

## **Agenda**

### **Greenbank MF 3000 flow meter for dry solids**

1. Applications of our mass flow measurement system
2. How does it work?
3. What is unique about it?
4. Tips for Installation
5. Benefits
6. Detailed Features and Functions
7. Options
8. Technical data
9. References (*see separate presentation*)

# Typical applications of our inline mass flow measurement system



Our mass flow measurement system

- is used to continuously measure the mass flow in **metallic pipelines**
- is a unique concept working **without weighting, without movable mechanical parts, maintenance-free** and **easy to retrofit** to existing lines.



# Typical applications of our inline mass flow measurement system



## - Typical applications:

- Dosing of material in a pipeline (dilute phase pneumatic conveying or freefall)
- Measure mass flow into or out of a storage bin
- Monitor the flow of bulk material (e.g. after a screener or to supervise airlocks)

## - Materials:

- All dust, powder, granulates, pellets, threads etc., also abrasive materials
- Grain size: best experience with approx. 1 nm – 20 mm

## - Typical industries:

- |                      |                      |                      |
|----------------------|----------------------|----------------------|
| - Aluminum and Steel | - Coal processing    | - Pigment production |
| - Animal feed        | - Detergent industry | - Plastic industry   |
| - Automotive         | - Fertilizer         | - Power plants       |
| - Building materials | - Food industry      | - Recycling          |
| - Cement industry    | - Glass production   | - Rubber goods       |
| - Ceramics industry  | - Metal production   | - Textiles industry  |
| - Chemical industry  | - Pharmaceutical     | - Tobacco industry   |

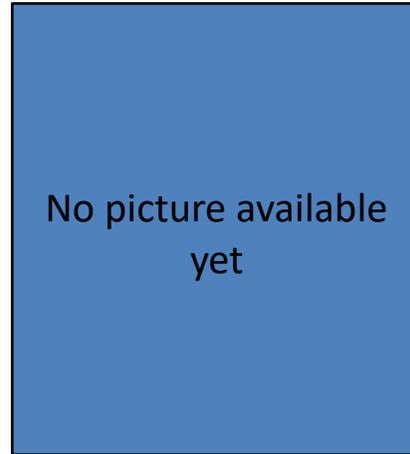
# Typical applications of our inline mass flow measurement system



Lime / Calcium carbonite



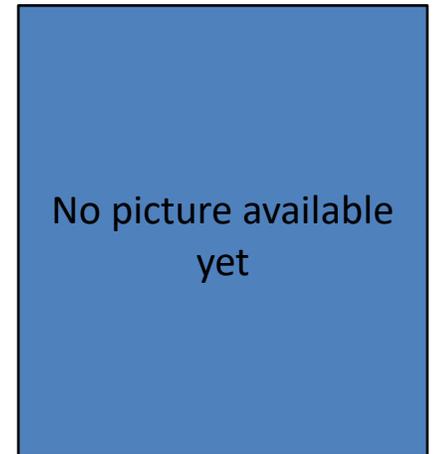
Lime and absorber  
(in flue gas cleaning)



Kaolin / clay



Plastic granulate /  
pellets / powder



Carbon Fiber



Mineral Wool



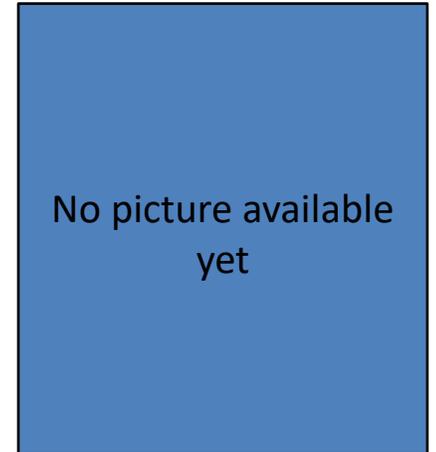
Fertilizer / Urea



Iron-II-Sulfate



Chrome IV  
(e.g. in cement production)



Sodium Chloride

# Typical applications of our inline mass flow measurement system



Coal dust for furnace & burner  
(e.g. for power stations, steel)



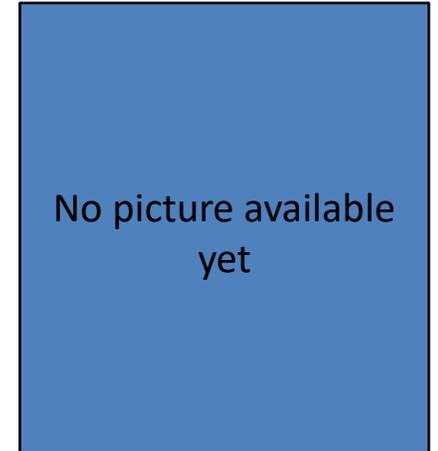
Coal dust for furnace & burner  
(e.g. for plaster, asphalt)



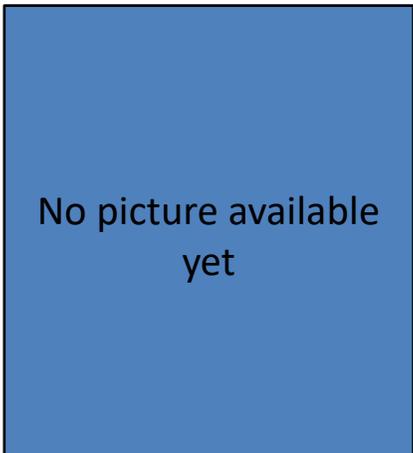
Wood dust for burner  
(e.g. in chipboard production)



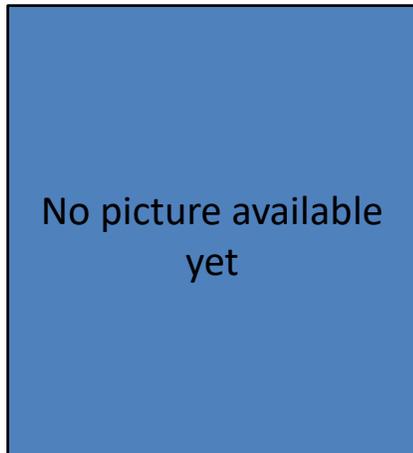
Jet Medium  
(e.g. sandblasting)



Pigments



Crushed corn



Starch



Soybean flour

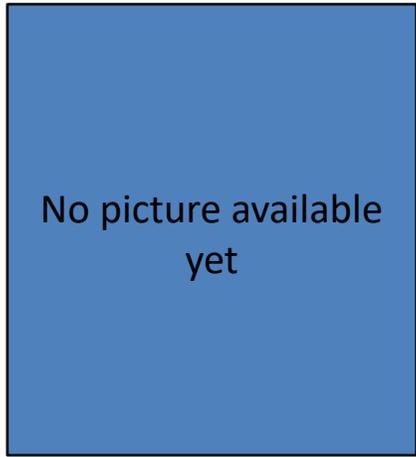


Oatmeal

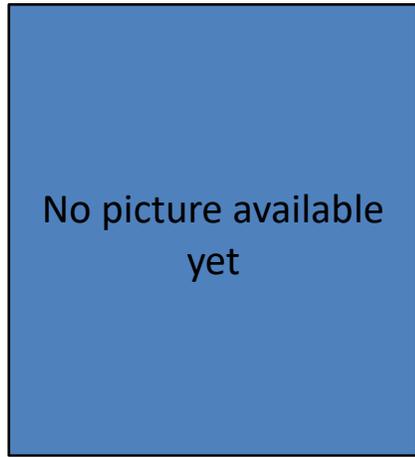


Wheat meal

# Typical applications of our inline mass flow measurement system



Cereal



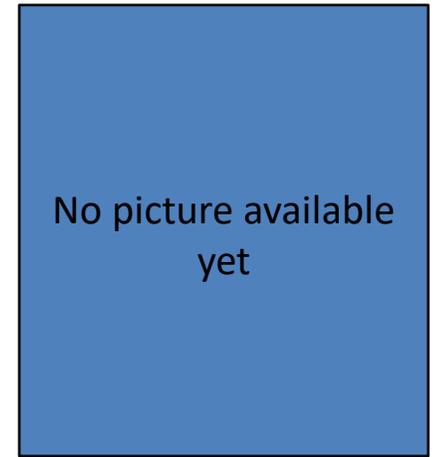
Salt



Sugar dust



Tobacco



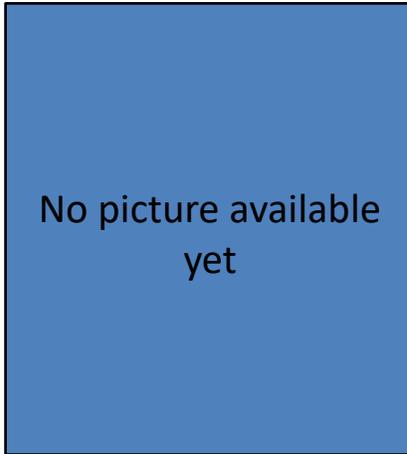
Cellulose



Alumina Oxide  
(e.g. for air cleaning)



Silica



Lithium

# References (MF 3000)



DAIMLER

HEIDELBERGCEMENT

HITACHI



ROCKWOOL®

RWE



TEPCO



# MF 3000



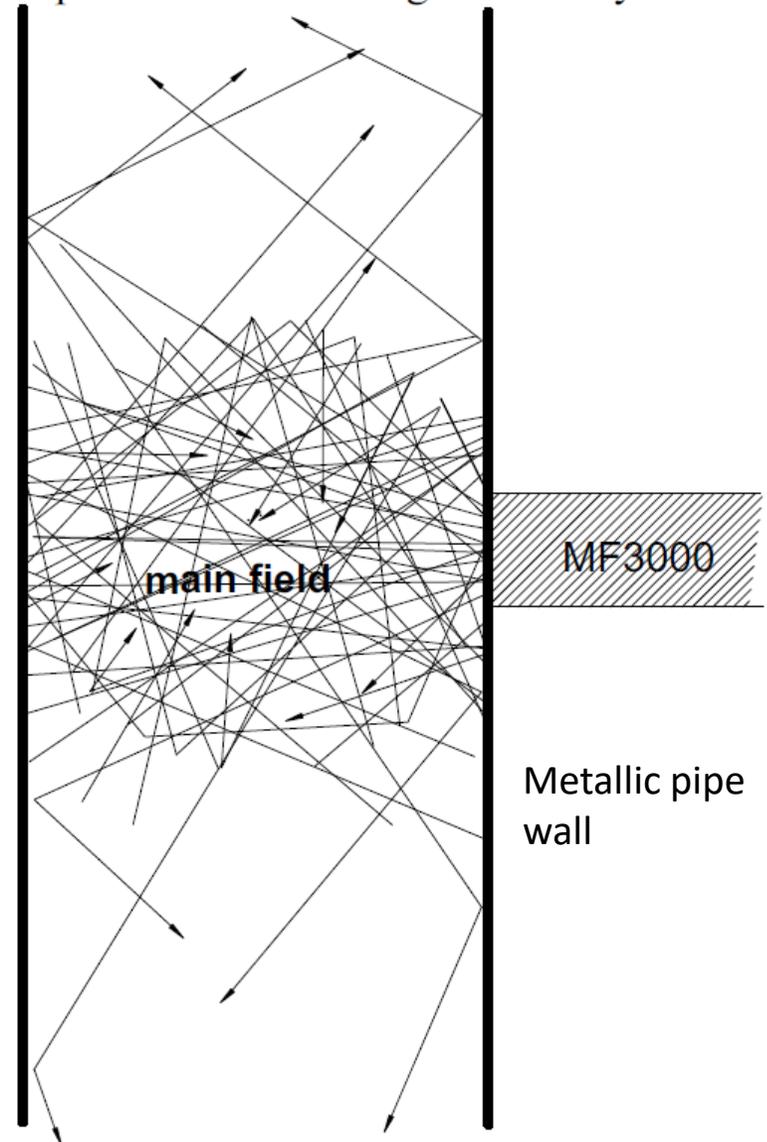
*MFS sensor and MFI transmitter*

## MF 3000 – How does it work?



- Based on the physical Doppler effect
- The sensor generates a uniform **field of microwaves** inside the pipe
- These microwaves are being reflected by the particles passing through the pipe
- This leads to a change in frequency and amplitude of the field, which is proportional to the speed and size of the solids
- The reflected signals will be measured and used as basis for the calculation of the solid substance quantity
- Non-moving particles like dust accumulation are excluded from the calculation

*Common microwave field generated by a MF 3000 in a metallic pipeline*

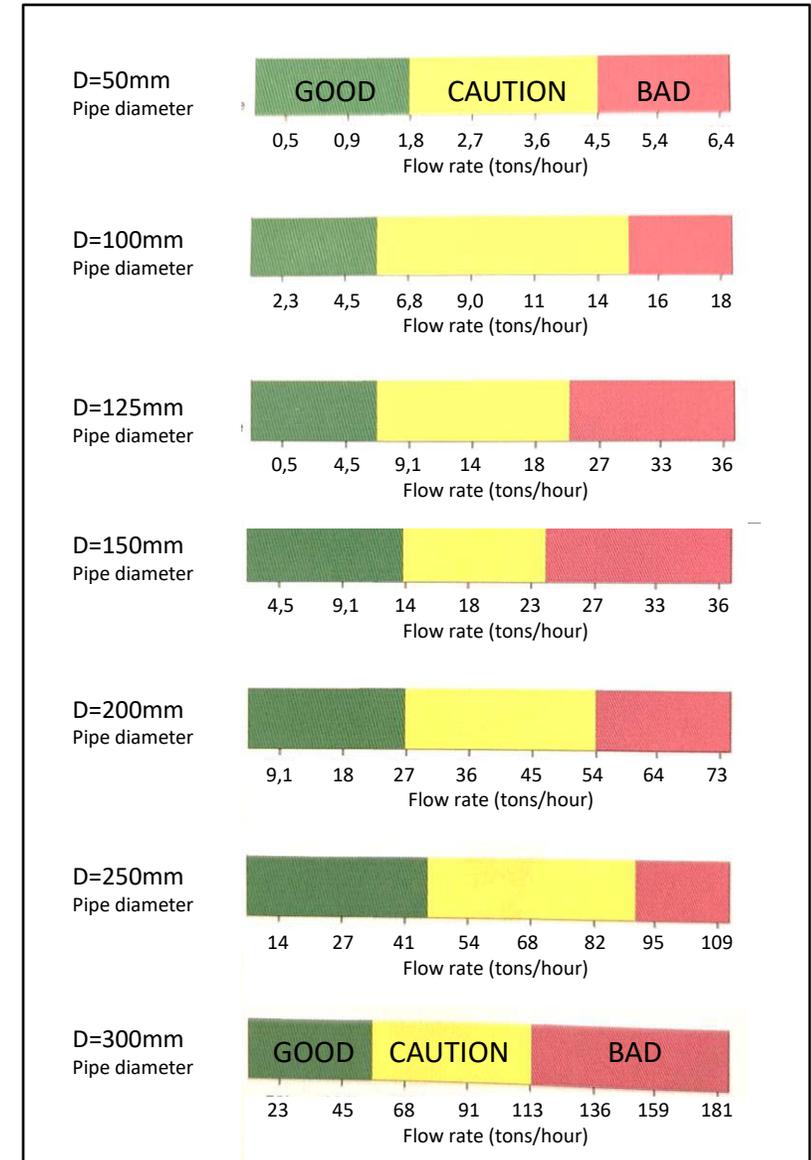


# MF 3000 – How does it work?



- The measurement principle requires a **metallic pipeline** (or metallic support structure) to reflect the microwaves
- **Pipe diameter can be up to 300 mm**, depending on flow rate (see chart at the right as first indication)
- The measurement is **not impacted by changes of temperature, moisture or static charge**
- **Changes in velocity of the conveyed material, particle size, bulk density, di-electrical constant and moisture content can affect the measurement**

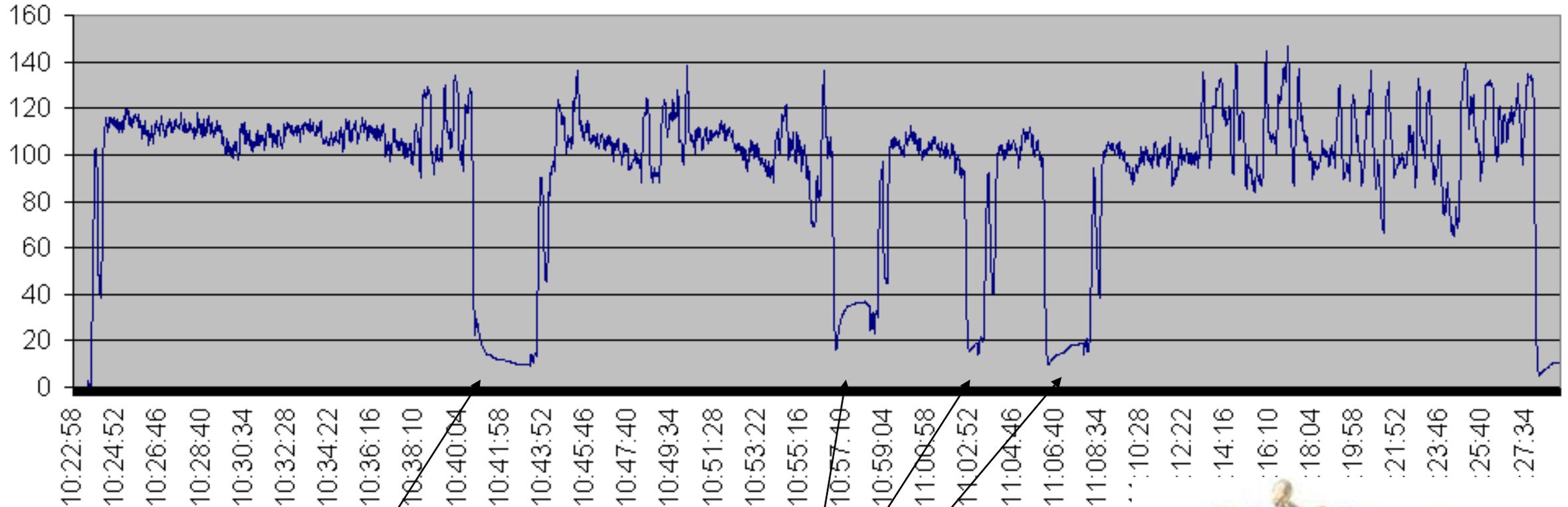
*First indication of measurable flow rates at different pipe diameter (green = good, yellow = handle with caution, red = difficult). Please note the different scales.*



# MF 3000 – How does it work?



- Sample measurement of sunflower seeds



Production stop

Production stop



# MF 3000 – What is unique about it?



Unique system to **measure mass flow** – nearly **contact-free**, **without moving parts** and **maintenance-free**

**Very robust design** out of stainless steel with encapsulated electronic and IP65 rating

**Simple, quick and inexpensive installation** into existing production lines

For **all kind of pneumatic conveyances and freefall processes** (with  $D \leq 300\text{mm}$ )

For **all kinds of bulk material** ranging from  $\sim 1 \text{ kg/h}$  up to  $\sim 100\text{t/h}$ , depending on pipe diameter

**Sensor surface** out of PA 6.6, Teflon or ceramic for normal material, food, abrasive or aggressive products



Several options available, e.g. 1.4307 or 1.4571 steel, high temperature versions for  $150$  or  $450^\circ\text{C}$ , ATEX / Ex in zone 20/21 or zone 2

# MF 3000 – What is unique about it?



**Analog output** (4-20mA; 0-10V),  
**pulse output**, max / min or sensor  
**alarm relay**, **RS 485** interface and  
**RS 232** for programming

Can be **connected with a PLC**  
using **RS 485 Modbus** interface

**Calibration** with 2 to 10 points  
per curve

Transmitter can be placed **up to 1000 m**  
**away from the sensor**

Up to **24 calibration**  
**data sets** savable

**Easy to install**, just click it  
into the **DIN rail** and connect  
the cables to the sensor,  
voltage supply and **PLC**

**User-friendly software**  
to calibrate the sensor



*MF1 transmitter*

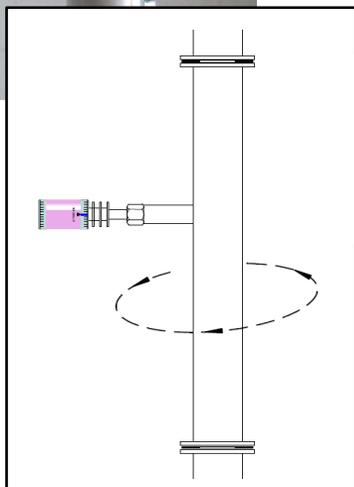
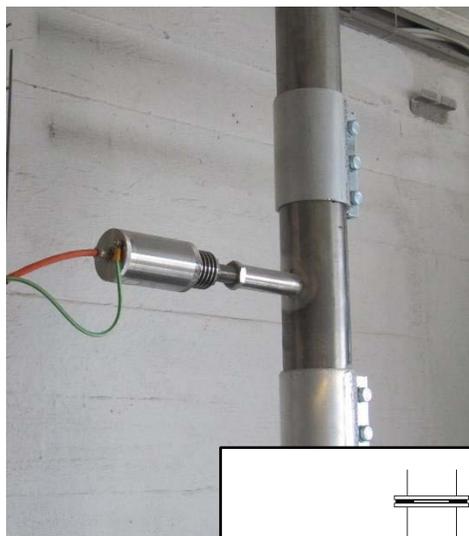
## MF 3000 – What is unique about it?



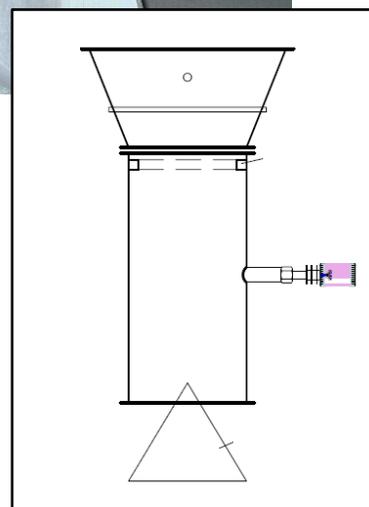
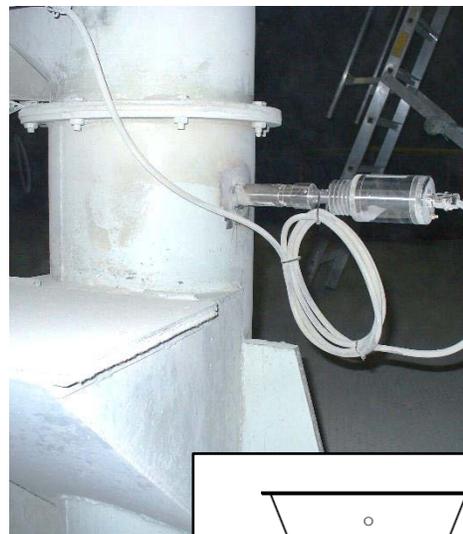
- Every single MF 3000 sensor is **tested over several hours**
- A **burn-in test** is executed **at rising temperatures** (from 10 to 70°C), and the measurement results compared with the expected results
- This allows to adjust each sensor individually and **ensure a minimum spread and consistent quality**

# Tips for installation

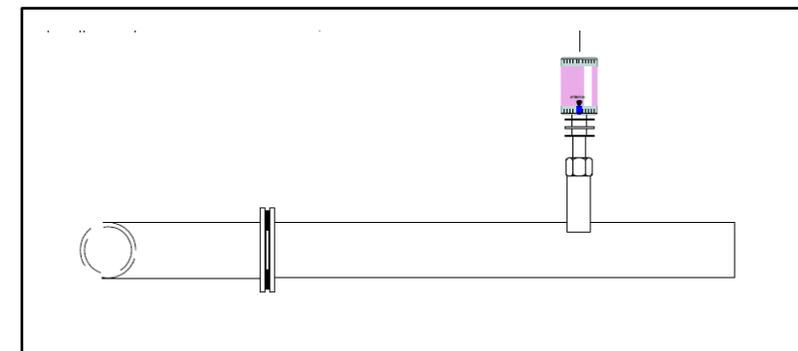
**Vertical pneumatical pipeline**  
(preferred installation with upward flow direction)



**Freefall / Gravity pipeline**  
(2<sup>nd</sup> best installation)



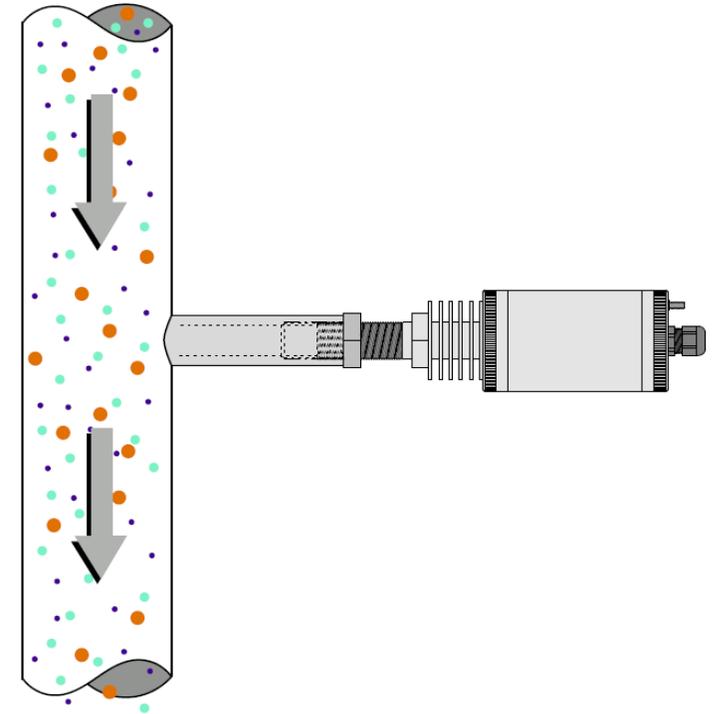
**Horizontal pneumatical pipeline**  
(depending on application)



## Tips for installation



- Identify the position where **particles are airborne** (fully suspended in a stream of air) and **most evenly distributed**
- Installation is easy: A branch is welded onto the pipe. An 18 mm hole is drilled, the sensor is **mounted flush with the inner diameter of the pipe** (mark length before)
- Keep a **distance to bends** (in: 6xD, out: 4xD), **blowers / valves** (in: 10xD, out: 6xD), **branches** (in: 8xD, out: 5xD) and **tapers** (in: 10xD, out: 6xD)
- Install the MF 3000 in a **rotatable pipe section** to find the position where the material flows most constantly (roping!)



## Tips for installation



- Add **anti-streaming rods, disc deflectors and pole crosses** to support uniform distribution of the particles in the stream
- Ensure the following factors are constant or multiple calibrations are taken: **velocity, particle size, di-electrical constant and bulk density**
- **Commissioning is** done in-situ by calibrating on three different flow conditions: no flow, minimum flow, maximum flow.
- **Reference data for calibration** needs to be captured by
  - weighting the conveyed material over a known time or by
  - emptying a known quantity (e.g. silo, vehicle) and measuring the required time or by
  - deriving the volume information from a theoretical flow rate of the conveying system
- **Buildup of residual material** on sensor surface can dampen the measurement over time and should be under control
- **Vibrations** can make measurement impossible

## Benefits of using our inline mass flow measurement system



- **Inline mass flow measurement** – without complicated, expensive weighting
- **Simple, quick and inexpensive installation** into existing production lines
- Nearly **contact-free measurement**
- **Measurement does not impact the material**, as it is a flush installation without additional fittings in the material flow
- **Without moving parts and maintenance-free**
- **Robust design for a long lifetime**
- **High resistance to abrasion**



# Benefits of using our inline mass flow measurement system



- **Reliable** measurement results – even after years of operation
- **Buildup of dust and material** in the pipeline does not affect the measurement, neither do **temperature or moisture changes** \*
- **Flexible to use**, for small to large flows, all kind of material, small to medium-sized pipes, low to high temperature etc.

For several applications the MF 3000 is the only way to measure the mass flow **inline and contact-free**. It allows **precise dosing** of material, **reducing material consumption** and ensuring **consistent product quality**



*\* Buildup of material on sensor surface can dampen the measurement over the time and has to be controlled*

# Questions before installation



## Questionnaire for applications with flow meter MF3000

- 1) Which material shall be measured?
- 2) Are material type and material consistence constant?  
If not: Quantity of different products:
- 3) What is the size of grain/particle of medium (in mm)?
- 4) Which is the temperature of medium? Is the temperature of medium constant?  yes  no
- 5) Which contents of moisture does the medium have? Is it still constant?  yes  no
- 6) Do we have to expect any abrasion by the material?  no abrasion  little  high
- 7) Do we have to expect sediments of material at the pipe?  no  little  high
- 8) Which kind of conveying?  
 freefall  
 pneumatic (vacuum)  
 pneumatic (compressed air)
- 9) At pneumatic conveying: Conveyed as:  Dilute phase  plug  dense phase  
What is the level of pressure?  
Which speed („v“ in m/s) is expected?
- 10) Is it a continuous conveying line?  yes  no  
If not: How long takes the batch?
- 11) What is the nominal diameter of the tube?
- 12) What is the length of the tube?
- 13) What kind of material has the pipe?  stainless steel  steel  other:
- 14) Is it possible to rotate the measuring section?  yes  no
- 15) What kind of process device is before the sensor?
- 16) What kind of process device is after the sensor?
- 17) Which is the ambient temperature?
- 18) Is ambient temperature still constant?  yes  no
- 19) Which mass flow (mass/time e.g. kg/h) is reached / expected?
- 20) Which accuracy is necessary / expected?
- 21) Is an execution in EEx needed? Gas-EX (Zone 2) | | Dust-EX (Zone 20) | | no
- 22) For the calibration process: Is it possible to get reference values?  
 No  Truck load  BigBag - filling  Scale  others:
- 23) What is the aim of measurement / which advantages will be caused by measurement?

# Connectivity



## MF 3000 (without local user interface)



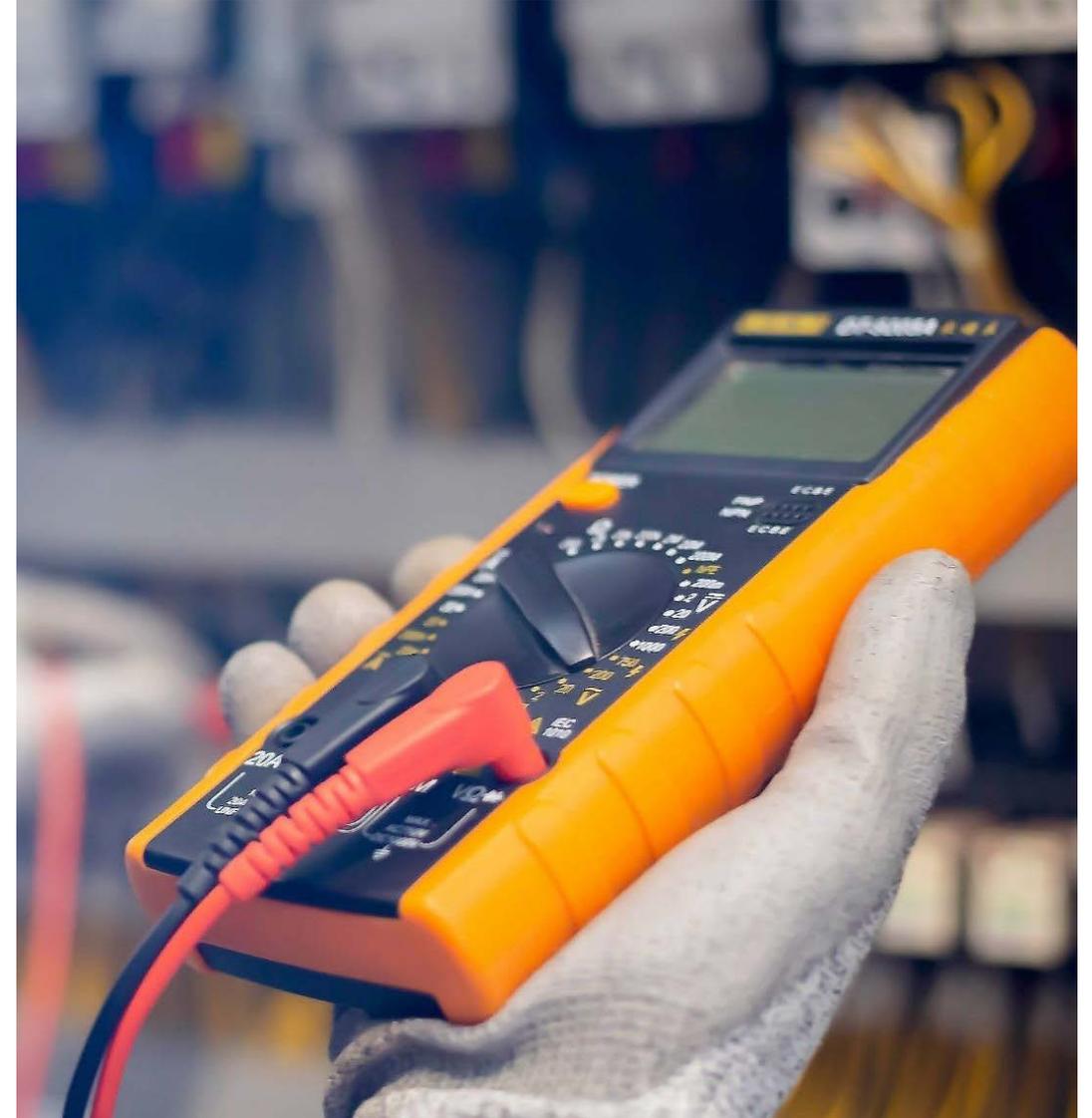
## SCS 3000 (as local user interface)



## Connectivity



- MF 3000 is connected with the PLC with a **4-20mA / 0-10V signal** or **RS485 Modbus**
- With the Modbus connection the PLC has **access on all data and settings**
- Separate **pulse output** for counting and separate configurable **alarm signal**
- **RS232** interface for PC connection for setup and programming



# Different surfaces and materials



- Choice of **sensor surface** – fits for every purpose:
  - PA: standard
  - Ceramic: for abrasive products and food (Non ATEX only)
  - Teflon: for chemical aggressive products
- Sensor housing made out of stainless steel 1,4307 or optionally 1.4571
- Ceramic material tested regarding food compliance

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 ul. Techniczna 1,  
36-040 BOGUCHWAŁA  
tel. +48 17 87 11 700, +48 17 87 20 273 Dział Marketingu +48 17 87 20 175,  
fax: +48 17 87 11 277, e-mail: [cerel@cerel.pl](mailto:cerel@cerel.pl) [www.cerel.pl](http://www.cerel.pl)

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**Quality Certificate**

Numer: \_\_\_\_\_ Data: \_\_\_\_\_  
Number: **257/2020** Date: **06.11.2020r.**

Zamawiający: **MÜTEC INSTRUMENTS**  
Client: \_\_\_\_\_

Nr zamówienia: \_\_\_\_\_ z dnia: \_\_\_\_\_ nb T.: ZAW/02/0388/20  
Order number: **E/2010389** date: 14.10.2020

Nazwa wyrobu wg rys. techn.: **Krażek/Ceramic Plug MF 3000 HT**  
Product name: \_\_\_\_\_

**Badania/Control:**

Liczność partii: \_\_\_\_\_ Liczba próbek poddanych badaniom: \_\_\_\_\_  
Lot size: **50 pieces** Number of the samples: **5 p. AC=0, RE=1**

1/ oględziny/ visual  
 2/ sprawdzenie wymiarów/dimension  
 3/ sprawdzenie masy/mass  
 4/ próba na nagłe zmiany temperatury/ thermal shock  
 5/ próba wytrzymałości mechanicznej/ mechanical strength  
 6/ próba nasiąkliwości/ wettability  
 7/ próba penetracji / Penetration test/

Na podstawie przeprowadzonych badań kontrolno-odbiorczych stwierdza się zgodność wyrobu z wymaganiami Klienta.  
On the basis of the control tests carried out, the product is in compliance with the customer's requirements.

We declare that the ceramic plugs MF3000HT are made out of the nontoxic material and are not harmful to the environment. There is no objection for contact with food."

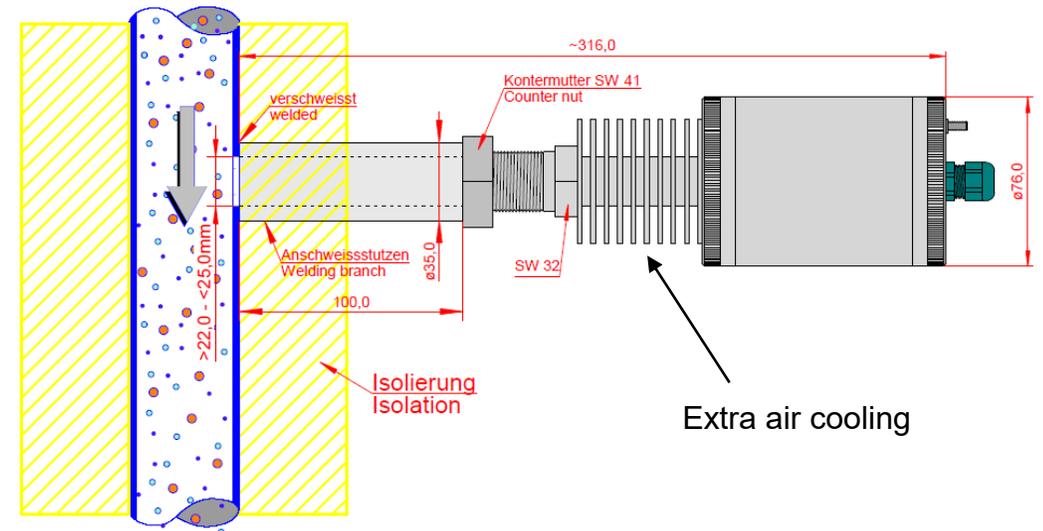
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NORMY STOSOWANE /Applied standards/  
PN-EN 60672-3:2002  
PN-ISO 2859-1:2003

KONTROLER JAKOŚCI  
*Zbigniew Błak*  
mgr inż. Zbigniew Błak

# Solutions for high process temperatures

- The MF 3000 can **cope well with high temperatures**
- At normal ambient temperature C the measured material can have
  - -20° up to 80° (PA 6.6, ATEX) or 90° (PA 6.6, Non ATEX)
  - -20° up to 100° (Teflon, ATEX) or 120° (Teflon, Non ATEX)
  - -20° up to 150° (HT 150 = Ceramic, glued housing, Non ATEX) \*
  - -20° up to 450° (HT 450 = Ceramic, larger air cooling element, Non ATEX) \*
- **450° high temperature version** requires a larger welding flange (M27 instead of M22; WB35 G/ V2A / MF 3000 HT 450 (E40443)), see picture on the right



\* Pressure is limited to 2 bar (HT 150) respective 1 bar (HT 450)

# ATEX / Ex solutions



- MF 3000 in **dusty or gas atmosphere**

Process temperature: max 80°C (PA) or 100°C (Teflon)

Max pressure: 1,1 bar



Hazardous area up to Zone 20/21 or Zone 2:  
Specially selected and tested **MFS sensor**



Non-hazardous area:  
Standard **MFI transmitter**

## Fixtures for installation



Welding flange WB 30  
G/ ST52 (V21003)

with screw thread, made of stainless steel ST 52

Welding flange WB 30  
G/ V2A (V21002)

with screw thread, made of stainless steel 1.4307 (SST 306)

Welding flange WB 30  
G/ V4A(V21009)

with screw thread, made of stainless steel 1.4571 (SST 316)

Welding flange WB 35  
G/ V2A / MF 3000 HAT  
450 (E40443)

with screw thread, for high temperature version 450°C, made of stainless steel 1.4307

Welding flange WB 30  
with ball valve / V2A  
(V21026)

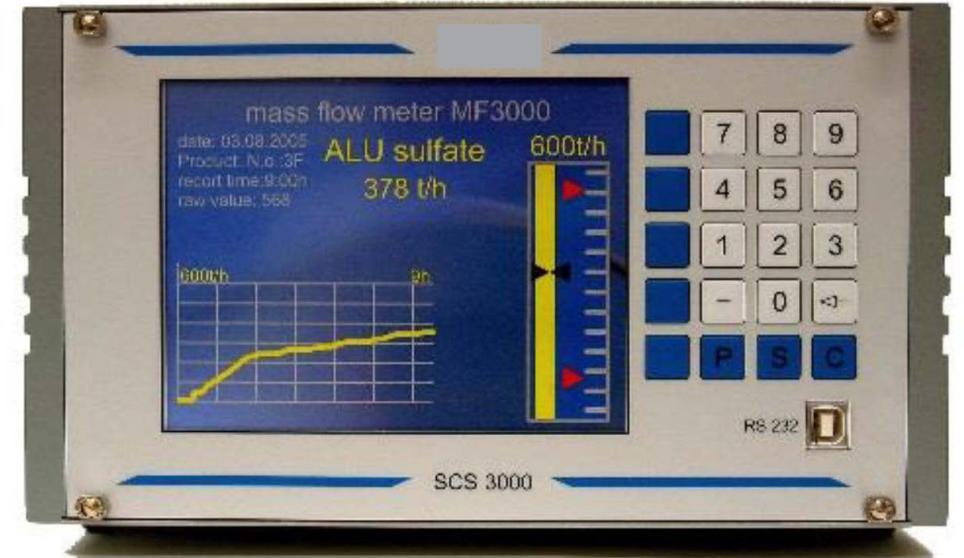
with screw thread, with ball valve, made of stainless steel 1.4307



## SCS 3000 for local display and interface



- SCS 3000 interface, allows to operate one MF 3000 sensor independent from PLC with a local control unit
- Multiple options available:
  - Table housing TG
  - Field housing FG 42
  - Panel mount housing SG



## Cables



USB / USB-mini cable  
(for MFI 3000) (E10199)

for adjustment of the MF 3000,  
adapts from USB mini to USB A

DRS 232 Interface cable  
(for SCS 3000) (xxxxx)

adapts from SCS 3000 -specific connector to RS232

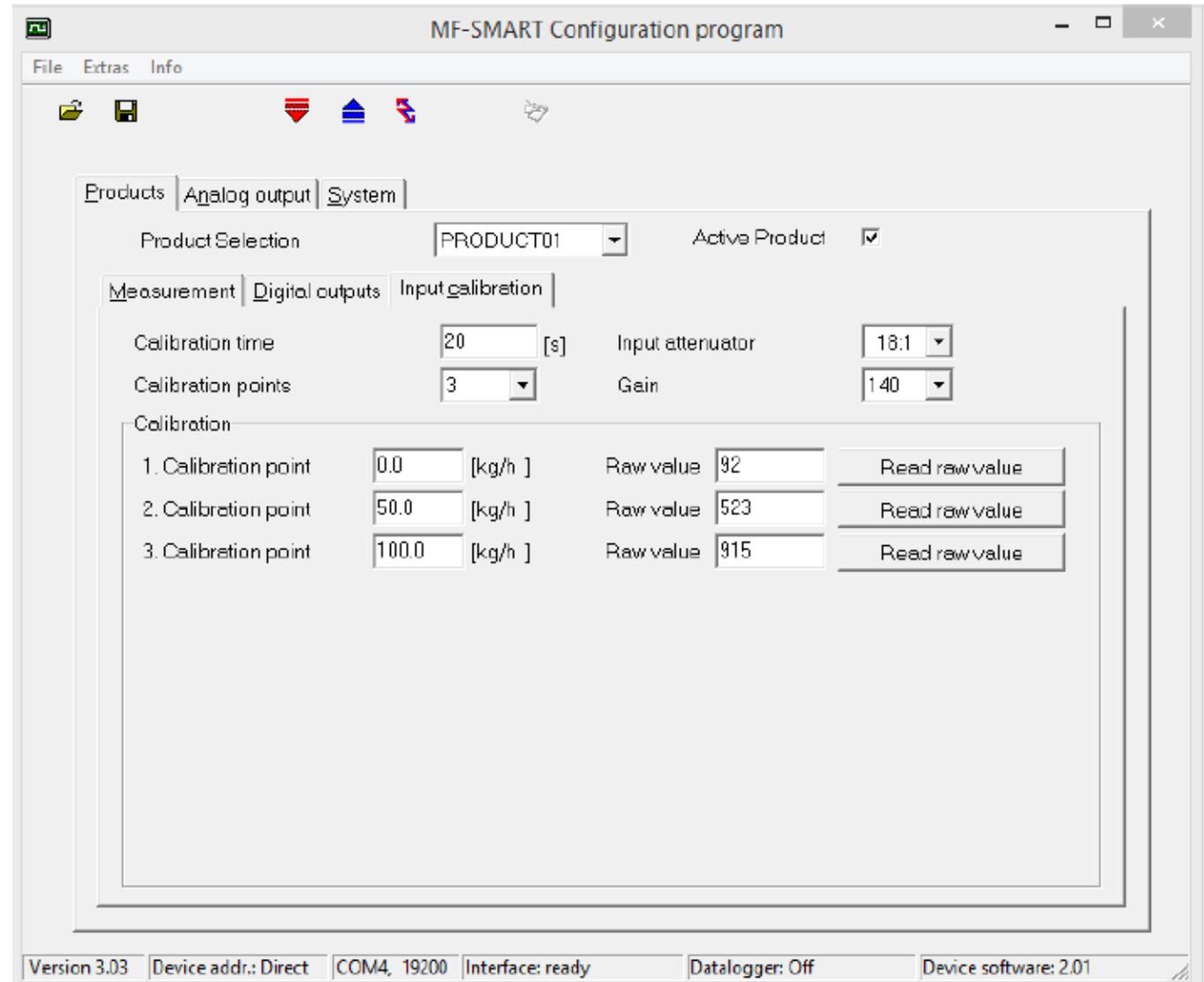
USB-RS232 adapter (E10002)  
(for SCS 3000)

adapts from RS 232 to USB 2.0

# MF Smart Software – to configure MF 3000

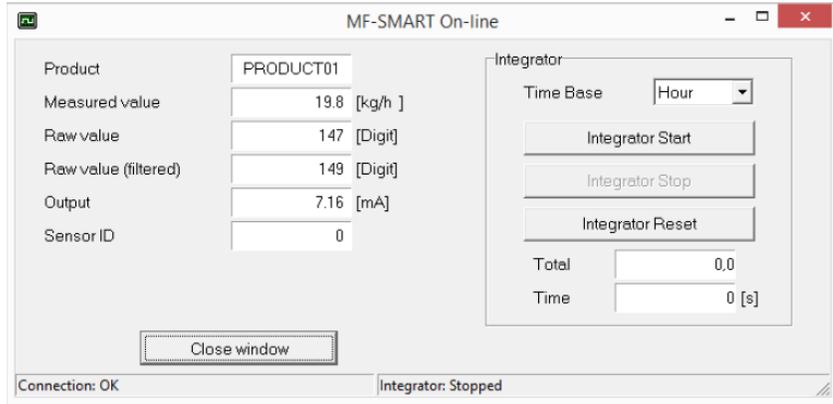


- **Easy to use** Windows software to configure the MF 3000 and calibrate the products / bulk material
- **Calibrate with 2-10 calibration points**
- **24 data sets** for different products savable
- **Set alarm value**
- **Setup input and output channels**

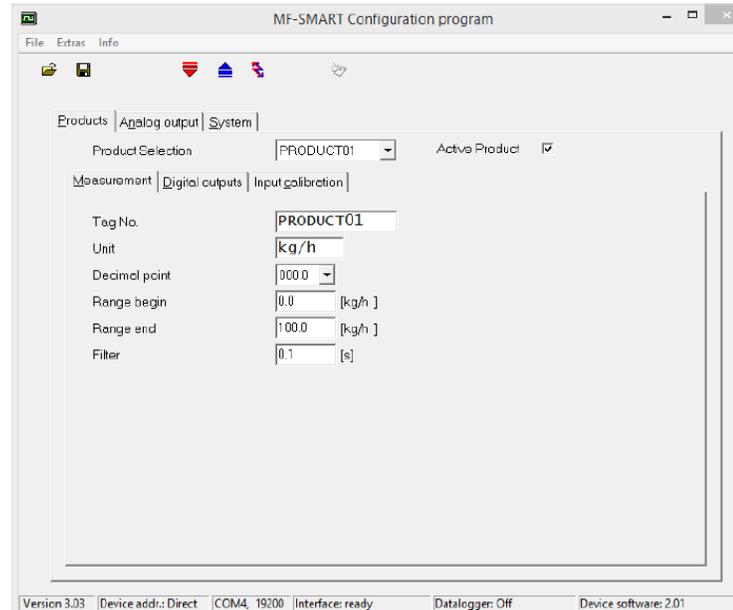


*Calibration and product selection*

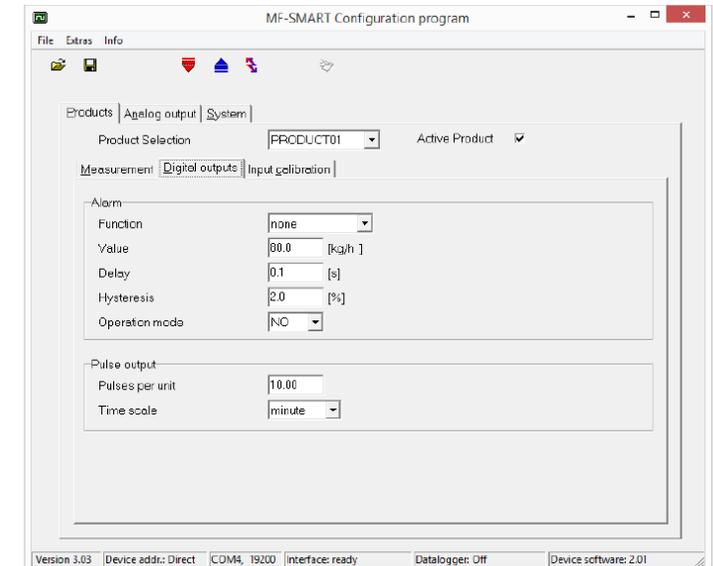
# MF Smart Software – to configure MF 3000



*Online display to call up the currently measured values*



*Detailed settings, e.g. for measurement range*



*Settings for output channels*

# Options available for MF 3000



MF 3000	
Sensor surface	PA 6.6 (standard) Teflon (option) Ceramic (option, Non ATEX only)
Housing material	1.4307 (standard) Option V4A, stainless steel 1.4571 (V21008)
Process Temperature	Standard: -20 to 80°/90°/100°/120° C (depending on sensor surface material) High Temperature Version HT 150: -20 to 150 °C (option, V21013) High Temperature Version HT 450: -20 to 450 °C (option, V21004)
Ex / ATEX	Non ATEX (standard) Ex / ATEX for zone 20/21 or zone 2 (V21005)
Installation	Welding flange WB 30 G/ ST52 (V21003) Welding flange WB 30 G/ V2A (V21002) Welding flange WB 30 G/ V4A(V21009) Welding flange WB 35 G/ V2A / MF 3000 HT 450 (E40443) Welding flange WB 30 with ball valve / V2A (V21026)
Cable	3m between MFS and MFI as standard, other lengths on request (up to 500 / 1000 m (ATEX / Non-ATEX)) USB / USB-mini cable (for MFI 3000) (E10199)

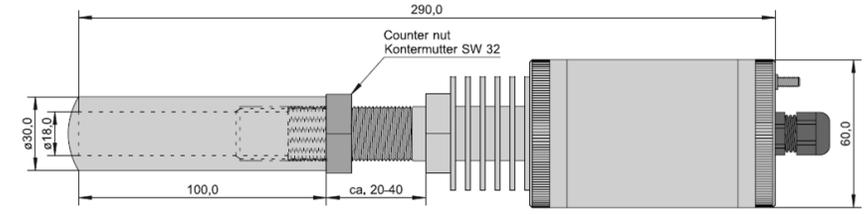
MF 3000 always consists of MFS sensor (V21027) and the mandatory MFI transmitter (V21028).

SCS 3000 can be used alternatively to the MFI as transmitter and local display. Please see SCS presentation for options.

# Technical data MF 3000



MFS 3000 – Sensor	
Supply voltage	16-24 VDC; 25mA
Output	RS 485 to connect with mandatory MFI 3000 transmitter
Cable length	3m as standard, other cable lengths on request
Transmit frequency range	24,150 to 24,250 GHz
Sensor surface	PA 6.6 or Teflon or ceramic (optional)
Housing material	Stainless steel (1,4307 or optionally 1.4571)
Mechanical connection	Welding flange, M22 (or M27 for HT 450)
Dimension & weight	D60 x 280 mm; 1,3 kg
Ambient temperature	-10 to +70°C (Non ATEX) -10 to +65°C (ATEX)
Process temperature	-20° up to 80° (PA 6.6, ATEX) or 90° (PA 6.6, Non ATEX) -20° up to 100° (Teflon, ATEX) or 120° (Teflon, Non ATEX) -20° up to 150° (HT 150 = Ceramic, glued housing, Non ATEX) * -20° up to 450° (HT 450 = Ceramic, adopted housing, Non ATEX) *
Pressure	6 bar (optionally 30 bar)
Protection class	IP 65
Ex-area / ATEX zone	Optional Zone 20/21 or Zone 2



# Technical data MF 3000



<b>MFI 3000 - Transmitter</b>	
Measured mass flow	~ 1 kg/h to approx. 100 t/h, limited by pipe diameter, max. D=300
Grain size	best experience with approx. 1 nm – 20 mm
Indicator	0 – 1023 digits
Accuracy	Up to 1 – 2 % (depending on product)
Average & Filter Value	1 – 500 sec
Savable calibration	Up to 24 calibrations / products
Supply Voltage	24 VAC (50-60 Hz) with +/-20%; 24 VDC with -20% / +30%; max. 2 W
Input	1x RS485 (from MFS 3000 sensor)
Output	1x Analog output for mass flow value (0/4-20mA; 0-10V) 1x Alarm relay for Max, Min or sensor fault 1x Pulse output for counting (<1,4 W, <28 VDC, <50mA); 1x RS232 for notebook connection 1x RS485 with MODBUS protocol for connection with PLC
Mechanical connection	Terminal case for mounting on DIN rail
Electrical connection	TE-1 to TE-24: Screw-plug connection with 2.5 mm <sup>2</sup> TE-B1 to TE-B5: TBUS connection with 2.5 mm <sup>2</sup>
Dimension & weight	22,5 x 115 x 100 mm without clamps; 150 g
Ambient conditions (transmitter)	-10 to +60°C;
Protection class (transmitter)	IP 20

