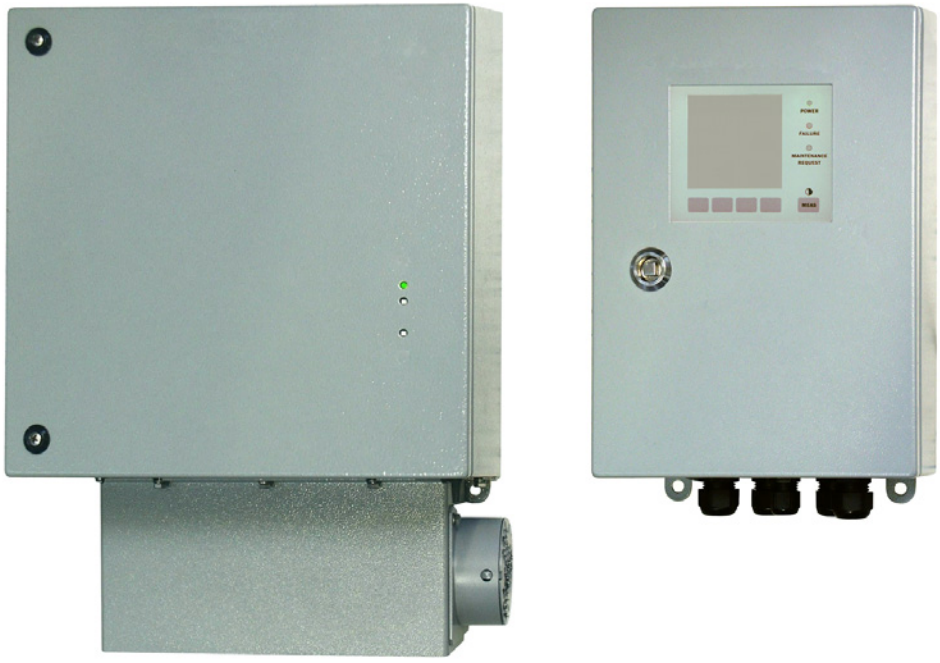
Operating Instructions
VICOTEC450

Visibility Measurement System



Endress+Hauser
People for Process Automation

Described product
Product name: VICOTEC450

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

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CE

Warning symbols


Hazard (general)


Hazard by voltage


Hazard by laser radiation

Warning levels / signal words

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

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

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

NOTICE
Hazard which *could* result in property damage.

Information symbols


Important technical information for this product


Supplementary information


Link to information at another place

VICOTEC450

1 Important information

Main hazards

Intended use

Responsibility of user

Using the VICOTEC450 for safety-critical measuring tasks (fire detection and signalisation)

1.1 Main hazards

1.1.1 Hazards through electrical equipment

The VICOTEC450 measuring system is operational equipment for use in industrial high voltage plants.

WARNING: Danger through mains voltage

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

1.1.2 Hazards through laser beam

The measuring unit of the VICOTEC450 contains a class 2 laser (eye-safe).

WARNING: Hazards through laser beam

- ⊗ Never look directly into the beam path
- ⊗ Do not point the laser beam at persons
- ► Prevent damaging reflections of the laser beam by reflective parts
- ► Do not operate the laser module outside the measuring unit.

1.2 Intended use

Purpose of the device

The VICOTEC450 measuring system serves for continuous visibility measurement in traffic tunnels.

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.

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1.3 Responsibility of user

1.3.1 General information

Designated users

The VICOTEC450 measuring system may only be operated by skilled technicians who, based on their technical training and knowledge as well as knowledge of the relevant regulations, can assess the tasks given and recognize the hazards involved.

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.

1.3.2 Safety information and protective measures

Protection devices

> ***NOTICE:***
> Suitable protection devices and safety equipment for persons must be available according to the respective hazard potential and be used by the personnel.

Preventive measures for operating safety

> ***NOTICE:***
> 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 (e.g. heavy contamination)
- Significant drifts in measured results
- Increased power consumption
- Higher temperatures of system components
- Monitoring devices triggering
- Smells or smoke emission

Avoiding damage

> ***NOTICE:***
> The operator must ensure the following to avoid malfunctions that can indirectly or directly lead to injuries to persons or material damage:
> - ► The responsible maintenance personnel are 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.

1.4 Using the VICOTEC450 for safety-critical measuring tasks (fire detection and signalisation)

The plant operator is always responsible for plant safety. Special attention should be paid to the following points:

- Plants with safety risks must always be redundantly monitored by suitable metrological equipment. Therefore the VICOTEC450 may not be used as the only link in a safety chain.
- The operator is **always** responsible for any switching thresholds or definition of switching criteria.
- Precautions have to be taken in good time to ensure safe operation of the plant during times when the VICOTEC450 is not available (e.g. during maintenance or repair).
- Endress+Hauser does not assume any liability for damage resulting from a possible device malfunction.

VICOTEC450

2 Product description

VICOTEC450 mode of operation
Device components

2.1 VICOTEC450 mode of operation

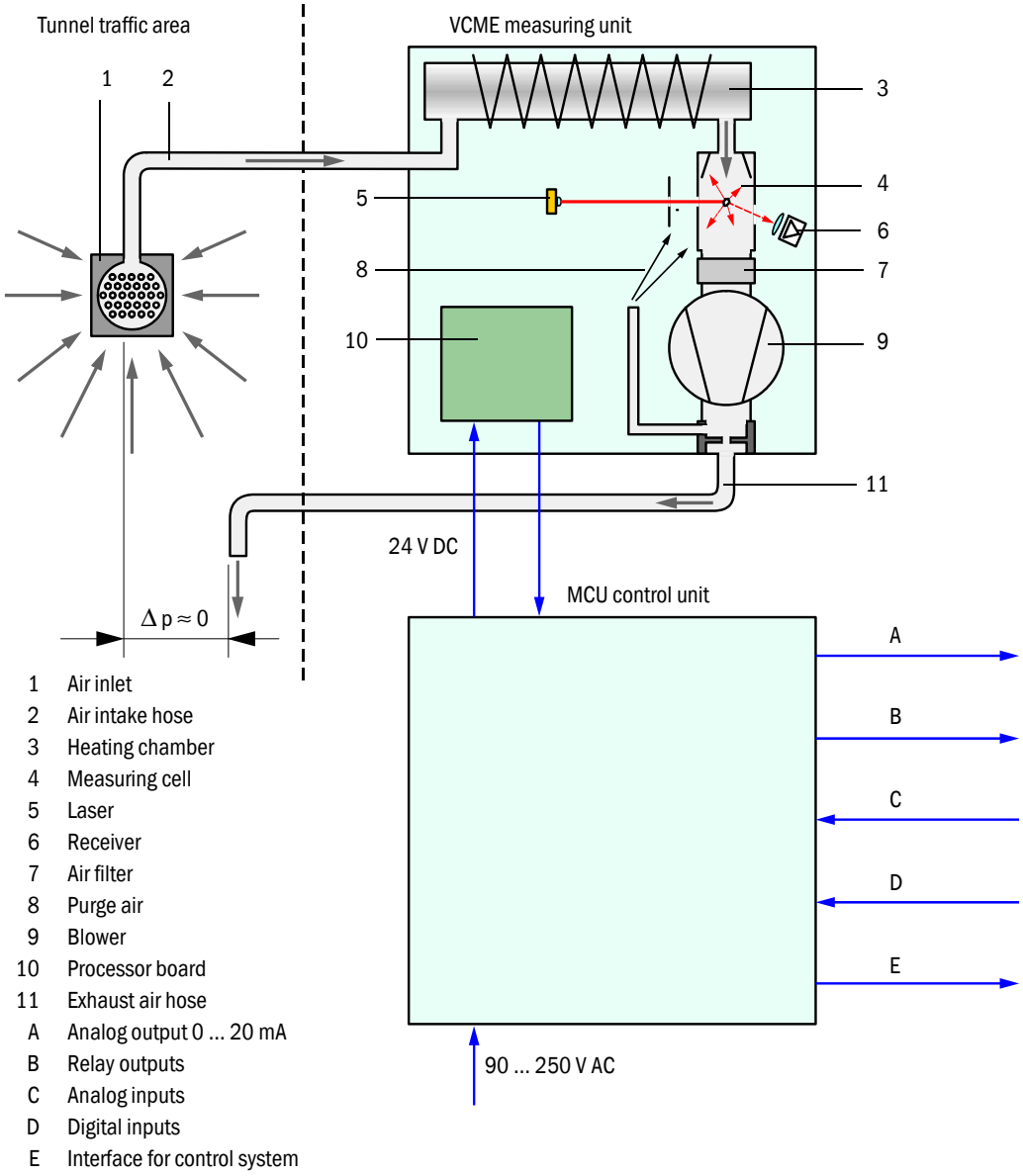
2.1.1 Functional principle

The VICOTEC450 runs as extractive system with in-situ measurement features.

Version with fog elimination.

An air flow is suctioned from the traffic area in the tunnel via an air intake hose and then fed to a heating chamber where it is heated to the point where any existing water drops (fog) are vaporized. The measuring air is fed to the measuring cell in which the scattered light intensity, as measure for the visibility, is determined using a laser. The measuring air is conveyed by a blower. An air filter is fitted before the blower to prevent deposits in the blower and to lengthen its service life. Apart from that, a partial flow of the clean air is guided to the optics to keep these clean. The air flow rate is set at the factory and continuously monitored by an integrated flow rate measurement.

Figure 1 VICOTEC450 basic layout (shown with fog elimination)

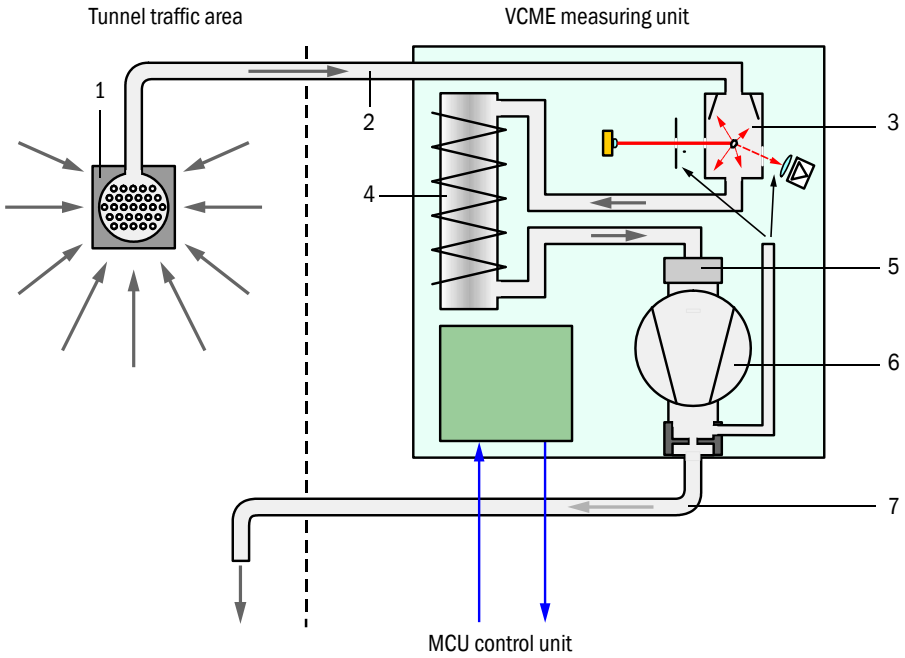


1 Air inlet
2 Air intake hose
3 Heating chamber
4 Measuring cell
5 Laser
6 Receiver
7 Air filter
8 Purge air
9 Blower
10 Processor board
11 Exhaust air hose
A Analog output 0 ... 20 mA
B Relay outputs
C Analog inputs
D Digital inputs
E Interface for control system

Version without fog elimination

In some cases, it can be necessary to include fog in the measurement. To realize this, the air sucked from the tunnel traffic area is first passed to the measuring chamber. The air is then passed to the heating chamber and then on to the air filter and blower. Heating the measuring air prevents moisture making the air filter ineffective in a short time.

Figure 2 Basic layout of a measuring unit without fog elimination

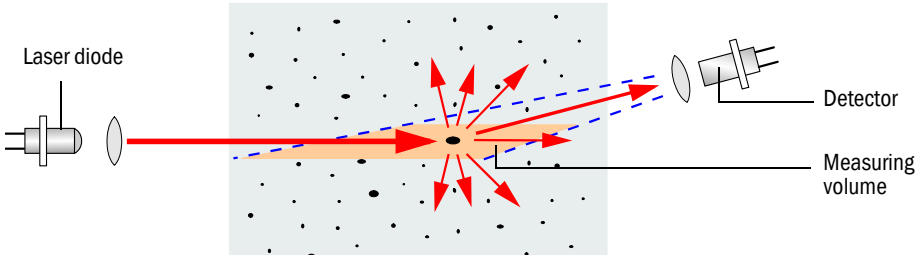


1 Air inlet
2 Air intake hose
3 Measuring cell
4 Heating chamber
5 Air filter
6 Blower
7 Exhaust air hose

2.1.2 Scattered light measurement principle

The VICOTEC450 operates according to the scattered light measurement principle (forward scattering). The extreme sensitivity of this principle makes it particularly suitable for measuring very small particle concentrations.

Figure 3 Scattered light measurement principle



A laser diode beams the dust particles in the measuring air flow with modulated light in the visual range (wavelength approx. 650 nm). The light scattered by the particles is recorded by a highly sensitive detector, electrically amplified and passed to the measuring channel of a microprocessor as central part of the measuring, control and evaluation electronics. The measuring volume in the measuring cell is defined by the intersection between the transmitted beam and the receiver aperture.

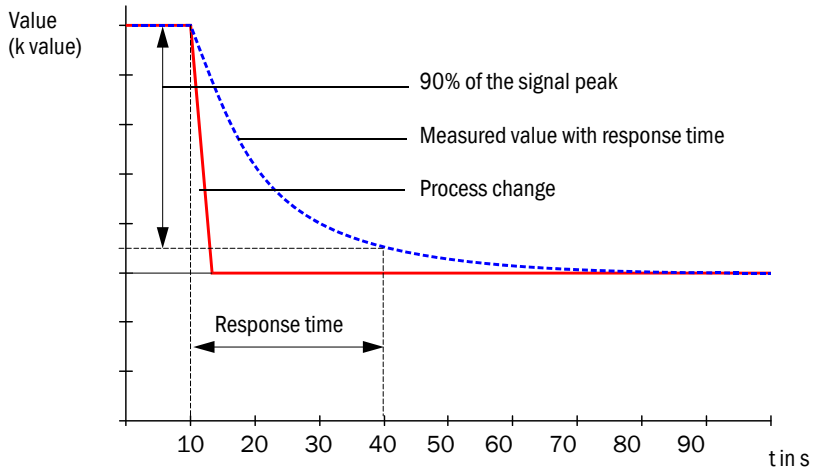
The smallest brightness changes of the laser beam emitted are detected by continuous monitoring of the sender level (partial beam to monitor receiver) and then used during measuring signal determination

The primary measured variable of scattered light intensity is almost proportional to particle concentration. The scattered light intensity is converted in the device to the k value used for visibility measurement which is then output as the measured value. The basis is a factory calibration of the VICOTEC450 with the transmission meter normally used.

2.1.3 Response time

The response time is the time taken to reach 90% of the signal peak after a sudden change in the measuring signal. The response time is freely adjustable between 1 ... 600 s. Setting a higher response time provides better attenuation of transient fluctuations in the measured value and malfunctions to produce a "smoother" output signal.

Figure 4 Response time



2.1.4 Function check

A check cycle 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 SOPAS ET (→ p. 66, §4.2.4). Any unallowed deviations from normal behavior that may occur are signaled as errors. A check cycle triggered manually can help localize possible error causes should a device malfunction occur.

A check cycle runs for approx. 120 s and is split into approx. 30 s measurement of contamination on optical surfaces and 90 s (default value) output of values determined.

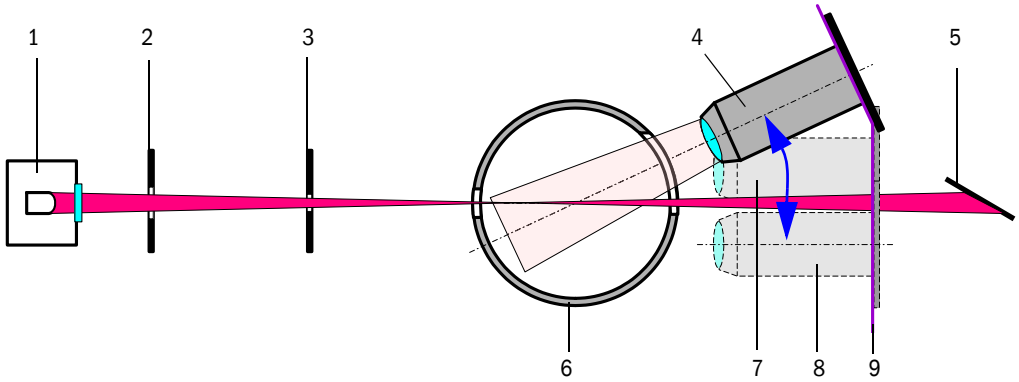
- The duration can be set as a parameter (→ p. 66, §4.2.4).
- The analog output must be activated to output check values on the analog output (→ p. 67, §4.2.5).
- The value measured last is output on the analog output during control value determination.
- If the check values are not output on the analog output, the current measured value is output when control value determination has completed.
- Relay 3 is activated during a check cycle (→ p. 40, Fig. 27).
- A check cycle is not started automatically when the measuring system is in "Maintenance" mode.
- "Function control" is displayed on the Display module (option) of the control unit during the check cycle.
- 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.

Contamination measurement

The receiver is moved completely through the laser beam in order to measure the contamination on the optical boundary surfaces. The light emitted by the laser diode is therefore measured directly. The intensity value measured during the swivel movement is computed with the factory setting to a correction factor. This fully compensates any contamination that occurs.

If the contamination value is lower than 50%, an analog value in a range between Live Zero and 20 mA and proportional to the contamination value is output during the check cycle otherwise the output current for device status "Malfunction" is always output (→ p. 67, §4.2.5).

Figure 5 Contamination measurement



1 Laser module
2 Aperture 1
3 Aperture 2
4 Receiver in measuring position
5 Light trap
6 Measuring cell
7 Reference position at cycle start
8 Reference position at cycle end
9 Guideway

2.2 Device components

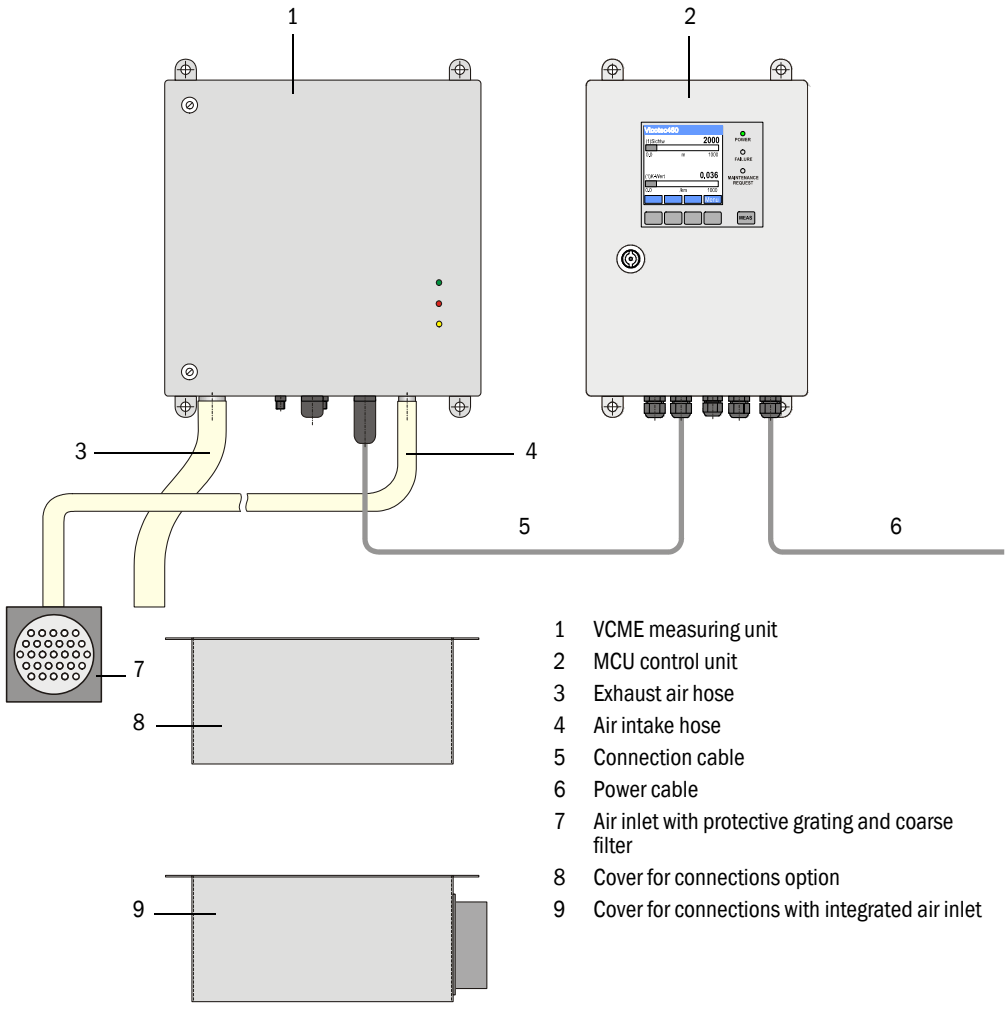
2.2.1 System overview

The measuring system comprises the following components:

- VCME measuring unit
  for signal recording, signal processing and controlling device functions
- MCU control unit
  for control, evaluation and output of the data of max. 8 sensors connected via RS485 interface
- Air inlet with protective grating

  Alternative:
- Cover for connections with integrated air inlet
- Air intake and exhaust air hoses (set, lengths 5 m, 10 m, 15 m)
- Connection cable to connect the measuring unit to the MCU (lengths 5 m, 10 m, 50 m, other lengths on request)
- Option, cover for connections
- Option, installation plate for measuring unit
- Option, connection box for bus wiring

Figure 6 VICOTEC450 components



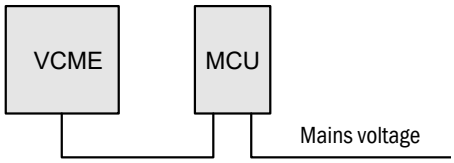
1 VCME measuring unit
2 MCU control unit
3 Exhaust air hose
4 Air intake hose
5 Connection cable
6 Power cable
7 Air inlet with protective grating and coarse filter
8 Cover for connections option
9 Cover for connections with integrated air inlet

2.2.2 Communication between measuring unit and control unit

Standard variant

In this version, one measuring unit is connected to one control unit using the connection cable.

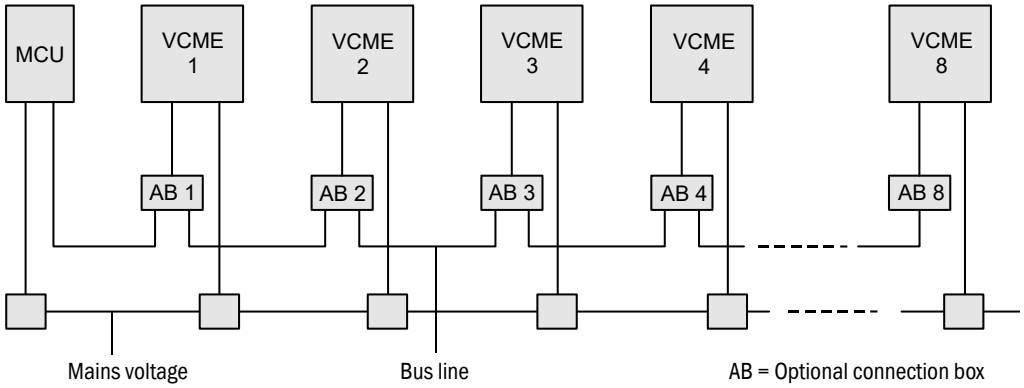
Figure 7 MCU - VCME standard connection



Bus variant

In this version, up to 8 measuring units can be connected to one control unit via the RS485 interface. The measuring units must be provided with mains voltage separately in this case. The optional power supply unit must be installed in the measuring unit for this purpose.

Figure 8 MCU - VCME bus connection



2.2.3 VCME measuring unit

The measuring unit analyzes the particle concentration in the air extracted from the tunnel traffic area as measure for the visibility prevailing in the tunnel.

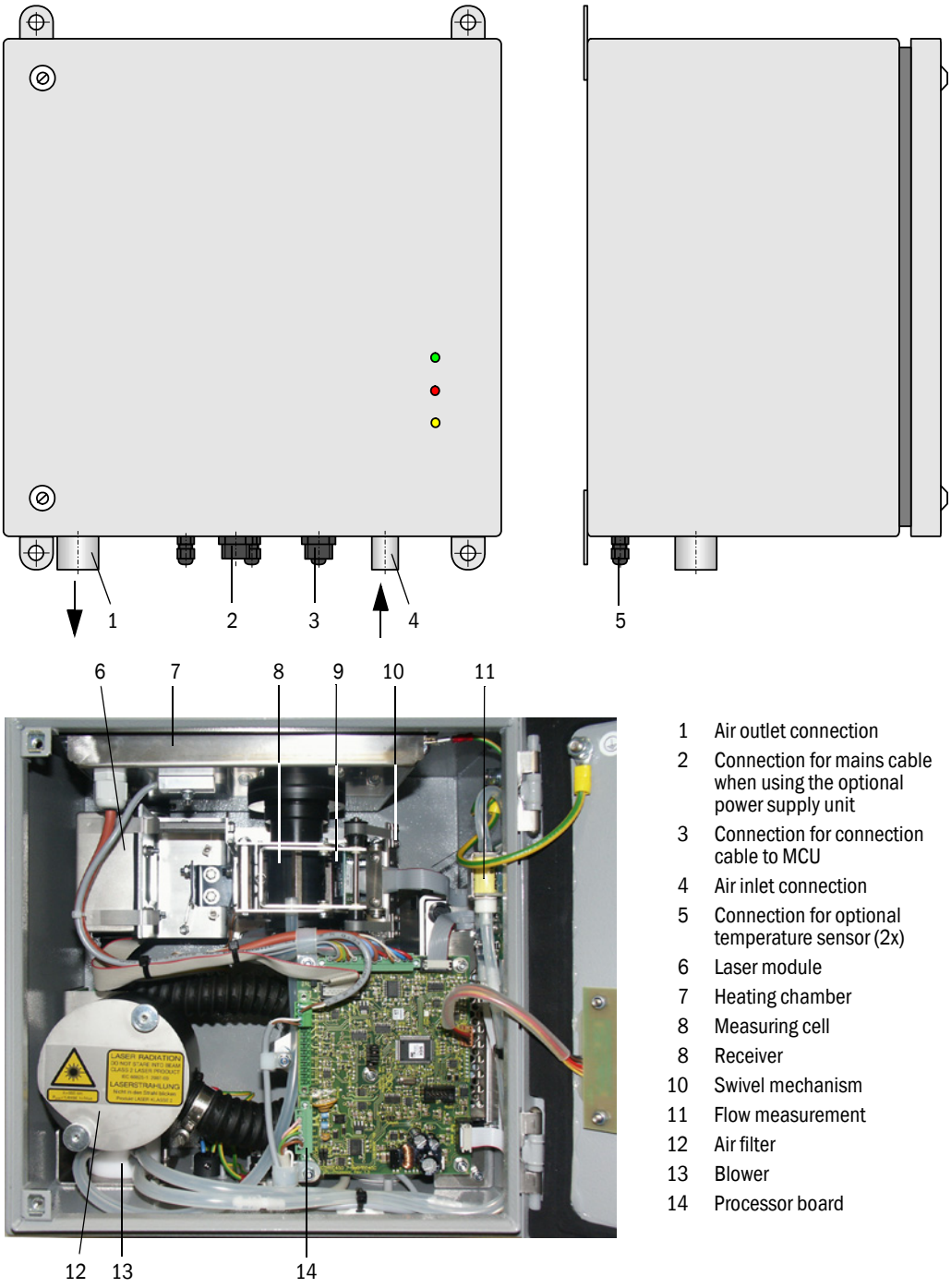
The measuring unit comprises the components (→ p. 19, Fig. 9):

- Measuring cell
- Laser module
- Processor board
- Heating chamber for fog damping
- Blower with air filter
- Flow measurement
- Housing for wall fitting, material 1.4571, coated gray (RAL7042)

When the measuring unit is installed as single connection to the control unit (→ Fig. 7), the measuring unit is provided with 24 V DC from the power supply unit in the control unit via the connection cable.

For larger distances (→ p. 31, §3.1.5) or bus connection, integrate an optional power supply unit in the measuring unit.

Figure 9 VCME measuring unit



1 Air outlet connection
2 Connection for mains cable when using the optional power supply unit
3 Connection for connection cable to MCU
4 Air inlet connection
5 Connection for optional temperature sensor (2x)
6 Laser module
7 Heating chamber
8 Measuring cell
8 Receiver
10 Swivel mechanism
11 Flow measurement
12 Air filter
13 Blower
14 Processor board

Flow measurement

The air flow rate through the measuring unit is monitored and controlled by a module with a differential pressure Sensor module. Cross-section reductions in the air intake line by deposits or other causes are detected reliably and included in the regulation of the air flow rate. This increases the functional reliability of the measuring system and reduces maintenance frequency.

Accessories

1 Air inlet with protective grating
Subassembly for freely selectable position of the air intake opening in the traffic area of the tunnel. The air intake hose serves as connection to the air inlet connection in the measuring unit. The layout depends on the installation location (on the tunnel wall or intermediate ceiling). An integrated filter prevents coarse particles or insects entering the air intake hose.

2 Air intake and exhaust air hoses (set, lengths 5 m, 10 m, 15 m)
Air intake hose made of silicone (flexible), inner diameter 13 mm (outer diameter 19 mm); exhaust air hose made of synthetic material, inner diameter 25 mm.

3 Cover for connections with integrated air inlet
This component combining the air inlet with protective grating, a very short air intake line and the optional cover for connections allows very easy assembly in the tunnel traffic area and protects the VCME connections against damage during tunnel cleaning using wash brushes.

4 Connection cable to connect the measuring unit to the MCU (lengths 5 m, 10 m, 50 m)
4-pole screened cable with socket for connection to the plug on the measuring unit and cable ends for connection to the terminals in the MCU.

Other lengths on request.

Options

1 Cover for connections
Plan this option when the measuring unit is to be fitted in the traffic area and the cover with integrated air inlet cannot be used. It protects the VCME connections during tunnel cleaning with wash brushes so that the measuring unit does not have to be dismantled during cleaning.

2 Temperature measurement with thermal element Ni-Cr-Ni, line 20 m (standard length) and electronic control

Measuring range: - 50 ... +250 °C
Accuracy (not calibrated): ± 2 K (resolution ± 0.25 K)

This option can be used with longer air intake lines (using the air inlet with protective screen subassembly) to measure the temperature at the suction location in addition to the air temperature measurement integrated in the VCME. Installing further temperature measurement units allows early fire detection by monitoring the temperature at various locations in the traffic area.

3 Power supply unit 24 V DC, 75 W
Serves separate power supply to the measuring unit when the distance between the measuring unit and the MCU is too large (voltage loss too high in the line) or when several measuring units are connected to one MCU (bus variant)

4 Installation plate
Serves to fit and remove the measuring unit at the installation location simply and conveniently without tools. The measuring unit can also be secured with a lock.

Options 2, 3 and 4 can only be integrated in the measuring unit at the factory. Send the measuring unit to the manufacturer when these options are to be fitted later.

Type code

The following type codes identify the various selection options:

Type key for measuring unit VCME-XX-P-X-X-X

Power supply
- 24: 24 V DC. from MCU
- WR: 90 ... 250 V AC with separate power supply unit 24 V DC 75 W

Flow measurement
- P: With differential pressure sensor

Optional temperature measurement with number of measuring points
- 0: Without
- n: With thermoelement Ni-Cr-Ni, line 20 m and electronic control n = 1 or 2

Fog elimination
- F: With
- N: Without

Misc.
- N: Without special features

Example: VCME-24-P-2-F-N

24 V DC from MCU
With flow measurement
With 2x optional temperature measurement
With fog elimination
Without special features

2.2.4 **MCU control unit**

The control unit has the following functions:

- Data transfer controlling and processing the data from the sender/receiver unit(s) connected via RS485 interface
- Signal output via analog outputs (measured value) and relay outputs (device status)
- Signal input via analog and digital inputs
- Voltage supply for the connected sender/receiver units
- Communication with host control systems via optional modules

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

The control unit is fitted in a steel sheet enclosure as standard.

Standard interfaces

Analog output	Analog inputs	Relay outputs	Digital inputs	Communication
1 output 0/2/4...22 mA (electrically isolated, active); for selectable output of measured variables: ● k value ● Inlet temperature ● Visibility ● Scattered light intensity Optionally: ● Dust concentration ● Flow too low ● Temperature external 1x ● Temperature external 2x 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/malfunction ● Maintenance ● Check cycle ● Maintenance request ● Limit value	4 inputs to connect potential-free contacts (e.g. to connect a maintenance switch or trigger a check cycle)	● USB 1.1 and RS232 (on terminals) for measured value inquiries, setting parameters and software updates. ● RS485 for sensor connection

Figure 10 MCU control unit in wall-housing with options

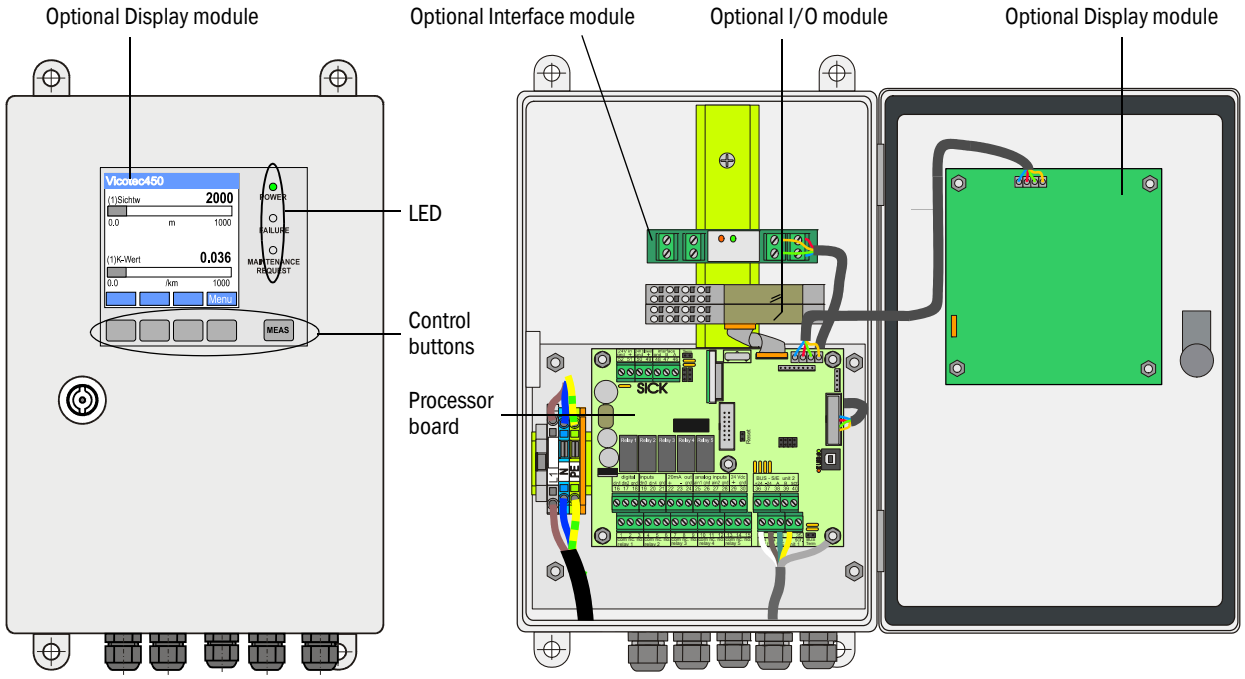
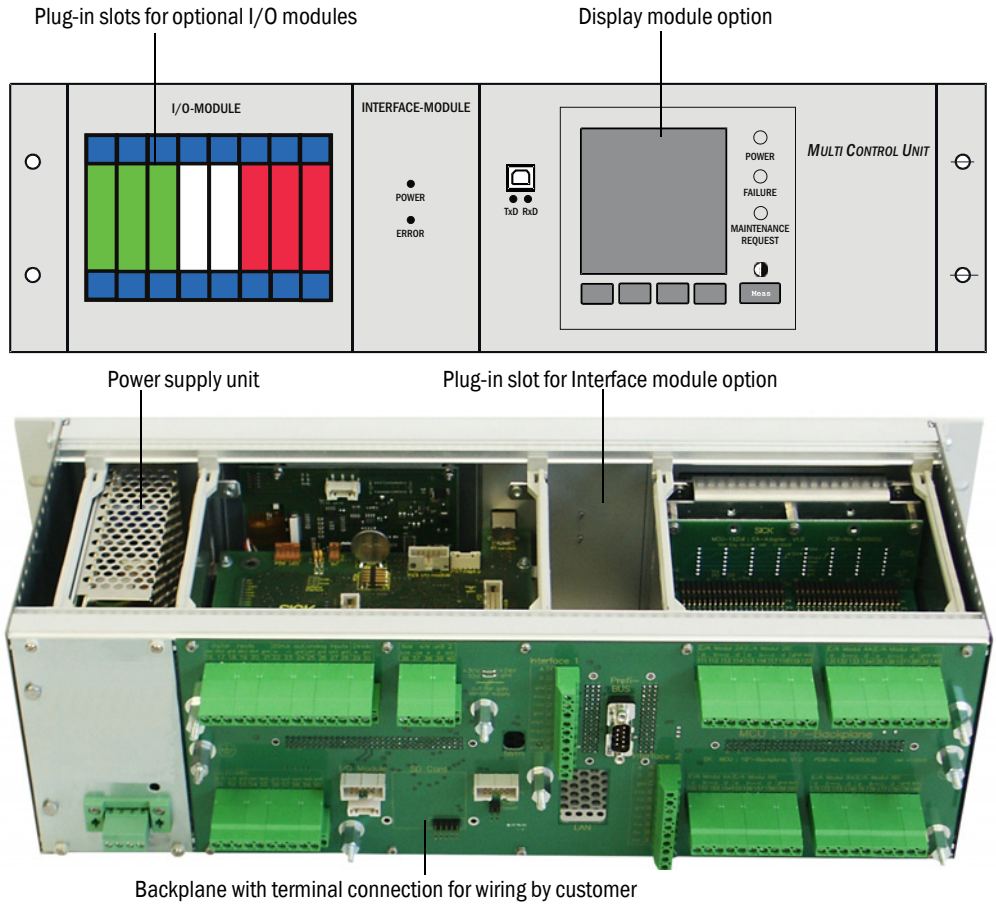


Figure 11 MCU control unit in 19” rack with options



Options

The following options serve to considerably extend the functionality of the MCU:

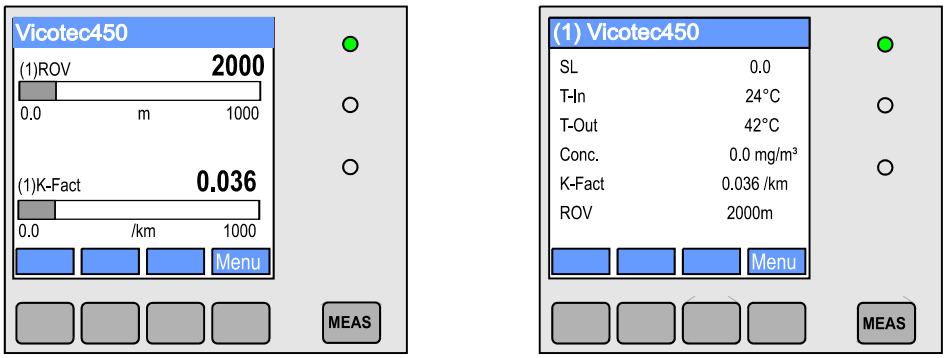
1 Display module
Module to display measured values and status information, and for configuring during start-up, selection via control buttons.

– Displays

Type		Display
LED	Power (green)	Voltage supply OK
	Failure (red)	Function fault
	Maintenance request (yellow)	Maintenance request
LC display	Graphic display (main screen)	– Scattered light intensity – Inlet temperature – Heater temperature – Temperature external 1x – Temperature external 2x – Dust concentration – k value – Visibility
	Text display	2 measured values (see graphic display) and 8 diagnosis values (→ p. 85, Fig. 80)

The graphic display shows two main measured values of a measuring unit selected at the factory or computed values from the MCU as bar charts. Alternatively, up to 8 single measured values of a measuring unit can be displayed (toggle with "Meas" button).

Figure 12 LC-Display with graphic (left) and text (right) display (example)



– 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 screen
Diag	Display alarm or error message
Menu	Display main menu and call up submenus

2 I/O module
For plugging on module carriers (MCU in wall housing) or in plug-in module (MCU in 19" rack), communication via I²C bus, optionally as:

– 2x analog output 0/4 ... 22 mA to output further measured variables (load 500 Ω)
– 2x analog input 0/4 ... 22 mA to read in values from external sensors
– 4x digital input for connection of galv. isolated contacts
– 2x digital output (changeover contacts, capacity 48 V AC/DC, 5 A)
– 4x digital output (NO contacts, capacity 48 V AC/DC, 0.5 A)

+i
● One module carrier is necessary for each module (to insert on top hat rail). One module carrier has to be connected to the processor board with a special cable, other module carriers can be docked to it.
● Max. 8 I/O modules can be plugged, max. 4 modules of these may be the same type.

3 Interface module
Module to pass measured values, system status and service information to higher level control systems, optional for Profibus DP-V0 or Ethernet, to plug onto hat rail (MCU in wall-housing) or to plug-in slot (MCU in 19" rack). The module is connected to the connection board by an associated cable.

+i
Profibus DP-V0 to transfer via RS485 in accordance with DIN 19245 Part 3 as well as IEC 61158.

Type code

The following type code defines the various configuration options in the same manner as for the measuring unit:

Type code control unit: MCU-N X X X N X X X X X X N N E

Integrated purge air supply
- N: Without

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

Housing variants
- G: Wall housing grey
- S: Wall housing, stainless steel 1.4571 (coated grey)
- R: 19" housing

Display module
- N: Without
- D: With

Other options
- N: Without

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

Optional analog output (plug-in module; 0/4...20 mA; 2 outputs per module)
- 0: Without
- n: With, n = 1...4 1)

Optional digital input (plug-in module; 4 inputs per module)
- 0: Without
- n: With, n = 1...4 12)

Optional digital output power (plug-in module; 48 V DCC, 5 A; 2 changeover contacts per module)
- 0: Without
- n: With, n = 1...4 12)

Optional digital output low power (plug-in module; 48 V DC, 0.5 A; 4 NO contact elements per module)
- 0: Without
- n: With, n = 1...4 1)

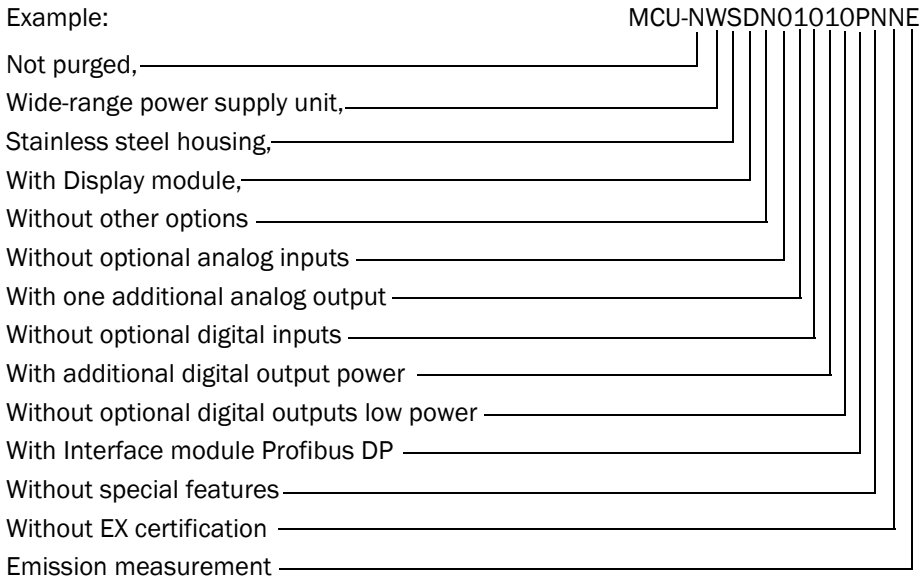
Optional Interface module
- N: Without
- E: Ethernet
- P: Profibus

Special versions
- N: No special features

EX certification
- N: Without EX certification

Software
- E: Emission measurement

1): Maximum number of all modules of the same type = 4



2.2.5 Fastening set

Various fastening sets are available to fasten the measuring unit, control unit and optional connection box on the tunnel wall or ceiling. Selection depends on the actual requirements. The Table below lists the respective parts and their usage options.

Fastening set		Usage		
Name (Part No.)	Contents	Requirements	For component	Qty. per comp.
4D8-1.4571/PA (2031889)	4x Fischer dowel S10 4x hexagon woodscrew 8*50 A4	No particular	Measuring unit and control unit in wall housing	1
2D4-1.4571/PA (2031890)	2x Fischer dowel S6 2x round head woodscrew 3.5*40 A4		Connection box option	1
2M8-1.4571 (2031891)	2x dowel SLM 8N A4 2x hexagon screw 8*55 A4	Stainless steel only	Measuring unit, control unit and connection box option in stainless steel housing	2
4M8-1.4529 (2031887)	4x Fischer tie bolt FAZ 8/10 C	Aggressive ambient air		1

VICOTEC450

3 Assembly and installation

Project planning
Assembly
Installation

3.1 Project planning

3.1.1 Planning steps

Plan the following before starting assembly and installation work:

- ► Determine the measuring locations.
- ► Select the system components according to usage conditions and customer demands (→ p. 18, §2.2.3 and → p. 22, §2.2.4).
- ► Determine the fitting locations for air inlet with protective grating (when used), measuring unit(s) and control unit.
- ► Plan the voltage supply and cabling.

3.1.2 Determining measuring locations and measuring unit arrangement in the tunnel

Measuring locations

The normal criteria for tunnel ventilation are applicable for the distance between measuring units inside the tunnel when using the VICOTEC450 as visibility measuring device. Experienced specialists should plan the details because these depend on many factors such as tunnel geometry, location, traffic volume and vehicle mix.

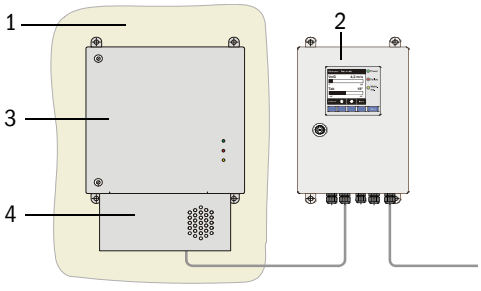
The following values can be used as basis:

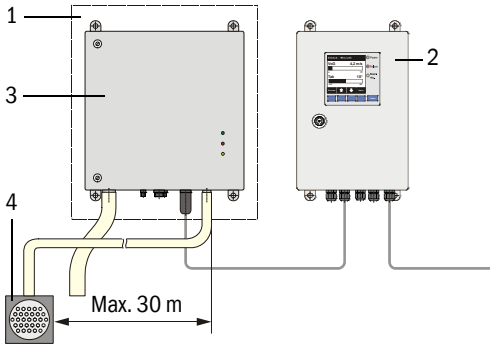
- An even spread along the tunnel length for semi and transverse ventilation with at least 2 measuring points per ventilation section.
- At least 3 measuring points in tunnels with one-way traffic (one each approx. 150 m from the entrances, at least one in the middle of the tunnel), according to the German "Richtlinie für die Ausstattung und den Betrieb von Straßentunneln, RABT" for lengthways ventilated tunnels (EU Directive 2004/54/EC Minimum safety requirements in tunnels) because two-way traffic cannot generally be excluded.

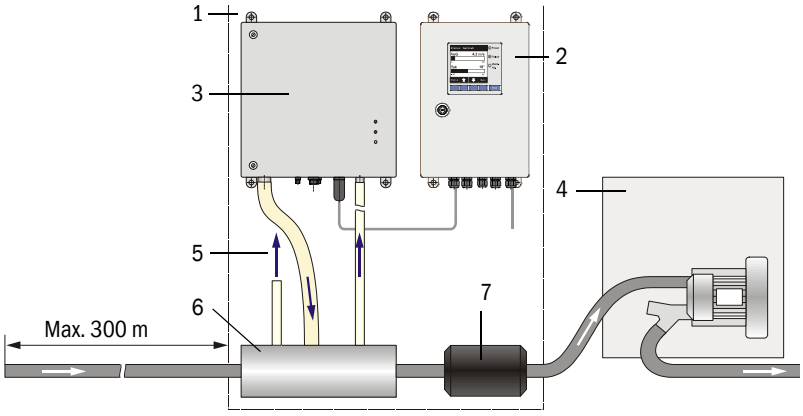
If the VICOTEC450 is to be used for smoke detection as well, the distance between two neighboring measuring points which serve as optical smoke detector shall not be larger than 100 m to 150 m. (See RABT2003, Astra modification proposal 2005).

Measuring unit arrangement

The measuring units can be installed in the tunnel in the following manner:

Measuring unit installation	Measured air extraction	Remarks
Directly in the traffic area on the tunnel wall  1 Tunnel wall 2 Control unit 3 Measuring unit 4 Cover with integrated air inlet	Via air inlet with protective grating or cover for connections with integrated air inlet (should be preferred due to lower installation effort)	Choose this arrangement when the respective measuring point will not be used to measure fog as visibility impairment. This is often the case for measuring points located less than 150 m from the tunnel portal. Prerequisite is sufficient space in the traffic area.

<table>
<tr><th>Measuring unit installation</th><th>Measured air extraction</th><th>Remarks</th></tr>
<tr><td>In recesses, switch cabinets for equipment in the tunnel traffic area, on intermediate ceilings or in operational rooms at an easily accessible location that can be reached without having to close the tunnel.
 

1 Control cabinet
2 Control unit
3 Measuring unit
4 Air inlet with protective grating</td><td>Via air inlet with protective grating and air intake hose with a maximum length of 30 m</td><td>Choose this arrangement when:
● There is not enough clearance for in-situ measuring devices (transmission meter) in the tunnel traffic area
● Fixtures in the traffic area are not possible or desired for other reasons
● Measuring is required at especially inaccessible locations where transmission meters cannot be installed.</td></tr>
<tr><td>In operational rooms
 

1 Control cabinet
2 Control unit
3 Measuring unit
4 Blower
5 Measuring air feed for further evaluation systems (e.g. SIDOR)
6 Pipe manifold
7 Air filter</td><td>Via air intake hoses up to 300 m in length with separate blower as bypass system</td><td>Only choose this arrangement when the previous installation options are not possible.
Disadvantages:
● Much longer response time (long air intake hose) → particularly important when using the VICOTEC450 as smoke detector
● High effort for planning, installation and operation (could possibly be higher than the device costs)
● Air intake hoses made from PVC or PE have unfavorable behavior in fire (PVC is not free from Halogen, PE is not self-extinguishing and can therefore spread fires further), and can become charged electrostatically → measured values can be falsified through changes in the measured air
● Air intake hoses made of stainless steel to be used preferably for this arrangement cause considerably higher costs
● Dust particles can deposit in the air intake hoses → reduced cross-section</td></tr>
</table>

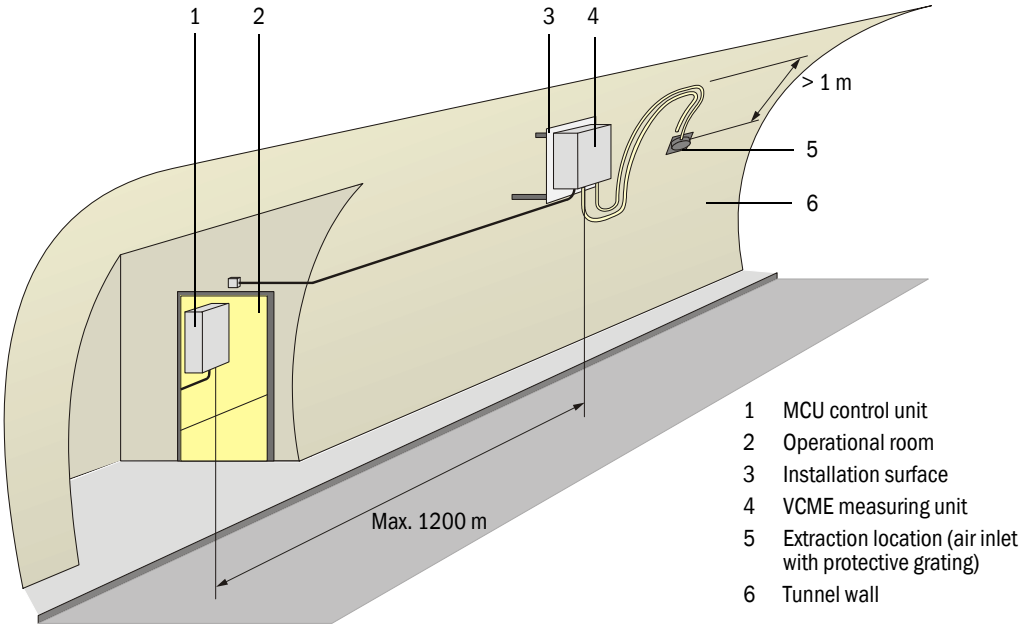
3.1.3 Installation locations

Fit measuring and control units at a level, easily accessible and protected location with enough clearance for opening the doors and laying air lines and cables (→ p. 34, §3.2.2 and → p. 35, §3.2.3). Ensure sufficient distance sideways to passing vehicles when the units are mounted on the tunnel wall in the traffic area.

The extraction location must be in the traffic area, centered on the tunnel ceiling if possible when the VICOTEC450 is used as smoke detector as well.

Install the MCU control unit in an operational room when possible. The maximum distance to the measuring unit is 1200 m.

Figure 13 Installation locations



3.1.4 Air intake and exhaust air hoses

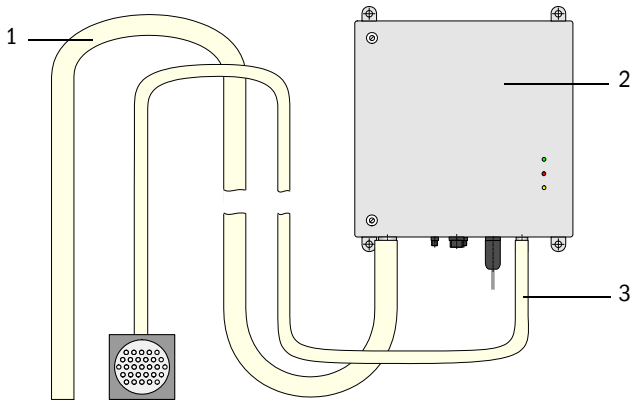
Observe the following requirements:

- Inside diameter of the air intake hose is 13 mm for elastic material and 16 mm for non-elastic material (connection via a flexible hose where appropriate).

  Outer diameter of the air inlet nozzle of the measuring unit 16 mm.

- Inside diameter of the exhaust air hose 25 mm.
- Minimal bend radiuses for air intake and exhaust air hoses 200 mm.
- The exhaust air hose must not be much longer than the air intake hose.
- The air pressure at the air intake location and at the location where the VICOTEC450 exhaust air flows back into the environment must be approximately the same.
- The exhaust air must not be led to operational rooms that are under overpressure.
- Air intake and exhaust air hoses must run continuously downwards away from the measuring unit so that no water can collect in the hoses or penetrate the measuring unit. If this cannot be realized, lay the hoses at the extraction location and measuring unit at least straight down for a certain distance (→ Fig. 13 and → p. 31, Fig. 14). The hoses should be as short as possible.
- It may be necessary to install a water separator in case of long air intake hoses, particularly when the hose is laid through areas with different temperatures.

Figure 14 Connection of air intake and exhaust air hoses when downward slope not available



1 Measuring unit
2 Exhaust air hose
3 Air intake hose

Endress+Hauser can deliver a set comprising the air intake and exhaust air hoses with lengths of 5 m, 10 m and 15 m.

3.1.5 Connection cable

The connection cable must have an adequate wire cross-section to cope with the power requirements for the blower and heating chamber when the MCU feeds the power supply to the measuring unit. This depends on the cable length.

Wire cross-section in mm²	Specific resistance in Ω/km	Maximum cable length in m
0.5	40	25
0.75	25	40
1.00	18	55
1.5	14	70
2.5	8	130

Minimum voltage for VCME is 20 V DC

For distances between the measuring and control units longer than 130 m, it is recommended, for cost reasons, to connect the measuring unit separately to the mains voltage using the optional power supply unit.

3.2 Assembly

All of the assembly and installation work has to be carried out onsite. This comprises mounting the measuring and control units, assembling the air inlet with protective grating and air intake hose (if the cover with integrated air inlet is not used).

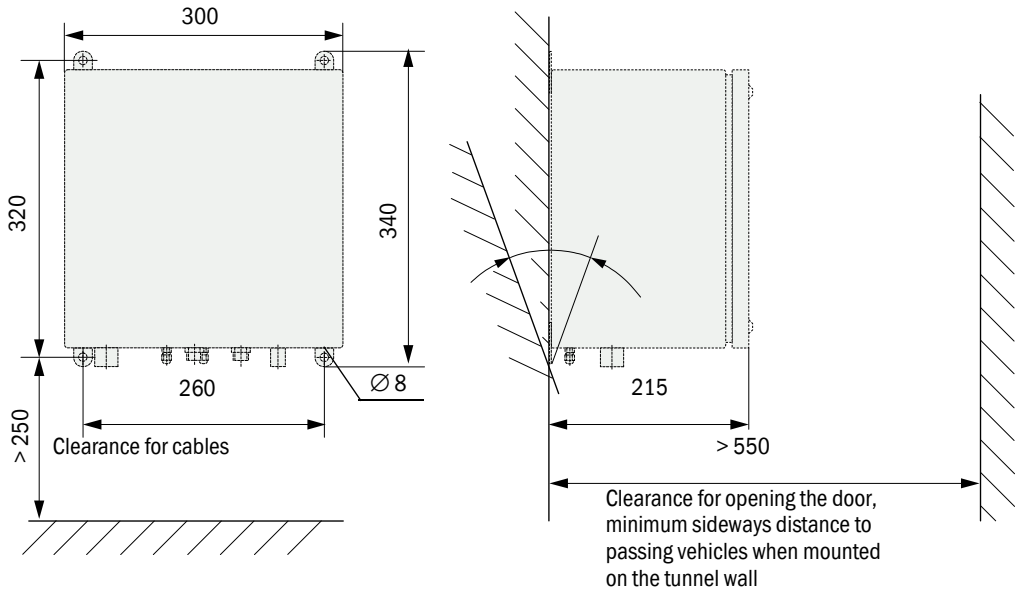
WARNING:
- ► Observe the relevant safety regulations as well as the safety notices in Section 1 when carrying all assembly work!
- ► If possible, only carry out assembly work when the tunnel is closed!
- ► Take suitable protective measures against possible hazards!

3.2.1 Installing the measuring unit

Fit the measuring unit at a level, easily accessible and protected location.

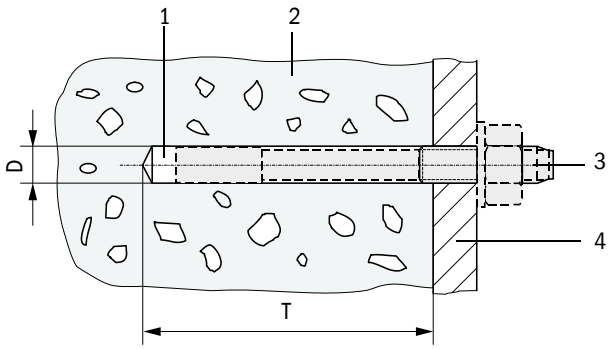
NOTICE:
The connections must always be below.

Figure 15 Measuring unit assembly dimensions



Work to be carried out
- ► Drill the holes as shown in p. 33, Fig. 16 (distances in accordance with Fig. 15).
- ► Insert dowels (fastening set 4D8-1.4571/PA, 2M8-1.4571) or tie bolts (fastening set 4M8-1.4529).
- ► Fasten the measuring unit with the hexagon head screws or nuts.

Figure 16 Drill hole dimensions



1 Drill hole
2 Tunnel wall
3 Tie bolt with fastening nut
4 Bracket of the measuring unit

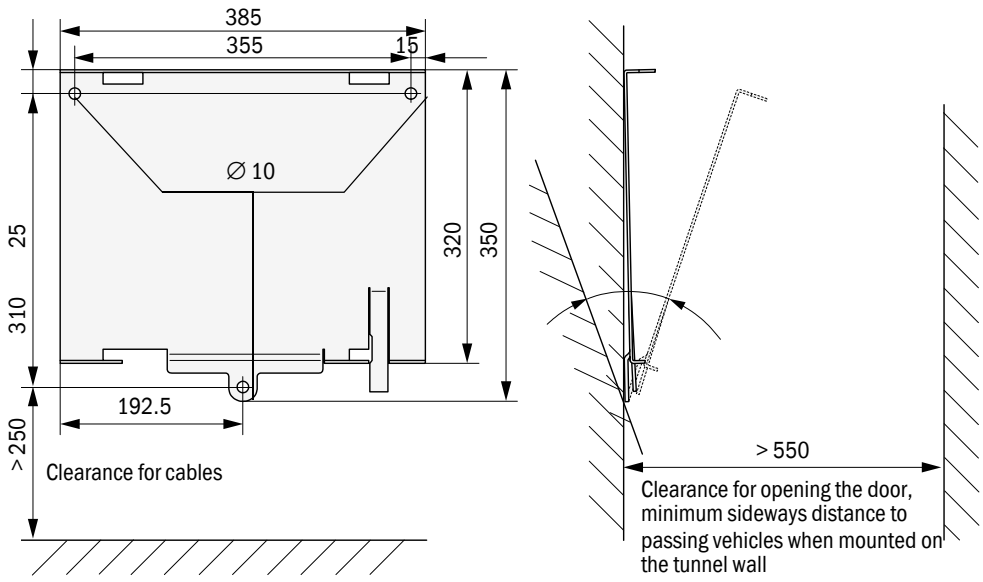
Fastening set	D [mm]	T [mm]	Remark
2D4-1.4571/PA	6	≥ 40	The dowel should be flush with the tunnel wall.
4D8-1.4571/PA	10	≥ 70	
2M8-1.4571	12	≥ 60	
4M8-1.4529	8	≥ 65	The tie bolt must not protrude more than 12 mm from the tunnel wall.

Installing the measuring unit using the optional installation plate

► Fit the measuring unit in accordance with Fig. 17.

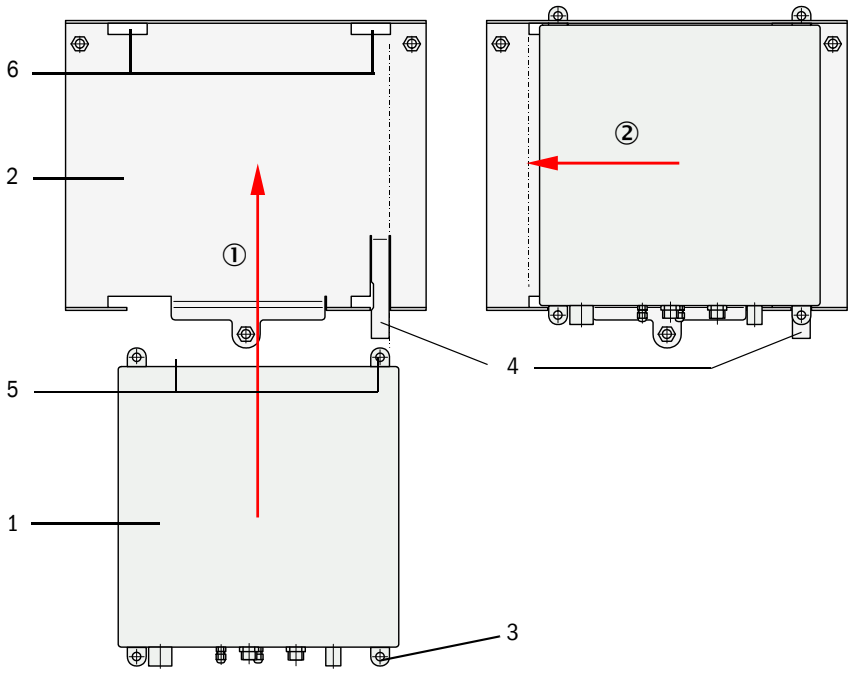
We recommend using M10 bolts on the fastening points on which the measuring unit can be positioned and fastened with self-locking nuts.

Figure 17 Installing the installation plate option



► Position measuring unit (1) on installation plate (2) so that the lower right bracket (3) lies on safety catch (4), slide upper brackets (5) into the associated recesses (6), and then slide the measuring unit to the left until the safety catch is freely movable, and then secure it.

Figure 18 Fitting the measuring unit on the installation plate



3.2.2 Installing the air inlet with protective grating

Figure 19 Installation dimensions for wall mounting

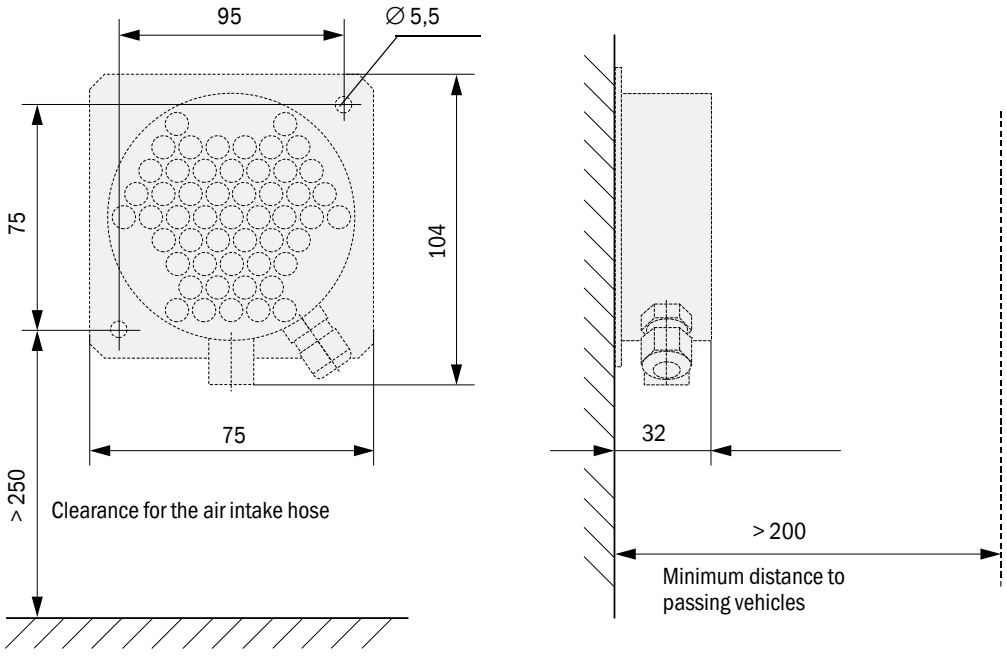
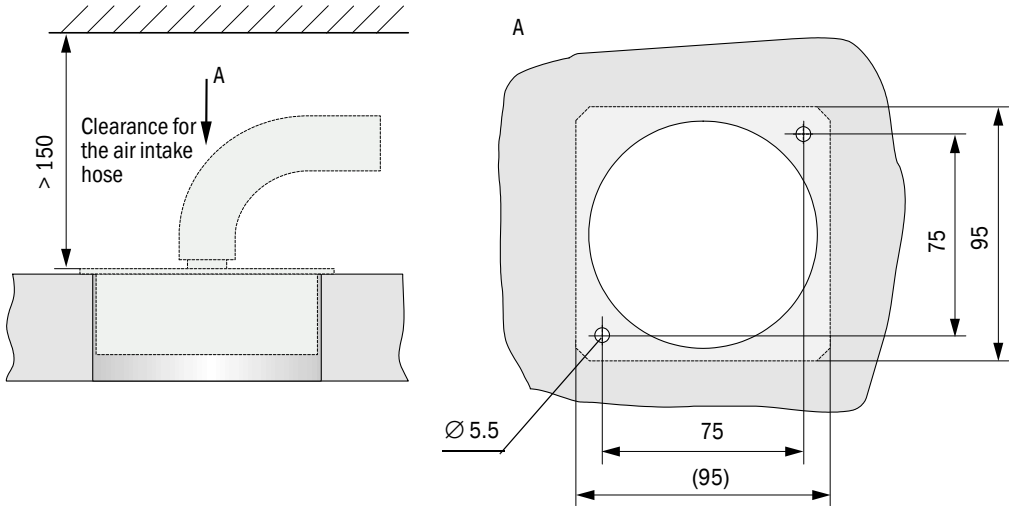


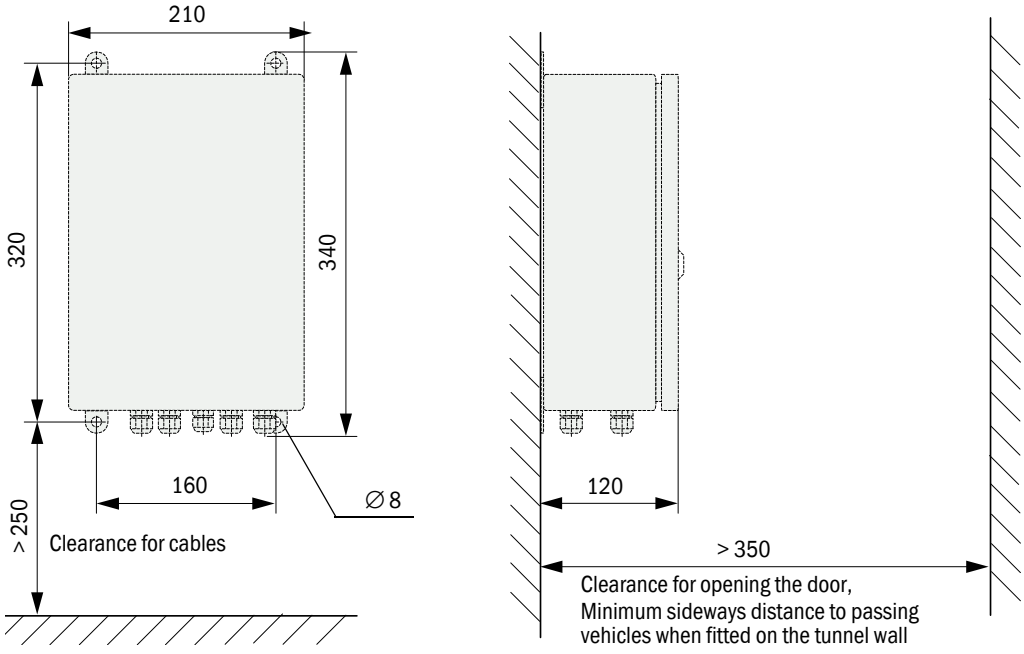
Figure 20 Installation dimensions for the air inlet with protective grating on the intermediate ceiling



3.2.3 Installing the control unit with wall housing

Fit the control unit in a vertical, level, easily accessible and protected location in accordance with Fig. 21.

Figure 21 Installation dimensions for MCU in steel sheet housing



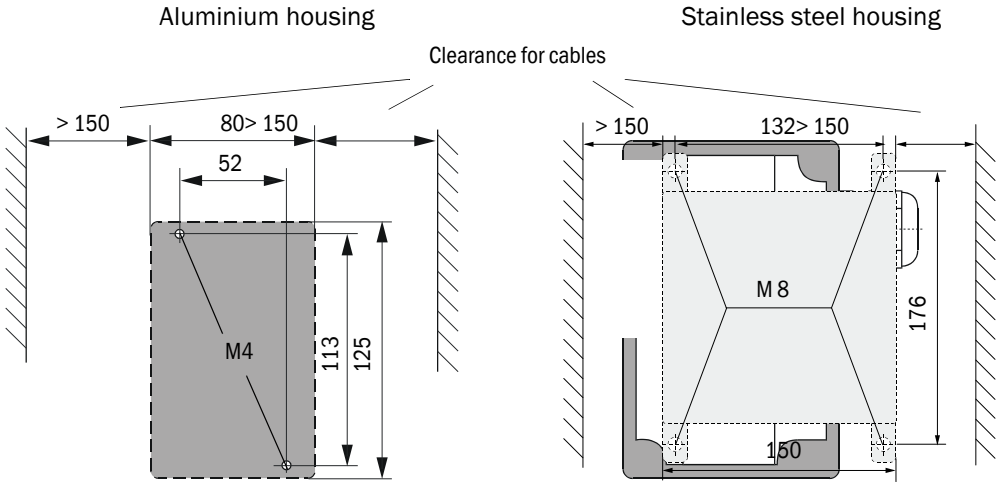
The respectively suitable fastening sets can be used for fastening (→ p. 26, §2.2.5; installation → p. 33, Fig. 16).

- The MCU control unit can be installed up to 1200 m away from the measuring unit when a suitable cable is used.
- We recommend installing the MCU in an operational room for trouble-free communication with the VICOTEC450.

3.2.4 Installing the connection box option

Fit this component on a level surface (tunnel wall or roof) as shown in Fig. 22. The respectively suitable fastening sets can be used for fastening (→ p. 26, §2.2.5; installation → p. 33, Fig. 16).

Figure 22 Installation dimensions for connection box option

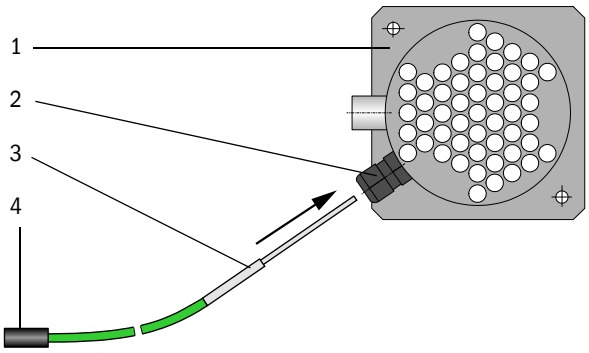


3.2.5 Installing the temperature sensor of the temperature measurement option

Fit the temperature measurement option with 1x temperature sensor as follows:

- If the air inlet with protective grating option is used, slide the temperature sensor into the screw fitting, and fasten it.

Figure 23 Installing the temperature sensor in the air inlet with protective grating



1 Air inlet with protective grating
2 Screw fitting
3 Temperature sensor
4 Connector

- If the cover for connections with integrated air inlet option is used, put the temperature sensor into one of the ducts in the bottom of the measuring unit, and fasten it. If both these options (temperature sensor and cover) are clearly assigned to one measuring unit when ordered, the temperature sensor is installed in this measuring unit at the factory.
- Fasten the temperature sensor in immediate proximity of the air intake opening when other air inlets are used.

Install the temperature sensors of the option temperature measurement with 2x temperature sensor in the traffic area of the tunnel so that optimal temperature monitoring for early fire detection is possible.

3.3 Installation

WARNING:
- ► Observe the relevant safety regulations as well as the safety information in Section 1 when carrying out all installation work!
- ► Take suitable protective measures against possible local or plant-specific hazards.

3.3.1 General information, prerequisites

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

All of the installation work must be carried out onsite. This includes:

- ► Complete laying of power supply and signal cables.
- ► Connecting the power supply and signal cables to all system parts.
- ► Installing switches and mains fuses.

- Plan adequate cable cross-sections (→ p. 106, §7.1).
- When using the optional power supply unit, ensure cable ends of the connection cable and power cable of the measuring unit are sufficiently long.
- Protect cable plug-in connectors not connected against moisture and dirt (screw cover on).

Requirements for cable types for onsite connection of measuring and control units

A data line with twisted pairs and common shield is required to connect the measuring and control units. Do not use normal telecommunications cables.

The following cable types are well or very well suited for data transfers:

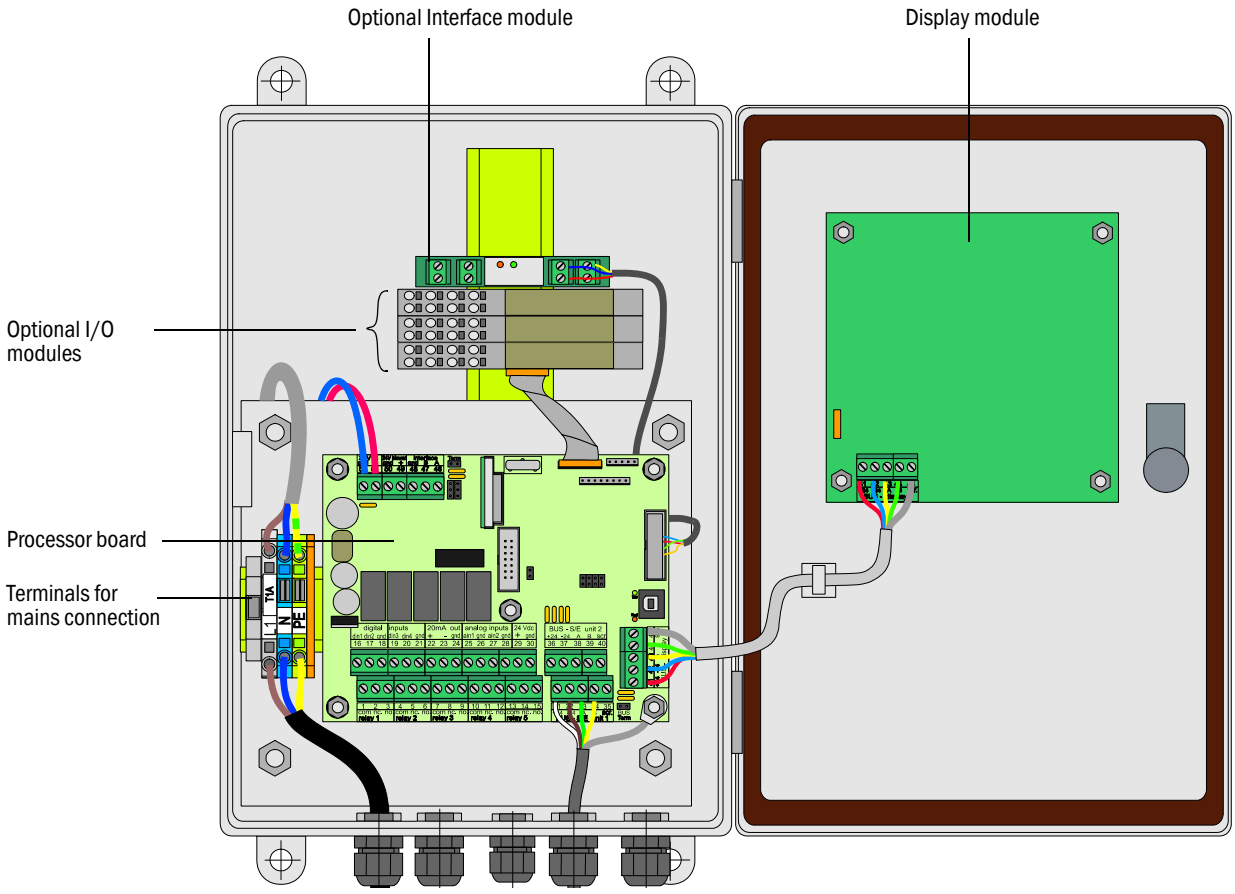
1. UNITRONIC LiYCY (TP) 4 x 2 x 0.75 mm²
   Not suitable for underground installation (protected laying required if necessary)
2. UNITRONIC Li2YCY (TP) 4 x 2 x 0.5 mm²
   Usable as alternative to item 1; not suitable for underground installation (protected laying required if necessary)
3. UNITRONIC Li2YCYv (TP) 4 x 2 x 0.5 mm²
   Suitable for underground installation
4. Special cable type ASS 4 x 2 x 0.5 mm²
   Silicone, halogen-free, high heat and cold resistance, cable sheath red (similar to RAL 3000)
5. Accessories:
   Braided cable sleeving PA-S 4, black, to provide mechanical protection or to cover the sheathing color if necessary.

- Manufacturer of UNITRONIC cables: LAPP-Kabel
- Manufacturer of special cable: metrofunk KABEL-UNION GmbH

NOTICE:
- We cannot grant any warranty for proper system function when cables which do not comply with the above specifications are used.
- Always use cables of the same type and ensure continuous shielding.

3.3.2 Connecting the control unit with wall housing

Figure 24 MCU in wall housing



Work to be carried out

- Connect the connection cable in accordance with → p. 40, Fig. 27 (standard connection) resp. → p. 41, Fig. 28 (bus variant).

Connect an onsite cable to a suitable 7-pole socket when used (→ p. 39, Fig. 26; Endress+Hauser Part No. 7045569)

NOTICE:

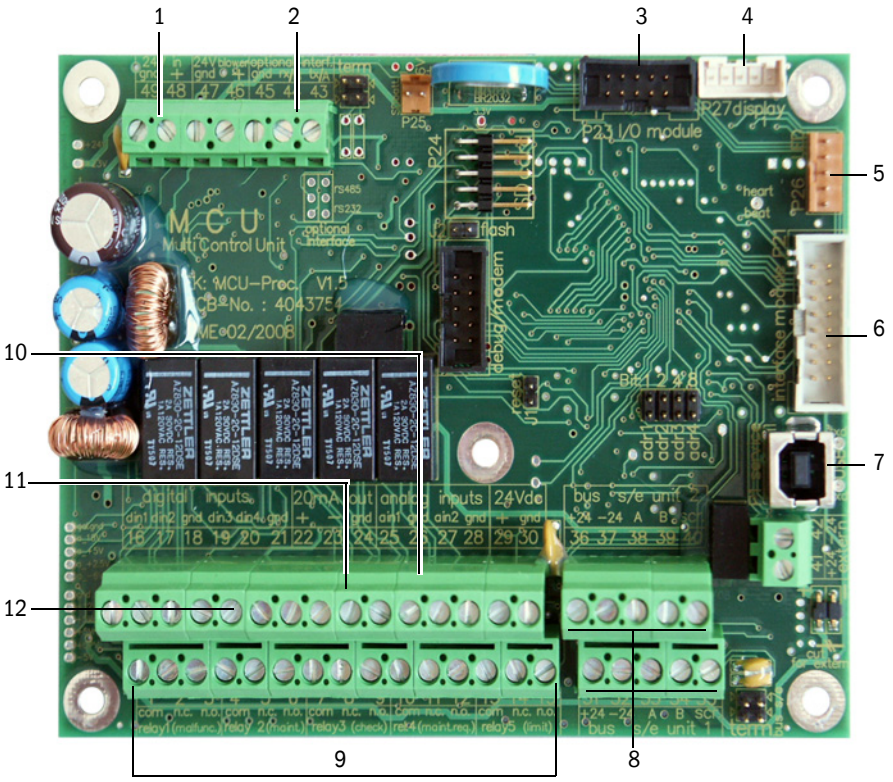
- Only use cables with twisted-pairs and shield (e.g. UNITRONIC LiYCY (TP) 2 x 2 x 0.5 mm^2 from LAPP-Kabel; not suitable for underground laying).

- Connect cables for status signals (operation/malfunction, maintenance, check cycle, maintenance request, limit value), analog output, analog and digital inputs according to requirements (Fig. 29, Fig. 30, Fig. 31, → p. 40, Fig. 27 and → p. 41, Fig. 28; only use cables with twisted-pairs and shield).
- Connect mains cable to terminals L1, N, PE of the MCU (→ Fig. 24).
- Close off unused cable openings with dummy plugs.

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

MCU processor board connections

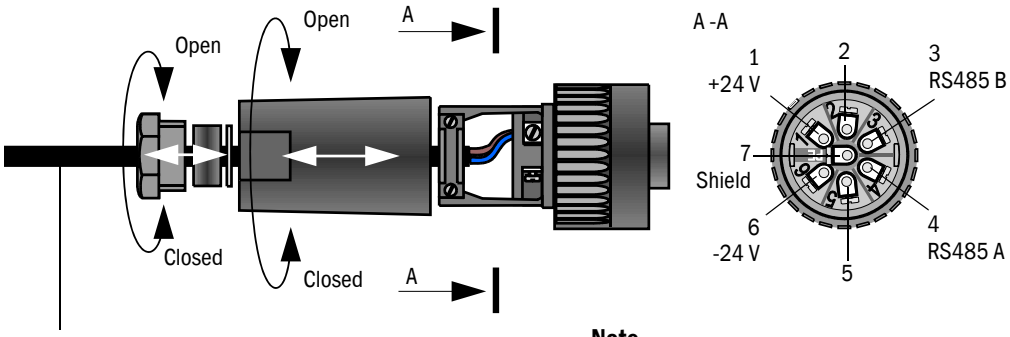
Figure 25 MCU processor board connections



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

Onsite connection cable plug-in connection to MCU

Figure 26 Plug-in connector connection on onsite cable

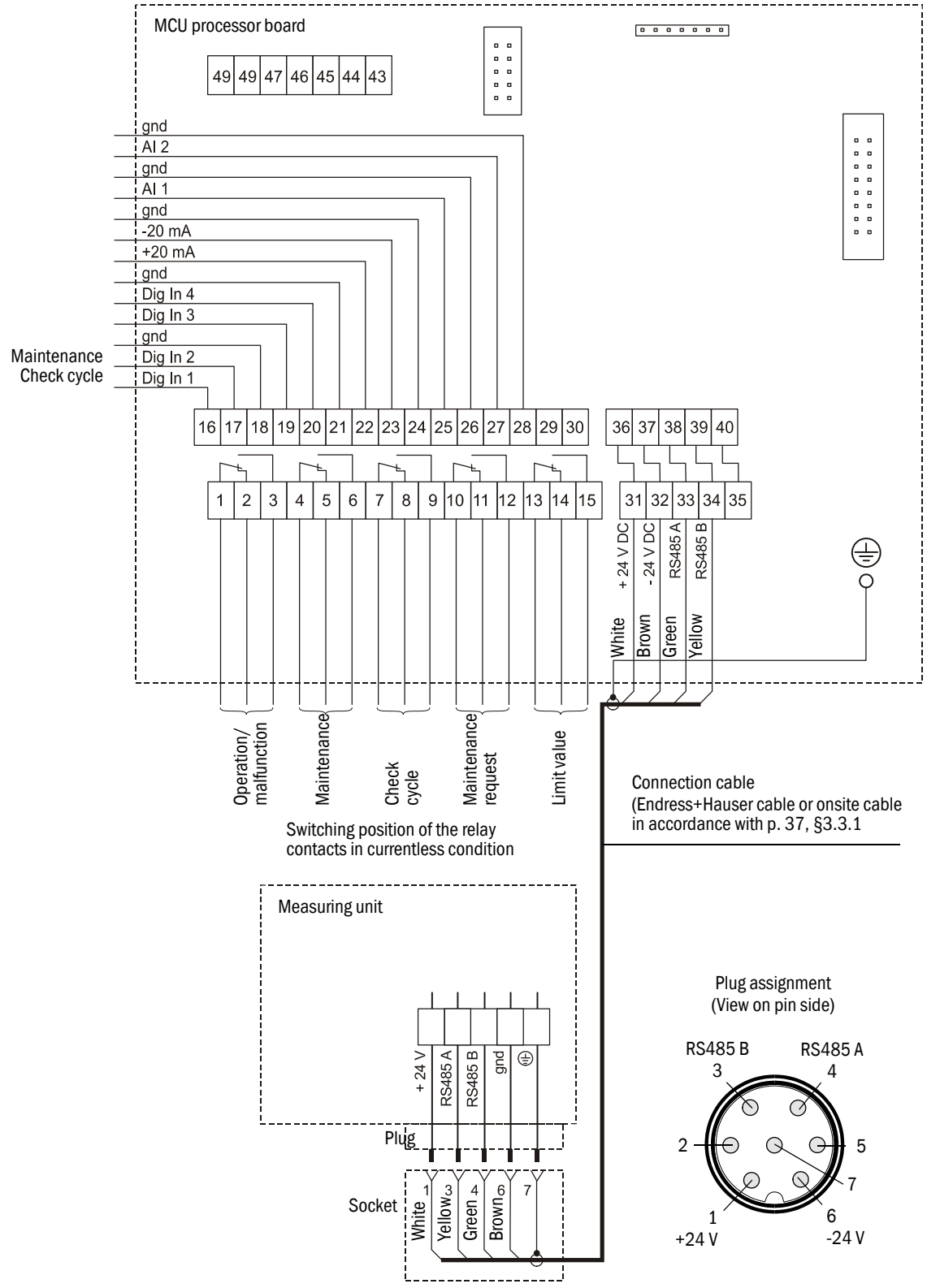


Onsite cable in accordance with p. 37, §3.3.1

Note
To open, connect the plug-in connector to the plug on the measuring unit.

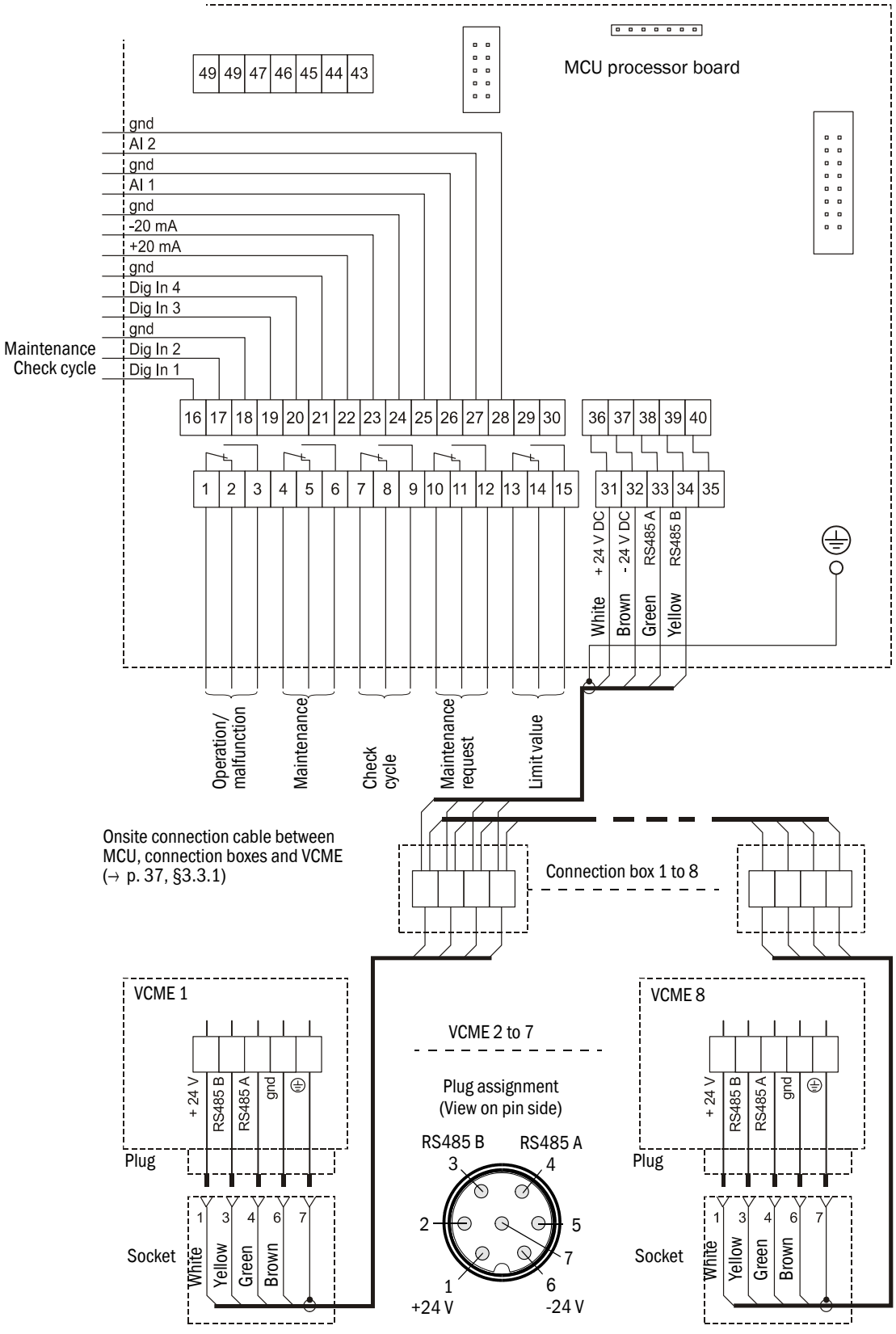
MCU - VCME standard connection

Figure 27 MCU - VCME standard connection



Bus variant

Figure 28 Bus variant



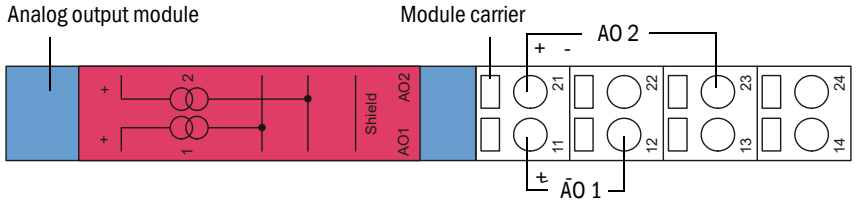
Fitting and connecting optional Interface and I/O modules

Plug interface modules and module carriers for I/O modules onto the hat rail in the MCU (→ p. 38, Fig. 24) and connect to the associated connection on the processor board with the cable with plug-in connector (→ p. 39, Fig. 25). Then plug the I/O module on the module carrier.

Connect I/O modules using the terminals on the module carrier (→ Fig. 29, Fig. 30, Fig. 31), the Profibus module using the terminals on the module and the Ethernet module via onsite network cable.

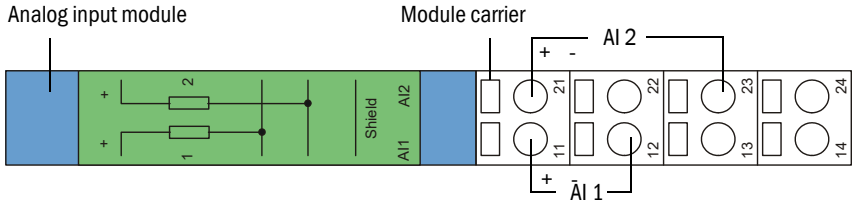
- Terminal assignment, AO module

Figure 29 Terminal assignment, analog output module



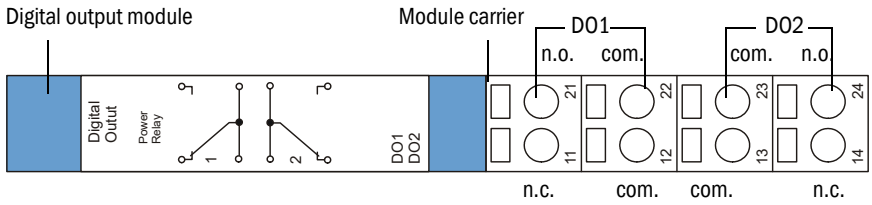
- Terminal assignment, AI module

Figure 30 Terminal assignment, analog input module



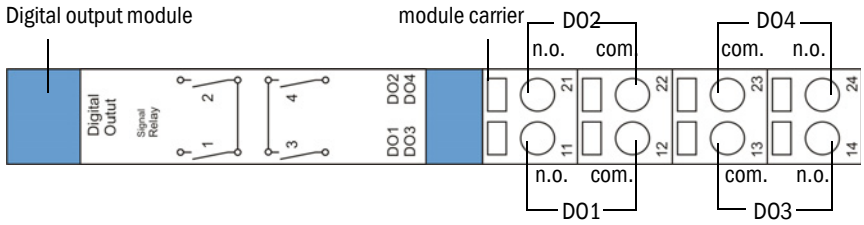
- Terminal assignment, DO module power relay (2 changeover contacts)

Figure 31 Terminal assignment, digital output module power relay



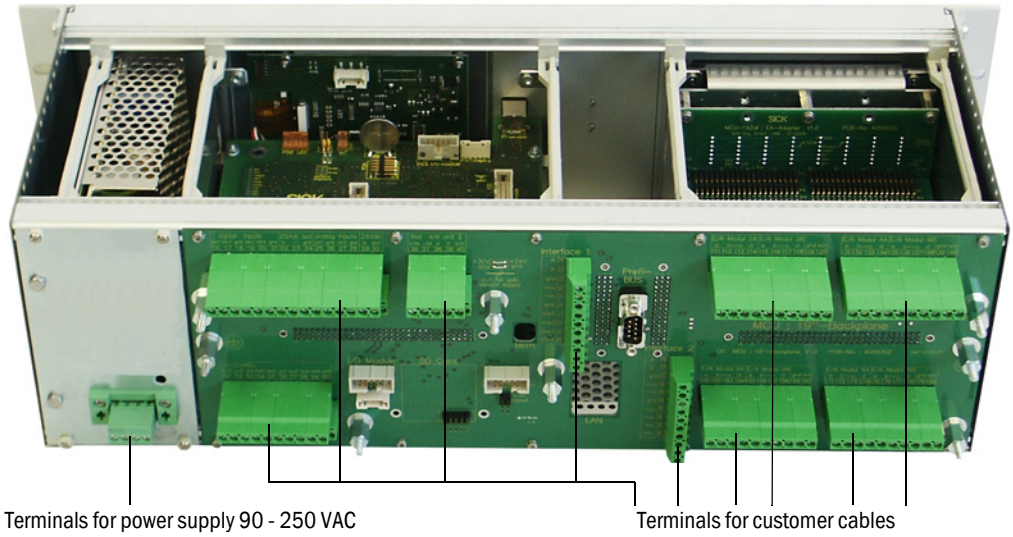
- Terminal assignment, DO module signal relay (4 NO contacts)

Figure 32 Terminal assignment, digital output module signal relay (4 NO contacts)



3.3.3 Connecting the control unit in 19” rack

Figure 33 MCU connections in 19" variant



Function	Connection	Terminal No.
Output relay 1 (operation/malfunction)	com	1
	n.c.[1)]	2
	n.o.[2)]	3
Output relay 2 (maintenance)	com	4
	n.c.[1)]	5
	n.o.[2)]	6
Output relay 3 (check cycle)	com	7
	n.c.[1)]	8
	n.o.[2)]	9
Output relay 4 (maintenance request)	com	10
	n.c.[1)]	11
	n.o.[2)]	12
Output relay 5 (limit value)	com	13
	n.c.[1)]	14
	n.o.[2)]	15
Digital input	d in 1	16
	d in 2	17
	gnd	18
	d in 3	19
	d in 4	20
	gnd	21
Analog output	+	22
	-	23
	gnd	24
Analog input	AI 1	25
	gnd	26
	AI 2	27
	gnd	28

Function	Connection	Terminal No.
Connections for measuring unit	+24	31 (36)
	-24	32 (37)
	RS485 A	33 (38)
	RS485 B	34 (39)
	scr.	35 (40)
Input voltage supply 24V DC	24 V	41
	gnd	42
Output voltage supply 24V DC	24 V	43
	gnd	44
Input 30 V galv. separated	+	45
	-	46
RS232/485	tx/A	51
	rx/B	52
	gnd	53
Interface 1	A	71
	B	72
	gnd	73
	+Us	74
	-Us	75
	gnd	76
	imp+	77
	imp-	78
	res 1	79
	res 2	80

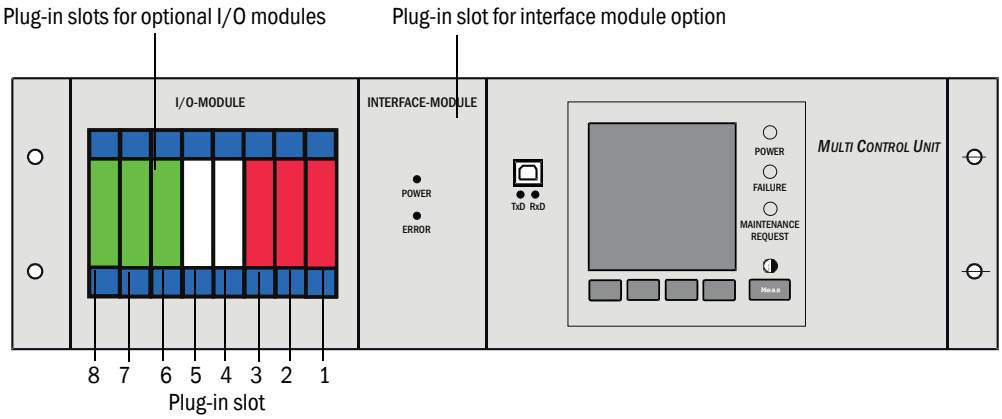
1): Closed in currentless condition (normal closed)

2): Open in currentless condition (normal open)

Installing and connecting optional I/O modules

Plug optional analog and digital modules without gaps in the plug-in slots on the module carrier starting with plug-in slot 1 in consecutive sequence AO → AI → DO → DI. If single module types are not available, the next one follows according to the sequence mentioned.

Figure 34 Plug-in slots for optional modules

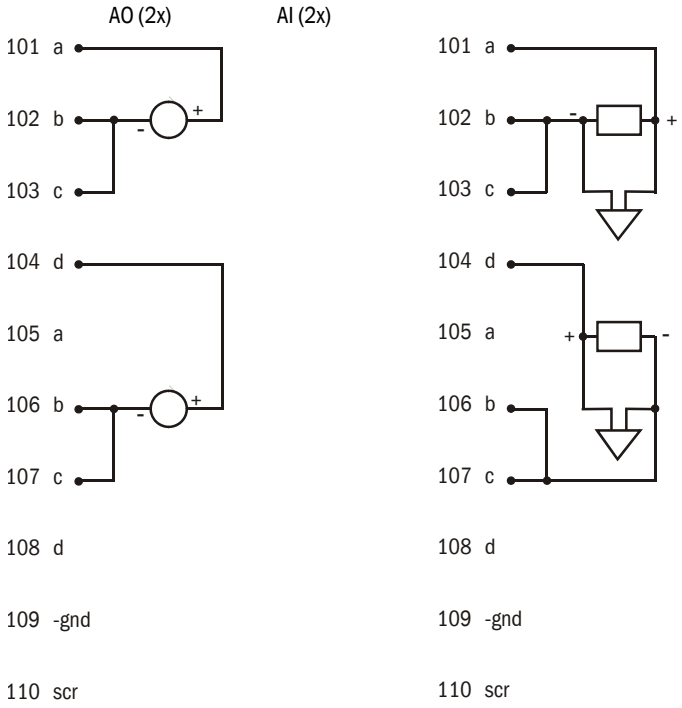


Connection is made on terminals 101-180 of the backplane.

I/O module connection is shown in the following using plug-in slot 1 as an example. I/O modules are connected to plug-in slots 2-8 in the same manner.

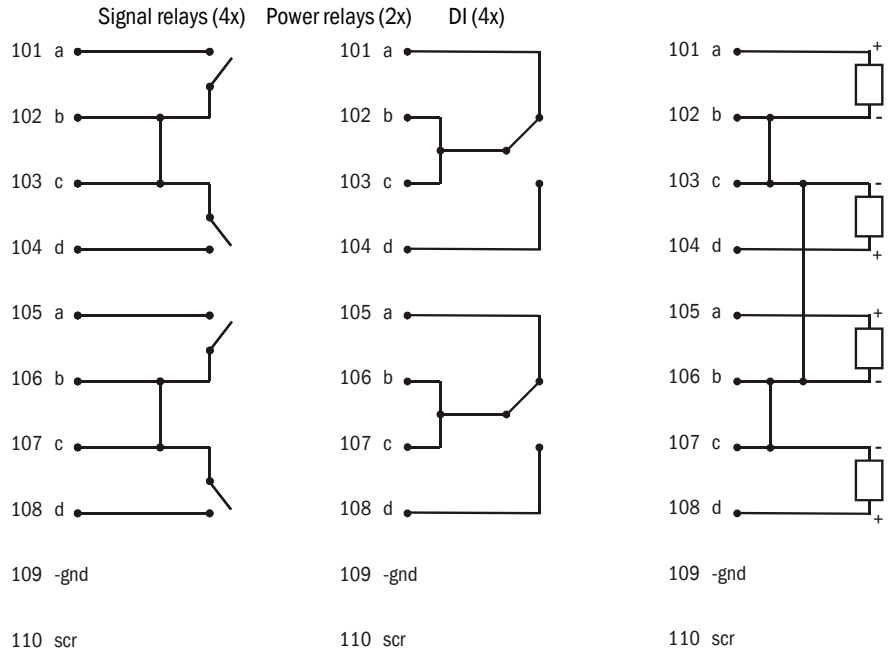
- Analog module connection

Figure 35 Analog module connection to plug-in slot 1 (terminals 101-110



- Digital module connection

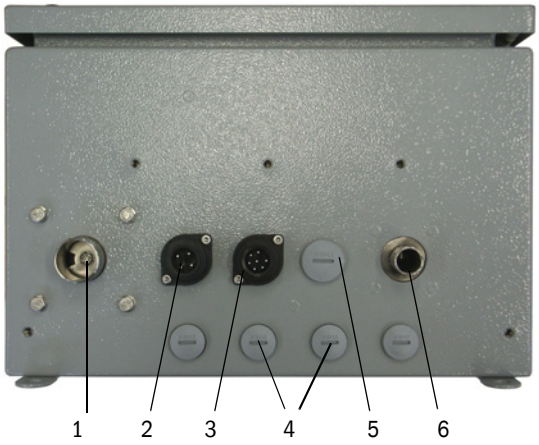
Figure 36 Digital module connection to plug-in slot 1 (terminals 101-110)



3.3.4 **Connecting the measuring unit(s)**

- ► Connect the connection cable to the MCU.
- ► Connect the air intake and exhaust air hoses.

Figure 37 Connections on underside of the measuring unit



1 Air outlet connection
2 Plug for separate power supply for the measuring unit
3 Plug for connecting cable to the MCU
4 Dummy plug *
5 Dummy plug for additional cable
6 Air inlet connection

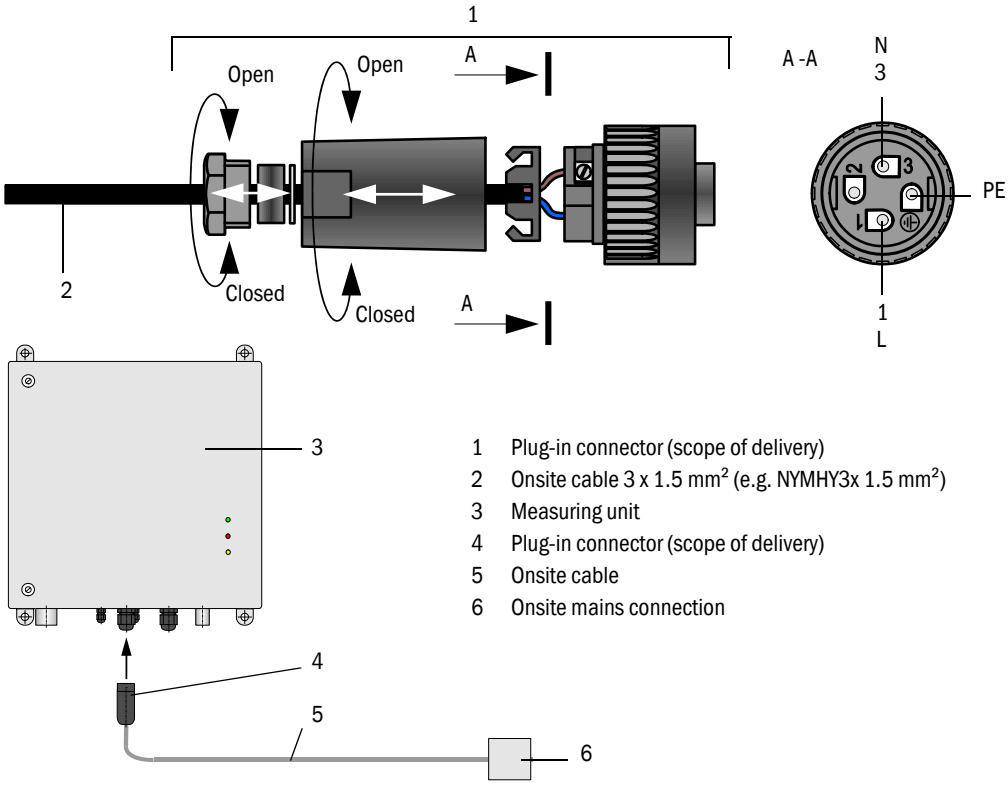
*: Replaced by sockets when the temperature measurement option is installed

Connecting the measuring unit with optional power supply unit 24 V DC 75 W to mains voltage

Connect the plug-in connector belonging to the scope of delivery for this version as shown in the following Figure.

WARNING:
The cable may only be connected to the plug-in connector by an authorized expert!

Figure 38 Connecting the measuring unit with optional power supply unit 24 V DC 75 W to mains voltage



1 Plug-in connector (scope of delivery)
2 Onsite cable 3 x 1.5 mm² (e.g. NYMHY3x 1.5 mm²)
3 Measuring unit
4 Plug-in connector (scope of delivery)
5 Onsite cable
6 Onsite mains connection

Connecting the temperature measurement option

► Connect the plug connected to the measuring line to the associated socket on the measuring unit

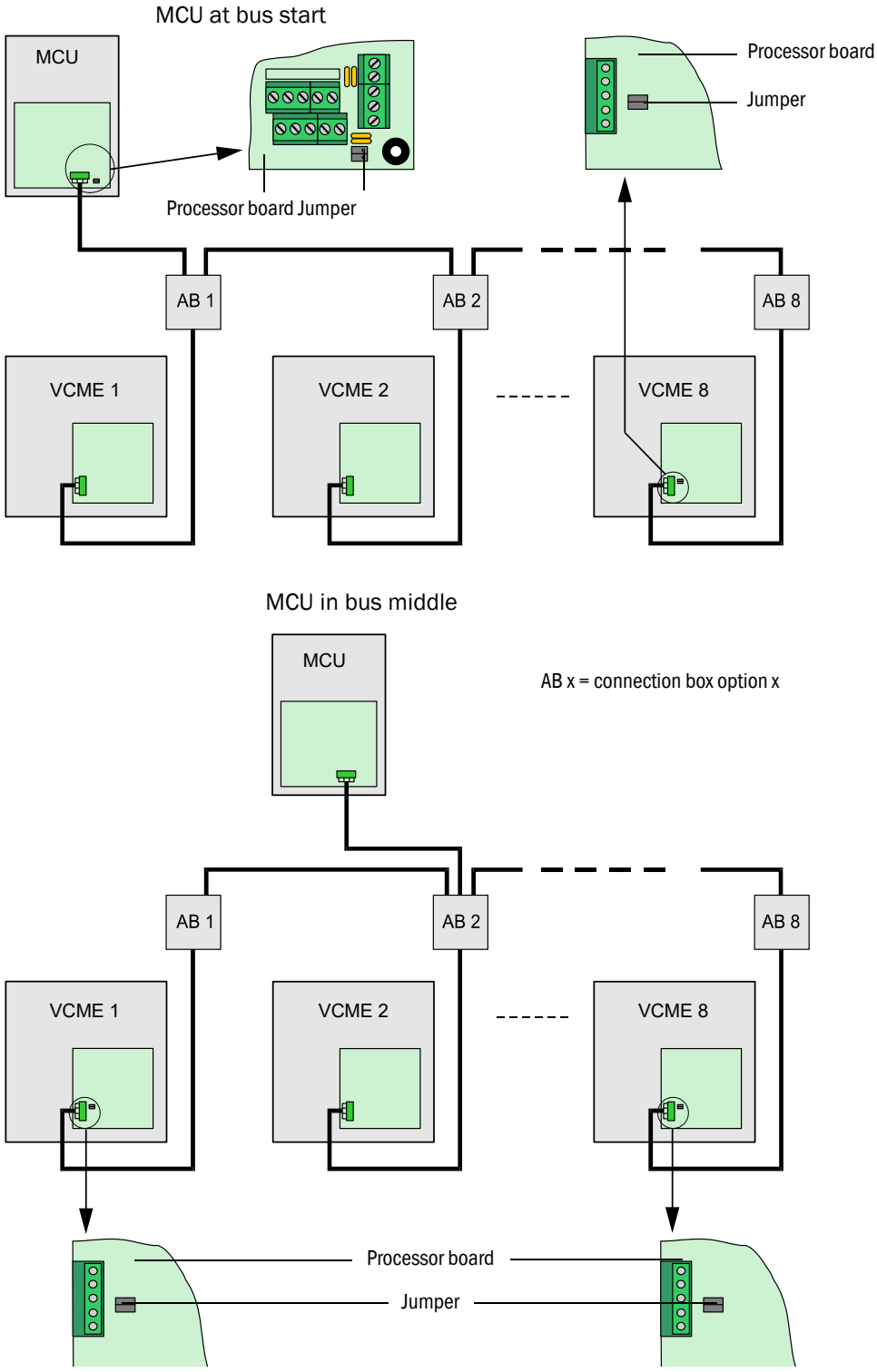
> ***NOTICE:***
> The assignment of the temperature sensor(s) to the connection(s) on the measuring unit according to the identification must be adhered to absolutely because the electronics and temperature sensor are adjusted to each other (adhere to the equipment-specific assignment when several measuring units with this option are used!)

3.3.5 Terminating the VCME - MCU connection

The RS485 connection between VCME and MCU must be terminated with resistors at the start and end. These are inserted as jumpers on the pins marked "term" on the processor boards of VCME and MCU.

Disconnect MCU and VCME from power supply for checking (and correction if necessary).

Figure 39 Bus termination



3.3.6 Bus addressing

The bus addresses required for bus systems (several measuring units on one MCU) can be assigned per hardware or software. Hardware addressing is read in at the start of SOPAS ET and has a higher priority than software addressing.

Bus address and sensor number in the MCU () are always identical.

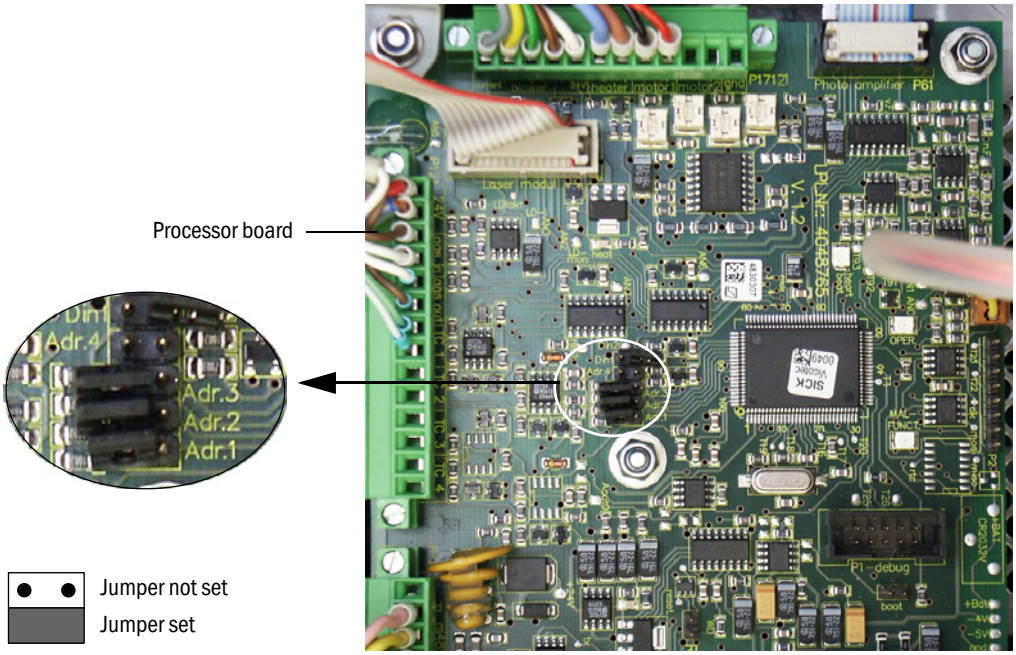
> ***NOTICE:***
> The measuring units must have different addresses. Identical addresses of several units causes the communication with the MCU to abort!

Hardware addressing

As standard, the addresses are assigned by setting jumpers on the processor board in the measuring unit (4 for hexadecimal addressing of addresses 1 to 8; → Fig. 40).

The address assigned to a measuring unit is shown on a label on the unit door.

Figure 40 Measuring unit addressing per hardware



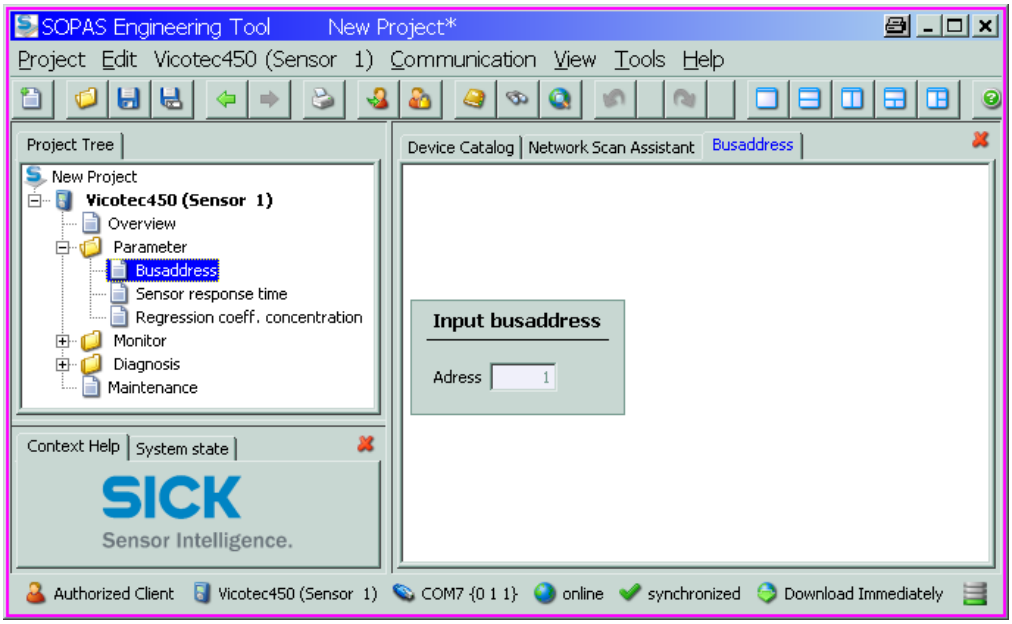
Address	Jumper	Address	Jumper	Address	Jumper	Address	Jumper
1	Adr.4 ● ● Adr.3 ● ● Adr.2 ● ● Adr.1 ■	3	Adr.4 ● ● Adr.3 ● ● Adr.2 ■ ■ Adr.1 ■	5	Adr.4 ● ● Adr.3 ■ ■ Adr.2 ● ● Adr.1 ■	7	Adr.4 ● ● Adr.3 ■ ■ Adr.2 ■ ■ Adr.1 ■
2	Adr.4 ● ● Adr.3 ● ● Adr.2 ■ ■ Adr.1 ● ●	4	Adr.4 ● ● Adr.3 ■ ■ Adr.2 ● ● Adr.1 ● ●	6	Adr.4 ● ● Adr.3 ■ ■ Adr.2 ■ ■ Adr.1 ● ●	8	Adr.4 ■ ■ Adr.3 ● ● Adr.2 ● ● Adr.1 ● ●

Software addressing

Alternatively, addressing can also be assigned in SOPAS ET (→ Fig. 41). To do so, connect the measuring system to SOPAS ET, select the "VICOTEC450" device file and set the measuring system to "Maintenance" mode.

> ***NOTICE:***
> No jumpers may be set (→ p. 49, Fig. 40).

Figure 41 "Parameter / Busaddress" directory



> The default value for the bus address is always 1. Assign higher addresses to units already connected before connecting further measuring units to the bus.

VICOTEC450

4 Startup and configuring

Basics
Customizing the configuration
Configuring optional modules
Operating/configuring via the LC-Display option

4.1 Basics

4.1.1 General information

Prerequisite is that assembly and installation have been completed as described in Section 3.

The VICOTEC450 is delivered with default values set at the factory so that start-up primarily involves checking cable and hose connections (visual control) and switching on the mains voltage. Zero point adjustment or calibration of the measuring system are not required.

The customer only needs to change parameters when the default values need to be modified (e.g. to set a limit value for smoke alarm). SOPAS ET is delivered with the device and can be used in such cases. The menu structure simplifies changing settings. Further functions are also available (e.g. data storage, graphic displays).

4.1.2 Installing the SOPAS ET operating and parameter program

Administrator access rights are required for installation.

Requirements

- Laptop/PC with:
  - Processor: Pentium III (or comparable type)
  - USB interface (alternative - RS232 via adapter)
  - Working memory (RAM): At least 256 MB
  - Operating system: MS Windows ME/2000/XP/Vista (not Windows 95/98/NT)
- USB interface cable to connect the Laptop/PC to the measuring system (MCU).
- The operating and parameter program as well as the USB driver (scope of delivery) must be installed on the Laptop/PC.
- The voltage supply must be switched on.

NOTICE:
SOPAS ET with version 02.22 (or higher) must be used for measuring units with firmware version as from 03.00.00 (otherwise communication is not possible).

Installing SOPAS ET

Insert the delivered CD in the PC drive, select the language, select "Software" and follow the instructions.

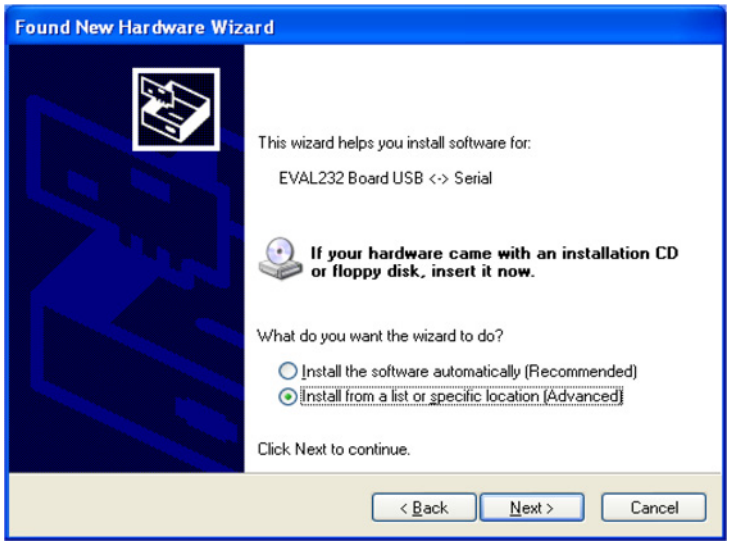
Start the file "setup.exe" should the start screen not appear.

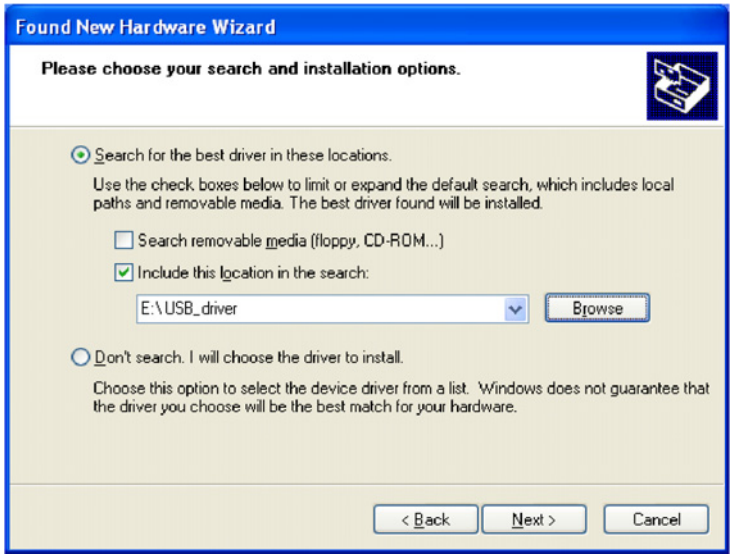
Installing the USB driver

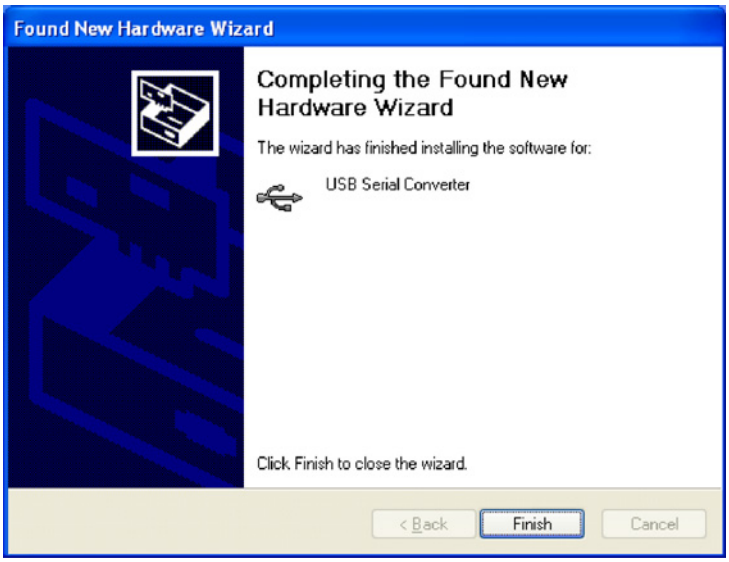
A special software driver is required for communication between SOPAS ET and the measuring system via the USB interface. Connect the MCU to the supply voltage and to the PC via USB cable to install the driver on the Laptop/PC. A message appears on the display that new hardware has been detected. Then insert the delivered CD in the PC drive and follow the installation instructions (→ p. 53, Fig. 42). The driver can also be installed by using the hardware installation program of the Windows Control Panel.

The USB driver creates a new COM port that is then used to connect SOPAS ET with the device (→ p. 57, §4.1.3.2).

Figure 42 Installing the USB driver



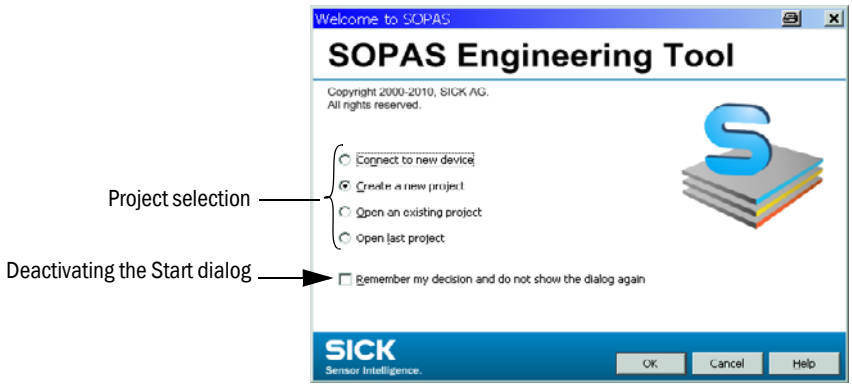




4.1.3 Connecting the device

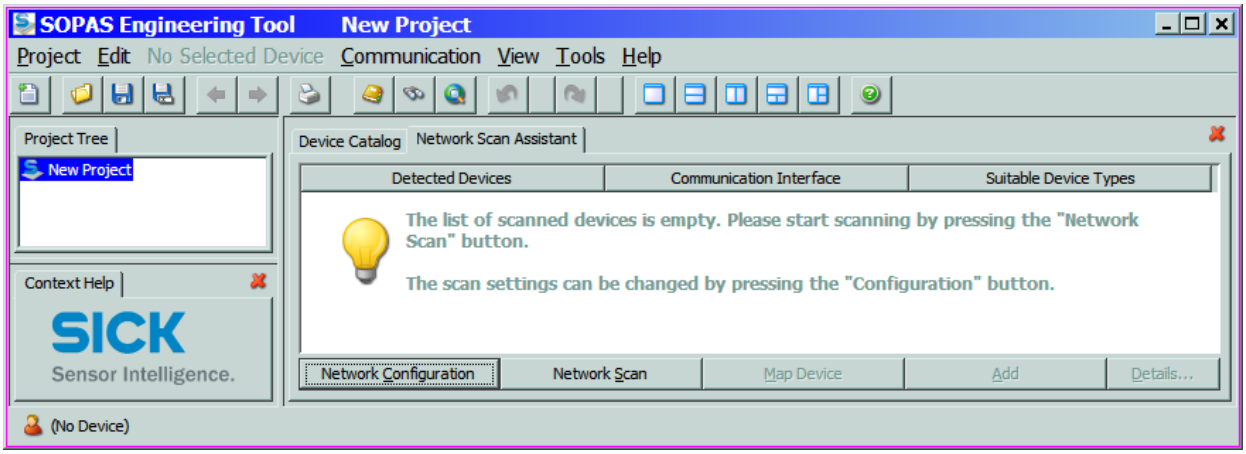
- ► Connect the USB cable to the MCU control unit (→ p. 39, Fig. 25) and Laptop/PC.
- ► Start the program from the "SICK\SOPAS" start menu.
- ► The start dialog appears on the screen (can be suppressed for further program use).

Figure 43 Start dialog



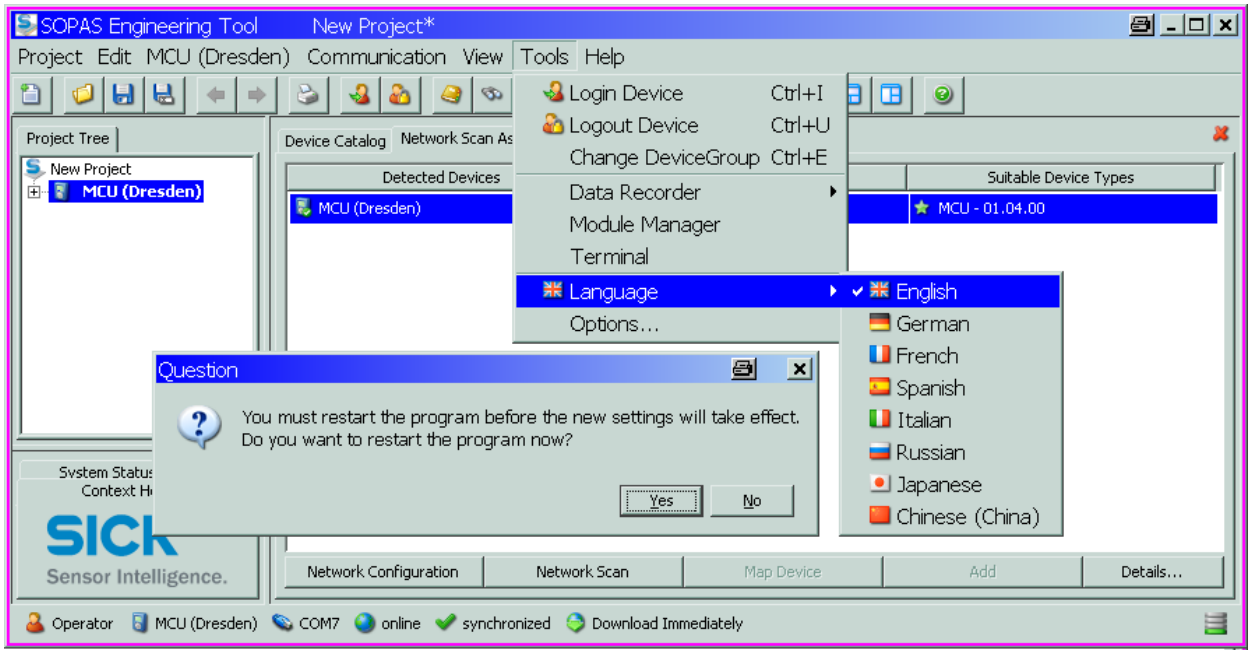
The following Start menu appears after confirmation with "OK".

Figure 44 Start menu



- ► If required, select the desired language in the "Tools / Language" menu (→ p. 55, Fig. 45→ p. 55, Fig. 45), confirm with "OK", and restart the program.

Figure 45 Changing the language setting

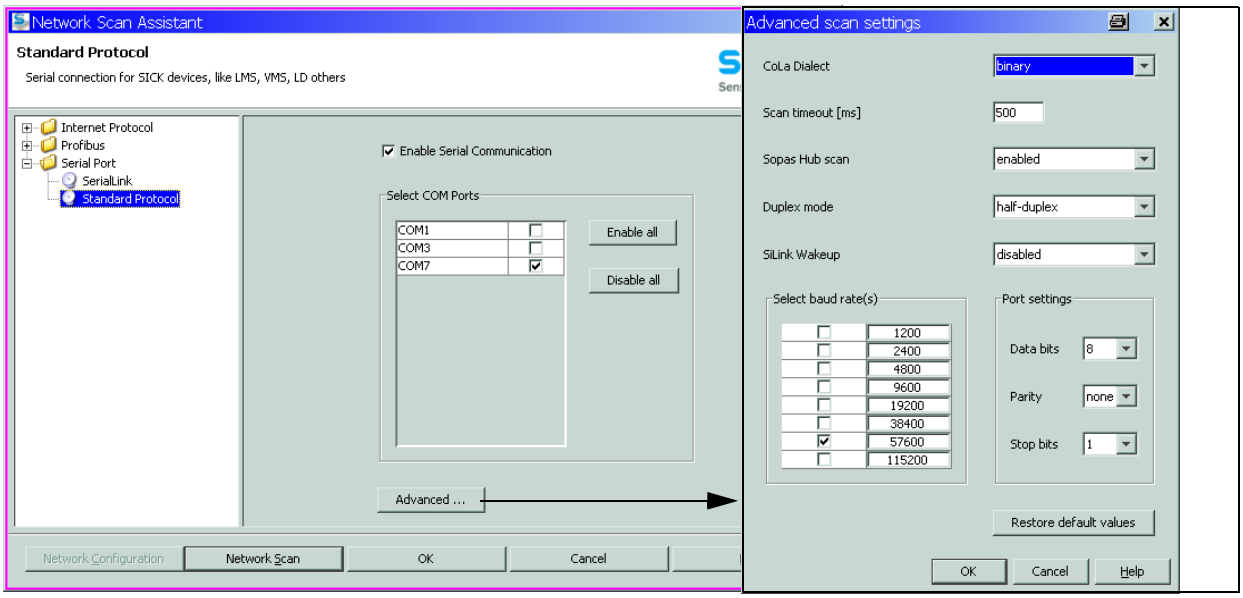


4.1.3.1 **Configuring the interface**

COM Port

- ► Click "Network Configuration" in the start menu (→ p. 54, Fig. 44) and select "Standard Protocol".
- ► Select the COM port in the "Select COM Ports" group that appears after connection of MCU and Laptop/PC, click the "Advanced..." button and configure in accordance with Fig. 46 (settings only required during the first connection to the measuring system).

Figure 46 COM port selection and configuration

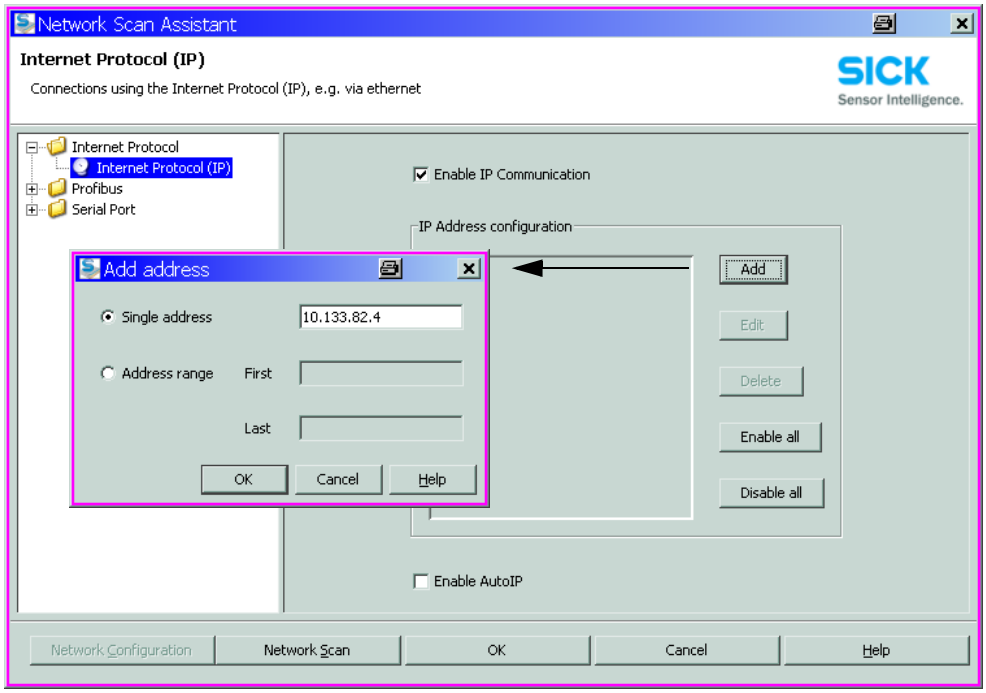


Ethernet

The Ethernet interface module (→ p. 115, §7.4.2) must be installed in the MCU (→ p. 38, §3.3.2) and configured (→ p. 80, §4.3.2) to connect to the measuring system via Ethernet.

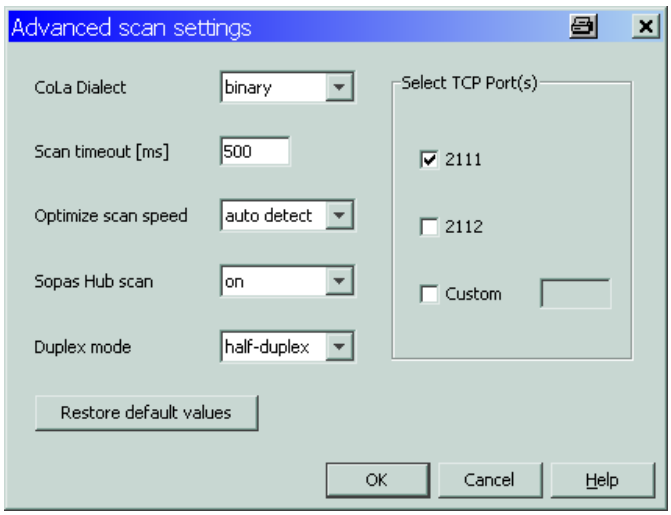
- ► Click "Network Configuration" in the start menu (→ p. 54, Fig. 44) and select "Internet Protocol (IP)".
- ► Click "Add ", enter the IP address and confirm with "OK".

Figure 47 Ethernet interface selection (example settings)



- ► Click "Advanced..." and configure the interface in accordance with Fig. 48.

Figure 48 Configuring the Ethernet interface

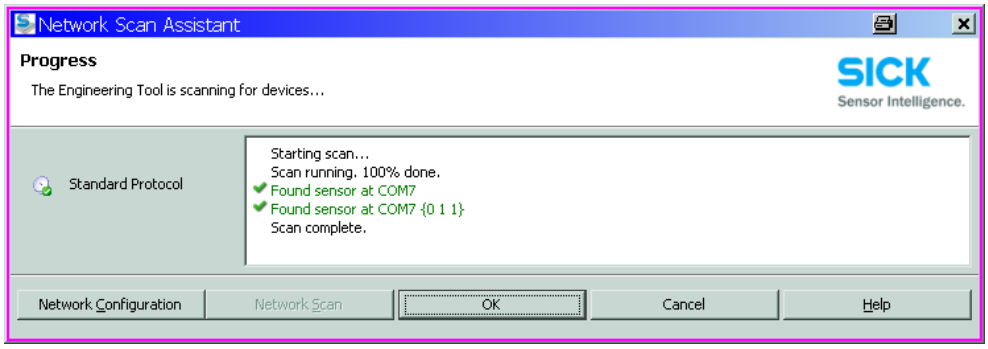


4.1.3.2 **Connecting using the "Network Scan Assistant" directory**

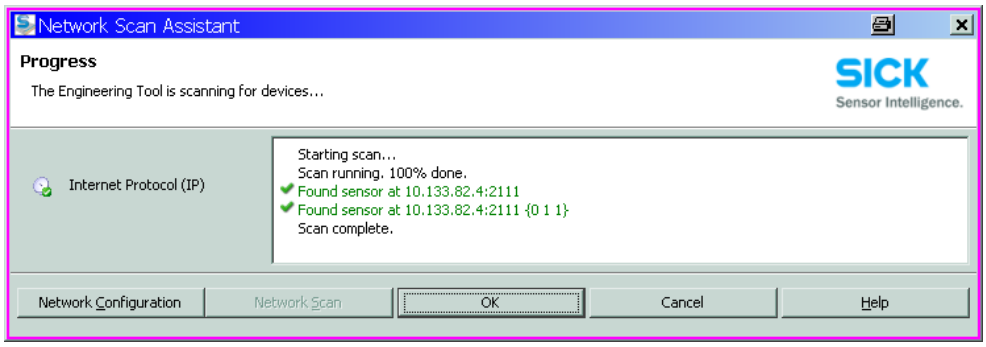
► Click "Network Scan" in the "Network Scan Assistant" directory.

Figure 49 Searching for connected devices

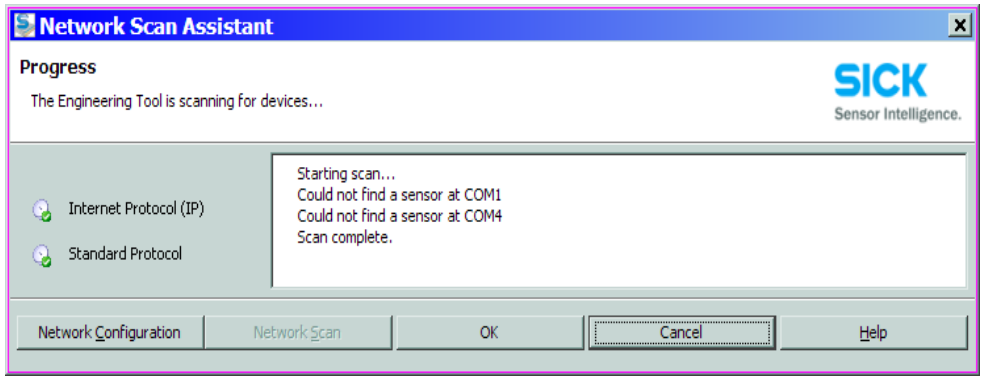
Connection via COM port



Connection via Ethernet



The following message appears when no device is found (troubleshooting, see Service Manual):



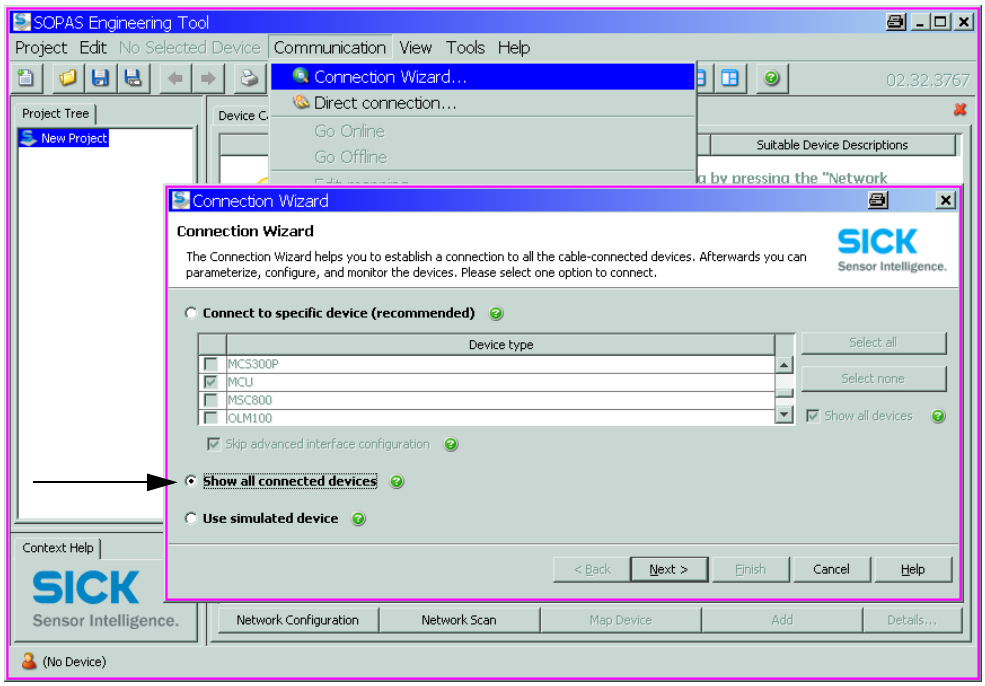
Problems with Ethernet connections can be caused by incorrect addressing → contact system administrator.

► Confirm search for connected devices with "OK".

4.1.3.3 **Connecting using the "Connection Wizard" menu (valid as from SOPAS ET Version 02.32)**

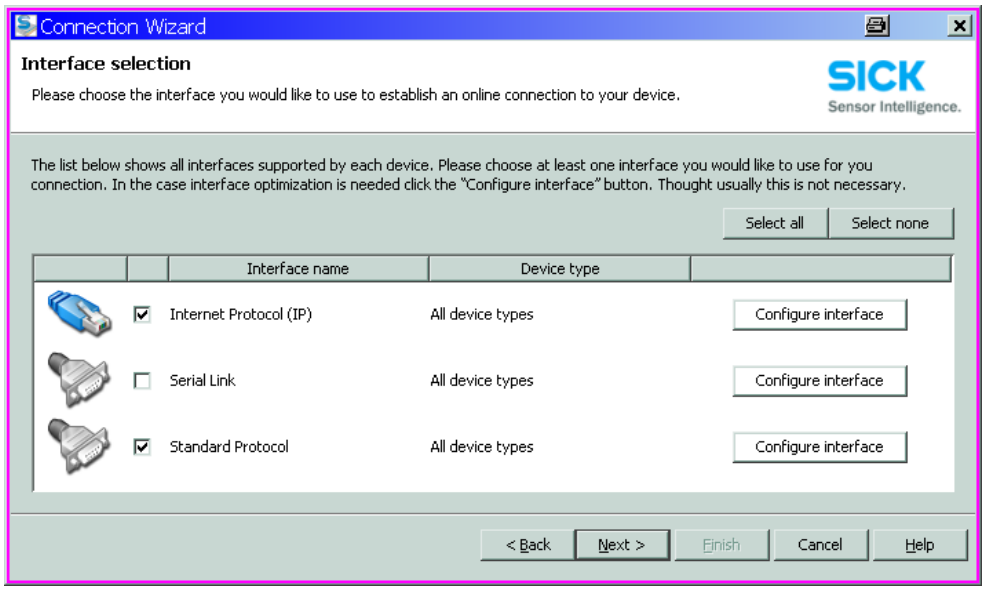
► Select menu "Communication / Connection Wizard" and activate "Show all connected devices".

Figure 50 "Communication / Connection Wizard" menu



► Click "Next >" and select the interface ("Standard Protocol" for connection via COM port, "Internet Protocol (IP)" for connection via Ethernet).

Figure 51 Selecting the interface

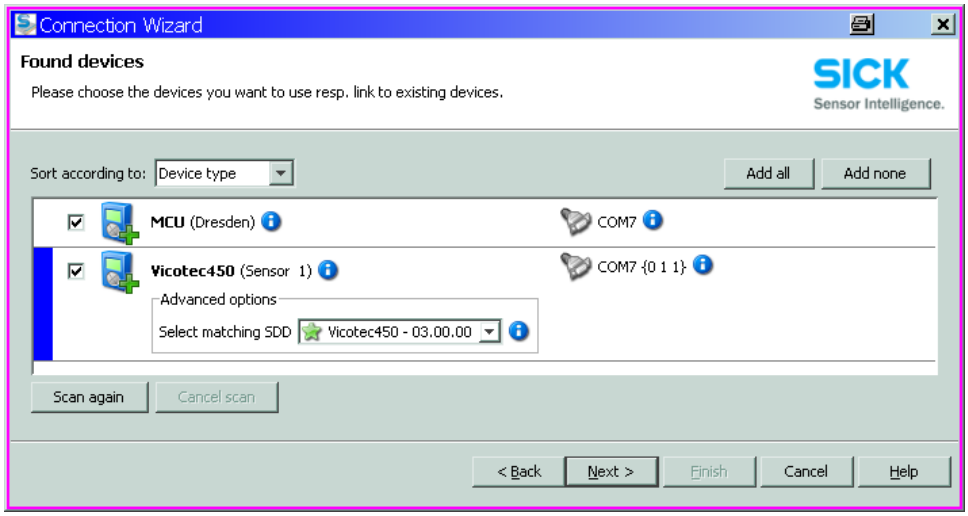


► Check the interface configuration for settings in accordance with p.57, §4.1.3.2 and change accordingly if necessary.

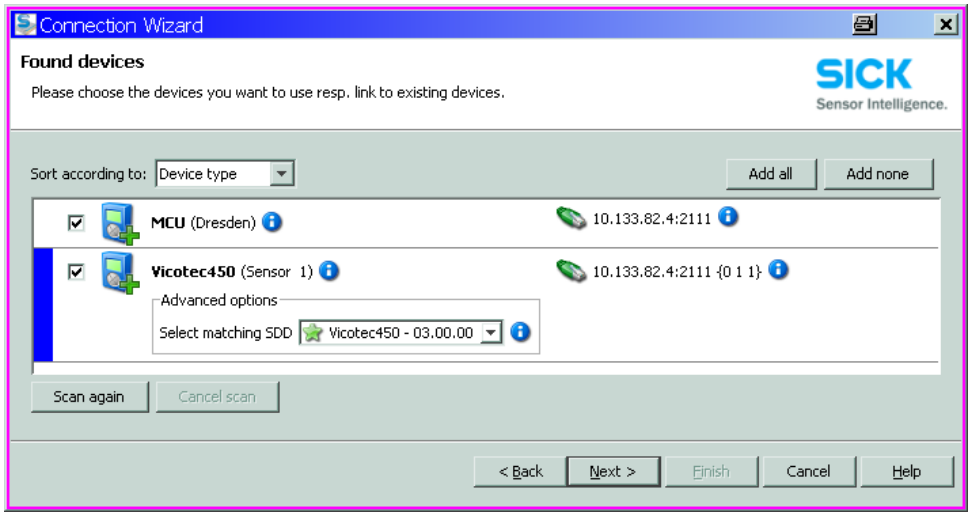
► Click "Next >".

Figure 52 Searching for connected devices

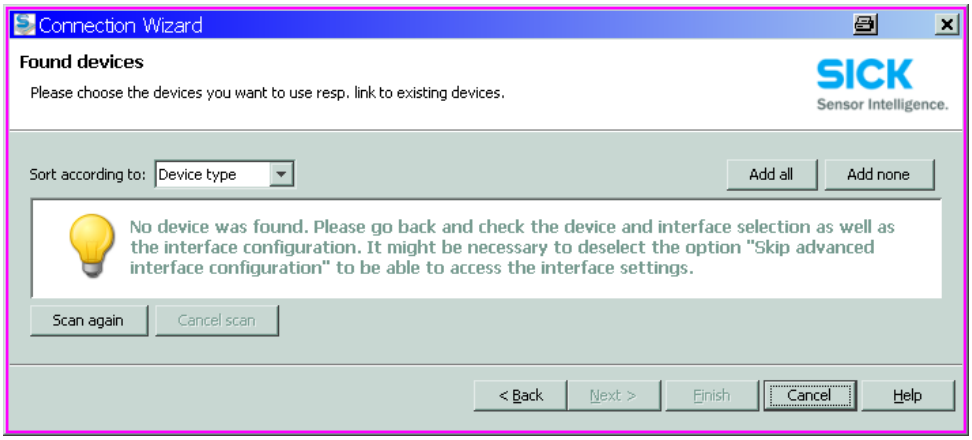
Connection via COM port



Connection via Ethernet



The following message appears when no device is found (troubleshooting, see Service Manual):

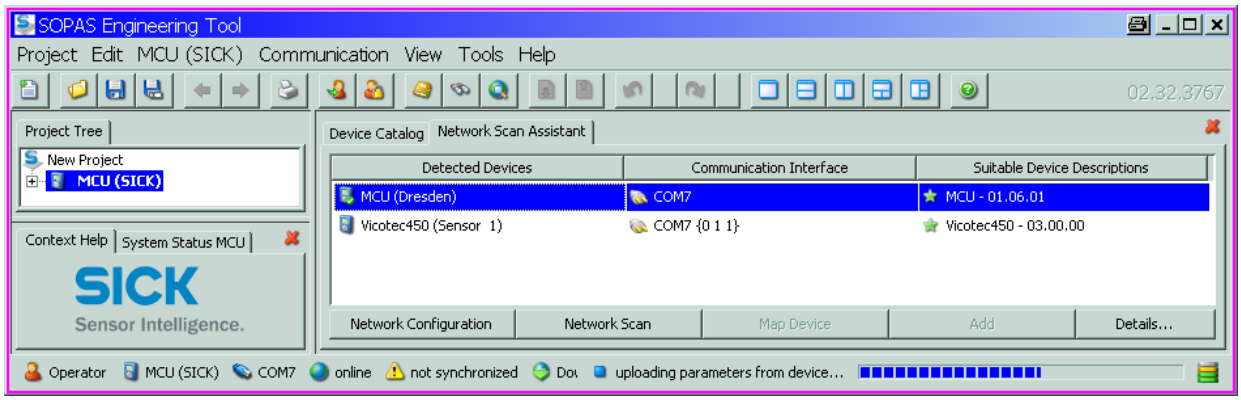


4.1.3.4 Selecting the device

Connection via COM port

Select the required device file in the "Network Scan Assistant / Detected devices" register and move it to the "Project Tree" window (drag-and-drop per mouse or click "Add").

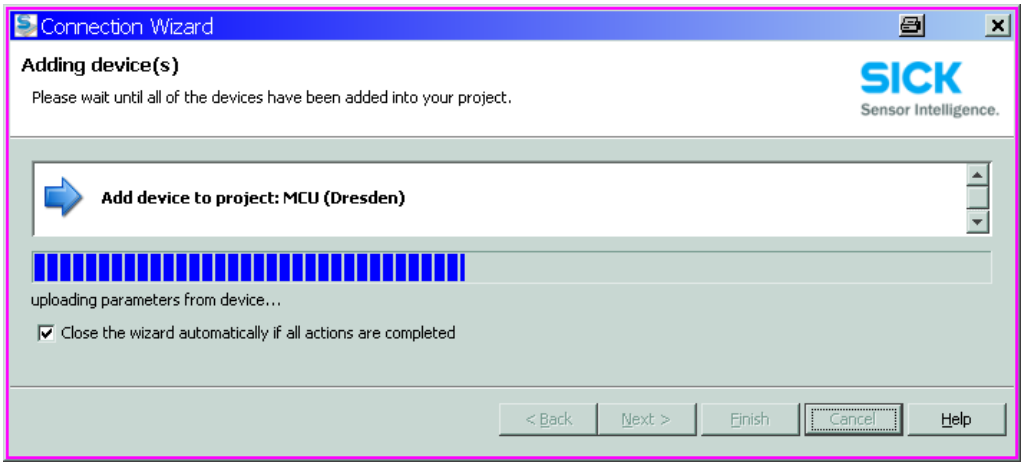
Figure 53 Selecting the device file



Connection via "Connection Wizard" menu

Activate the checkbox of the required device file in the "Connection Wizard / Found devices" (→ p. 59, Fig. 52) and click "Next >". This transfers the device file to the "Project Tree" window.

Figure 54 Transferring the device file



4.1.4 Information on using the program

Password

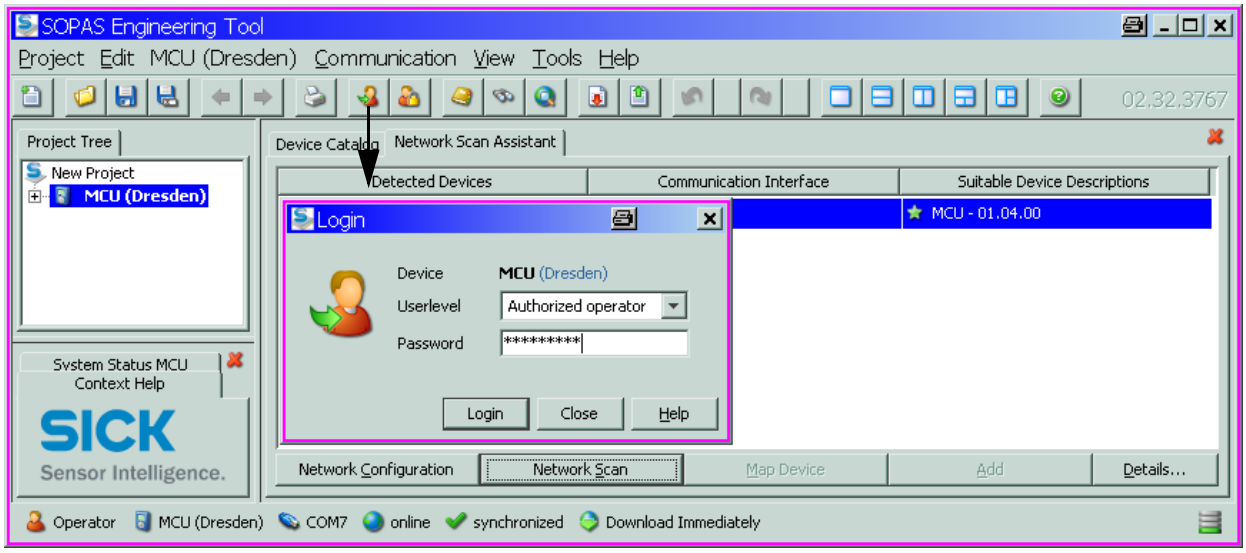
Certain device functions are first accessible after a password has been entered (→ Fig. 55). Access rights are assigned in 3 levels:

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

*): Depends on the program version

The level 1 password is contained in the Annex.

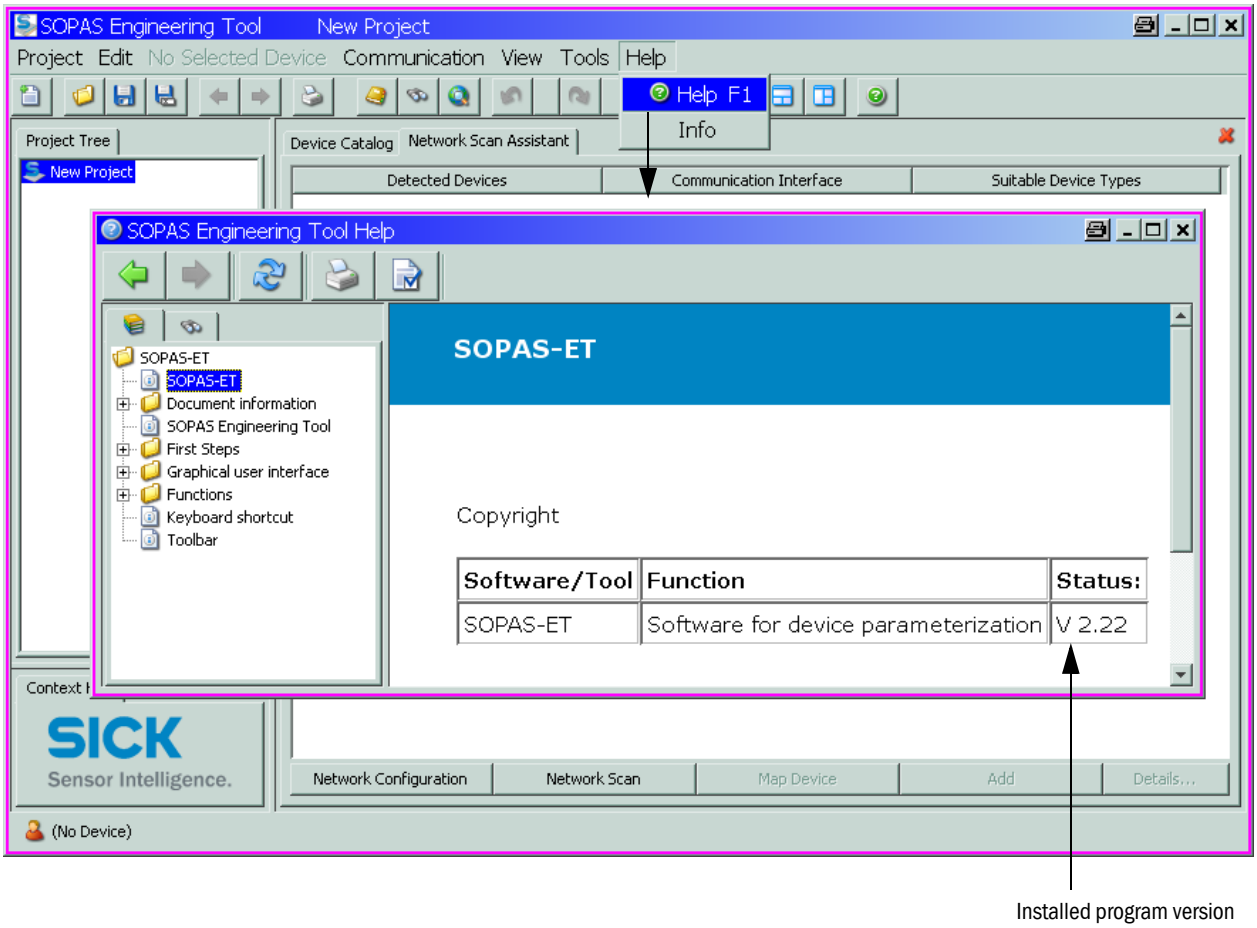
Figure 55 Entering the password



4.1.5 Online Help

Individual menus and setting options are described in detail in the Online Help and are therefore not described further here.

Figure 56 Online Help



4.2 Customizing the configuration

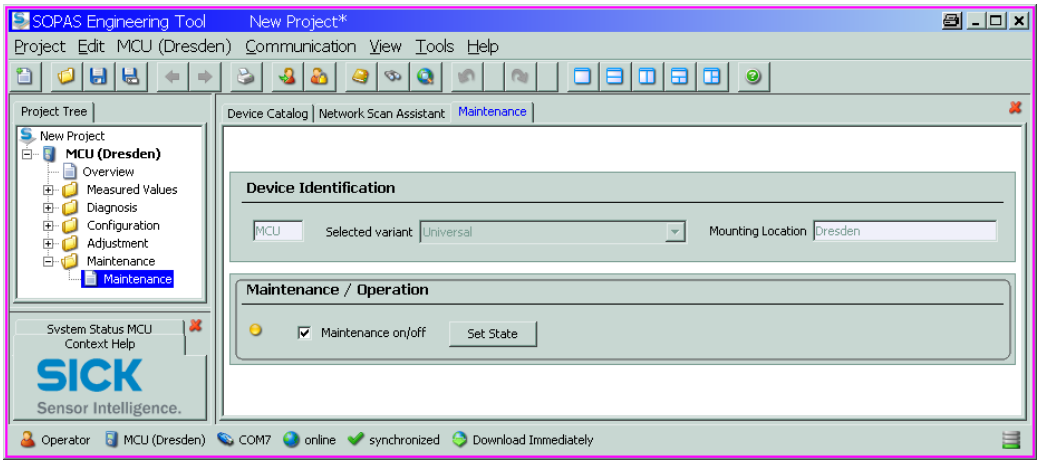
Factory settings

Parameter		Value
Analog output setting (AO)	Live zero (LZ)	4 mA
	Upper measuring range value	20 mA
	Current during maintenance	0.5 mA
	Current by malfunction	No output on AO
Output on standard AO	Measured variable	k value
	Value for LZ	0 /km
	Value for FS	15 /km
Check cycle		Every 24 h; no output of check values on standard analog output
Response time		60 s for all measured variables
Coefficients set (only for dust concentration)		0.00 / 1.00 / 0.00

Connect the measuring system to SOPAS ET and move the required device file to the "Project Tree" window (→ p. 54, §4.1.3) to set or change parameters. Then enter the level 1 password (→ p. 61, §4.1.4), and set the measuring system to "Maintenance" mode (open the "Maintenance/Maintenance" directory, activate the "Maintenance on/off" checkbox, and press "Set State".

Use device file "MCU" to configure.

Figure 57 Setting "Maintenance" mode



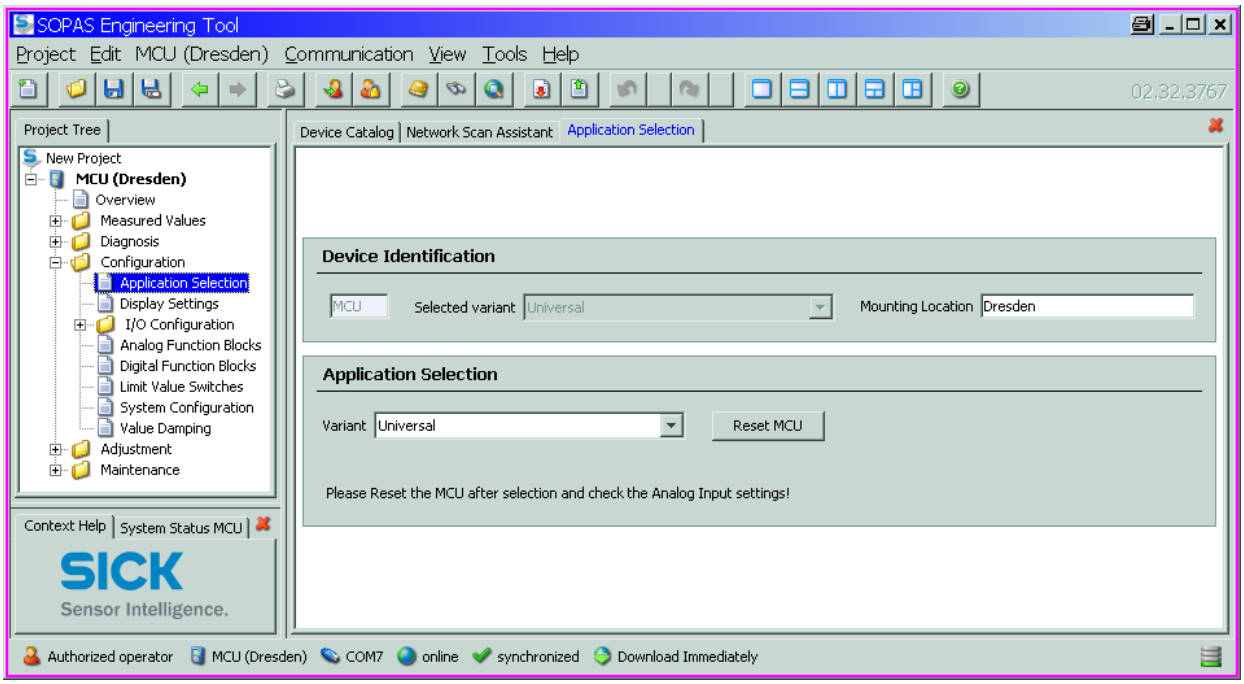
4.2.1 Assigning the sensors

The MCU must be assigned to the connected measuring unit. 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:

- ► Select the "MCU" device file and open the "Configuration / Application selection“ directory.
- ► Click "Reset MCU" when the type shown in the "Variant" window ("Application selection" group) is correct ("Universal" for VICOTEC450).

The measuring unit must be connected to the MCU.

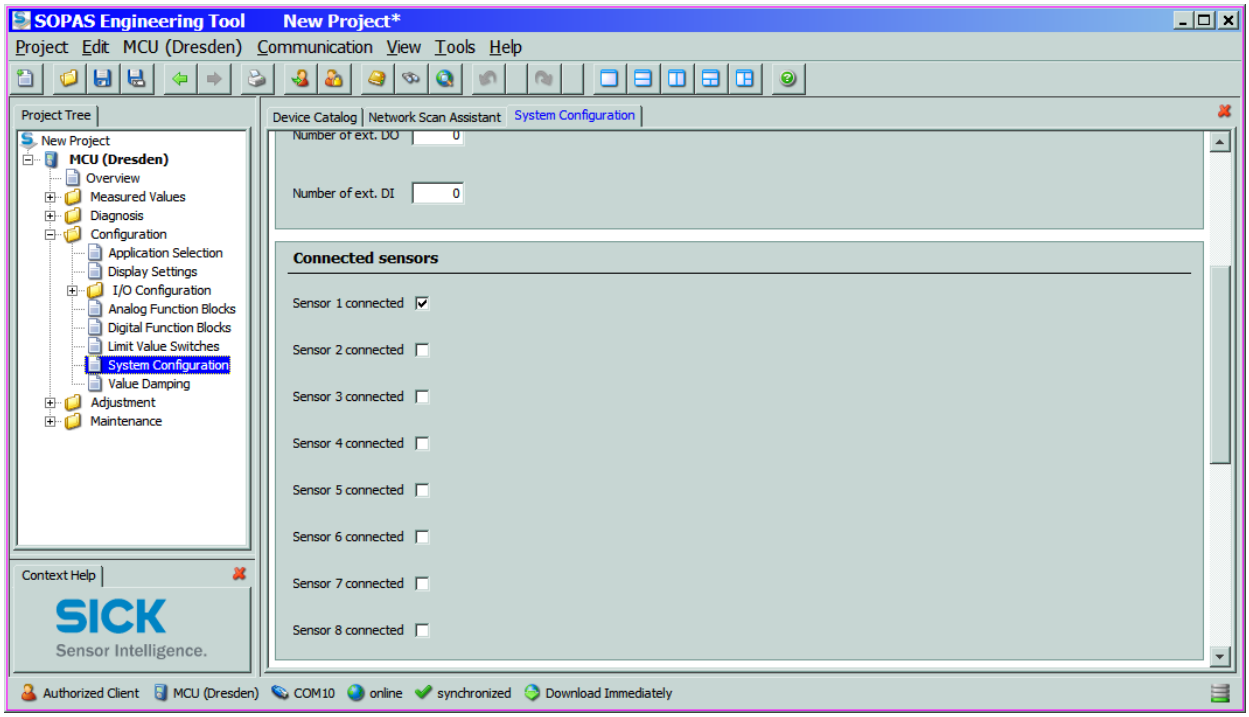
Figure 58 Assigning the sensor



4.2.2 Activating connected measuring units

All measuring units connected to the MCU must be activated for correct communication by checking them in the "Connected sensors" group in the "Configuration / System Configuration" directory (→ p. 65, Fig. 59) (correct when necessary).

Figure 59 "Configuration / System Configuration" directory (example for settings)

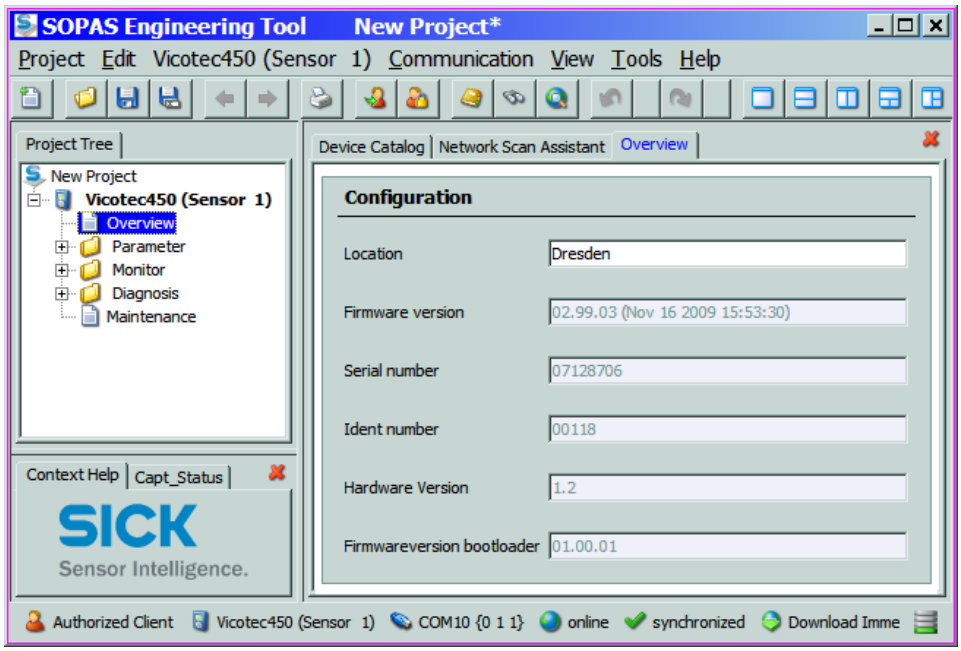


4.2.3 Assigning the measuring system to the installation location

Measuring unit and MCU can be assigned explicitly to the respective measuring location.

- ► Select "Configuration / Application Selection“ directory (→ p. 64, Fig. 58) for the MCU.
- ► Move the "Vicotec450" device file into the "Project tree" window and select the "Overview" directory for the measuring unit.
- ► Enter the desired name in the "Location" window.

Figure 60 "Overview" directory

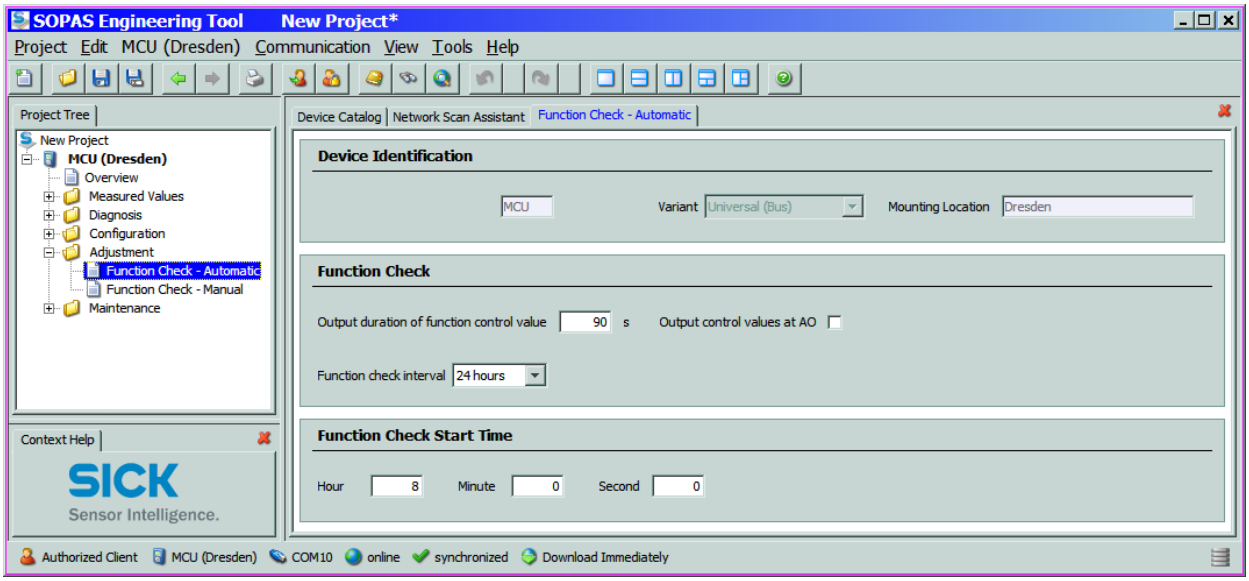


4.2.4 Defining the check cycle

To set/change the interval time, control value output on the analog output and the starting timepoint for the automatic check cycle, move the "MCU" device file into the "Project tree" window and select the "Adjustment / Function Check - Automatic" directory.

Default values → p. 63, §4.2

Figure 61 "Adjustment / Function Check - Automatic" directory (example for settings)



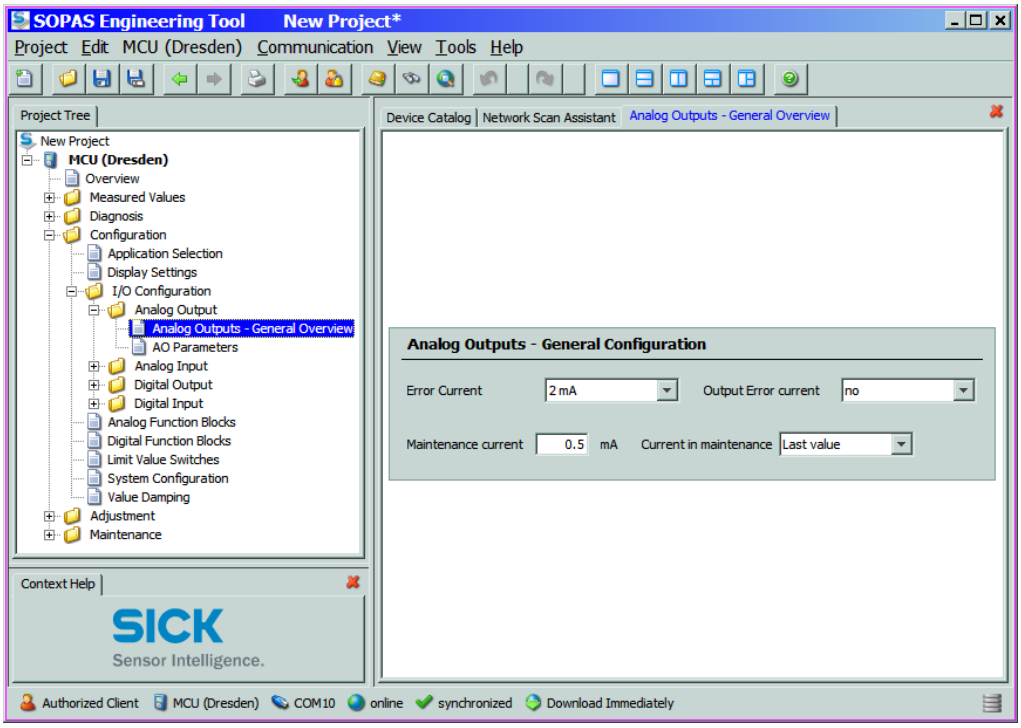
Field	Parameter	Remark
Function check output duration	Value in seconds	Output duration of control values
Output duration of function control value at AO	Inactive	Control values are generally not output on the analog output.
	Active	Control values can be output on the respective analog output depending on this setting (→ p. 68, Fig. 63).
Function check interval	Time between two check cycles	→ p. 15, §2.1.4 (recommended value 24 h)
Function Check Start Time	Hours	Defines a start timepoint in hours, minutes and seconds
	Minutes	
	Seconds	

4.2.5 Configuring the analog output

Basic settings

Enter the current to be output on the analog output in the "Maintenance" or "Malfunction" state in the "Configuration / I/O Configuration / Analog Output / Analog Outputs - General Overview" directory.

Figure 62 "Overview" submenu (example for settings)

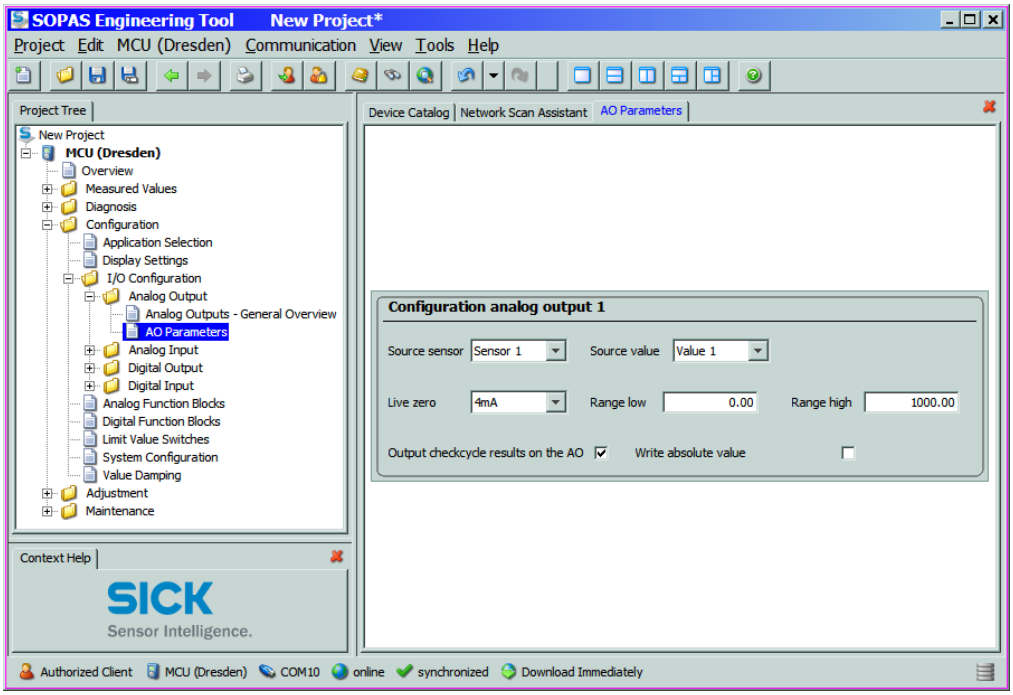


Field	Parameter	Remark
Error Current	Value < Live Zero (LZ) or > 20 mA	mA value to be output in "Malfunction" state (error case) (size depends on connected evaluation system).
Output error current	yes	The error current is output.
	no	The error current is not output.
Maintenance current	Value if possible ≠ Live Zero	mA value to be output during "Maintenance" mode
Current in maintenance	User value	A value to be defined is output during "Maintenance"
	Last measured value	The value measured last is output during "Maintenance"
	Measured value output	The current measured value is output during "Maintenance".

Configuring

The "Configuration / I/O Configuration / Analog Output / AO Parameters" directory serves to assign the signal source (measuring signal of a measuring unit) to the standard analog output (AO), and to define the values for Live Zero and measuring range.

Figure 63 "AO Parameters" submenu (example for settings)



Field	Parameter	Remark
Source sensor	Sensor 1 to 8	Measuring unit for which the output signal is to be assigned to the analog output.
Source value 1)	Value 1	Scattered light intensity
	Value 2	Inlet temperature [°C]
	Value 3	Heater temperature [°C]
	Value 4	External temperature 1 [°C] *
	Value 5	External temperature 2 [°C] *
	Value 6	Dust concentration [mg/m³] * 2)
	Value 7	k value [/km]
	Value 8	Visibility [m]
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.
Range low	Lower measuring range limit	Physical value at live zero
Range high	Upper measuring range limit	Physical value at 20 mA
Output check cycle results on the AO	Inactive	Control values (→ p. 15, §2.1.4) 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.

1): Assignment is made at the factory in the predefined sequence. The next sequential measured variable moves up one position when an option (*) has not been ordered. Assignment is made by Endress+Hauser Service when options are added later.

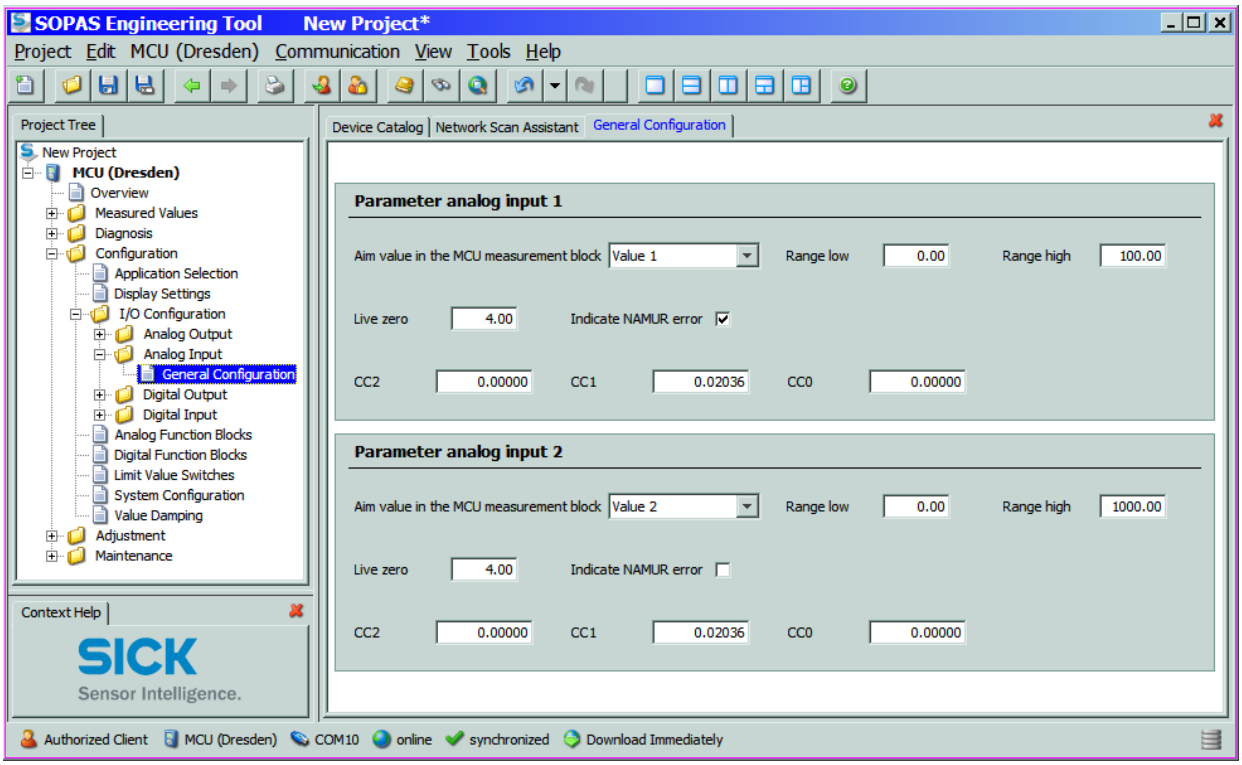
2): Only important for special applications

4.2.6 Configuring the analog inputs

The "Configuration / I/O Configuration / Analog input / General Configuration" directory serves to assign the standard analog inputs (groups "Parameter analog input 1" and "Parameter analog input 2") to measured values for possible scaling, and to define the respective measurement range.

> ***NOTICE:***
> Calibration coefficients CC2, CC1 and CC0 are predefined at the factory and may only be changed by Endress+Hauser Service.

Figure 64 "Configuration / I/O Configuration / Analog input / General Configuration" directory (example for settings)

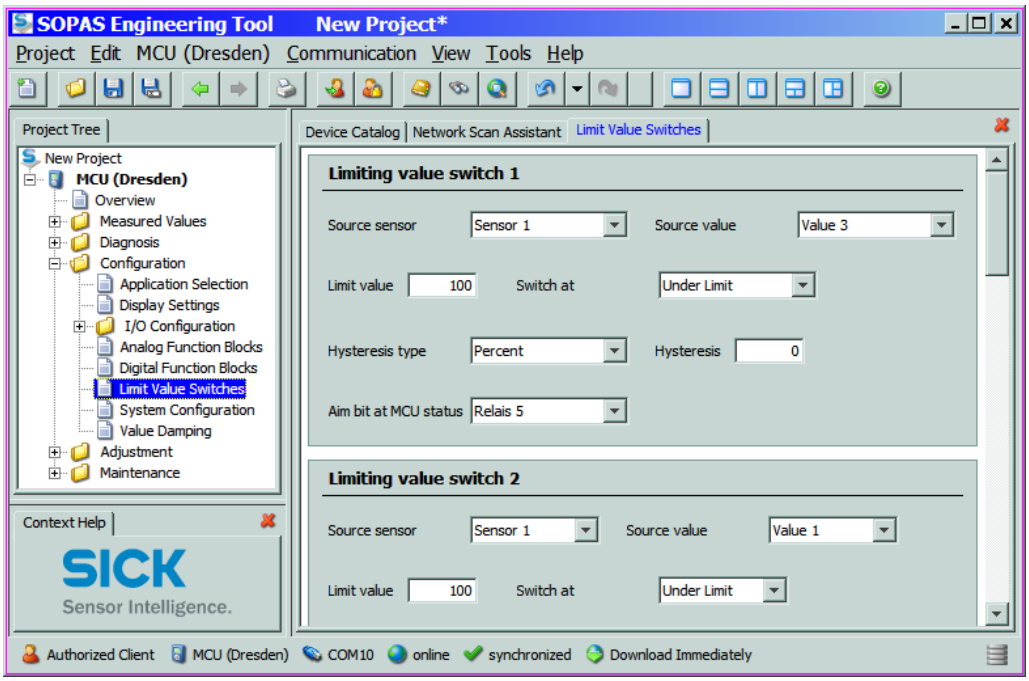


Field	Parameter	Remark
Aim value in the MCU measurement block	Measured value 1 to 8	Variable to be assigned to the selected analog input
Range low	Lower measuring range limit	Physical value at live zero
Range high	Upper measuring range limit	Physical value at maximum current
Live Zero	Zero point value > 0 mA)	Specification of the mA value for measurement range start
Indicate NAMUR error	Inactive	No error is reported for underflow or overflow of the set current range (LZ to 20 mA).
	Active	An error is reported for underflow or overflow of the set current range (LZ to 20 mA).

4.2.7 Configuring the limit value relay

Select the "Configuration / Limit Value Switches" directory for configuring.

Figure 65 ”Configuration / Limit Values Switches” directory



Field	Parameter	Remark
Source sensor	Sensor 1 to 8	Sensor for which a limit value is to be assigned to the output signal.
Source value 1)	Value 1	Scattered light intensity
	Value 2	Inlet temperature [°C]
	Value 3	Heater temperature [°C]
	Value 4	External temperature 1 [°C] *
	Value 5	External temperature 2 [°C] *
	Value 6	Dust concentration [mg/m³] * 2)
	Value 7	k value [/km]
	Value 8	Visibility [m]
Limit value	Value	The limit value relay switches when the entered value is overflown or underflown.
Switch at	Over Limit	Specification of the switching direction
	Under Limit	
Hysteresis type	Percent	Assignment of the value entered in the "Hysteresis Type" field as relative or absolute value of the defined limit value
	Absolute	
Hysteresis	Value	Defines a tolerance for resetting the limit value relay
Aim bit at MCU status	Relay 5	Aim bit = special memory in the MCU for monitoring limit values

1): Assignment is made at the factory in the predefined sequence. The next sequential measured variable moves up one position when an option (*) has not been ordered. Assignment is made by Endress+Hauser Service when options are added later.

2): Only important for special applications

4.2.8 Calibrating for dust concentration measurement

Measuring the dust concentration is only important for special applications.

NOTICE:
The steps described here serve to avoid input errors. Carrying out comparison measurements demands special knowledge that cannot be described in detail here.

For exact dust concentration measurement, the relation between the primary measured variable scattered light intensity and the actual dust concentration at the measuring location must be established. To do this, the dust concentration must be determined based on a gravimetric comparison measurement in accordance with EN 13284-1 or comparable regulations and set in relation to the scattered light values measured at the same time by the measuring system.

Steps to be taken

- Select the "Configuration / I/O Configuration / Analog Output / AO Parameters" directory (→ p. 68, Fig. 63) and assign the "Scattered light intensity" measured variable to the analog output.
- Estimate the measuring range required for the dust concentration in operational state and enter the lower and upper measuring range limits
- Deactivate "Maintenance" mode.
- Carry out the gravimetric comparison measurement in accordance with EN 13284-1,.
- Determine regression coefficients from the mA values of the analog output for "Scattered light intensity" and the dust concentrations act. 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

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

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

- Enter the calibration coefficients

  There are two options:

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

NOTICE:
In this case, the regression coefficients set in the measuring unit and the measuring range set in the MCU may not be changed anymore. The dust concentration is displayed in mg/m³ on the LC-Display as an uncalibrated value.

– Using the regression function of the measuring system (measured value computer not necessary).
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.

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

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

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

Using (3), the result is as follows:

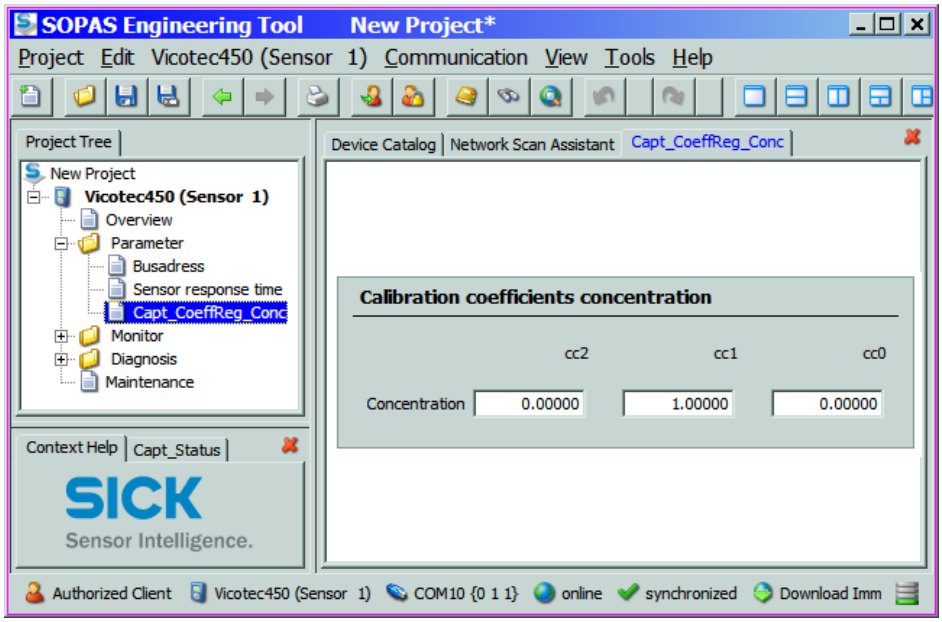
$$cc0 = K2 \cdot LZ^2 + K1 \cdot LZ + K0$$

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

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

Now enter the determined regression coefficients cc2, cc1 and cc0 in the "Parameter / Capt_CoeffReg_Conc" directory. To do this, select the "Vicotec450" device file, set the measuring unit to "Maintenance" mode and enter the level 1 password.

Figure 66 "Parameter / Capt_CoeffReg_Conc" directory



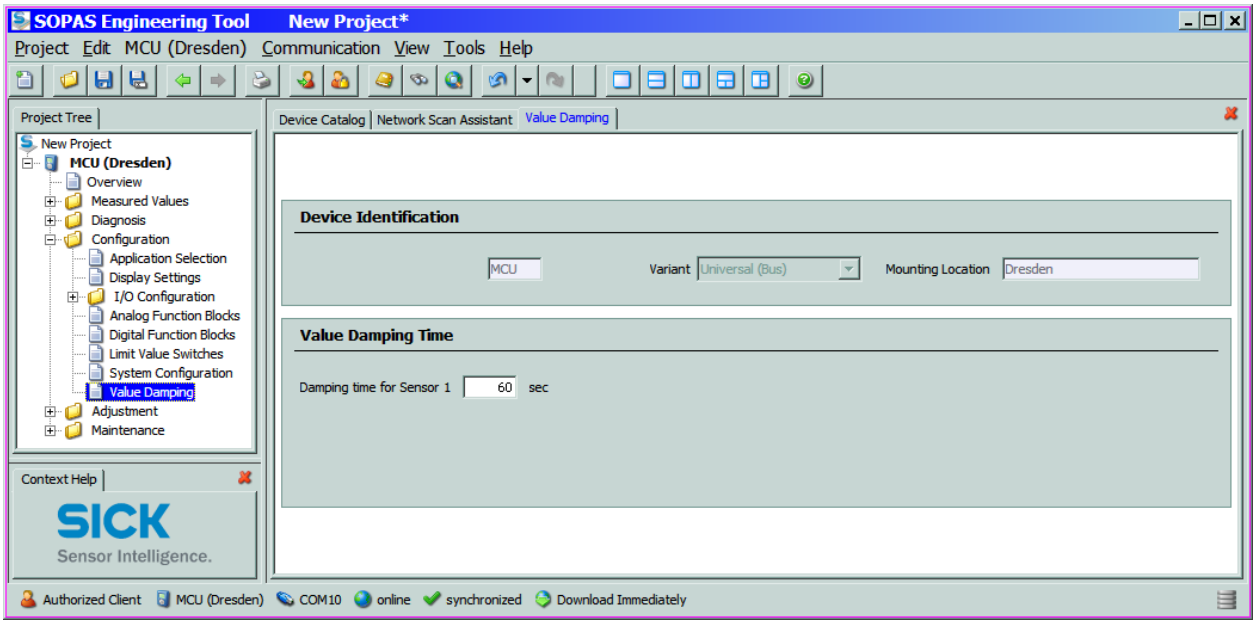
Switch the measuring unit back to "Measure" mode after entering the coefficients.

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

4.2.9 Setting the response time

Select the "Configuration / Value Damping" directory to set the response time.

Figure 67 "Configuration / Value Damping" directory (display for one connected measuring unit)



Field	Parameter	Remark
Damping time for Sensor 1	Value in s	Response time for the selected measured variable (→ p. 15, §2.1.3) (recommended value 60 s)

If more than one measuring unit is connected, a separate input window exists for each measuring unit to set the individual response time.

4.2.10 Flow measurement

The flow rate is adjusted at the factory so that no further work is required onsite.

Changes may be made only by trained personnel (user level "Service" is required, see Service Manual).

4.2.11 Data backup

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

The following options are available.

- Saving as a project (particularly advantageous for diagnosis and troubleshooting)
  This allows saving not only device parameters but also data logs.
- Saving as a device file
  Stored parameters can be processed without the device attached and transferred into the device again later.

See the Service Manual for a description.

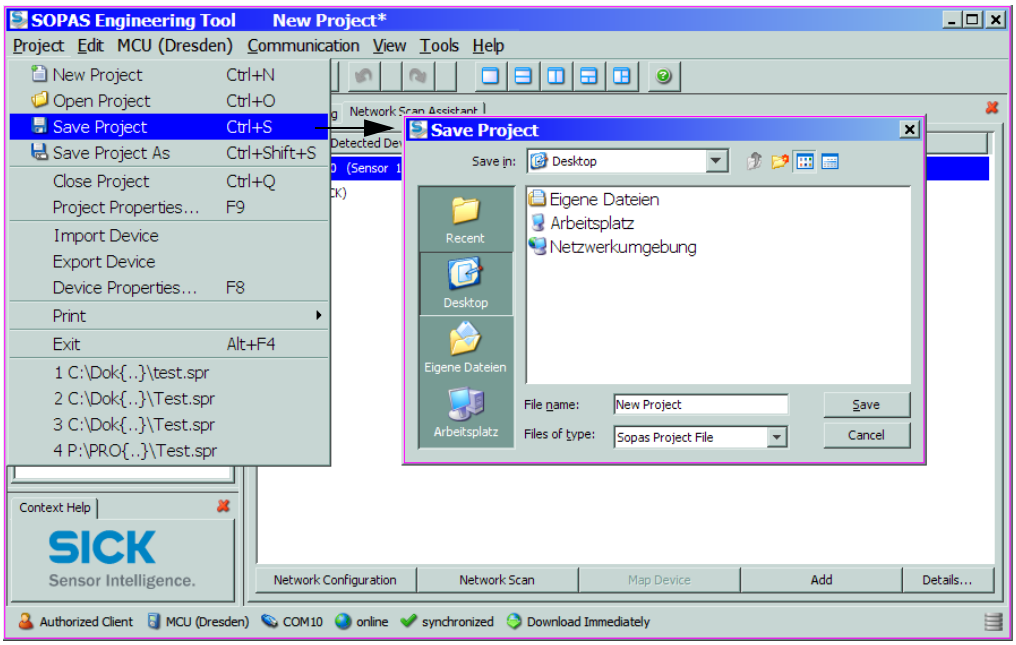
- Saving as a protocol (MCU)
  Device data and parameters are recorded in the Parameter protocol.
  A Diagnosis protocol can be created for analysis of the device function and detection of possible malfunctions.

Saving as a project

It is recommended to store a "project" when connections are frequent. Only the "project" needs to be opened for renewed connection. All data stored previously are transmitted automatically to SOPAS ET.

To save, select the "Project / Export Device" menu and then define the target directory and file name. The name of the file to be stored can be chosen freely. It is useful to specify a name with a reference to the sampling point involved (name of the company, equipment name).

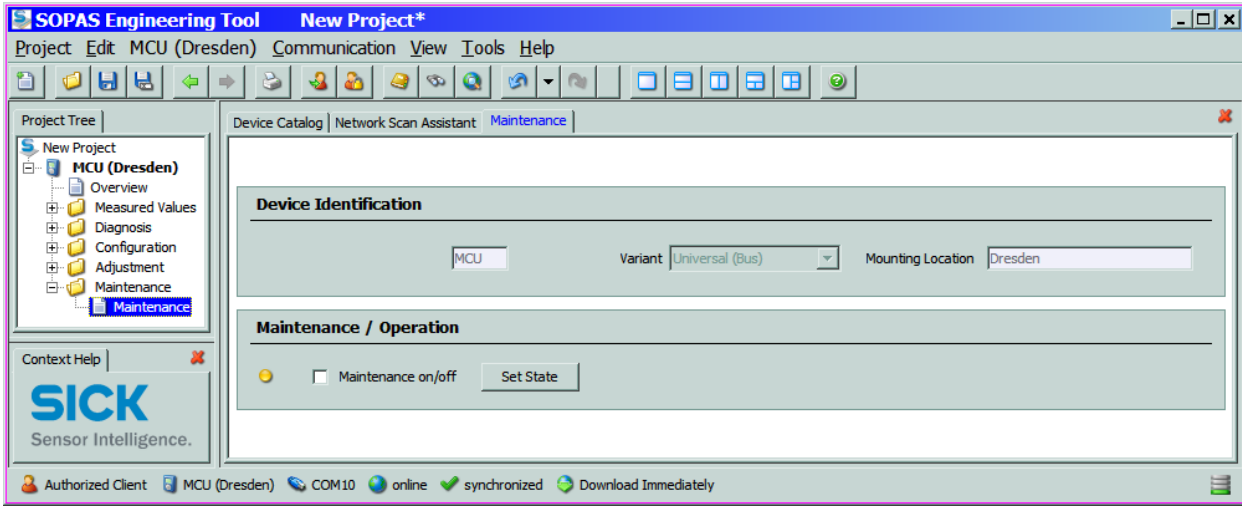
Figure 68 "Project / Save Project" menu



4.2.12 Starting normal measuring operation

Set the measuring system to "Measurement" mode after entering/modifying parameters. To do this, switch to the "Maintenance / Maintenance" directory, deactivate the "Maintenance on/off" checkbox and click "Set State" (→ Fig. 69). Standard start-up is now completed.

Figure 69 Setting the operational state

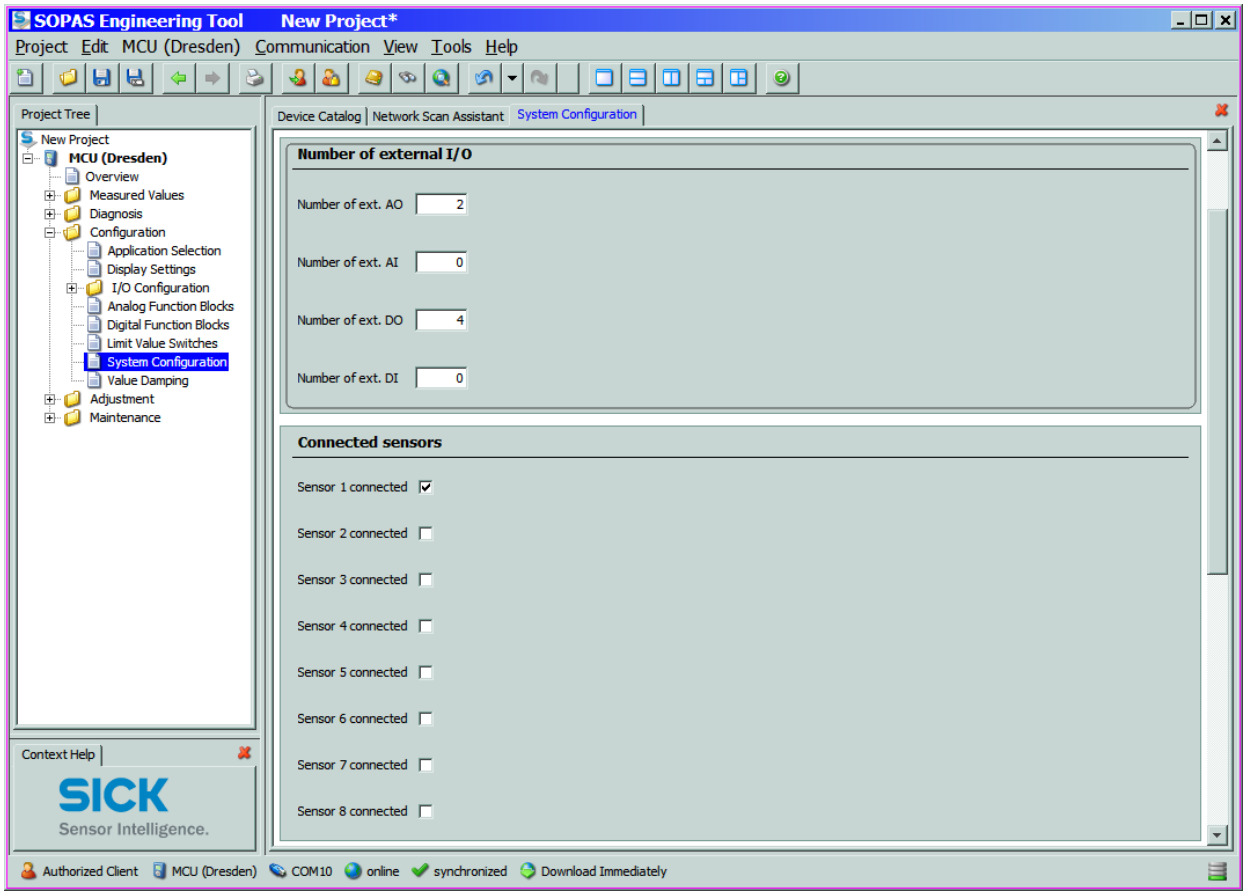


4.3 Configuring optional modules

4.3.1 Configuring analog and digital output modules

To do this, the modules installed in the MCU must be activated. Move the "MCU" device file into the "Project tree" window, select the ”Configuration / System Configuration” directory and check whether the number of outputs set in the ”Number of external I/O” group corresponds to the existing outputs (correct when necessary).

Figure 70 ”Configuration / System Configuration” directory (example for settings)



4.3.1.1 Optional analog outputs

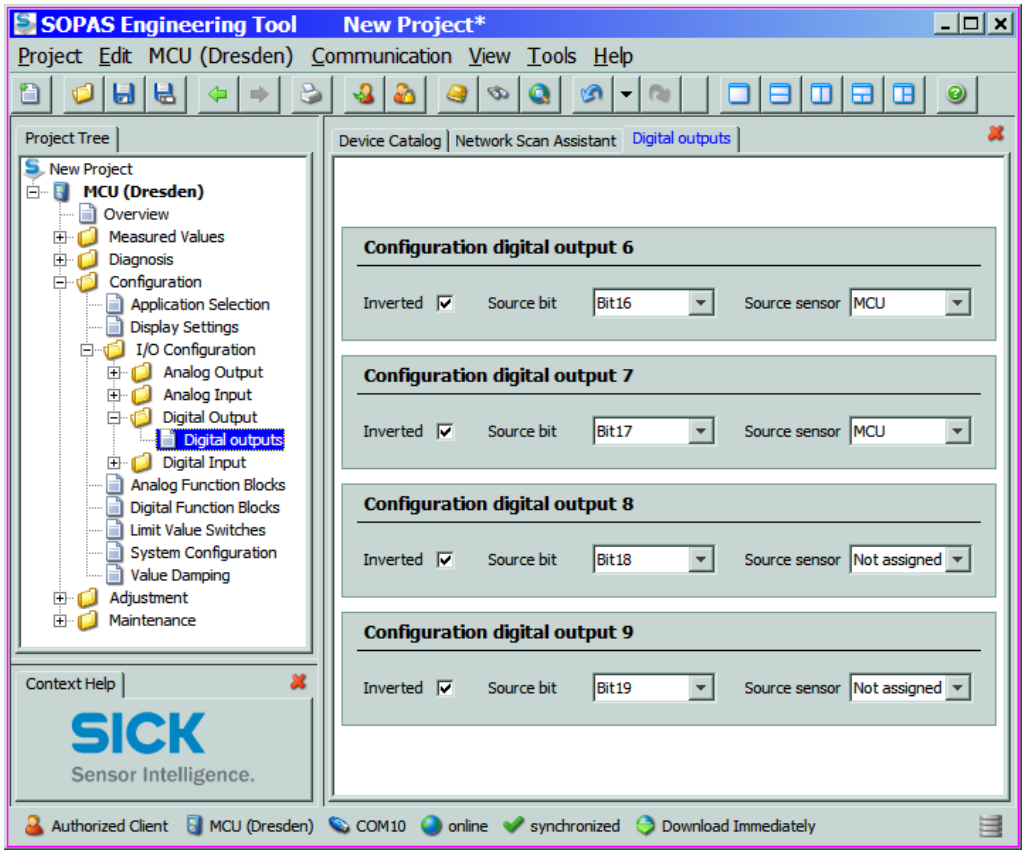
Configure in accordance with → p. 67, §4.2.5 (→ p. 68, Fig. 63).

The basic settings ("Analog Outputs - General Overview" subdirectory; → p. 67, Fig. 62) apply to all available analog outputs in the same manner.

4.3.1.2 Optional digital outputs

Select the ”Configuration / I/O Configuration / Digital Output / Digital outputs” directory for configuration.

Figure 71 ”Configuration / I/O Configuration / Digital Output / Digital outputs” directory

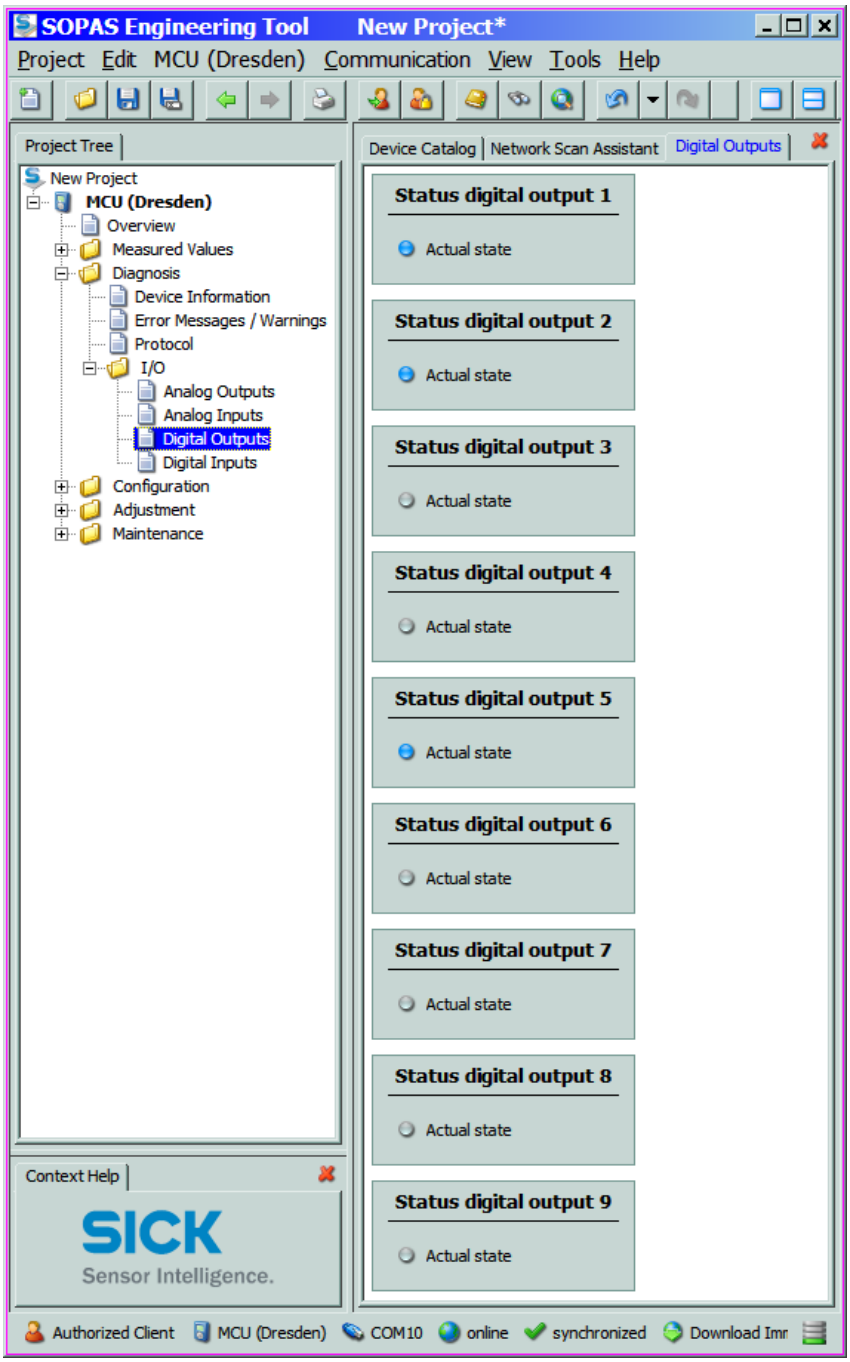


Field	Parameter	Remark
inverted	Inactive	Specification of the switching direction
	Active	
Source bit	Bit 0	Malfunction
	Bit 1	Maintenance
	Bit 2	Maintenance request
	Bit 3	Function check
	Bit 7	Operation (no malfunction)
	Bit 16 to 31	Aim bit of the limit value switch (→ p. 79, Fig. 73)
Source sensor		Selection of the component: - Sensor 1 to 8 when the device status is to be output - MCU when limit values are to be reported

Checking settings

The current status of each relay is shown in the "Diagnosis / I/O / Digital Outputs" directory.

Figure 72 "Diagnosis / I/O / Digital Outputs" directory



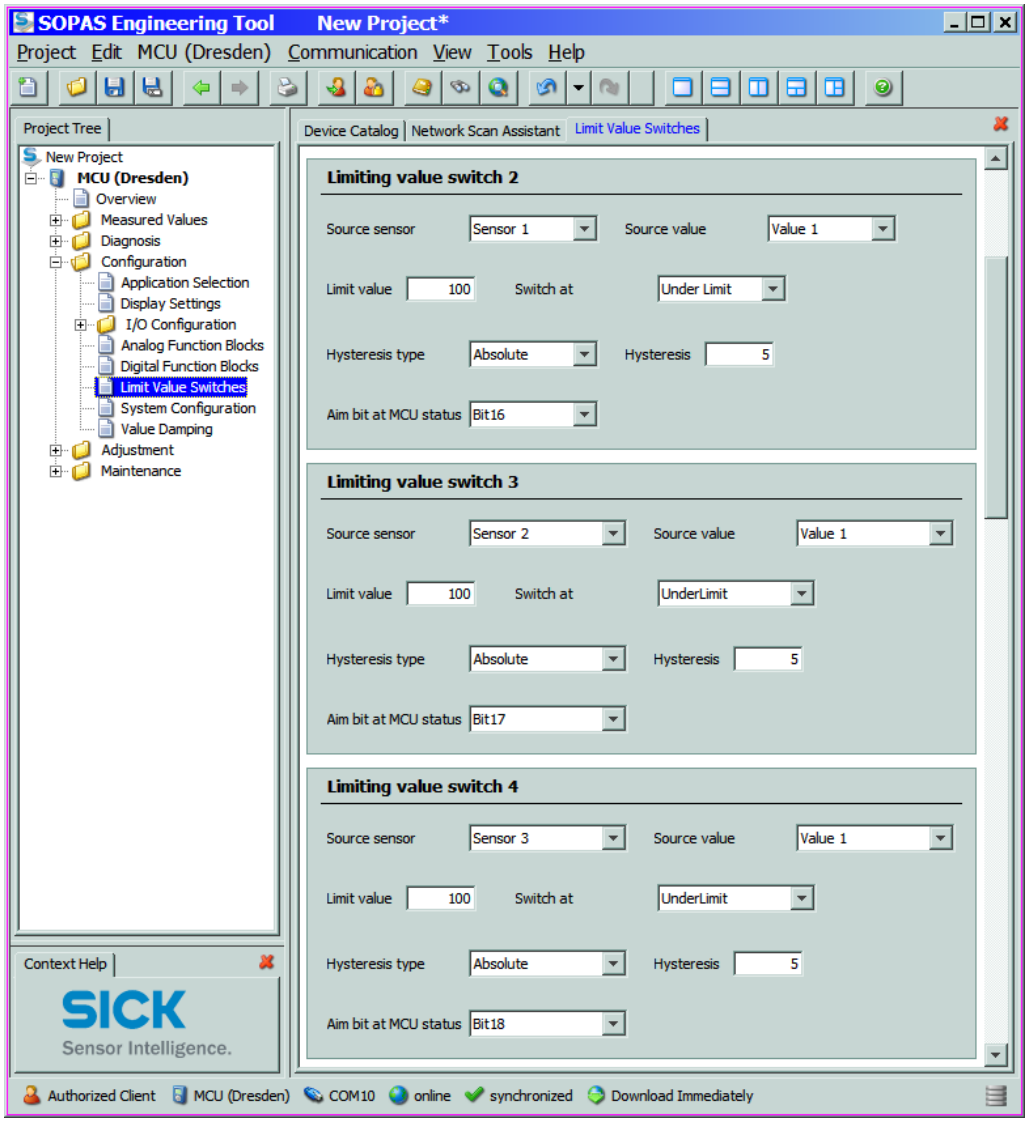
To check whether relays switch as intended, measured values which exceed the configured limits must be created.

In addition, a continuity tester can be connected to the respective relay output for an external check.

4.3.1.3 **Assigning and configuring limit value switches to optional digital outputs**

Select the ”Configuration / Limit Values Switches” directory” for assigning. Configure in accordance with → p. 70, §4.2.7.

Figure 73 ”Configuration / Limit Values Switches” directory



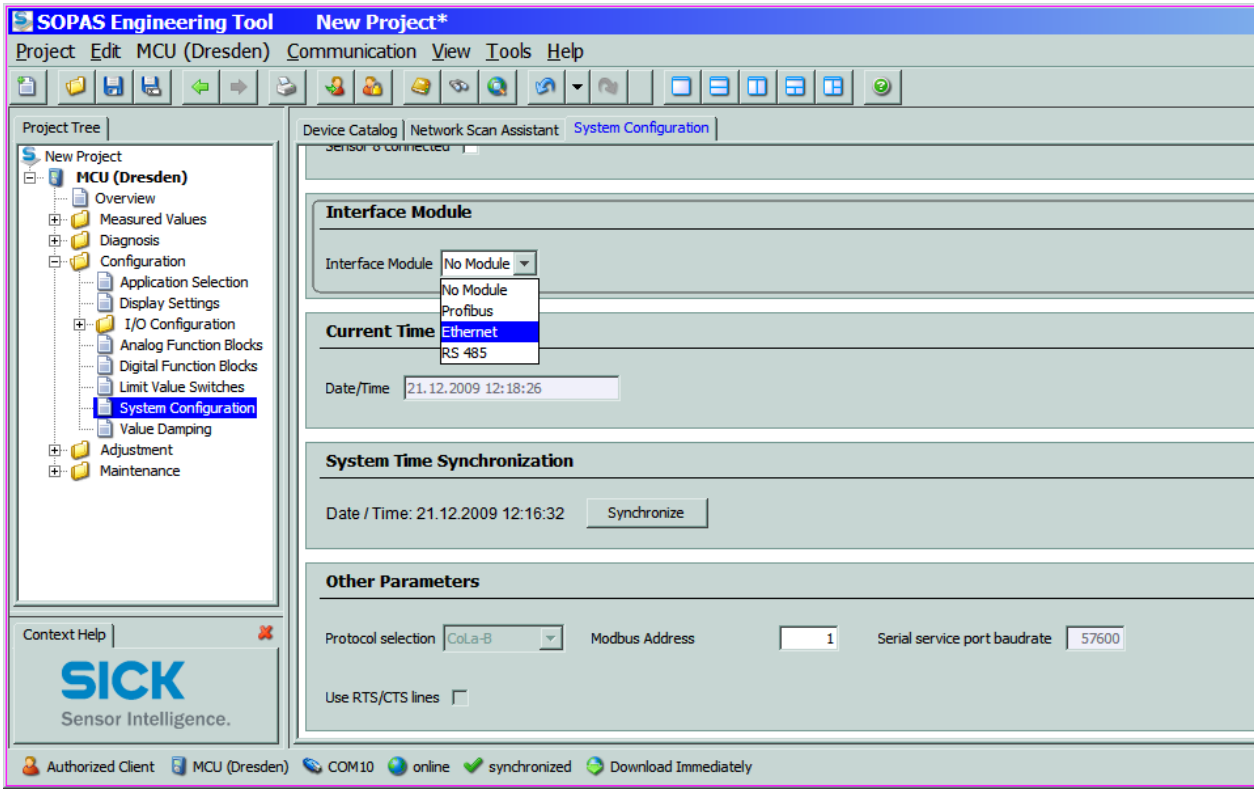
4.3.2 Configuring optional Interface modules

4.3.2.1 General information

The following steps are necessary to select and set the optionally available Interface modules Profibus DP and Ethernet:

- ► Select the "MCU" device file, set the measuring system to "Maintenance" mode and enter the level 1 password (→ p. 61, §4.1.4).
- ► Switch to the "Configuration / System Configuration" directory.
  The Interface module installed is shown as "Interface Module".
- ► Configure the Interface module as required.

Figure 74 "Configuration / System Configuration" directory



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

4.3.2.2 Configuring the Ethernet module

> ***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).

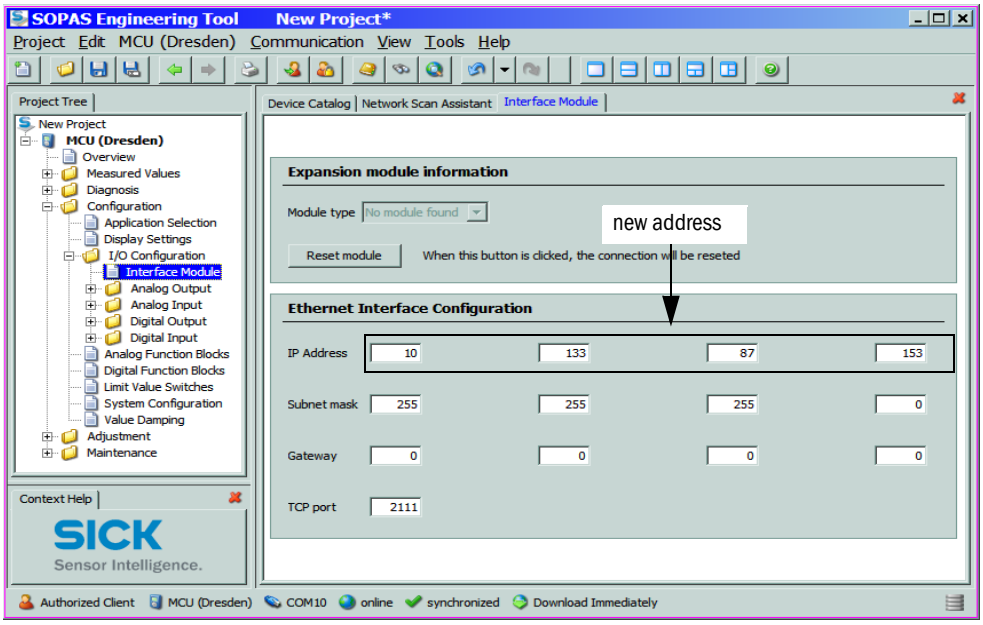
Assigning a new IP address to the Ethernet modules

An IP address specified by the customer is entered at the factory when the address is available when the device is ordered. Otherwise standard address 192.168.0.10 is entered.

The following steps are necessary to make a change:

- ► Switch to the „Parameter / IO Configuration / Interface Module“ directory.
- ► Enter the desired network configuration in the "Ethernet Interface Configuration“ group and click "Reset module" under "Expansion module information".

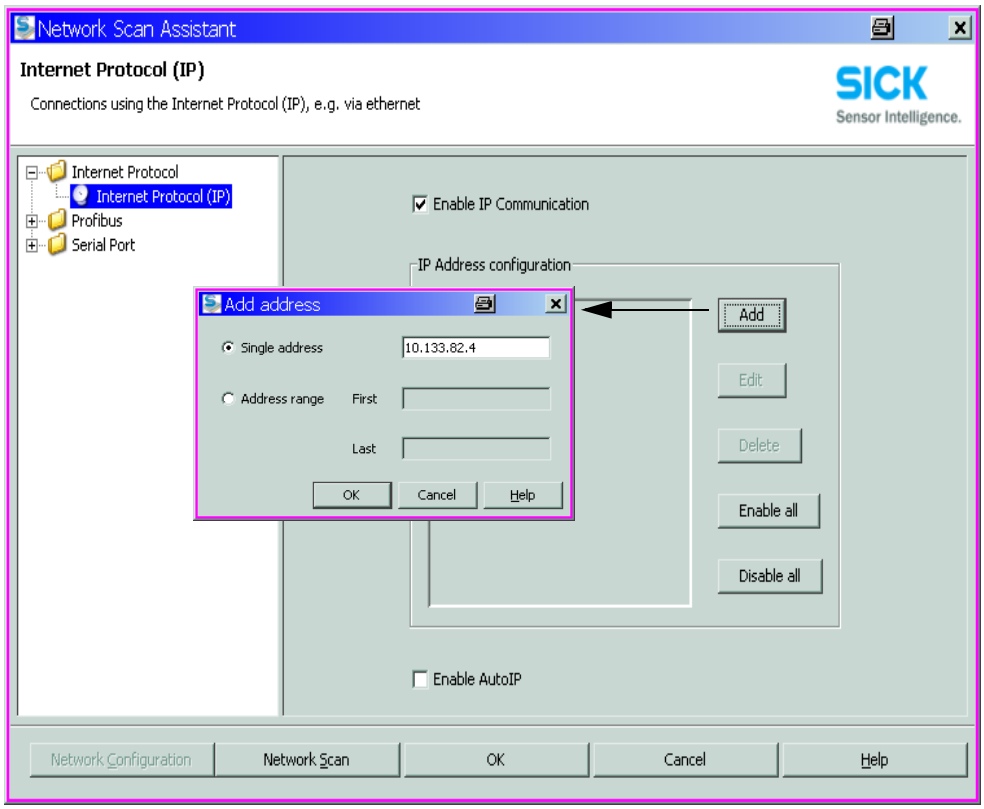
Figure 75 "Configuration / IO Configuration / Interface Module" directory



Assigning the new IP address to SOPAS ET

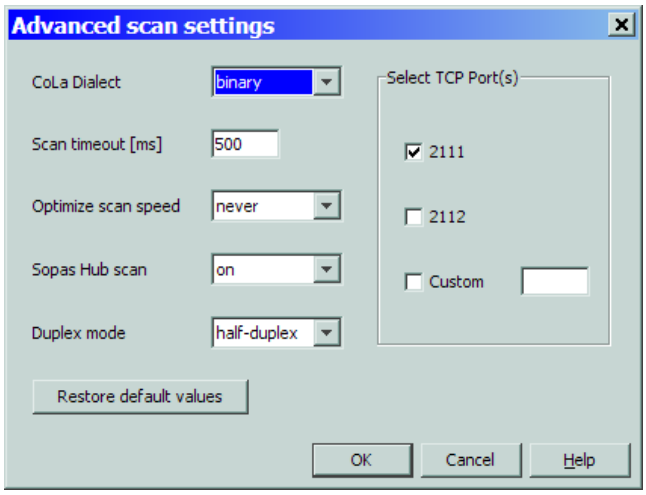
- ► Select the "Network Scan Assistant" register and click "Network Configuration".
- ► Select the "Internet Protocol (IP)" directory, set the "Enable IP Communication" entry field to active and click "Add".
- ► Enter the new IP address set in the "Configuration / IO Configuration /Interface Module" directory and confirm with "OK".

Figure 76 Entering the IP address (example)



- ► Click "Advanced..." in the "Internet Protocol (IP)“ directory.
- ► Select port address "2111" and confirm with "OK" (all other settings are factory settings in accordance with Fig. 77).

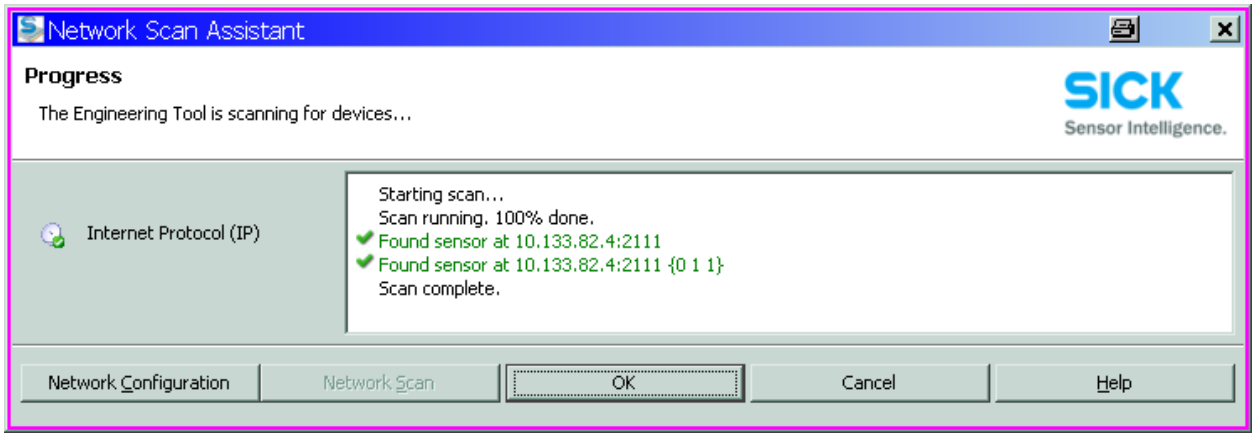
Figure 77 Specifying the TCP port



- ► Activate only the required TCP port.
- ► To use a TCP port other than 2111 or 2112, activate the "Custom" checkbox and enter the port number in the adjacent field.

► Select the "Network Scan Assistant" register, click "Network Scan" and check whether the set address is displayed.

Figure 78 Network scanning



NOTICE:

During communication via Ethernet, disturbances in data transfers can arise which are not caused by the measuring system.

- ► If measured values are transferred exclusively via Ethernet and used to control processes, disturbances in plant operation are possible for which the VICOTEC450 manufacturer is not responsible.

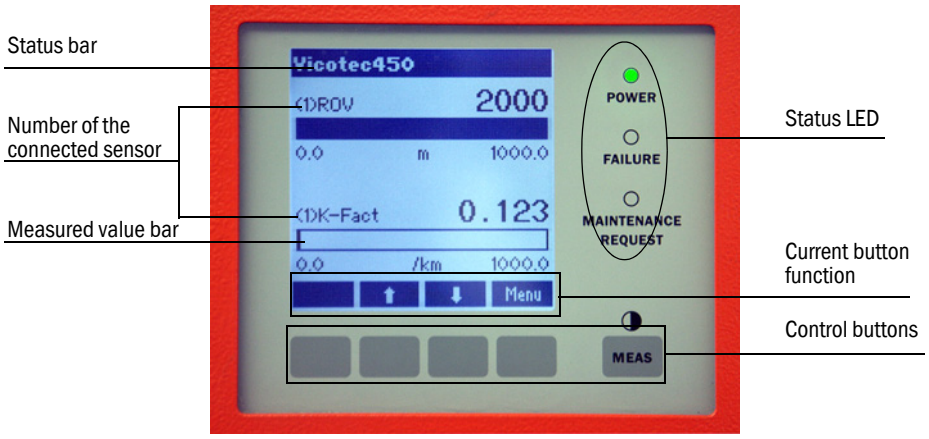
Increasing the value in field "Scan timeout" from 500 ms to 3000 ms can minimize communication problems.

4.4 Operating/configuring via the LC-Display option

4.4.1 General information on use

The display and operating interface of the LC-Display contains the functional elements shown in Fig. 79.

Figure 79 LC-Display functional elements



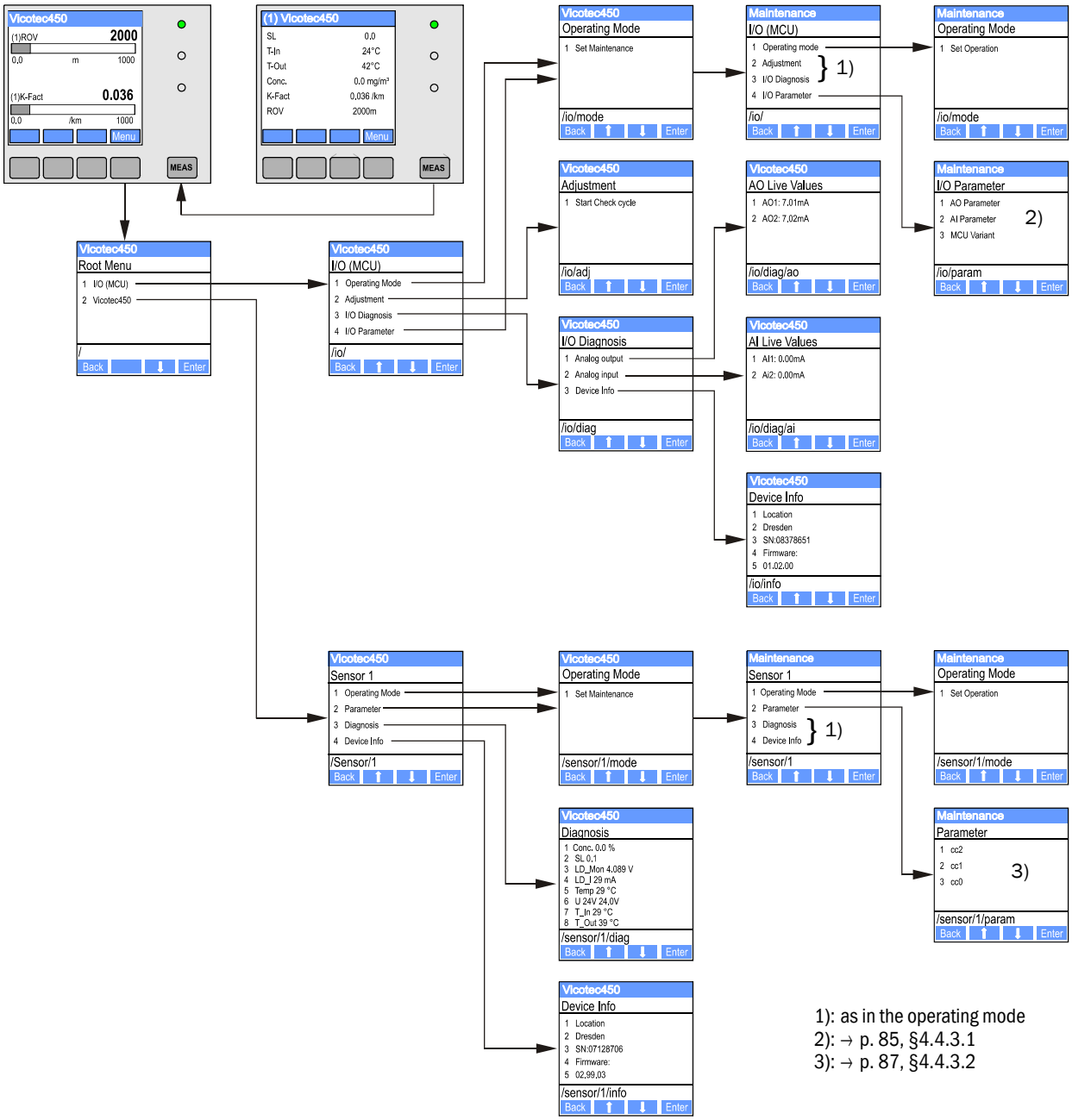
Button functions

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; → p. 85, Fig. 80)
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 configuration)
Start	Start an action
Save	Store a changed parameter
Meas	● Toggle between display of measured values in a bar (graphics display) or in text form When connecting several measuring units to one MCU, the measured values of the individual measuring units are shown in succession. ● Display the contrast setting (press the button at least 2.5 s)

4.4.2 Menu structure

Figure 80 LC-Display menu structure



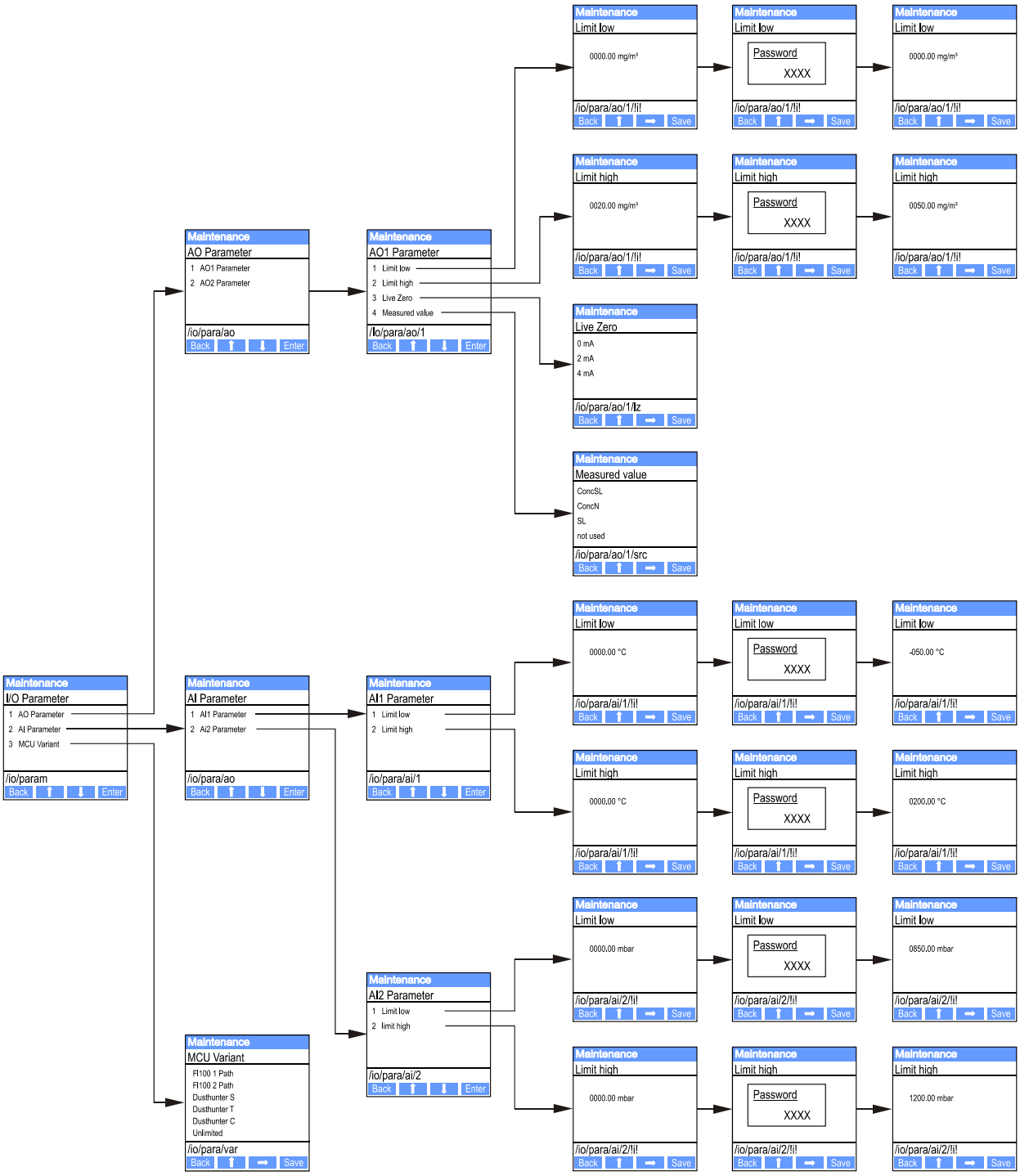
4.4.3 Configuring

4.4.3.1 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).

Figure 81 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 VICOTEC450 measuring unit to be connected (→ p. 64, §4.2.1), :

- ► Set the MCU to "Maintenance" mode, select the "MCU Variant" submenu, and select the type "Universal (Bus)".
- ► Enter the default password and store the type with "Save" (confirm 2x).

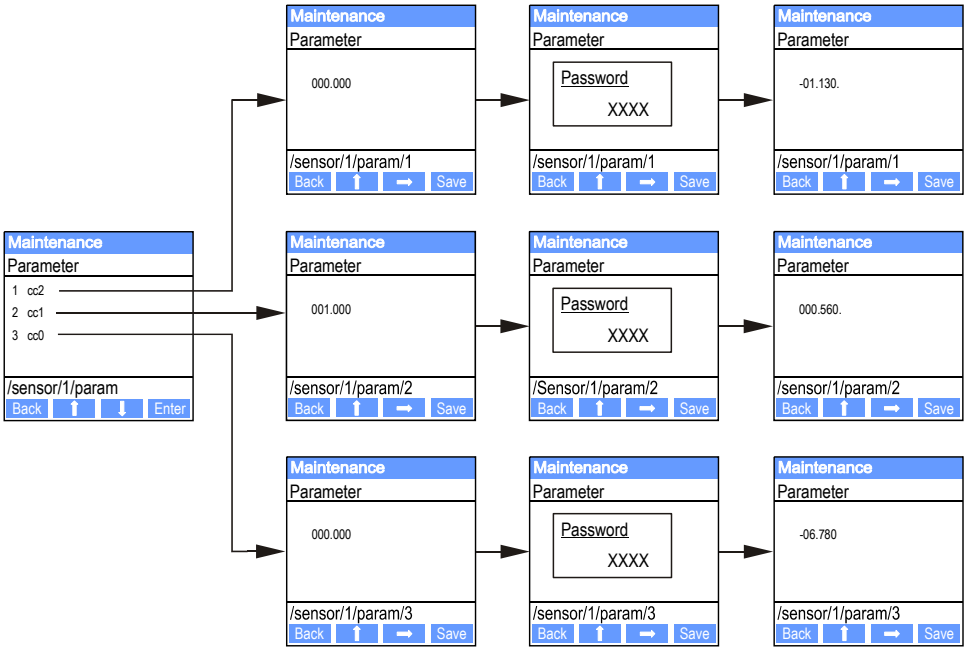
The other selection options have no significance here.

4.4.3.2 **Measuring unit (when setting to measure the dust concentration)**

The following steps are required to enter the regression coefficients:

- ► Set the measuring unit to "Maintenance" and select the "Parameter" submenu.
- ► Choose the parameter to be entered and enter the default password "1234".
- ► Set the calculated coefficients (→ p. 71, §4.2.8) using the "^" and/or "→" buttons and write to the device with "Save" (confirm 2x).

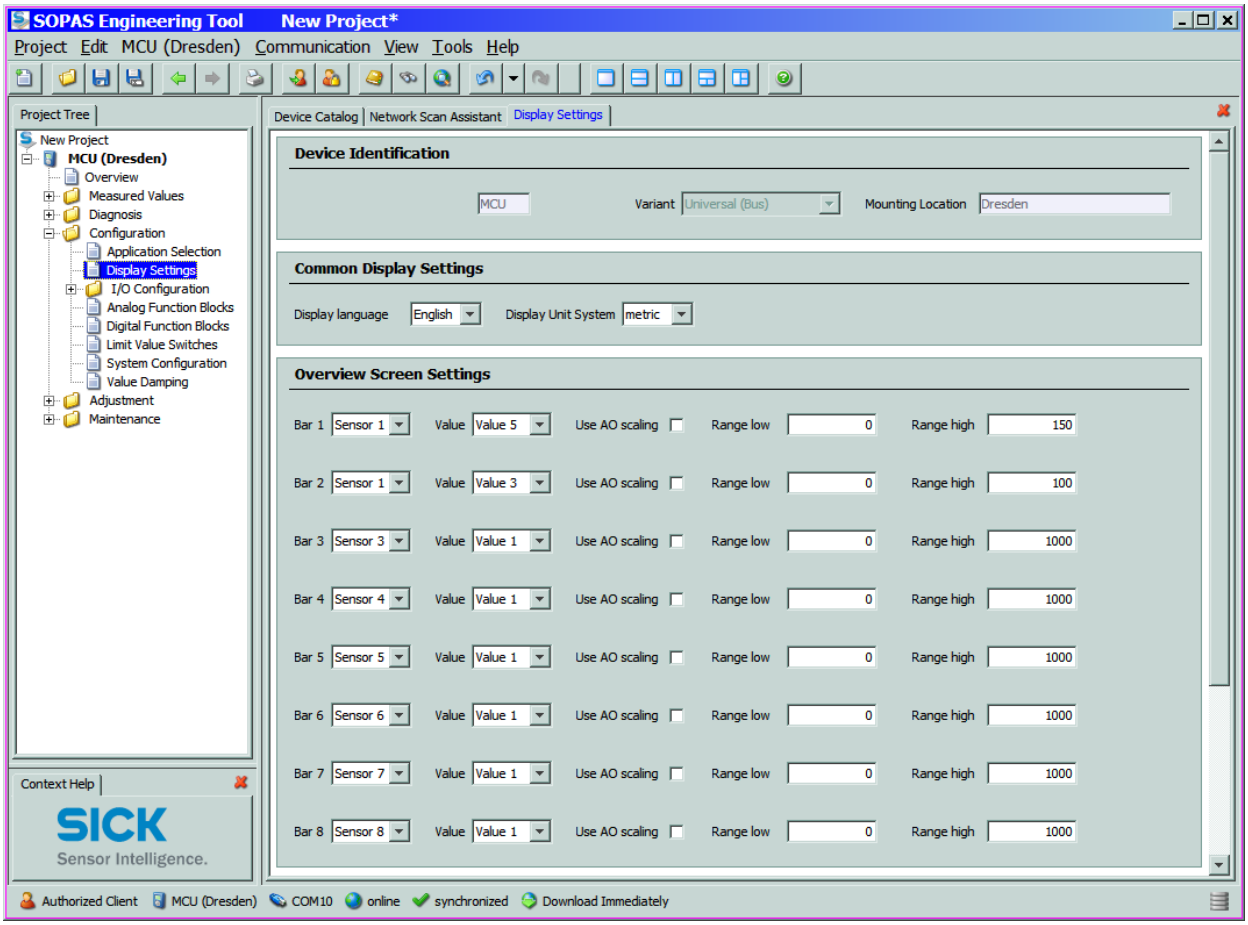
Figure 82 Entering the regression coefficients



4.4.4 Using SOPAS ET to modify display settings

To modify the factory settings, select device file "MCU" in the "Project tree“ window, enter the level 1 password and select the "Configuration/Display Settings“ directory.

Figure 83 "Configuration/Display Settings“ directory



Field	Field	Significance
Common Display Settings	Display language	Language version shown on the LC-Display
	Display Unit System	Unit of measure system used in displays
Overview Screen Settings	Bar 1 to 8	Sensor address for the respective 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 this selection box is 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	

Measured value assignment

MCU measured value	Measuring unit measured value
Value 1	Scattered light intensity
Value 2	Inlet temperature [°C]
Value 3	Heater temperature [°C]
Value 4	External Temperature 1 [°C] 1)
Value 5	External Temperature 2 [°C] 1)
Value 6	Dust concentration [mg/m^3] 1) 2)
Value 7	k value [/km]
Value 8	Visibility [m]

1): The next sequential measured variable moves up one position when an option has not been ordered. Assignment is made by Endress+Hauser Service when options are added later.

2): Only important for special applications

VICOTEC450

5 Maintenance

General information
Maintaining the measuring unit
Putting out of operation

5.1 General information

The maintenance work to be carried out consists of:

- Checking and cleaning the optical boundary surfaces
- Examining installed air intake and exhaust air hoses
- Checking the door of the measuring unit
- Exchanging the air filter of the measuring unit.

Switch the VICOTEC450 to "Maintenance" mode before starting any maintenance work (→ p. 63, §4.2).

WARNING:
All activities must be carried out in line with the relevant safety regulations and instructions (→ p. 9, §1.3).

- "Maintenance" mode can also be set by connecting an external maintenance switch to the terminals for Dig In2 (17, 18) in the MCU (→ p. 46, §3.3.4) or using the buttons on the LC-Display on the MCU (→ p. 85, §4.4.2) if this option is available.
- No automatic check cycle is carried out during "Maintenance".
- The value set for "Maintenance" is output on the analog output (→ p. 67, §4.2.5). This also applies when a malfunction exists (signalized on the relay output).
- "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.

Switch back to measuring operation when the work has been completed → p. 75, §4.2.12 or open the contact on Dig In 2).

Maintenance intervals

The tunnel operator is responsible for defining the maintenance intervals. The intervals depend on the specific operating parameters and ambient conditions. Maintenance intervals are normally 1 year. Longer maintenance intervals are possible for favorable conditions.

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

Maintenance contract

Regular maintenance activities can be carried out by the tunnel operator. These activities must only be carried out by qualified persons according to Section 1. If requested, all maintenance activities can also be performed by Endress+Hauser Service or an authorized Service partner.

Auxiliary means required

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

5.2 Maintaining the measuring unit

> ***NOTICE:***
> Do not damage any device parts during maintenance work.

5.2.1 Inspection work

- Check air intake and exhaust air lines.
  Check the lines regularly for tight connection and any possible deposits inside. If necessary, disconnect the lines from the connections and flush with water.
- Check the light trap for contamination.
- Check the laser beam for free passage through the aperture.
- Check the fan for audible running noises.
- Check the seal on the door of the measuring unit for intactness.

> ***NOTICE:***
> Measuring results can be incorrect when the door is not tight..

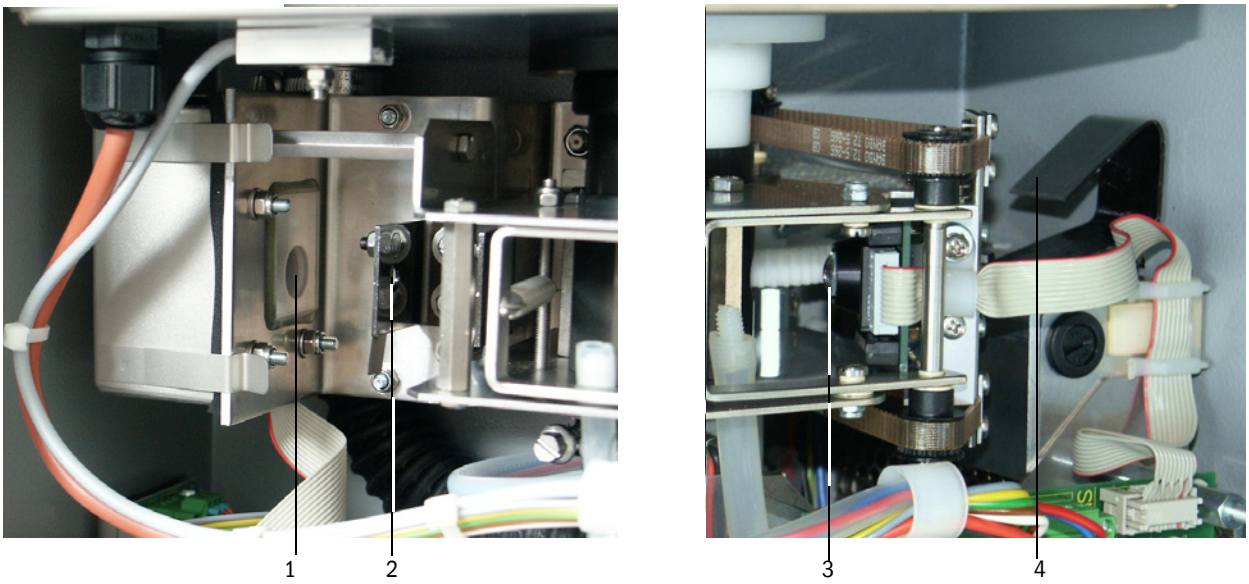
5.2.2 Cleaning the optical boundary surfaces of laser module and receiver

Only clean the optical boundary surfaces when deposits are visible or before the contamination value reaches the 30% warning limit (50% for malfunction).

Activities

- Open the measuring unit door.
- Clean the optics carefully with cleaning sticks and, if necessary, the light trap as well.
- Close the door again tightly (tighten the lock screws firmly).

Figure 84 Cleaning the optics



1 Sender lens
2 Aperture
3 Receiver optics
4 Light trap

5.2.3 Cleaning the coarse filter in the air inlet

- Disconnect the measuring unit from the mains (disconnect the connection cable to MCU or mains voltage supply).

> When the fan is switched on, particles can penetrate and contaminate the optics.

- Open the cover on the air inlet (→ p. 108, Fig. 94, → p. 109, Fig. 96).
- Remove the coarse filter and clean it (rinse when necessary), replace with a new filter when necessary (→ p. 116, §7.5).
- Put the coarse filter back into the air inlet and close the cover.
- Reconnect the mains voltage.

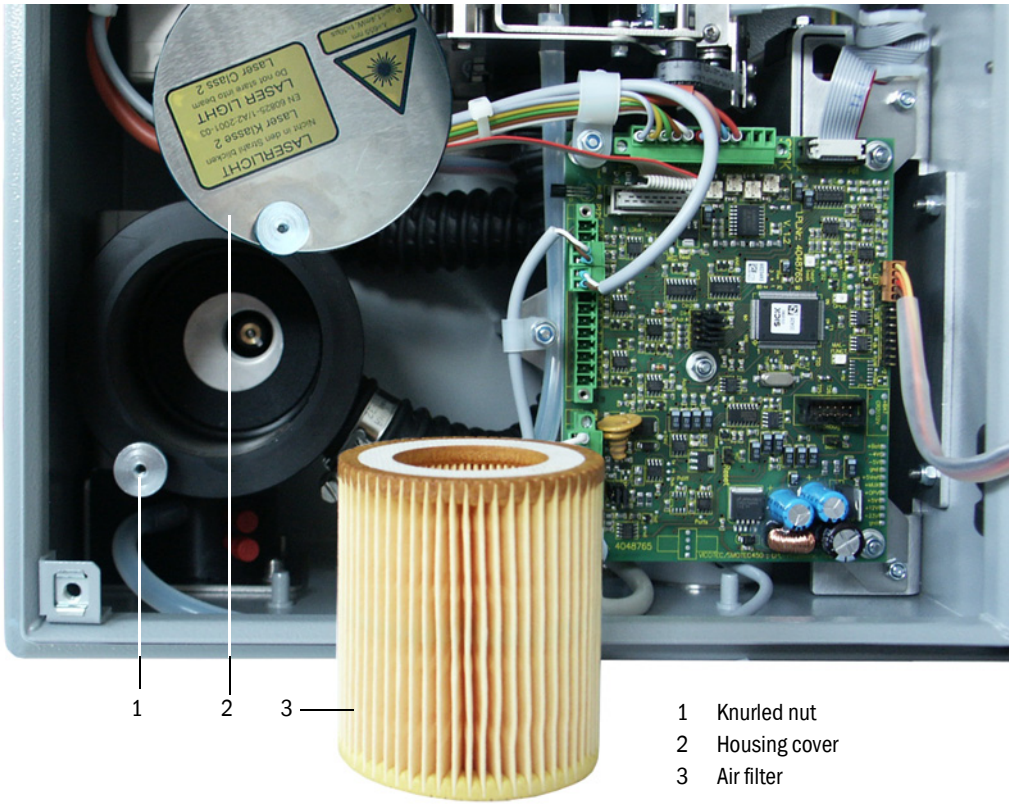
5.2.4 Replacing the air filter

Replace the air filter regularly. The interval should be 1 year.

Activities

- Disconnect the measuring unit from the mains (disconnect the connection cable to MCU or mains voltage supply)
- Open the door of the measuring unit.
- Turn the cover of the air filter housing up after loosening the knurled nuts.
- Remove the old air filter and insert a new one.
- Then refit and tighten the cover.
- Close the door again tightly (tighten the lock screws firmly).
- Reconnect the mains voltage.

Figure 85 Replacing the air filter



1 Knurled nut
2 Housing cover
3 Air filter

5.3 Putting out of operation

Put the VICOTEC450 out of operation during longer tunnel closures or construction work causing dust in the tunnel.

Alternatively, the VICOTEC450 can still be operated in such cases when air intake and exhaust air lines are connected to each other so that neither dust nor humidity can penetrate.

Activities

- Disconnect the connection cable to the control unit.
- Pull air intake and exhaust air lines off the connections, secure hose ends to prevent dirt and moisture penetrating the lines.
- Dismantle the measuring unit(s).
- Disconnect the control unit from mains voltage.

WARNING:

- When disassembling, observe the relevant safety regulations and the safety information in Section 1!
- Take suitable protective measures against possible local hazards or hazards arising from the plant!
- Secure switches that must not be switched on for safety reasons with labels and safeguards to prevent unintentional switching on.

Storage

- Store dismantled device parts in a clean, dry location.
- Use suitable auxiliary material to protect plug-in connectors of the connection cable against dirt and moisture.
- Ensure that no dirt or moisture can enter the air intake and exhaust air lines.

VICOTEC450

6 Malfunctions

General information
Measuring unit
Control unit

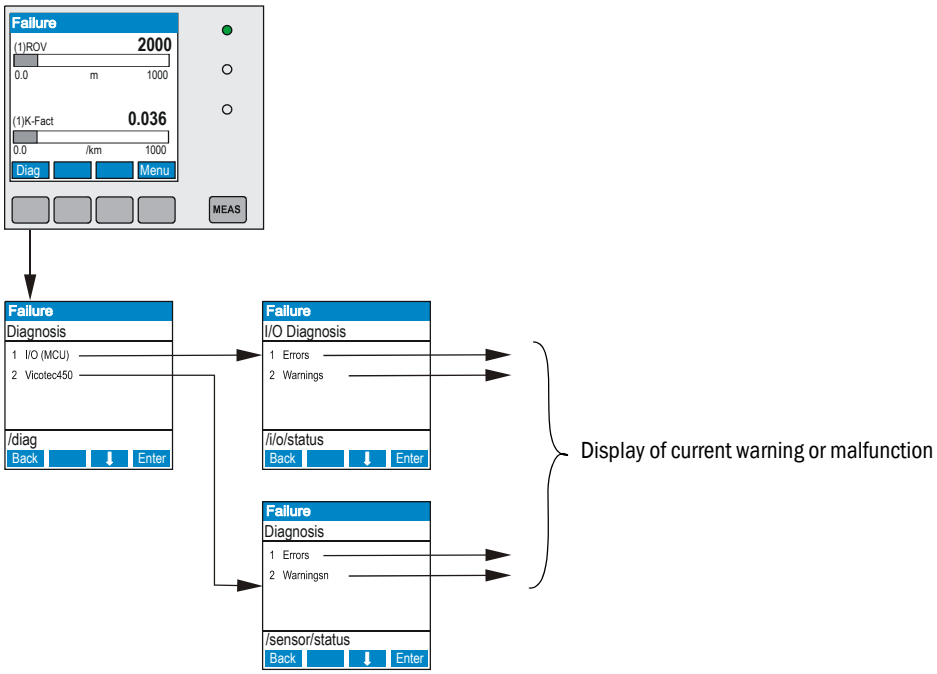
6.1 General information

Warning or error messages are output as follows:

- On the MCU, the respective relay is switched on (→ p. 39, Fig. 25).
- "Maintenance requ." or "Failure" is displayed in the status bar of the LC-Display (→ p. 84, §4.4.1). 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 "Vicotec450").

Figure 86 Display on the LC-Display



Detailed information on current device status is provided by the „Monitor/System state - details" (measuring unit) or "Diagnosis/Errors/Warnings" (MCU) directories.. Connect the measuring system to SOPAS ET and start the device file "Vicotec450" or "MCU" (→ p. 54, §4.1.3 and → p. 61, §4.1.4) to display the relevant information.

The significance of the individual messages is described in more detail in a separate window after moving the cursor to the respective display. Clicking on the display shows a short description of possible causes and corrections under "Help" (→ p. 99, Fig. 87, → p. 101, Fig. 89).

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 is still output via the analog output.

Refer to the Service Manual for more detailed descriptions of messages and clearance options.

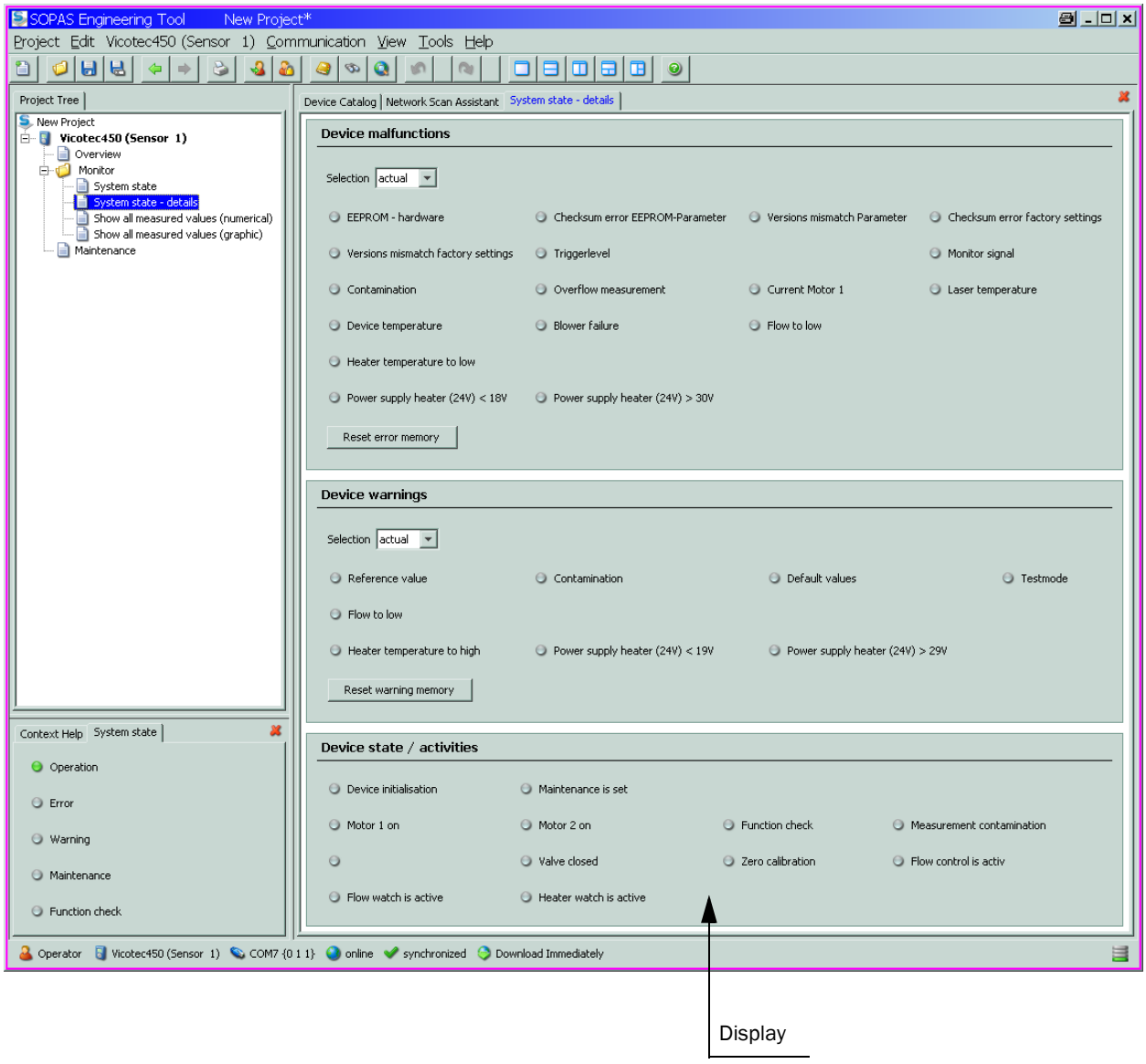
6.2 Measuring unit

6.2.1 Malfunctions

Symptom	Possible cause	Action
LEDs are not on	● No supply voltage ● Connection cable not connected correctly or defective ● Defective plug-in connector	▶ Check plug-in connector and cable. ▶ If the optional power supply unit is installed, check the fuse and replace if necessary ▶ Contact Endress+Hauser Service.

6.2.2 Warning and error messages in SOPAS ET

Figure 87 "Monitor/System state - details" directory



Current warning or error messages, or earlier messages stored in the error memory, can be shown by selecting "actual" or "memory" in the "Selection" window ("Device malfunction" group).→ p. 99, Fig. 87

The following malfunctions can possibly be cleared onsite.

Message	Significance	Possible cause	Action
Contamination	Current reception intensity is lower than the allowable limit value (→ p. 106, §7.1)	● Deposits on the optical interfaces ● Unclean purge air	▶ Clean optical surfaces (→ p. 93, §5.2.2). ▶ Check purge air filter (→ p. 94, §5.2.3) ▶ Contact Endress+Hauser Service.
Overflow measurement	Reception intensity too high.	● Receiver not in measuring position ● Relay for reception intensity damping defective	▶ Check receiver position ▶ Trigger a check cycle and check procedure flow (→ p. 66, §4.2.4). ▶ Contact Endress+Hauser Service.
Blower failure		● Plug-in connector or cable defective ● Blower defective	▶ Replace blower (see Service Manual). ▶ Contact Endress+Hauser Service.
Flow too low	Air flow rate too low	● Air intake and/or exhaust air line blocked ● Pressure sensor and/or regulation of flow measurement option defective ● Air filter contaminated ● Coarse filter contaminated	▶ Check air intake and exhaust air lines, clean when necessary (→ p. 93, §5.2.1). ▶ Check flow rate. ▶ Clean air / coarse filter and replace when necessary (→ p. 94, §5.2.3, → p. 94, §5.2.4 ▶ Check flow measurement. ▶ Contact Endress+Hauser Service.

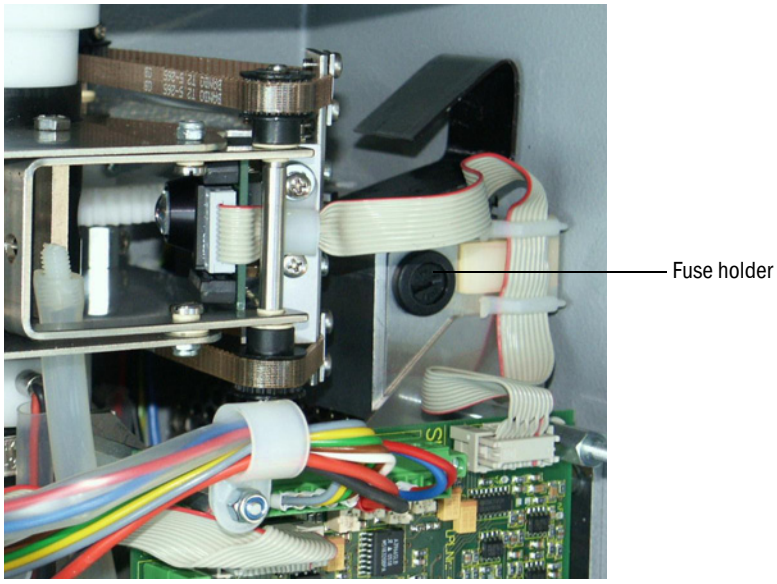
6.2.3 Replacing the fuse for the optional power supply unit

▶ Open the measuring unit door.

▶ Unscrew the fuse holder, replace the defective fuse and screw the fuse holder in again.

▶ Close the door tightly.

Figure 88 Fuse holder for optional power supply unit



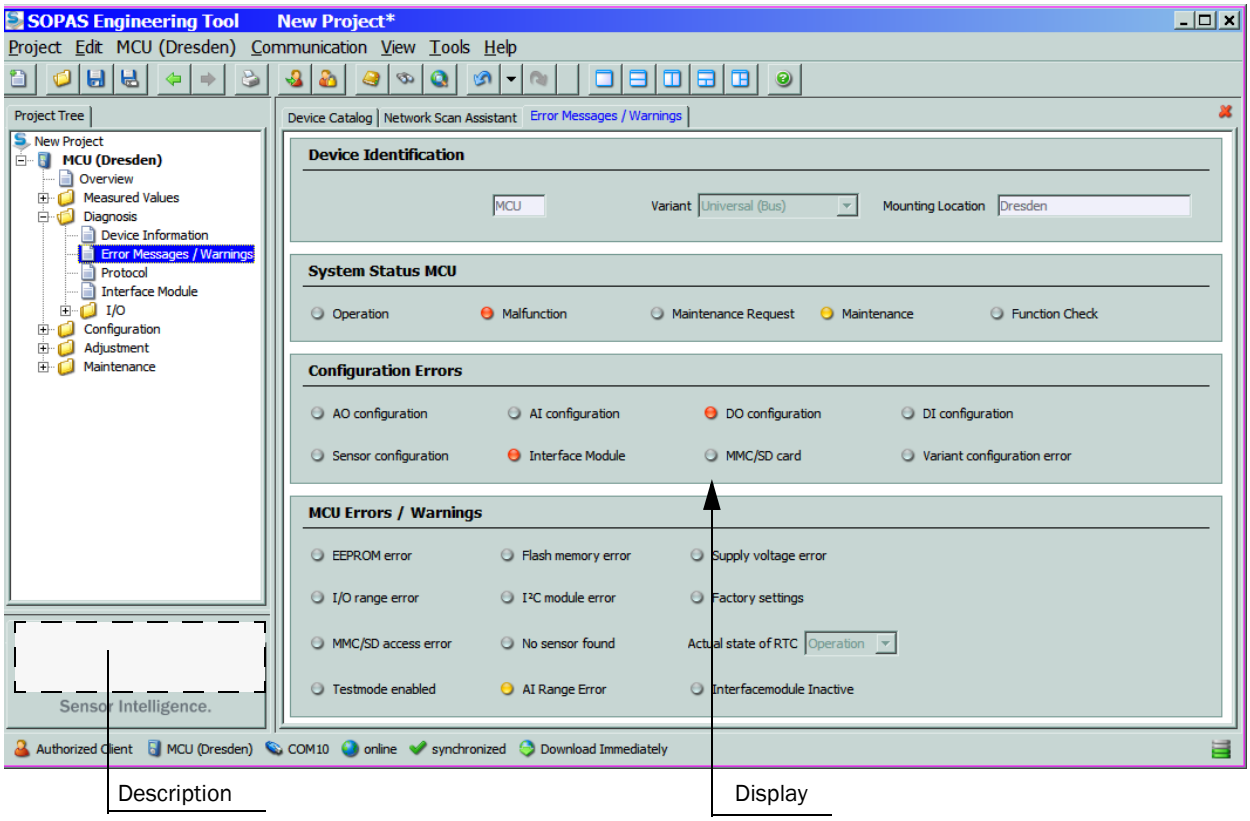
6.3 Control unit

6.3.1 Malfunctions

Symptom	Possible cause	Action
No display on the LC-Display (option)	● No supply voltage ● Cable to LC-Display not connected or damaged ● Defective fuse	▶ Check voltage supply. ▶ Check connection cable. ▶ Exchange fuse. ▶ Contact Endress+Hauser Service.

6.3.2 Warning and error messages in SOPAS ET

Figure 89 "Diagnosis/Error Messages/Warnings" directory

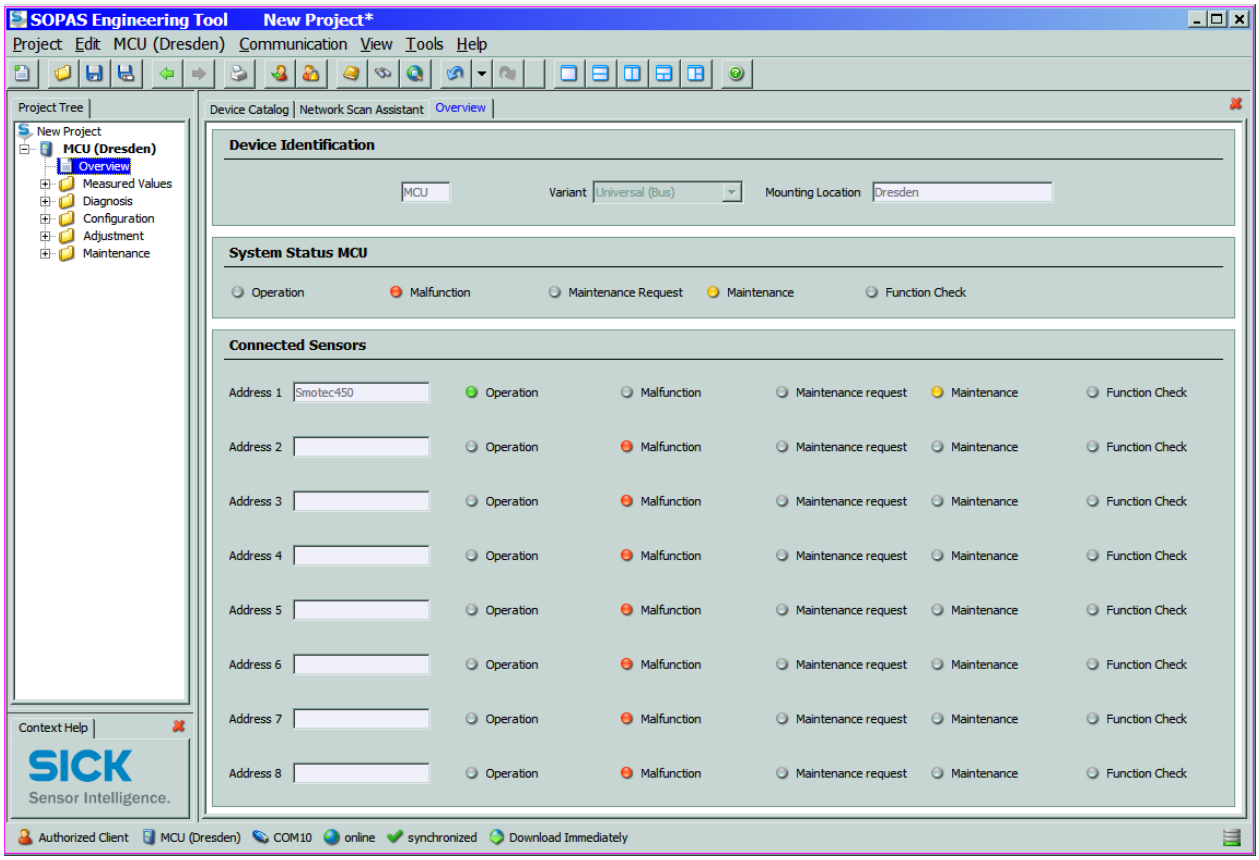


The following malfunctions can possibly be cleared onsite.

Message	Significance	Possible cause	Action
AO configuration	The number of optional modules does not match the number of analog outputs configured.	● No parameters set for AO ● Connection error ● Module failure	▶ Check configuration (→ p. 67, §4.2.5). ▶ Contact Endress+Hauser Service.
AI configuration	The number of optional modules does not match the number of analog inputs configured.	● No parameters set for AI ● Connection error ● Module failure	▶ Check configuration → p. 69, §4.2.6). ▶ Contact Endress+Hauser Service.
DO configuration	The number of optional modules does not match the number of digital outputs configured.	● No parameters set for DO ● Connection error ● Module failure	▶ Check configuration → p. 76, §4.3.1). ▶ Contact Endress+Hauser Service.

Message	Significance	Possible cause	Action
Sensor configuration	The number of available sensors does not match the number of connected sensors.	● Sensor failure ● Communication problems on RS485 line	▶ Check sensor addressing and availability (→ p. 102, Fig. 90). ▶ Correct sensor selection (→ p. 76, Fig. 70). ▶ Contact Endress+Hauser Service.
Interface Module	No communication via Interface module	● No parameters set for module ● Connection error ● Module failure	▶ Check configuration (→ p. 81, §4.3.2.2). ▶ Contact Endress+Hauser Service.
Variant configuration error	MCU setting does not connected sensor	Sensor type has been changed	▶ Correct application settings (→ p. 64, §4.2.1).
Testmode enabled	MCU in "Test" mode.		▶ Deactivate "System Test" mode ("Maintenance" directory)

Figure 90 "Overview" directory

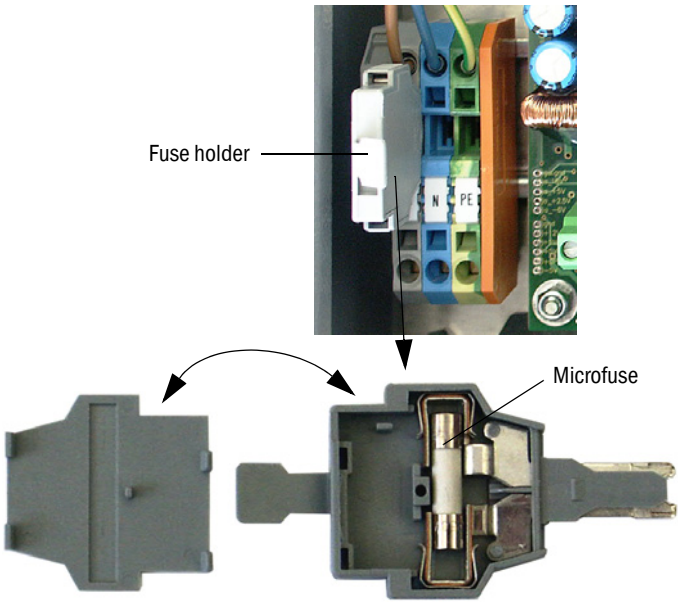


6.3.3 Replacing the fuse

MCU in wall housing

- ► Disconnect the measuring system from the mains.
- ► Open the door of the MCU control unit.
- ► Remove and open the fuse holder.
- ► Replace the defective fuse (→ p. 116, §7.6).
- ► Close and attach the fuse holder.
- ► Close the door and connect mains voltage.

Figure 91 Replacing the fuse

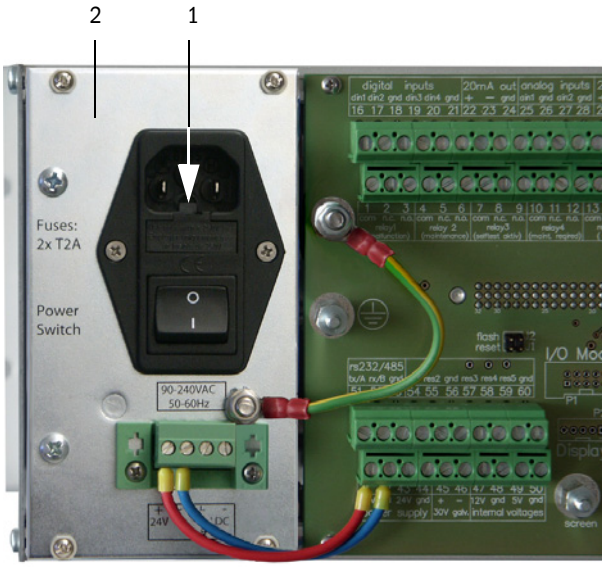


Control unit in 19” rack

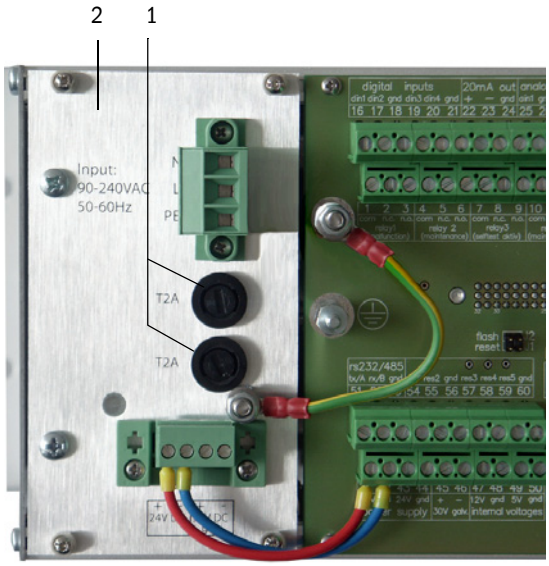
- ► Disconnect the measuring system from the mains.
- ► Pull control unit out of the 19” frame.
- ► Open fuse holder (1) (on the rear side of power supply unit (2)).
- ► Replace the defective fuse (→ p. 116, §7.6).
- ► Close fuse holder.
- ► Insert control unit and reconnect the mains voltage.

Figure 92 Replacing the fuse

Power supply unit with plug-in connection



Power supply unit with terminal connection



VICOTEC450

7 Specifications

Technical Data
Dimensions, Part Nos.
Installation accessories
Options
Consumable parts for 2-year operation
Spare parts
Password

7.1 Technical Data

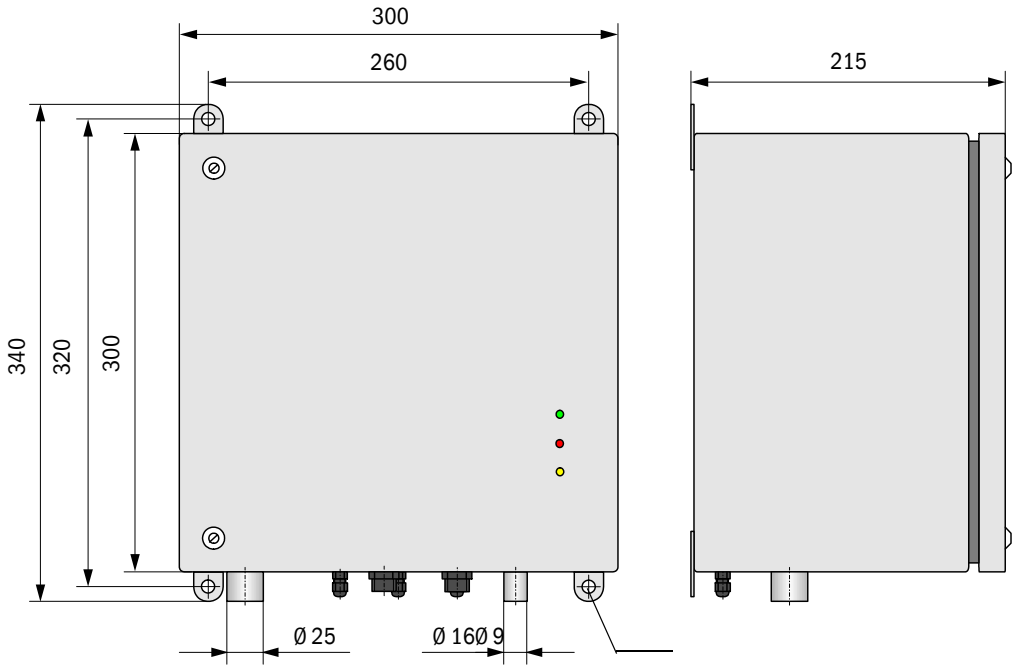
Measured value recording	
Measured variable	Scattered light intensity, computed to visibility (k value)
Measuring range k value	0 ... 150/km; freely selectable
Repeat accuracy	±2% of upper measuring range value
Resolution	Approx. 0.1/km
Response time	1 ... 600 s; freely selectable (without dwell time for air suctioned in the air intake line)
Measuring delay	Dwell time in air intake hose = line length [m] / air intake rate [m/s]
Air intake rate	Approx. 3 m/s for air intake hose inner diameter 13 mm and air intake hose length max. 30 m
Temp. measurement (option)	Measuring range -50 ... +250 °C; accuracy (not calibrated) ± 2 K; resolution ± 0.25 K
Function check	
Automatic self-test	Contamination, drift, aging Contamination limit values: 30% for warning; 50% for malfunction
Manual linearity check	With reference filter
Output signals	
Analog output	0/2/4 ... 20 mA, max. load 750 Ω; resolution 10 bits; electrically isolated Further analog outputs when using I/O modules (option, → p. 22, §2.2.4)
Relay outputs	5 potential-free outputs (changeover contact) for operation/malfunction status signals, maintenance, function check, maintenance request, limit value; contact load 48 V, 1 A; further relay outputs when using I/O modules (option, → p. 22, §2.2.4)
Input signals	
Analog inputs	2 inputs 0 ... 5/10 V or 0 ... 20 mA (standard, without electrical isolation); resolution 10 bits; further analog inputs when using I/O modules (option, → p. 22, §2.2.4)
Digital inputs	4 inputs for connection of potential-free contacts (e.g. to connect a maintenance switch or trigger a check cycle) Further digital inputs when using I/O modules (option, → p. 22, §2.2.4)
Communication interfaces	
USB 1.1, RS 232 (on terminals)	For measured value inquiries and software updates per PC/laptop using the operating program
RS485	To connect measuring unit(s)
Interface module option	To communicate with the Host PC, optional for Profibus, Ethernet
Power supply	
VCME	Operational voltage: 24 V DC 90 ... 250 V AC; 50/60 Hz with integrated optional power supply unit Power input: Max. 35 W
MCU	Operational voltage: 90 ... 250 V AC; 50/60 Hz Power input: Approx. 50 W for VCME power supply
Ambient conditions	
Temperature range	–30 ... +55 °C
Storage temperature	–40 ... +60 °C
Protection class	IP 66 (after correct installation)
Mass	
VCME	Approx. 12 kg (stainless steel housing 1.4571)
MCU	Approx. 5 kg (stainless steel housing 1.4571)
Misc.	
Laser	Laser class 2; power < 1 mW;wavelength approx. 650 nm; service life approx. 100,000 h (MTBF) at 20 °C
Electrical safety	In accordance with EN 61010-1
Blower output	Approx. 30 ... 35 l/min

7.2 Dimensions, Part Nos.

All dimensions are specified in mm.

7.2.1 Measuring unit

Figure 93 Measuring unit



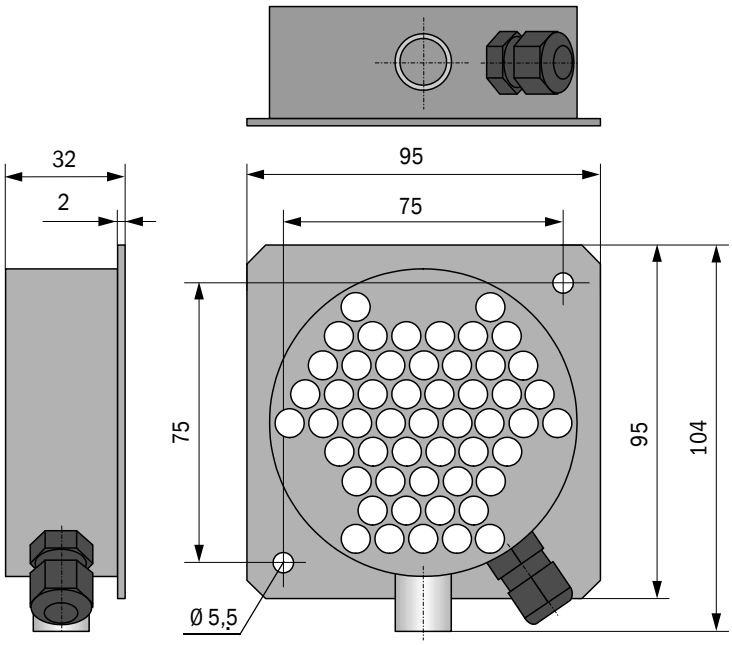
Name	Part No.
VCME-24-N-0-N measuring unit	1040575
VCME-24-N-0-F measuring unit	1040691
VCME-WR-N-0-N measuring unit	1040692
VCME-WR-N-0-F measuring unit	1040693

Type code → p. 18, §2.2.3

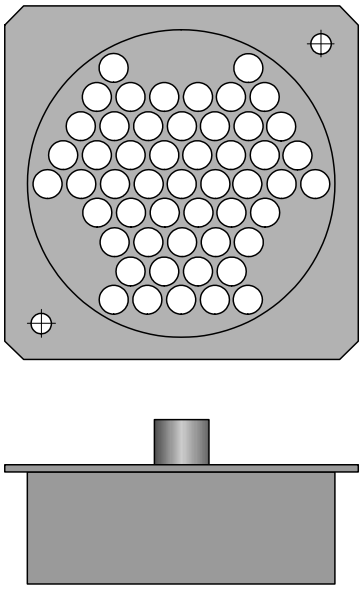
7.2.2 Air inlet with protective grating

Figure 94 Air inlet with protective grating

For wall fitting



For fitting on intermediate ceiling

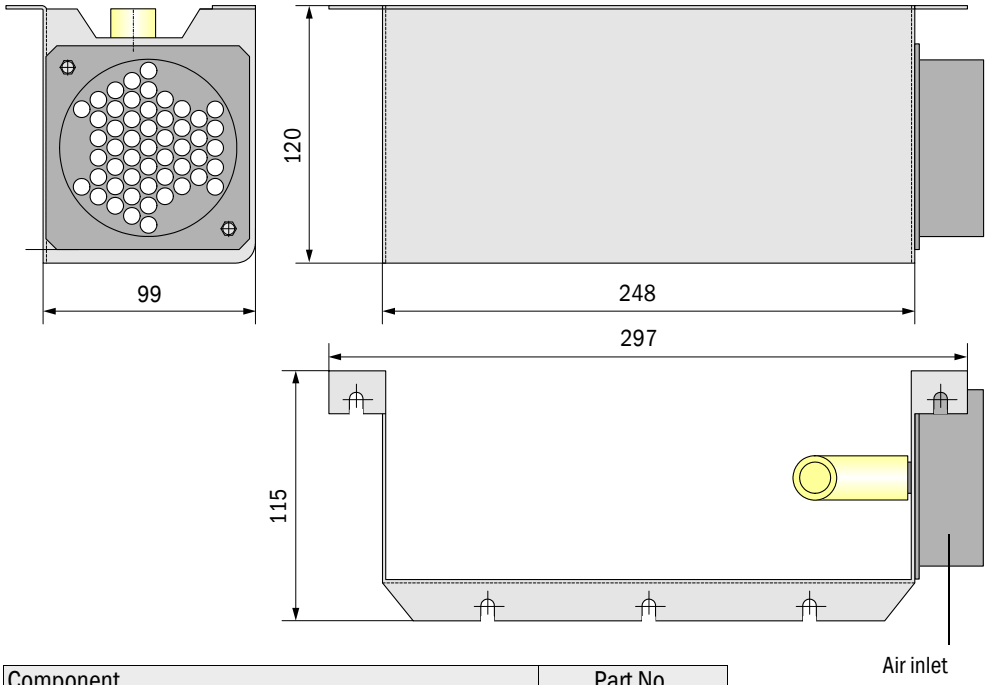


Dimensions and assembly dimensions as for wall fitting design

Name	Part No.
Air inlet with protective grating for wall fitting	2040848
Air inlet with protective grating for intermediate ceiling fitting	2040875

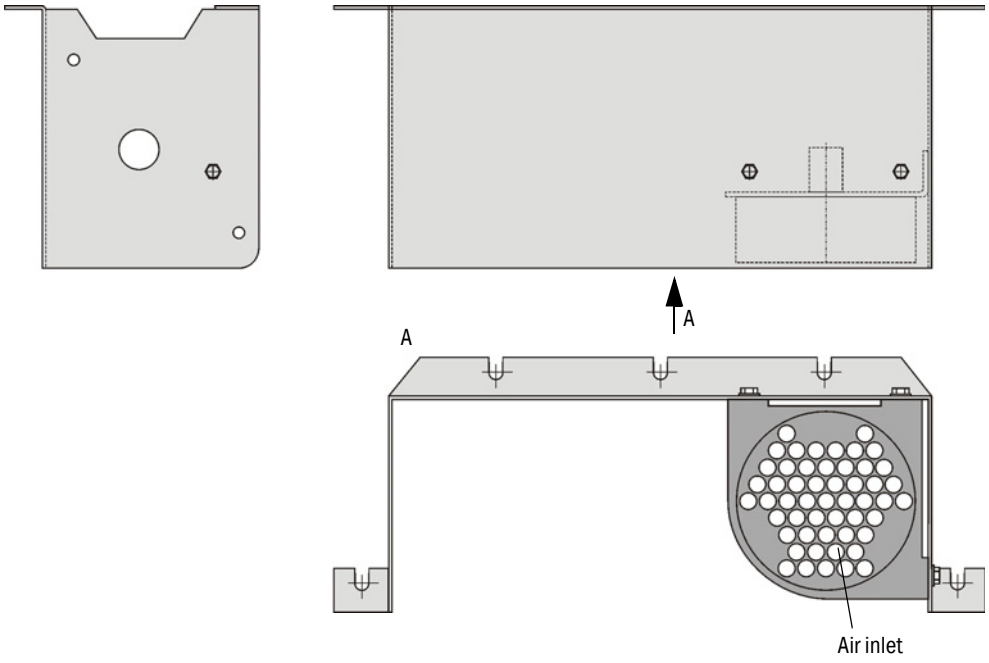
7.2.3 Cover with integrated air inlet

Figure 95 Cover with integrated air inlet from the side



Component	Part No.
Cover with integrated air inlet	2040850

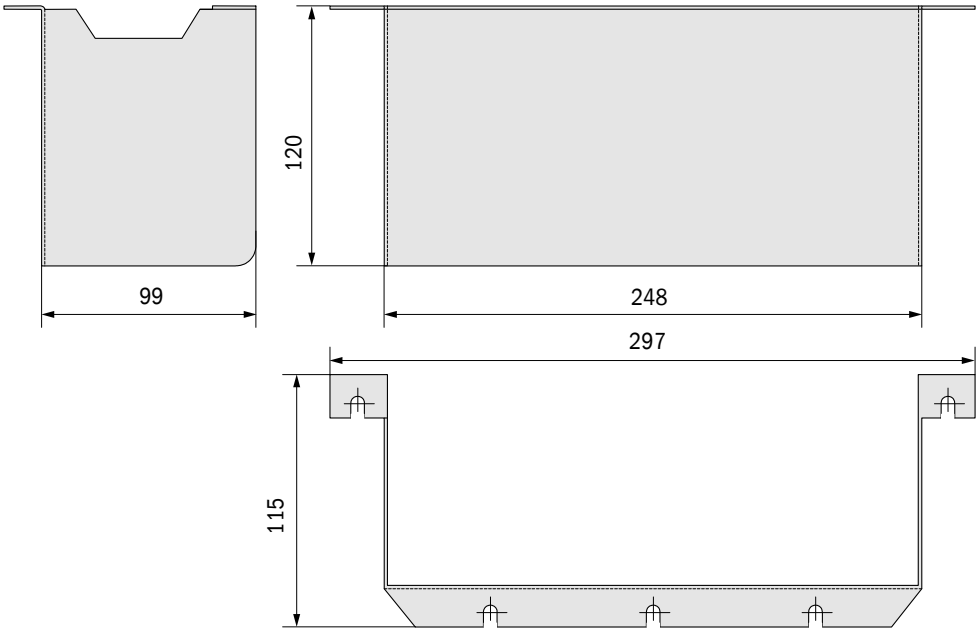
Figure 96 Cover with integrated air inlet from below



Component	Part No.
Cover with integrated air inlet concealed	2061799

7.2.4 Cover for connections option

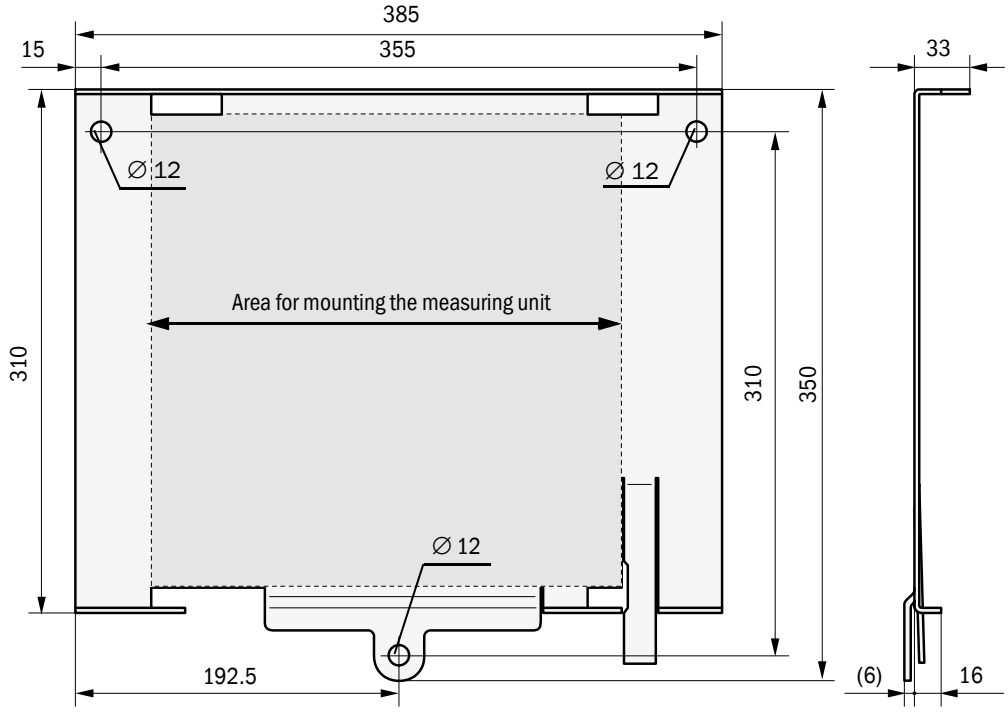
Figure 97 Optional cover for connections

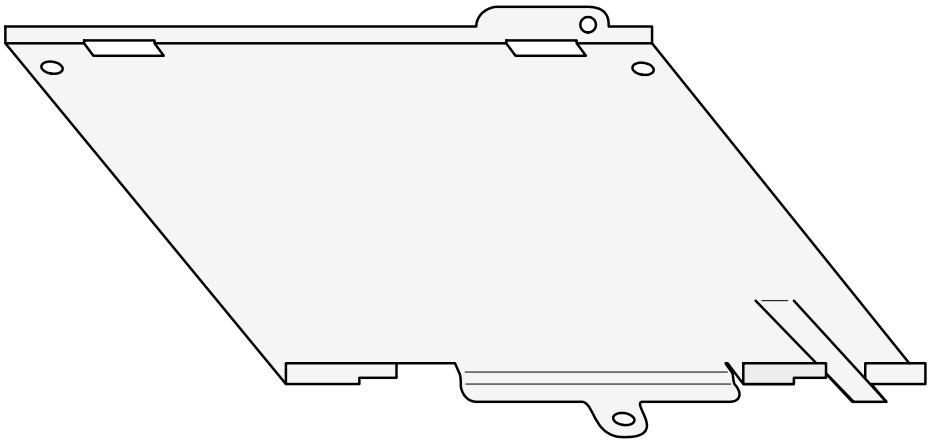


Name	Part No.
Cover for connections option	2040849

7.2.5 Optional installation plate

Figure 98 Installation plate option

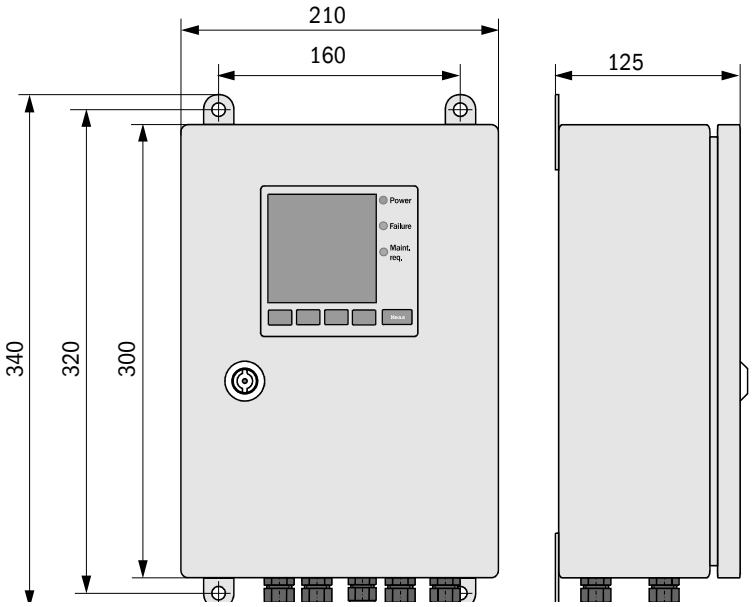




Name	Part No.
Installation plate	2040856

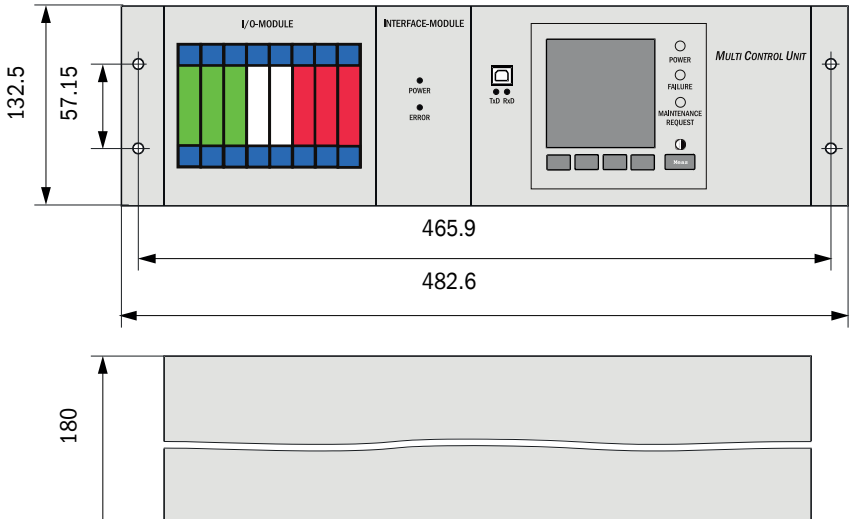
7.2.6 MCU control unit

Figure 99 MCU control unit in wall housing (shown with Display module option)



Name	Part No.
MCU-NWSN control unit	1046298
MCU-N2SN control unit	1046299
MCU-NWSD control unit	1046113
MCU-N2SD control unit	1046115

Figure 100 MCU control unit in 19” rack ((shown with Display module option)

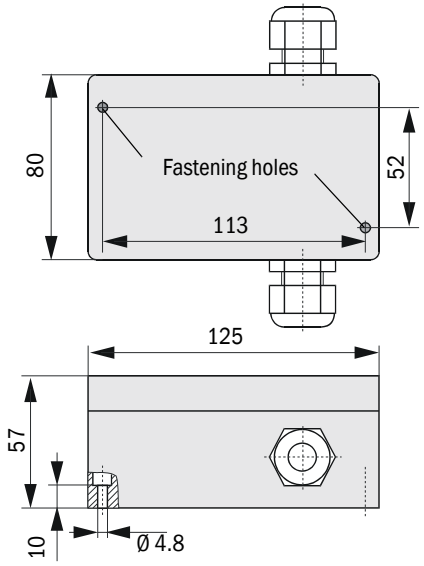


Name	Part No.
MCU-NWTD control unit in 19” rack	1046288
MCU-N2RD control unit in 19” rack	1046116

7.2.7 Optional connection box for connection cables

In aluminium housing

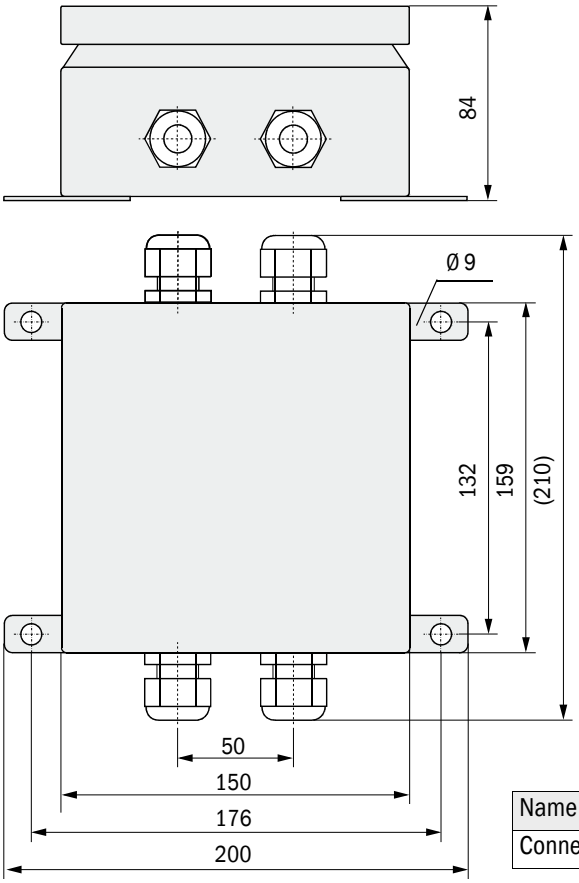
Figure 101 Connection box



Name	Part No.
Connection box	2046418

In stainless steel housing

Figure 102 Connection box in stainless steel housing



Name	Part No.
Connection box in stainless steel housing	2048067

7.3 Installation accessories

7.3.1 Air intake and exhaust air hoses

Name	Part No.
Air intake and exhaust air hoses, set, length 5 m	2042078
Air intake and exhaust air hoses, set, length 10 m	2042079
Air intake and exhaust air hoses, set, length 15 m	2042098

7.3.2 Connection cable

Name	Part No.
Connection cable for VCME to MCU connection, length 5 m	7042017
Connection cable for VCME to MCU connection, length 10 m	7042018
Connection cable for VCME to MCU connection, length 50 m	7042019

7.3.3 Fastening sets

Name	Part No.
Fastening set 4D8-1.4571/PA	2031889
Fastening set 2D4-1.4571/PA	2031890
Fastening set 2M8-1.4571	2031891
Fastening set 4M8-1.4529	2031887

7.4 Options

7.4.1 VCME measuring unit

Name	Part No.
Power supply unit 24 V DC, 75 W	2050635
Temperature measurement with 1x temperature sensor Ni-Cr-Ni, electronics module and line length 20 m (standard length)	2040852
Temperature measurement with 2 x temperature sensor Ni-Cr-Ni, electronics module and line length 20 m (standard length)	2040853

7.4.2 MCU control unit

Name	Part No.
Options for MCU control unit	
Analog input module, 2 channels, 100 Ω, 0/4...22 mA, electrically isolated (80 V difference)	2034656
Analog output module, 2 channels, 500 Ω 0/4 ... 22 mA, electrically isolated per module	2034657
Digital input module, 4 channels, for potential-free contacts, max. 4.5 mA	2034658
Digital output module, power relay 2 changeover contacts, contact load 48 V AC/DC, 5 A	2034659
Digital output module, signal relay, 4 NO contacts, contact load 48 V AC/DC, 0.5 A	2034661
Additional options for MCU control unit in wall housing	
Module carrier (each for one AI, AO, DI or DO module)	6028668
Connection cable for optional I/O modules	2040977
Profibus DP V0 interface module	2040961
Ethernet interface module	2040965
Additional options for MCU control unit in 19" rack	
I/O module carrier 19" (for installation of up to 4 AI/AO and DI/DO modules)	2050589
Interface module 19" Profibus DP	2049334
Interface module 19" Ethernet	2048377

7.4.3 Accessories for device check

Name	Part No.
Check filter set for VICOTEC450	2043331

7.5 Consumable parts for 2-year operation

VCME measuring unit

Name	Qty.	Part No.
Filter insert C1140 (only old versions with blower 6033052)	2	7047560
Filter insert C 630	2	5324368
Coarse filter (for air inlet with protective grating)	2	4050450
Optics cloth	2	4003353

7.6 Spare parts

Name	Part No.
Measuring unit	
Knurled nut M4	5313198
Socket 7-pole (to connect connection cable to MCU)	7045569
Socket 4-pole (to connect mains voltage to measuring unit with optional power supply unit)	7045613
Fuse set T2A	2054541
Control unit	
Fuse set T2A (for MCU with mains voltage supply)	2054541
Fuse set T4A (for MCU with 24 V supply)	2056334

7.7 Password

SICK

Passwort „Autorisierter Kunde“

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

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

Passwort **sickoptic** benötigt.

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

Password "Authorized Client"

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

password **sickoptic** must be entered

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

8029835/AE00/V2-3/2014-06

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