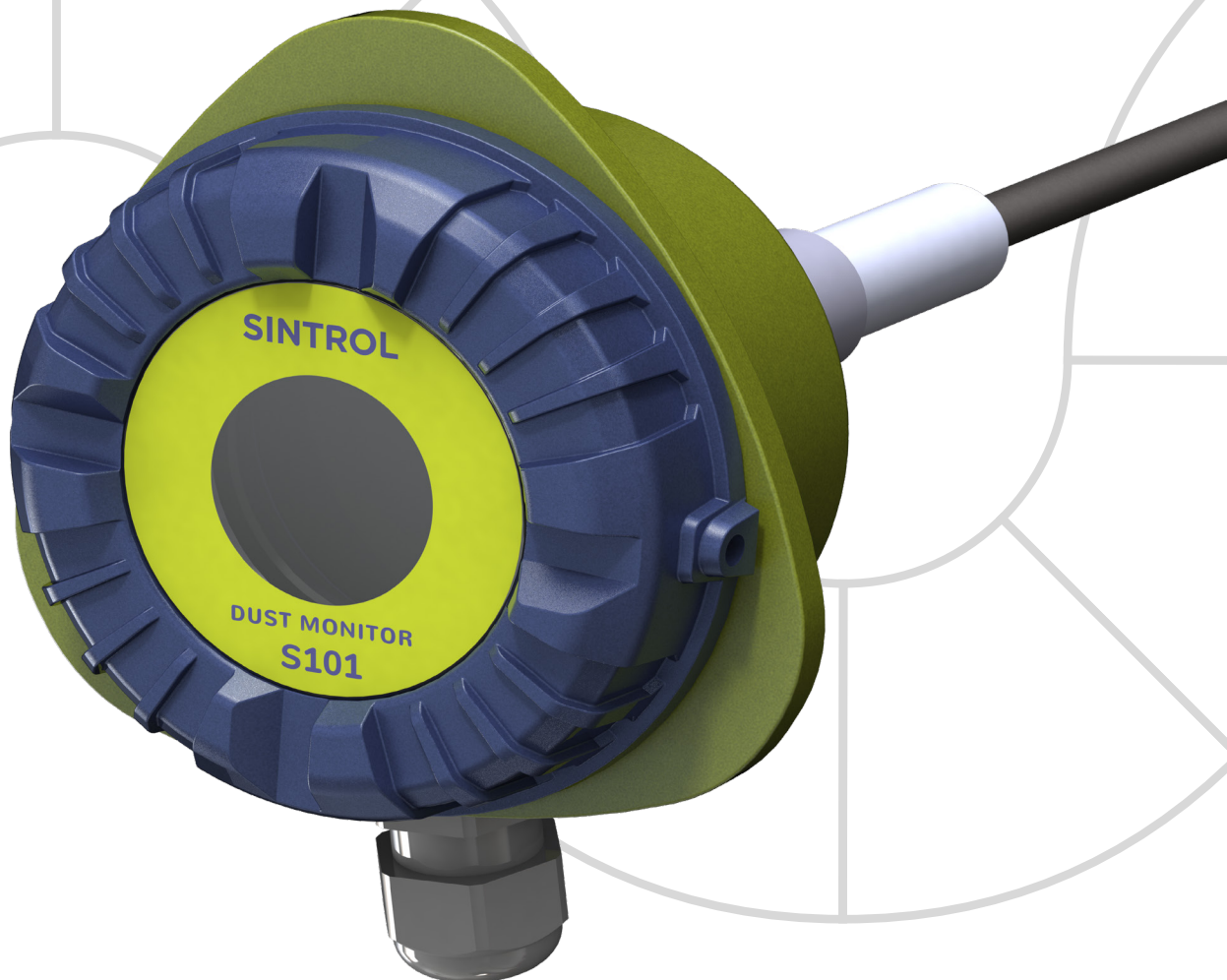


USER MANUAL

S100 Series Dust Monitor

Model S101



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1 About this manual

This user manual contains the installation, commissioning, operating and maintenance instructions for S100 series dust monitor model S101. Read this manual carefully before using the device. This manual is an important part of the product, and it must always be available for reference to all personnel installing, commissioning, operating or performing maintenance on the device. In case the manual is lost or damaged, request a new copy from the manufacturer.

1.1 Description of symbols

These symbols are used to alert you to any potential personal injury hazards, and to provide information on how to avoid them. Obey all safety messages that use these symbols to avoid possible injury or death. Symbols that provide additional information about using and handling the product are also described here.

Symbol	Description
	General warning symbol.
	Hot surface.
	Electric hazard.
	Toxic hazard.
	Explosion hazard.
	Important or useful information related to installing, maintaining or operating the device.
	Read the user manual before doing a procedure or operating the device.
	Wear protective gloves.

Symbol	Description
	Wear protective glasses.
	Wear protective overalls.
	Wear a welding mask.
	Wear respiratory protection.
	CE marking indicates that the device has been designed and manufactured to meet all applicable health, safety and environmental protection standards required for products sold in the European Union.
	Electronic devices that are marked with this symbol must not be disposed of with general waste. If a defective or broken-down device cannot be repaired, it must be recycled and disposed of in accordance with WEEE directive (2002/95/EC) or other applicable local regulations.
	This symbol indicates waste material that must be recycled.

1.2 Abbreviations

Abbreviation	Explanation
ESP	Electrostatic precipitator
ID	Inside diameter
IEU	Inductive electrification unit
MB	Modbus
OD	Outside diameter
RF	Radio frequency
RH	Relative humidity
SNT	Sintrol Network
SSR	Solid-state relay
TSP	Total suspended particles

2 Safety



**Read this chapter carefully before handling the device in any way.
In addition, read all safety notes before work steps and other instructions.**

Only trained and qualified personnel can install, commission, operate and perform maintenance on the device. All personnel must read and understand this manual and follow its instructions accurately. Failure to follow the safety instructions and safety precautions can result in serious injury or death.

If you encounter any unexpected situations during the intended use of the device that are not described in this manual, contact the manufacturer.

In addition to the safety instructions described in this manual, the personnel using the device must follow all applicable country- and industry-specific safety standards and regulations.

2.1 Warnings



DANGER!

“DANGER” indicates a hazard with a high level of risk, which will result in death or serious injury if not avoided.



WARNING!

“WARNING” indicates a hazard with a medium level of risk, which can result in death or serious injury if not avoided.



CAUTION!

“CAUTION” indicates a hazard with a low level of risk, which can result in minor or moderate injury if not avoided.

NOTICE

“NOTICE” indicates a situation with a risk of equipment damage.

2.2 Intended use

This device is designed for filter leak detection in various industrial applications. It operates by measuring the concentration of solid particles in an airflow inside conductive pipes and ducts. The intended use is as described in this user manual. Any other use is considered improper and can result in injury or equipment damage.



The manufacturer or distributor cannot be held liable for any damage, injury or financial loss resulting from improper use.

The device must not be modified or repaired in any way that is not specifically described in this manual. Do not perform any mechanical or electrical repairs without contacting the manufacturer or an authorized service center or distributor. Only original Sintrol parts can be used for repairs. If third-party spare parts are used, the manufacturer cannot guarantee safe operation of the device.

Before installing and commissioning the device, carefully inspect it for any damage or defects. Do not use the device if it is damaged, or if the power supply is defective. Return damaged device to the manufacturer.

Non-compliance with any of these conditions immediately voids the warranty, and the manufacturer's responsibility no longer applies.



Wear appropriate protective gloves at all times when installing the device.

DANGER!



Explosion hazard

The device is not UL/CSA or IECEx/ATEX certified. Do not use the device in potentially explosive atmospheres.

WARNING!



Use in critical applications

Improper use in critical applications can lead to hazardous situations or have severe adverse health effects. Such critical applications include, but are not limited to:

- **Health protection**
- **Emission monitoring**
- **Process control**
- **Fire and explosion prevention**



Many factors can affect the operation of the dust monitoring system. These factors can include, for example, dust particle size, dust material, the design of the pipes or ducts that the dust monitor is installed on, and operator error. Because of this, an industry specialist must evaluate and approve the suitability of Sintrol products for any given dust monitoring system. This is particularly true when the instruments are only a component in a larger monitoring system, or when they are used in critical applications.

2.3 Conformity to standards and directives

This device has been designed and manufactured to comply with the requirements of ISO 9001:2008 standard related to quality management. See **Appendix A** for ISO 9001 certificate.

This device has been designed and manufactured to comply with the following standards and directives:

- EN 61326-1:2012
- ROHS Directive 2011/65/EU (RoHS II)

3 Product overview

3.1 Product description

The device is designed to measure the concentration of dust particles inside a pipe or duct. This makes it an ideal solution for detecting filter leaks or failures in cyclonic separation in various industrial applications.

The operating principle is based on inductive electrification technology, where particles interacting with an isolated probe induce a signal that is transmitted to the monitoring system. The normal dust level is determined during commissioning, and the signal generated by the sensor is then scaled in proportion to this baseline level when the dust level fluctuates.



The device is intended for use in non-condensing environments. The sensor does not distinguish liquid droplets from dust particles. If the measured airflow contains liquid droplets, the measurement results are inaccurate.

For detailed technical data, see chapter **Specifications**.

3.1.1 Key properties

Table 1: Key properties

Enclosure:	Aluminum
Probe length:	250 mm (9.84 in), can be shortened by the user
Probe material:	Stainless steel (316L)
Insulation material:	Polyether ether ketone (PEEK)
Output signal:	2 × Independent solid-state relays
Communication protocol:	<ul style="list-style-type: none"> • Modbus RTU • Sintrol network
Max. temperature:	250 °C (482 °F)
Max. pressure:	200 kPa (29 psi)
Flow speed:	Min. 3 m/s (9.84 ft/s), max. tested 40 m/s (131.23 ft/s)

3.1.2 Commissioning

Commissioning is easy with Auto Setup feature, which determines the baseline dust level and sets up two alarm thresholds that are proportional to the baseline. An alarm is triggered when the dust concentration exceeds a configured threshold.

3.1.3 Installation

The device is equipped with a male 1/2-inch NPT thread on the base of the sensor probe. During installation the device is secured to a 1/2-inch NPT female pipe coupler that is welded on the pipe or duct.

3.1.4 Settings and parameters

You can access and change the device settings and parameters with RS-485 connection using complementary DustTool software. You can download DustTool free of charge at www.sintrolproducts.com/products/software/DustTool/.

3.2 Design drawings

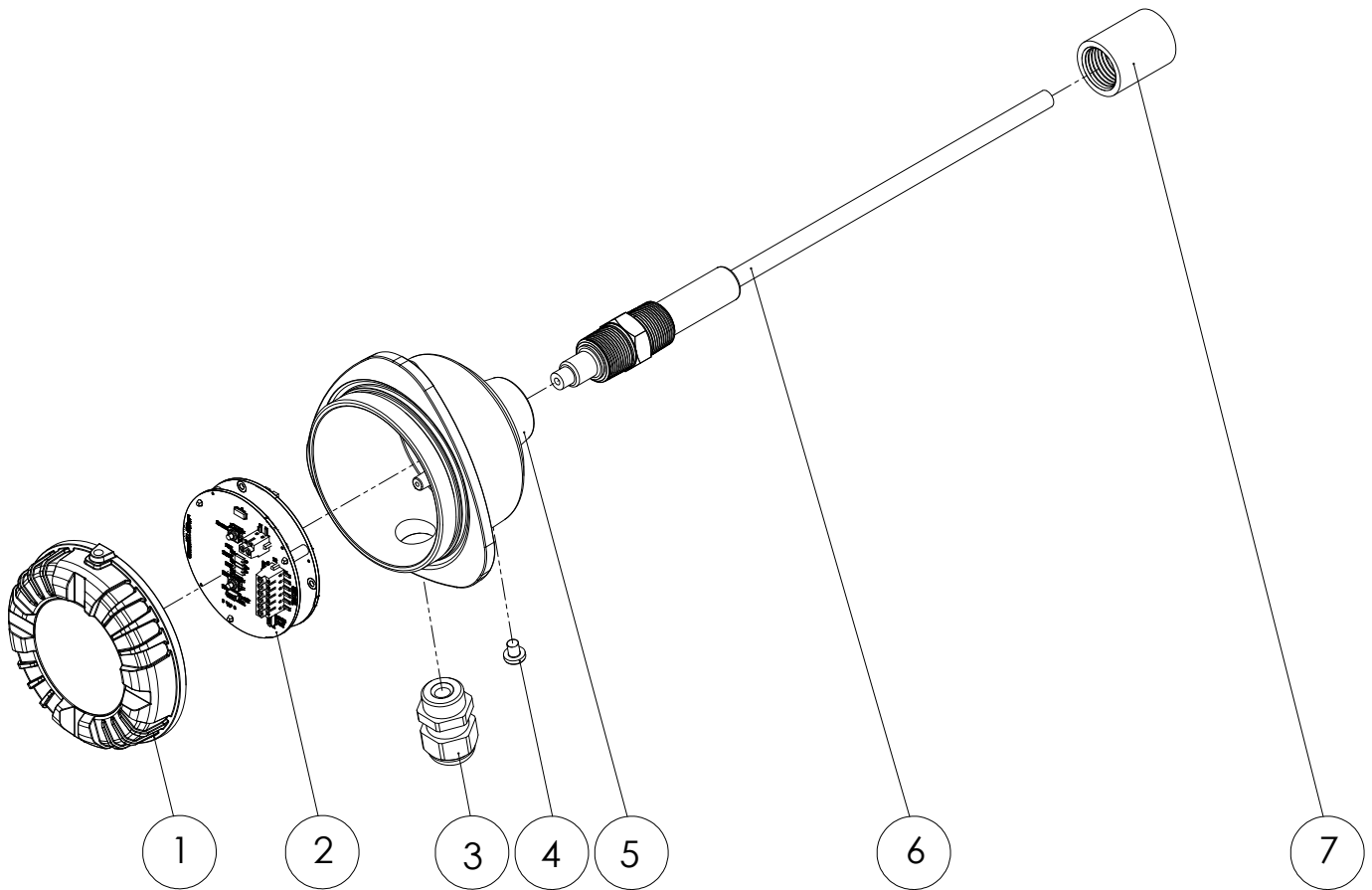


Figure 1: Main components

① Threaded lid with a window	⑤ Aluminum enclosure
② Main board	⑥ Sensor probe
③ Cable gland	⑦ 1/2-inch NPT female pipe coupler for connecting the device to the process*
④ External ground connection	

* Not included in standard delivery

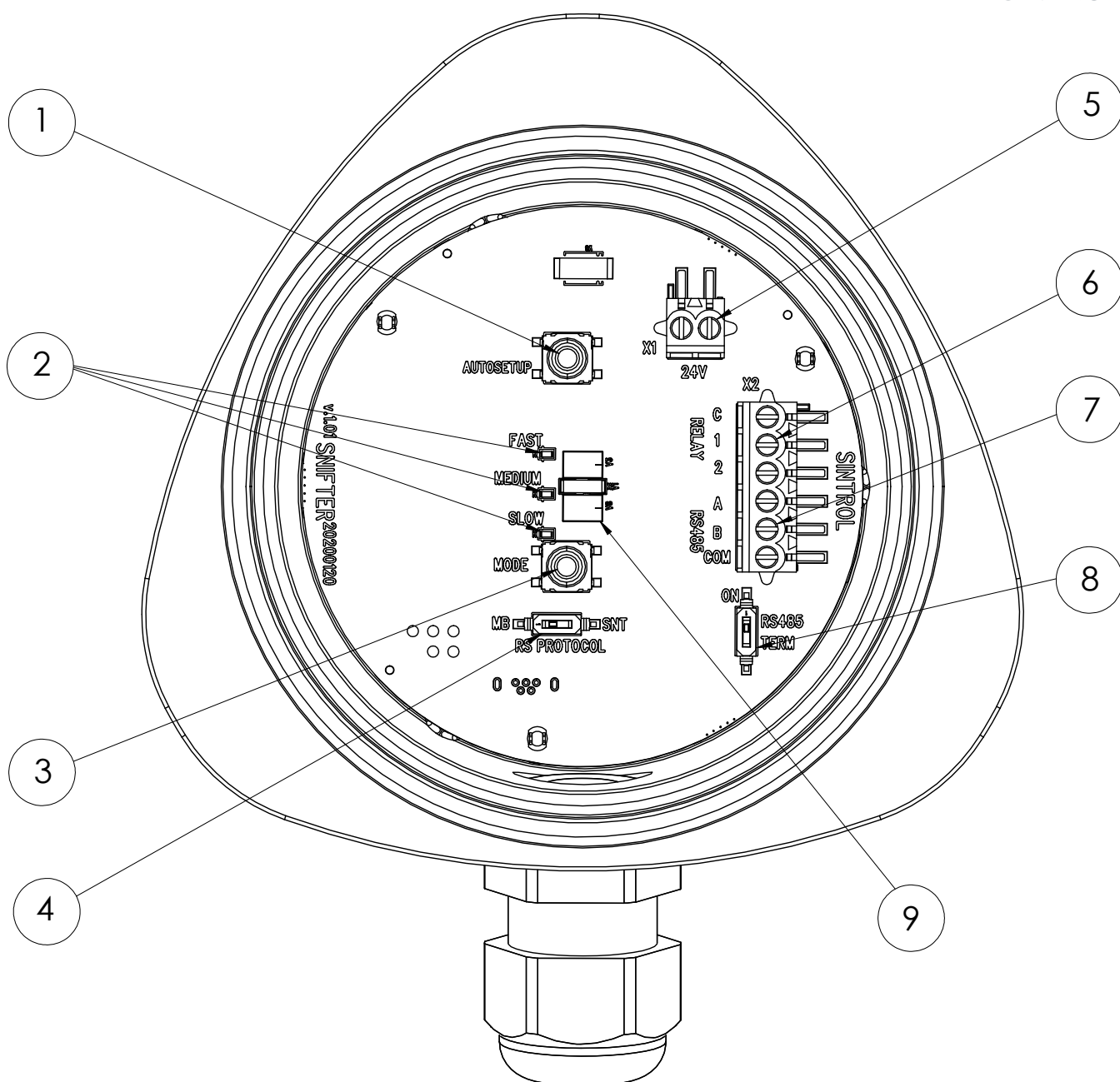


Figure 2: Main board and electrical connections of the dust monitor

①	AUTOSETUP key	⑥	Solid-state relay terminal
②	Mode indicator LEDs	⑦	RS-485 bus
③	Mode selector key	⑧	RS-485 terminator switch
④	RS PROTOCOL switch	⑨	Status LEDs
⑤	24 V DC power supply terminal		

3.2.1 Dimension drawings

Side view

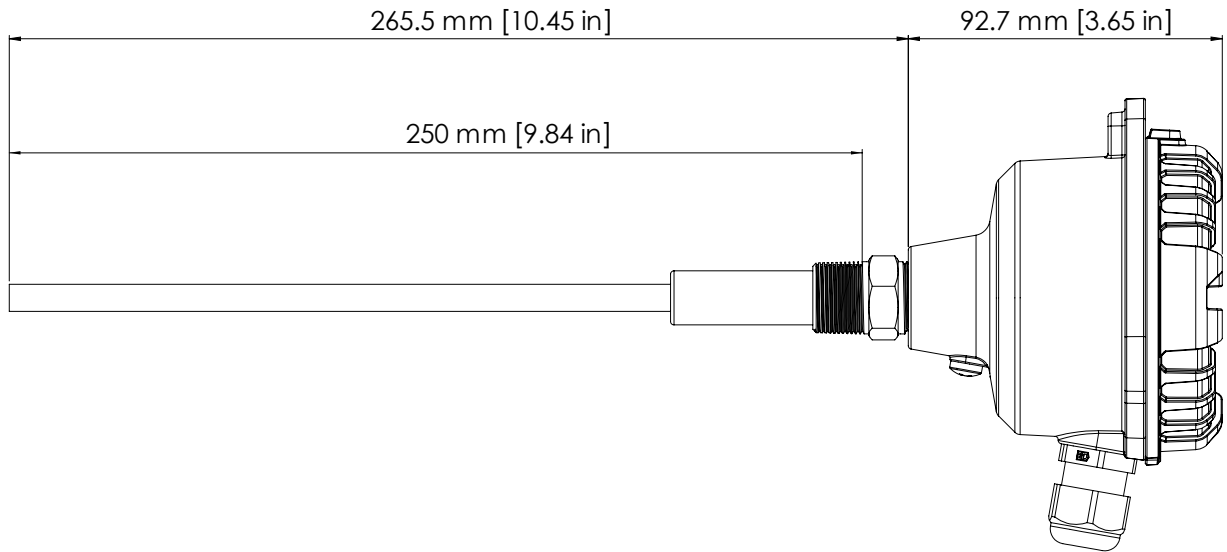


Figure 3: Side view dimensions of the enclosure and probe

If you need a sensor probe that is shorter than the standard 250 mm (9.84 in), you can shorten the probe by simply cutting part of it off with an appropriate tool.

Front view

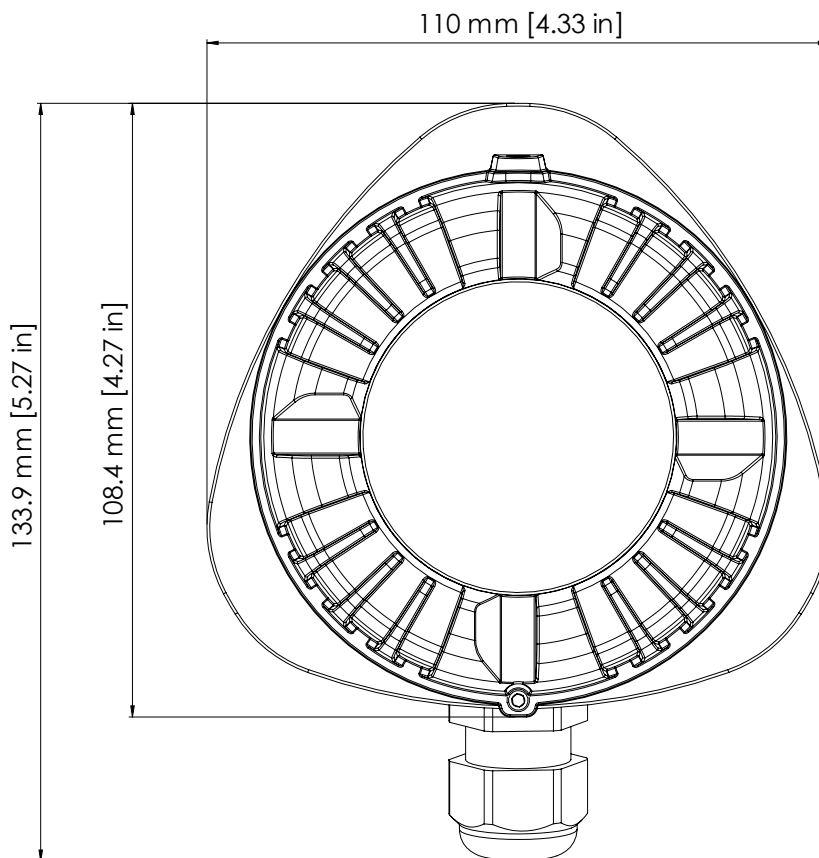


Figure 4: Front view dimensions of the enclosure

3.2.2 Standard 1/2-inch NPT female pipe coupler

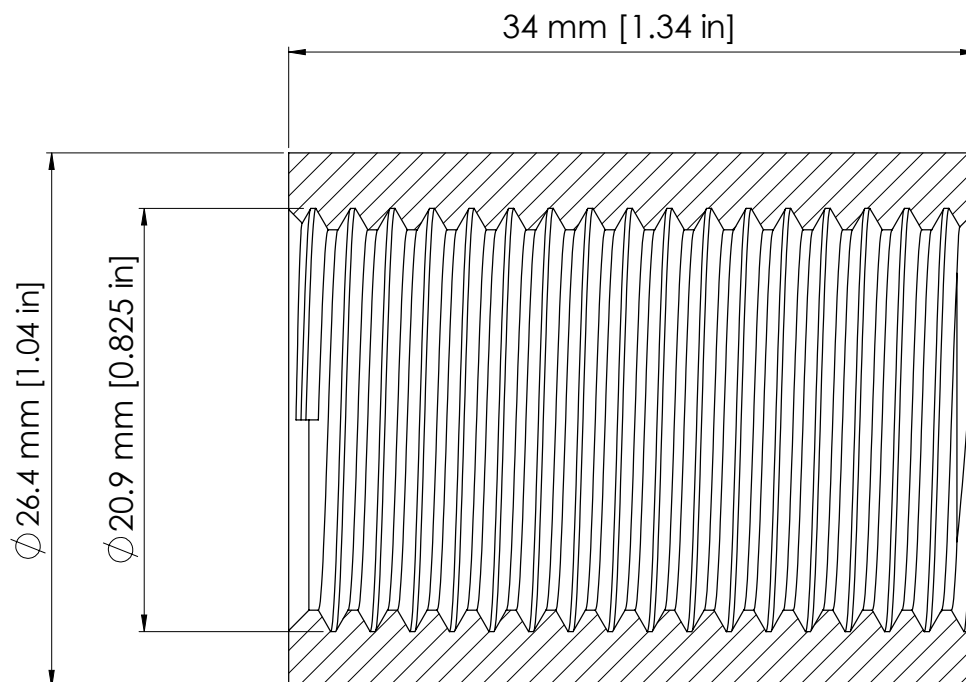


Figure 5: Standard 1/2-inch NPT female pipe coupler dimensions

3.2.3 Identification

Identification label is located on the side of the enclosure, next to the cable gland.

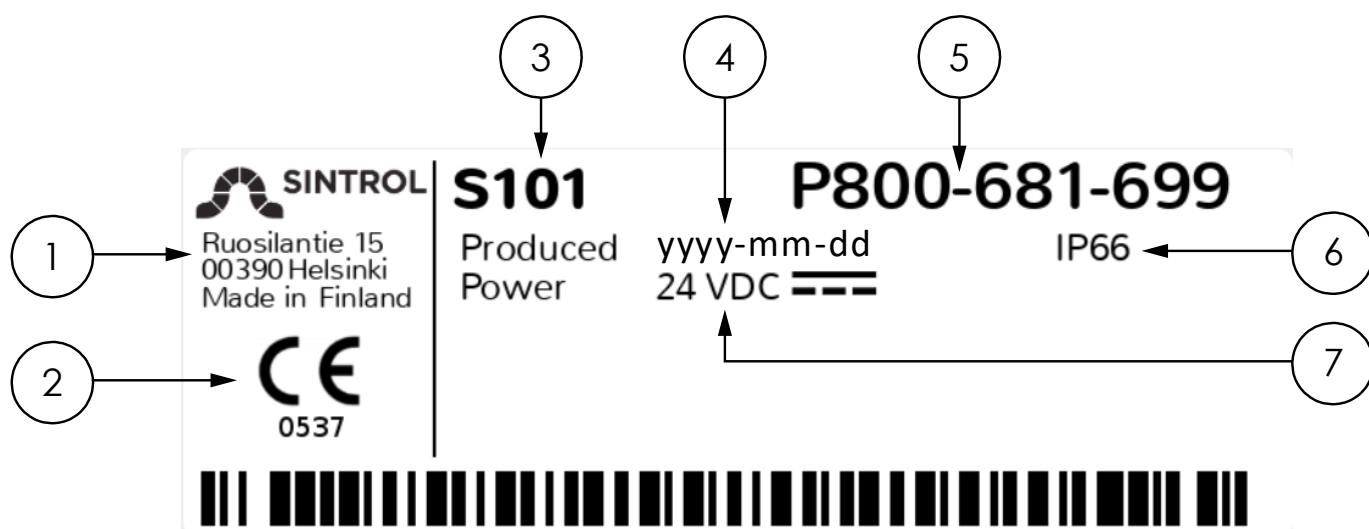


Figure 6: Identification label

①	Manufacturer details	⑤	Serial number
②	CE marking	⑥	IP rating
③	Device model	⑦	Power supply specifications
④	Production date		

3.3 Scope of delivery

A standard delivery includes one S101 dust monitor, DustTool software and this user manual.

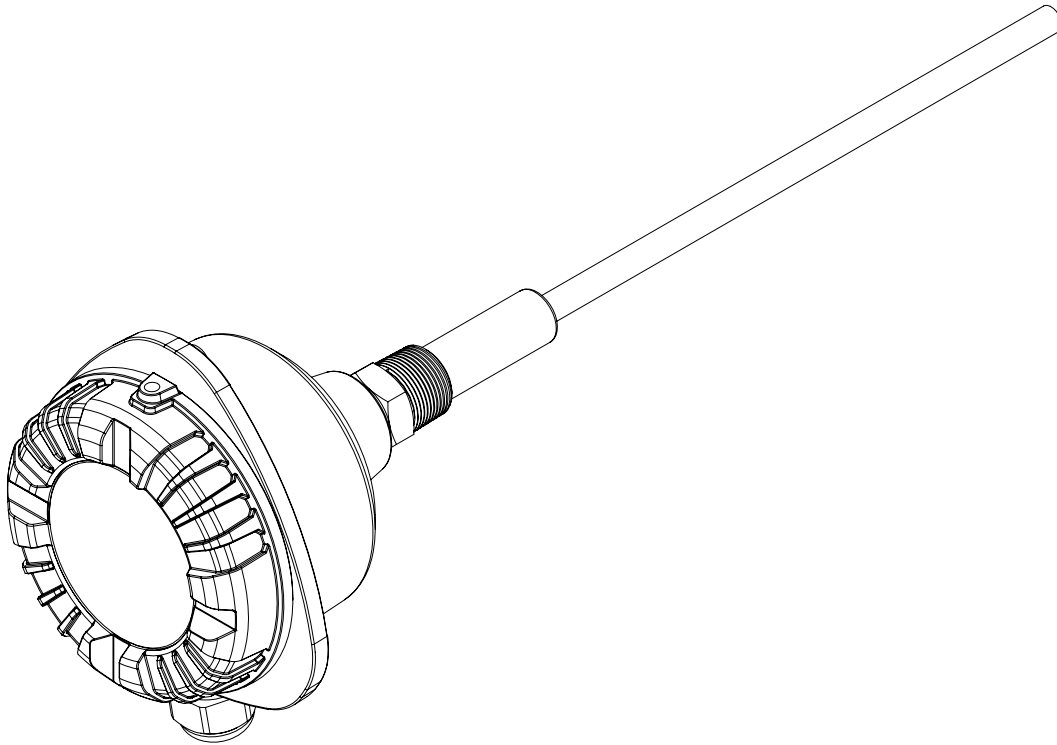


Figure 7: Standard delivery

Additionally, you need a 1/2-inch NPT female pipe coupler for connecting the device to the monitored process, and a 1/2-inch NPT male plug to close off the sensor end of the female pipe coupler when the device is removed from the process for cleaning and inspection.



1/2-inch NPT female pipe coupler and 1/2-inch NPT male plug are not included in the standard delivery. Suitable pipe couplers and plugs are standard stock in regular hardware stores.

3.4 Features and accessories

3.4.1 Standard features

A standard delivery includes the following features:

Table 2: Overview of standard features of S101 dust monitor

Rugged IP66-rated pressure-casted aluminum enclosure
1/2-inch NPT thread on the sensor probe for easy installation
Two status indicator lights with independent green, yellow and red LEDs
Auto Setup function for easy commissioning
Mode selector key with user-selectable FAST, MEDIUM and SLOW response modes
Two independent solid-state relays to indicate dust alert and dust alarm

DustTool software for easy setup

RS-485 bus for integration into existing control systems using Modbus RTU, and for connecting multiple devices in parallel using Modbus RTU or Sintrol Network protocol

3.4.2 Optional features and accessories

The device has some customization options and additional accessories that you can use to take full advantage of its standard features.

Mounting

The device can be ordered with an alternative mounting option, where a mounting socket is welded on the pipe or duct. A process connection counterpart is attached to the device with 1/2-inch NPT thread, and secured to the process connection with a quick-clamp.

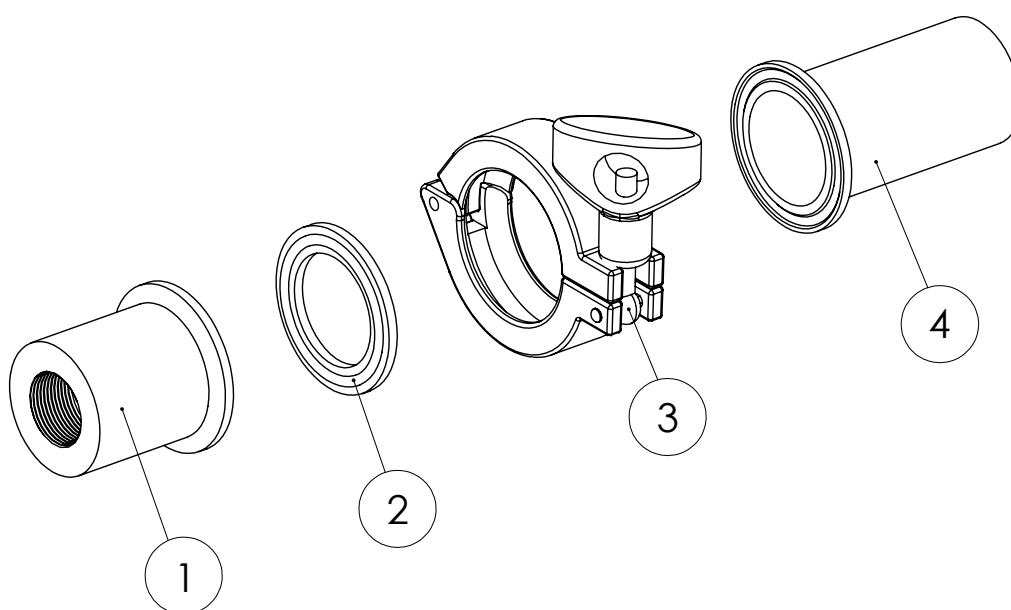


Figure 8: Mounting with a quick-clamp connector

<p>① Process connection counterpart with 1/2-inch NPT thread Part number: MC900093</p>	<p>③ Quick-clamp connector Part number: MC900034</p>
<p>② Quick-clamp gasket Part number: OC900007</p>	<p>④ Weld-on process connection Part number: MC900229</p>

In case your process requires some other mounting option, contact the manufacturer.

Accessories

The device can be ordered with the following optional accessories:

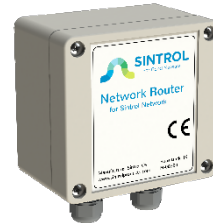
RS-485 to USB converter for connecting the device to a computer using Sintrol Network protocol.

Part number: EC900041



Network Router for setting up device chains and networks.

Part number: PC900091



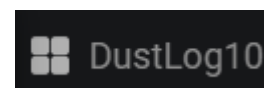
Wireless Router for integrating the device into a network that utilizes both wired and radio frequency (RF) communication.

S101 dust monitor cannot be equipped with wireless communication option, but it can be used in device networks that combine wired and wireless communication.

Part number: PC900090



DustLog 10 reporting software for additional data logging and reporting options.



3.5 Operating principle

The device is designed for measuring solid particles in the airflow inside conductive pipes and ducts. A complete installation consists of an isolated probe that is inserted inside a duct, perpendicular to the airflow.

When dust particles moving inside the duct pass or hit the sensor probe, a signal is induced. This signal is then transferred to a monitoring system, for example a computer running a monitoring software. The underlying technology is called “inductive electrification”. This technology is very sensitive, and it minimizes the influence that sensor contamination, changes in process temperature and flow speed have on the measurement results.

Inductive electrification technology enables a detection limit of as low as 0.01 mg/m^3 .

3.5.1 Inductive Electrification Unit

The signal level generated by the device is measured in Inductive Electrification Units (IEU). The device uses these units to communicate the dust level to the monitoring system. The IEU value can be anything from 0 up to several million units, which allows very accurate monitoring of dust levels.

Auto Setup function uses IEU values to set two alarm limits that are triggered when the dust levels increase.

3.5.2 Potential influences on measurement results

With the inductive electrification technology, the signal level shows the following behavior over the measuring range:

- **Linear range:** Signal level increases linearly from the detection limit 0.01 mg/m^3 to several hundred mg/m^3 .
- **Nonlinear range:** From linear range up to several g/m^3 .
- **Saturation:** After non-linear range. The signal level reaches saturation and no longer increases.

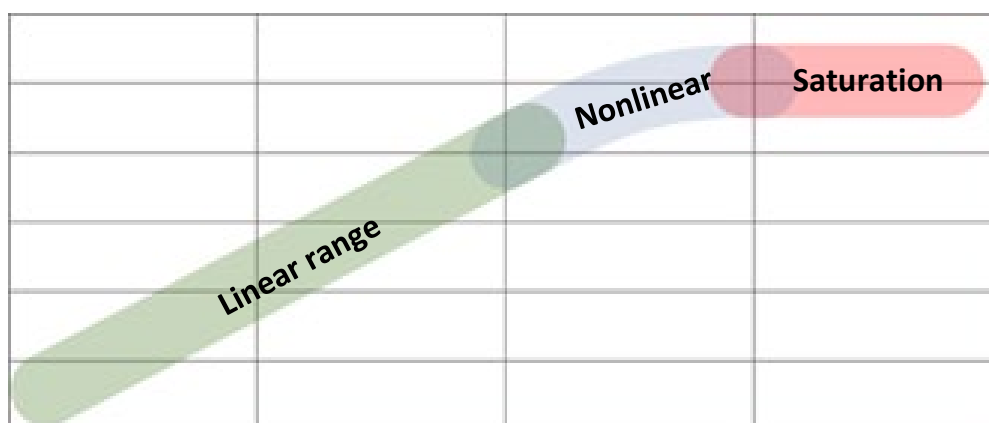


Figure 9: Uncalibrated measuring behavior

Many factors can affect the measuring range and behavior of the device. These factors include dust material, particle size, flow speed and installation environment.

Probe length

The recommended minimum probe length depends on the measuring conditions and environment. For example, in vertical ducts, the dust particles will concentrate in the middle of the duct with high flow speed. In horizontal ducts, large particles will concentrate on the lower part of the duct with low flow speed.

If the probe is too short compared to the duct diameter, the measurement results are inaccurate.

Recommended probe lengths are:

- For indicative monitoring, a minimum probe length of one fourth ($\frac{1}{4}$) of the duct diameter is recommended.
- For demanding and critical applications with varying flow speed, a minimum probe length of one third ($\frac{1}{3}$) of the duct diameter is recommended.



The standard probe length is 250 mm (9.84 in), which means that the maximum pipe diameter where the device can be used is 1 meter.



The sensor probe must not touch the opposite surface inside the duct, because it distorts the measurement results.

Particle material

Different materials can have different amounts of electrostatic charge. This means that the signals transmitted by dust particles can vary significantly from one material to another:

- Metals (inorganic, electroconductive) generate the lowest signals.
- Cement and minerals (inorganic, dielectric) generate average signals.
- Wood and flour (organic, dielectric) generate the highest signals.

As a result, different types of dust generate a different output signal at the same concentration.



Certain heavy metal dusts generate extremely low signals. For measuring such dusts, the device must be tested with a dust sample before delivery.

Common dust particle materials include:

- | | | |
|-------------|---------------------------|-------------|
| • Grains | • Ceramics | • Minerals |
| • Sugar | • Textiles | • Ores |
| • Coal | • Wood and paper | • Cement |
| • Cosmetics | • Soap | • Plastics |
| • Dyes | • Metals and metal oxides | • Chemicals |

Particle size

The minimum particle size that the device can detect is 0.3 μm . The optimal detection range is from 1 to 200 μm .

Relative humidity

The device is intended for use in non-condensing environments in both indoor and outdoor applications.

The relative humidity (RH) has an insignificant effect on the measurement results. However, the sensor does not distinguish liquid droplets from dust particles. This means that the measured airflow must not contain condensation. If the measured airflow contains condensed liquid droplets, it is possible that the device does not produce output signal at all, or the output signal can be too high.

Ambient temperature

Ambient temperature only has a very minor effect on the output signal.

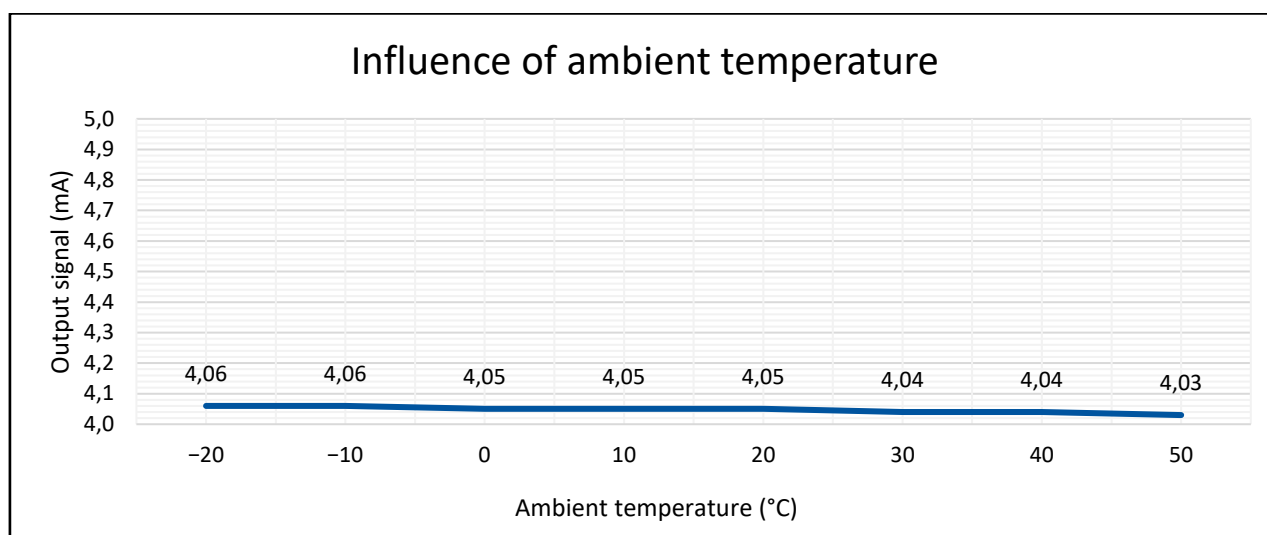


Figure 10: Influence of ambient temperature on the output signal



Recommended minimum flow speed is 3 m/s (9.84 ft/s).

Maximum tested flow speed is 40 m/s (131.23 ft/s).

An increase in flow speed also increases the output signal level. Dust material, particle size, temperature and installation environment can all affect output signal level.

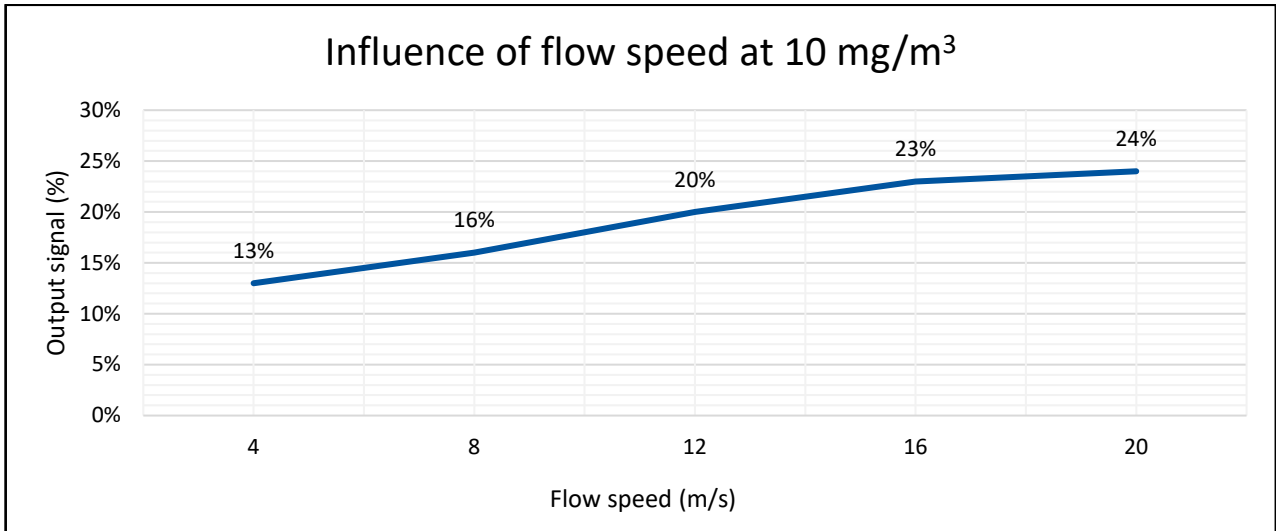


Figure 11: Influence of flow speed on the output signal

4 Storage

NOTICE

Improper storage can cause damage to the equipment.

When storing the device:

- Select a dry, dust-free location.
- Store the device in its original packaging.
- Do not place any heavy objects on the device.
- Storage temperature must be within range $-40 \dots 60 \text{ }^{\circ}\text{C}$ ($-40 \dots 140 \text{ }^{\circ}\text{F}$).

Retain the original packaging in case the device ever needs to be transported or returned. For instructions on how to return a damaged or defective device for repair or replacement, see section **Returns** in chapter **Maintenance and inspection**.

5 Mechanical installation



Read chapter “Safety” carefully before installing the device.

5.1 Unpacking and inspection

5.1.1 Unpacking

NOTICE

Improper handling during unpacking can cause damage to the equipment.

When unpacking the device:

- If you use a knife or scissors to open the package, be careful not to damage the device or its parts.
- Handle the device and its components with care when taking them out of the package.
- Do not drop the device or subject it to blows.

5.1.2 Inspection

After unpacking the device:

- Check that the device and all its standard and optional parts are included in the delivery.
- Inspect the device and its individual parts for any defects, or damage that may have occurred during delivery.

For instructions on how to return a damaged or defective device for repair or replacement, see section **Returns** in chapter **Maintenance and inspection**.

5.2 Selecting installation location



Any information given in this user manual regarding the installation location or suitability for a specific application does not replace careful functionality checks and necessary approvals from an industry specialist.



Do not install the device close to large motors, cables carrying high voltages, or other potential sources of interference. These can distort the measurement results.

5.2.1 Ambient environment

NOTICE

If there are any structures that radiate heat near the device, you must insulate the heat source. Very high temperatures will damage the device.

To minimize the effect that the environment has on the measurement results, install the device in a suitable location. Table 3 shows the suitable ambient conditions for the device.

Table 3: Ambient conditions of the installation location

Ambient temperature:	-40 ... 60 °C (-40 ... 140 °F)
Relative humidity:	Max. 95 % RH (non-condensing)



The device is intended for use in non-condensing environments. The sensor does not distinguish liquid droplets from dust particles. If the measured airflow contains liquid droplets, the measurement results are inaccurate.

If the device is installed on the side of the duct in a location with occasional condensation, it is recommended to install the sensor probe with a 5° downward tilt. This helps prevent liquid from accumulating on the insulation.

5.2.2 Location

An optimal location for installation is in a section of pipe or duct where the dust particles are evenly distributed in the airflow, and the flow is as laminar as possible. This ensures that the sensor probe comes into contact with an amount of particles that represents the actual dust concentration in the airflow.

Install the device in a straight section of pipe or duct that has no bends, valves, dampers or other obstacles in its vicinity. The recommended minimum distance to any obstacle is 5× the duct diameter if the obstacle is located upstream from the device, and 3× the duct diameter if the obstacle is located downstream from the device.

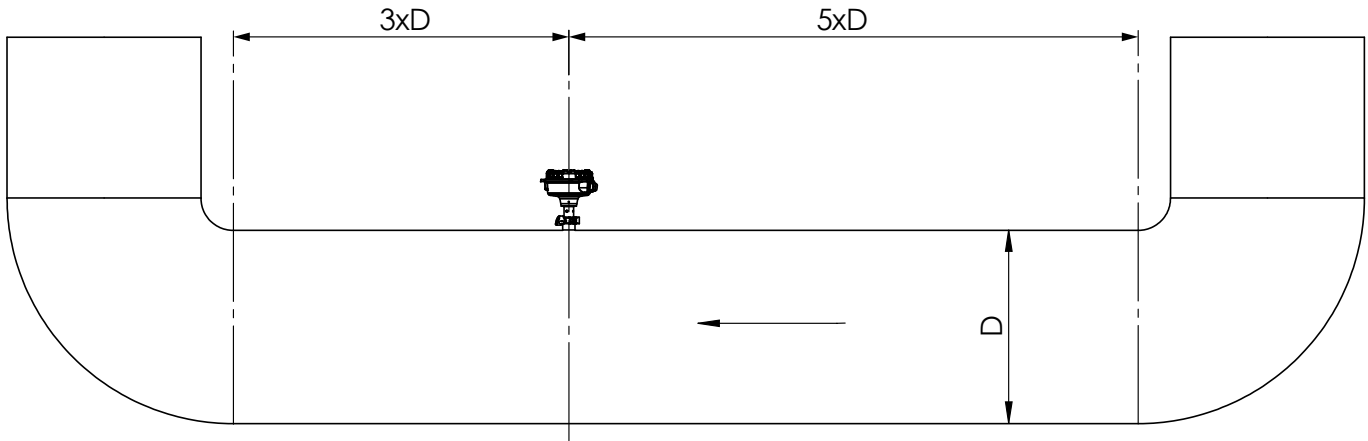


Figure 12: Recommended distance to obstacles (D = Duct diameter)

If the device is installed downstream from an electrostatic precipitator (ESP), the distance to ESP must be at least 40 m (131.23 ft). An ESP creates an electric field that can distort the measurement results.



If installing the sensor in a suboptimal location cannot be avoided, make sure that the location meets most of the requirements. Installation location must always meet these recommendations as closely as possible.

5.2.3 Orientation

The device must be installed perpendicular to the airflow, so that dust particles pass the sensor probe at a 90° angle.



If the device is installed on the side of the duct in a location with occasional condensation, it is recommended to install the sensor rod with 5° downward tilt. This helps prevent liquid from accumulating on the device insulation.

5.2.4 Probe length

The recommended minimum probe length depends on the measuring conditions and environment. For example, in vertical ducts, the dust particles will concentrate in the middle of the duct with high flow speed. In horizontal ducts, large particles will concentrate on the lower part of the duct with low flow speed.

If the probe is too short compared to the duct diameter, the measurement results are inaccurate.

Recommended probe lengths are:

- For indicative monitoring, a minimum probe length of one fourth ($\frac{1}{4}$) of the duct diameter is recommended.
- For demanding and critical applications with varying flow speed, a minimum probe length of one third ($\frac{1}{3}$) of the duct diameter is recommended.



The standard probe length is 250 mm (9.84 in), which means that the maximum pipe diameter where the device can be used is 1 meter.



The sensor probe must not touch the opposite surface inside the duct, because it distorts the measurement results.

If you need a sensor probe that is shorter than the standard 250 mm (9.84 in), you can shorten the probe by simply cutting part of it off with an appropriate tool.

5.2.5 Position



Information in this section mostly applies to horizontal pipes and ducts. On vertical pipes and ducts, the requirements for the installation position are not as strict. However, never install the device on a corner of a pipe or duct.

Square ducts

When installing on a square duct, the device can be placed either on the top of the duct, or to the side:

- When installing on the top, the device must be positioned in the middle of the duct.
- When installing on the side, the device must be positioned in the middle, or in the lower part of the duct. Recommended position is between $\frac{1}{2}$ and $\frac{2}{3}$ of the duct height measured from the top.

Permitted installation locations on square ducts are highlighted in green in Figure 13.

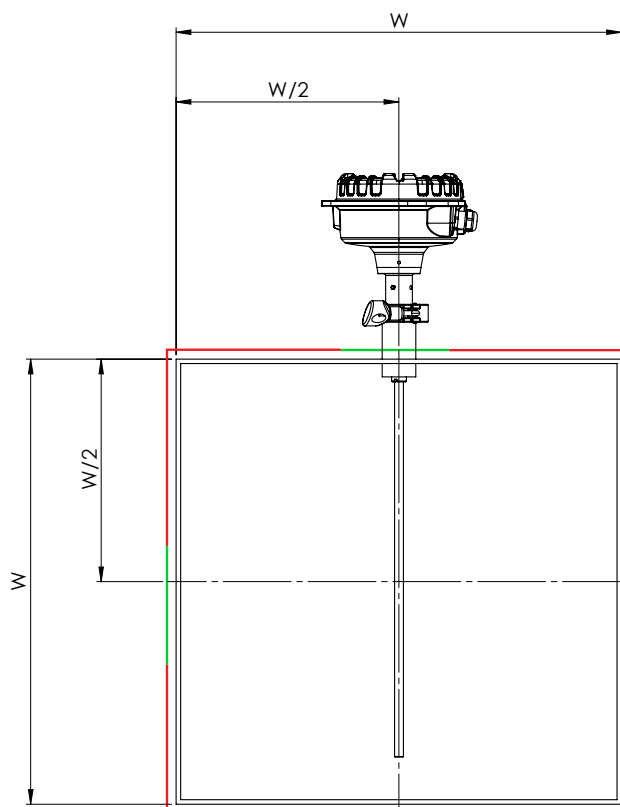


Figure 13: Approved installation positions on a square duct (W = Duct width)

You can always install the device on top of the duct if the installation location is within the specified ambient temperature range ($-40 \dots 60 \text{ }^{\circ}\text{C}$ [$-40 \dots 140 \text{ }^{\circ}\text{F}$]). However, if there is significant heat transfer from the process, the device must be installed on the side of the duct.

The device must not be installed on the bottom or corners of the duct. Installing on the bottom or corners can result in inaccurate measurement results.

Round ducts

When installing on a round duct, the device can be positioned anywhere on the top half of the duct, between 9 o'clock and 3 o'clock positions. Permitted installation locations on round ducts are highlighted in green in Figure 14:

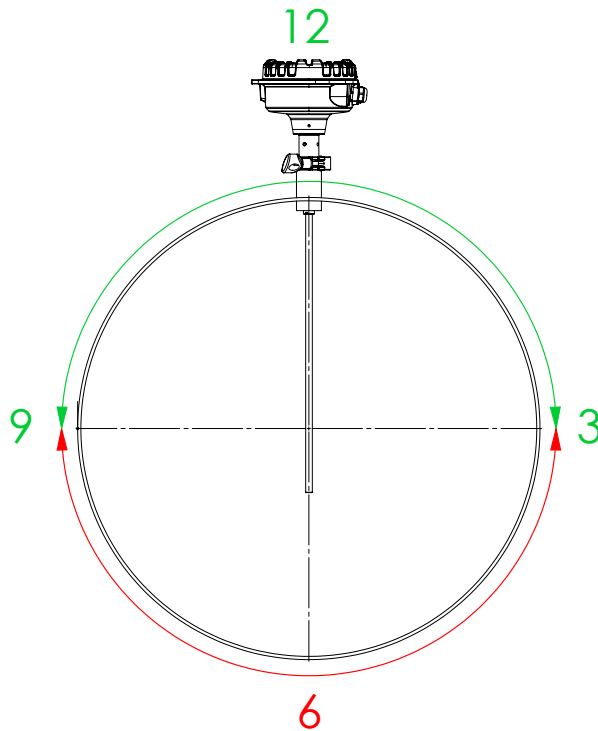


Figure 14: Approved installation positions on a round duct

You can always install the device on top of the duct if the installation location is within the specified ambient temperature range ($-40 \dots 60 \text{ }^{\circ}\text{C}$ [$-40 \dots 140 \text{ }^{\circ}\text{F}$]). However, if there is significant heat transfer from the process, the device must be installed on the side of the duct.

The device must not be installed on the bottom half of the duct. Installing on the bottom can result in inaccurate measurement results.

5.2.6 Duct pressure

If possible, install the device in a location where the duct pressure is lower than the surrounding environment. This prevents the process gases from being released or minimizes the amount of gas that is released from the duct during installation.

If the duct pressure is higher than the surrounding environment, there is a risk that process gases are released from the duct.

5.3 Installing sensor

5.3.1 Safety precautions

DANGER!



Poisonous and hot gas hazard

When installing or removing the device, poisonous and hot gas can be released from the duct.



Wear appropriate respiratory and eye protection gear when installing or removing the device. Follow all applicable local and plant-specific safety codes before proceeding.

WARNING!



Risk of burns due to hot components

When installing or removing equipment, the device or the installation surface can be hot.



Wear appropriate heat-resistant gloves and follow all applicable local and plant-specific safety codes before proceeding.

WARNING!



Risk of losing eyesight

Risk of burns

Welding arcs and flames emit intense heat and light that will damage eyesight and burn unprotected skin.

When welding, wear a welding mask and appropriate heat resistant gloves and clothing.



5.3.2 Installation

For mechanical installation, you need:

- A tool that is suitable for making an opening to the duct or pipe
- Welding equipment
- Protective gear for welding
- Wrench 22 mm (0.87 in)
- 1/2-inch NPT female pipe coupler

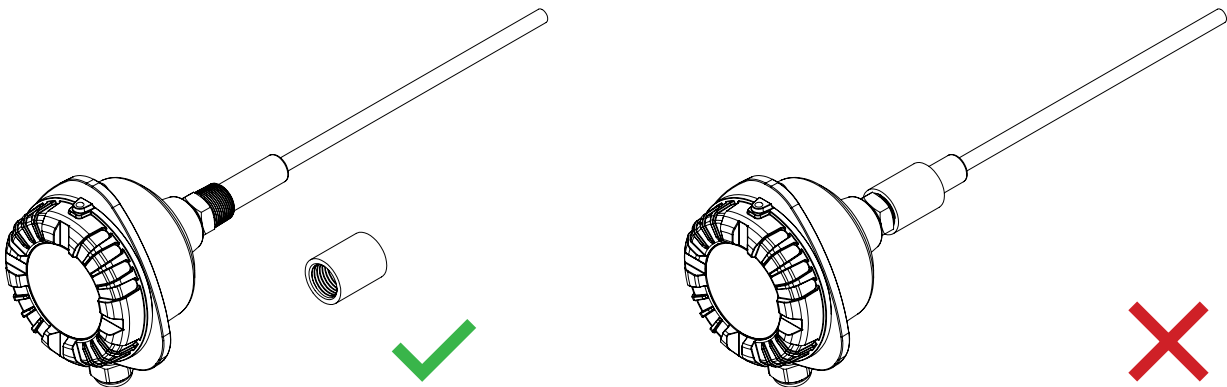
To install the device:

1. Determine if the process that the device is installed on must be shut down before installation.
 - If the duct pressure is lower than the surrounding environment and the process does not produce any hot or dangerous gases, you can leave the process running.
 - If the duct pressure is higher than the surrounding environment and the process produces hot or dangerous gases, consider shutting the process down before installation.



It is the responsibility of the plant operator to decide whether a process can be running when the device is installed. Always follow the local and plant-specific safety standards when installing the device.

2. Make sure that the 1/2-inch NPT female pipe coupler is not attached to the device.



NOTICE

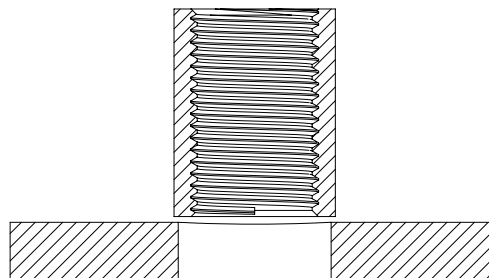
Do not weld the female pipe coupler to the pipe if it is connected to the device. If you weld the pipe coupler in place with the device attached, you can damage the sensor.

3. Cut an opening to the duct or pipe.
Diameter of the opening depends on the shape and radius of the installation surface.
 - If the installation surface is even or it has a large radius:
Cut an opening that is approximately 23 mm (0.91 in) in diameter. This is slightly smaller than the outside diameter (OD) of the female pipe coupler (26.4 mm [1.04 in]) but larger than its inside diameter (ID) (20.96 mm [0.825 in]).

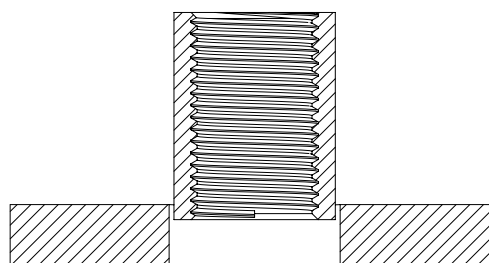
- If the installation surface is curved or uneven or it has a small radius:
Cut an opening that is 27 to 28 mm (1.06 to 1.10 in) in diameter. This is slightly larger than the outside diameter (OD) of the female pipe coupler (26.4 mm [1.04 in]).

4. Place the pipe coupler over the opening or insert it slightly through the opening, depending on its diameter.

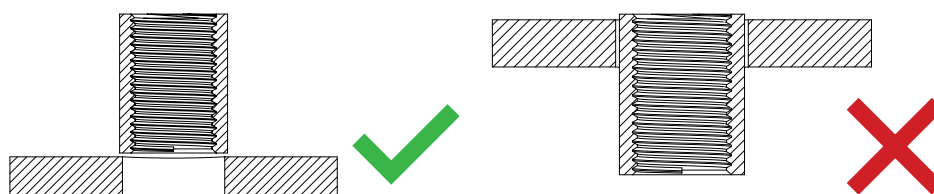
- If the diameter of the opening is smaller than the OD of the pipe coupler, place the pipe coupler on the installation surface, over the opening.



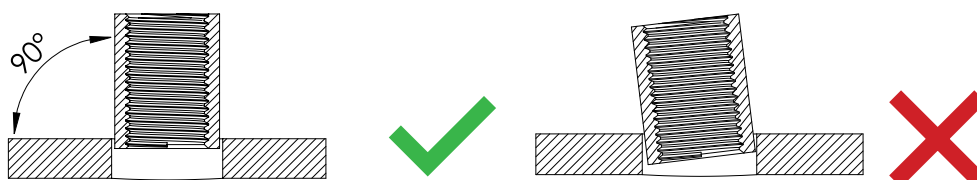
- If the diameter of the opening is larger than the OD of the pipe coupler, insert the pipe coupler slightly through the opening.



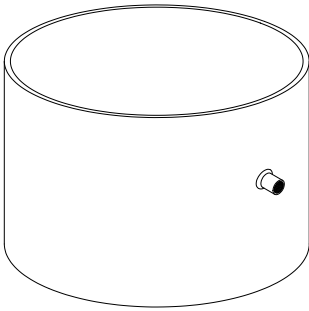
Do not push the process connection all the way through the opening.



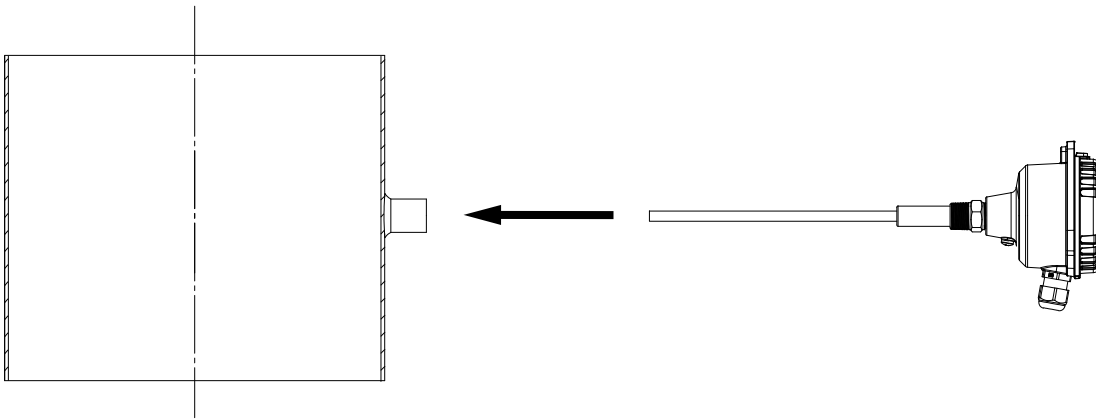
5. Make sure that the pipe coupler is in the right position and correctly aligned. The pipe coupler must be perpendicular to the airflow inside the duct.



6. Weld the pipe coupler to the installation surface.
Make sure that the welding joint is airtight

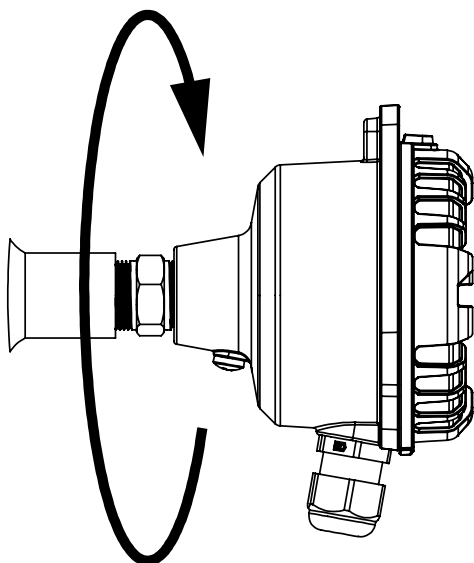


7. Insert the sensor probe through the pipe coupler.



The sensor probe must not touch the opposite surface inside the duct, because it distorts the measurement results.

8. Fasten the sensor to the pipe coupler. Grab the hexagonal nut that is located on the enclosure base with a wrench and turn it clockwise.



NOTICE

When fastening the sensor in place, do not turn the device by grabbing the enclosure. This can damage the connection that attaches the main board to the sensor probe inside the enclosure. Use the hexagonal nut on the enclosure base to fasten the sensor to the threaded pipe coupler.

6 Electrical installation



Read chapter “Safety” carefully before making any electrical connections to the device.

6.1 Electrical safety



Wear protective glasses when making electrical connections on the device.

WARNING!



Electric shock hazard

Faulty electrical installations, too high line voltage or incorrect operation of the device can result in an electric shock. Only trained and qualified personnel can install, commission, operate and perform maintenance on the device.

To ensure safe installation of electrical connections:

- Power down and unplug the device when you are not using it, when you intend to clean it, or in the event of malfunction.
- Connect the device to line voltage only if the power supply specifications correspond to the data on the identification label of the device.
- Disconnect power supply before inspecting the device or performing maintenance.
- Make sure that all equipment is properly grounded.
- Stand on an insulating pad and check components only with one hand.
- Never work alone on electrical connections.

When connecting cables, give them enough extra length. This allows the device to be removed from the mechanical installation for inspection and maintenance without disconnecting the cables.



Cables must be installed in accordance with all applicable local safety codes.

6.2 Cable types



Make sure that the cables are suitable for the environment and industrial application where the device is used. The cables must meet and be installed according to all applicable local safety standards.

When choosing cables:

- Use a shielded cable if possible. Connect the cable shield to ground on one end only.
- Minimum required conductor size is 0.3 mm² or 22 AWG.

The device uses screw-type wire-to-board terminal blocks for electrical connections. See Table 4 in section **Terminal blocks** for specifications.

6.3 Electrical connections

6.3.1 Main board

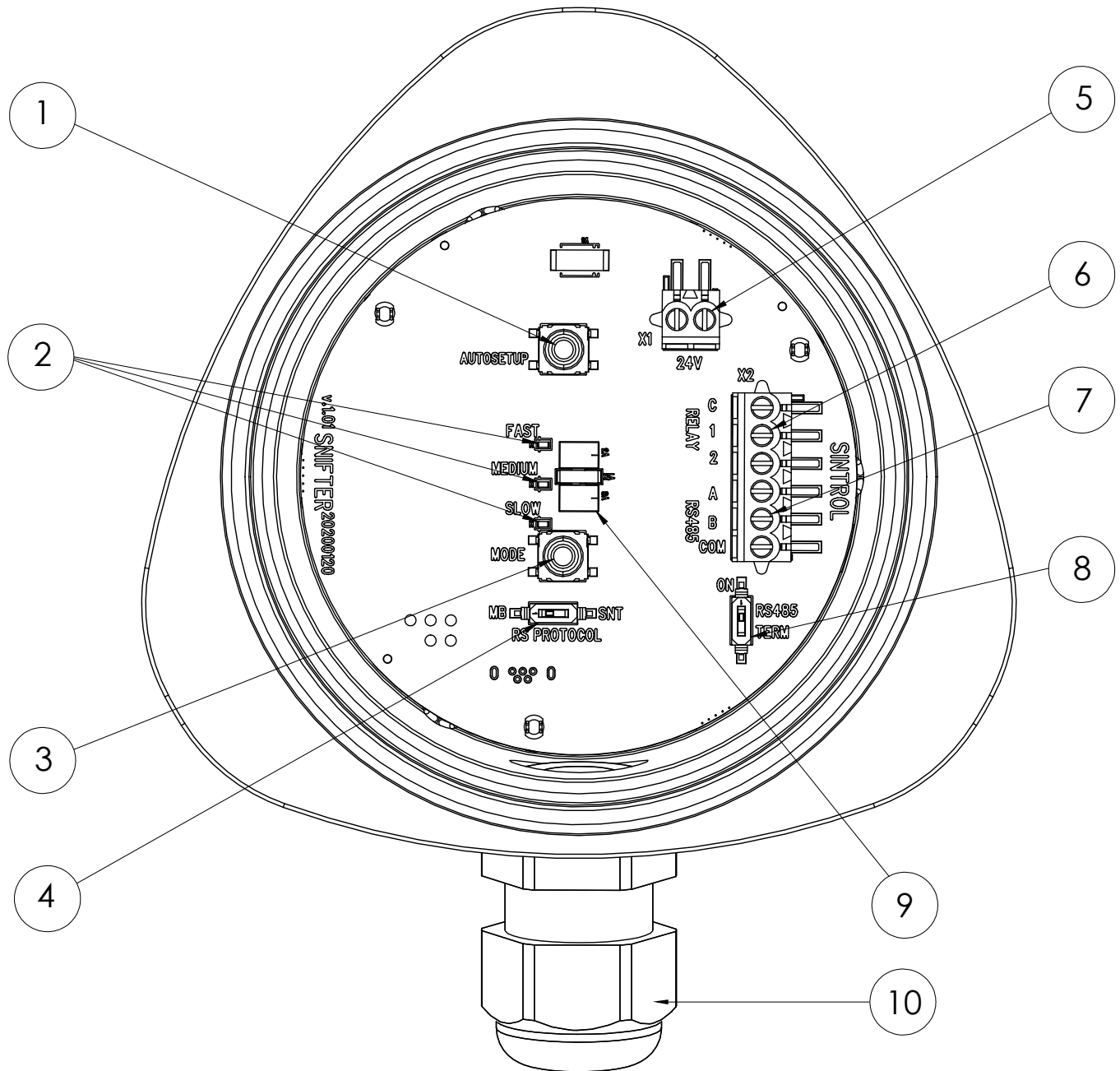


Figure 15: Main board and electrical connections

①	AUTOSETUP key	⑥	Solid-state relay terminal
②	Mode indicator LEDs	⑦	RS-485 bus
③	Mode selector key	⑧	RS-485 terminator switch
④	RS PROTOCOL switch	⑨	Status LEDs
⑤	24 V DC power supply terminal	⑩	Cable gland

6.3.2 Terminal blocks

The device uses screw-type wire-to-board terminal blocks for electrical connections. See Table 4 for specifications:

Table 4: Specifications of the terminal blocks

Connection method:	M2 screw		
Tightening torque:	0.2 Nm (1.7 in-lb)		
Insulation stripping length:	4 to 5 mm (0.157 to 0.196 in)		
Conductor size:	<u>Solid</u>	<u>Stranded</u>	<u>AWG</u>
	0.05 ... 1.33 mm ²	0.05 ... 1.33 mm ²	16 ... 30



Terminal blocks are compatible with smaller conductor sizes than the minimum conductor size that is recommended for the device. Do not use a conductor size that is smaller than 0.3 mm² / 22 AWG to make electrical connections on the device.

6.3.3 Grounding

WARNING!



Risk of malfunction

Risk of injury

Different ground potentials between the power supply and installation location can create ground current loops, which can result in false measurement results. Depending on the application, this can have severe implications on worker health and safety. Always make sure that the device is grounded properly

For proper and safe operation, it is critical that the device is properly connected to ground. The device is equipped with one ground connection on the aluminum enclosure (Figure 16).

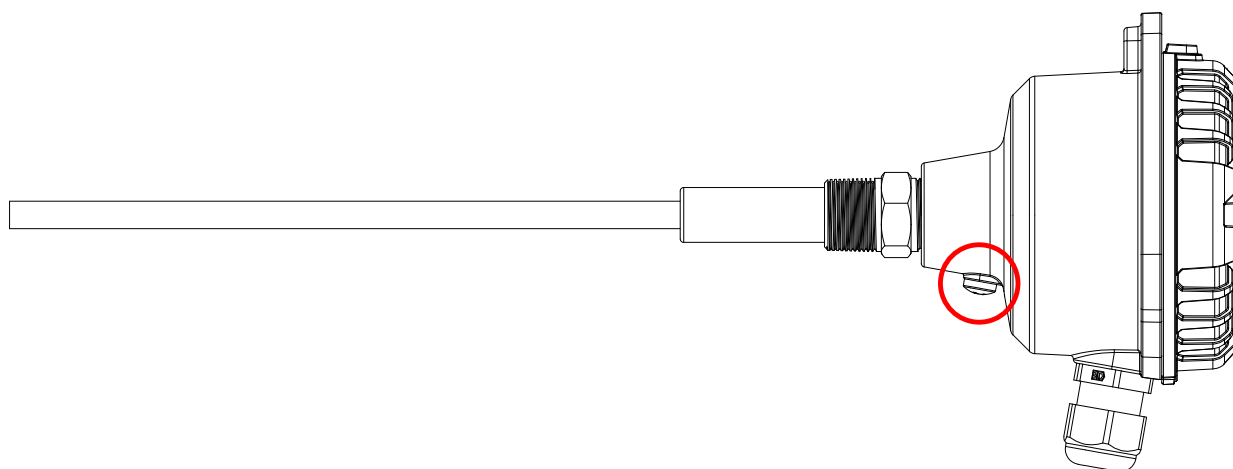


Figure 16: Position of the ground connection on the enclosure

When the device is grounded properly, there must be a clear change in the output signal level when you touch the probe. There must be no change in the output signal level when you touch the enclosure.

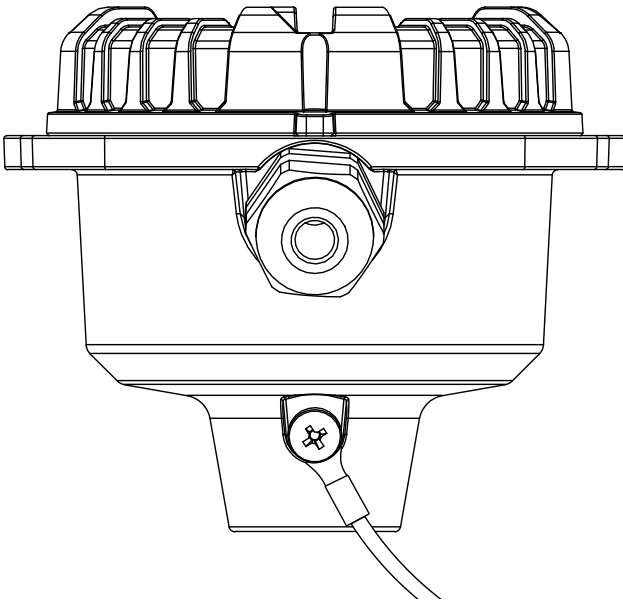
Connecting ground wire

To connect the device to ground, you need:

- Protective gear for electric work
- Phillips-head screwdriver (M5)
- Suitable ground wire

To connect the device to ground:

1. Make sure that the device is not connected to the power supply, or that the power supply is disconnected or isolated.
2. Loosen the screw on the ground connection with a screwdriver.
3. Place the ground wire under the screw head on the ground connection and tighten the screw.



4. Connect the other end of the ground wire to a location with the same ground potential as the ductwork that the device is installed on.

Signs of improper grounding

If the device is not grounded properly, it can show the following behavior:

- Base value of the output signal is >3000 IEU when the process is not running.
- The output signal level does not change significantly when you touch the probe.
- The output signal level changes when you touch the enclosure.



Subpar power supply can cause behavior similar to improper grounding. Only use Class 2 or equivalent power supply.

6.3.4 Power supply

DANGER!



Electric shock hazard

Before connecting the device to a power supply, make sure that the power supply is isolated or disconnected. Electric shock from a connected power supply cable can result in serious injury or death.

When connecting the device to a power supply, wear protective glasses, protective clothing and insulating rubber gloves.



The device has a polarity-free 24 V DC power input. Only use Class 2 or equivalent power supply.



Follow all applicable local regulations when selecting the circuit breakers that protect the cables.

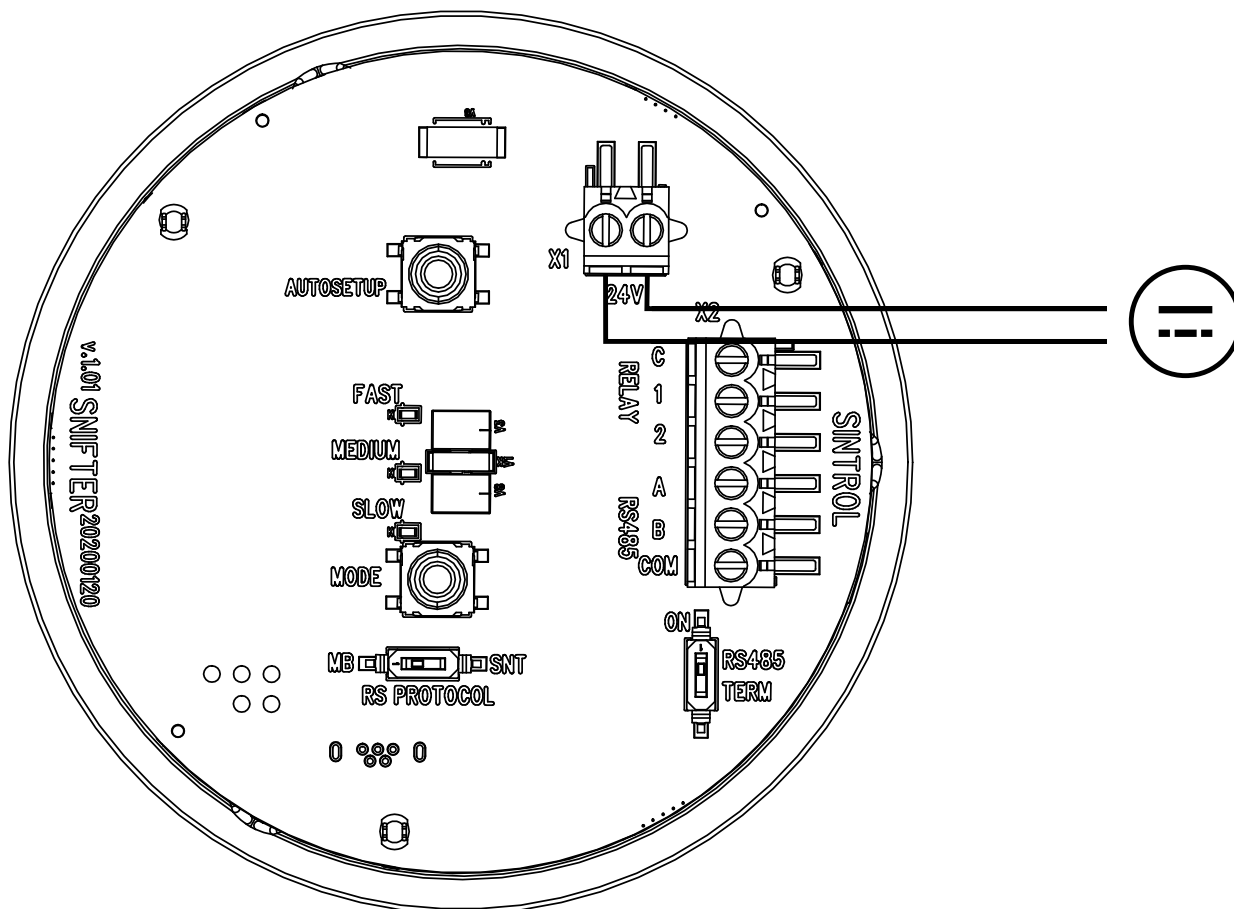


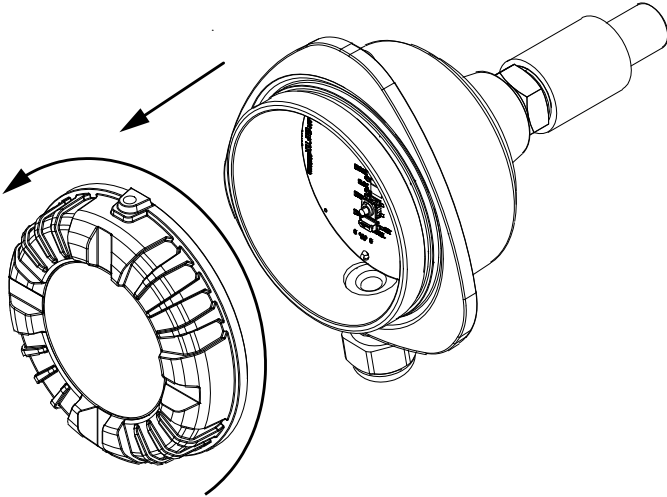
Figure 17: DC power input on the main board

To connect the power supply, you need:

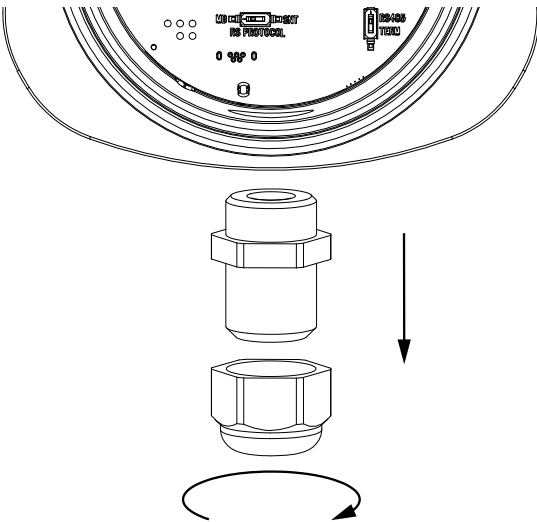
- Protective gear for electric work
- Screwdriver (M2)
- Wrench (20 mm [0.7874 in] or adjustable)
- Suitable power cable

To connect the device to power supply:

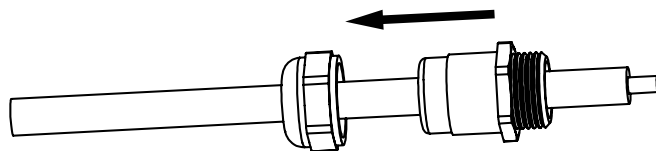
1. Make sure that the power supply is disconnected or isolated.
2. Remove the device lid by turning it counterclockwise to access the main board.



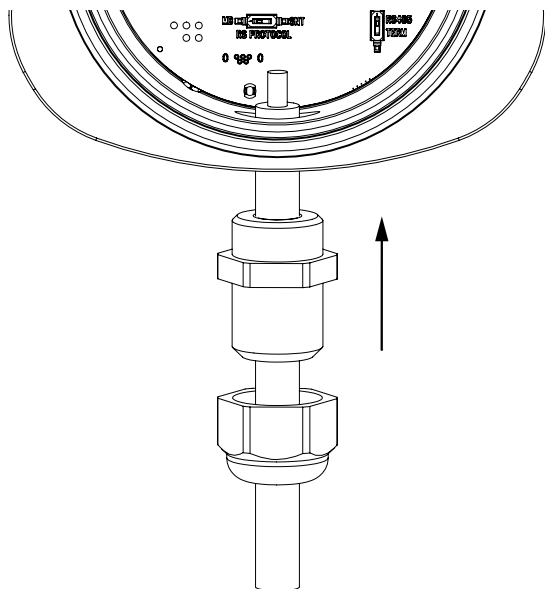
3. Remove the cable gland. Loosen the cable gland cap by turning it counterclockwise with a wrench.



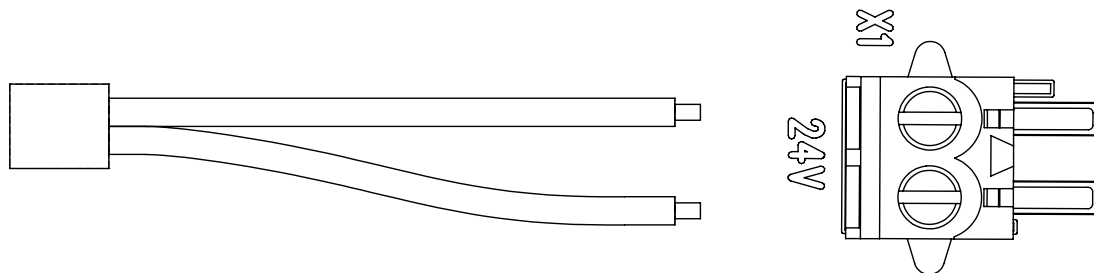
4. Slide the cable gland over the incoming power cable.



5. Insert the power cable through the cable entry.

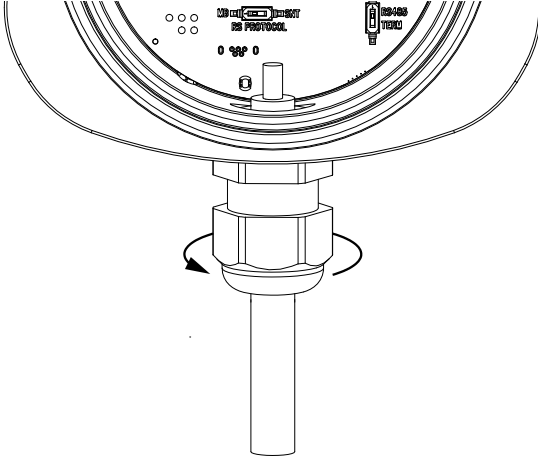


6. Connect the power cable to the 24 V DC power supply terminal. Insert the wires to the terminal block and tighten the screws.

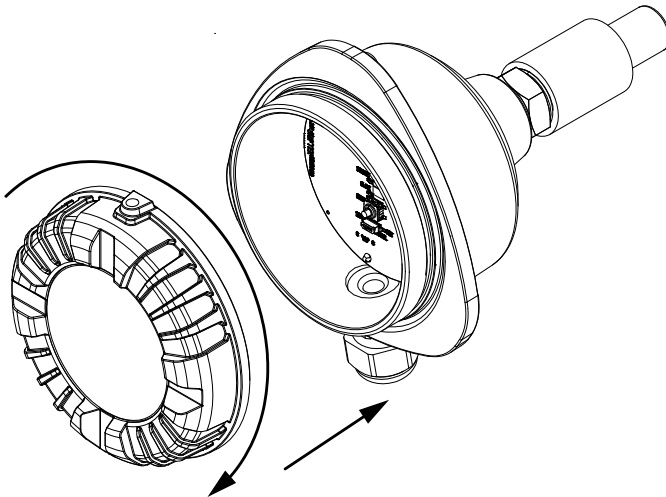


7. If you do not need to make any other electrical connections:

- Push the cable gland back inside the cable entry and tighten the cap with a wrench.



- Attach the device lid by tightening it clockwise.



- Enable or connect the power supply, and power up the device.

6.3.5 Relays

The device has two independent solid-state relays (SSR). The relays are used to indicate dust alarm statuses to a monitoring system. The contacts on the relay terminal block are labeled “1” and “2” for the individual relays. The common contact is labeled “C”. The relays can be used to power external loads of up to 30 V DC / 200 mA.

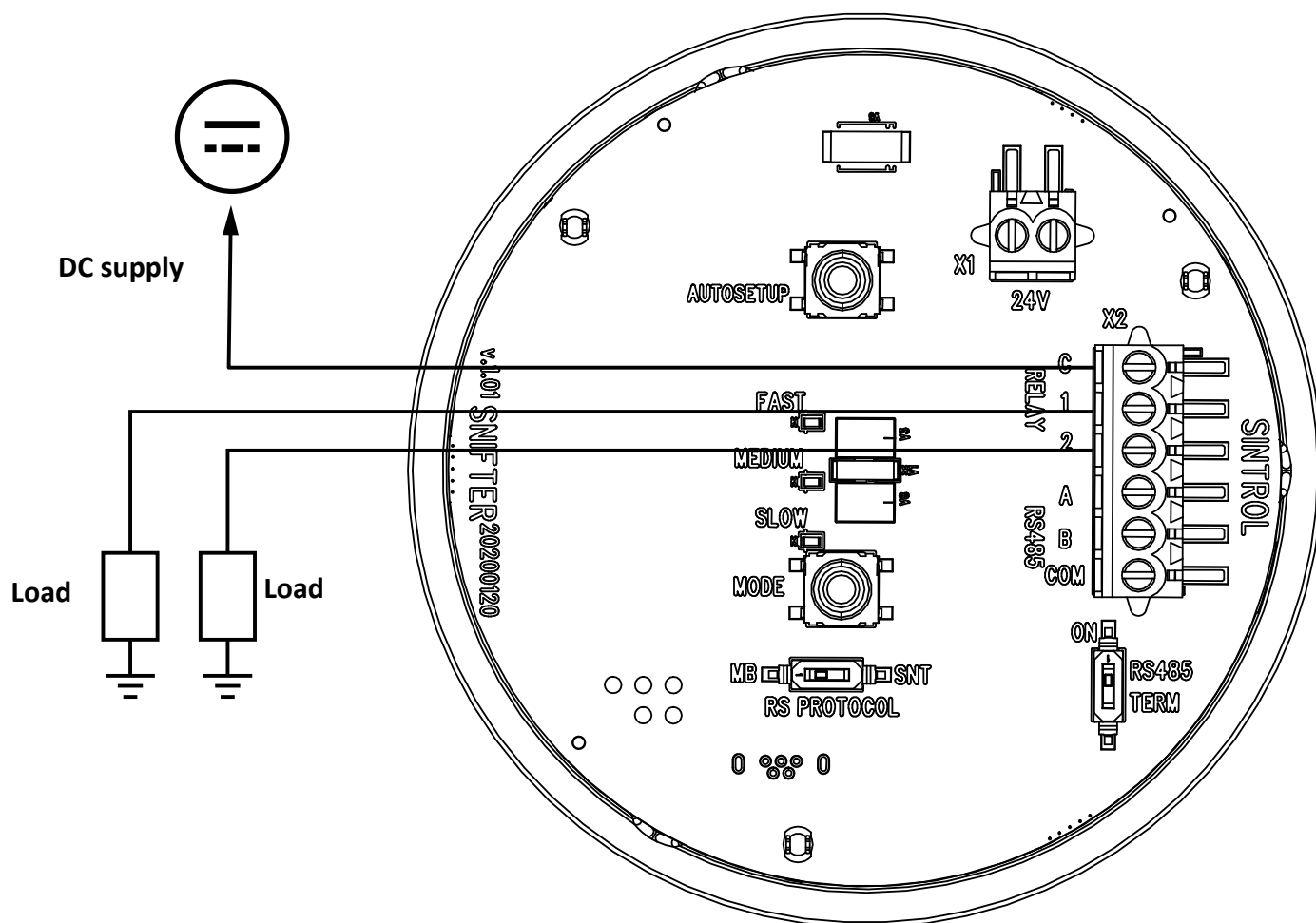


Figure 18: Relay terminal block on the main board

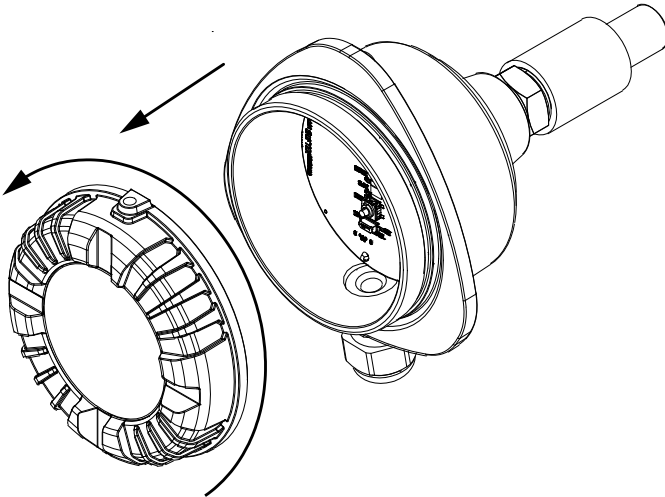
To connect a relay, you need:

- Protective gear for electric work
- Screwdriver (M2)
- Wrench (20 mm [0.7874 in] or adjustable)
- Suitable signal cable

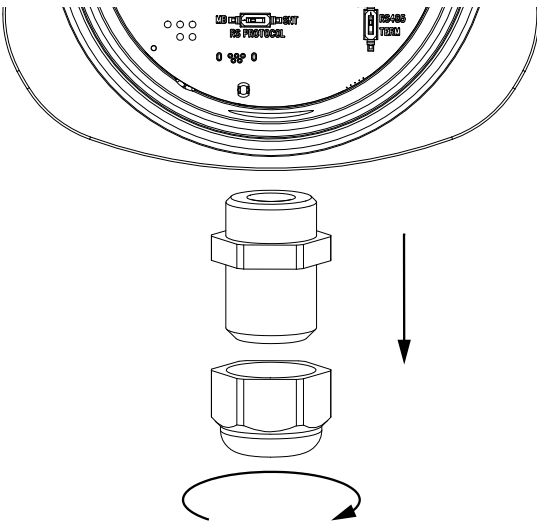
To connect the relays:

1. Make sure that the power supply is disconnected or isolated.

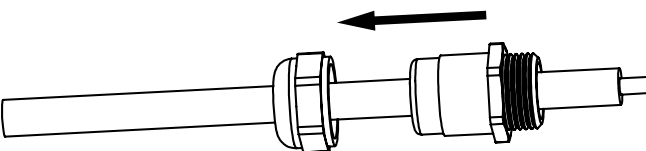
2. Remove the device lid by turning it counterclockwise to access the main board.



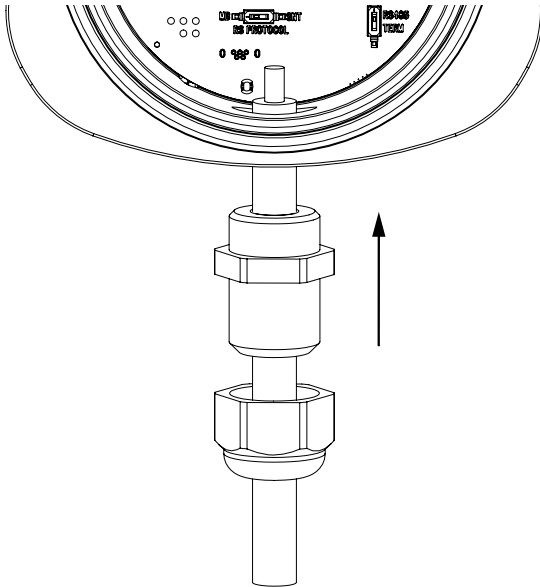
3. Remove the cable gland. Loosen the cable gland cap by turning it counterclockwise with a wrench.



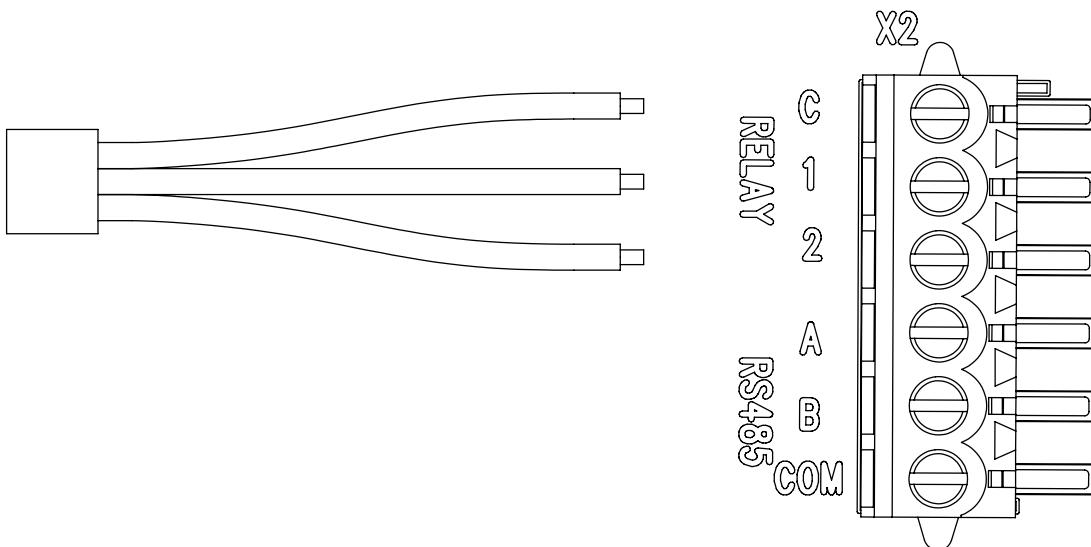
4. Slide the cable gland over the incoming signal cable.



5. Insert the signal cable through the cable entry.



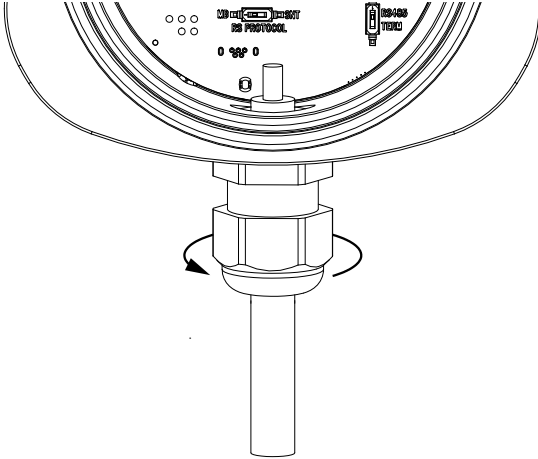
6. Connect the signal cable to contacts 1, 2 and C.



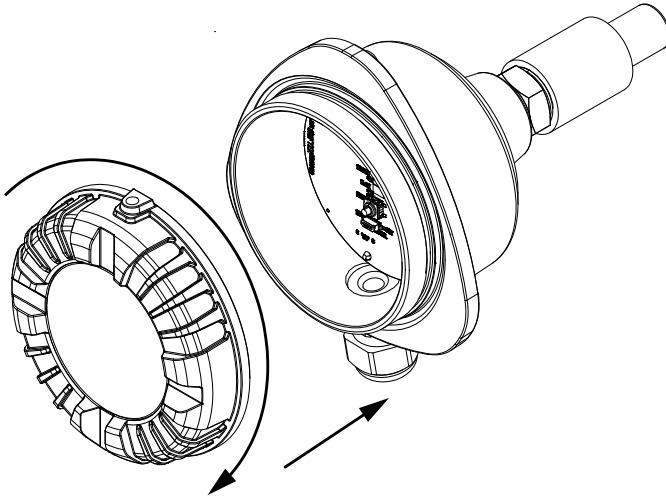
7. Connect the other end of each signal cable to the appropriate terminals on the application that you want to control with the relays.

8. If you do not need to make any other electrical connections:

- Push the cable gland back inside the cable entry and tighten the cap with a wrench.



- Attach the device lid by tightening it clockwise.



- Enable or connect the power supply, and power up the device.

When programming the external device to receive the signals from the relays, refer to Table 13 in section **Relay logic** in chapter **Operation**.

6.3.6 RS-485 bus

The device has an isolated RS-485 bus that can be used to integrate the device into existing automation systems, and to connect multiple devices in parallel to create a device network. The bus can be used to read data from the device, and to change device parameter. The device supports Modbus RTU and proprietary Sintrol Network communication protocols.

The RS-485 bus on the main board is labeled “RS485”. In addition, the main board is equipped with a switch labeled “RS PROTOCOL” for switching between RS-485 (MB position) and direct PC communication (SNT position) modes.

Communication protocols

Both Modbus RTU and Sintrol Network protocol can be used to control the device with an external master device, and to set up device networks by connecting multiple devices in parallel into a single bus.

- When using Modbus RTU, you need a Modbus master device to act as a host.
- When using Sintrol Network, you need Sintrol Router or Wireless Router to act as a communication station. The router must be connected to a host computer running DustTool software.

The default communication parameters for Modbus RTU are as follows:

Table 5: Modbus RTU communication parameters

Baud rate:	38400
Data bits:	8
Stop bits:	2
Parity:	None

For a quick reference of the register definitions of the Modbus RTU interface, see **Appendix B**.

For information about setting up device networks, see section **Setting up device network** in chapter **Commissioning and system setup**.

Polarity

Polarity of the RS-485 bus is indicated with labels A and B, where wire A is negative (–) and wire B is positive (+). Make sure to always connect wires A and B using correct polarity to the device that receives the signal.



Markings that indicate polarity on the RS-485-to-USB converter supplied by Sintrol are inverted. When using RS-485-to-USB converter supplied by Sintrol, connect wire A to + and wire B to –.

Some manufacturers have the RS-485 output signals inverted, and the way signal polarity is labeled can differ between manufacturers. For example, some manufacturers indicate negative polarity with TX–/RX– or D– instead of A, and positive polarity with TX+/RX+ or D+ instead of B.



If you are connecting the device into an existing Modbus RTU automation system or if you are using a third-party RS-485-to-USB converter or cable, read the related user documentation carefully before connecting the RS-485 output.

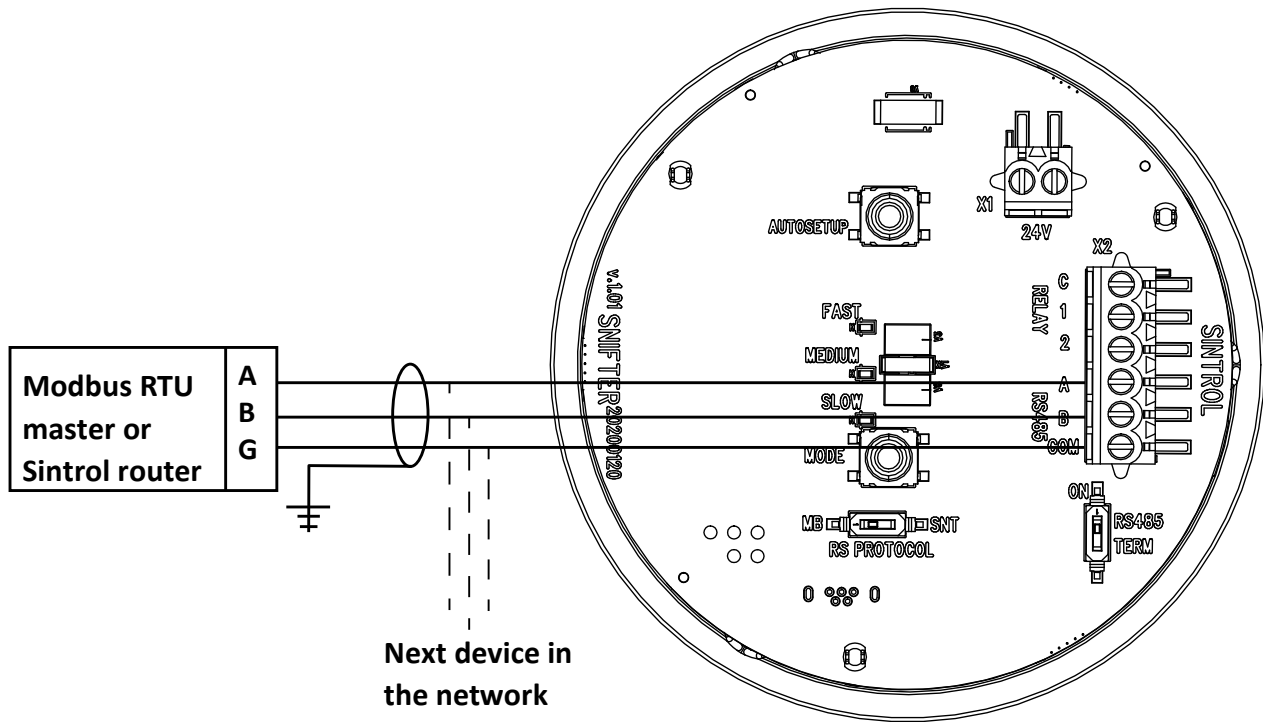


Figure 19: RS-485 bus on the main board



Connect the sheath of a shielded cable to ground only on one end. Connecting both ends to ground can create a ground loop.

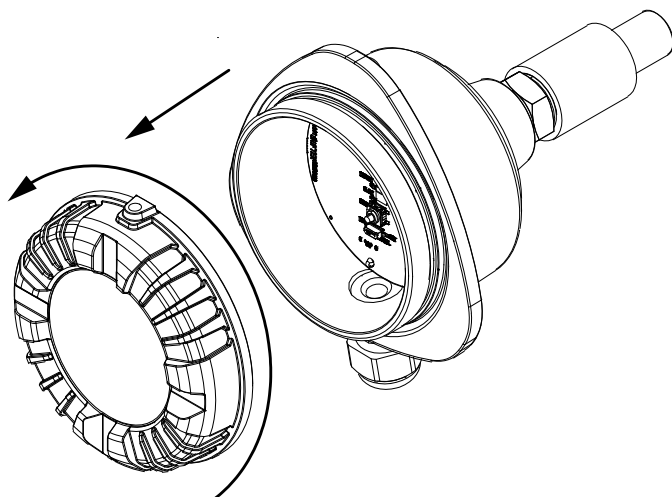
To connect a RS-485 bus, you need:

- Protective gear for electric work
- Screwdriver (M2)
- Wrench (20 mm [0.7874 in] or adjustable)
- Suitable signal cable

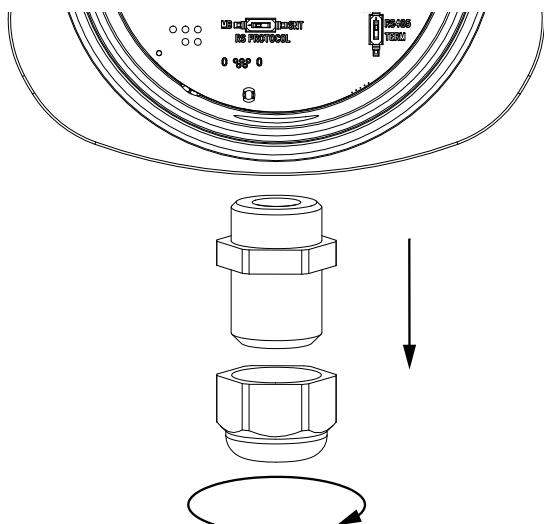
To connect a RS-485 bus:

1. Make sure that the device is not connected to the power supply, or that the power supply is disconnected or isolated.
2. Select whether you want to use the bus with RS PROTOCOL switch in MB or SNT position.
 - For MB position, use a 3-wire shielded twisted pair cable.
 - For SNT position, use a RS-485-to-USB cable, or a converter with a suitable 3-wire shielded cable.

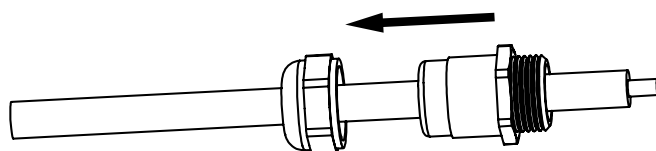
3. Remove the device lid by turning it counterclockwise to access the main board.



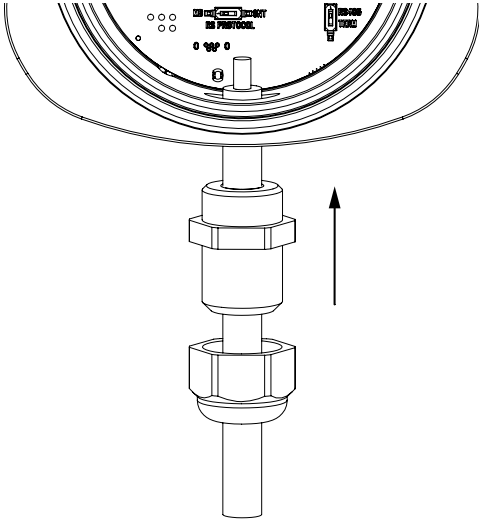
4. Remove the cable gland. Loosen the cable gland cap by turning it counterclockwise with a wrench.



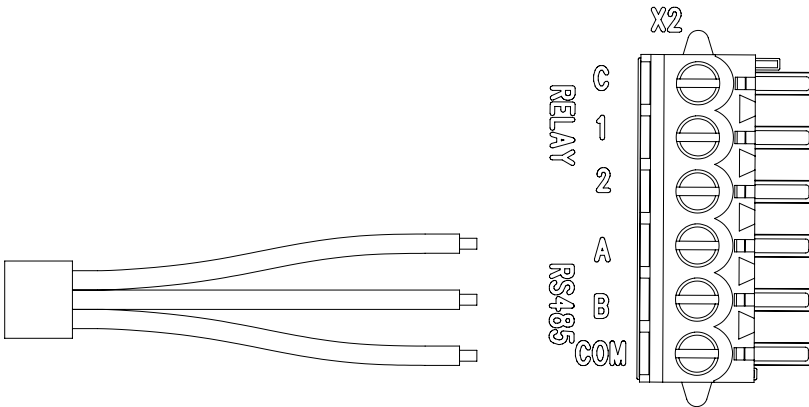
5. Slide the cable gland over the incoming signal cable.



6. Insert the signal cable through the cable entry.



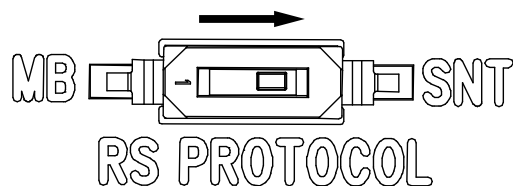
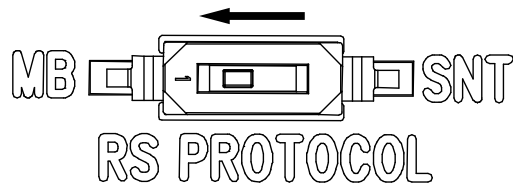
7. Connect the signal cable to the RS-485 output terminal block.



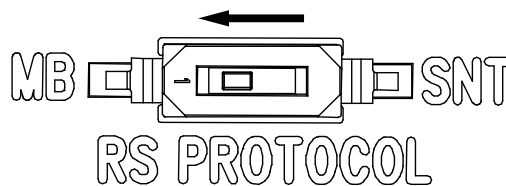
If you connect several devices in parallel, you must adjust the settings for each device in DustTool according to instructions in section “Setting up device network” in chapter “Commissioning and system setup”.

8. Set the position of the RS PROTOCOL switch according to the intended use.

- For connecting multiple devices in parallel and controlling them with a Modbus master device or DustTool software, set the switch to MB position.
- For connecting a single device to PC and configuring it with DustTool software, set the switch to SNT position.



- For connecting a single device and controlling it with Modbus master device, set the switch to MB position.

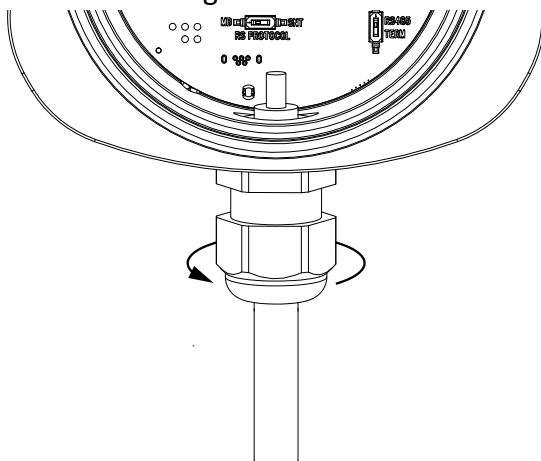


9. Connect the other end of the signal cable to the application that receives the RS-485 output.

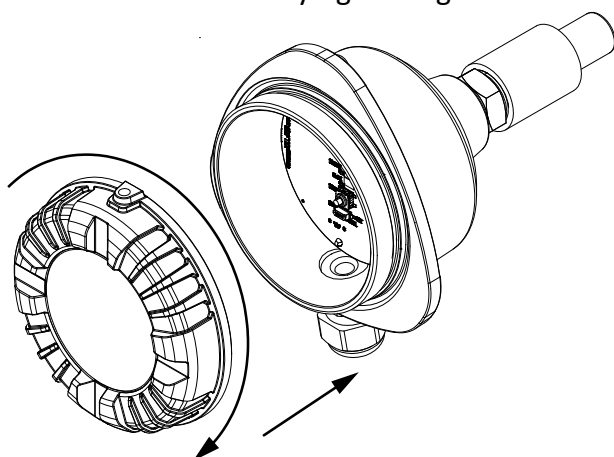
- When using Modbus RTU, connect the signal cable to a Modbus master device. RS PROTOCOL switch must be in MB position.
- When using Sintrol Network in a device network, connect the signal cable to Sintrol Router that is connected to a host computer. RS PROTOCOL switch must be in MB position.
- When using PC to change settings and parameters of a single device, connect the signal cable to a computer with RS-485 to USB converter. RS PROTOCOL switch must be in SNT position.

10. If you do not need to make any other electrical connections:

- Push the cable gland back inside the cable entry and tighten the cap with a wrench.



- Attach the device lid by tightening it clockwise.

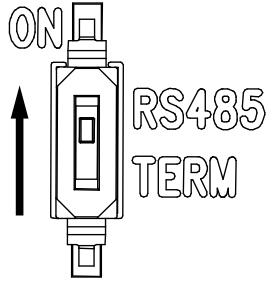
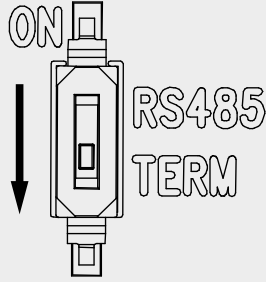
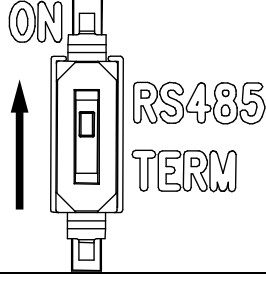


- Enable or connect the power supply, and power up the device.

Terminator switch

RS-485 bus allows multiple devices to be connected in parallel to create device chains and networks. The main board is equipped with a terminator jumper pin that must be disabled or enabled based on the position of the device in the chain. The terminator switch must be set to ON position only on the last device in the chain. On all other devices, the terminator switch must be in OFF position.

Table 6: Terminator switch positions

Device position	Switch position	Note
Single device		A single connected device is always considered the last in a chain. If a single device is connected to the RS-485 bus, switch the terminator switch to ON position.
First or middle in chain		If the device is the first of a chain or in the middle of a chain, make sure that the terminator switch is in OFF position.
Last in chain		If the device is the last in a chain, switch the terminator switch to ON position.

7 DustTool

7.1 Overview

DustTool is a complementary software that can be used to control the parameters and features of the device with a Windows computer. The device can be connected to a computer running DustTool with RS-485-to-USB converter or by using Sintrol Router.

You can download DustTool free of charge at www.sintrolproducts.com/products/software/DustTool/.



To enable communication using RS-485 protocol, the host computer must have DustTool version 1.2.1701101750 or later installed.



If you enable Lock Password feature in DustTool, it is no longer possible to run Auto Setup or change the device parameters. If you forget the password, you must contact Sintrol support to unlock the device with a device-specific master password.



DustTool is developed to set up and manage the device parameters and properties. If you need to save measurement data, create additional alarms, generate reports or access measurement history, monitoring software DustLog 10 is required.

7.2 System requirements

DustTool is developed for Windows operating system. See Table 7 for system requirements.

Table 7: System requirements for DustTool

Minimum		Recommended	
Operating system:	Windows XP	Operating system:	Windows 10
Display:	1024×768	Display:	1920×1080
RAM:	512 MB	RAM:	4 GB

7.3 Main view

When you launch DustTool, it looks up any connected Sintrol devices. The software automatically detects the interface that is used for communication and connects to the device. Connected devices appear on the main view of the software, where you can manage them.

Figure 20 shows the main view that opens each time DustTool is launched.

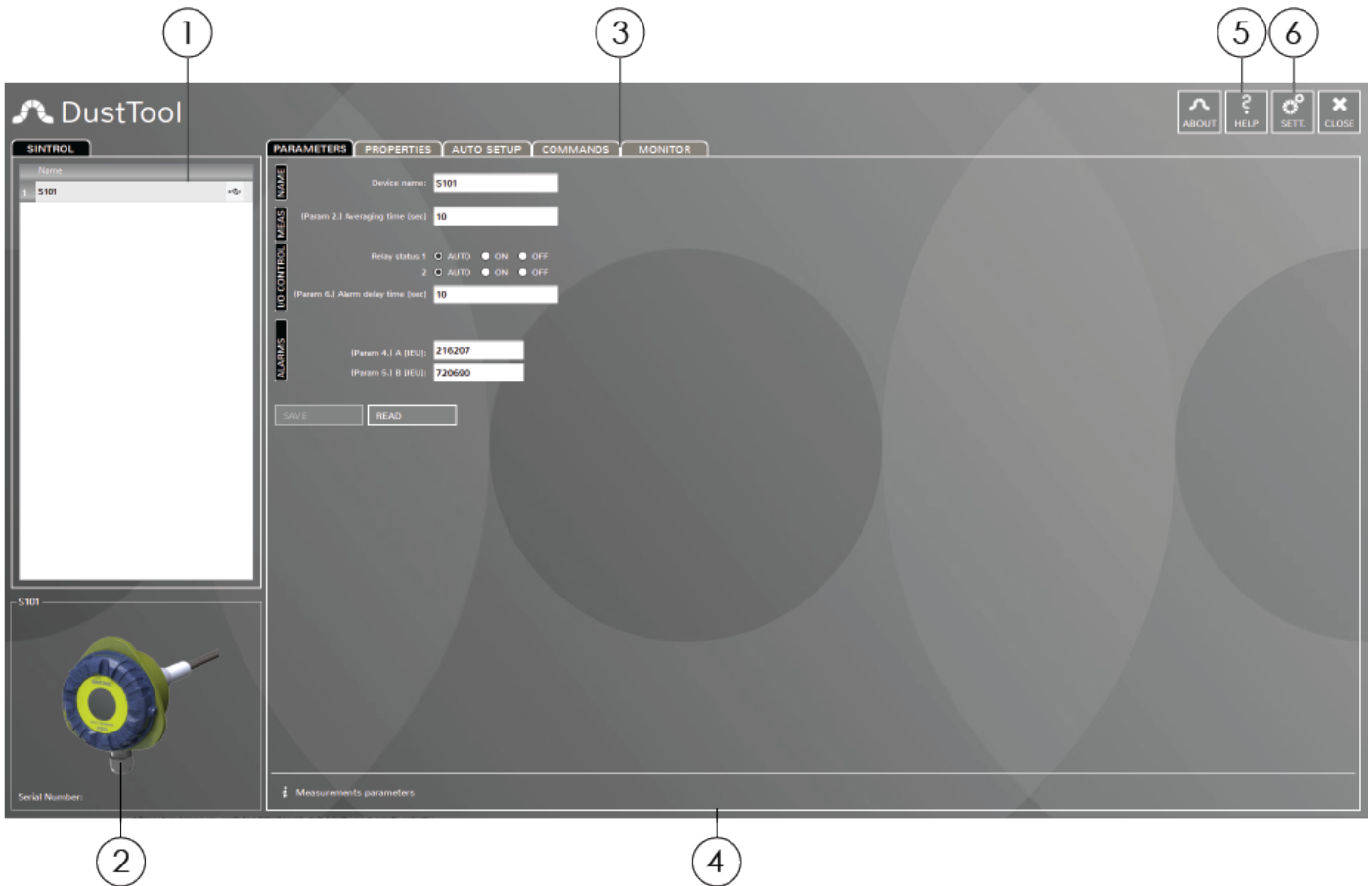


Figure 20: DustTool main view

- ① List of currently connected products. Connection type is displayed with a small icon next to the device name.
- ② Description of the selected product with the model name, serial number and picture.
- ③ Tabs help navigate the software, and manage device features related to calibration, parameters, Auto Setup, and commands. Monitor view provides a visualization of the current process conditions.
- ④ Info area on the bottom of the window displays information about the fields and items on the screen when you hover the mouse cursor over them.
- ⑤ Help view provides direct access to documentation related to the connected devices. In order to access user documentation, network access must be enabled.
- ⑥ Settings give you full control over software properties, like updates and network access.

8 Commissioning and system setup

The device requires minimal setup to establish regular operating condition. For basic trend monitoring applications, it is enough to only run the Auto Setup procedure that determines the normal dust level and sets the thresholds for dust alarms. In addition, the device has user-selectable FAST, MEDIUM and SLOW response modes, which control how fast the device reacts to changes in dust levels.

After commissioning and setting up the device, you can adjust the device parameters and alarm thresholds by using DustTool or a Modbus master device.

8.1 Auto setup



Parameters of the Auto Setup feature can be modified with DustTool software. This section only describes the default Auto Setup with factory settings.

In normal operation, the device continuously measures the dust concentration in the airflow. During Auto Setup, the device analyzes the present measurement signal, determines an average signal level and establishes normal process conditions that are used as a baseline for future measurements.

Auto Setup also sets up two alarm thresholds (ALERT and ALARM) that are proportional to the normal dust level. An alarm is triggered when the dust concentration exceeds the configured dust level threshold.

Auto Setup is performed during normal operating conditions after the device is installed and the process that the device monitors is running.



Make sure that Auto Setup is performed during normal operating conditions and usual dust levels. Performing Auto Setup during irregular conditions can result in false measurement results.

During Auto Setup, the device always uses the parameter values from MEDIUM response mode for signal averaging time (50 seconds) and alarm delay time (30 seconds). Signal averaging time determines the period from which the device calculates the average signal level, and alarm delay time determines how long the dust level must be above the configured ALERT or ALARM threshold before the relays switch position and trigger the alarms.

Auto Setup takes 500 seconds (approximately 8 minutes) to complete. After Auto Setup is completed or cancelled, signal averaging time and alarm delay time automatically revert to their previous values.

8.1.1 Response modes

The device has user-selectable FAST, MEDIUM and SLOW response modes, which control how fast the device reacts to changes in dust levels. Additionally, each response mode has pre-programmed multipliers for the measurement baseline that are used to set the ALERT and ALARM thresholds. The baseline multipliers used in each response mode are described in Table 8.

Table 8: Alarm thresholds after Auto Setup

Response mode	ALERT threshold	ALARM threshold
FAST	3× baseline level	10× baseline level
MEDIUM	5× baseline level	20× baseline level
SLOW	5× baseline level	20× baseline level

The baseline of the previous Auto Setup is always stored in the device memory. When you change the response mode, the device applies the appropriate multipliers to the baseline, and adjusts the parameters for ALARM and ALERT thresholds automatically.

For more detailed information about device parameters, see section **Parameters** in chapter **Operation**.

8.1.2 Operation statuses

Table 9 shows the relation between different operation statuses and signals after Auto Setup:

Table 9: Description of default operation statuses after Auto Setup

Status	Description
Normal:	Normal operation range
Measurement baseline:	Average signal level during Auto Setup
ALERT:	<ul style="list-style-type: none"> • 3× or 5× increase in dust concentration compared to measurement baseline. Multiplier is applied based on the selected response mode • Relay 1 switches position
ALARM:	<ul style="list-style-type: none"> • 10× or 20× increase in dust concentration compared to measurement baseline. Multiplier is applied based on the selected response mode • Relay 2 switches position

For more detailed information on operation statuses, see chapter **Operation**.

Figure 21 illustrates the relation between Auto Setup baseline and the alarm thresholds with MEDIUM response mode:

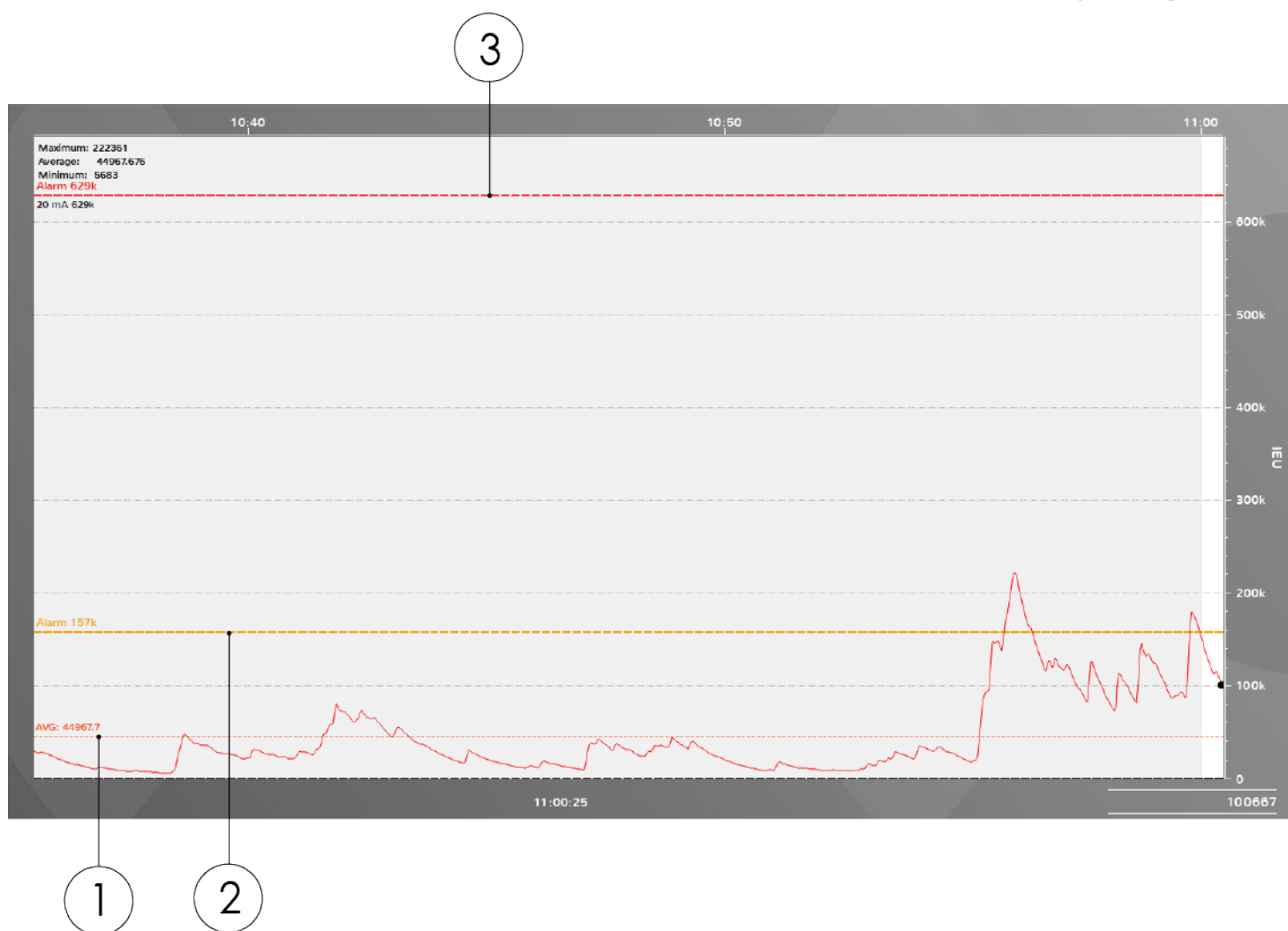


Figure 21: Relation between the output signal baseline and alarm thresholds in MEDIUM mode

- | | |
|---|---|
| ① | Average output signal. Dust concentration baseline in the example is 31 430 IEU. |
| ② | Dust ALERT threshold. ALERT is triggered when there is 5× increase in dust level compared to the baseline as determined by MEDIUM response mode. In the example this corresponds to 157 150 IEU. |
| ③ | Dust ALARM threshold. ALARM is triggered when there is 20× increase in dust level compared to the baseline as determined by MEDIUM response mode. In the example this corresponds to 628 600 IEU. |

The actual dust concentration at the baseline depends on the location of the measurement point. If the measurement point is located after a filtration system, the baseline dust level is naturally very low. Likewise, if the measurement point is located before after a filtration system, the baseline dust level is several times higher. In both cases, no manual range setup is necessary.

8.1.3 Performing Auto Setup

You can perform Auto Setup by pressing AUTOSETUP key on the main board, or by starting it in DustTool

Main board

The easiest way to perform Auto Setup is to start it manually on the main board of the device.

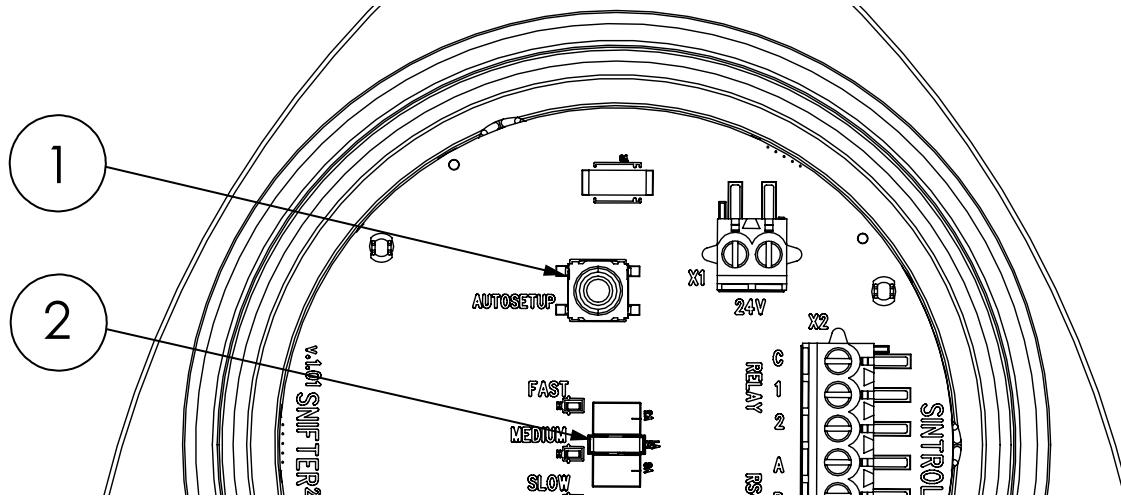
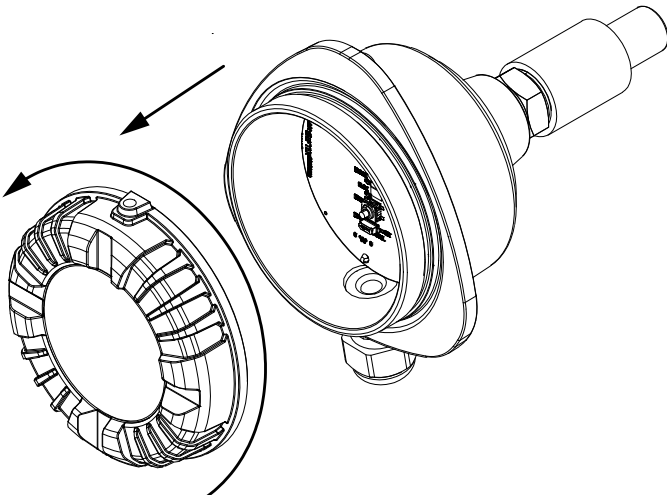


Figure 22: AUTOSETUP key on the main board

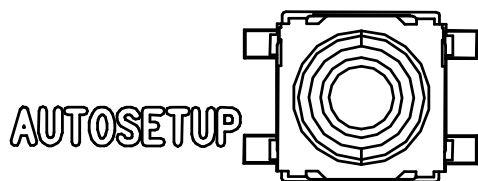
- | | |
|---|---------------|
| ① | AUTOSETUP key |
| ② | Status LEDs |

To perform Auto Setup:

1. Remove the device lid by turning it counterclockwise to access the main board.



2. Press AUTOSETUP key for 1 second. Green LEDs on the main board start blinking.



3. Auto Setup is completed when the LEDs stop blinking. The device resumes normal operation.

Auto Setup takes 500 seconds (approximately 8 minutes) to complete.



If you want to cancel Auto Setup, press AUTOSETUP key again for 1 second.

For a more detailed description of the main board of the device, see section **Main board** in chapter **Electrical installation**.

DustTool

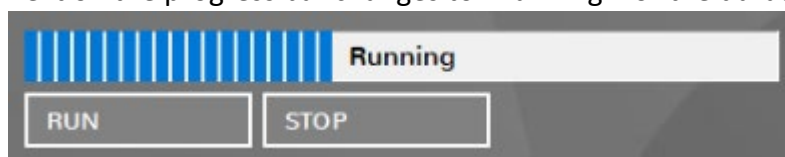
To perform Auto Setup in DustTool, you must have the device connected to a host computer either through RS-485 to USB converter or Sintrol router device.

To perform Auto Setup in DustTool:

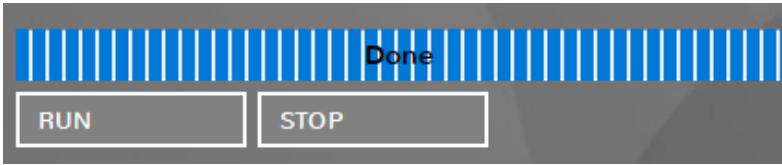
1. Launch DustTool and connect the device to the host computer.
2. Navigate to AUTO SETUP tab.



3. Click the RUN button. This starts the Auto Setup procedure.
 - Green LEDs on the device main board start to blink.
 - Text on the progress bar changes to “Running” for the duration of the procedure.



4. When Auto Setup is completed, the LEDs on the device main board stop blinking. Text on the progress bar changes to “Done”.



Auto Setup takes 500 seconds (approximately 8 minutes) to complete.



If you want to cancel Auto Setup, click the STOP button in DustTool.

8.2 Changing parameters

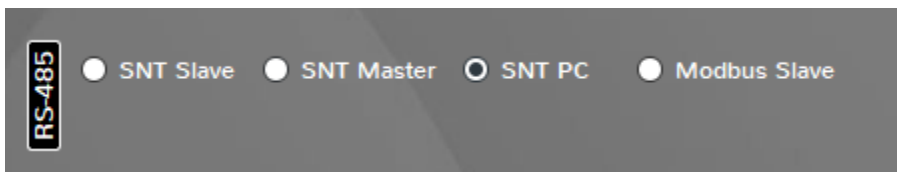
You must use the RS-485 bus on the main board to connect the device to a host application and use it to change the parameters.

8.2.1 DustTool

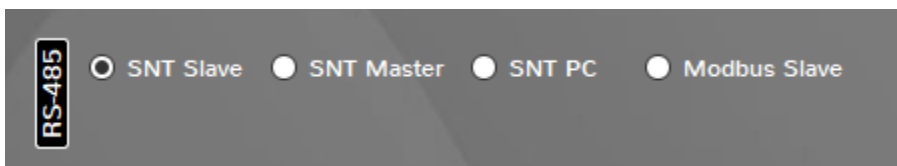
You can modify the operating parameters of the connected devices in DustTool.

To change the device parameters in DustTool:

1. Launch DustTool.
2. Make sure that the RS-485 bus is connected as instructed in section **RS-485 bus** in chapter **Electrical connections**.
3. Connect the device to a Windows computer with RS-485 to USB converter or using Sintrol Router.
 - If you are changing the parameters of a single device using RS-485 to USB converter:
 - a. Set the RS PROTOCOL switch to SNT position. This forces the device to SNT PC operating mode.



- b. Connect the device to a host computer running DustTool.
- If you have connected multiple devices in parallel to the same bus:
 - a. Make sure that the device network has been set up as instructed in section **Setting up device network**. Each device in the network should be in “SNT slave” operating mode.



- b. Select the device you want to control from the list on the left side of the main view.
4. Find the parameter that you want to edit. Parameter settings are located on PARAMETERS tab.

5. Edit the parameter value.
6. Click the SAVE button on the bottom of the screen to store the changes in the device memory.



If you do not click the SAVE button, the changes to the parameter values are lost when you close the program or disconnect the device.

7. Click the READ button to view the parameter values that are currently stored in the device memory.

For a more detailed overview of the DustTool software, see chapter **DustTool**.

8.2.2 Modbus RTU

You can use Modbus RTU protocol to control the device parameters with an automation control system or any Modbus master device. To enable communication through Modbus RTU, set the RS PROTOCOL switch to MB position and connect the device to the master device with the RS-485 bus. You must also enable “Modbus Slave” option in DustTool.



Figure 23: "Modbus slave" setting in DustTool

For information on how to control slave devices, refer to the user documentation of your Modbus master device or control system.

For a quick reference of the register definitions of the Modbus RTU interface, see **Appendix B**.

For information on how to connect the RS-485 bus, see section **Connecting RS-485 bus** in chapter **Electrical installation**.

8.3 Setting up device network

RS-485 bus allows multiple devices to be connected in parallel to create a device network. This makes it possible to communicate with several devices at the same time with minimum wiring. Wired connections can use either Modbus RTU or Sintrol Network protocol for communication. Wireless communication, and combination of wired and wireless connections require the use of Sintrol Network protocol.

A complete measurement system that is based on Sintrol Network protocol can consist of up to 254 devices connected to a single network. These can be connected either wirelessly, with the RS-485 bus, or with a combination of the two.

S100 series dust monitors cannot communicate wirelessly, but they can be part of a device network that utilizes radio frequency (RF) communication.

8.3.1 Naming devices

It is recommended to assign each device in the network a unique name before installation. Because the network is created automatically when Sintrol Network protocol is used, naming the individual devices makes it easier to identify them.

To assign a name to a device:

1. Launch DustTool.
2. Connect the device to a Windows computer using the RS-485 bus.
 - The software automatically detects the interface that is used for communication and connects to the device.
 - If you have already set up a device chain, select the device you want to assign a name to from the list on the left side of the main view.
3. Navigate to PARAMETERS tab and assign an individual name for the device in the Device name field.



4. Click the SAVE button to store the new device name in the device memory.



5. Disconnect the device.

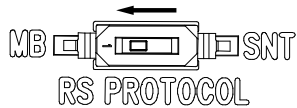

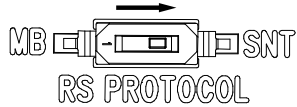
8.3.2 Wired device network

The device has an isolated RS-485 bus that is designed for connecting multiple devices into a single bus using either Modbus RTU or Sintrol Network protocol. Additionally, the main board is equipped with RS PROTOCOL switch, that can be used to enable RS-485 protocol or force the device to direct PC communication mode.

For a device network to operate properly, the RS PROTOCOL switch must always be in MB position during normal operation. SNT position is designed only for connecting a single device to a PC that is running DustTool software, and for changing the device settings and parameters.

RS PROTOCOL switch must be in a correct position based on the intended use. Effectively, it functions as an ON/OFF switch for RS-485 protocol.

Table 10: RS-485 settings and RS PROTOCOL switch configurations

Communication protocol	RS-485 setting in DustTool	Description	Switch position
Modbus RTU	Modbus Slave	When RS PROTOCOL switch is in MB position, the device communicates using Modbus RTU protocol.	
Sintrol Network	SNT Slave	When RS PROTOCOL switch is in MB position, the device communicates using Sintrol Network protocol.	
Sintrol Network	SNT PC (set automatically)	When RS PROTOCOL switch is in SNT position, the device can only communicate directly with a PC using RS-485 to USB converter.	

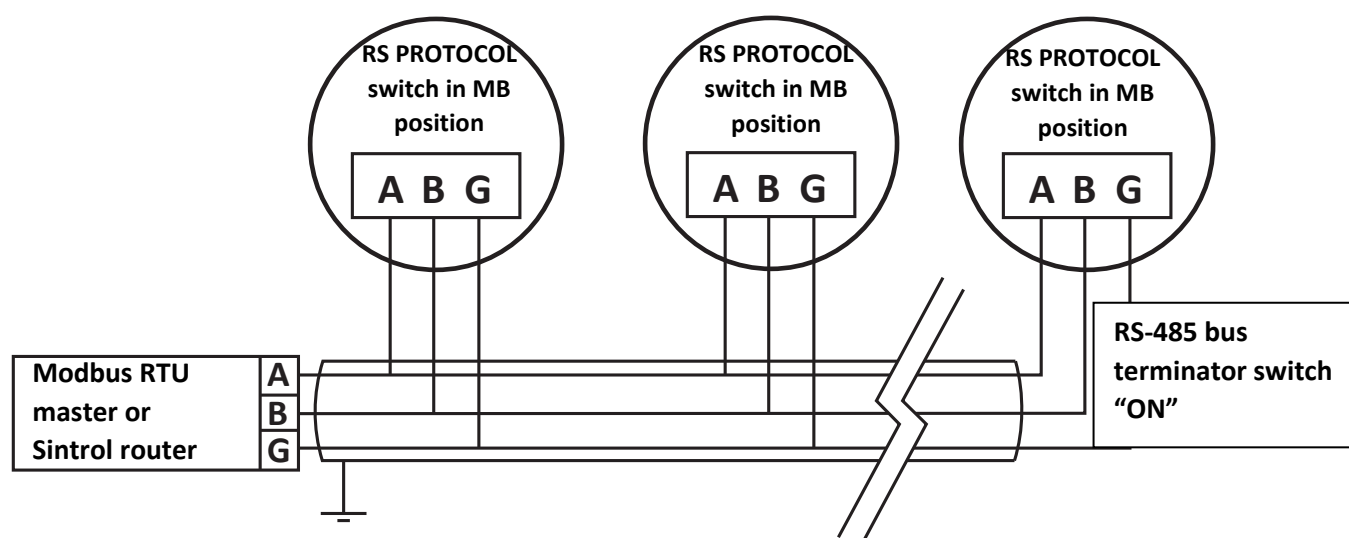


Figure 24: A device network created with RS-485 connections

To create a wired device network, you need:

- Communication base station
 - Modbus master device for Modbus RTU protocol
 - Network Router or Wireless Router for Sintrol Network protocol
- Suitable 3-wire shielded cable
- DustTool software

To set up a wired network, all devices in the chain must first be installed according to the instructions in chapters **Mechanical installation** and **Electrical installation**.

After the devices have been installed, the settings for each individual device must be adjusted in DustTool. To adjust the device settings in DustTool:

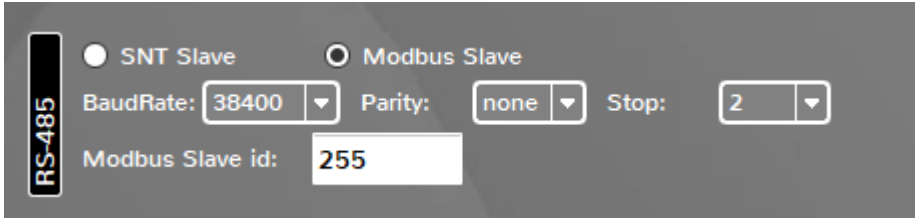
1. Connect the device to a computer with USB.

2. Launch DustTool and navigate to PROPERTIES tab.

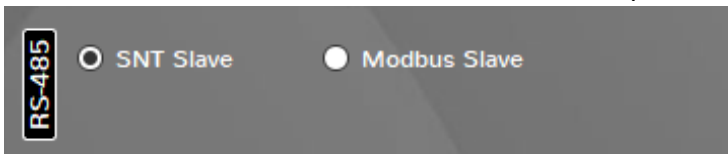


3. Adjust the settings for the RS-485 protocol as necessary:

- To use Modbus RTU protocol and to control the device network with Modbus master device, select the option “Modbus Slave” and assign an appropriate unique slave ID. “Modbus Slave” is selected by default.



- To use Sintrol Network protocol and to control the device network with DustTool software and Network Router or Wireless Router, select the option “SNT Slave”.



4. Click the SAVE button to store the new settings in the device memory.

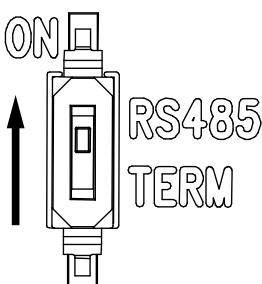


5. Disconnect the device.

6. Repeat steps 1 to 4 for each individual device in the network.

After you have adjusted the settings for each individual device according to the selected communication protocol:

7. Switch the terminator switch 1 to ON position on the last device of the chain.



8. Connect the first device of the chain to the communication base station.

- If your device chain communicates through Modbus RTU protocol, the first device in the chain must be connected to a Modbus master device.
- If your device chain communicates through Sintrol Network protocol, the first device in the chain must be connected to Sintrol Router or Network Router. The router device in turn must be connected to a host computer.

The device network is now operational, and you can use the master device to control the devices.

9 Operation

9.1 Main board

The main board of the device is equipped with a mode selector key that is used to select one of the three user-selectable response modes, and Auto Setup key that is used to start the Auto Setup function. Operation status of the device is indicated with two LEDs that can change color between green, yellow and red.

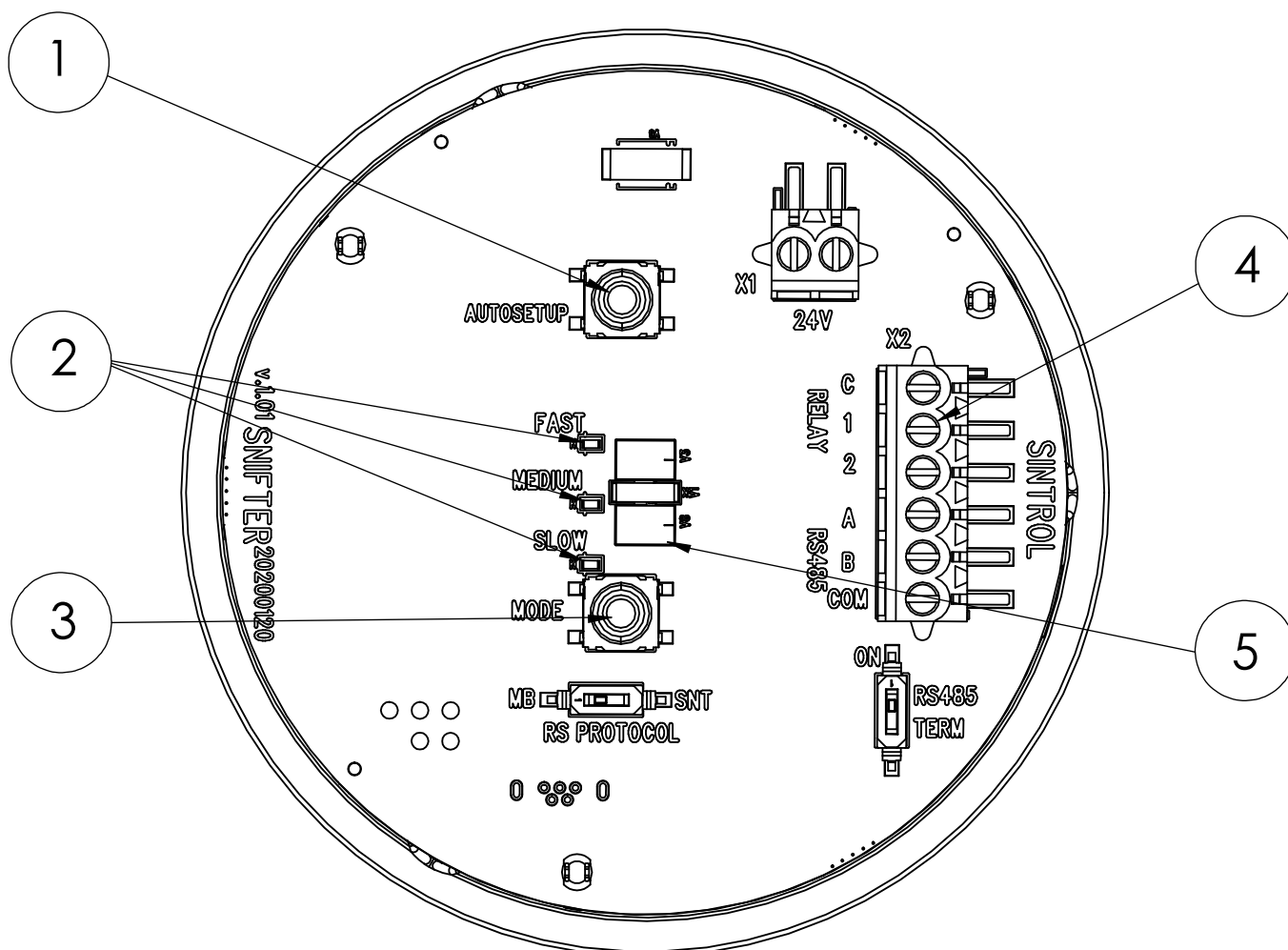


Figure 25: The main board of the device

①	AUTOSETUP key	④	Solid-state relay terminal
②	Mode indicator LEDs	⑤	Status LEDs
③	Mode selector key		

9.2 Relay, LED and display functional logic

The device has various operation statuses that are indicated to the user with two independent solid-state relays, and two LEDs that can change color between green, yellow and red.

9.2.1 Operation statuses

The operation statuses are described in Table 11.

Table 11: Operation statuses and their descriptions

Device status	Description
NORMAL OPERATION	The device operates normally according to the initial setup. The dust level is below the configured thresholds for ALERT and ALARM statuses.
ALERT	<p>The device operates normally according to the initial setup.</p> <ul style="list-style-type: none"> The dust level is above the configured threshold for ALERT status. The dust level is below the configured threshold for ALARM status.
ALARM	The device operates normally according to the initial setup. The dust level is above the configured threshold for ALARM status.
AUTO SETUP	The device analyzes and establishes normal process conditions that are used as a baseline for future measurements.
FAULT	<p>The device has detected a fault in the operation.</p> <p>The device indicates this by flashing red LEDs on the main board.</p>

9.2.2 Relay logic

The device has two independent solid-state relays. The relays are used to indicate dust alarm statuses to the monitoring system. The contacts on the relay terminal block are labeled “1” and “2” for the individual relays. The common contact is labeled “C”. The relays can be used to power external loads of up to 30 V DC / 200 mA.

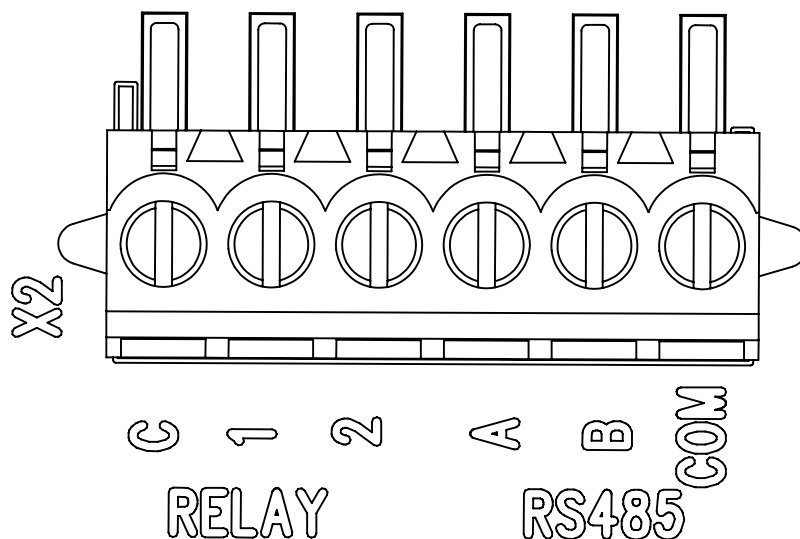
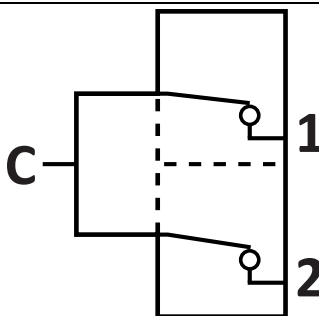
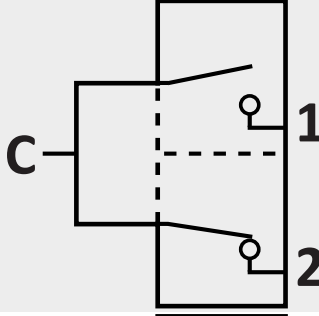
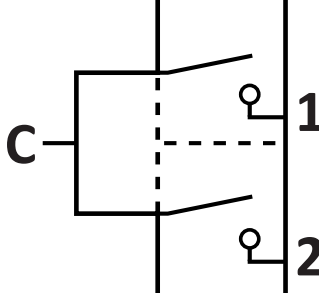


Figure 26: Relay and RS-485 terminal on the main board

Both relays are energized during normal operation, which means that voltage is applied to the electromagnetic coils. When the dust level exceeds the configured alarm thresholds, the voltage is no longer supplied, and the relays are relaxed.

Table 12: Relay statuses

Relay status	Relay contacts	Description
Relay 1: Energized Relay 2: Energized		<p>The device operates normally, and dust concentration is below the configured ALERT and ALARM thresholds.</p> <p>Voltage is supplied to both relays.</p>
Relay 1: Relaxed Relay 2: Energized		<p>The dust concentration is above the ALERT threshold but below the ALARM threshold.</p> <p>Relay 1 switches status and triggers ALERT. Voltage is supplied to Relay 2.</p>
Relay 1: Relaxed Relay 2: Relaxed		<p>The dust concentration is above the configured ALARM threshold.</p> <p>Relay 2 switches status and triggers ALARM. Both relays are relaxed.</p>

The operation logic of the relays is described in Table 13.

Table 13: Operation logic of the relays

Device status	Relay 1 status	Relay 2 status
NORMAL OPERATION	Energized	Energized
ALERT	Relaxed	Energized
ALARM	Relaxed	Relaxed
AUTO SETUP	Energized	Relaxed
FAULT	Relaxed	Relaxed

9.2.3 LED logic

The main panel of the device is equipped with two LEDs that change color in response to changes in the operation status.

Table 14: Operation logic of the LEDs and display

Device status	LED behavior
Normal operation	Green
ALERT	Yellow
ALARM	Red
AUTO SETUP	Green, blinking
FAULT	Red, blinking

9.3 Response modes

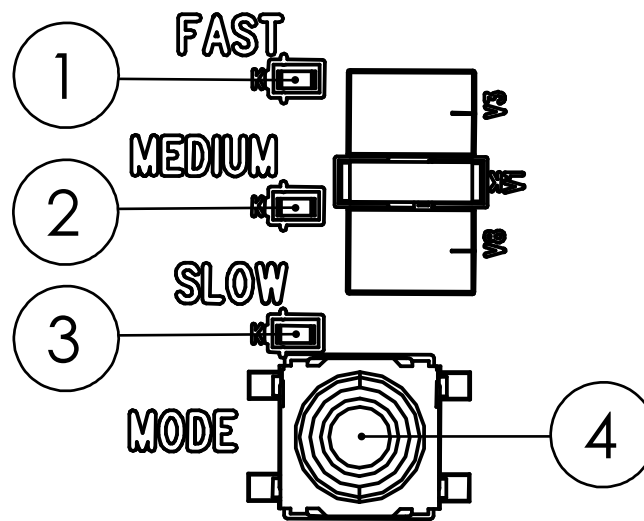


Figure 27: Mode selector section on the main board

① FAST mode indicator LED	③ SLOW mode indicator LED
② MEDIUM mode indicator LED	④ Mode selector key

The device has user-selectable FAST, MEDIUM and SLOW response modes, which determine how fast the device reacts to changes in dust levels. This is done by applying pre-programmed values to parameters that control signal averaging time and alarm delay time.

Signal averaging time determines the period from which the device calculates the average signal level. Alarm delay time determines how long the dust level must be above the configured ALERT or ALARM threshold before the relays switch position and activate the alarms. This is to avoid false alarms caused by naturally occurring peaks in dust levels in certain processes.

Response modes also affect the ALERT and ALARM thresholds that the device sets automatically during Auto Setup based on the measurement baseline. Each response mode has pre-programmed multipliers for the measurement baseline that are used to set the ALERT and ALARM thresholds.

The response modes are pre-programmed, and you can change them with a mode selector key that is located on the main board of the device. A small yellow LED next to the mode name indicates the selected response mode.

Settings used in each response mode are described in Table 15.

Table 15: Pre-programmed response modes

Response mode	Signal averaging time	Alarm delay time	Alarm thresholds after Auto Setup
FAST	10 second	10 seconds	ALERT: 3× baseline ALARM: 10× baseline
MEDIUM	50 seconds	30 seconds	ALERT: 5× baseline ALARM: 20× baseline
SLOW	100 seconds	60 seconds	ALERT: 5× baseline ALARM: 20× baseline

The baseline of the previous Auto Setup is always stored in the device memory. When you change the response mode, the device applies the appropriate multipliers to the baseline, and adjusts the parameters for ALARM and ALERT thresholds automatically.

In addition to the mode selector on the device main board, all device parameters can be manually adjusted in DustTool. For more detailed information about device parameters, see section **Parameters** in this chapter.



Using the mode selector key overwrites any parameters changes made in DustTool.

9.4 Parameters

You can control how the device operates and reacts to changes in dust levels by adjusting the device parameters. The parameters can be changed in DustTool or with a Modbus master device. For instructions on how to change the device parameters, see section **Changing parameters** in chapter **Commissioning and system setup**.

9.4.1 Overview

See Table 16 for an overview of the user-adjustable parameters.

Table 16: The device parameters

Parameter	Description
Signal averaging time (sec)	Determines the period from which the device calculates the average signal level.
Alarm delay time (sec)	Determines how long the dust level must be above the configured ALERT or ALARM threshold before the alarms activate.
ALERT threshold (IEU)	Sets an IEU value that determines the dust concentration that triggers ALERT status.
ALARM threshold (IEU)	Sets an IEU value that determines the dust concentration that triggers ALARM status.

9.4.2 Signal averaging time

Signal averaging time refers to the period from which the device calculates the average signal level.

Parameter value corresponds to the signal averaging time in seconds.

Table 17: Signal averaging time values

Description	Maximum value	Default values
Determines the signal averaging time in seconds.	6000 seconds	FAST: 10 seconds
		MEDIUM: 50 seconds
		SLOW: 100 seconds
		AUTO SETUP: 50 seconds

In DustTool, you can adjust this parameter on PARAMETERS tab in section MEAS.

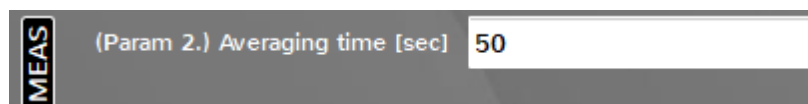


Figure 28: Changing signal averaging time parameter in DustTool

9.4.3 Alarm delay time

Alarm delay time determines how long the average dust level must be above the configured ALERT or ALARM threshold before an alarm is triggered. This is to avoid false alarms caused by naturally occurring peaks in dust levels in certain processes.

Parameter value corresponds to the alarm delay time in seconds.

Table 18: Alarm delay time values

Description	Maximum value	Default values	
Sets the alarm delay time in seconds.	180 seconds	FAST:	10 seconds
		MEDIUM:	30 seconds
		SLOW:	60 seconds
		AUTO SETUP:	30 seconds

In DustTool, you can adjust this parameter on PARAMETERS tab in section I/O CONTROL.

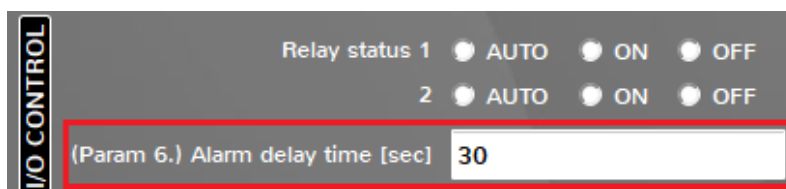


Figure 29: Changing alarm delay time parameter in DustTool

9.4.4 Alarm thresholds

Alarm thresholds set the IEU values that trigger ALARM and ALERT statuses. Auto Setup function sets these values automatically in relation to the baseline dust level. By changing these parameters in DustTool, you can set the limits manually.

IEU values are measured on a scale that extends up to several million units.

Table 19: ALARM and ALERT threshold values

Parameter	Description	Default values	
ALERT threshold (A)	Sets the signal level required to trigger the ALERT status.	FAST:	3× baseline
		MEDIUM:	5× baseline
		SLOW:	5× baseline
ALARM threshold (B)	Sets the signal level required to trigger the ALARM status.	FAST:	10× baseline
		MEDIUM:	20× baseline
		SLOW:	20× baseline

In DustTool, you can adjust these parameters on PARAMETERS tab in section ALARMS.

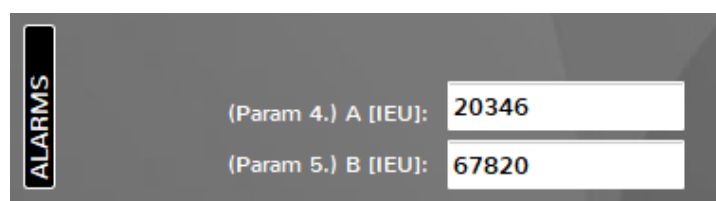


Figure 30: Changing alarm threshold parameters in DustTool

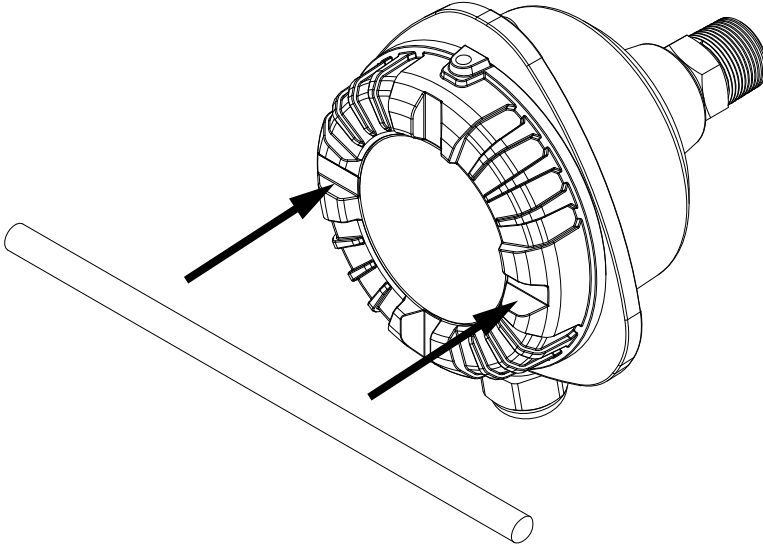
9.5 Troubleshooting

If performing the checks as instructed in this section does not solve your problem, contact the manufacturer or an authorized distributor.

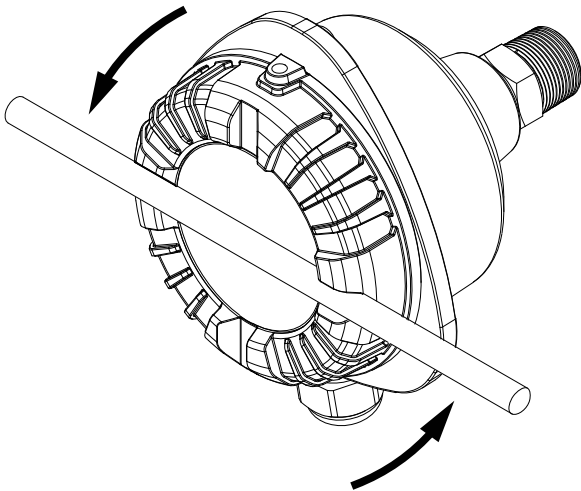
9.5.1 Device lid does not open

The device lid can become stuck if too much dust accumulates between the threads. In this case, you can use a rod or other suitable tool to force the lid open. To force the lid open:

1. Place a rod or other suitable tool between two opposite slots on the device lid. The lid has four slots.



2. Use the rod to turn the lid counterclockwise. The slots lock the rod in place, allowing you to force the lid open.



The design of the slots makes the rod slip out if you attempt to use it to turn the lid clockwise. This prevents you from using a tool to close the lid by force.

9.5.2 No output signal

If the device does not generate a valid output signal during normal operation:

- Make sure that the device is connected to a power source and that all electrical connections are made correctly.
- Make sure that the power supply is ON.
- Make sure that normal processes are running.
- Perform Auto Setup.

9.5.3 No response after Auto Setup

If the device does not respond after you have performed Auto Setup:

- Make sure that the device is connected to a power source and that all electrical connections are done correctly.
- Make sure that the power supply is ON.
- Make sure that the signal is not leaking to ground. Possible causes for a signal leak are:
 - Contact between the sensor probe and the duct wall.
 - Condensed droplets in the gas flow.
 - Sticky dust buildup on the sensor base, which can cause bridging between the sensor probe and the duct wall.
- Make sure that normal processes are running during Auto Setup.

10 Maintenance and inspection

10.1 Safety precautions



Read chapter “Safety” carefully before performing maintenance on the device.

The device must not be modified or repaired in any way that is not specifically described in this manual. Do not perform any mechanical or electrical repairs without contacting the manufacturer or an authorized service center or distributor.

Only original Sintrol parts can be used for repairs. If third-party spare parts are used, the manufacturer cannot guarantee safe operation of the device. The manufacturer or distributor cannot be held liable for any damage, injury or financial loss resulting from improper use.



Wear protective glasses when working on electrical connections.

DANGER!



Poisonous and hot gas hazard

When installing or removing the device, poisonous and hot gas can be released from the duct.



Wear appropriate respiratory and eye protection gear when installing or removing the device. Follow all applicable local and plant-specific safety codes before proceeding.

WARNING!



Risk of burns due to hot components

When installing or removing equipment, the device or the installation surface can be hot.



Wear appropriate heat-resistant gloves and follow all applicable local and plant-specific safety codes before proceeding.

WARNING!**Electric shock hazard**

Faulty electrical installations, too high line voltage or incorrect operation of the device can result in an electric shock. Only trained and qualified personnel can install, commission, operate and perform maintenance on the device.

To ensure that performing maintenance on the device is safe, keep the following points in mind:

- Turn off and unplug the device when you are not using it, when you intend to clean it, or in the event of malfunction.
- Disconnect power supply before inspecting the device or performing maintenance.
- Make sure that all equipment is properly grounded.
- Never perform maintenance on the device alone.

10.2 Maintenance and inspection interval

The recommended inspection and maintenance intervals depend on the operating conditions. The amount of dust and other possible substances in the measurement air affect how often the sensor must be inspected and cleaned.

During the first months after installation (up to 6 months), it is recommended to perform maintenance on the device monthly. If there is no noticeable dust build-up on the sensor probe and the probe is easy to clean, the maintenance interval can be increased step-by-step.



It is the responsibility of the plant operator to decide what is the appropriate maintenance interval.

A monthly interval is recommended for the visual inspection of the device and testing of the device functions.

If you notice that the device is not operating normally, contact the manufacturer or an authorized distributor. Make sure that an industry specialist inspects and approves the device for use in the monitoring system that the device is part of, and ensures that its use complies with all local safety standards and regulations.

10.3 Maintenance and inspection

Do the following inspections monthly:

- Visually inspect the outer parts of the device, its accessories, and cables. Make sure that there is no obvious visible damage.
- Make sure that the device lid, threaded connection to pipe coupler, cable glands and cables are tightly secured.
- Clean the device enclosure, lid and the window.

- Make sure that the measurement results are within the expected range.
- Make sure that the device is properly grounded by touching the enclosure and the probe. The device is properly grounded if:
 - The output signal does not change when you touch the enclosure.
 - The output signal changes when you touch the probe.

In addition, do the following maintenance tasks at regular intervals determined by the plant operator:

- Clean the sensor probe by wiping it with a cloth. If necessary, you can use a brush.

10.3.1 Removing device from the process

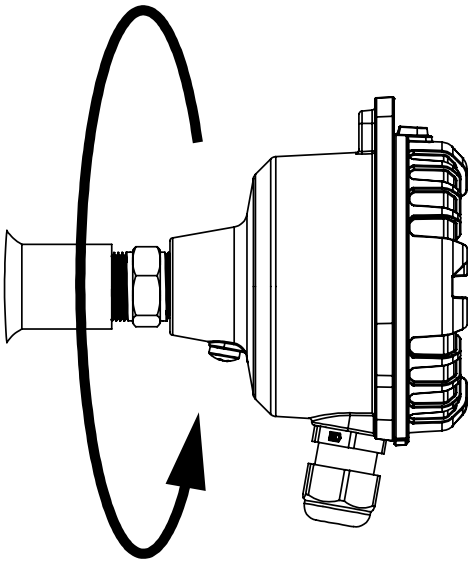
To test that the probe reacts properly to being touched and to clean it, the device must be removed from the process.

To remove the device from the process, you need:

- Wrench 22 mm (0.87 in)
- 1/2-inch NPT male plug

To remove the device from the process:

1. Loosen the sensor from the pipe coupler. Grab the hexagonal nut that is located on the enclosure base with a wrench and turn it counterclockwise.



NOTICE

When removing the sensor, do not turn the device by grabbing the enclosure. This can damage the connection that attaches the main board to the sensor probe inside the enclosure. Use the hexagonal nut on the enclosure base to loosen the sensor from the threaded pipe coupler.

2. Use a 1/2-inch NPT male plug to close off the sensor end of the female pipe coupler.
3. Do necessary inspections and maintenance on the probe.
4. When you are done, remove the 1/2-inch NPT male plug. Install the device again by grabbing the hexagonal nut with a wrench and securing the device to the female pipe coupler by rotating it clockwise.

10.3.2 Cleaning supplies

Use a cloth or paper towel to clean the device enclosure and probe. If necessary, you can apply mild detergent or isopropyl alcohol to remove stuck-on dirt.

NOTICE

Do not use any abrasive material or corrosive substances to clean the device enclosure or sensor probe. It can cause damage to the device or probe and influence the measurement results.

You can use a steel brush to gently clean a standard uncoated steel probe, for example if the probe is encrusted with burned particles from the process.

10.4 Returns

If you need to return a defective device for repair, replacement or disposal, contact the manufacturer or an authorized service center or distributor. Deliver the device to the manufacturer in its original packaging, or in a suitable secure container.

Contact details for the manufacturer's offices are available on the back cover of this user manual, and online at www.sintrolproducts.com/contact/company-contact-information.

11 Recycling and disposal

11.1 Packaging



Recycle any paper, cardboard or plastic material used in the product packaging, and sort them in an appropriate recycling container.

Any non-recyclable packaging material must be disposed of with general waste.

11.2 Device



Electronic devices that are marked with this symbol must not be disposed of with general or household waste. If a defective or broken-down device cannot be repaired, it must be recycled and disposed of in accordance with WEEE directive (2002/95/EC) or other applicable local regulations.

12 Specifications

For dimensions, see section **Dimension drawings** in chapter **Product overview**.

General information

Product name:	S101
Measured objects:	Solid particles in gas flow
Measurement principle:	Inductive electrification
Measurement range:	Detection limit 0.01 mg/m ³ Max. range up to several g/m ³ depending on operating conditions
Ingress protection:	IP66
Power supply:	24 V DC ±10%
Power consumption:	1 W
Output signals:	2 × Independent solid-state relays, max. 30 V DC / 200 mA
Communication interface:	RS-485
Communication protocol:	<ul style="list-style-type: none"> • Modbus RTU • Sintrol network

Physical characteristics

Enclosure:	Aluminum
Probe length:	250 mm (9.84 in), can be shortened by the user
Wetted parts:	<ul style="list-style-type: none"> • Probe: Stainless steel (316L) • Insulation: Polyether ether ketone (PEEK)
Weight:	0.7 kg (1.54 lb)

Ambient conditions

Temperature:	-40 ... 60 °C (-40 ... 140 °F)
Humidity:	Max. 95 % relative humidity (non-condensing)

Process conditions

Temperature:	Max. 250 °C (482 °F)
Pressure:	Max. 200 kPa (29 psi)
Flow speed:	Min. 3 m/s (9.84 ft/s)

Appendix A: ISO 9001 certificate



CERTIFICATE

Inspecta Sertifiointi Oy has issued an IQNet recognized certificate that the organization:

**Sintrol Oy
Helsinki**

has implemented and maintains a

Quality Management System

for the following scope:

Development, manufacturing, marketing, sales and maintenance services of solutions demanding a high degree of knowledge for measuring, analyzing and testing.

which fulfils the requirements of the following standard:

ISO 9001:2015

Issued on: 2018-02-22

Expires on: 2021-02-06

This attestation is directly linked to the IQNet Partner's original certificate and shall not be used as a stand-alone document.

Registration Number: FI 5236-04



*Alex Stoichitoiu
President of IQNet*



*Mikko Törmänen
Managing Director
Inspecta Sertifiointi Oy*

Inspecta

IQNet Partners:**

AENOR *Spain* AFNOR Certification *France* APCER *Portugal* CCC *Cyprus* CISQ *Italy*
CQC *China* CQM *China* CQS *Czech Republic* Cro Cert *Croatia* DQS Holding GmbH *Germany* FCAV *Brazil*
FONDONORMA *Venezuela* ICONTEC *Colombia* Inspecta Sertifiointi Oy *Finland* INTECO *Costa Rica*
IRAM *Argentina* JQA *Japan* KFQ *Korea* MIRTEC *Greece* MSZT *Hungary* Nemko AS *Norway* NSAI *Ireland*
NYCE-SIGE *Mexico* PCBC *Poland* Quality Austria *Austria* RR *Russia* SII *Israel* SIQ *Slovenia*
SIRIM QAS International *Malaysia* SQS *Switzerland* SRAC *Romania* TEST *St Petersburg Russia* TSE *Turkey* YUQS *Serbia*
IQNet is represented in the USA by: AFNOR Certification, CISQ, DQS Holding GmbH and NSAI Inc.

* This attestation is directly linked to the IQNet Partner's original certificate and shall not be used as a stand-alone document

** The list of IQNet partners is valid at the time of issue of this certificate. Updated information is available under www.iqnet-certification.com

Appendix B: Modbus RTU registers

Full register definitions available from the manufacturer on request.

Default Modbus communication parameters

Baud rate:	38400
Data bits:	8
Stop bits:	2
Parity:	None

Supported function codes

Input registers (R – Read only)

- 4 – Read Input Registers

Holding registers (R/W – Read and Write)

- 3 – Read Holding Registers
- 6 – Write Single register



Modbus RTU quick reference guide

Description	Register address	R or R/W	Data type	Notes																		
Auto Setup remaining time	34	R	16-bit unsigned integer	Remaining Auto Setup time in seconds																		
Alarm status	50	R	16-bit Boolean values	Alarm status of the device: 0000000000000000[bit1][bit0]: <table border="1"> <thead> <tr> <th></th> <th>Bit 0</th> <th>Bit 1</th> </tr> </thead> <tbody> <tr> <td><u>No alarm</u></td> <td>1</td> <td>1</td> </tr> <tr> <td><u>ALERT</u></td> <td>0</td> <td>1</td> </tr> <tr> <td><u>ALARM</u></td> <td>0</td> <td>0</td> </tr> <tr> <td><u>Maintenance</u></td> <td>1</td> <td>0</td> </tr> <tr> <td><u>Fault</u></td> <td>0</td> <td>0</td> </tr> </tbody> </table>		Bit 0	Bit 1	<u>No alarm</u>	1	1	<u>ALERT</u>	0	1	<u>ALARM</u>	0	0	<u>Maintenance</u>	1	0	<u>Fault</u>	0	0
	Bit 0	Bit 1																				
<u>No alarm</u>	1	1																				
<u>ALERT</u>	0	1																				
<u>ALARM</u>	0	0																				
<u>Maintenance</u>	1	0																				
<u>Fault</u>	0	0																				
Auto Setup command register	1536	W	16-bit integer	1 Start Auto Setup 2 Cancel Auto Setup																		
Signal averaging time	4096	R/W	16-bit unsigned integer	Measurement moving averaging time in seconds, divided by 10. For example, value 100 = 10.0 seconds.																		
Save measurement parameters	1538	W	16-bit integer	1 Save parameters																		

Notes

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