

Electromechanical Level Measurement Systems *silopilot FMM 760, FMM 760 Z*

**Level measurement system of high versatility
for bulk solids and liquids**



Silopilot FMM 760 with
standard sensing weight

Application

The Silopilot FMM 760, FMM 760 Z is an electromechanical level measurement system. Appropriate weights, which sense the surface of the product, are available to suit the application. Depending on the weight selected, the level of product in silos or bunkers can be measured, whether the product be dusty, fine or coarse-grained. The level of liquids in tanks can also be measured. Versions of the Silopilot FMM 760 are available for level measurement in silos or tanks with an operating temperature up to 150 °C, at an operating pressure up to 2 bar or in aggressive atmosphere, e. g. acid vapour.

Features and Benefits

- Measurement of levels up to 70 m independent of product properties
- Accuracy of ± 1 pulse, therefore precise detection of the level
- Electronic minimum fail-safe mode, therefore no running down of the sensing weight into the silo outlet, no damage of conveying systems
- Lifting power up to 850 N, therefore reliable lifting of the sensing weight
- Manual or automatic operation with remote start and indication, therefore ideal device for automatic silo control and monitoring
- Compact design, quick and economic mounting, easy maintenance
- Version FMM 760 Z with BVS certificate for application in dust explosion hazardous areas Zones 10 and 11.

Endress + Hauser

The Power of Know How

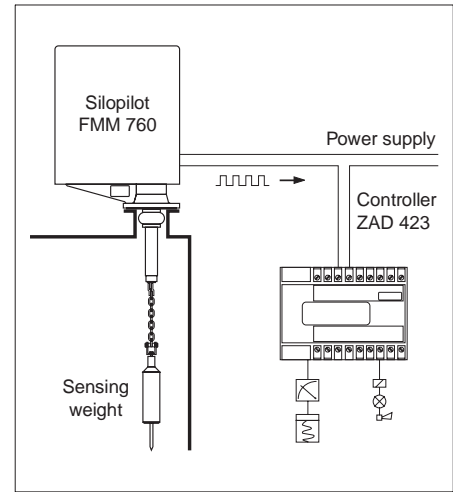


Measuring System

A complete measuring system comprises:

- Silopilot FMM 760 with sensing weight
- Controller ZAD 423
or
subtracting electromechanical counter ZCD 151, ZCD 152, ZCD 155 or ZCD 156
- Connected peripherals, such as signalling systems, registration units, etc.

The module concept allows electrical and mechanical components to be combined to create a system entirely appropriate to the application requirements (see section "Product Structure").



Measuring system with controller ZAD 423

Measurement Principle

A measuring tape with a sensing weight attached to the end is driven down into the bunker. When the weight touches the surface of the product, the tape slackens and the motor reverses. The weight returns to the start "parked" position. During the downward or upward movement of the weight, the

Silopilot emits pulses equivalent to the length of the extended tape. The pulses are recorded by the controller ZAD 423 or by an electromechanical counter. The measured value is stored until the next measuring cycle. This is initiated by a start button or a timer.

Versions

Version FMM 760 Z (Dust-Ex)

For application in flammable dust hazardous areas Zones 10 and 11.

Mechanical and Electrical Versions

- With heating:
Thermostatically controlled, electrical housing heater 230 V, 50/60 Hz for ambient temperatures to $-45\text{ }^{\circ}\text{C}$ (indicate min. ambient temperature when placing an order). Also recommended for moist vessel and ambient temperature below $0\text{ }^{\circ}\text{C}$.
- Pressure-tight up to 2 bar silo gauge pressure.
- Climatic protection:
All metal parts coated against acids, alkalis, humidity and heat.
- Stove enamelled:
Cover and housing base stove enamelled.
- High temperature version:
All parts within silo temperature-resistant up to $150\text{ }^{\circ}\text{C}$.
- With weather protection cover (this is also available separately, see Sect. "Accessories").

Minimum Fail-Safe Function

Optional electrical function that causes a descent limiting of sensing weight.

Signal Function for Tape Running and Control

Maximum four of the following output signals may be selected:

- Upper parked position of sensing weight
- Tape break alarm
- Tape reverse / slack band
- Descent of sensing weight
- Ascent of sensing weight
- Energising the circuit for minimum fail-safe mode.

Sensing Weights

See section "Sensing Weights".

Other Options

- Counting step and tape length
- Metal parts in silo and tape-wipe mechanism
- Power supply for control and motor.

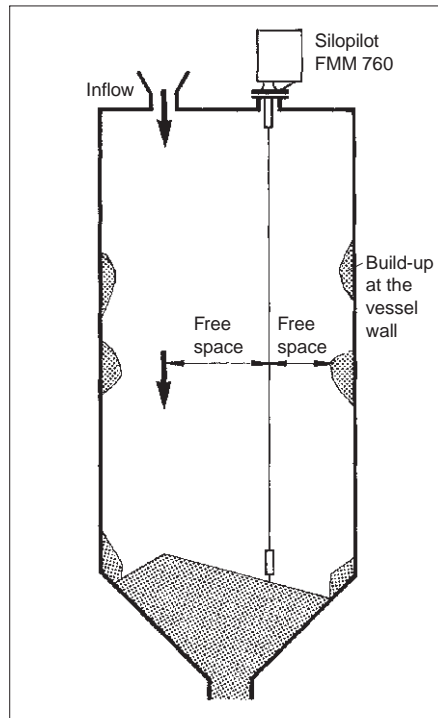
For a complete list of available versions refer to Sect. "Product Structure".

Planning and Installation

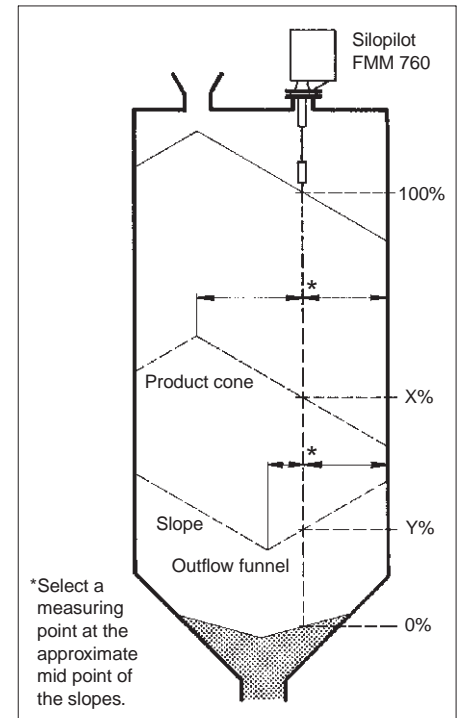
Installation Site

Select an installation site on the silo roof where flowing or falling product cannot cover the sensing weight or damage the measuring tape. Take into consideration

the shape and position of the inflow cone and the outflow funnel. The sensing path should not cross internal fixtures that may touch the tape.



Selecting installation site



Selecting installation site

Mounting Preparation

The Silopilot FMM 760 is mounted on a counter flange C 100 x d₁ DIN 2633 or a flange of the same connecting dimensions.

The flange must be mounted exactly horizontally and the pipe on that it is welded should be exactly vertical. The pipe should be as short as possible. If

it must be longer than 200 mm, e. g. because of a thick silo roof or a high operating temperature, then order the Silopilot with extended tape-wipe mechanism (500 or 1000 mm).

When installing outside, fit a weather protection cover or roof (see Sect. "Accessories") over the Silopilot.

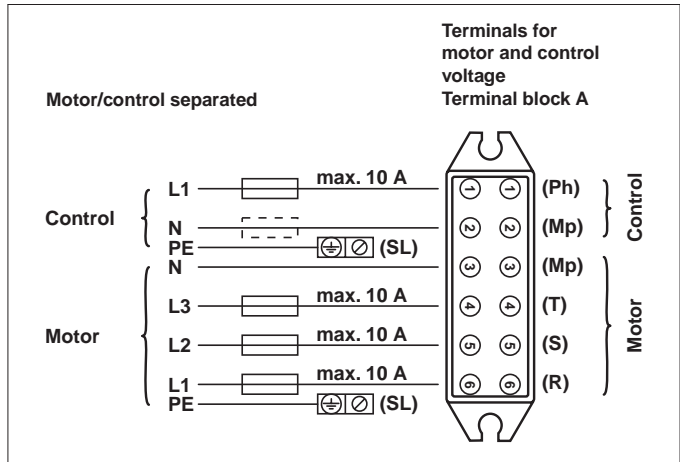
Electrical Connection

Connection of Motor and Control voltages

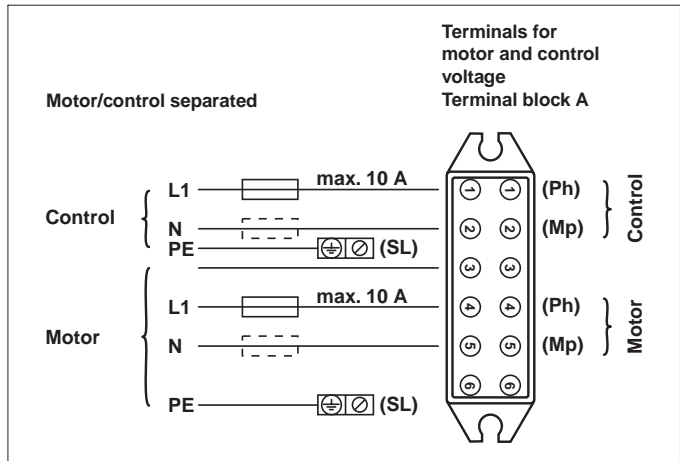
Connecting a Silopilot FMM 760 with three-phase or single-phase motor, respectively: see Figs.

Max. cable cross section for the terminals: 4 mm².
Fuse: mains cables max. 10 A.

Connection Silopilot FMM 760 with three-phase motor



Connection Silopilot FMM 760 with single-phase motor

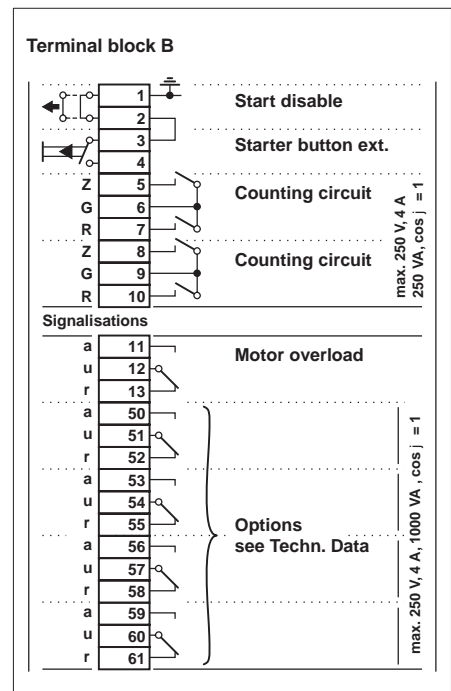


Connection of Control and Alarm systems

All corresponding connections are located on terminal block B; see Fig. Max. cable cross section for the terminals: 2.5 mm².

Separate cables for external start and start disabling from signal and supply cables.

Connection of control and alarm systems



Sensing Weights



Variants

The following shapes are available and will be described on the following pages:

- Normal cylindrical sensing weight with spike
- Umbrella weight
- Bag weight
- Cage weight
- Oval float (for FMM 760 only)
- Bell weight.

Selection

Observe the following points when selecting the sensing weight:

- The sensing weight must neither sink into the product nor slip on the cone during measurement.
- The sensing weight must match the chemical product properties and the temperature in the bunker.

Special versions for particular applications are available on request.

Mounting

Normal weight, umbrella weight and bag weight can be introduced into the bunker through the DN 100 mounting flange.

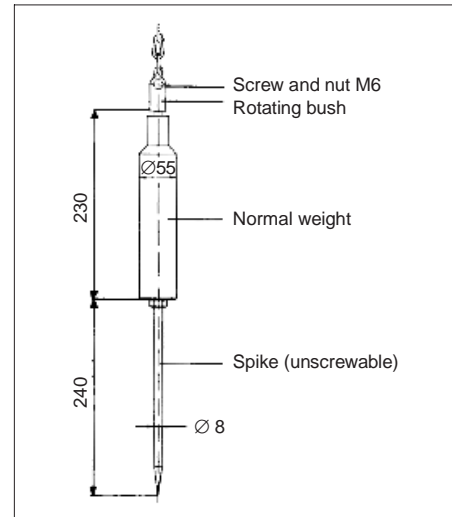
The measuring tape is pressed into the tape assembly by two screws. A third screw takes the chain. At the lower part of the chain, a rotating bush is located. Its function is to absorb the rotations of the sensing weight.

In standard version, the weight fastening (tape assembly, chain and rotating bush) is made out of galvanised steel. However, the parts are as well available in a special version of stainless steel. The measuring tape is made out of stainless steel also in standard version.

Sensing Weights (continued)

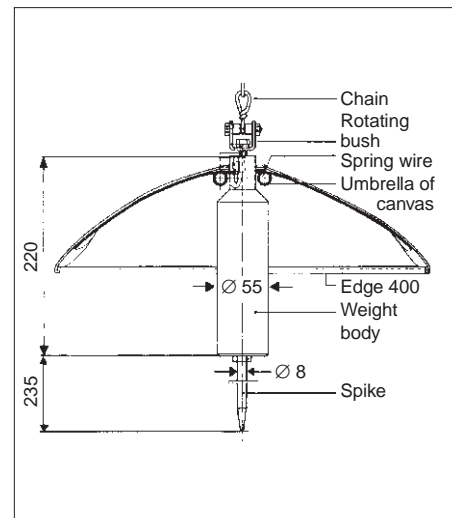
Normal Weight

- Application:
For coarse-grained solids, e. g. coal, ore or stones, and for granules.
- The spike can be unscrewed.
- If a crusher or mill is connected to the bunker, then we recommend the electrical signal function "tape break" or the use of a cage weight. This will prevent damage of the plant in case of a tape break.
- Materials:
steel or stainless steel.
- Weight: 3.5 kg.



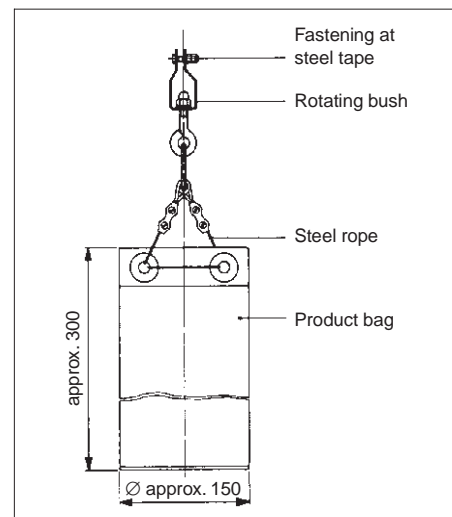
Umbrella Weight

- Application:
For very light and loose solids, e. g. flour or coaldust.
- The umbrella weight has a large square surface. This will prevent deep sinking into the product.
- In folded state, the weight can be introduced into the bunker through the DN 100 mounting flange.
- Max. permissible temperature: 100 °C.
- Materials:
steel or stainless steel, canvas.
- Weight: 3.5 kg.



Bag Weight

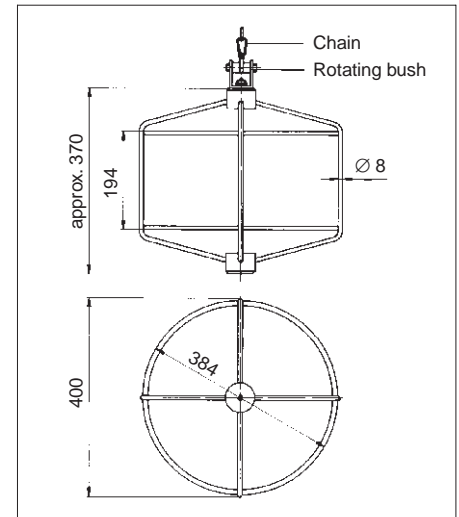
- Application:
In bunkers to which e. g. mills are connected.
- The bag contains the product stored in the bunker.
- Max. permissible temperature: 100 °C.
- Materials:
bag of linen, loops reinforced by leather, all metal parts of stainless steel.
- Weight: empty 0.25 kg, filled 3.5 kg.
- Tie up the bag at the top. This will prevent the contents from falling out, if the bag is upset when hitting the slope of a product cone.



Sensing Weights (continued)

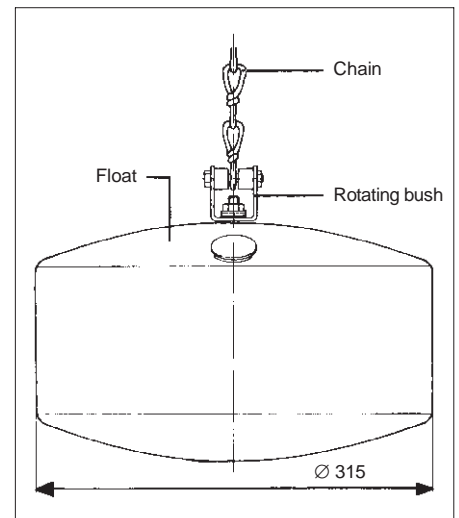
Cage Weight

- Application:
For fine solids in silos with relatively small product outlet that must never be blocked by a broken sensing weight.
- Also suitable for high temperatures that do not allow the use of a bag.
- The weight can get stuck over the outlet, but lets the product pass. Since the cage cannot get into a conveyor system (e. g. cellular wheel feeder or screw conveyor), it will prevent consequent damage.
- Standard dimensions: see Fig. Other dimensions on request.
- Material: steel.
- Weight: 3.5 kg.



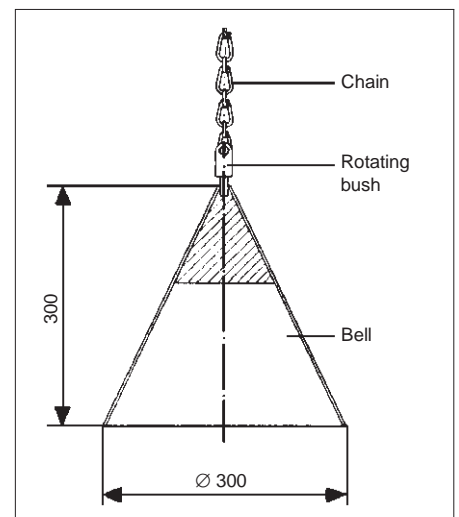
Oval Float (for FMM 760 only)

- Application:
For liquids, e. g. fuel oil, also for granules.
- Material: hard PVC.
- Max. permissible temperature: 60 °C.
- The float must be filled with product up to the total weight of 3.5 kg.



Bell Weight

- Application:
For light and loose solids; especially in cases where high temperatures and particular product properties do not allow the use of an umbrella weight.
- Materials:
steel or stainless steel.
- Weight: 4.3 kg.



Counting steps / tape length

- A Pulse per 1 dm, tape length 25 m
- B Pulse per 1 dm, tape length 50 m
- C Pulse per 1 dm, tape length 70 m
- D Pulse per 0.5 dm, tape length 25 m
- E Pulse per 0.5 dm, tape length 50 m
- F Pulse per 0.5 dm, tape length 70 m
- G Pulse per 1 in, tape length 25 m
- H Pulse per 1 in, tape length 50 m
- J Pulse per 1 in, tape length 70 m
- K Pulse per 1/10 ft, tape length 25 m
- L Pulse per 1/10 ft, tape length 50 m
- M Pulse per 1/10 ft, tape length 70 m
- N Pulse per 1 cm, tape length 10 m
- Y Special version on request

Minimum fail-safe function

- 0 Without minimum fail-safe function
- 1 With minimum fail-safe function
- 9 Special version on request

Signal function for tape running and control

- 00 Without additional status message relays
 - 01 One relay for maximum message
 - 02 One relay for tape break message
 - 04 One relay for tape reverse message
 - 08 One relay for descent message
 - 16 One relay for ascent message
 - 32 One relay for minimum message
- Combinations are defined by addition of the codes.
Maximum 4 functions can be combined.

Metal parts in silo and tape-wipe

- A Metal parts of steel, tape-wipe short, of cast aluminum
- K Metal parts of steel, tape-wipe 500 mm long, of cast aluminum
- L Metal parts of steel, tape-wipe 1000 mm long, of cast aluminum
- B Metal parts of 1.4571, tape-wipe short, of cast aluminum
- C Metal parts of 1.4571, tape-wipe 500 mm long, of cast aluminum
- D Metal parts of 1.4571, tape-wipe 1000 mm long, of cast aluminum
- E Metal parts of 1.4571, tape-wipe short, of 1.4571
- F Metal parts of 1.4571, tape-wipe 500 mm long, of 1.4571
- G Metal parts of 1.4571, tape-wipe 1000 mm long, of 1.4571
- Y Special version on request

Mechanical and electrical variants

- 00 Without additional features
 - 01 With heating 230 V, 50/60 Hz
 - 02 Pressure-tight up to 2 bar
 - 04 With climatic protection
 - 08 Stove enamelled
 - 16 High temperature version
 - 32 With weather protection cover
- Combinations are defined by addition of the codes.

Power supply for control

- Q Power supply 575 V, 50/60 Hz
- P Power supply 550 V, 50/60 Hz
- N Power supply 500 V, 50/60 Hz
- T Power supply 440 V, 50/60 Hz
- S Power supply 415 V, 50/60 Hz
- R Power supply 400 V, 50/60 Hz
- J Power supply 240 V, 50/60 Hz
- E Power supply 230 V, 50/60 Hz
- G Power supply 127 V, 50/60 Hz
- F Power supply 115 V, 50/60 Hz
- B Power supply 110 V, 50/60 Hz
- C Power supply 48 V, 50/60 Hz
- K Power supply 42 V, 50/60 Hz
- D Power supply 24 V, 50/60 Hz
- Y Special power supply on request

FMM 760 –							
FMM 760 Z –							

Product designation, first part
Continued on next page

Product designation, first part
Continued on next page

Product Structure (continued)

Silopilot FMM 760, FMM 760 Z							
Power supply for motor							
Q	Three-phase motor 3 × 575 V, 50 Hz						
N	Three-phase motor 3 × 500 V, 50 Hz						
L	Three-phase motor 3 × 440 V, 50 Hz						
J	Three-phase motor 3 × 415 V, 50 Hz						
G	Three-phase motor 3 × 400 V, 50 Hz						
1	Three-phase motor 3 × 230 V, 50 Hz						
C	Three-phase motor 3 × 127 V, 50 Hz						
W	One-phase motor 240 V, 50 Hz						
2	One-phase motor 230 V, 50 Hz						
3	One-phase motor 115 V, 50 Hz						
R	Three-phase motor 3 × 575 V, 60 Hz						
P	Three-phase motor 3 × 500 V, 60 Hz						
M	Three-phase motor 3 × 440 V, 60 Hz						
K	Three-phase motor 3 × 415 V, 60 Hz						
H	Three-phase motor 3 × 400 V, 60 Hz						
4	Three-phase motor 3 × 230 V, 60 Hz						
D	Three-phase motor 3 × 127 V, 60 Hz						
X	One-phase motor 240 V, 60 Hz						
5	One-phase motor 230 V, 60 Hz						
6	One-phase motor 115 V, 60 Hz						
Y	Special version on request						
Sensing weight							
0	Without sensing weight						
1	Standard sensing weight of steel						
2	Sensing weight of 1.4571						
3	Umbrella weight of steel / canvas						
4	Umbrella weight of 1.4571 / canvas						
5	Linen bag weight						
6	Cage weight of steel						
7	Oval float of hard PVC (for FMM 760 only)						
8	Bell weight of steel						
9	Special version on request						
FMM 760 –							Complete product designation
FMM 760 Z –							Complete product designation

Preferred Packages

Silopilot FMM 760 with standard sensing weight of steel and with controller ZAD 423	
<p>Used options of Silopilot FMM 760:</p> <ul style="list-style-type: none"> – Counting: 1 dm, Tape: 50 m – Minimum level alarm included – 3 relays (maximum, breakage, tape reversal) – Tape wipe 300 mm, steel parts – With sun protection cover – Power supply, control: 230 V AC – Motor: three-phase 3 x 400 V AC, 50 Hz <p>Used options of controller ZAD 423:</p> <ul style="list-style-type: none"> – For non hazardous area – MINIPAC housing 100 mm with terminal block – Power supply: 230 V AC 	<p>Order No: 941260-0000</p>
<p>same version as before but with linen bag weight</p>	<p>941260-0010</p>

Technical Data

General Specifications

Manufacturer	Endress+Hauser GmbH+Co.
Instrument designation	Silopilot FMM 760, FMM 760 Z

Operation and System Design

Measurement principle	During the movement of a measuring tape, pulses are emitted and registered. Their number is proportional to the filling level.
Modularity	Silopilot FMM 760, FMM 760 Z with sensing weight, controller ZAD 423 or subtracting electromechanical counter, connected peripherals (e. g. signalling systems or registration units)

Input Variables

Measured variable	Filling level for bulk solids and liquids
Counting steps (options)	1 dm, 0.5 dm, 1 in, $\frac{1}{10}$ ft, 1 cm
Measuring ranges (options)	counting step 1 cm: 10 m, otherwise: 25 m, 50 m, 70 m
Sensing velocity (at 50 Hz mains frequency)	counting step 1 cm: approx. 8...10 cm/s, otherwise: approx. 20...35 cm/s

Output Variables

Output signals	potential-free change-over contact
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Accuracy

Measured error	max. ± 1 pulse
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Application Conditions

Installation

Installation instructions	see Sect. "Planning and Installation"
Lifting capacity	three-phase motor: briefly 850 N, one-phase motor: briefly 150 N

Environment

Ambient temperature	-20...+60 °C, version from -45 °C in preparation
Ingress protection	IP 55
Electromagnetic Compatibility	Interference Emission to EN 61326, Electrical Equipment Class B Interference Immunity to EN 61326, Annex A (Industrial) and NAMUR Recommendation NE 21 (EMC) Use a screened cable between the sensor and transmitter. Refer to TI 241F for installation instructions pertaining to screened cables and general instructions on EMC test conditions for E+H equipment.

Process

Product temperature	-20...+80 °C, version up to +150 °C, with oval float up to +60 °C
Limit process pressure range	0 bar, version 2 bar

Construction

Design	see Sects. "Versions" and "Product Structure"
Dimensions	see Sects. "Dimensions" and "Sensing Weights"
Weight	without sensing weight: approx. 31 kg normal weight: 3.5 kg cage weight: 3.5 kg umbrella weight: 3.5 kg oval float: 3.5 kg bag weight: empty 0.25 kg bell weight: 4.3 kg filled 3.5 kg
Materials	housing: aluminium protection cover: enamelled sheet steel metal parts in silo and tape-wipe: see Sect. "Product Structure" measuring tape: special corrosion-resistant spring steel sensing weights: see Sects. "Sensing Weights" and "Product Structure"

Power Supply

Power supply for control (options)	575 V, 550 V, 500 V, 440 V, 415 V, 400 V, 240 V, 230 V, 127 V, 115 V, 110 V, 48 V, 42 V, 24 V, 50/60 Hz each, mains voltage tolerance +15%, -10%
Power supply for motor (options)	three-phase motor: 3 × 575 V, 3 × 500 V, 3 × 440 V, 3 × 415 V, 3 × 400 V, 3 × 230 V, 3 × 127 V, 50 or 60 Hz each, mains voltage tolerance $\pm 10\%$ one-phase motor: 240 V, 230 V, 115 V, 50 or 60 Hz each, mains voltage tolerance $\pm 10\%$
Power consumption	control max. 70 VA, motor max. 300 VA

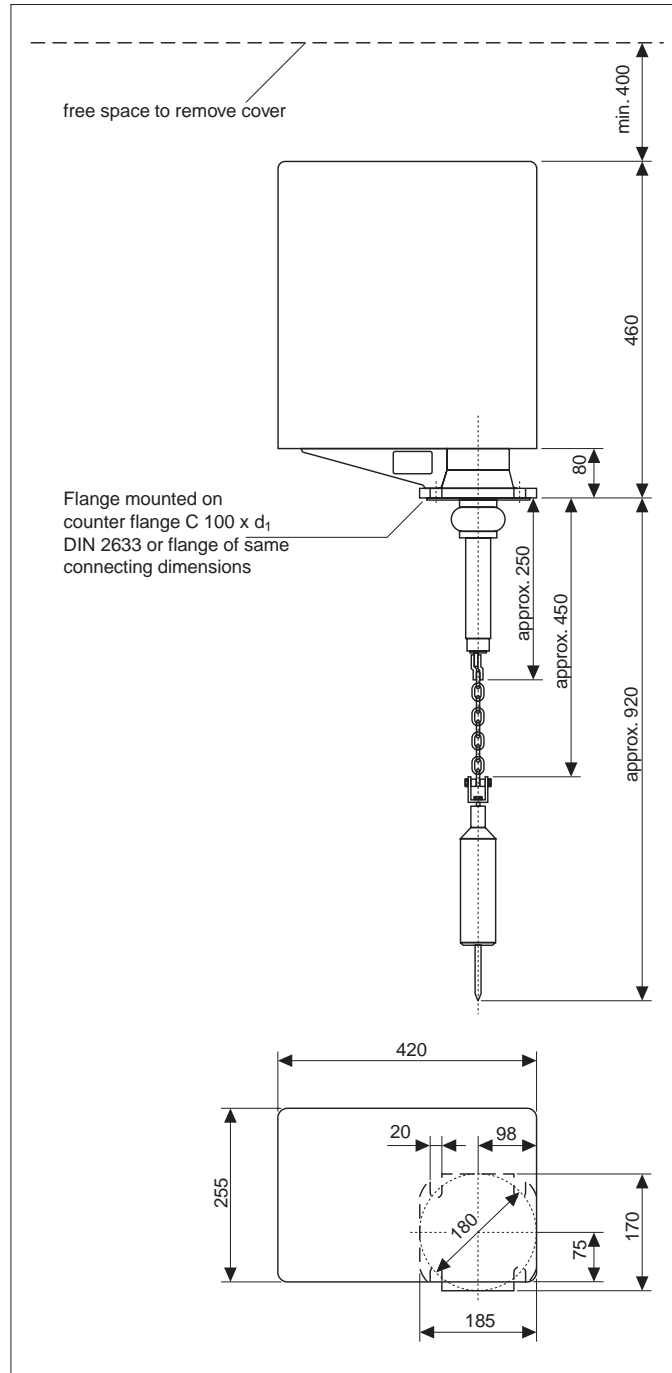
Technical Data (continued)

Certificates and Approvals

Dust ignition protection

version FMM 760 Z for application in dust explosion hazardous areas Zones 10 and 11
BVS certificate No. St Ex 6/81 B dated July 29th, 1981

Dimensions



Dimensions
Silopilot FMM 760 with normal
sensing weight

Accessories

- ❑ Weather protection of white plastic (ASA 776)
metal parts of stainless steel
ambient temperature max. +60 °C
dimensions (H × W × L):
415 × 285 × 478 mm
- ❑ Subtracting electromechanical counters
ZCD 151, ZCD 152
ZCD 155, ZCD 156
- ❑ Sensing weights
see Sect. "Sensing Weights"
- ❑ Controller ZAD 423

Accessories (continued)



Weather protection
cover



Counter ZCD 151, 152



Controller ZAD 423



Counter ZCD 155, 156

Supplementary Documentation

- ❑ Controller ZAD 423
Technical Information TI 277F/00/en
- ❑ Counter ZCD 151, ZCD 152
Technical Information TI 11.73.04
- ❑ Counter ZCD 155, ZCD 156
Technical Information TI 08.78.01

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