Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical Information

Silopilot T FMM20

Electromechanical Level System

Application

The Silopilot T FMM20 is an electromechanical level system for light bulk solids such as wheat, plastic granules and powder. Depending on the sensing weight, the level can be measured in bunkers or silos with dusty, fine-grain or coarse-grain bulk solids.

Your benefits

- Measurement of levels up to 32 m, regardless of bulk solid properties
- Accuracy ±2.5 cm or ±1 pulse, thus measured level recorded precisely
- Process temperatures up to 150°C possible
- Compact transmitter with 0/4 - 20 mA current output and additional freely programmable signal outputs (e.g. counting pulses)
- Easy menu-guided local operation via four-line plain text display
- Fully electronic digital minimum fail-safe mode, thus no movement into silo outlet, conveyor elements not affected
- Supply voltage 90 - 253 VAC (wide-range voltage power unit) as well as 24 VDC, depending on version selected
- Optional version with "dust ignition-proof" certificate for use in dust incendive hazard areas, Zones 20, 21 and 22 (measuring environment) or Zones 21 and 22 (instrument environment), Category 1/2D.

Endress+Hauser

People for Process Automation

TI421F/97/en/11.06

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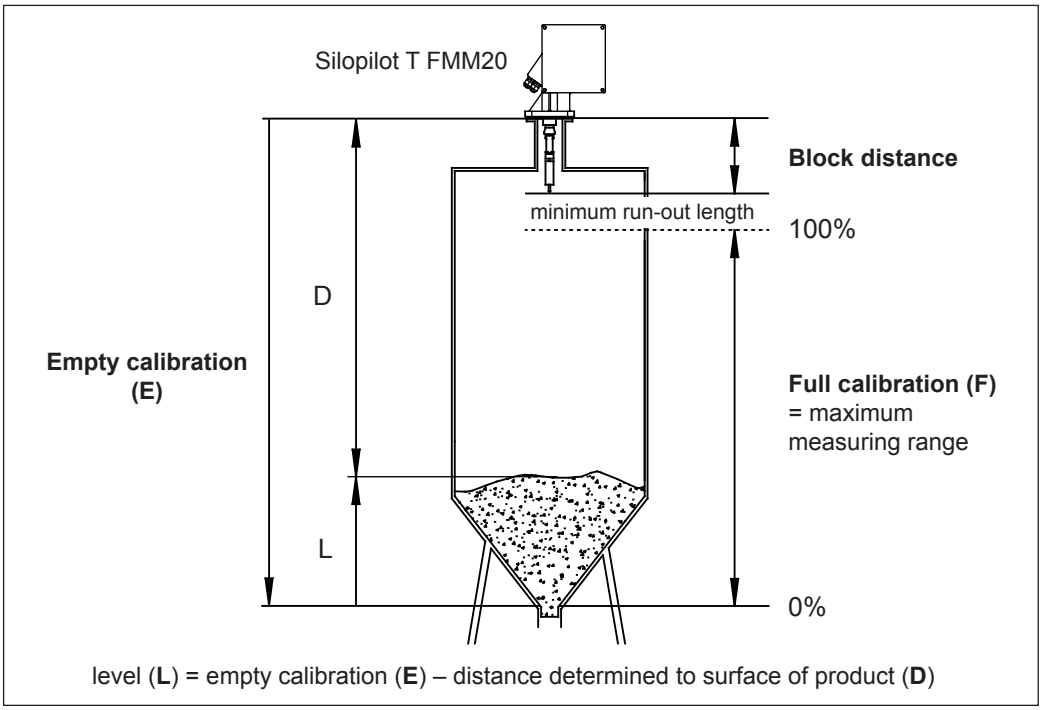
Function and system design

Measuring principle

A measuring rope or tape, from which a sensing element is suspended, is lowered into the bunker or silo. When the weight meets the surface of the product, the tensile force on the measuring rope or tape decreases and this is detected by the electronics of the Silopilot.



Measured value formation

The measured value is output at the 0/4 - 20 mA current output. The sensing weight then returns to the end position whereby the measured value determined is retained until the next measurement.

The 0/4 - 20 mA current output signal corresponds to the level (L). When the device is delivered, the basic settings are preset to the maximum possible measuring range in accordance with the device version (see Ordering Information). Menu-guided operation via the four-line plain text display guarantees unproblematic and rapid adjustment to the container geometry in question. This adjustment must be made before the first time the instrument is started to avoid damage to the conveyor elements.

During the entire measurement procedure (moving the sensing weight up and down), the Silopilot can additionally emit pulses (relay output or optionally optocoupler output) in accordance with the length of the rolled out measuring rope or tape. These pulses can be recorded by a process control system or an electromechanical counter.

Single measurements or periodic measurement procedures are possible. The measurement can thus be started manually (e.g. start button connected externally) or periodically (e.g. programmed function at Silopilot).

Highest measurable point

The highest measurable point is calculated from the block distance plus a minimum run-out length of 20 cm. This overall length must be taken into account when entering the maximum measuring range (**full calibration**).

The individual value of the block distance is preset when delivered and only has to be adjusted when the sensing weight is replaced, for example. The operating matrix provides a way of entering this information.

Measuring system

The Silopilot T FMM20 is a compact device. It makes extensive inputs and outputs available. Please refer to the ordering information for details.

Device versions

"Dust ignition-proof" version
For use in areas which are hazardous due to combustible dusts of Zones 20, 21 and 22 (measuring environment) or Zones 21 and 22 (instrument environment), Category 1/2D.

Mechanical and electrical versions
- Ambient temperature:
  -20°C to +60°C or -40°C to +60°C when using the self-regulating device heater
  (to -35°C for "dust ignition-proof" version)
  The optional device heater is also recommended in the event of moisture in the container and ambient temperatures below 0°C.

- Process temperature:
  -20°C to +70°C or
  -20°C to +150°C (not for "dust ignition-proof" version)

- With two supply voltage ranges as standard:
  90 - 253 VAC, 50/60 Hz or 20 - 28 VDC

- Wiper:
  - Material: aluminum/steel or stainless steel (304)

- Optional:
  - Two additional relay outputs (standard: 2 relay outputs)
  - External start button on housing and sight-glass in housing cover
  - Extended climate class (with ambient temperature range from -20°C to +60°C)
  - Powder-coated housing (RAL 5012, cover RAL 7035)
  - Wiper extension aluminum/steel or stainless steel, 500 mm or 1000 mm

- Sensing weights:
  A wide range of sensing weights are available depending on the application.
  For details, please see the section in question.

Extended features of Silopilot M FMM50

Alternative level measuring device FMM50

- Higher motor traction power:
  - Max. 500 N, for heavy bulk solids such as cement, lime, gypsum, sand

- Large measuring range:
  - Max. 70 m

- Higher max. process temperature:
  - Up to 230°C

- Higher max. process pressure:
  - Up to 3 bar absolute

- Optionally 4 instead of 2 additional relay outputs

- Extended functionality such as
  - limit value formation
  - linearization or
  - current magnifier

- Larger selection of standard sensing weights such as
  - cage weight,
  - bell weight or
  - oval float

Please refer to Technical Information TI395F/97/en for details on the Silopilot M FMM50 level measuring device!

Input

Measured variable

The measured variable is the distance between the lower flange edge of the Silopilot minus a block distance (see figure "Measuring principle", page 3) and the product surface. The level is then calculated taking into account the calibration values entered, e.g. silo height. Alternatively, the distance to the surface of the product can also be output.

Block distance

The block distance depends on the wiper used and the sensing weight:

Sensing weight	Wiper 230 mm	Wiper 500 mm	Wiper 1000 mm
B, C, D, E	0.72 m	1.02 m	1.52 m
G	1.22 m	1.52 m	2.02 m
N	0.72 m	1.02 m	1.52 m

Measuring range

- Max. 32 m

Measuring error

- Independent of the measuring range selected:
  ±2.5 cm or ±1 pulse

Inputs

Two inputs (active/passive) are available to operate the Silopilot externally:
- Active input:
  - NO contact
  - Connection of a control voltage from an external system
  - Input voltage range: 12 to 24 VDC
- Passive input:
  - NO contact
  - Connection of an external command unit, e.g. switch, key, relay contact
  - Contact load: max. 5 mW
- Start pulse length:
  - Min. 200 ms
- Optional:
  - Start button on device, can be operated externally
- Selectable functions of inputs:
  Start measurement or lock measurement

Output

Output signal

- 0/4 - 20 mA current output, active
- 2 relay outputs (optional 4 relay outputs)
  - Contact load: 250 VAC, 6 A
  - Contact material: silver-cadmium-oxide, gold flashing
- Selectable relay functions:
  - Counting pulse: output pulses in accordance with rope/tape length rolled out, e.g. for downstream control units
  - Reset pulse: pulse before every new measurement, e.g. to reset an external counter
  - Running up the sensing weight: display when running up rope/tape, e.g. to hide counting pulses when running up rope/tape
  - Upper end position of sensing weight: display when upper end position reached (end of measurement)
  - Measurement active: displays an active measuring cycle, e.g. to lock a filling device to protect the Silopilot from being covered by medium
  - Alarm: fault states output
  - Service interval: information on Silopilot maintenance
- Optocoupler output for counting pulse (optional when 4 relays are selected)

Signal on alarm

Breakdown information can be called up via the following interfaces:
- Local display:
  - Error symbol
  - Error code with plain text display
- Current output, state can be programmed:
  - Minimum: current value <= 3.6 mA (4 - 20 mA) or current value 0 mA (0 - 20 mA)
  - Maximum: maximum current value + 10% (≈22 mA)
- Relay outputs (alarm function)

Power supply

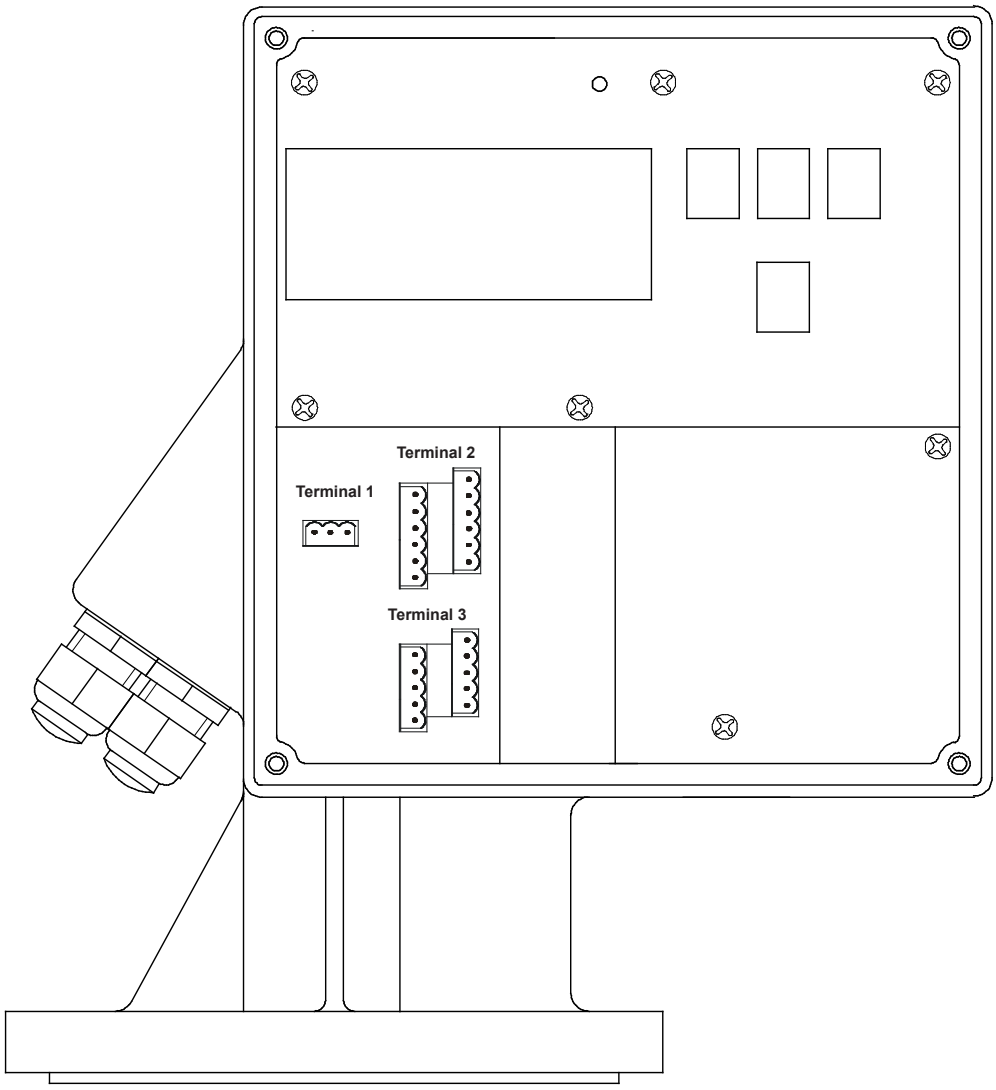
Supply voltage

- 90 - 253 VAC, 50/60 Hz or
  20 - 28 VDC
- Power consumption:
  - Without heater: approx. 150 VA
  - With heater (optional): approx. 170 VA

Cable entry

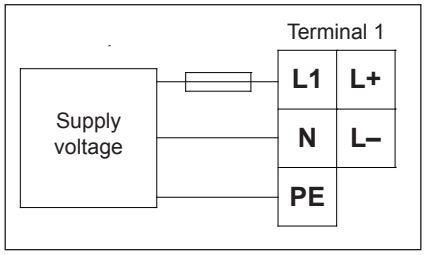
- M20 x 1.5
- Number: 3
- Cable gland:
  - Material: Plastic
  - Color: gray (for ATEX: black)

Terminal assignment

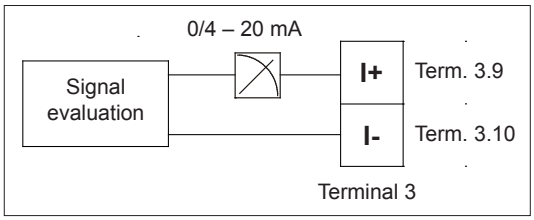


Electrical connection

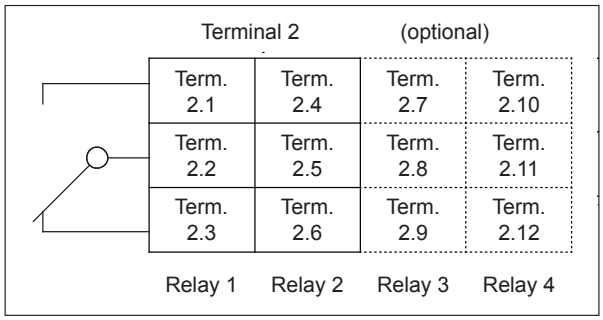
Supply voltage
The supply voltage (mains voltage) is connected to the plug-in terminals of terminal 1.
The maximum conductor cross-section is 2.5 mm².
A fuse should be fitted to protect the supply voltage against short circuits.



0/4 - 20 mA current output
The active 0/4 – 20 mA current output is connected to the plug-in terminals of terminal 3.
The maximum conductor cross-section is 2.5 mm².
Normal installation cables are sufficient for making the connections.



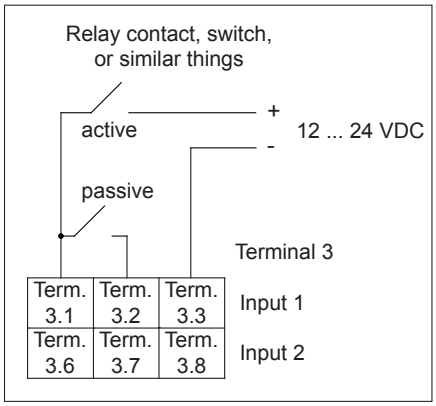
Relay
The connection cables are connected to the plug-in terminals of terminal 2, relay 1 to relay 2 and optionally to relay 4.
The maximum conductor cross-section is 2.5 mm².
Normal installation cables are sufficient for making the connections.
The individual circuits must have a maximum of 6 A fuse protection (see technical data of relay outputs).



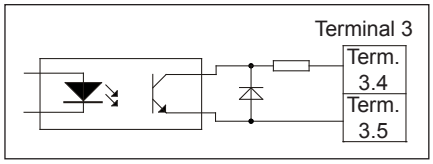
Signal inputs
The signal inputs are connected to the plug-in terminals of terminal 3.
The maximum conductor cross-section is 2.5 mm².
Normal installation cables are sufficient for making the connections.

Active
Input voltage range: 12 – 24 VDC
Passive
Contact load: max. 5 mW

Note on the signal inputs:
The signal inputs (active/passive) can only be used alternatively. A double assignment for input x active and passive is not possible! The minimum start pulse length is 200 ms.



Optocoupler output (optional when 4 relays are selected)
The connection cables of the optoelectronic coupler output are connected to the plug-in terminals of terminal 3.
The maximum conductor cross-section is 2.5 mm².
Normal installation cables are sufficient for making the connections.



Operating conditions

Recommendations for selecting rope or tape version

For very dusty products, we recommend using the tape version of Silopilot T FMM20 and purging air (see **Silopilot installation**). We also recommend the tape version for products that tend to cake.

Sensing weight

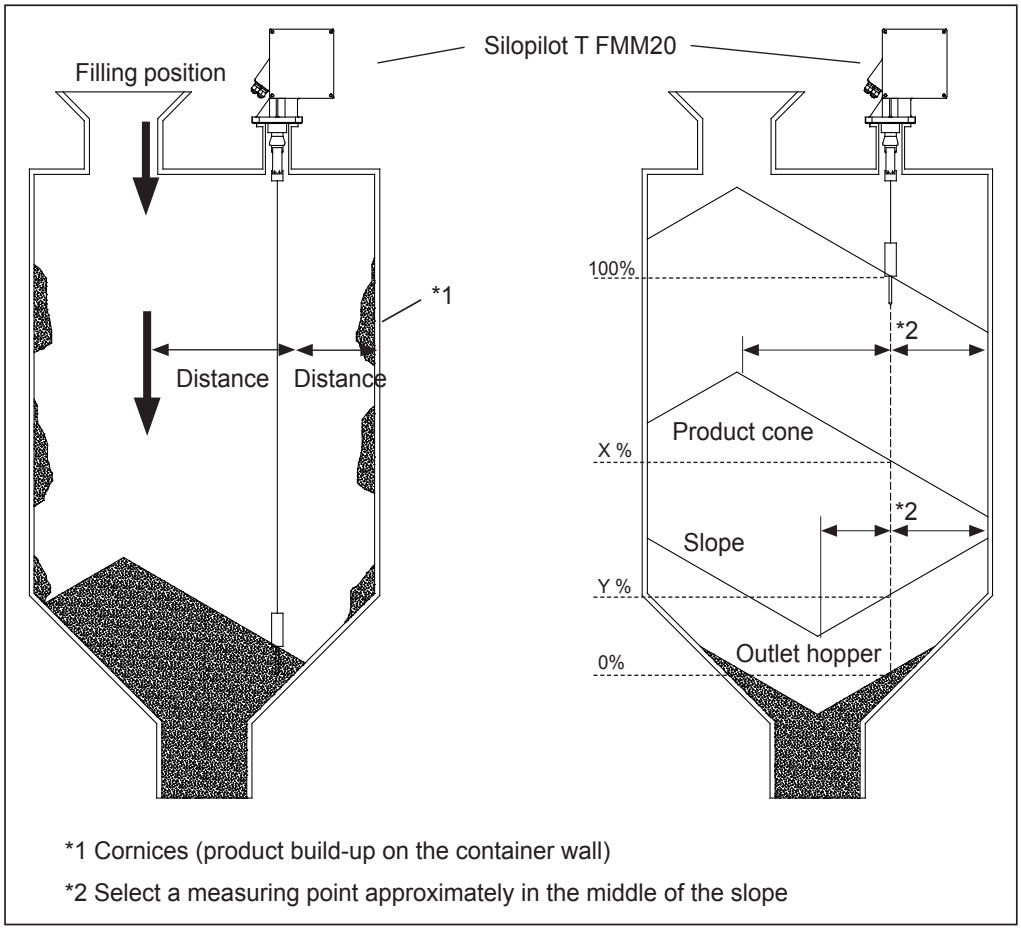
Sensing weights (see appropriate section)

Please note the following when selecting the sensing weight:
- The sensing weight must not sink into the product nor be diverted by contact with the product cone during the measuring procedure.
- The sensing weight must be suited to the chemical characteristics of the product and the temperature in the bunker/silo.

Special versions for special applications are available on request.

Mounting location

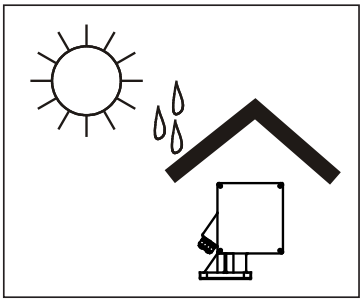
Planning the mounting location
Select the mounting location on the bunker or silo roof in such a way that falling product during filling or collapsing cornices cannot spill the sensing weight and cannot damage the measuring rope or tape.
Observe the shape and the position of the product cone and/or outlet hopper in the container.
The measurement section should not run too close to internals and struts, so that the measuring rope or tape does not touch them when the sensing weight is swinging.
The length of the wiper should be selected in such a way that the sensing weight protrudes out of the mounting connection.



Selecting the mounting location

Installation preparation

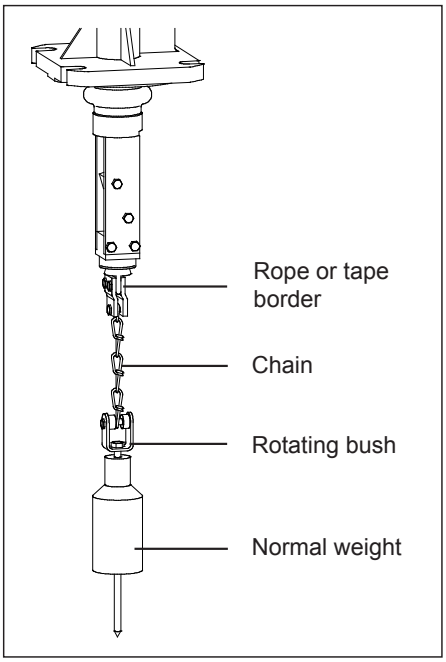
The Silopilot is best mounted on a counter flange DN100 PN16 (connection dimensions acc. to EN 1092-1) or a flange with the same connection dimensions. This counter flange must be exactly horizontal so that the Silopilot can also be mounted horizontally (maximum angle of inclination 2°).



Weather protection

When installing outside, fit the protective hood available as an accessory or mount a weather protection cover.

Mounting the sensing weight

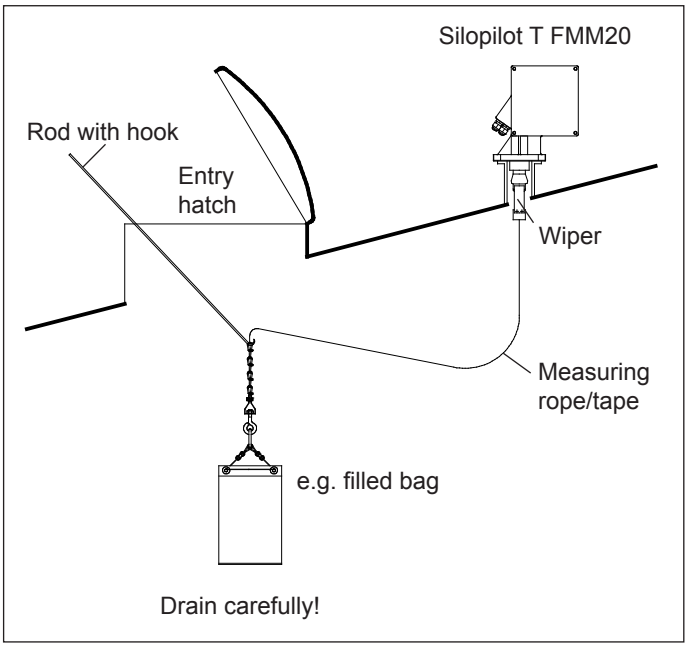


Mounted sensing weight

Normal weights, umbrella weights and bags (see overview in the "Sensing weights" section) can be passed into the bunker or silo via the DN100 mounting flange.

The measuring rope or tape is pressed into the rope or tape border by two M6 screws. A third screw secures the chain. A rotating bush is mounted at the bottom end of the chain to accommodate any turning motion of the sensing weight.

The rope or tape border, chain and rotating bush are made from galvanized steel or stainless steel.



Mounting larger sensing weights

When using larger sensing weights, such as a filled medium bag for example, a point must be present in the design of the bunker or silo where these eights can be installed (see figure).

Please refer to the Operating Instructions for information on mounting!

Mounting the Silopilot

Fit a sealing ring on the flange (particularly if there is overpressure in the bunker/silo). Carefully guide the sensing weight into the bunker/silo.

Now place the Silopilot onto the flange and secure it using four M16 bolts of a suitable length. Please note the following when doing so:
- Install the Silopilot horizontally (see "Installation preparation" section).
- Pay attention to the position of the cable entries for the electrical connection.

When using in bunkers/silos with severe dust emission, you can connect a compressed air line to the mounting flange of the Silopilot to generate a slight overpressure at the Silopilot (air volume as required). A G¼ bore is provided for this purpose (see housing dimensions).

Environment

Ambient temperature at the Silopilot:
- -20 to +60°C
- -40 to +60°C when using the self-regulating device heater, without ATEX certification, or
  -35 to +60°C when using the self-regulating device heater with ATEX certification

Process

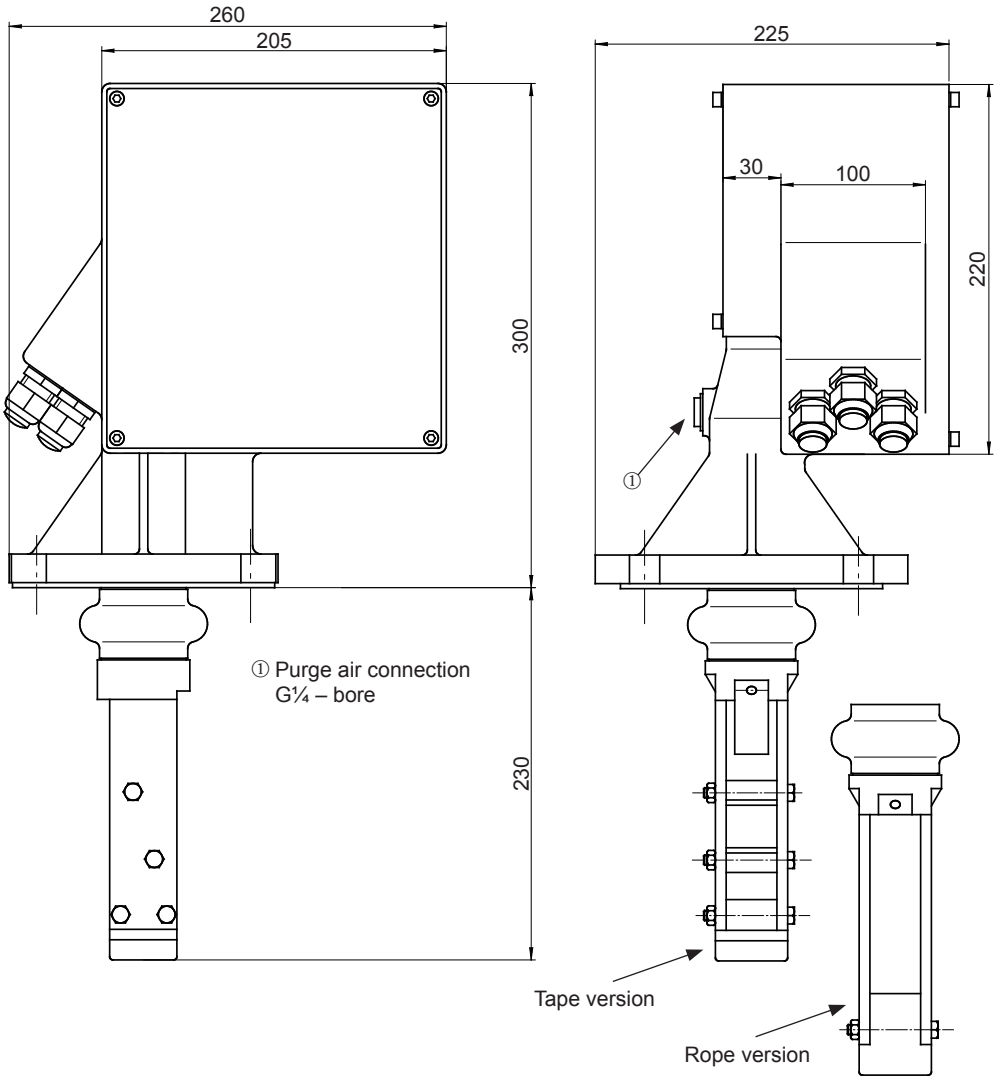
Process temperature:
- -20 to +70°C (standard version, version with ATEX certification)
- -20 to +150°C

Line pressure (in bunker/silo):
- 0.8 to 1.1 bar absolute

Mechanical construction

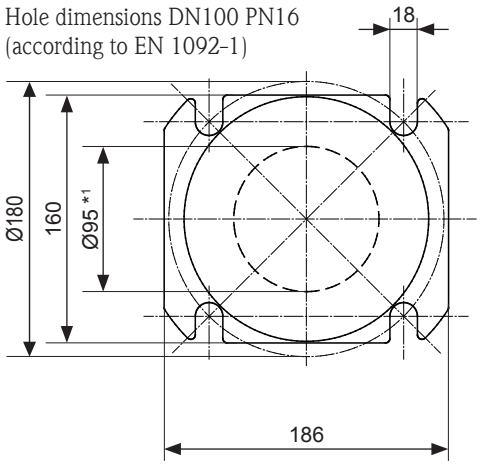
Design, dimensions

Housing dimensions (with standard wiper 230 mm)

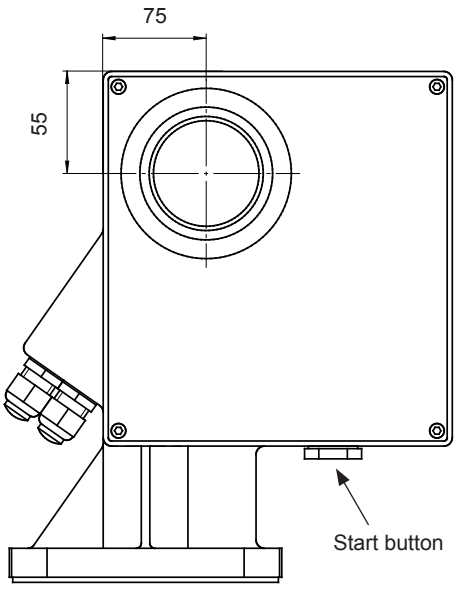


Dimensions of process connection and optional sight-glass/start button

Hole dimensions DN100 PN16
(according to EN 1092-1)



*1 Minimum dimension for installing the wiper mechanism and standard weight



Sensing weights

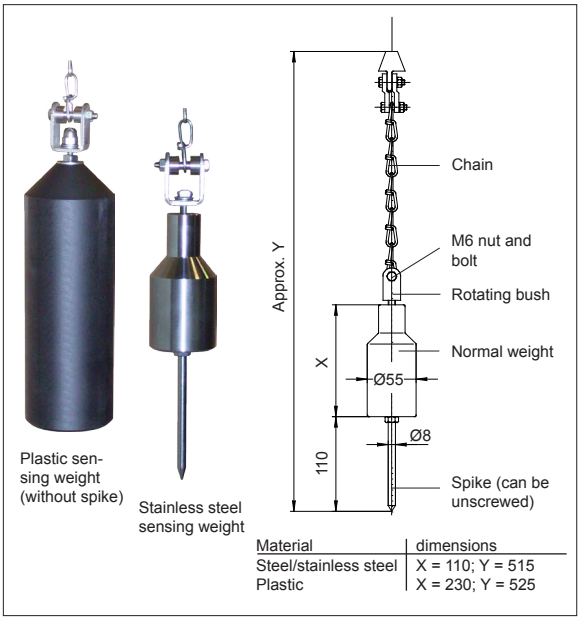
Selection recommendation

You should note the following when selecting the sensing weight:
- The sensing weight must not sink into the product nor be diverted by contact with the product cone during the measuring procedure.
- The sensing weight must be suited to the chemical characteristics of the product and the temperature in the bunker/silo.

Versions

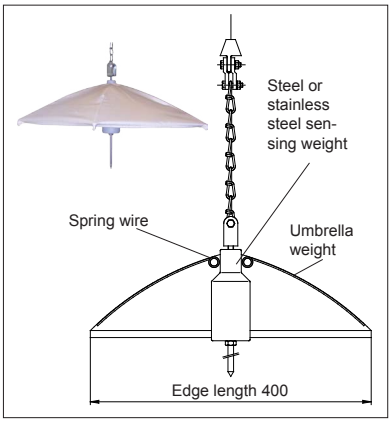
Normal weight

- Application:
  For granules and compressed bulk solids.
- The spike can be removed (plastic sensing weight without spike).
- If a crushing or milling system is downstream from the silo, we recommend using the electrical signal function "rope/tape breakage" to avoid damaging the system in the event of the sensing weight breaking free.
- Materials:
  Steel, stainless steel (316TI) or plastic
- Maximum permitted temperature:
  - Steel or stainless steel 150°C
  - Plastic 70°C
- Use of the plastic sensing weight is not permitted in the "dust ignition-proof" version
- Weight:
  1.5 kg



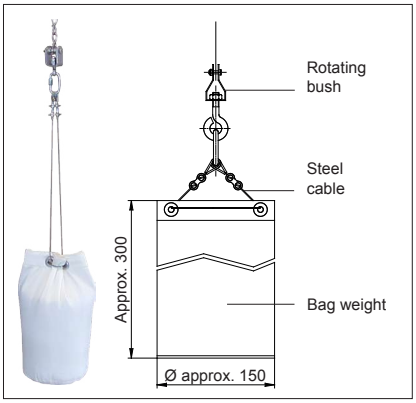
Umbrella weight

- Application:
  For very light and loose bulk solids, e g. flour or coal-dust.
- The umbrella weight has a large square surface area which prevents it from sinking deeply into the product.
- When folded closed, the weight can be passed into the bunker via the mounting flange DN100.
- Maximum permitted temperature:
  150°C
- Materials:
  - Steel or stainless steel (316TI)
  - Polyester
- Weight:
  1.5 kg



Bag weight

- Application:
  In bunkers where mills are located downstream.
- The bag contains whichever product is contained within the bunker.
- Maximum permitted temperature:
  150°C
- Materials:
  Polyester, all metal parts made of stainless steel (316)
- Weight:
  - 0.25 kg (empty)
  - 1.50 kg (with filling)
- Bind the bag closed at the top so that the contents cannot fall out if the bag tips over on the slope of a product cone.



Controls and instrumentation

Control concept

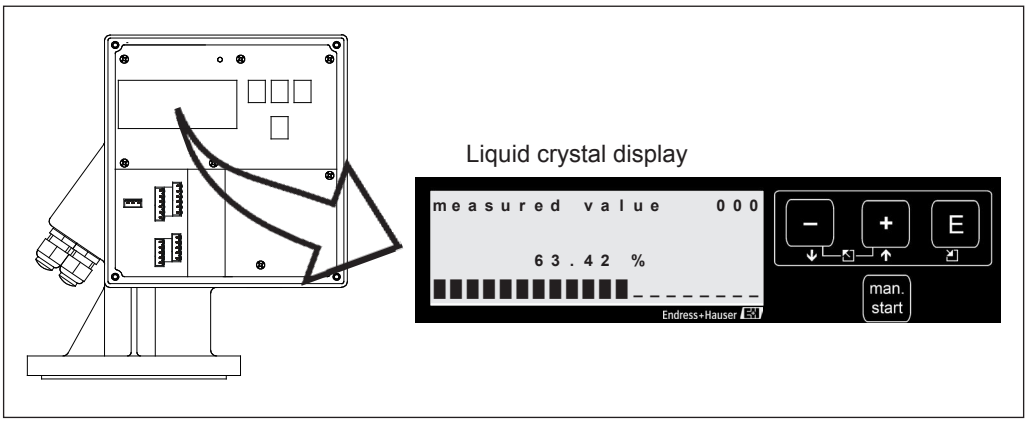
The Silopilot is configured onsite by means of a large 4-line plain text display which can also show the current measured value.

Menu guidance with integrated help text offers quick and safe commissioning.

Display elements

Liquid crystal display (LC display)

- Four-line
- 20 characters per line
- Display contrast can be set via key combination



Controls and instrumentation

Operating elements

The operating elements are located within the housing (exception: optional start button, can be operated from outside) and can be operated once the electronics cover is opened.

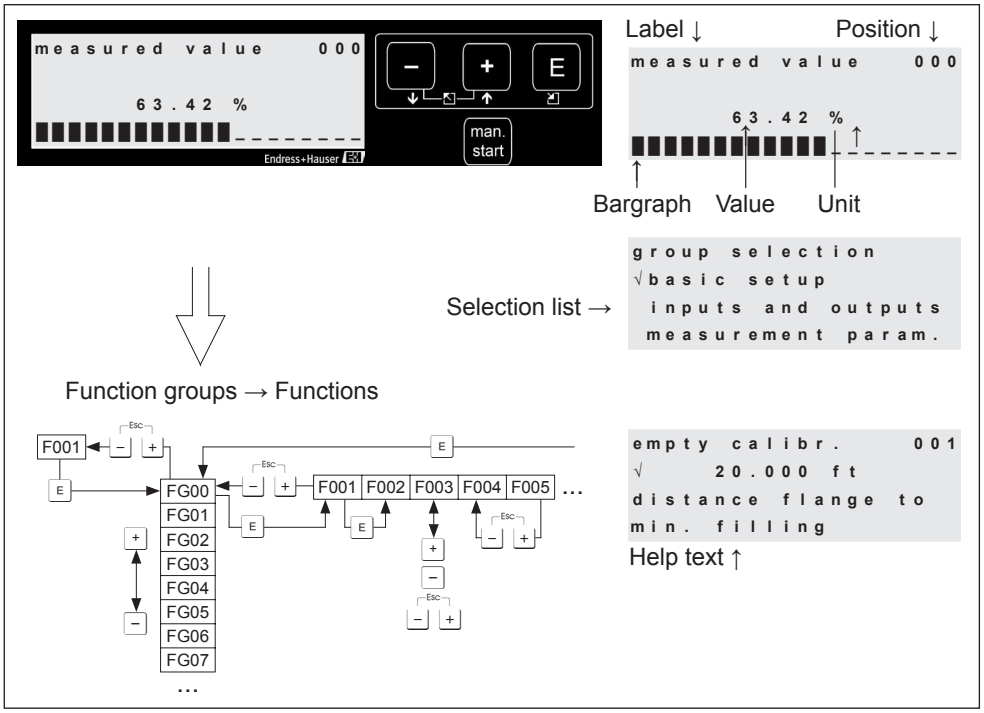
⚠ *The Silopilot can only be operated in the hazardous area with the covers closed!*
The system must be adjusted to the tank geometry before the first measurement procedure to avoid damage to the conveyor elements.

Function of buttons

Button(s)	Meaning
[+] or [↑]	- Upwards navigation in the selection list - Edit the numerical values within a function
[–] or [↑]	- Downwards navigation in the selection list - Edit the numerical values within a function
[Esc] [–] [+] or [←]	- Navigation to the left within a function group
[E]	- Navigation to the right within a function group - Confirmation
[+] and [E] or [–] and [E]	Contrast setting for liquid crystal display - [+] and [E] increases the contrast - [–] and [E] reduces the contrast
[man. start]	- Starts measurement process (provided that the Silopilot is in the measured value display function)

Local operation

With the help of the LC display, the configuration can be carried out using 3 buttons directly at the Silopilot. All device functions can be set by means of a menu-guided control system. The menu consists of function groups and functions. Application parameters can be read or set in the functions. When doing so, the user is guided through the complete commissioning procedure.



Local operation

Safety instructions

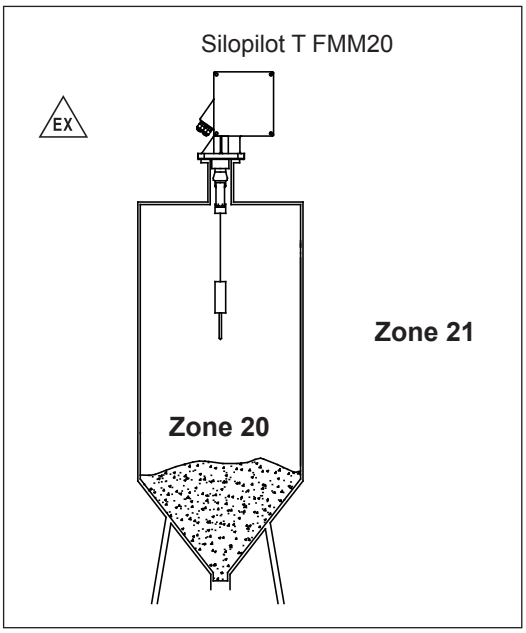
Features of the ATEX version

- Labeling:
  ⟨Ex⟩ **II 1/2D IP67 T99°C**
- Certification number:
  BVS 05 ATEX E 049

Designated use

- The Silopilot T FMM20 can only be operated in the hazardous area with the housing closed.
- The Silopilot T FMM20 approved to ATEX may only be repaired by the manufacturer.
- The requirements laid down in EN 50281-1-2, for example relating to dust deposits and temperatures, must be observed.

Installation instructions



Installation instructions (ATEX)

Certificates and approvals

CE mark

The Silopilot T FMM20 device meets the statutory requirements of the EC Directives.
By applying the CE mark, Endress+Hauser confirms that the device has passed the necessary tests.

Other standards and guidelines

- **EN 60529**
  Degrees of protection through housing (IP code)
- **EN 61010-1**
  Protection measures for electrical equipment for measurement, control, regulation and laboratory procedures
- **EN 61326**
  Interference emission (Class B equipment) and interference immunity (Appendix A – Industry)
- **EN 50281-1-1**
  Electrical equipment for use in areas with combustible dust
- **Directive 89/336/EEC**
  EMC Guideline
- **Directive 94/9/EC**
  ATEX Guideline

Ordering information

Ordering information for Silopilot T FMM20

10	**Approval:**							
	A	Non-hazardous area						
	B	ATEX II 1/2D IP67 T99°C						
	Y	Special version, to be specified						
20		**Housing:**						
		1	Aluminum					
		2	Aluminum, coated					
		9	Special version, to be specified					
30			**Measurement range:**					
			1	15 m, rope, stainless steel (316)				
			2	32 m, rope, stainless steel (316)				
			4	15 m, tape, stainless steel (301, modified)				
			5	32 m, tape, stainless steel (301, modified)				
			9	Special version, to be specified				
40				**Max. connection height; wiper:**				
				A	230 mm, aluminum/steel			
				B	230 mm, stainless steel (304)			
				C	500 mm, aluminum/steel			
				D	500 mm, stainless steel (304)			
				E	1000 mm, aluminum/steel			
				F	1000 mm, stainless steel (304)			
				Y	Special version, to be specified			
50					**Power supply:**			
					1	90 - 253 VAC, 50/60 Hz		
					3	20 - 28 VDC		
					9	Special version, to be specified		
60						**Output:**		
						A	0/4 - 20 mA + 2x relay, adjustable	
						C	0/4 - 20 mA + 4x relay, adjustable	
							Relay function: counting pulse, reset pulse, maintenance, run-up, upper limit position, alarm or measurement active	
						Y	Special version, to be specified	
70							**Ambient temperature:**	
							D	Range -20 to +60°C
							E	Range -40 to +60°C + heating (ATEX II 1/2D min. -35°C)
							F	Range -20 to +60°C + extended climate resistance
							Y	Special version, to be specified

Ordering information for Silopilot T FMM20, continued

80	**Process temperature:**	
	1	Range -20 to +70°C
	2	Range -20 to +150°C
	9	Special version, to be specified

90	**Sensing weight:**	
	A	none
	B	Steel
	C	Stainless steel (316TI)
	D	Steel + umbrella
	E	Stainless steel (316TI) + umbrella
	G	Medium bag
	N	Plastic
	Y	Special version, to be specified

100	**Additional equipment:**	
	1	Basic version
	2	Window + start push button, extern
	9	Special version, to be specified

FMM20-	Product designation

Information on product overview

The following restrictions apply to devices with ATEX approval:
- **Ambient temperature (70), option E:** min. -35°C
- **Process temperature (80):** only (**1**)
- **Sensing weights (90):** only (**A**) to (**G**)
- **Additional fittings (100):** only (**1**)

Other restrictions:
- **Ambient temperature (70), option F:** only in conjunction with coated housing
- **Process temperature (80), option 2:** only sensing weight (**A**) to (**G**)

Technical data

Mechanical

- Weight:
  Approx. 10 kg without sensing weight or 11.5 kg with sensing weight

- Housing:
  Material: Aluminum
  Optional coating (RAL 5012, cover RAL 7035)

- Wiper:
  Material: aluminum/steel or stainless steel (304)

- Ambient temperature range:
  -20 to +60°C standard version
  -40 to +60°C with self-regulating heater, without ATEX certification
  -35 to +60°C with self-regulating heater, with ATEX certification

- Dimensions of standard version [mm]:
  300 x 260 x 225 [HxBxD]

- Measuring rope or tape
  - Measuring tape material: stainless steel (301, modified)
    Measuring rope material: stainless steel (316)
  - Length: max. 32 m

- Traction power:
  Max. 150 N

- Tape run-off speed:
  - Min. 0.16 m/s
  - Max. 0.25 m/s

- Degree of protection:
  IP67 as per EN 60529

- Angle of inclination:
  Max. 2°

Electrical

- Supply voltage:
  90 - 253 VAC, 50/60 Hz or
  20 - 28 VDC

- Power consumption:
  Without heater: max. 150 VA
  With heater (optional): max. 170 VA

- Inputs:
  Active: input voltage range 12 – 24 VDC
  Passive: contact load max. 5 mW
  Start pulse length: min. 200 ms

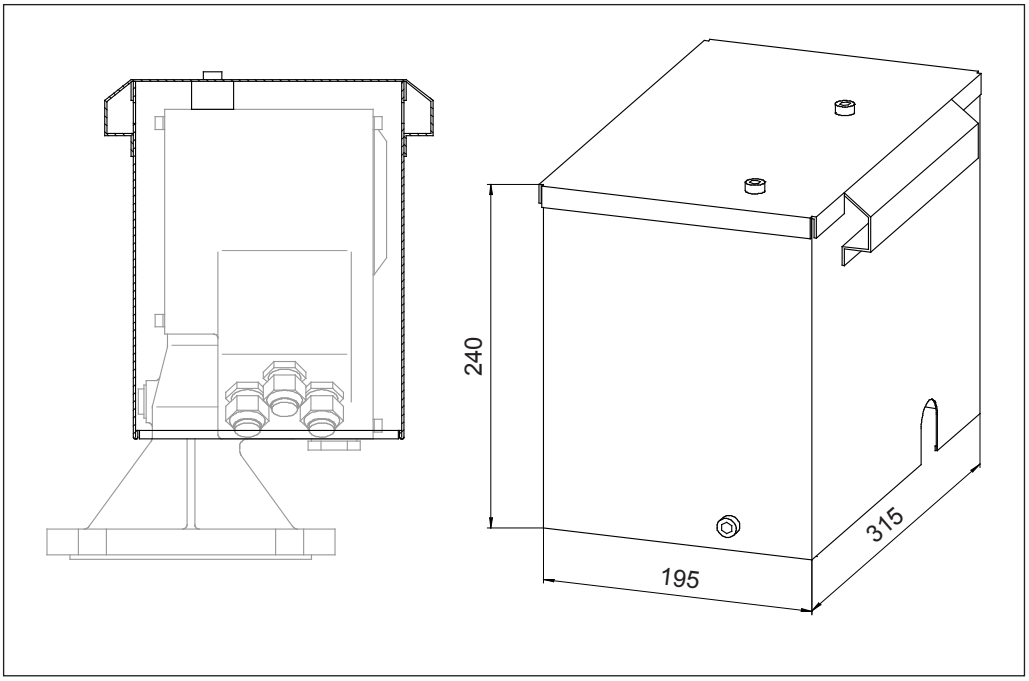
- Outputs:
  - Current output 0/4 – 20 mA, active
  - Relay outputs, max. 250 VAC / 6 A
  - Optocoupler output (optional when 4 relays are selected), max. 30 VDC / 10 mA

- Terminals:
  Max. 2.5 mm^2

Accessories

The following accessories are available for the electromechanical level system Silopilot T FMM20:

- Protective hood FMM20
  - Order No.: 71028956
  - Material: stainless steel
  - The delivery contains suitable mounting screws.



Documentation

Operating Instructions

Silopilot T FMM20
Operating Instructions for Silopilot T FMM20, BA334F/97/en

Subject to modification

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