contact SICK Customer Service.

6.3.2 Warning and error messages in the SOPAS ET program

Fig. 71: 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

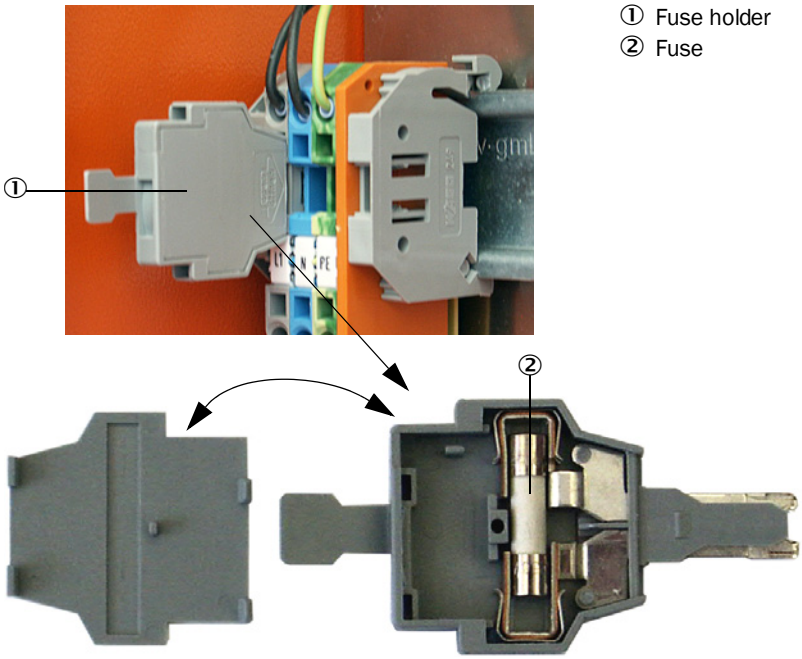
Malfunctions listed below can probably be cleared onsite.

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 71). ▶ Contact SICK Customer 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 74). ▶ Contact SICK Customer Service.
Interface Module	No communication via Interface module	• No parameters set for module • Connection error • Module failure	▶ Check configuration (see “Setting the Ethernet module parameters”, page 83). ▶ Contact SICK Customer Service.
No sensor found	Sender/receiver unit was not recognized	• Communication problems on RS485 line • Supply voltage problems	▶ Check system settings. ▶ Check the connection line ▶ Check voltage supply. ▶ Contact SICK Customer Service.
Variant configuration error	MCU setting does not match the connected sensor	Sensor type has been changed	▶ Correct application settings (see “Assigning the MCU to the sender/receiver unit”, page 68).
Testmode enabled	MCU in “Test” mode.		▶ Deactivate “System Test” mode (“Maintenance” directory)

6.3.3 Replacing the fuse

- Control unit MCU must be disconnected from the power supply and potential-free.
- Open the door of the MCU, remove and open fuse holder (1).
- Replace the defective fuse (2) (see “Miscellaneous”, page 123).
- Close and attach the fuse holder.
- Close the door and connect power voltage.

Fig. 72: Replacing the fuse



① Fuse holder
② Fuse

7 Specifications

7.1 Compliances

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

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

Applied EN standards:

- EN 61010-1, Safety requirements for electrical equipment for measurement, control and laboratory use
- EN 61326, Electrical equipment for measurement technology, control technology and laboratory use - EMC requirements
- EN 14181, Stationary source emissions - Quality assurance of automated measuring systems

Electrical protection

- Insulation: Protection class 1 according to EN 61010-1.
- Insulation coordination: Measuring category II according to EN 61010-1.
- Contamination: The device operates safely in an environment up to degree of contamination 2 according to EN 61010-1 (usual, not conductive contamination and temporary conductivity by occasional moisture condensation).
- Electrical energy: The wiring system to the power supply voltage of the system must be installed and fused according to the relevant regulations.

Approvals

DUSTHUNTER C200 is performance-tested according to EN 15267 and may be used for continuous emission monitoring in plants requiring approval and plants according to EU Directives.

7.2 Technical Data

Measuring Parameters		
Measured variable	Transmission, opacity, relative opacity, extinction, scattered light intensity, dust concentration	
Measuring range (freely adjustable)	Min.	Max.
• Transmission	100 ... 90%	100 ... 0%
• Opacity	0 ... 10%	0 ... 100%
• Relative opacity	0 ... 10%	0 ... 100%
• Extinction	0 ... 0,045	0 ... 2
• Dust concentration	Scattered light measurement	
	0 - 5 mg/m³	0 - 200 mg/m³
	Transmission measurement (depending on active measuring path and particle characteristics; see special graphics)	
	0 - 200 mg/m³	0 ... 10,000 mg/m³
Measurement uncertainty [1]	± 2%	
Response time	1 ... 600 s; freely selectable	
Measuring Conditions		
Distance flange - flange [2]	with reflector/scattered light receiver DHC-R0 with reflector/scattered light receiver DHC-R1	0.5 ... 3 m 2.5 ... 8 m
Effective active measuring path (scattered light measurement) [3]	with reflector/scattered light receiver DHC-R0 with reflector/scattered light receiver DHC-R1	Approx. 0,1 m Approx. 0,3 m
Swivel error [4]	0.2% transmission	
Gas temperature (above dew point)	-40 ... 300 °C	Higher on request
Sample gas pressure	-50 hPa ... +2 hPa -50 hPa... +30 hPa	MCU-P control unit Optional external purge air unit
Ambient temperature	-40 ... +60°C -40 ... +45°C	Sender/receiver unit, reflector/scattered light receiver, MCU-N control unit MCU-P control unit, intake temperature for purge air
Function Check		
Automatic self-test	Linearity, drift, aging, contamination Contamination limit value: From 30% warning: From 40% failure	
Manual linearity check	Using a reference filter	
Output Signals		
Analog output	3 outputs 0/2/4 ... 22 mA, max. load 500 W (standard output max. 750 W); resolution 10 bits; electrically isolated 2 further analog inputs when using an Analog Input module (option, see “MCU control unit”, page 23)	
Relay outputs	5 potential-free outputs (changeover contacts) for status signal; load 48 V, 1 A	
Input signals		
Analog input	2 inputs 0...20 mA (standard; without electric isolation); resolution 10 bits 2 further analog inputs when using an Analog Input module (option, see “MCU control unit”, page 23)	
Digital input	4 inputs to connect potential-free contacts (e.g., for external maintenance switch, triggering function check);	
Communication Interfaces		
USB 1.1, RS 232 (on terminals)	For measured value inquiries and software updates per PC/laptop using the operating program	
RS485	For connection of sender/receiver unit	
Optional Interface module	To communicate with the Host PC, optional for Profibus, Ethernet	

1): In temperature range - 20 °C ... +50 °C
2): Upper limits only with distortion-free fitting
3): see “Measuring principle with transmission and scattered light measurement with forward dispersion”, page 11
4): With swivel angle ± 0.3 °; total swivel range ±1 °

Power supply		
MCU control unit	Voltage supply: Power consumption:	90...250 V AC, 47...63 Hz; opt. 24 V DC ± 2 V Max. 30 W without purge air supply Max. 70 W with purge air supply
Sender/receiver unit	Voltage supply: Power consumption:	24 V from MCU control unit Max. 17 W
Optional external purge air unit (with blower 2BH13)	Voltage supply: Rated current: Motor rating:	200 ... 240 V/345...415 V at 50 Hz; 220...275 V/380...480 V at 60 Hz 2.6 A/Y 1.5 A 0.37 kW at 50 Hz; 0.45 kW at 60 Hz
MCU connection line	Shielded lines with twisted pairs (e.g., UNITRONIC LiYCY (TP) 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).	
Weight		
Sender/receiver unit	9.5 kg	
Reflector/scattered light receiver	8.0 kg 12.0kg	DHC-R0 DHC-R1
MCU control unit	13.5 kg 4.5 kg	MCU-P MCU-N
Optional external purge air unit	14 kg	
Miscellaneous		
Protection class	IP 66 IP 54	Sender/receiver unit, reflector/scattered light receiver, MCU control unit Optional external purge air unit
Connection line length	5 m, 10 m, 20 m 5)	Other lengths on request
Purge air hose length	5 m, 10 m	Other lengths on request
Sender LED	White light, wavelength between 450 nm and 700 nm	
Laser	Degree of protection 2; capacity < 1 mW; wavelength between 640 nm and 660 nm	
Purge air feed volume	Max. 20 m^3/h Max. 63 m^3/h	MCU-P control unit Optional external purge air unit

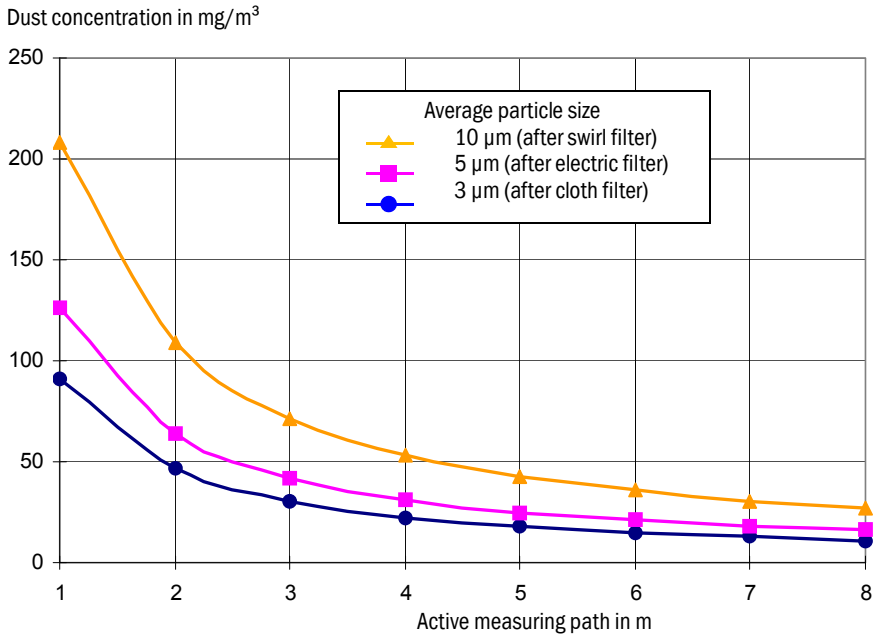
5): for connection of reflector/scattered light receiver to sender/receiver unit

7.2.1 Dust concentration measuring range

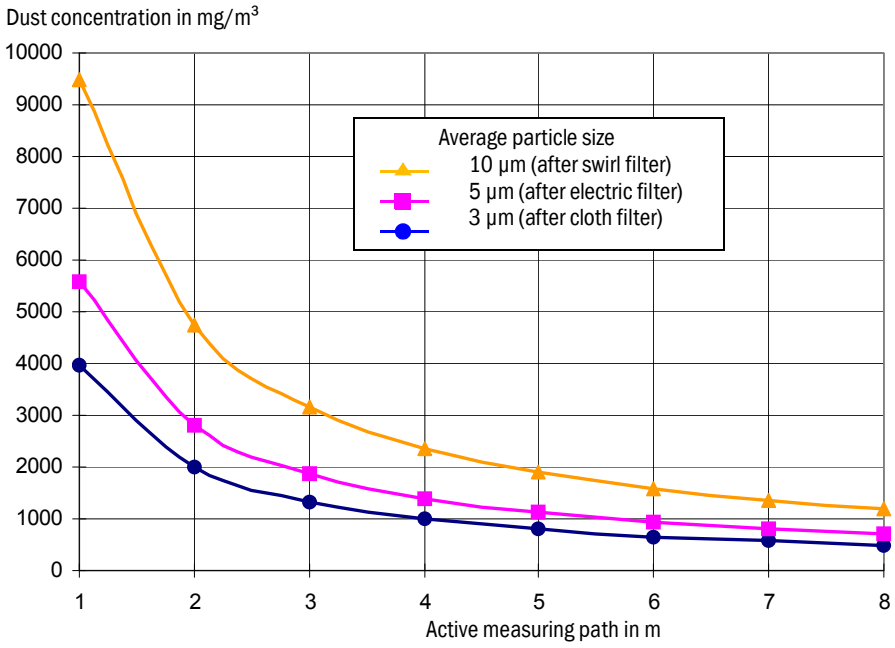
The limits for the smallest/largest measuring range depend on the extinction measuring range, active measuring path and optical particle characteristics. Therefore exact range limits cannot be specified here. The following charts can be used to estimate the ranges used. These have been determined based on SICK's many years of experience and are valid assuming constant particle size and characteristics.

Fig. 73: Measuring ranges for dust concentration measurement based on extinction

Smallest measuring range



Largest measuring range

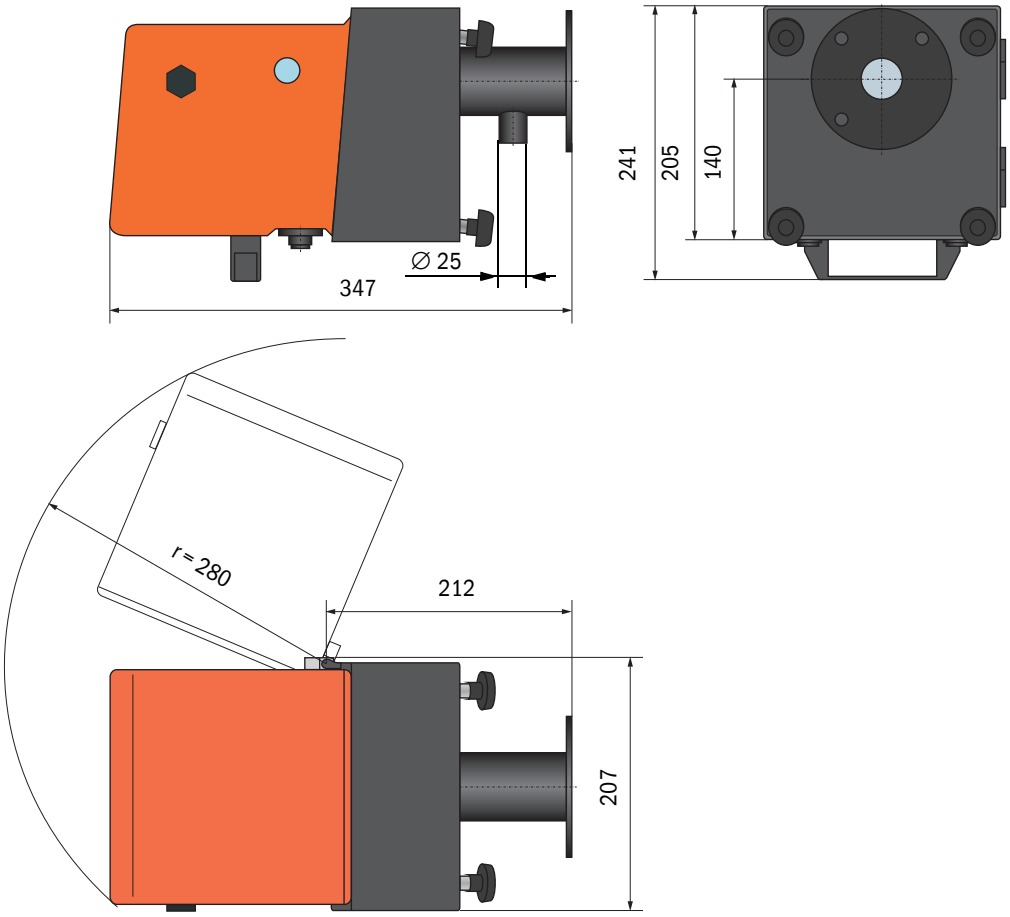


7.3 Dimensions, part Nos.

All measures are specified in mm.

7.3.1 Sender/receiver unit

Fig. 74: Sender/receiver unit

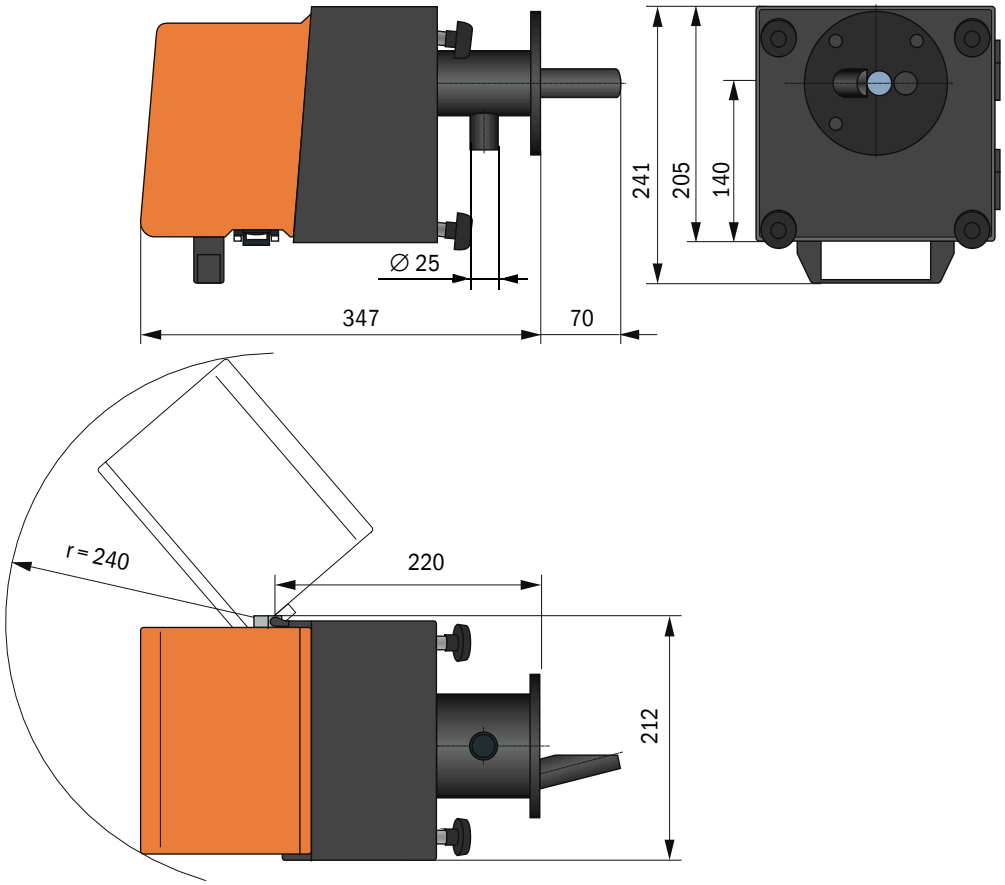


Designation	Part No.
Sender/receiver unit DHC-T	1044863

7.3.2 Reflector/scattered light receiver

Reflector/scattered light receiver DHC-R0 for short measuring paths

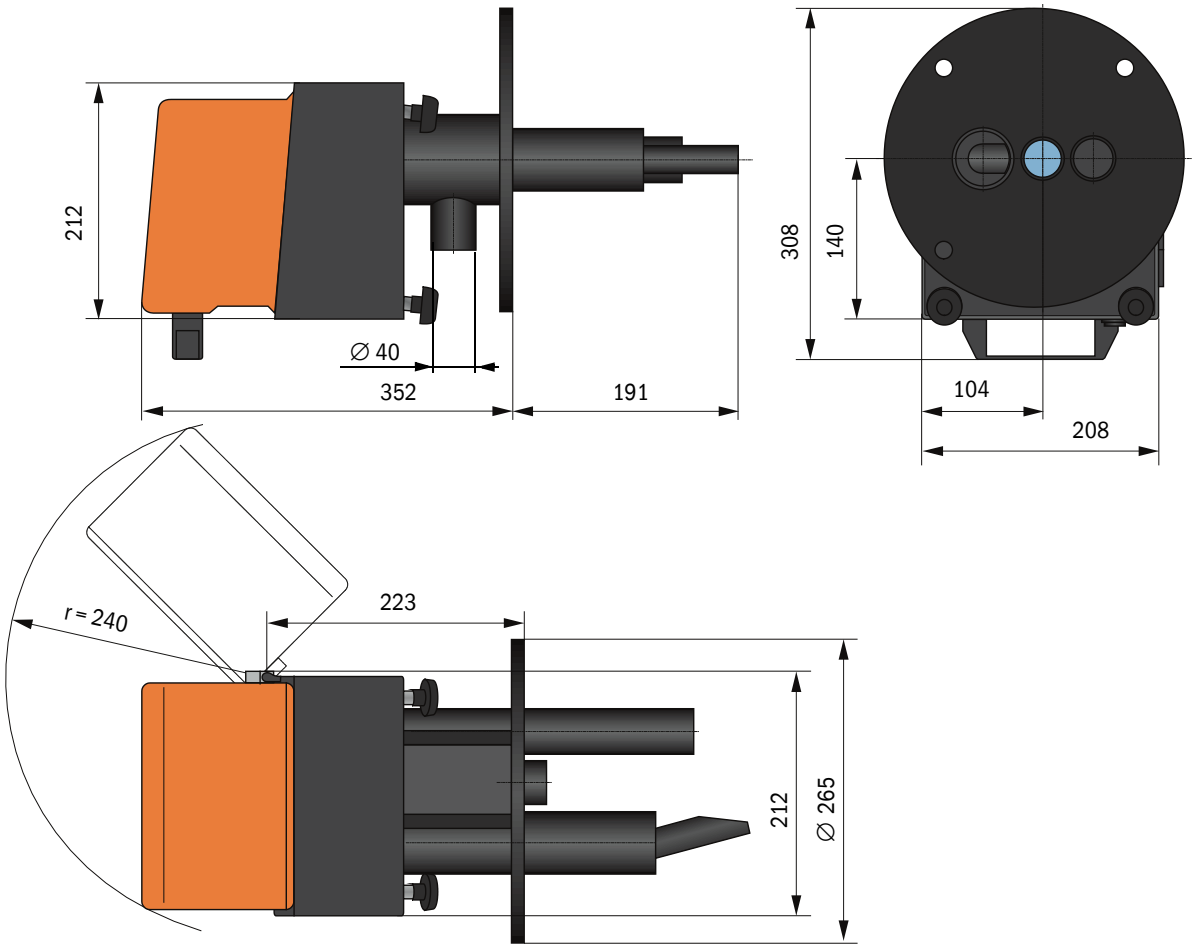
Fig. 75: Reflector/scattered light receiver DHC-R0



Designation	Part No.
Reflector/scattered light receiver DHC-R0	1044864

Reflector/scattered light receiver DHC-R1 for long measuring paths

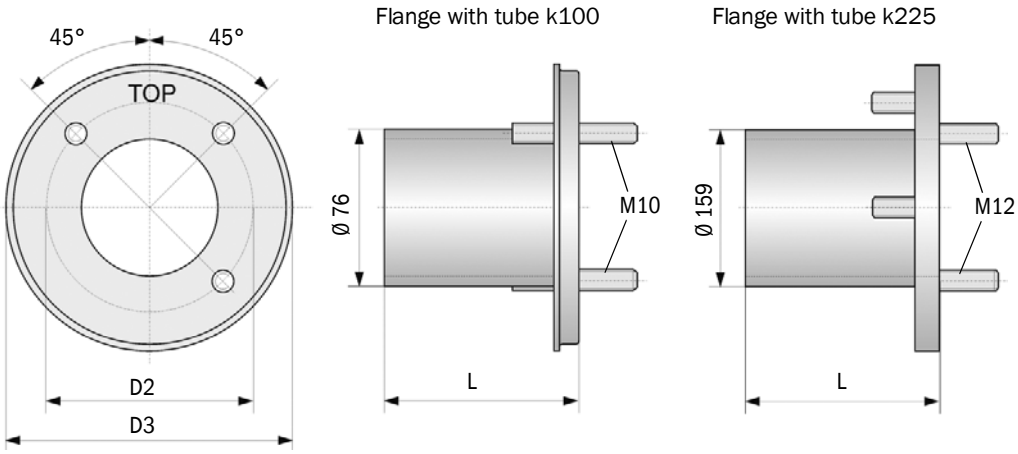
Fig. 76: Reflector/scattered light receiver DHC-R1



Designation	Part No.
Reflector/scattered light receiver DHC-R1	1044865

7.3.3 Flange with tube

Fig. 77: Flange with tube



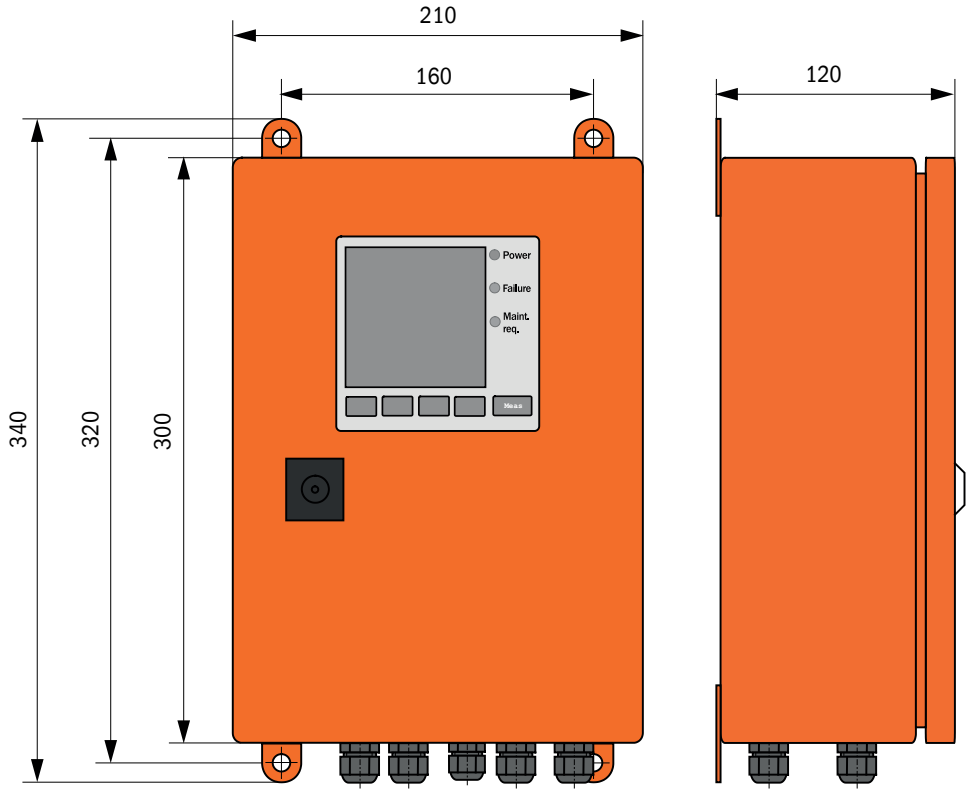
Dimen-sion	Flange with tube	
	k100	k225
D2	Ø 100	Ø 225
D3	Ø 130	Ø 265
L	110, 130, 240, 500	350

Designation	Part No.	Usage on
Flange type k100		
Flange with tube, Di = 70.2 Length 130 mm, St37	2017845	DHC-T
Flange with tube, Di = 70.2 Length 240 mm, St37	2017847	
Flange with tube, Di = 70.2 Length 500 mm, St37	2017849	
Flange with tube, Di = 70.2 Length 130 mm, 1.4571	2017846	
Flange with tube, Di = 70.2 Length 240 mm, 1.4571	2017848	
Flange with tube, Di = 70.2 Length 500 mm, 1.4571	2017850	
Flange with tube, Di = 70.2 Length 110 mm, St37	2054535	DHC-R0
Flange with tube, Di = 70.2 Length 110 mm, 1.4571	2054536	
Flange type k225		
Flange with tube, Di = 152 Length 350 mm, St37	2045418	DHC-R1
Flange with tube, Di = 152 Length 350 mm, 1.4571	2045420	

7.3.4 MCU control unit

MCU-N control unit and MCU remote control unit without integrated purge air supply

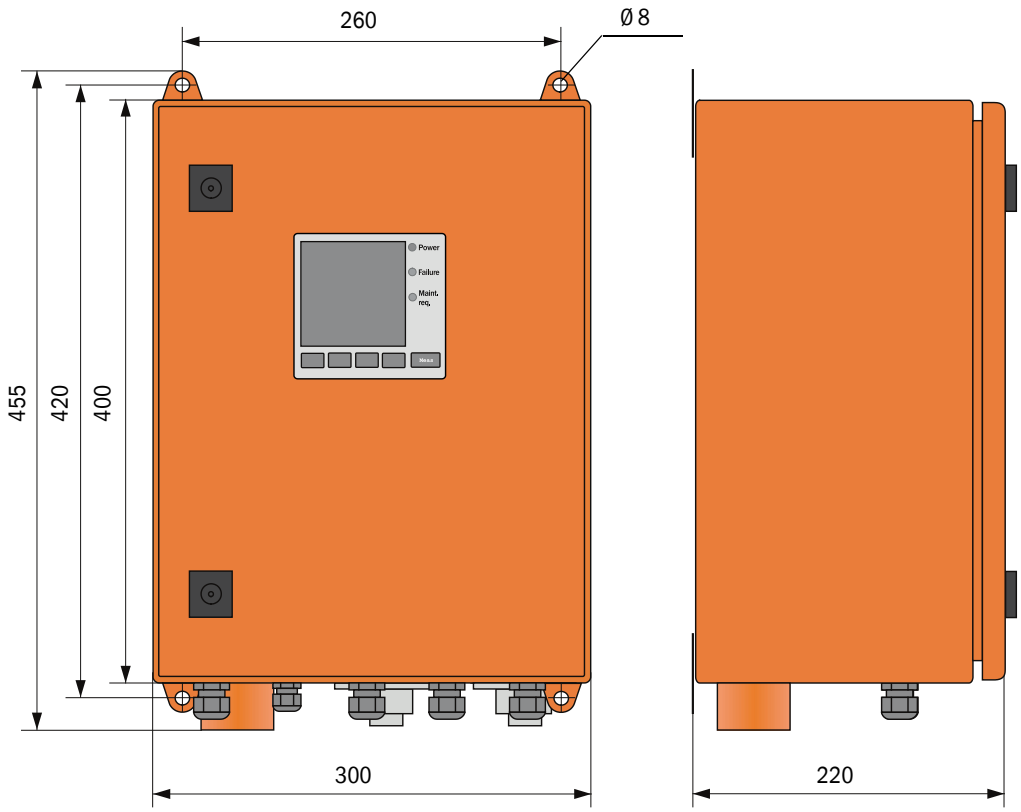
Fig. 78: MCU-N control unit



Designation	Part No.
Control unit MCU-NW0DN01000NNNE in wall-mounted enclosure (orange), Supply voltage 90 ... 250 V AC, without purge air unit, with display	1045001
Control unit MCU-N20DN01000NNNE in wall-mounted enclosure (orange), Supply voltage 24 V DC, without purge air unit, with display	1045003
MCU remote control unit without power supply unit	2075567
MCU remote control unit with power supply unit	2075568

MCU-P control unit with integrated purge air supply

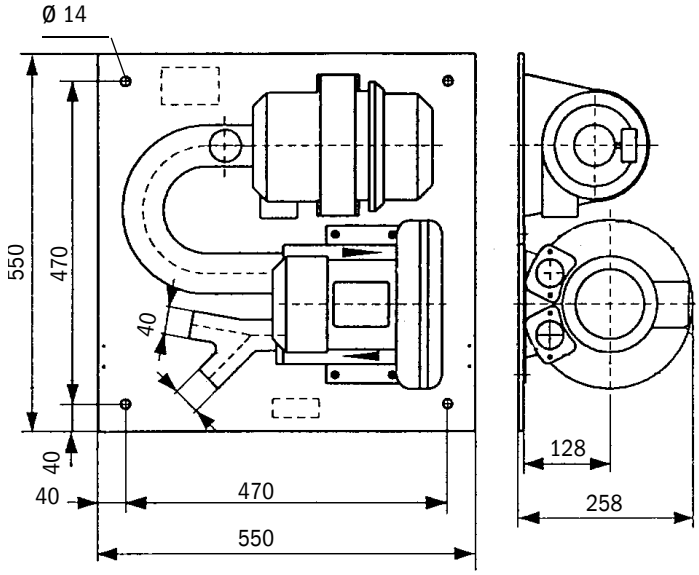
Fig. 79: MCU-P control unit



Designation	Part No.
Control unit MCU-PWODN01000NNNE in wall-mounted enclosure (orange), Supply voltage 90 ... 250 V AC, with purge air unit, with display	1045002
Control unit MCU-P2ODN01000NNNE in wall-mounted enclosure (orange), Supply voltage 24 V DC, with purge air unit, with display	1045004

7.3.5 Optional external purge air unit

Fig. 80: Optional external purge air unit

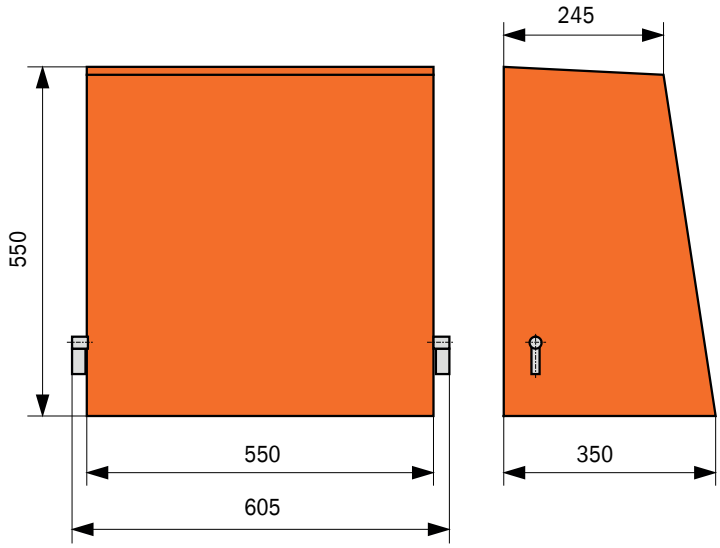


Designation	Part No.
Purge air unit with blower 2BH13 and purge air hose, length 5 m	1012424
Purge air unit with blower 2BH13 and purge air hose, length 10 m	1012409

7.3.6 Weatherproof covers

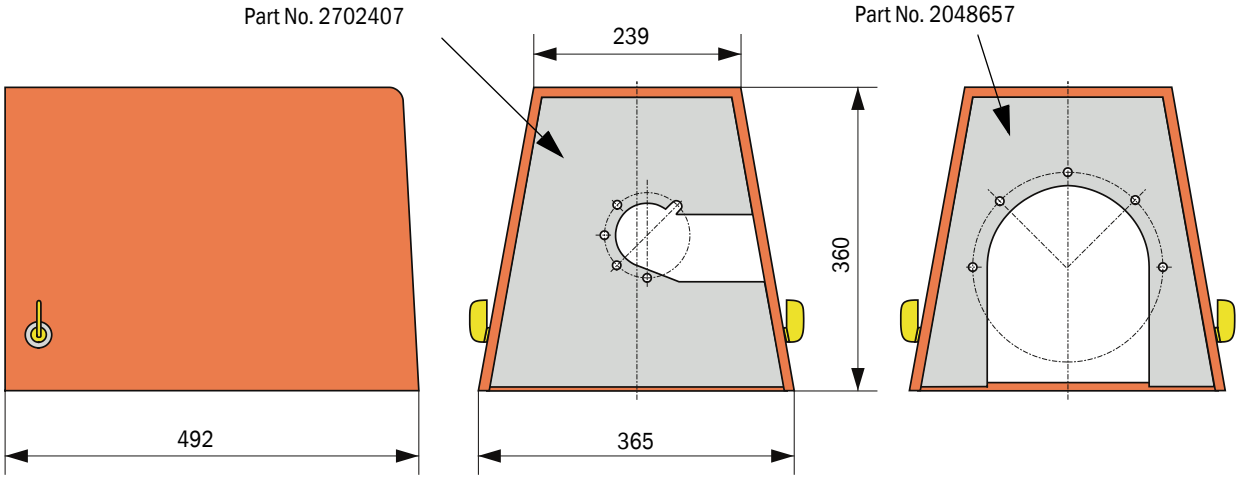
Weatherproof cover for external purge air unit

Fig. 81: Weatherproof cover for external purge air unit



Designation	Part No.
Weatherproof cover for purge air unit	5306108

Fig. 82: Weatherproof cover for analyzer



Designation	Part No.	Usage on
Weatherproof cover for analyzer	2702407	DHC-T, DHC-R0
Weatherproof cover flange k225	2048567	DHC-R1

7.4 Accessories

7.4.1 Line sender/receiver unit - MCU

Designation	Part No.
Connection line, length 5 m	7042017
Connection line, length 10 m	7042018

7.4.2 Line from sender/receiver unit to reflector/scattered light receiver

Designation	Part No.
Connection line, length 5 m	2045416
Connection line, length 10 m	2045417
Connection line, length 20 m	2048674

7.4.3 Purge air supply

Designation	Part No.
Purge air hose DN 40, sold by the meter	5304683
Purge air hose DN 25, length 5 m	2046091
Purge air hose DN 25, length 10 m	7047536
Adapter 40-25	7047814
Hose clamp D20-32	7045039
Hose clamp D32-52	5300809

7.4.4 Assembly parts

Designation	Part No.
Assembly kit, flange - analyzer (for sender/receiver unit and reflector/scattered light receiver DHC-R0)	2018183
Assembly kit receiver (for reflector/scattered light receiver DHC-R1)	2060477

7.4.5 Device check accessories

Designation	Part No.
Check filter set	2048676
Adjusting stand	2042907

7.4.6 Options for MCU control unit

Designation	Part No.
Analog input module, 2 channels, 100 W, 0/4...22 mA, electrically isolated	2034656
Module carrier (for one each AI or AO module)	6028668
Connection line for optional I/O modules	2040977
Interface, Profibus module DP V0	2048920
Interface module Ethernet type 1	2055719

7.4.7 Miscellaneous

Designation	Part No.
Optical adjusting device for flange assembly	1700462
Cover	2052377
Fuse set T 2 A (for MCU with power voltage supply)	2054541
Fuse set T 4 A (for MCU with 24 V supply)	2056334

7.5 Consumable parts for 2-years operation

7.5.1 Sender/receiver unit and reflector

Designation	Number	Part No.
Sealing tape	4	4704676
Sealing tape 235x50x2 (for DHC-R1)	2	4058792

7.5.2 MCU with integrated purge air supply

Designation	Number	Part No.
Filter element C1140	4	7047560
Optics cloth	4	4003353

7.5.3 Optional external purge air unit

Designation	Number	Part No.
Filter element Micro-Topelement C11 100	4	5306091
Optics cloth	4	4003353

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