

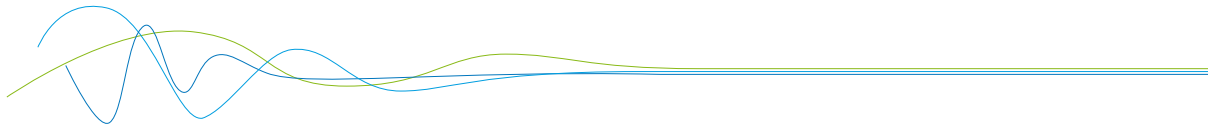


OPERATING INSTRUCTIONS

Dusty C

COMPACT SENSOR FOR BROKEN BAG DETECTION

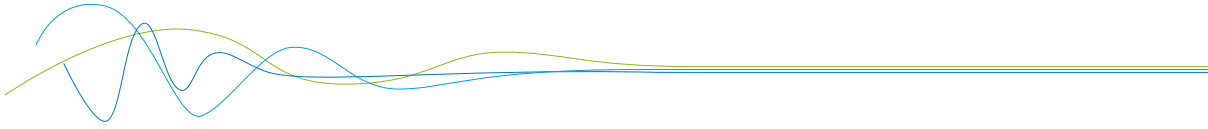




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1. Introduction

1.1 Safety information

The Dusty C filter monitoring sensor requires a $24 \pm 10\%$ V DC power supply. $24 \pm 10\%$ V DC is regarded as safe.

Precautionary measures:

The pipe must be opened when installing and maintaining the sensor.

The following risks must be borne in mind:

- Escape of gas or dust dangerous to health.
- Escaping material may be inflammable, explosive or toxic.
- Escaping material may be hot or pressurised.

1.2 Product description

The Dusty C filter monitoring sensor is a microprocessor-based, preset device for measuring dust concentrations in moving air streams. Dusty C is used for monitoring the clean, filtered side after the filter elements.

Dusty C is a compact device for easy installation and simple operation.

The sensor's electronics are accommodated in housing which is protected to class IP 65, and have a button for operating the device, three status display LEDs and a current and relay output.

The LEDs indicate the measurement status, the alarm output and the sensor's internal error check.

Simple "one-button operation" enables the device's status to be queried at any time, the alarm threshold to be increased or decreased, the dust concentration to be measured in order to redefine the switching point, or the device to be set back to its default settings.

The current output converts the measured value into a 4 ... 20 mA trend signal. This can replace the sensor's relay output.

The sensor can be operated using PC software which replaces the functions of the button on the sensor and enables trend visualisation.

The PC software, which can also be used to change the sensor's internal parameters (filter times, alarm holding times etc.), is available as an option. This software also allows parameter files and log files of the measured value recording to be saved.

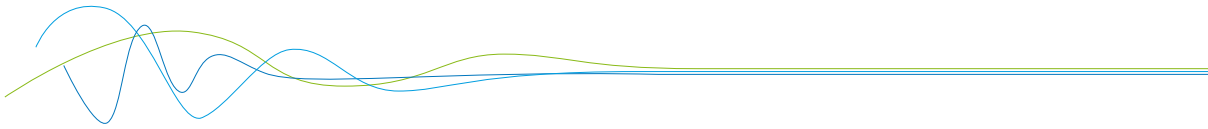
Dusty C is designed for use in applications with a pressure of up to 2 bar and temperatures of up to 140 °C.

The system can optionally be installed in Ex zones, category 3 (gas + dust).

The sensor is connected with an 8-wire cable which supplies the electrical power and optionally the current output, relay output or digital communication.

1.3 Reliability

For any additional information concerning product reliability, please contact ENVEA Process.



1.4 How does it work

The Dusty C filter monitoring sensor is based on the electrodynamic technology: dust particles streaming past or impinging on the probe exchange the smallest electrical charges with the probe.

These small electrical charges result in a signal which is proportional to the dust content in the air flowing past, even if particles accumulate on the probe. A reliable measured value can consequently be obtained with this virtually maintenance-free and wear-free measuring system.

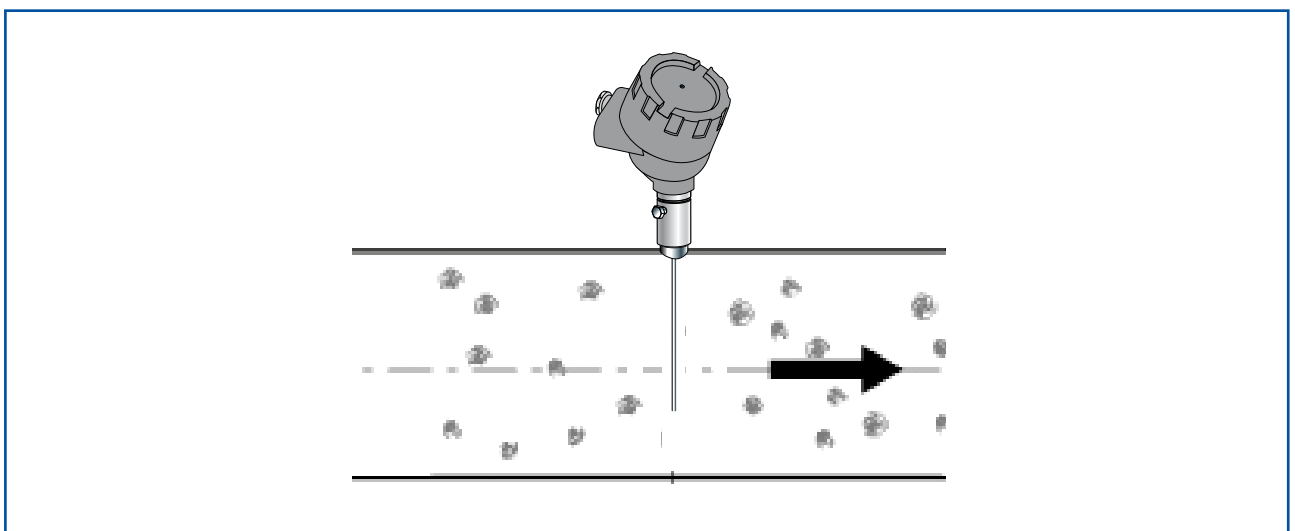
After switching on, a short flash sequence indicates that the sensor is connected: The red LED then flashes during the internal system check. After this, the yellow LED flashes according to the multiplier setting for the alarm threshold. (See also section 5.1)

The sensor then starts to monitor the dust content. This is indicated by the flashing green LED. The flashing frequency indicates the ratio of the measured value to the alarm threshold: the lower the flashing frequency, the lower the dust content – the higher the flashing frequency, the closer the measured value is to the alarm threshold. The green LED goes out if the alarm threshold is reached or exceeded, and the yellow LED indicates the alarm situation. At the same time, the yellow LED indicates that the relay is switched. The internal error message from the sensor also indicates any faults occurring via the relay and the current output.

The Dusty C measuring system offers an **integrated 4 ... 20 mA current output** as a trend display for the dust content. The sensor is designed such that the current output does not need to be calibrated.

The measured value is only output by means of a linear function, whereby a current of 4 mA corresponds to a measured value of zero and a current of 12 mA corresponds to the alarm threshold value. Therefore, the **alarm threshold** always corresponds to **half of the measuring range**.

If a fault is detected during the internal function check, the current output is set to **2 mA**.



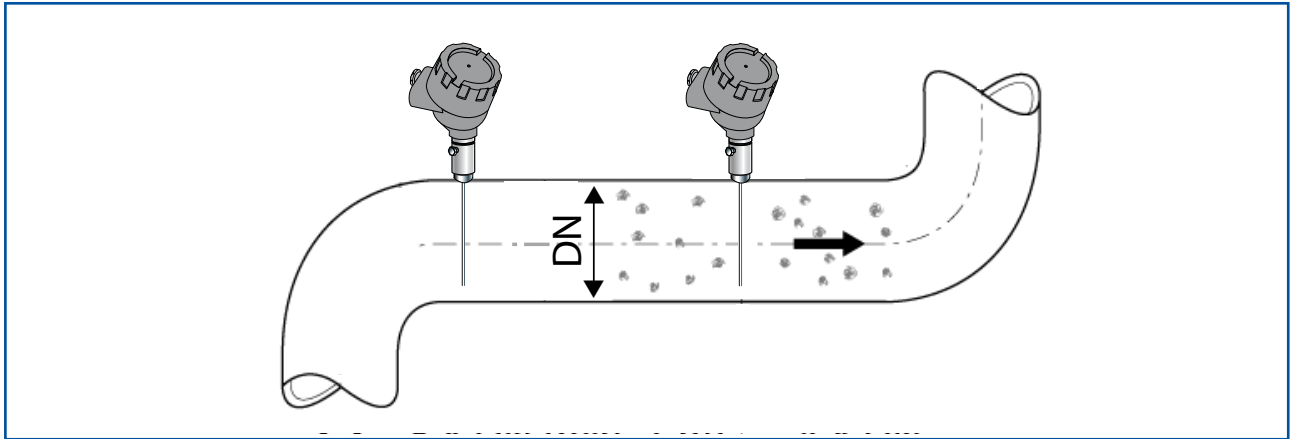
2. Installation

2.1 Selecting the installation location

The best installation position for the sensor in a duct or pipe is located in an area in which the particles are uniformly distributed and flow past the sensor at uniform velocity.

The installation site can be in a horizontal or vertical duct.

With pipeline diameters larger than DN 600, the installation location should be at the output of a curve on the centrifugal force side.



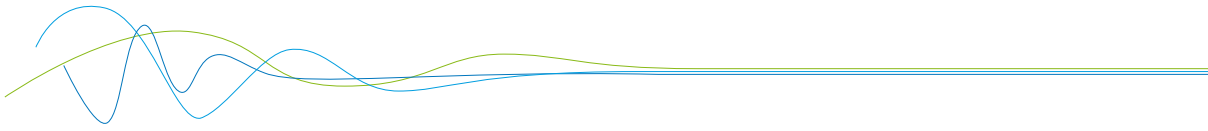
In applications that cannot fully satisfy the requirements for the installation location, choose the best possible installation location.

Dusty C should be installed in a metallic duct in order to attain sufficient shielding against electrical influences.

In the event of non-metallic lines, a metal casing, a metal foil or a fine-meshed metal net with a length of approx. 5 times the pipe diameter must be provided upstream and downstream of the measuring point.

It must also be ensured that the duct and sensor are earthed properly.

1. Dusty C should be installed such that the dust meets the sensor rod at an angle of 90°.
2. In horizontal pipes with a round cross-section, Dusty C can be installed in any position above the horizontal axis (between 9 and 3 o'clock). (See figure 2a)
3. In horizontal pipes with a square cross-section, the system can be installed in the centre at the top or side. (See figure 2b)
4. Even though the sensor function is not impaired by vibration, strong vibrations should be avoided as they can destroy the electronics.
5. The sensor housing should not be exposed to direct sunlight or used in areas with an ambient temperature of over 60 °C.
6. The sensor rod must not come into contact with the pipe wall on the opposite side, or with any other device. This would short-circuit the electrodynamic signal. The length of the sensor can be shortened to a minimum of 70 mm for this purpose. Never damage the plastic sleeve when doing this.
 - The recommended antenna length is the pipe diameter minus 10 mm. However, it must always be ensured that contact through coating formation does not result, even if deposits form on the inside wall of the pipe.
 - The minimum length of the antenna should be 1/3rd of the pipe diameter.
 - A golden rule: the lower the dust concentration, the longer the rod length.



7. A position downstream of the blower is generally recommended as an installation position for monitoring a filter system. If the sensor is used downstream of an electric filter, the distance to the electric filter should be at least 20 metres. Even if the function of the sensor is not impaired by vibrations, extremely strong vibrations over a long period of time should be avoided.

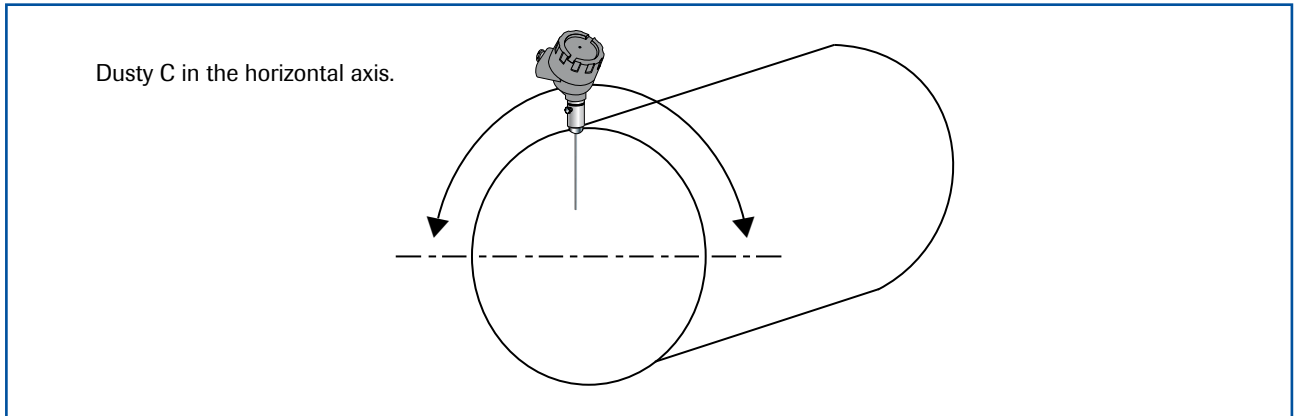


Fig. 2a: Round cross-section

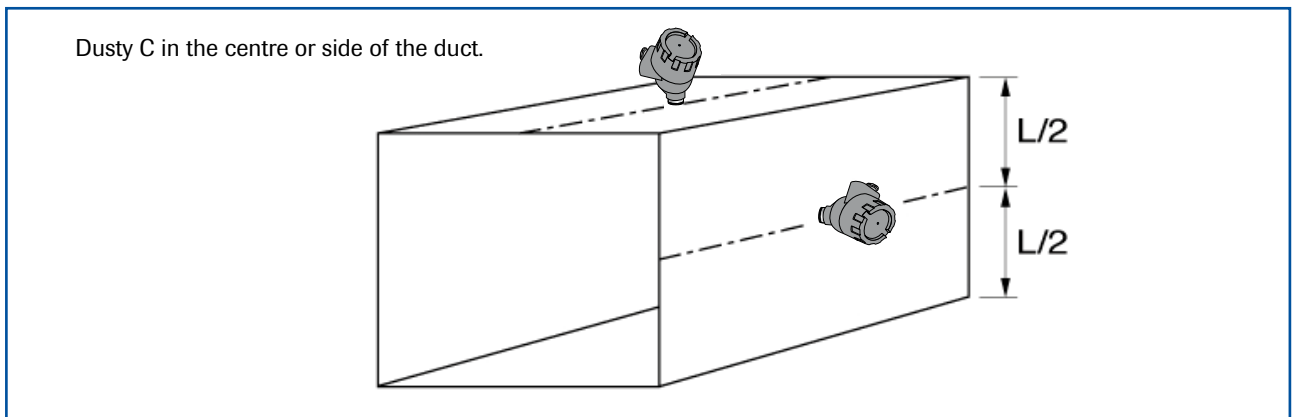


Fig. 2b: Square cross-section

2.2 Sensor installation - standard

First weld the G 1/2" internal threaded socket onto the pipe wall in the chosen installation location and fully drill onto the inside diameter of the socket. Then screw the sensor tightly in. Check the connection for tightness!

Important:

- Use the correct tool (wrench size S27) for the G 1/2".
Do not screw the sensor in by hand as the screw connector could come loose from the housing which would mean that the housing is not tight.
- Do not undo the grub screw in the housing plinth.
- Incorrect installation will render the warranty null and void!

2.3 Sensor installation - mounting with TriClamp

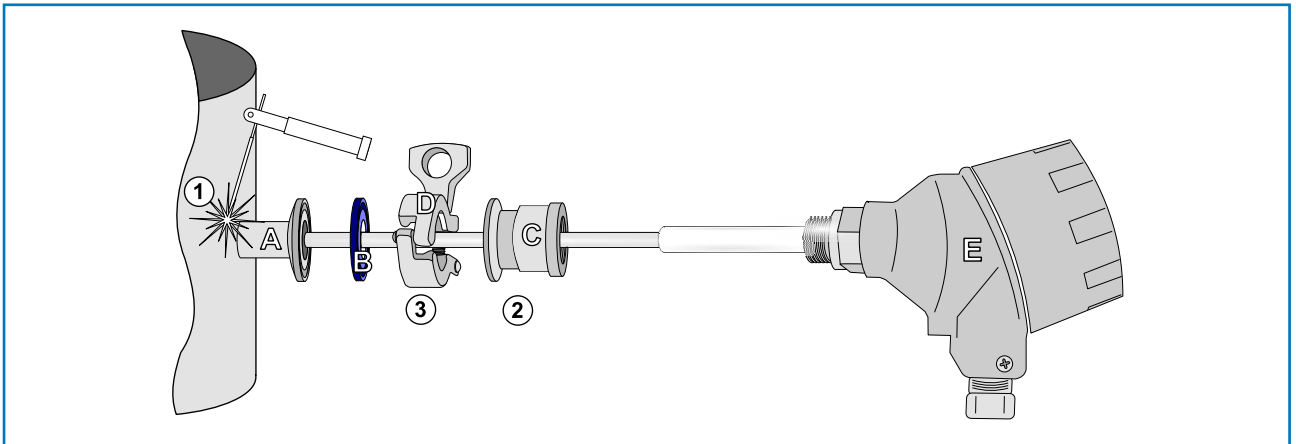


Fig. 2c: Mounting Operations

- ① Weld the flange "A" on the duct wall and opened by drill completely (\varnothing 20 mm).
- ② Mount the sensor "E" on female socket "C" using the proper wrench.

Caution:

- Use the correct size wrench. Do not screw the sensor in by hand since the screw connector could come loose and this can damage the electronics.
- Do not undo the grub screw in the housing plinth.

- ③ Lock female socket "C" on welded socket "A" using the clamp collar "D".
Do not forget the clamp gasket "B"

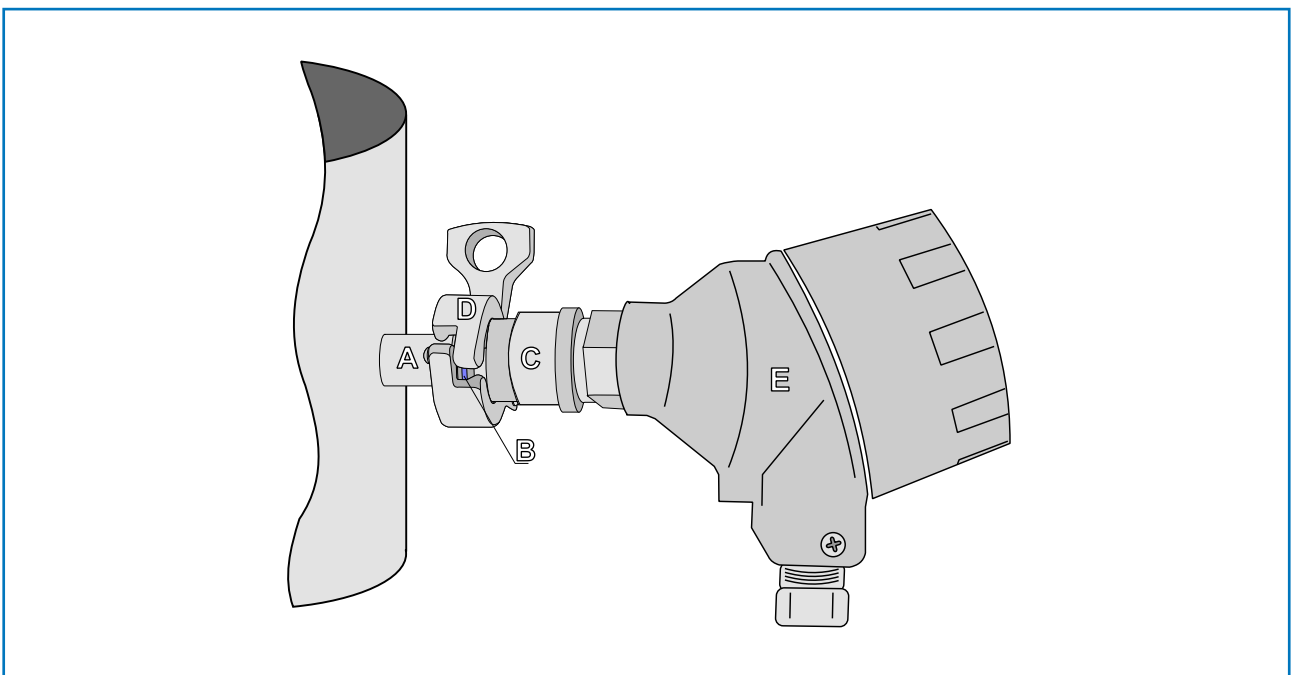
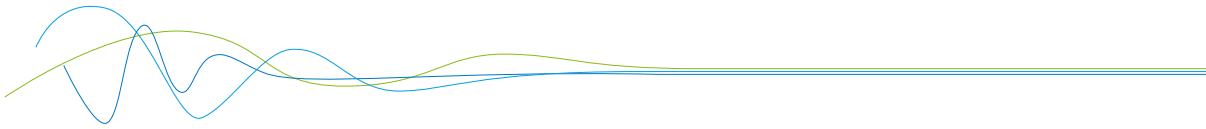


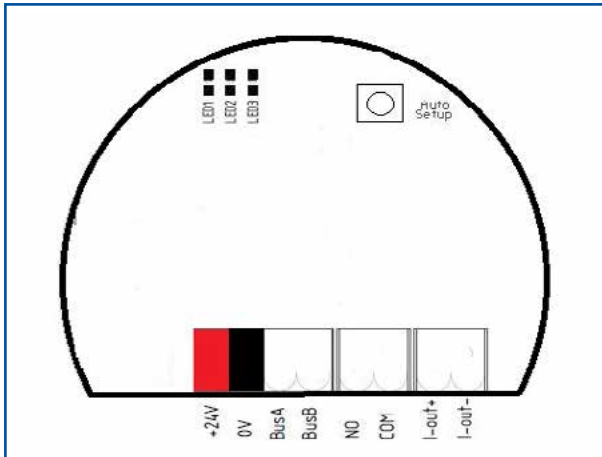
Fig. 2d: Assembled TriClamp



3. Electrical connection

A cable of type “Öfflex Classic 110 CY” is recommended. The cable should be four wired, twisted and shielded. A minimum cable cross-section of 0.75 mm² should be observed. For distances more than 150 m the cable cross-section should be adjusted.

Dusty C has an internal connection chamber with plug-in contacts which can be cabled to suit the appropriate installation option:



Contact no.	Signal
1	+ 24 V DC
2	- 0 V DC
3	ModBus A
4	ModBus B
5	Relay NO
6	Relay COM
7	Current output + 4 ... 20 mA
8	Current output - 4 ... 20 mA

3.1 Dusty C as a filter monitoring sensor with a relay output

The following contacts must be connected if Dusty C is used as a filter monitoring sensor with a relay output:

Contact no.	Signal
1	+ 24 V DC
2	- 0 V DC
5	Relay NO
6	Relay COM

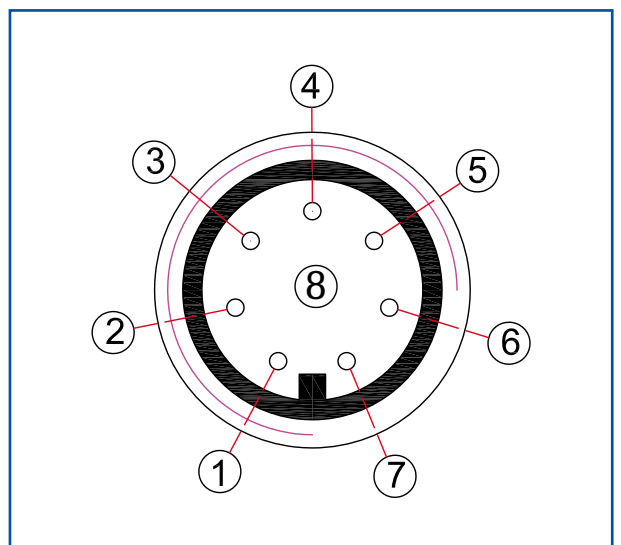
3.2 Dusty C with M12 connector

Dusty C with M12 connector / socket


Plug no.	Signal
1	+ 24 V DC
2	- 0 V DC
3	ModBus A
4	ModBus B
5	Relay NO
6	Relay COM
7	Current output + 4 ... 20 mA
8	Current output - 4 ... 20 mA



SENSOR side connector view



3.3 Use in hazardous areas

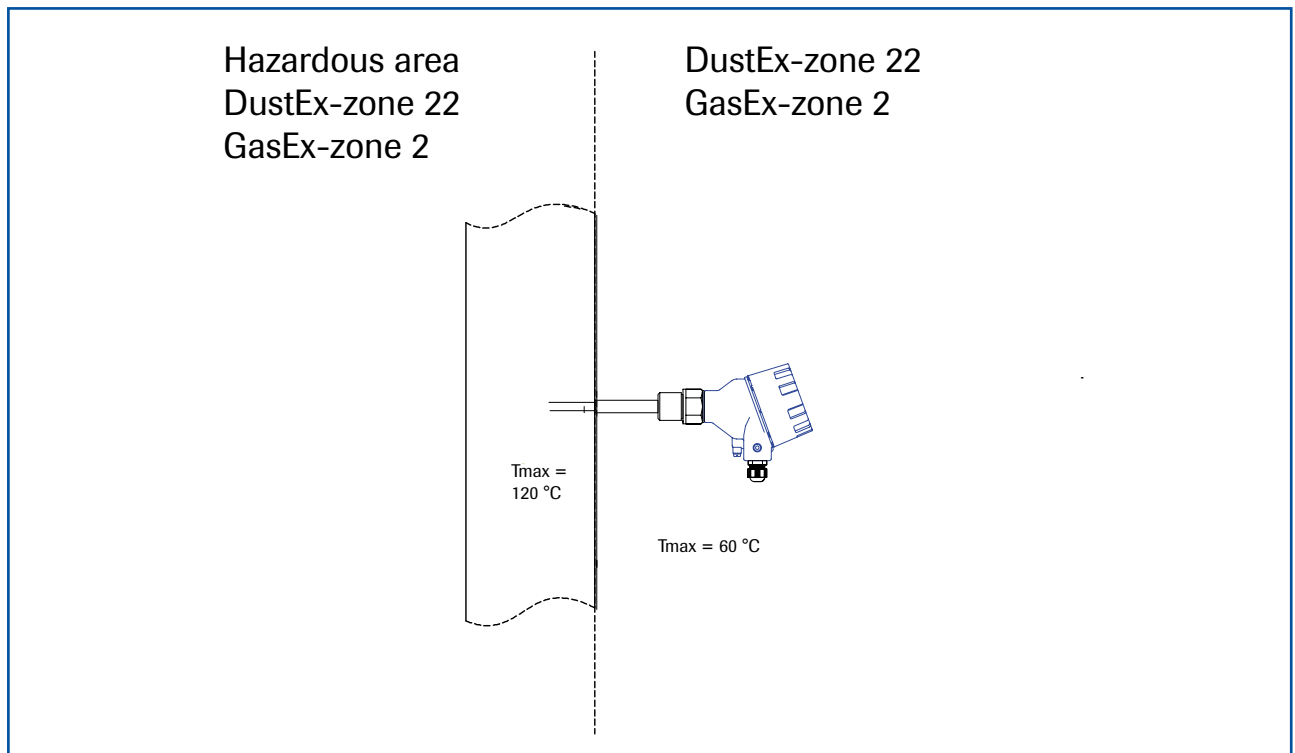
Hazardous area identification:  **II 3D Ex ia/tc IIIC 120°C**

- Equipment group 2
- Equipment category: 3
- For explosive mixtures of air and combustible dust
- IP code 66
- Permitted process temperature -20 to 120 °C

Gas explosion zone identification:  **II 3G Ex ia/d IIC T4**

The sensor must not be used in areas of gas group IIC in which intensive charging processes are to be expected.

- Equipment group 2
- Equipment category: 3
- For explosive mixtures of air and combustible gases
- IP code 66
- Permitted process temperature -20 to 120 °C



3.3.1 Ex Protection type

The electronics of the Dusty C sensor are designed to be intrinsically safe with respect to the rod probe. The separation between the intrinsically safe circuit at the rod probe and other parts of the electronics, protected by flameproof enclosure for explosive gas atmospheres and by enclosure for explosive dust atmospheres, takes place within the housing.

With this setup, cabling with intrinsically safe circuits, blue sheathed cables, and blue fittings are not required.

4. Dimensions

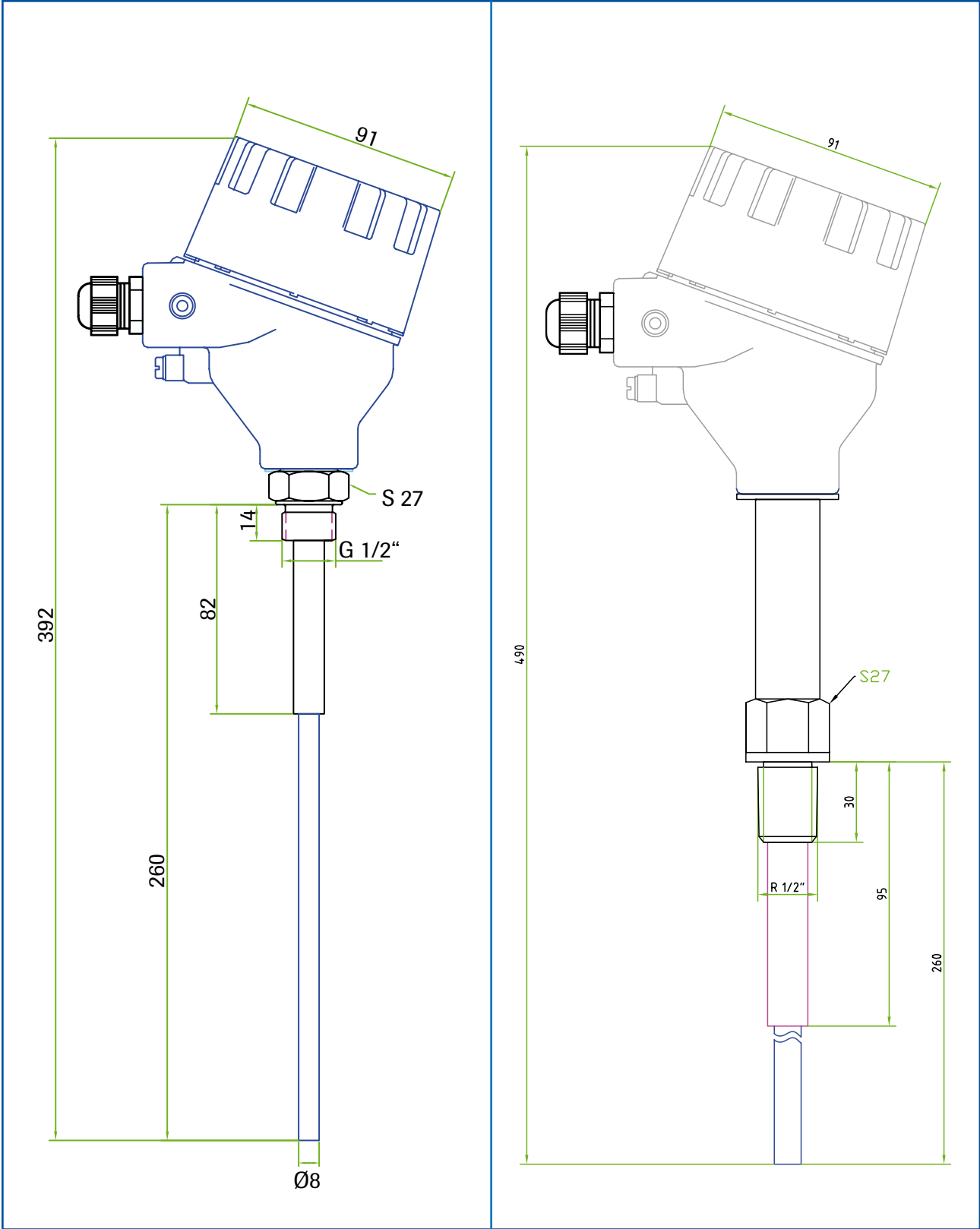
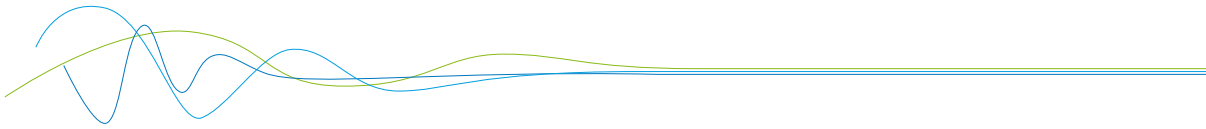


Fig. 6: Dusty C / Dusty C HT dimensions



5. Operation

The Dusty C filter monitoring sensor measures the dust content in gas flowing past the sensor based on the electrodynamic technology by means of the exchange of charge carriers between the dust particles and the sensor probe.

When switched on, the LEDs will flash to provide information about the sensor status: initially the red LED will flash during internal system checks. After this, the yellow LED will flash to provide information about the set multiplier for the alarm threshold. After this, the green LED indicates that it is in measuring mode by a frequency which increases as the dust content rises. The green LED will go out if the alarm threshold is reached or exceeded.

Measurements above the alarm level will be indicated by the yellow LED. At the same time, the value of the current output increases above **12 mA** and the alarm output (relay) is activated.

The detection of an internal error will be indicated by the red LED flashing whilst the sensor is in measuring mode.

5.1 Alert level

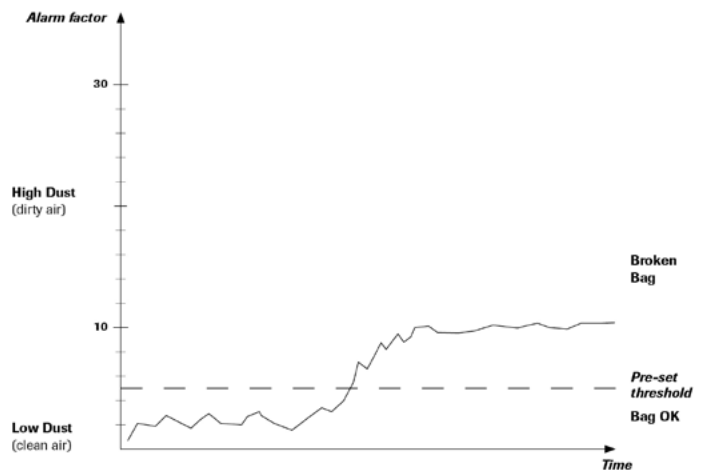
The alert level (Threshold/TRH) is pre-adjusted in factory to a level that allow to detect filter failure in most cases.

To adjust to customer's desire there is one button to increase or decrease the switching level by simply changing a multiplier factor. To change the factor see chapter 5.2 One button operation.

This factor allow a 5 times lower TRH than factory setup (Very clean air) to a 6 times higher TRH than factory setting (Dirty air).

- An internal measure value is pre-calibrated in factory to fit most common cases.
- A factor is pre-set to 5
- The Alert level (TRH) can be setup via the Alarm factor. This factor as a range between 1 (very sensitive) to 30 (not sensitive), according customer conditions..

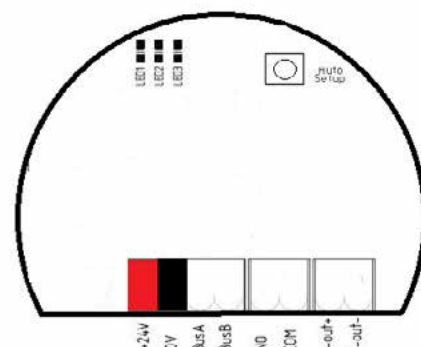
Higher dust levels can be adjusted with AutoSetup function.

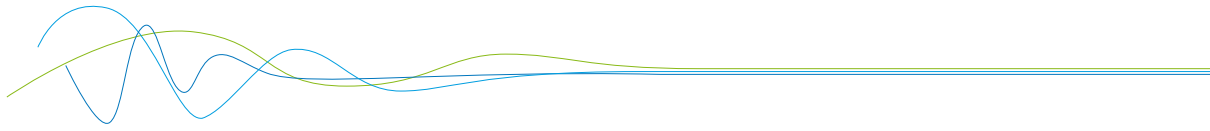


5.2 One button operation

Pressing S1 starts a sequence of flashing signals on the LEDs.

To start a specific function, the button must be released when the required function is indicated by the flashing pattern.





1. Command sequence: for information only!

Initially all three LEDs flash together up to 5 times. If you release S1 during this sequence, the activation procedure will be repeated, in other words the red LED will flash twice during the internal function test and the yellow LED will flash to indicate the current multiplier.

2. Command sequence: change the multiplier!

If you continue to hold S1 beyond the first sequence, the yellow LED will start to flash. If you release S1, the number of times the yellow LED flashes will determine the value of the multiplier. The yellow LED will flash a maximum of 30 times.

3. Command sequence: AutoSetup!

If you continue to hold S1, a countdown will start on all 3 LEDs. After this, all three LEDs will flash up to 5 times. The AutoSetup function will start if you release S1 while they are flashing at the same time. (See section 5.3)

4. Command sequence: restore factory settings!

If you continue to hold S1, a new countdown will show the last sequence: The LEDs will flash together again up to 5 times. If you release S1 during this, the factory settings will be restored.

The LEDs will go out after the last sequence until S1 is released again. In this case no changes will be made.

5.3 AutoSetup

Use the AutoSetup function to set an individual alarm threshold. AutoSetup considers the current dust content in the duct and saves this as the internal measurement level multiplied by the current multiplier as the new alarm threshold. (See section 5.1)

To use the AutoSetup function successfully the process should be carried out with a uniform dust content and the device should be operated for at least 10 minutes. The AutoSetup function is started by pressing S1. (See section 5.2)

The LEDs flash during AutoSetup to act as chaser lights and the sensor then measures the dust content in the duct. The sensor saves the peak values from the measurement which occur during AutoSetup.

The highest peak value (after internal measurement filtration) is used to calculate the internal measurement level and used with the set multiplier to calculate a new alarm threshold.

The AutoSetup function takes 5 minutes. Afterwards, the new alarm threshold is saved, the LEDs go out and the green LED starts to flash again at a frequency which corresponds to the ratio of the dust content to the alarm threshold, thus indicating it is ready for use.

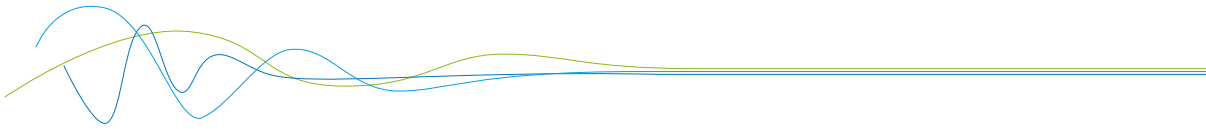
The AutoSetup function can be cancelled by pressing S1. This results in no parameters being saved or changed.

5.4 Current outputs

Once it has been connected, the sensor's current output takes the saved alarm threshold as **the 12 mA point** and the measurement of zero as the 4 mA point to define a linear transfer characteristic curve from the current measurement to the current output.

If the alarm threshold is changed by AutoSetup, the gradient for the transfer characteristic curve is adjusted automatically.

It is possible to communicate with the sensor using simple user software in order to adjust the sensor in the event that it is difficult to access due to its installation situation.



5.5 Relay output configuration

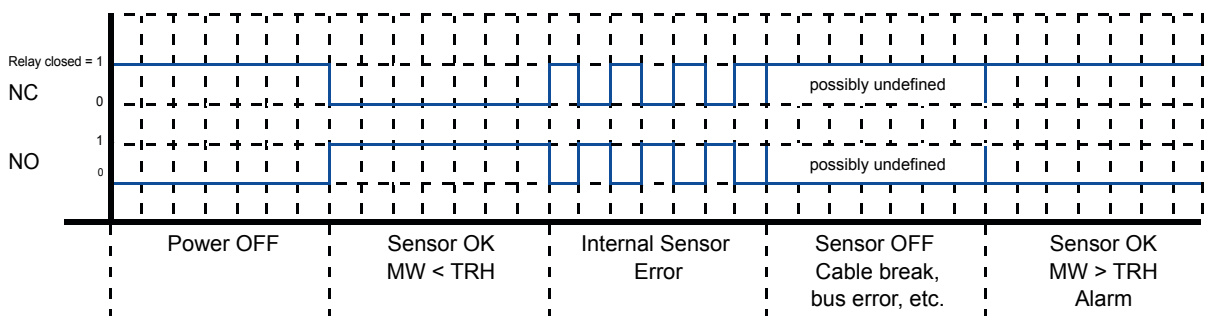
By configuring the Dusty C system correctly it is possible to obtain maximum monitoring and to distinguish between sensor states:

5.5.1 Connection and setting

Use the relay connectors NO (plug contacts 5+6) on the sensor:

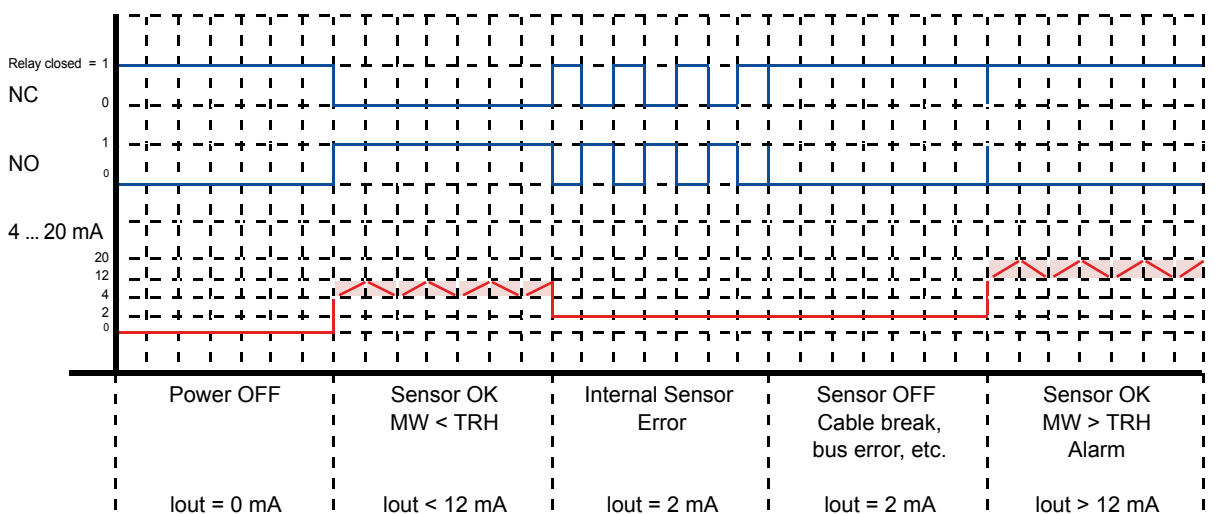
Plug No.	Signal
1	V+ (24 V DC)
2	V- (0 V)
5	Relay NO
6	Relay COM

5.5.2 Dusty C relay function

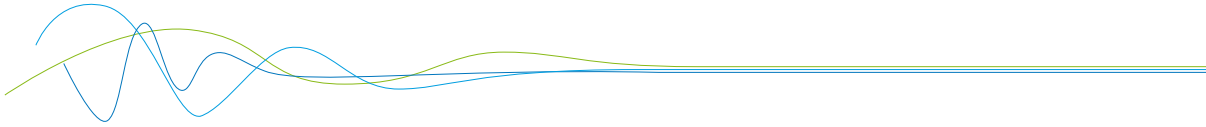


In the event that a cable breaks or is crushed, the state of the relay, but not the signal can before cast at the PLC input and may be undefined.

5.5.3 Relay/current output function



In the event that a cable breaks or is crushed, the state of the relay, but not the signal can be forecast at the PLC input and may be undefined.



6. PC software

Dusty C is supplied as standard without software. However, 2 different software versions are available which can be optionally used. These are “Dusty Base Software” and “Dusty Professional Software”.

Communication between the sensor and the PC is established via ModBus. For this, an RS 485 interface is required. We also offer the necessary USB 485 adapter as a special item. When ordering the adapter, the basic software is automatically included. If you already have a USB 485 adapter, we will be happy to send you the basic software free of charge.

We also offer the “Dusty Professional Software” for a charge, as a special item.

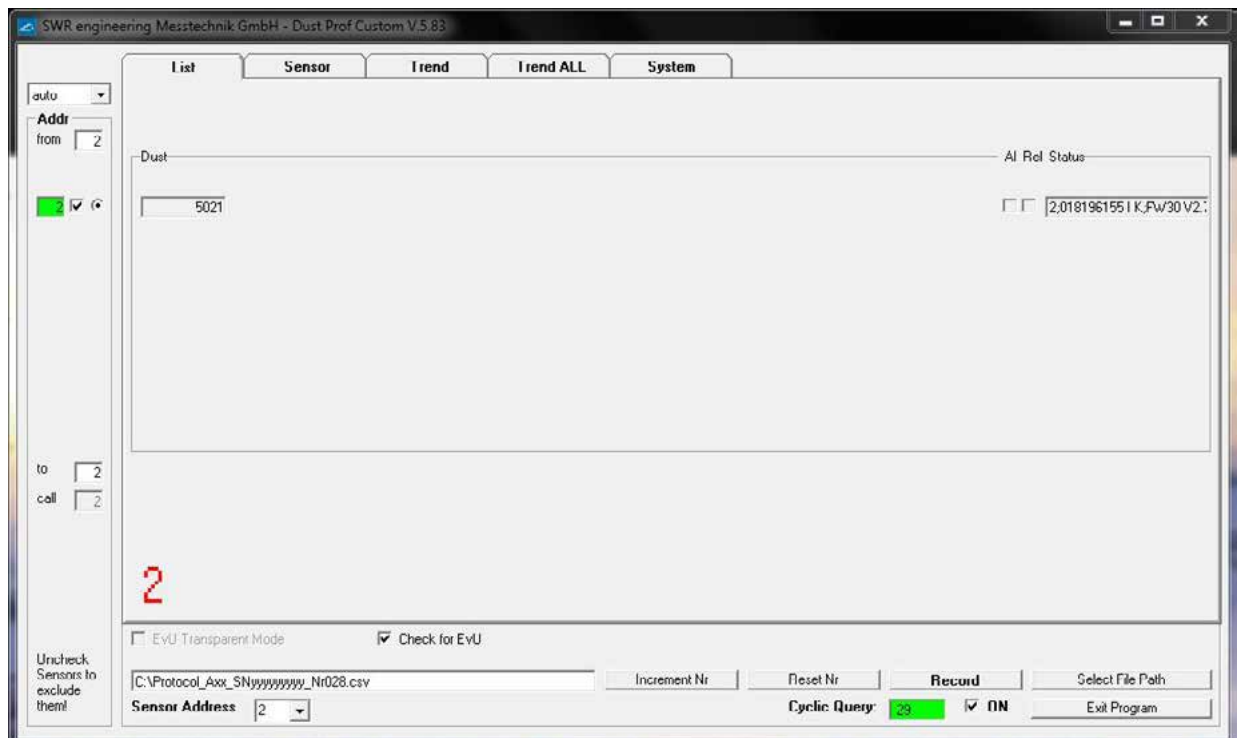
The “Professional Software” can be used to display and analyse up to 10 sensors.

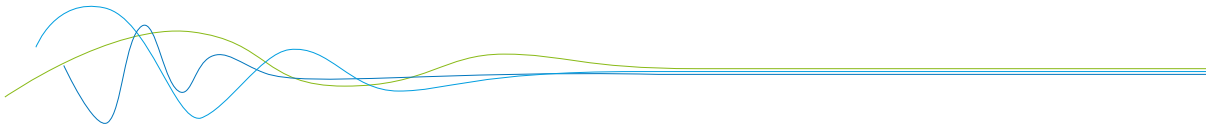
A data log function is also included in the software.

6.1 List tab (Professional Software only)

The list tab lists and displays all the connected sensors.

You can remove individual sensors from the query by removing the respective ticks.

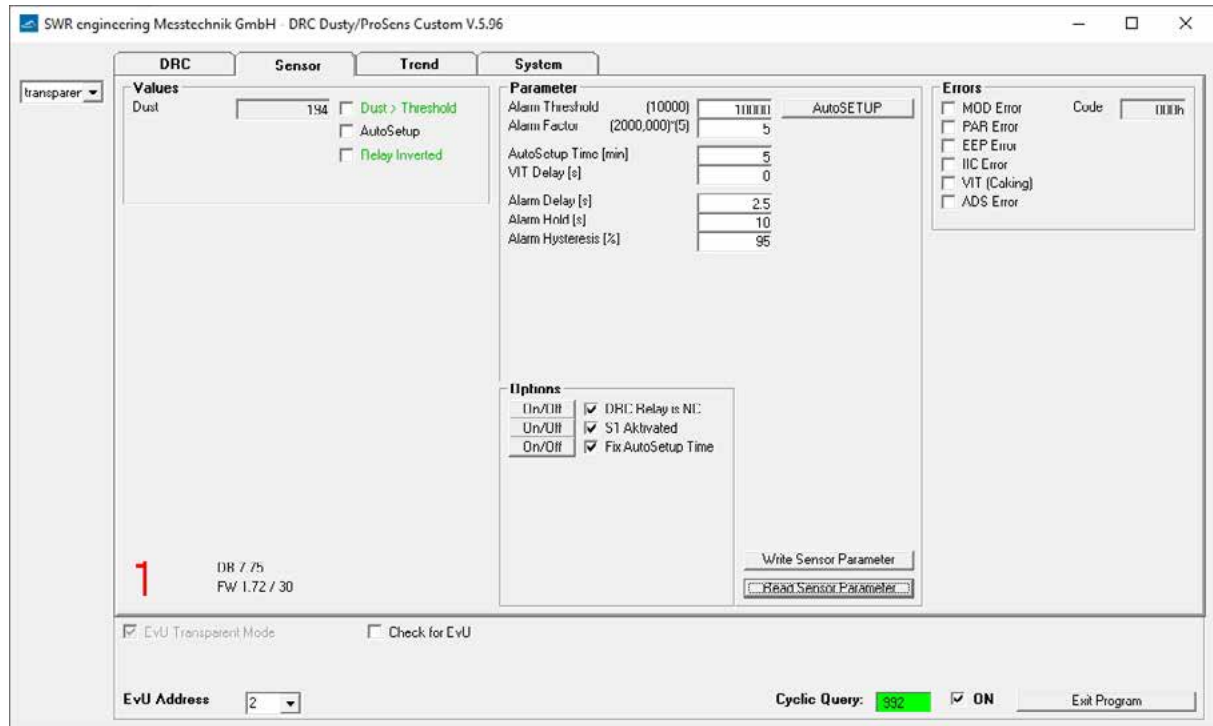




6.2 Sensor tab

Individual settings for the sensor can be made in the Sensor tab.

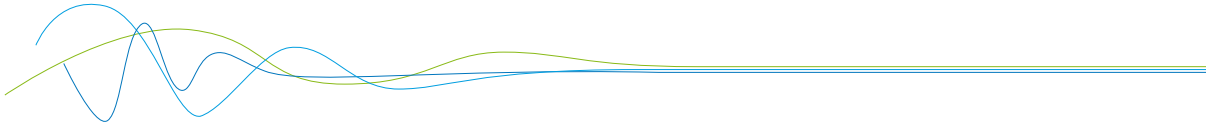
The measurements for the sensor (**Metering**) can be observed here and the basic parameters (**Parameter**) for the sensor can be set.



6.2.1 Basic parameters

Parameter	Standard value	Meaning
Sensor address	2	ModBus address
Alarm threshold	10000	Threshold for triggering the alarm
Alarm factor	5	Factor
AutoSetup time	5 min	Duration of AutoSetup
VIT delay [s]	12 s	Time from when the Vitality Error (coating formation on the measuring probe) is displayed
Alarm delay [s]	2.5	Time during which the alarm value must remain above or below the limit to trigger the alarm
Alarm holding time [s]	10	Minimum time during which the alarm must remain on even if the alarm threshold returns below/above the level in the meantime
Alarm hysteresis [%]	95	Threshold for resetting the alarm

Option		
I-R test	On/Off	Sensor outputs self-check
S1 activated	On/Off	Activate/disable test switch
Fixed AutoSetup time	On/Off	
REL INV (NO)	On/Off	Relay inversion



6.2.2 AutoSetup

"AutoSetup" starts a search of the alarm value:
the sensor searches for the signal level corresponding to the current dust load.
See section 5.3 for a detailed description.

6.2.3 Current output

First row	Current dust value
Second row	Dust value at 4 mA
Third row	Dust value at 20 mA
Cal. 4 mA	The 4 mA signal can be read-in via the functions.
Cal. 20 mA	The 20 mA signal can be read-in via the functions.

6.2.4 Sensor measurement data

- Dust: Measurement for the dust load
- ✓ Delta > TRH: Alarm threshold TRH exceeded
- ✓ Relay INVERT: Switch relay INV to ON so that the alarm output (flag and sensor relay) are inverted
- ✓ Auto Setup: AutoSetup has been initiated and is currently running

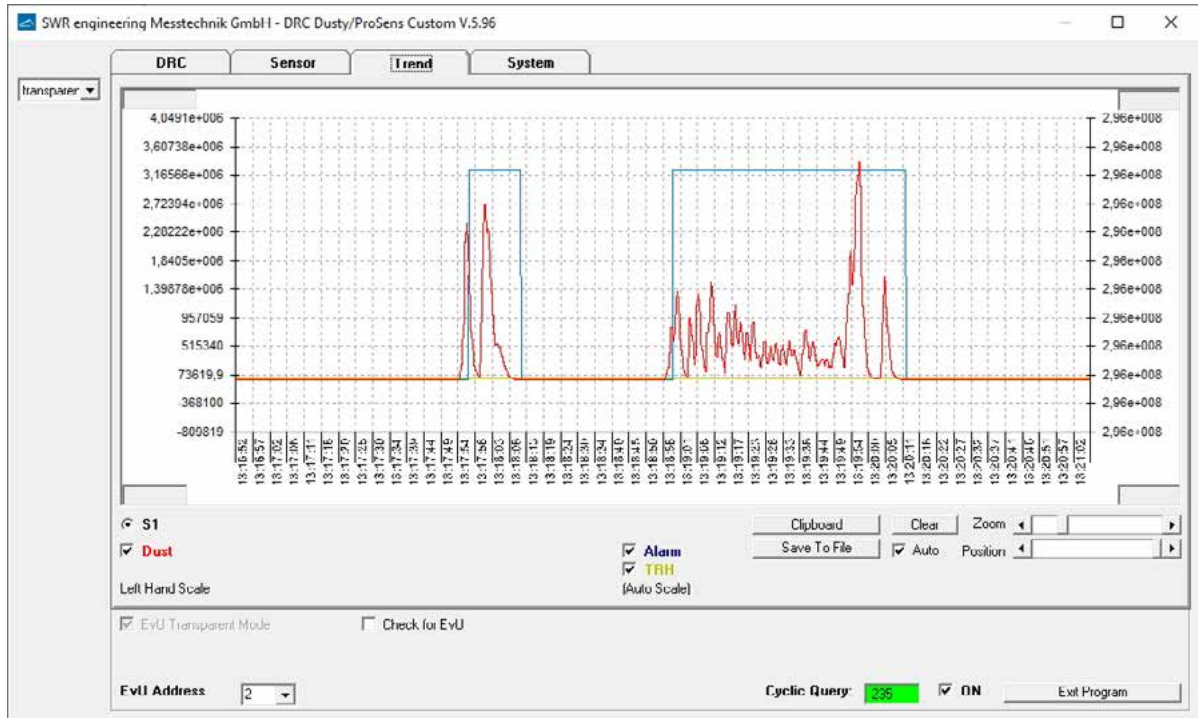
6.2.5 Internal sensor error

The "Error" indicator shows the results of function tests which run permanently during the system's runtime.

- ✓ MOD error: ModBus connection is defective
- ✓ PARA error: EPRM cannot be read/written
- ✓ EEP error: EEPROM supplying inconsistent data
- ✓ IIC error: IIC bus defect
- ✓ Vitality (coating): Restricted measurement range due to coating formation (conductive)
- ✓ ADS error: Incorrect internal timing

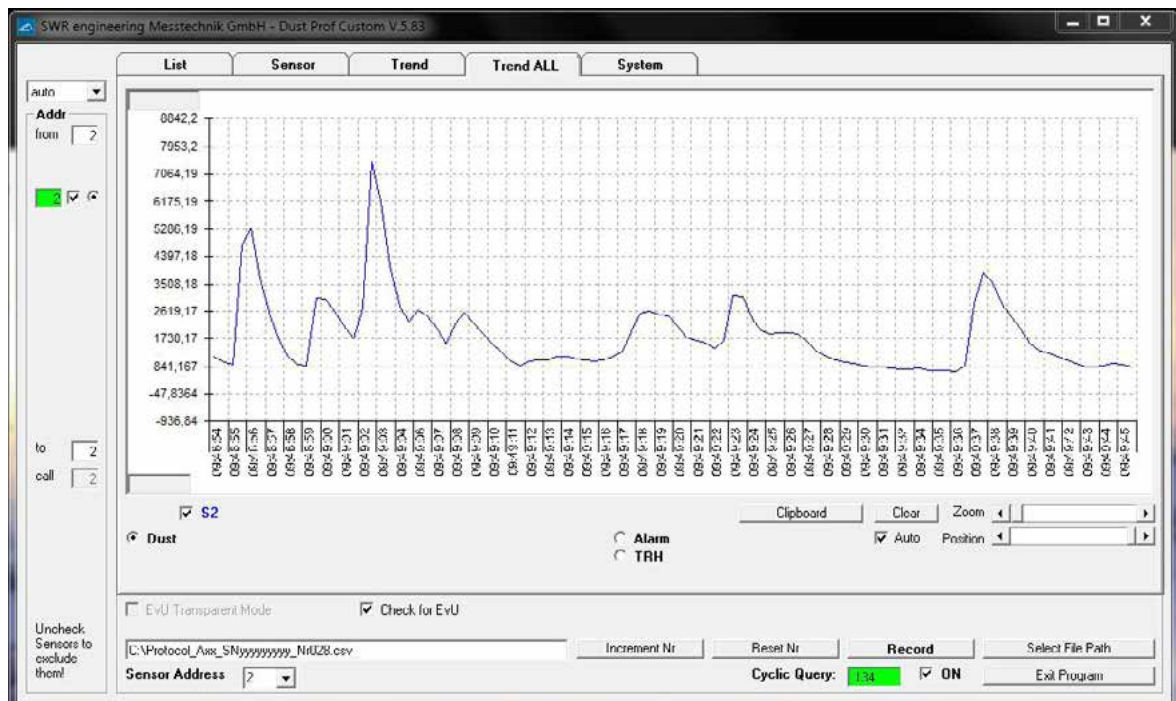
6.3 Trend tab

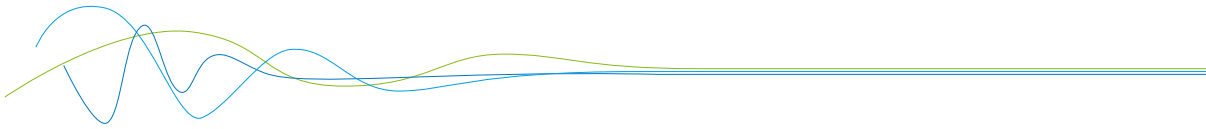
The sensor's measured values and calculation values can be observed here. The sensor's dust value is always scaled on the left while the switch threshold or relay output, for example, can be viewed on the right.



6.4 Trend all (Professional Software only)

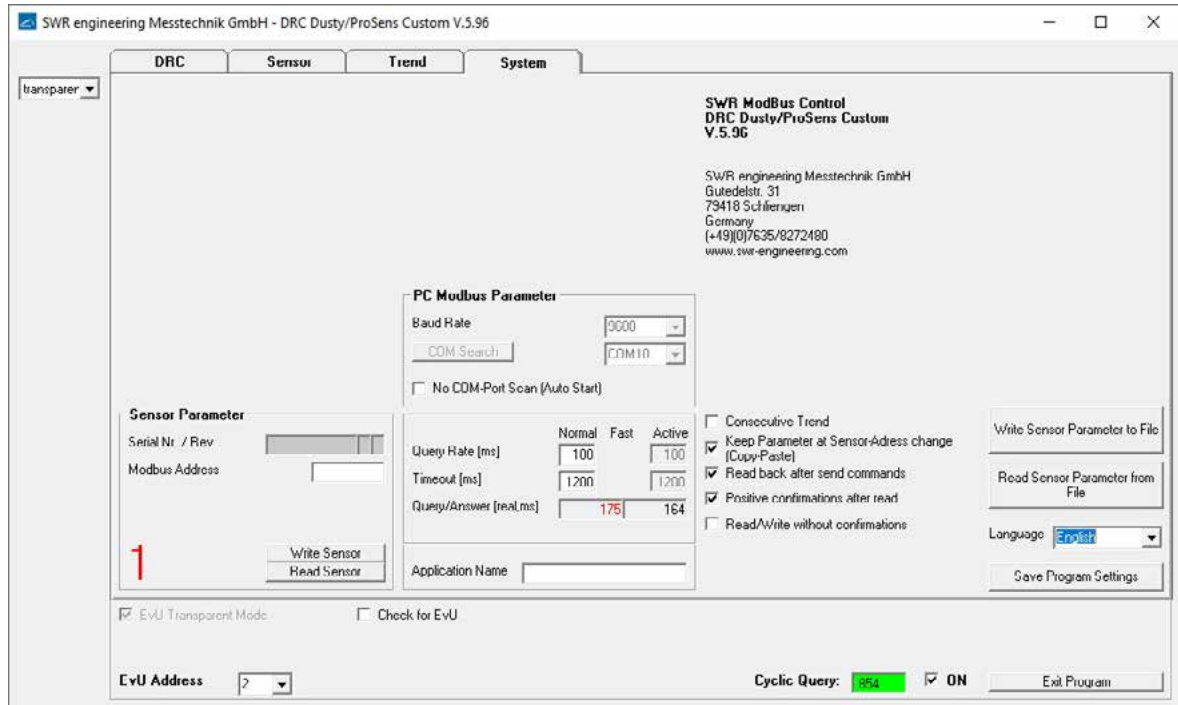
In trend all, all the individual sensors are displayed at the same time. The thin lines represent the individual values of the respective sensors. The middle value is shown as a thicker line:





6.5 Systems

This is where the COM port, Baud rate and sensor address are set:



6.5.1 PC mode parameter:

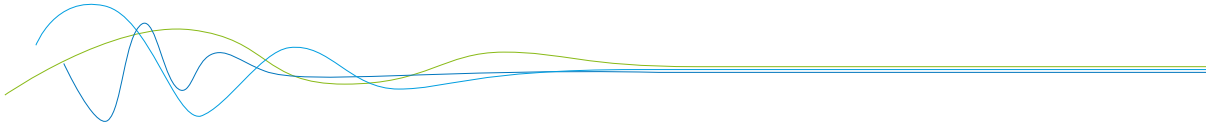
Baud rate: Standard 9600
COM port: Provided by PC

6.5.2 Sensor parameters:

Serial number: Sensor serial number
ModBus address: 2 (standard)

6.5.3 PC data logger (Professional Software only):

The PC data logger shows all sensor data in a CSV file.
This enables long-term data recording.



7. Maintenance

Maintenance work is restricted to removing the sensor from the process now and again and cleaning any accumulated particles off the probe and the insulation section using a cloth.

This is designed to prevent any accumulated material from forming a bridge with the earthed environment as this would have a significantly adverse effect on the measurement. The other aim is to prevent the probe from becoming encased with accumulated material.

If the particles tend to accumulate to a great extent, maintenance work should be carried out more frequently.

8. Troubleshooting

8.1 Output relay fails to switch or no signal on the current output

1. Check the power supply and the connection contacts.
2. Check whether the green LED in the sensor is flashing (no alarm) or the yellow LED is lit (alarm):
This indicates a problem with the relay contact.
3. Check whether the red LED is flashing during an active measurement: error code!!

If the sensor is still not giving a signal after these issues have been checked, contact our agents or ENVEA Process directly.

8.2 Measured value not displayed even after AutoSetup

1. Check whether the process is running normally and whether the conditions were normal during the AutoSetup procedure.
2. Check the flashing frequency of the green LED and the status of the yellow LED.
3. Check the power supply and cabling.
4. Check for bridge formation and short circuiting on the specimen probe.
 - Contact between probe and duct wall?
 - Bridge formation between probe and duct?
 - Casing formation around the probe due to condensate?

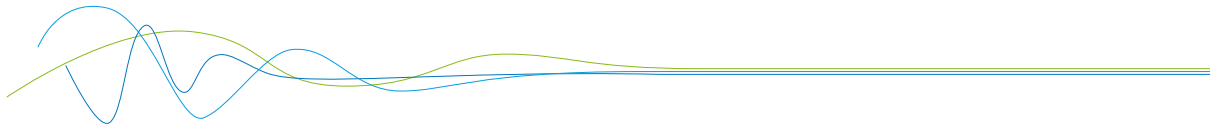
8.3 Relay switches every second or 2 mA indicated on current output

Coating formation

If the sensor detects the formation of a conductive coating between the specimen probe and the pipeline, it will signal this for the duration of the coating formation for at least one minute by switching the relay every second and indicating **2 mA** on the current output.

The devices comply with the following standard:

	Product standard – electrical equipment for measurement, testing and laboratory use, EMC requirement
	Reference standard EN 661326
	Year of publication (1997) Updates A1 (1998), A2 (2001), A3 (2003)



9. Technical data

Sensor	
Measurement objects	Solid particles in the gas flow
Measurement range	From 0.1 mg/m ³
Measurement range setup	Precalibrated
Process temperature	Max. 140 °C (optional 250 °C)
Ambient temperature	- 20 ... + 60 °C
Pressure	Max. 2 bar
Air velocity	Min. 2 m/s
Humidity	95 % RH (non-condensing)
Measurement principle	Electrodynamic
Damping time	1 s
Output signals	Current output, relay output, ModBus
Alarm steps	Measured value > alarm threshold
Sensor rod	Standard total length: 420 mm, HT 490 mm; Standard probe length: 260 mm
Enclosure	Aluminium
Using in Ex zones (Dusty C Ex)	Cat. 3 G/D (Zone 2 Gas / Zone 22 dust)
Protection category	IP65, Dusty Ex IP66
Power supply	24 ± 10 % V DC
Power consumption	2.5 W
Electrical connections	Integrated connection chamber
Cable (power + signal)	8-wire
Process connection	R 1/2" or TriClamp clamp connection
Weight	Approx. 0.7 kg
Connection terminals cable cross-section	0.2 – 2.5 mm ² [AWG 24-14]
Current output	4 ... 20 mA, load < 500 Ω (Active)
Switch output measurement alarm	Relay output NO (make contact)
Switch output error alarm	- max. 250 V AC at 1 A
Field bus communication	ModBus RTU (RS 485)
Data backup	Flash memory

