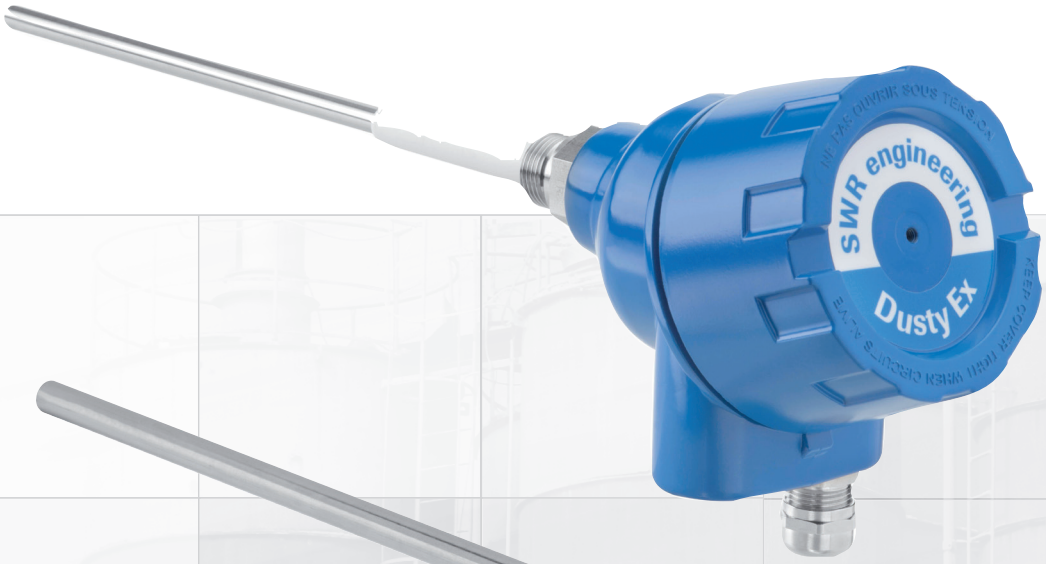
EN

Competence in Solids

SWR engineering

Dusty / Dusty Ex

Low-Cost
Broken Bag Detection



Operating Instructions

SWR engineering Messtechnik GmbH

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1. Introduction

1.1 Safety

Dusty requires 24 ±10 % V DC power supply. 24 ±10 % V DC voltage level is considered as safe.
DIN Rail Converter requires 24 ±10 % V DC power supply. 24 ±10 % V DC voltage level is considered as safe.

Precautions:
The duct has to be opened at the installation and the maintenance.
Thereby some risks have to be considered:

- The flow of gas or dust can be hazardous to health.
- The flow can be inflammable, explosive or toxic.
- The gas can be hot or under pressure.

1.2 Product Overview

The Dusty is a microprocessor-based, pre-adjusted device, equipped with 1 switch for setup, 1 relay output and 3 LED, viewable when the cover is open.

The Dusty is designed for filter bag leak detection. It is a compact unit consisting of sensor and control electronics built into an IP 65 enclosure, which has been specifically designed for easy installation and operation.

Pre-adjusted alert level is on 25 mg/m³ of organic dust material at 14 m/s air velocity. If the measure of dust is higher than this alert level the relay output will be switched.

LEDs on the sensor show the status of measure, alarm output and internal function status.

Easy „One Button User Interface“ allows to increase/decrease the alert level, to perform a AutoSetup and to restore factory setting.

Optional there is a DIN Rail Converter providing a 4 ... 20 mA trend signal and replacing the relay output. With the DIN Rail Converter there is a PC software to increase/decrease the alert level, to perform a AutoSetup and to restore factory setting.

Optional there is a PC software to change additional parameter (filter time, hold time etc.) of the sensor, to view signal trends and to write protocol files.

The Dusty is designed for applications at up to 2 bars and 140 °C.
As an option the system can also be used in Ex-areas of category 3 (gas + dust).

The device is connected to a 4 wire cable in its internal terminal box.

1.3 How does it work

The Dusty works with its proven and reliable tribo-electric technology whereby the interaction of dust particles with the sensor rod causes a small electric charge, when the particles pass or strike by the sensor rod.

This small electric charge generates a signal proportional to the dust level even if there is an accumulation of particles on the sensor rod. Experience has shown that this method of sensing dust level in gases offers accurate results with a minimum of maintenance.

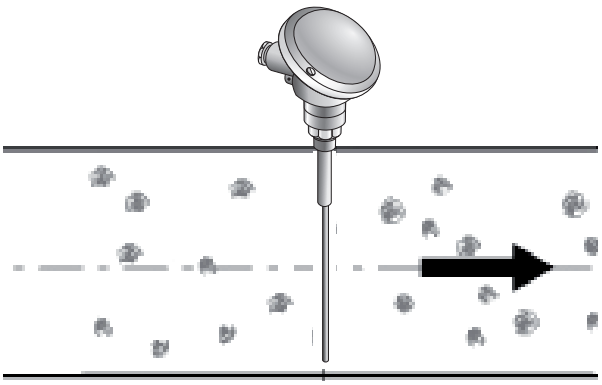
After start-up the sensor blinks on the LEDs for information purpose: the red LED blinks two times during system check, the orange LED blinks to inform about the actual factor of alert level (threshold).

Then the device starts to monitor the dust level and the green LED will blink with a frequency that shows the relation of actual measure against actual alert level: the lower the frequency the lower the measure.
If the measure goes higher the frequency goes faster, if the measure is equal or higher than the alert level the green LED stops blinking and the orange LED switches on. If the orange LED is switched on, the relay output is switched to indicate the alarm situation.
If the relay is used as “normally closed” (NC), the sensor is also monitored on power cut. Also any other fail will be alarmed via the relay.

With optional DIN Rail Converter the system provides a 4 ... 20 mA output as a trend of the dust load.
There is no need to maintain or set up the DIN Rail Converter and the output signal cannot be calibrated: a current of 4 mA means no dust in the duct, a current of 12 mA means that dust level is equal to alert level (switch-point of relay). Dust concentrations will be indicated linear up to 20 mA.

If there is an error found by internal system checks the output is set to 2 mA.

The relay output function of the sensor device is replaced by the DIN Rail Converter relay output due to alternative cabling between sensor and DIN Rail Converter.



2. Installation

2.1 Selecting the Installation Location

The best location for installation of the Dusty is in a duct section where the flow has its most even distribution and the flow is as laminar as possible.

The optimal position would be in a horizontal or vertical section of the duct. There have to be no bends, valves, dampers or other obstructions in a distance equal to a quintuple of the duct diameter in every direction of flow to the sensor rod. (See figure 1)

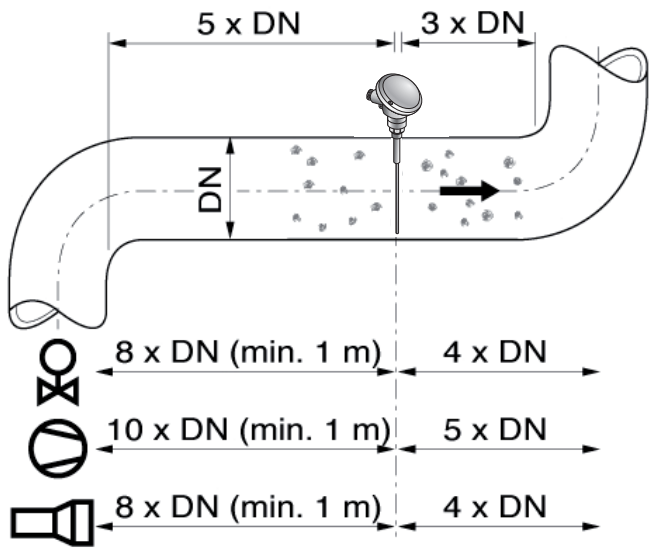


Fig. 1: Recommended distances to bends (DN = duct diameter)

In some applications a compromise has to be made and the sensor will have to be fitted in a position that satisfies the majority of above requirements.

The Dusty housing must be attached to metal ductwork so that they will be electrically shielded from interference and be provided with a good grounding. For non-metal ducts, a section of the duct, approx. five diameters in length, should be covered with a metal foil or fine-mesh on the periphery of the duct.

1. The unit shall be installed in a position, where the gas flow passes the sensor rod in a 90° angle.
2. In round cross-section ducts the unit can be installed in any position above the horizontal axis (between 9 and 3 o'clock). (See figure 2a)
3. For square cross-section ducts, the unit must be positioned in the middle of the top or in the middle of one of the sides. (See figure 2b)
4. Although the sensor is not affected by vibration, very high vibration levels should be avoided.
5. The units should not be installed in direct sunlight or in areas where the ambient temperature is above 60 °C.

6. The sensor rod must not contact the opposite duct wall or any other obstacle inside the duct!
   In cases of need the sensor rod can be shorten to a minimum length of 70 mm. Be careful not to damage the plastic cap by doing this.
   - The recommended length of the antenna is pipe diameter minus 10 mm. Certainly you have to insure that there will not come up any contact to the pipe, even there will grow any coating inside the pipe.
   - The minimum length of the antenna should be 1/3 of the pipe diameter.
   - A main rule is: the lower the dust concentration the longer the length of the antenna.
7. By monitoring a precipitator it is recommended to look for a sensor position behind the blower. If the sensor is to be used behind an electrostatic precipitator the distance to the precipitator should be a minimum of 20 m.
   Even so the sensor function is not affected due to vibration, the sensor should not be exposed to high vibration during a long time period.

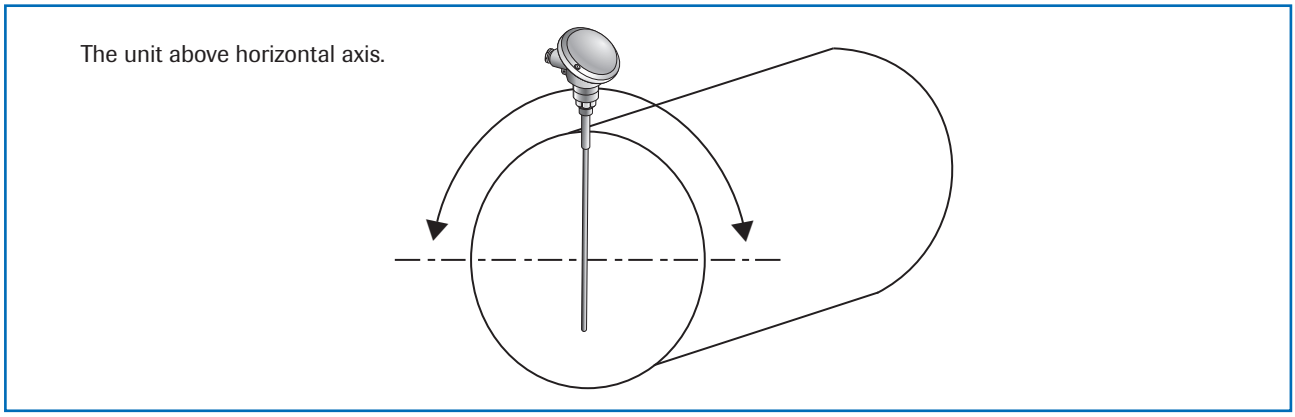


Fig. 2a: Round cross-section duct

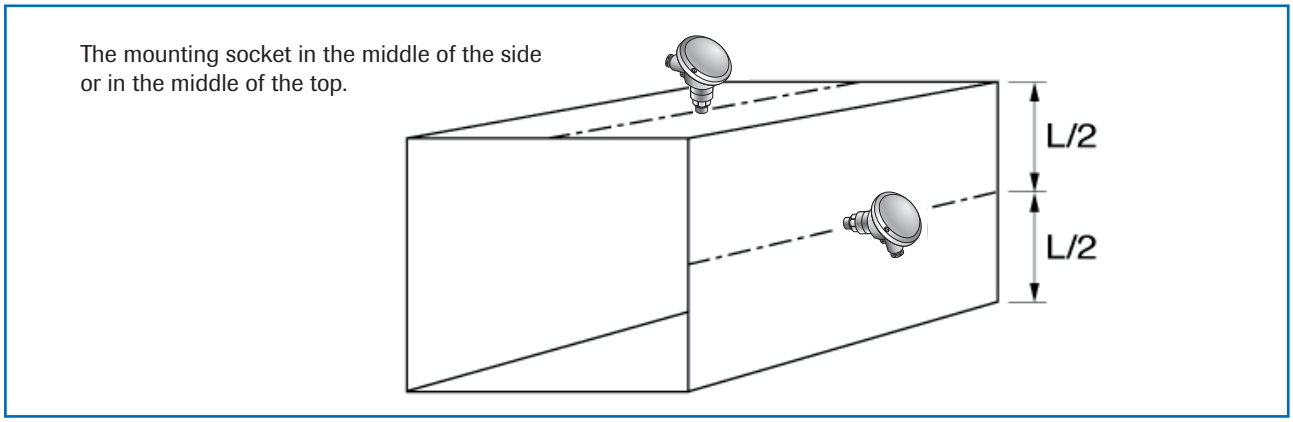


Fig. 2b: Square cross-section duct

2.2 Installing the Sensor

Once the location of the unit has been selected, the R 1/2" male thread is welded on the duct wall. Then the R 1/2" female thread is screwed in until there is a tight connection to the process.

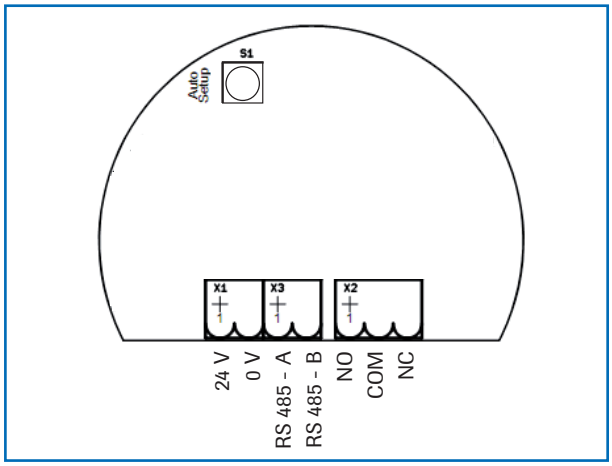
Caution:

Do not over tight the Dusty with the process, because it could cause damage to the sensor and electronics!

Do not open the hexagon socket screw to turn the head of the Dusty, because the cables could be torn off the board.

3. Electrical Connection

The Dusty is fit out with an internal wiring box, providing the plugs for different options:



Plug number	Signal name
1	V+ (24 V DC)
2	V- (0 V)
3	RS 485 - A
4	RS 485 - B
5	Relay NO
6	Relay C
7	Relay NC

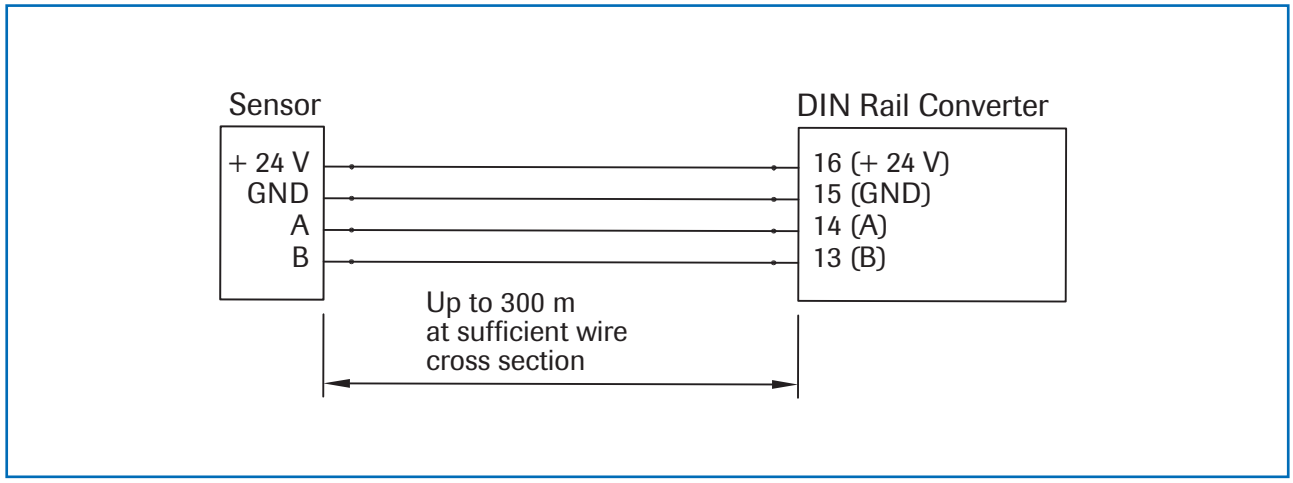
3.1 Dusty as Stand Alone Dust Switch

If used as a stand alone dust switch there are 4 wires to be installed.

Plug number	Dusty
1	V+ (24 V DC)
2	V- (0 V)
5	Relay NO
6	Relay C
7	Relay NC (alternative)

3.2 Dusty with DIN Rail Converter

If used with the DIN Rail Converter the 4 cable wiring can still be used but has to be altered on the plugs: If the DIN Rail Converter is used the relay output of the sensor is replaced by the relay output of the DIN Rail Converter.

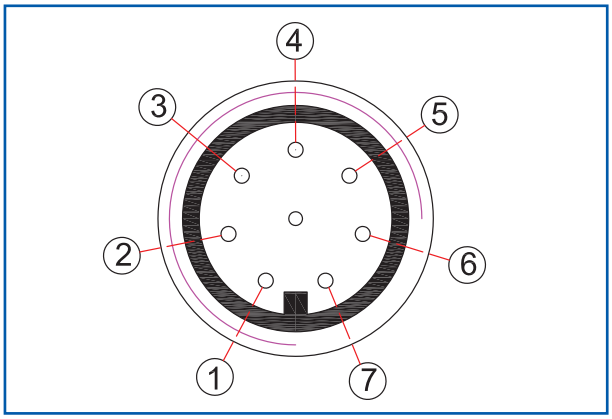


For long distances and noisy environment shielded cables and twisted pair wiring is recommended!

3.3 Dusty with M12 plug

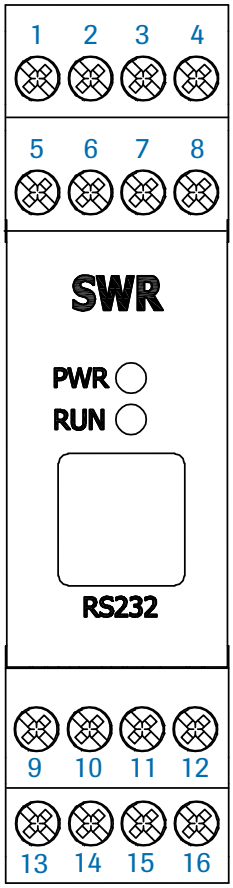
SWR Dusty with M12 plug / socket

Plug No.	Signal
1	V (+24 V DC)
2	V (0 V)
3	ModBus A
4	ModBus B
5	Relay NO
6	Relay COM
7	Relay NC



3.4 DIN Rail Converter

1 Current output - 4 ... 20 mA	**2** Current output + 4 ... 20 mA	**3** Input power supply 0 V DC	**4** Input power supply + 24 V DC
5 Not reserved	**6** Alarm relay NC (Opener)	**7** Alarm relay C	**8** Alarm relay NO (Closer)



9 Not reserved	**10** Not reserved	**11** RS 485- interface data B	**12** RS 485- interface data A
13 **Sensor connection** RS 485 Data B	**14** **Sensor connection** RS 485 Data A	**15** **Sensor connection** Power supply 0 V	**16** **Sensor connection** Power supply + 24 V

3.5 Use in Ex Hazardous Areas

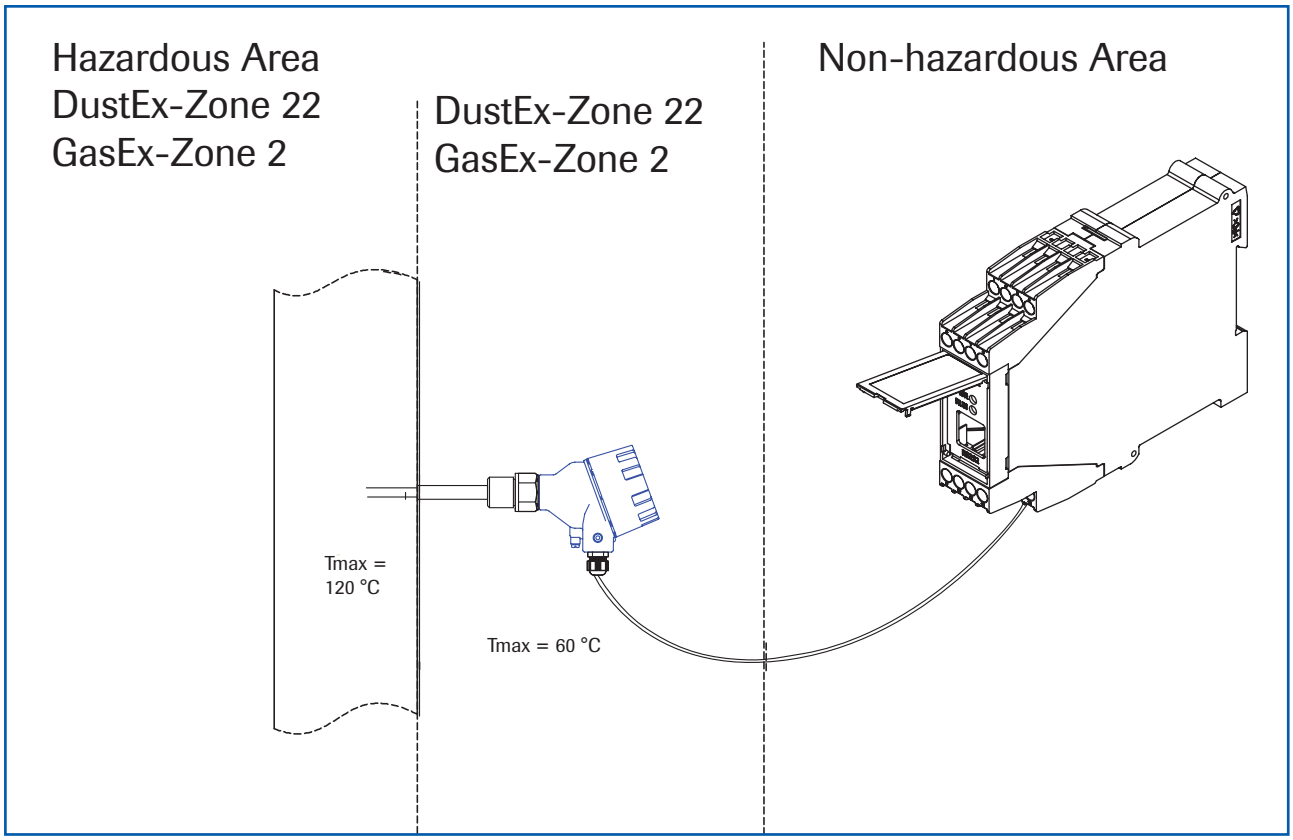
Marking DustEx: **II 3D Ex ia/tc IIIC 120 °C**

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

Marking GasEx: **II 3G Ex ia/d IIC T4**

The sensor is not allowed to be used in areas of class IIC, in case of expected, intense charging processes.

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



4. Dimensions

4.1 Sensor

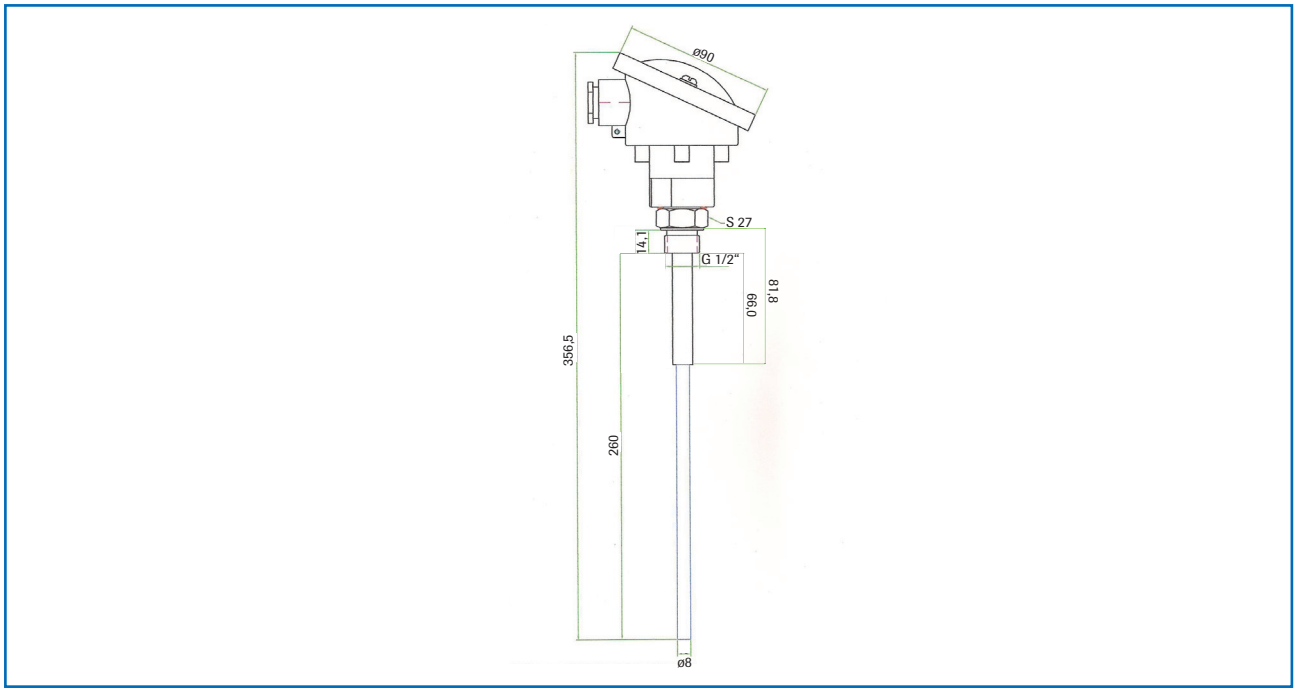


Fig. 3: Dimensions of Dusty

4.2 DIN Rail Converter

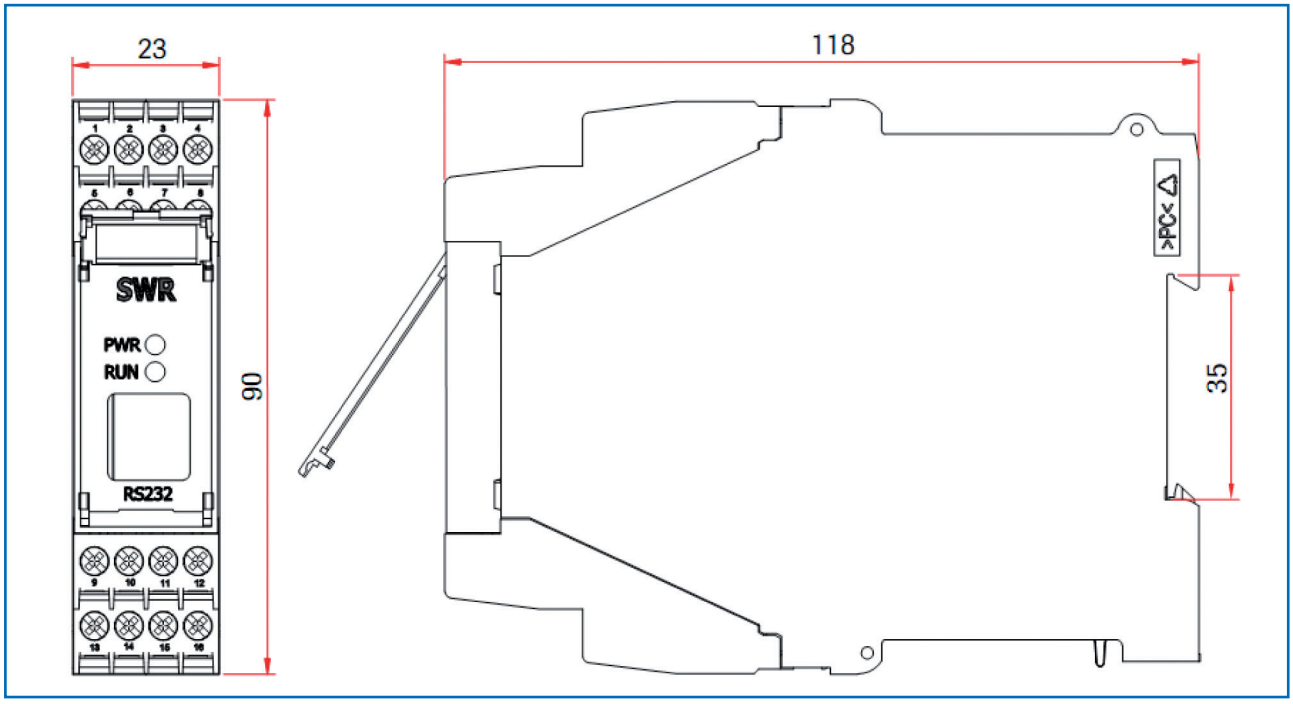


Fig. 4: Dimensions of DIN Rail Converter

5. Operation

The sensor measures the dust level in a gas flow by collecting tribo-electric energy by dust particles hitting or passing near by the probe.

After start-up the sensor blinks on the LEDs for information purpose: the red LED blinks to inform about the actual ModBus address, the orange LED blinks to inform about the actual factor of alert level and then the green LED starts to blink with a frequency that shows the relation of actual measure against actual threshold: the lower the frequency the lower the measure. If the measure is high the frequency goes faster, if the measure is equal or higher than the alert level the LED stops blinking.

Measuring levels higher than the alert level will be indicated by the yellow LED in ON status. The relay contact works as an alarm output. If the measured dust level is higher than the alert level, the relay is activated (accordingly to the yellow LED).

Blinking of the red LED indicates an internal error.

5.1 Alert Level

The alert level is factory pre-adjusted to a level of approx. 25 mg/m³ of organic dust material at 14 m/s of air velocity.

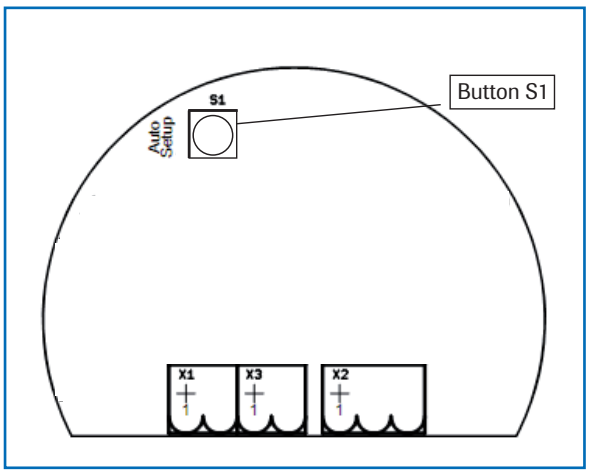
This switching level is measured at the factory dust channel and is no absolute level for customers dust amount.

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.

- An **internal measure value** is pre-calibrated to 5 mg/m³ in factory test duct
- A multiplier **factor** is pre-set to 5
- **Alert level** (threshold) is calculated with **[factor * internal measure value] = [5 * 5 mg/m³]**
- **Alert level** = 25 mg/m³
- Changing the **factor** to 4 means changing to **alert level = 4*5 mg/m³ = 20 mg/m³**
- Changing the **factor** to 10 means changing to **alert level = 10*5 mg /m³ = 50 mg/m³**
- Maximum **factor** is 30, maximum **alert level = 30*5 mg/m³ = 150 mg/m³**

Higher dust levels can be adjusted with AutoSetup function.

5.2 One Button Operation



Pressing the button S1 will start a sequence of command options by blinking patterns. To get the desired function just RELEASE the button while it blinks accordingly!

1. **Command sequence: Information only!**
   Release the button while all three LEDs are blinking up to 5 times in common: the red LED will blink out the sensors address and the yellow LED will blink accordingly to the actual factor.
2. **Command sequence: Setup of factor:**
   Release the button while only the yellow LED is blinking: the factor is increased/decreased to the count of blinks of the yellow LED. Count the blinks to set new multiplier factor (max. 30 times)
3. **Command sequence: AutoSetup!**
   After a countdown of all 3 LEDs the LEDs are blinking up to 5 times in common: release the button while blinking of the LEDs. Sensor will enter AutoSetup mode (see chapter 5.3 for details)
4. **Command sequence: Restore the factory setting:**
   After a second countdown of all 3 LEDs the LEDs are blinking up to 5 times in common again: release the button while blinking of the LEDs to restore the factory pre-set for alert level (threshold) and factor.

The LEDs will go to OFF status after the last sequence. No changes are made after the LEDs are OFF.

5.3 AutoSetup

To set an individual alert level you can use the AutoSetup procedure. AutoSetup will count the actual level of dust in the duct and will store this value as internal measure value multiplied by factor as the new alert level (see chapter 5.1 alert level).

To use AutoSetup procedure, make sure that the process is running with a normal dust flow rate. Ensure that the device is powered on for at least 10 minutes. Open the cover of the device and initiate AutoSetup by pressing the button and release it accordingly to the description in chapter 5.2.

The LEDs will flash consecutively and the sensor will look for peaks in the measurement value to keep the highest possible measurement value during the process of AutoSetup The highest peak will be the internal measure value that will be multiplied by the factor to calculate the new alert level.

AutoSetup procedure takes 5 minutes to be completed, the LEDs stops flashing, green LED goes back into blinking state to indicate that the device is ready to use again.

AutoSetup procedure can be cancelled by pressing the button S1 during AutoSetup procedure.
No changes will be made when AutoSetup is cancelled.

5.4 DIN Rail Converter

The DIN Rail Converter communicates with the sensor via digital bus line, so it needs to be wired in an alternative way.

If installed it takes the alert level value form the sensor as 12 mA point and zero as 4 mA point to calculate a linear function for the measure value. The measured value will be given as a current output value according to this linear function. So there is no need to set up any parameter on the DIN Rail Converter.

If the alert level is changed by changing the factor or by changing the alert value due to AutoSetup procedure the gradient of the function automatically will be adjusted.

The relay output of the DIN Rail Converter will show exactly the same behaviour as the relay output of the sensor.

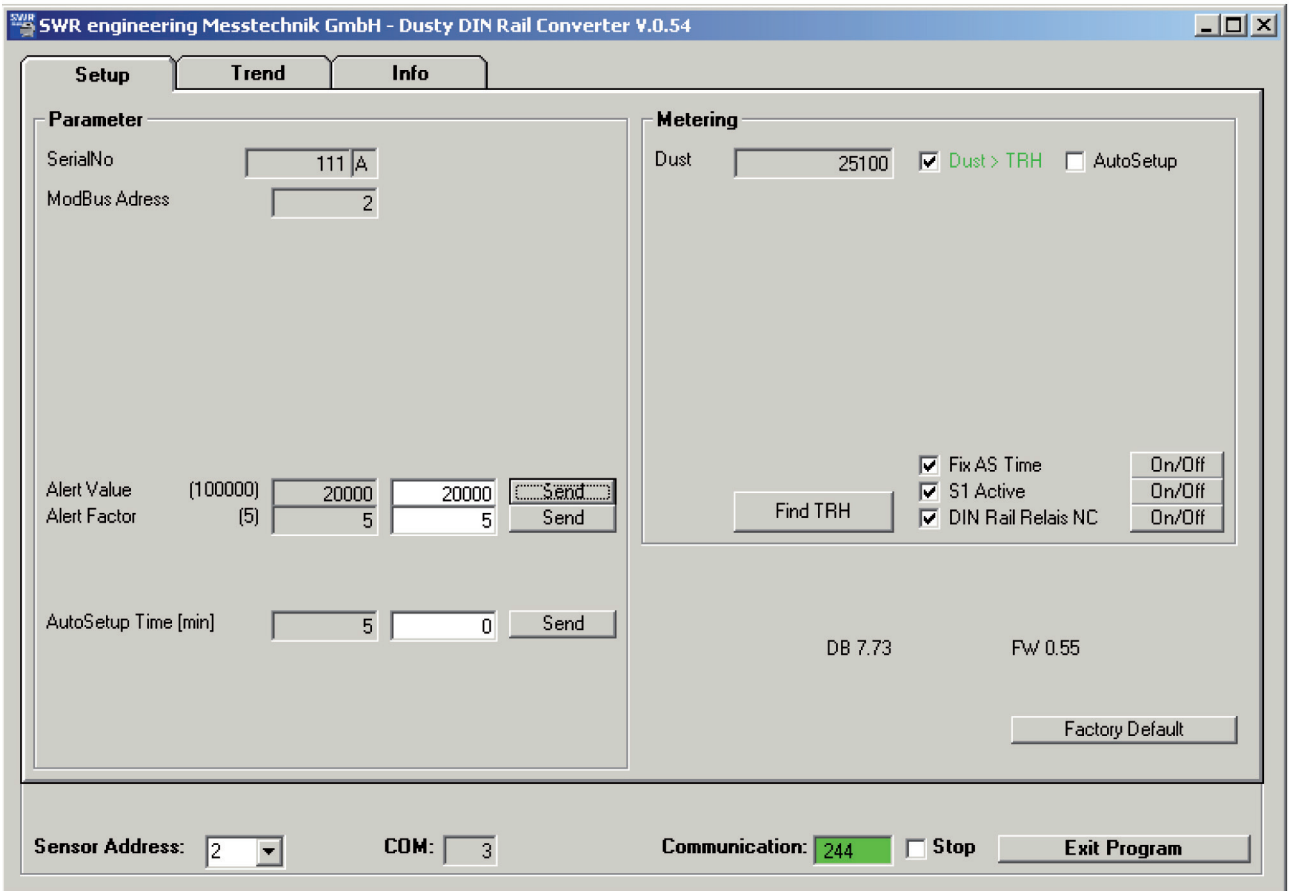
There is a simple software to use the DIN Rail Converter and its digital communication to the sensor to achieve a remote control to the sensor, e.g. if the sensor is in an inconveniently installation situation.

5.5 PC Software

If the DIN Rail Converter is used there is a PC Software to replace the access to the setup button and to set the function of the relay.

The software is easy to use and self explaining.

On the register card info you have to select your COM port (port numbers 1 to 10).



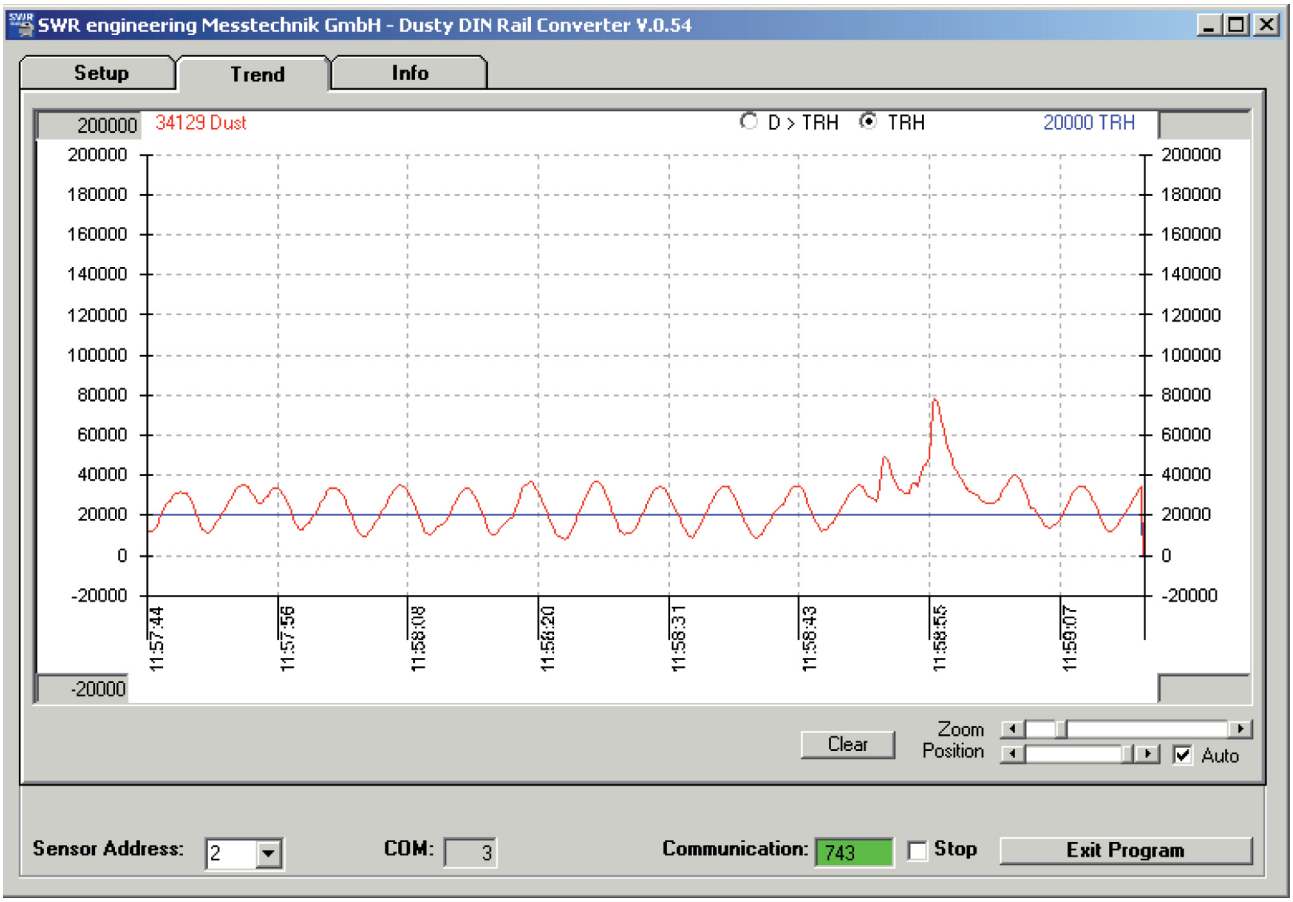
You can alter the alert value and the alert factor as well as the AutoSetup time by entering and sending new values. By doing this you will lose the factory settings, because values sent over serial communication will also be saved as factory defaults.

You can initiate an AutoSetup procedure by pressing the button „Find TRH".

You can choose the following options by pressing the appropriate "ON/OFF" button:

- **Fix AS Time:** if hooked the given AutoSetup time is used to measure the dust level during AutoSetup procedure. If un-hooked the AutoSetup procedure is extended by the given AutoSetup time if the measure of dust shows a peak higher than the last highest peak.
- **S1 Active:** if un-hooked the hardware button S1 on the device is de-activated. This is for security purpose to avoid unauthorised change on the device.
- **DIN Rail Relay NC:** if hooked the relay on the DIN Rail Converter is NC (normally closed), otherwise it is NO (normally open).

You can read out the serial number, the DB-version and the FW-version of the sensor as well as the actual measure value, the status of the alarm output (dust > TRH) and eventually running AutoSetup procedure.



In the trend window you can see the actual reading of dust level compared to threshold or the status of the alarm output.

6. Maintenance

For the maintenance the unit has to be removed from the process so that the sensor probe and the sensor insulation (white sleeve) can be cleaned.

Hereby it's possible to prevent deposit bridges between the sensor rod and the duct wall which could induce to a function failure or short-circuit.

If particles in the gas are sticky and tend to build up, the cleaning needs to be done more often.
Inside the enclosure maintenance is not needed.

7. Troubleshooting

7.1 No Switching of the Output Signals

1. Check the power and the connection of the contacts.
2. Check if green LED is blinking or orange LED is on: determines the relay stat!
3. Check if red LED is blinking more than one per second: count the flashes as error code!

If the sensor is not giving any output signals after the checks 1, 2 and 3, please contact:
our branch offices OR our distributors OR SWR engineering Messtechnik GmbH.

7.2 No Sensor Response after AutoSetup

1. Check if the normal process is going on and if there were normal operation conditions during the AutoSetup.
2. Check the blinking frequency of green LED.
3. Check if there is no short circuit
   - there is no contact between the sensor probe and the duct wall.
   - the gas is not condensing (because of build up).
   - the dust is not sticky: so there is no build up on the sensor base which could induce to a bridge between the sensor probe and the duct wall.

This instrument conforms to the following standards:

CE	Product standard - electrical equipment for measurement, control and laboratory use - EMC requirement
	Reference standard EN 61326
	Publication year (1997) amendment(s) A1 (1998), A2 (2001), A3 (2003)

8. Technical Data

Sensor	
Measurement objects	Solid particles in a gas flow
Particle size	0.3 µm or larger
Measurement range	From 0.1 mg/m³
Range setup	Pre-adjusted and automatic
Process temperature	Max. 140 °C
Ambient temperature	- 20 ... + 60 °C
Pressure	Max. 2 bar
Gas velocity	Min. 4 m/s
Humidity	95 % RH (non-condensing)
Measurement principle	Tribo-electricity (electrostatic detection)
Damping time	1 s
Output signals	1 relay output (NO / NC)
Alarm settings	Alert - dust level > threshold
Sensor rod	Total length: 260 mm, length of stainless steel rod: approx. 194 mm
Enclosure	Aluminium
Using in Ex-zones	Cat. 3 G/D (zone 2 gas / zone 22 dust)
Protection category	IP 65
Power supply	24 ± 10 % V DC
Power consumption	1 W
Electrical connections	Internal connection box
Cable (power + signal)	4 wires
Process connection	G 1/2" male thread
Weight	Approx. 0.7 kg
DIN Rail Converter	
Power Supply	24 ± 10 % V DC
Power consumption	5 W / 24 VA
Protection category	IP 40 according to EN 60529
Operating temperature	-10 ... + 45 °C
Dimensions	22,55 x 90 x 118,8 (W x H x D)
Weight	Approx. 350 g
Cable cross section	0.2 - 2.5 mm² [AWG 24-14]
Current output signal	4 ... 20 mA, load < 500 Ω
Alarm output Error output	Relay with toggle switch - max. 250 V AC, 1 A
Digital interface	ModBus (RS 485)
Data protection	Flash memory

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