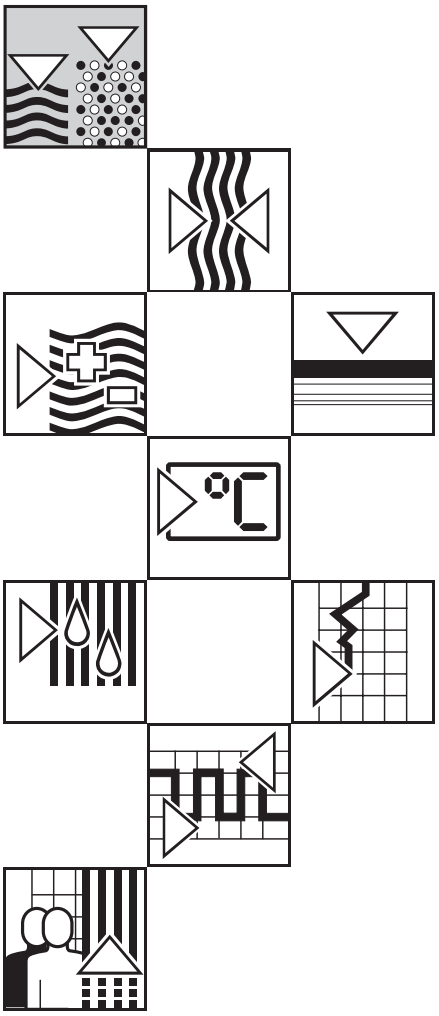
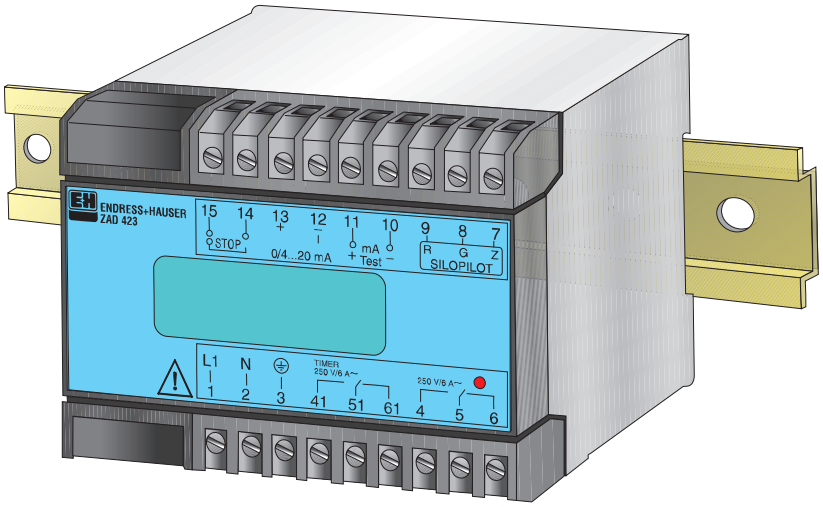
BA 161F/00/en/09.97
Software version 1.0
Part No. 017273-1000

Controller
ZAD 423
for Silopilot FMM

Operating Instructions



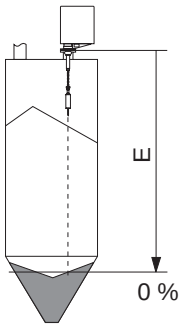
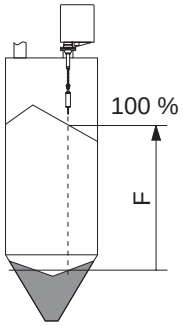


Endress+Hauser

Nothing beats know-how

Quick Guide

Basic calibration

Step	Calibration field H	Entry ● + ● – ❍ H ❍ S		Example	Remarks
		Set counting interval			
1	❍ + ❍ – ● H **8** ❍ S	Number corresponding to counting step of connected Silopilot FMM	0 = 1 dm 1 = 5 cm 2 = 1 cm 3 = 1 in 4 = 1/10 ft	0 = counting step 1 dm	For counting step see nameplate Silopilot FMM "Zähleinheit" or "Zählung (unit)"
		Empty calibration			
2	❍ + ❍ – ● H **1** ❍ S	Height E from flange to zero point of measurement (empty silo)	in **m** for steps of 1 cm 5 cm 1 dm in **in** for steps of 1 in in **ft** for steps of 1/10 ft	18.7 (m)	
		Full calibration			
3	❍ + ❍ – ● H **2** ❍ S	Height F from zero point of measurement (empty silo) to maximum height	in **m** for step of 1 cm 5 cm 1 dm in **in** for step of 1 in in **ft** for step of 1/10 ft	17.2 (m)	
		For display:			
4	❍ + ❍ – ● H **0** ❍ S **LEVEL**			40.0 or ##.#	Reset or previous measured value
5		❍ ❍ ❍ ● **Press Pushbutton S** min. 3 s			Silopilot starts measurement
		Wait for Silopilot sensing weight to descend		12.3	**Level is shown**

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1 Software changes

Version, Date	Revisions	Changes
1.0 04.04.1997		new

2 Notes on Safety

2.1 General information

In order to highlight safety-relevant or alternative operating procedures in the manual, the following conventions have been used, each indicated by a corresponding icon.

Icons for notes on safety

Icon	Significance
Note!	**Note!** A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned.
Caution!	**Caution!** Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument.
Warning!	**Warning!** A warning highlights actions or procedures which, if not performed correctly, will lead to serious personal injury, a safety hazard or destruction of the instrument.

Explosion protection

	Device certified for use in explosion hazardous area If the device has this symbol embossed on its nameplate it can be installed in an explosion hazardous area.
	Explosion hazardous area Symbol used in drawings in these operating instructions to indicate explosion hazardous areas. — Devices located in and wiring entering explosion hazardous areas must conform with the stated type of protection.
	Safe area (non-explosion hazardous area) Symbol used in drawings in these operating instructions to indicate non-explosion hazardous areas. — Devices located in safe areas still require a certificate if their outputs run into explosion hazardous areas.

Electrical symbols

	Direct voltage A terminal to which or from which a direct current or voltage may be applied or supplied.
	Alternating voltage A terminal to which or from which an alternating (sine-wave) current or voltage may be applied or supplied.
	Grounded terminal A grounded terminal, which as far as the operator is concerned, is already grounded by means of an earth grounding system.
	Protective grounding A terminal which must be connected to earth ground prior to making any other connection to the equipment.
	Equipotential connection A connection must be made to the plant grounding system which may be of type e.g. equipotential line or neutral star according to national or company practice.

2.2 Special notes on safety

Approved usage

The ZAD 423 controller is used to control the Silopilot FMM level measuring device, to show level on the digital display, to convert the level into an analogue output signal and to supply limit signals.

The electrical components are specifically designed for this application.

Installation, commissioning, operation

The controller has been designed to operate safely in accordance with current technical and safety and EU standards. If installed incorrectly or used for applications for which it is not intended, however, it is possible that application-related dangers may arise, e.g. product overflow or damage to the Silopilot due to incorrect calibration. For this reason, the instrument must be installed, connected, commissioned, operated, maintained and repaired according to the instructions in this manual. Personnel must be authorised and suitably qualified. Modifications or repairs to the equipment which are not expressly approved in this manual or by the bodies responsible for compliance may void the user's authority to operate the equipment.

Explosion hazardous areas

All local standards must be complied with when using the Silopilot in explosion hazardous areas.

- Ensure that all personnel are suitably qualified.
- All technical and safety specifications must be complied with at the measuring point.

3 Introduction

3.1 Application

Controller for level measurement with the Silopilot FMM 760 or FMM 460 electromechanical level sensor:

- Automatic and manual output of start pulses for the Silopilot which can also be switched off, e.g. during filling
- Digital display of silo level
- Conversion of the digital measured value into a standard analogue output signal
  - for remote display of level
    or - inverted -
  - for remote display of free space between the surface and silo roof
- Output of two limit signals

3.2 Measuring system

The measuring system consists of:

- Silopilot FMM 760 or FMM 460
- Controller ZAD 423 with
  - integrated time switch,
  - digital display,
  - analogue output,
  - limit switch
- Connected peripherals, such as
  - signalling systems,
  - registration units, etc.

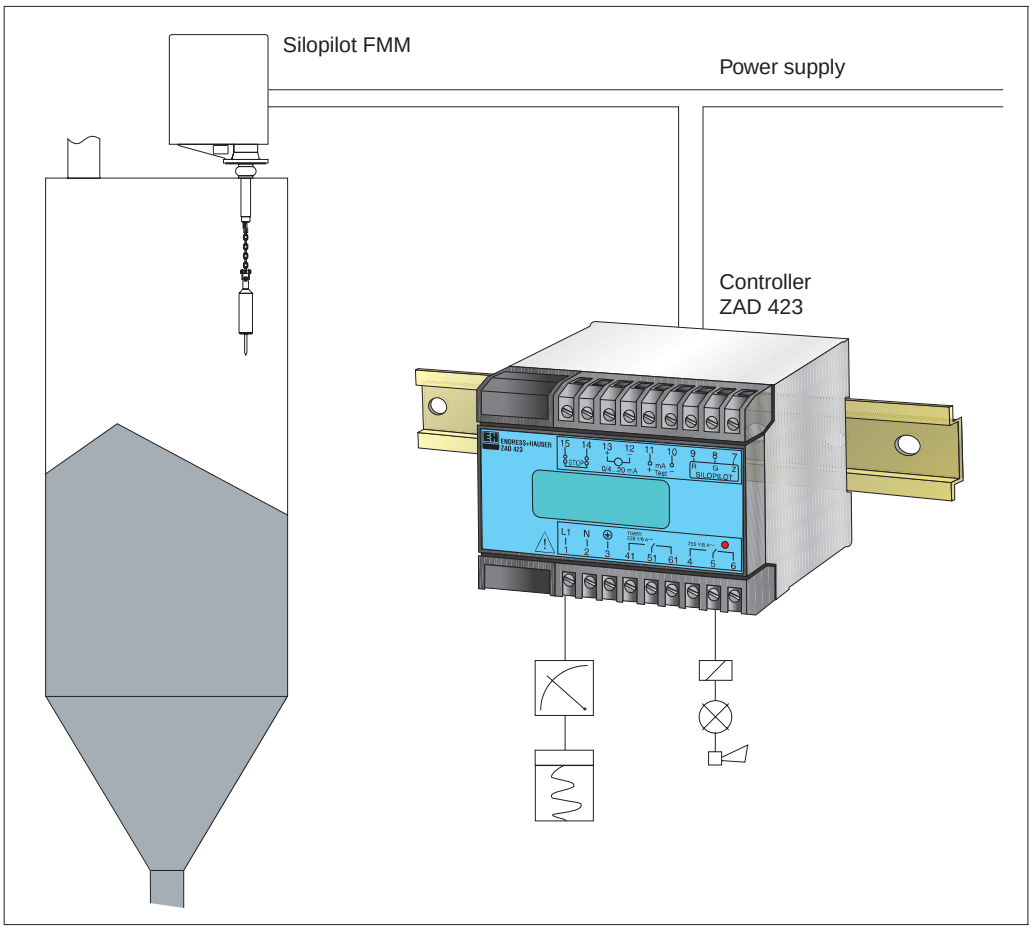


Fig. 1
Measuring system

3.3 Operating principle

Start-up

The integrated time switch (timer) for automatic start-up of the Silopilot can be adjusted in ten minute intervals, ranging from every 10 minutes to 24 hours.
The timer can also be switched off, e.g. during filling, to prevent the sensor weight from being buried.

The Silopilot can also be started manually from the ZAD 423 controller.

Level measurement

The controller is set to the units of distance (= counting steps) with which the Silopilot measures the distance to the surface of the solid (e.g. cm, dm , in, 1/10 ft).
The controller receives a reset pulse from the Silopilot every time measurement begins. It then counts the number of pulses transmitted by the Silopilot. At the end of the measurement cycle, the level in the silo is shown on the digital display of the ZAD 423 controller in the units required (e.g. m, in, ft).

Output signal

The analogue signal (0/4 ... 20 mA) is derived from the digital measurement signal at the end of the measurement cycle. It can be inverted and set to indicate either the level of material or the free space remaining in the silo.

On a fault, the output signal can be selected to
- fall to –10 % (MIN. = –2 mA / +2,4 mA),
- rise to 110 % (MAX. = 22 mA),
- remain unchanged (HOLD).

Limit signals

The integrated relay with potential-free changeover contact can be set to energise when a freely selectable height has been reached and to de-energise at another (two-point control) or else to switch at a limit point.
The relay switching status is shown by an LED.

The relay de-energises on a fault (power failure, defective cable, breakdown of Silopilot).

4 Installation

4.1 Planning

The ZAD 423 controller must be installed in a control room or else in a protective housing. (This must be outside the explosion hazardous area if the Silopilot FMM is used in a dust explosion hazardous area.)

The instrument is in Minipac form for single or row-mounting on a symmetrical rail to EN 50022-35x7.5 or EN 50022-35x15.
A protective housing with ingress protection IP 55 is available for mounting in the open; see accessories.

Note the permissible ambient temperature, which is dependent on the type of mounting.
Avoid aggressive atmospheres and excessive humidity which can cause corrosion to contacts or condensation on the printed circuit board.

See dimensional sketch for dimensions and minimum intervals.

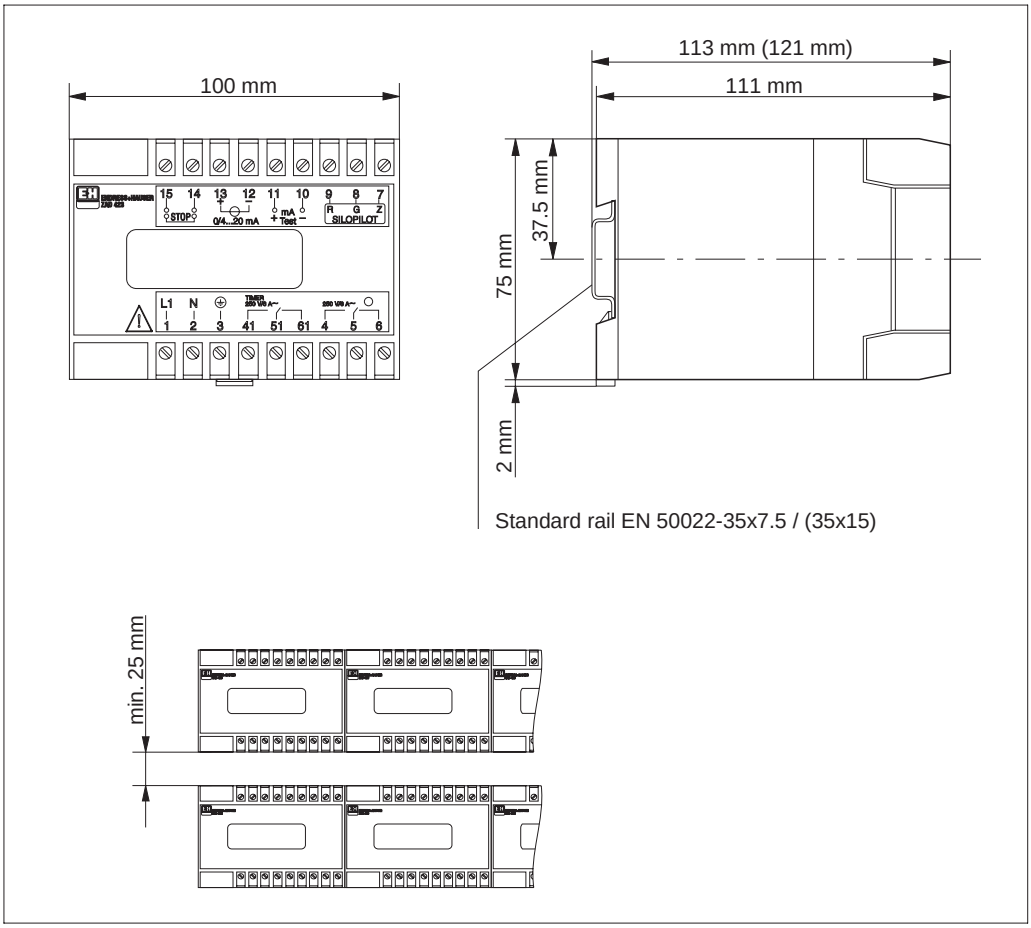


Fig. 2
Dimensional drawing and minimum distance between two rows of instruments

Dimensions in mm
100 mm = 3.94 in

4.2 Mounting

Instrument identification

Before installing, check to see if you have the correct instrument.
Information about the product is given on the nameplate.
Compare the product designation with that given in the product structure.

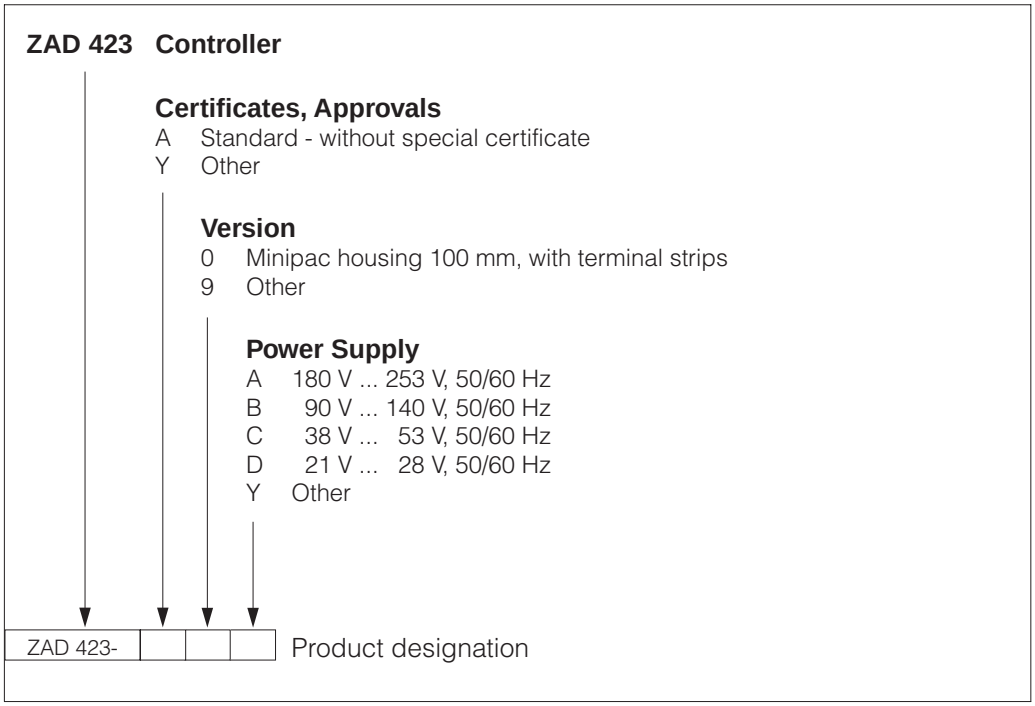


Fig. 3
Product structure

Mounting on the standard rail

See Fig. below
For disposing of packaging see Section 8.6 "Disposal".

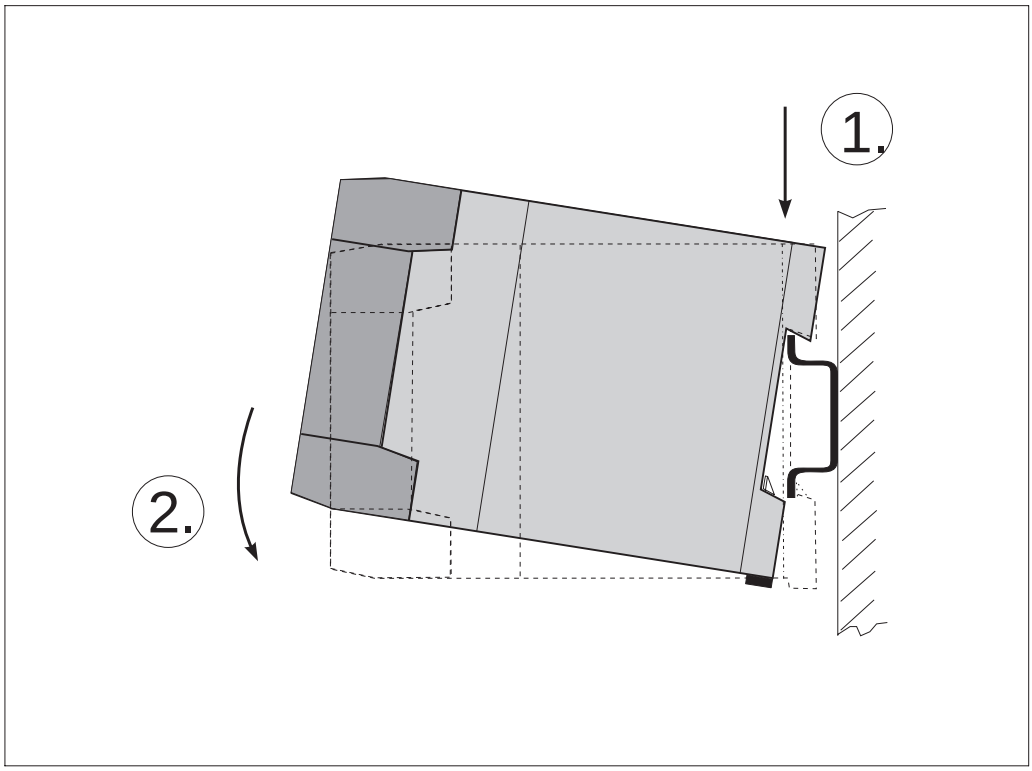


Fig. 4
Mounting
1. place against standard rail
2. tilt front downwards and clip in at back

5 Electrical Connection

Warning!
Some of the connecting cables can carry hazardous contact voltages.
Before connecting up switch off all power to the Silopilot FMM, the ZAD 423 controller and all peripherals (already or still to be connected).

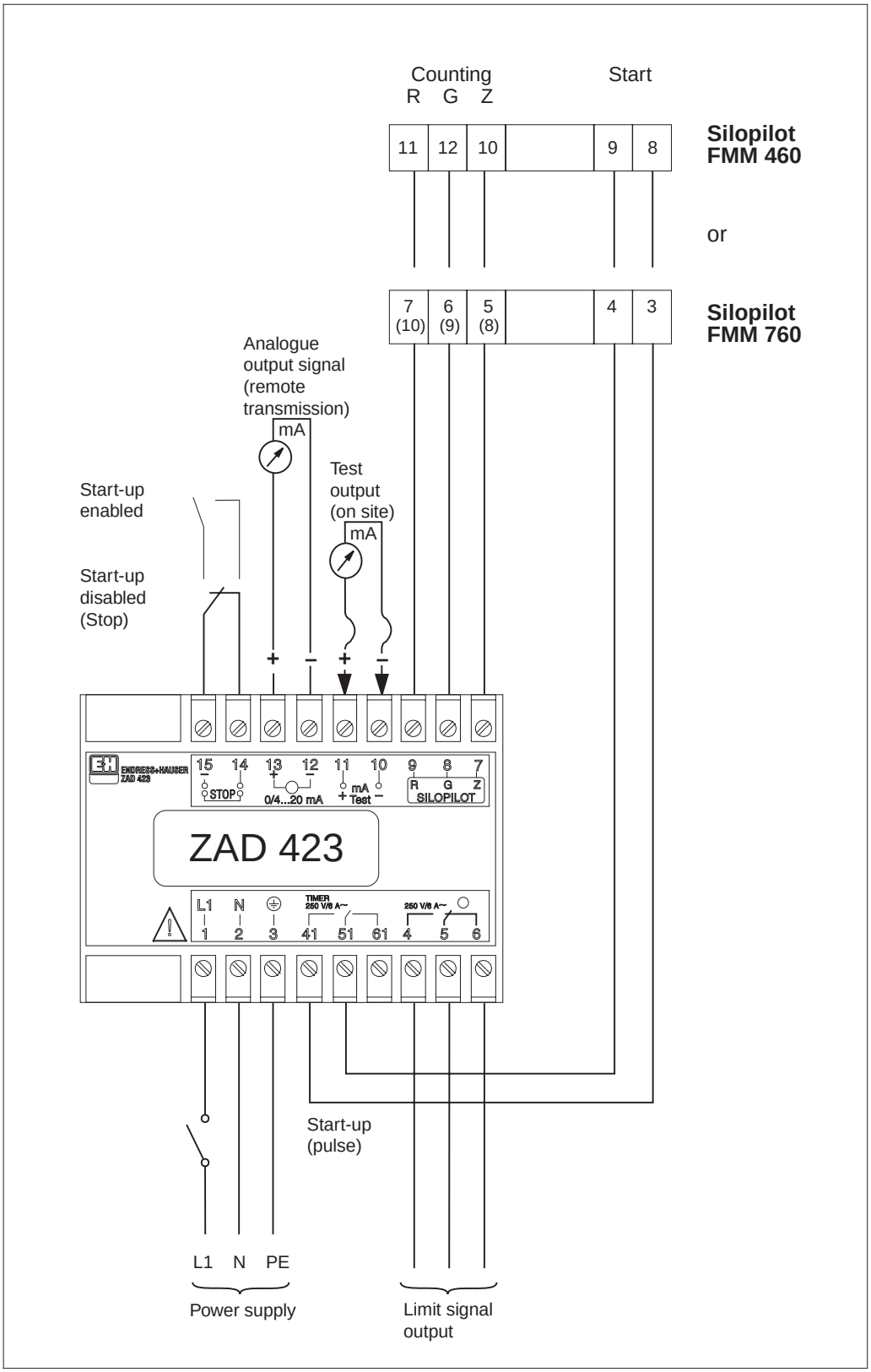


Fig. 5
Electrical diagram

Note!

Note:
- The ZAD 423 controller is to be connected to **one** Silopilot FMM level sensor.
- The ZAD 423 controller and counters must **not** be connected in parallel to the same pulse counting outputs of the Silopilot FMM.
- Only operational low voltages are present at the upper terminal block of the ZAD 423. Terminals 12 and 15 are connected internally.
- Observe all local guidelines covering installation!
- When using screened cable, the screening must be grounded at both ends. Observe all local regulations covering explosion protection if the Silopilot FMM is to be mounted in the explosion hazardous area.

Tools

Usual tools for connecting electrical devices.

5.1 Connecting the Silopilot FMM to the ZAD 423 Controller

Start-up line

(Terminals 41, 51)
To connect the **FMM 460**:
The two-wire cable for the start-up line can be unscreened or screened commercial cable for line voltage.
Cable diameter min. 1.5 mm² / *SWG 17 / AWG 16*, max. 2.5 mm² / *SWG 16 / AWG 14*, (strands with end sleeves).
Cable length max. 250 m / *750 ft* (see FMM 460 operating manual on special procedures for lengths up to 3000 m / *9000 ft*).

To connect to the **FMM 760**:
The two-wire cable for the start-up line can be screened or unscreened commercial cable for low voltages (10 V).
Cable diameter max. 2.5 mm² / *SWG 16 / AWG 14* (strands with end sleeves).
Cable length max. 500 m / *1500 ft*.

Pulse counting line

(Terminals 7, 8, 9)
The three-wire cable for the pulse counting line can be screened or unscreened commercial cable for low voltages.
Cable diameter max. 2.5 mm² / *SWG 16 / AWG 14* (strands with end sleeves).
Cable length max. 500 m / *1500 ft*.

To prevent mutual interference, the start-up and pulse counting lines should be laid as separate cables.

5.2 Disabling the start-up line (Stop)

(Terminals 14, 15)
Connecting Terminals 14 and 15 together disables automatic and manual start-up from the controller. This can be used, e.g. during the filling cycle to prevent the sensor weight of the Silopilot FMM from being buried.

A suitable control switch or relay contact can be connected using screened or unscreened commercial cable or multicore instrumentation cable up to 500 m / *1500 ft*.
Contact load: max. 5 V, max. 1 mA.

5.3 Analogue output signal, current output

(Terminals 12, 13)
Standard 0 … 20 mA or 4 … 20 mA signal for 0 … 100 % measuring range or inverted 100 … 0 % as required.
Connection of non-grounded display units, plotters, limit signal transmitters etc. in series if the total load including the cable resistance is less than 500 Ω.
Screened or unscreened commercial cable or multicore instrumentation cable can be used.
If the output signal must be galvanically isolated from the rest of the circuit we recommend the use of a direct current isolator, e.g. HAA 420 TSP.

5.4 Test output

(Terminals 10, 11)
For direct connection of an ammeter on site to monitor the analogue output signal without interrupting the current output.

5.5 Limit signal output

(Terminals 4, 5, 6)
Note that when connecting other devices to the relay contact, the operation of the limit switch depends on the setting and the level. See Section 6.6 "Limit Signals".

For contact load see Section 9 "Technical Data, Output, Limit Signal".

5.6 Power supply

(Terminals 1, 2, 3)
Note the voltage stated on the nameplate, as well as the voltage tolerances for the power supply and consumption (see Technical Data).
An isolating switch for a power supply should be installed near to the instrument.
A fine-wire fuse is built into the ZAD 423 controller so that the connection of another fine-wire fuse is not required.

Important: The protective earth wire (PE) **must** be connected to Terminal 3.

- Switching to other voltages
  and
- replacing the fine-wire fuse
  see Section 8.3 "Replacing parts".

6 Start-Up

6.1 Initial procedures

For the controller ZAD 423:
- Check for correct wiring
  - to the Silopilot FMM
  - to the peripherals

For the Silopilot FMM on the silo:
- Check for correct wiring
- Note the counting step (1 cm, 5 cm, 1 dm, 1 in or 1/10 ft)
  - FMM 460, nameplate: indicated as "Zähleinheit"
  - FMM 760, nameplate: indicated as "Zählung" (unit)
- FMM 760: set counting to "descend"
- Start up the Silopilot FMM and check operation according to instructions in the appropriate operating manual.

Counting step of the Silopilot FMM

6.2 General information on settings

- Switch on the power supply to the ZAD 423 controller.

When switching on for the first time or after a reset, the instrument displays the following:

Fig. 6
Display after first switching on or after reset

Pushbuttons for calibration are behind the front panel.
The functions of the pushbuttons are printed on the reverse side of the front panel.

- Opening the front panel:

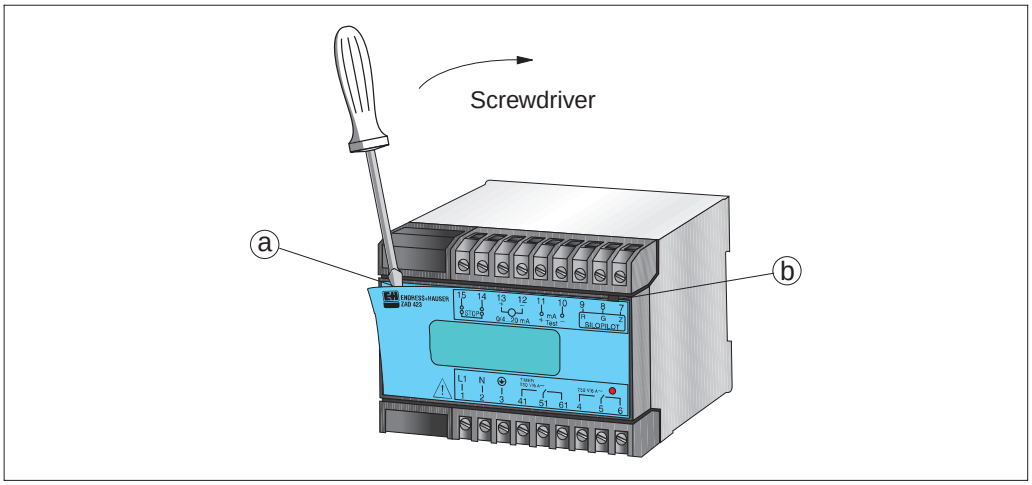
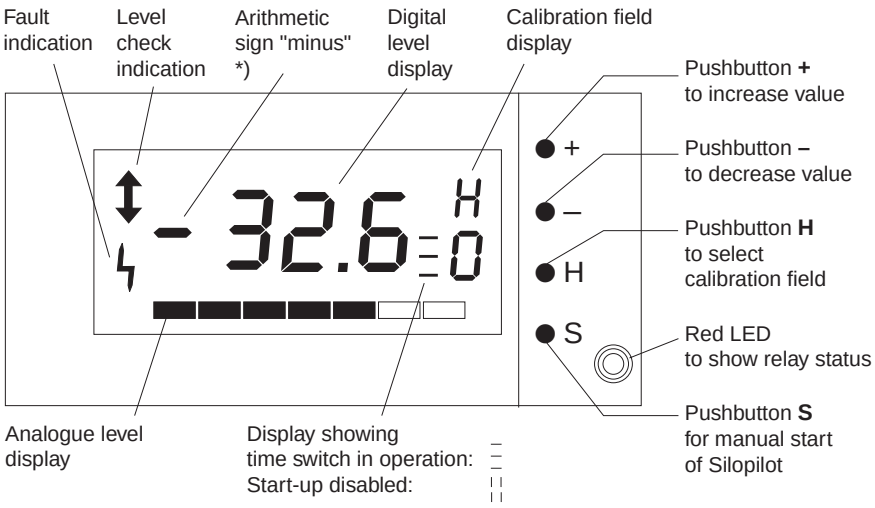


Fig. 7
Opening the front panel



*) Arithmetic sign –, if the weight falls below the preset zero point (H 1) of measurement level.

Fig. 8
Pushbuttons and display field behind front panel

The ZAD 423 controller is set using a row of 10 fields:

Calibration field	H 0	H **1**	H **2**	H **3**	H **4**
Description	Measured value display	Empty calibration	Full calibration	Output signal	Distance A (Offset)
Calibration modes	None *)	Height E (Fig. 10) *)	Height F (Fig. 10) *)	0 = 4…20 mA 1 = 20…4 mA 2 = 0…20 mA 3 = 20…0 mA	Height A (Fig. 10) *)
Factory setting (Reset)	–9999	50.0	45.0	0	0.7

Calibration field	H 5	H **6**	H **7**	H **8**	H **9**
Description	Limit signal Relay energised	Limit signal Relay de-energised	Output signal on fault	Counting step of Silopilot	Time switch (Timer)
Calibration modes	Height of limit point for relay energised (Fig. 10) *)	Height of limit point for relay de-energised (Fig. 10) *)	0 = –10 % 1 = 110 % 2 = remains un-changed	0 = 1 dm 1 = 5 cm 2 = 1 cm 3 = 1 in 4 = 1/10 ft	Start-up cycle h. min **)
Factory setting (Reset)	40.0	5.0	0	0	0.00

Fig. 9
The 10 Calibration fields

*) For fields H **0**, H **1**, H **2**, H **4**, H **5**, H **6**:

The units	are set	by the counting step in H **8**.
m (meter)	with counting step	1 cm, 5 cm, 1 dm
in (inch)	with counting step	1 in
ft (foot)	with counting step	1/10 ft

The decimal point depends on the counting step used.

**) Adjustable in 10-minute intervals;
hours to the left of the point,
minutes to the right of the point.

- **Selecting the fields:**
  Press pushbutton **H** so long or so often, until the correct field is shown under the letter H.

- **Entering the values or numbers:**
  Press pushbutton **+** or **–** so long or so often, until the correct number is shown.

- **Storing the value:**
  Press pushbutton **H** again after setting the value.

- **Calling up the stored value:**
  Press pushbutton **H** so long or so often, until the correct field is shown under the letter H.

- **Reset**
  Press pushbuttons **H** and **+** at the same time for a min. 4 s, then all values in the fields are reset to factory values.

Start with the calibration in Section 6.3 "Basic settings".

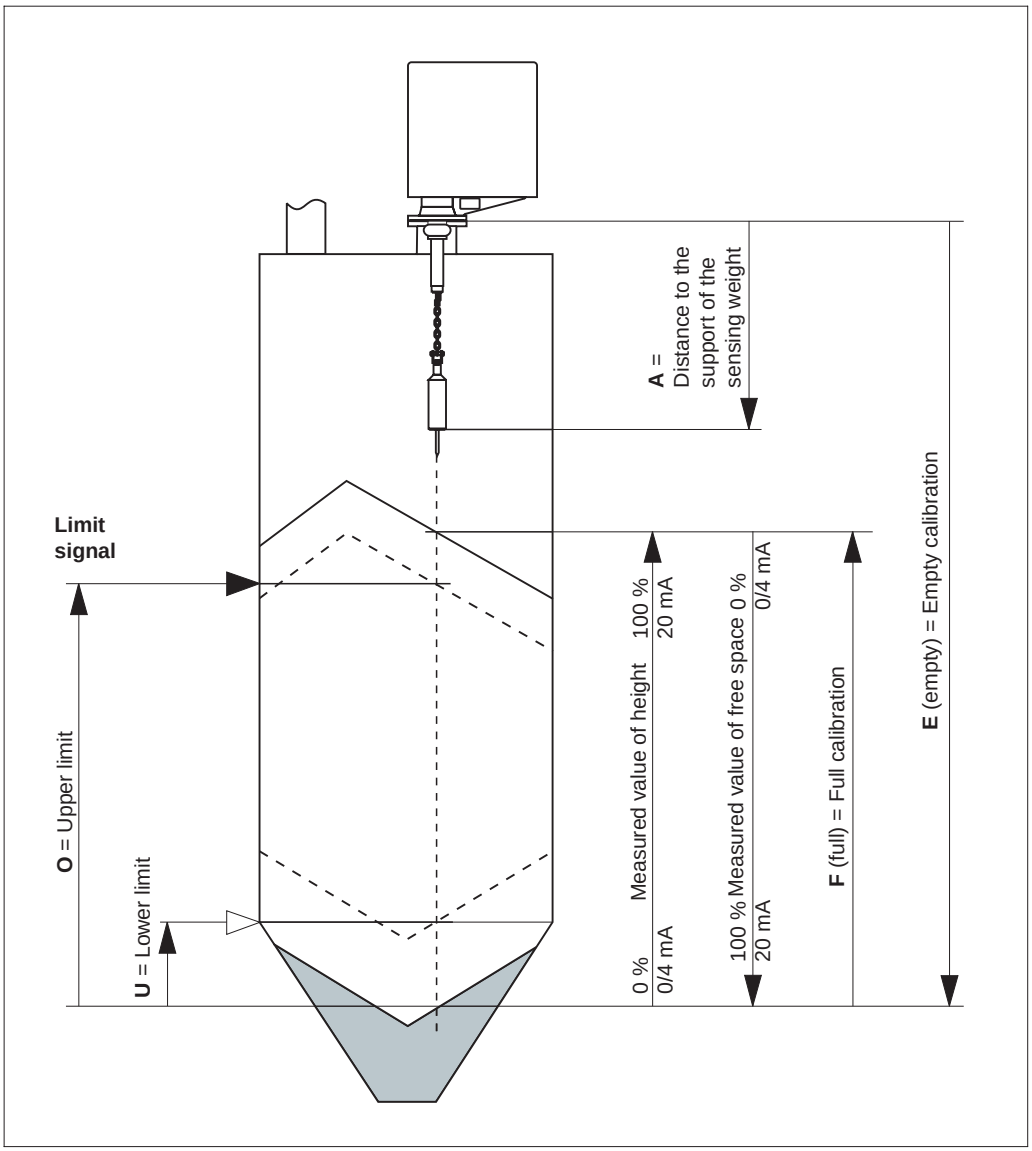


Fig. 10
Calibration variables

6.3 Basic settings

6.3.1 Setting the counting step

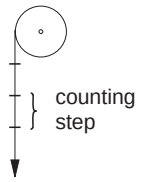
Note!

Note:
The counting step is distance per pulse which the Silopilot counts as the sensing weight is lowered into the silo. The counting step (= "Zählung / Zähleinheit / unit") is

- on the nameplate of the Silopilot FMM
  or
- above the order designation (e.g. on the delivery note):

FMM 460(Z)-**#1**… or FMM 460(Z)-**#2**…			=	1 dm ❑
FMM 460(Z)-**#3**… or FMM 460(Z)-**#4**…			=	1/10 ft ❑
FMM 760(Z)-**A**…	or FMM 760(Z)-**B**…	or FMM 760(Z)-**C**…	=	1 dm ❑
FMM 760(Z)-**D**…	or FMM 760(Z)-**E**…	or FMM 760(Z)-**F**…	=	5 cm ❑
FMM 760(Z)-**G**…	or FMM 760(Z)-**H**…	or FMM 760(Z)-**J**…	=	1 in ❑
FMM 760(Z)-**K**…	or FMM 760(Z)-**L**…	or FMM 760(Z)-**M**…	=	1/10 ft ❑
FMM 760(Z)-**N**…			=	1 cm ❑

Set counting step

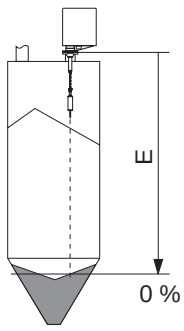
Step	Calibration field ● H	Entry ● + ● –		Example	Remarks
1	H **8**	Number corresponding to counting step of connected Silopilot FMM	0 = 1 dm 1 = 5 cm 2 = 1 cm 3 = 1 in 4 = 1/10 ft	0 = step 1 dm	
2	H 9				Stores entry

6.3.2 Empty calibration

Note!

Note:
When defining the zero point for measurement, take into account
- the discharge funnel formed by the bulk solid
- the mounting point of the Silopilot.

Procedure for empty calibration

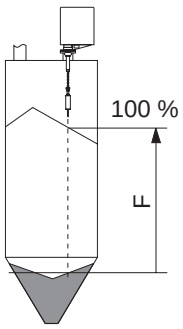
Step	Calibration field ● H	Entry ● + ● –		Example	Remarks
1	H **1** 	Height E from flange to zero point of measurement (empty silo)	in **m** for steps of 1 cm 5 cm 1 dm in **in** for steps of 1 in in **ft** for steps of 1/10 ft	18.7 (m)	
2	H 2				Stores entry

6.3.3 Full calibration

Note:
When defining the maximum height (100%) for measurement, take into account
- the mounds formed by the bulk solid and
- the mounting point of the Silopilot.

The maximum height must be below the tip of the sensing weight of the Silopilot FMM.

Note!

Step	Calibration field ● H	Entry ● + ● –		Example	Remarks
1	H **2** 	Height F from zero point of measurement (empty silo) to maximum height	in **m** for steps of 1 cm 5 cm 1 dm in **in** for steps of 1 in in **ft** for steps of 1/10 ft	17.2 (m)	
2	H **0**				Stores entry
3		**Press Pushbutton ● S** min. 3 s			Silopilot will be activated
				12.3	Height is shown *)

Procedure for full calibration

*) If the sign ϟ for a fault is shown to the left of the display field, then the Silopilot is incorrectly connected or is counting when ascending. Check the wiring and settings of the Silopilot.

If the sign **–** is shown in front of the measured value, then the sensing weight is below the preset zero point of measurement.

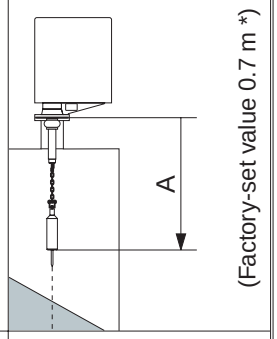
6.4 Silopilot design

The factory settings of the ZAD 423 take into account the dimensions of a Silopilot FMM 760 with standard wiper rods and sensing weight, i.e. 0.7 m from the flange to the lower edge of the sensing weight (without spike), if the counting step is set to 1 dm.

For small silos, a change of the factory setting "Offset" in order to increase measurement accuracy is **only** of use for:
- other counting steps
- FMM 760 with extended wiper rods
- FMM 760 with other sensing weight
- FMM 460

See corresponding dimensional sketches on the Silopilot and sensing weight.

Taking account of the model

Step	Calibration field ● H	Entry ● + ● –		Example	Remarks
1	H **4** **Offset**	Distance A from flange to the support of the sensing weight	in **m** for steps of 1 cm 5 cm 1 dm in **in** for steps of 1 in in **ft** for steps of 1/10 ft	1.1 (m) for Silopilot with extended wiping rod	 (Factory-set value 0.7 m *)
2	H 5				Stores entry

*) The factory settings change when switching to other counting steps:

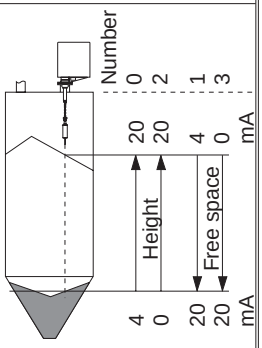
Step	1 dm	—	Factory setting	0.7 m
Step	1 cm	—	Factory setting	0.07 m
Step	5 cm	—	Factory setting	0.35 m
Step	1 in	—	Factory setting	7 in (0.18 m)
Step	1/10 ft	—	Factory setting	0.7 ft (0.21 m)

6.5 Analogue output signal

6.5.1 Selecting the output signal

The preset height F in H 2 represents a measuring range of 100%,
which can be transmitted as an analogue output signal (load-independent current):

- as a level signal 0 % level = 0 or 4 mA,
  100 % level = 20 mA
  or inverted
- for showing the free space silo empty = 20 mA,
  silo full = 0 or 4 mA

Step	Calibration field ● H	Entry ● + ● –		Example	Remarks
1	H **3**	Number corresponding to required output signal	Height: 0 = 4 … 20 mA 2 = 0 … 20 mA Free space: 1 = 20 … 4 mA 3 = 20 … 0 mA *)	0 = Output signal 4 … 20 mA for height 0 … 100 %	
2	H 4				Stores entry

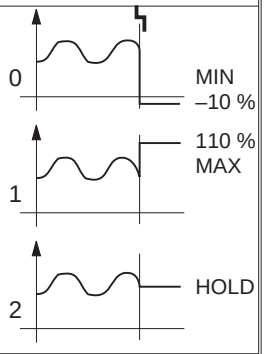
Select output signal

*) 100 % free space is only the empty space from the defined 100-% level to the zero point of measurement and not the free space from the sensing weight or from the silo roof to the zero point.

6.5.2 Setting the response on fault

The ZAD 423 controller monitors the cable connection to the Silopilot.
A fault is shown in the display field if no pulse for reset or counting comes from the Silopilot after a start-up from the controller.
How the analogue output signal is to respond depends on the devices connected.
You can select:

- MIN = output signal goes to –10 % (–2 mA or +2.4 mA)
- MAX = output signal goes to 110 % (22 mA)
- HOLD = output signal remains unchanged

Step	Calibration field ● H	Entry ● + ● –		Example	Remarks
1	H **7**	Number corresponding to required response of output signal	0 = MIN 1 = MAX 2 = HOLD	0 = MIN Output signal on fault –10 %	
2	H 8				Stores entry

Setting response on fault

6.6 Limit signals

There is a relay in the ZAD 423 controller with a change-over contact, which can be set to minimum or maximum fail-safe.
Minimum fail-safe means that the relay de-energises on reaching the *lower* limit, on a fault or on power failure.
Maximum fail-safe means that the relay de-energises on reaching the *upper* limit, on a fault or on power failure.

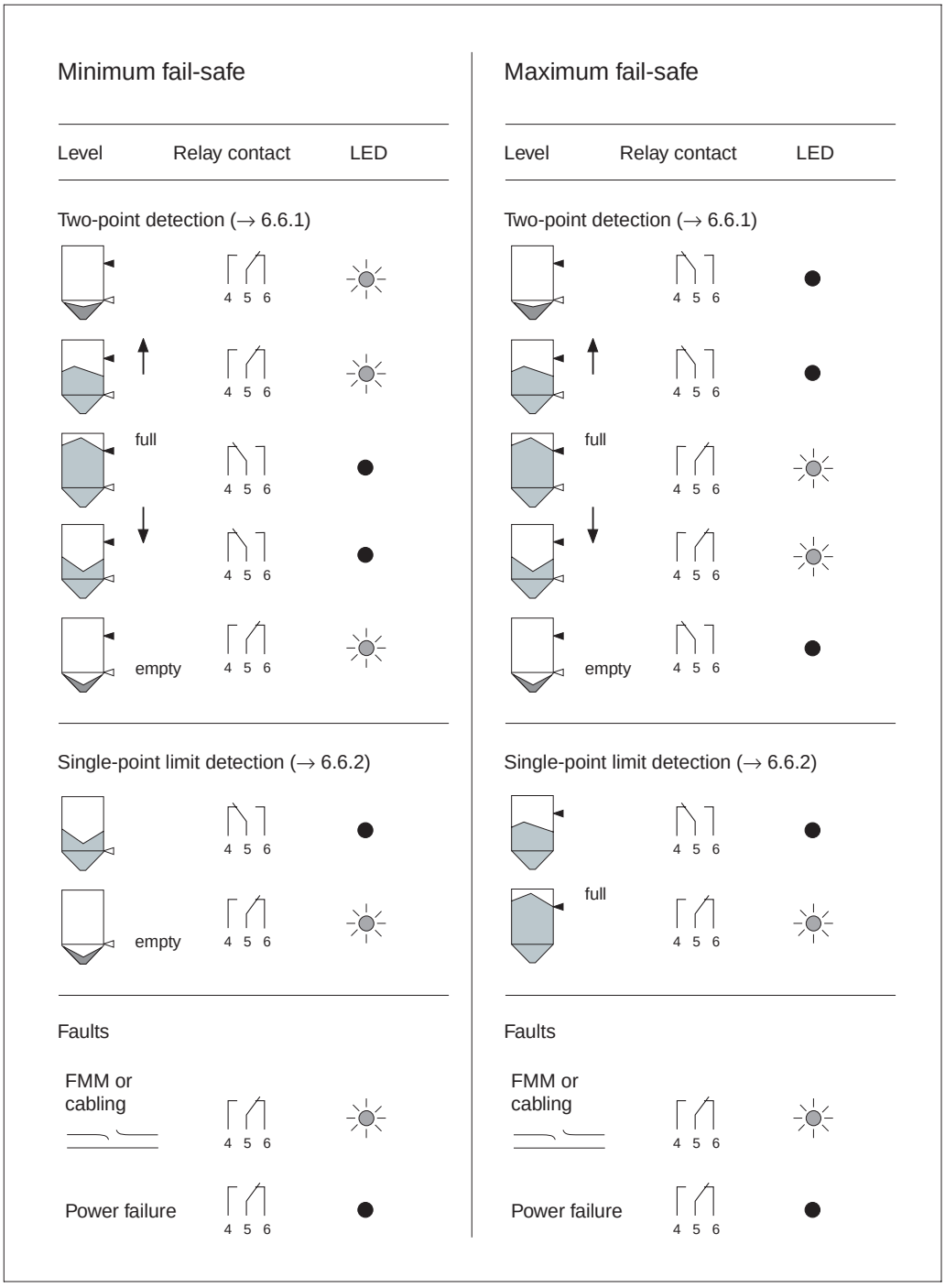


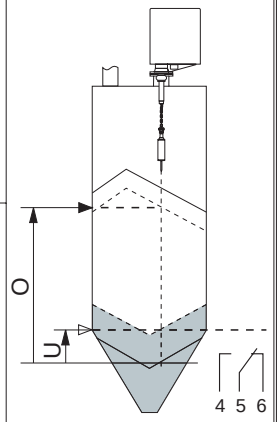
Fig. 11
Function of the limit signals (relay and LED) for two-point detection or single-point limit detection depending on the fail-safe mode and level

The **lower** limit cannot be set lower than that given in H 1 as the defined height for the zero point in the silo for an empty calibration. Negative numbers cannot be entered.

The **upper** limit can be higher than that given in H 2 as the defined height in the silo for a full calibration. It cannot, however, be higher than the retracted sensing weight.

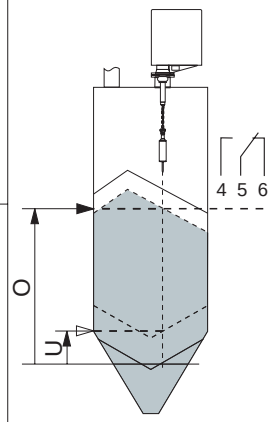
6.6.1 Setting two-point detection

Two-point detection with ***minimum*** fail-safe mode:

Step	Calibration field ● **H**	**Entry** ● + ● –		**Example**	**Remarks**
1	H **5** Relay **ON** LEVEL	Height O from zero point of measurement (empty silo) to upper limit	in m for steps of 1 cm 5 cm 1 dm in **in** for steps of 1 in in **ft** for steps of 1/10 ft	16.5 (m)	
2	H **6** Relay **OFF** LEVEL	Height U from zero point of measurement (empty silo) to lower limit		1.0 (m)	
3	H 7				Stores entry

Two-point detection, setting minimum fail-safe

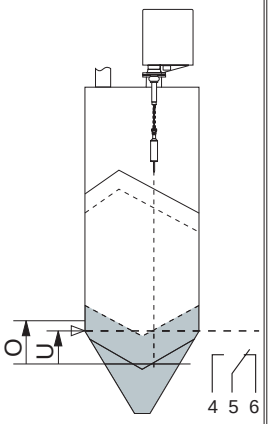
Two-point detection with ***maximum*** fail-safe mode:

Step	**Calibration field ● H**	**Entry** ● + ● –		**Example**	**Remarks**
1	H **5** Relay **ON** LEVEL	Height U from zero point of measurement (empty silo) to lower limit	in **m** for steps of 1 cm 5 cm 1 dm in **in** for steps of 1 in in **ft** for steps of 1/10 ft	0.5 (m)	
2	H **6** Relay **OFF** LEVEL	Height O from zero point of measurement (empty silo) to upper limit		16.2 (m)	
3	H 7				Stores entry

Two-point detection, setting maximum fail-safe

6.6.2 Setting single-point detection

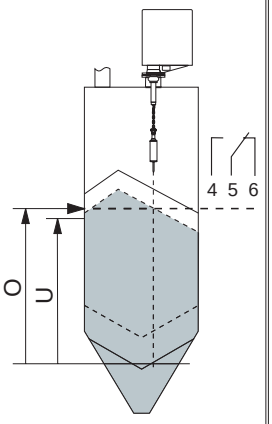
Limit detection with ***minimum*** fail-safe mode:

Step	Calibration field ● **H**	Entry ● + ● –		Example	Remarks
1	H **5** Relay **ON** LEVEL	Height O from zero point of measurement (empty silo) to just above the limit *)	in m for steps of 1 cm 5 cm 1 dm in **in** for steps of 1 in in **ft** for steps of 1/10 ft	1.2 (m)	
2	H **6** Relay **OFF** LEVEL	Height U from zero point of measurement (empty silo) exactly to limit *)		1.0 (m)	
3	H 7				Stores entry

Limit detection, setting minimum fail-safe

*) Height U = required switchpoint for minimum limit detection
Height O = *somewhat higher* than the required minimum limit

Limit detection with ***maximum*** fail-safe mode:

Step	Calibration field ● **H**	Entry ● + ● –		Example	Remarks
1	H **5** Relay **ON** LEVEL	Height U from zero point of measurement (empty silo) to just below the limit *)	in **m** for steps of 1 cm 5 cm 1 dm in **in** for steps of 1 in in **ft** for steps of 1/10 ft	16.1 (m)	
2	H **6** Relay **OFF** LEVEL	Height O from zero point of measurement (empty silo) exactly to limit *)		16.3 (m)	
3	H 7				Stores entry

Limit detection, setting maximum fail-safe

*) Height O = required switchpoint for maximum limit detection
Height U = *somewhat lower* than the required maximum limit

The difference between the heights O and U is the **switching hysteresis**.
The difference in height to be chosen for reliable switching depends on:
- grain-size of the material,
- slope of the mound,
- movement of the material,
- sensing weight, etc.

6.7 Time switch (Timer)

The time switch allows the Silopilot to be started up at regular intervals to measure level. The frequency of start-ups depends on the application.

In order to keep current consumption and wear to a minimum, the Silopilot should not be in operation more than necessary. The start-up cycles should therefore be set as far apart as possible. Start-up intervals between 10 minutes and 24 hours can be set.

Note that for the FMM 760 (Z) with a single-phase motor and for start-up cycles of less than an hour that the minimum permissible start-up cycle is a function of operating temperature, counting step and level. See operating manual FMM 760.

The start-up cycle begins after calibrating in Field H 9, when pushbutton H is again pressed (---> H 0).

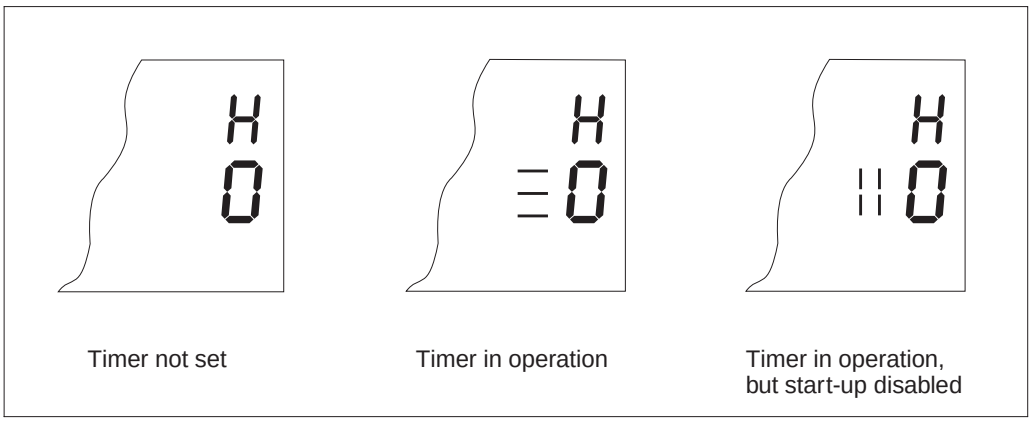
Step	Calibration field ● **H**	**Entry** ● **+** ● **–**		**Example**	**Remarks**
1	H **9** **hh.mm**	Start-up cycle in 10-minute intervals	Minimum 10 minutes = 0.10 Maximum 24 hours = 24.00	1.30 = Start-up pulse every 1½ hours	Setting 0.00 = timer disabled, no automatic start-up
2	H **0**				Stores entry, timer begins

Setting the start-up cycle

On a power failure (> 0.2 s) the timer is interrupted; it begins again when the power supply is restored. Thus it is possible that the start-up for measuring level is not always at the same time, e.g. on the hour.

If the start-up pulse is disabled by connecting together Terminals 14–15 (see Section 5.2) the timer is not affected.
The controller simply omits to supply a start pulse.

Display in the display field:



Timer not set | Timer in operation | Timer in operation, but start-up disabled

Fig. 12
Display of timer function

6.8 Display of the measured value

For measured value display

Step	Calibration field ● H	Procedure	Remarks
1	H **0** **LEVEL**	**Press Start pushbutton ● S** for min. 3 s	Silopilot carries out a level start-up (descent takes max. 5 minutes) *)
2		Check display	See Fig. below. **)
3		Close front panel	

*) If the display for level start-up ↕ is not shown, then the start is disabled.
See Section 5.2 "Disabling the start-up line (Stop)".

**) If the display for fault ϟ is shown, then refer to Section 8 "Trouble-shooting, repairs".
If the level display, the analogue output signal or the relay status display does not appear to be correct, then check the height in the silo and the settings on the ZAD 423 controller (H 1 to H 9).

The measured value for the level display remains stored if the power fails.
The display shows the same value when the power is again switched on.

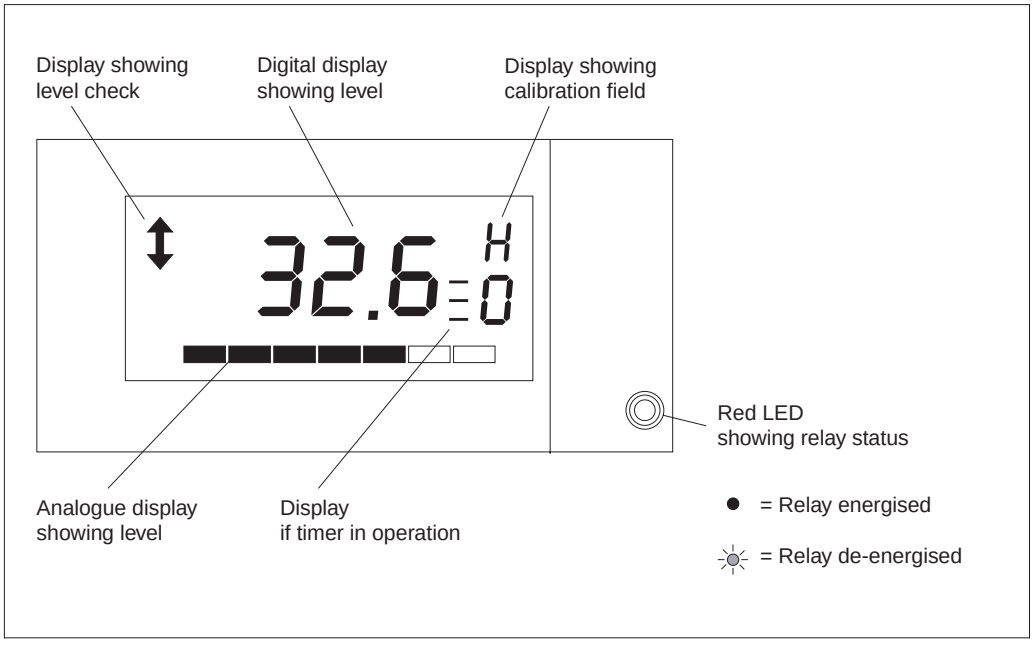


Fig. 13
Display field

7 Maintenance

Regular maintenance of the ZAD 423 controller is not required.
See the appropriate operating manual for carrying out maintenance to the Silopilot FMM.

8 Trouble-shooting, repairs

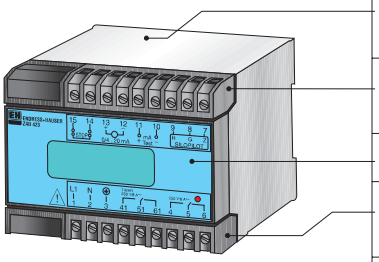
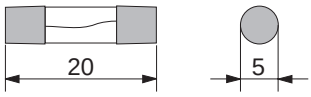
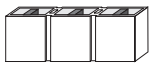
The following faults in the measuring system will be indicated:
- damage to the signal cables to the Silopilot or incorrect connections
- power failure to the Silopilot
- no start-up of the Silopilot

The following table will help in trouble-shooting.

8.1 Trouble-shooting table

Error function / display	Possible cause	Remedy
No display in the display field	Power failure (No power supply or power below tolerance)	Check power supply
	Fine-wire fuse in instrument blown	Replace fuse; if fuse blows again, replace instrument
	Jumper for changing voltage in the instrument is incorrectly inserted or missing	Insert the jumper correctly
Display showing fault and –9999	Silopilot FMM not operating	Check signal cables to the FMM Check power supply for the FMM Control switch on FMM to "On"? Sensing weight buried?
Display remains constant	Silopilot FMM not operating; Start-up continually disabled Timer (H 9) shows 0.00	Enable timer Set timer
Display flashes	Measuring range exceeded	Check settings (especially H 8) and carefully carry out the procedure in the operating instructions
Incorrect measurement	Counting steps on Silopilot FMM and controller are different	Check counting step on the FMM and change on the ZAD 423 if necessary (H 8)
	Values for empty and full silo were not correct	Carry out setting as exactly described in these operating instructions (H 1, H 2)
	Other dimensions of FMM not included	Carry out setting as exactly described in these operating instructions (H 4)
Incorrect fail-safe response of the limit signal	Values U and O transposed	Carry out setting as exactly described in these operating instructions (H 5, H 6)

8.2 Spare parts

Figure	Description	Order number
	Complete housing without front panel	517017-0000
	9-pole terminal strip for signal side (above)	917169-0000
	Front panel	517015-0114
	9-pole terminal strip for power supply side (below)	917168-0000
	Fuse in power supply loop for 180 V ... 253 V: T 50 mA for 90 V ... 140 V: T 160 mA for 38 V ... 53 V: T 200 mA for 21 V ... 28 V: T 500 mA	 013499-0000 016189-0000 014739-0000 014741-0000
	Jumper block for power supply change-over	013835-0003

8.3 Replacing parts

Parts may be replaced **by trained and authorised personnel only!**

Warning!
Some of the connecting cables to the ZAD 423 controller can carry hazardous contact voltages. Before carrying out any procedure

- Switch off the power supply to:
  - the Silopilot FMM,
  - the ZAD 423 controller,
  - the peripherals

Removing terminal blocks

See Fig. 14.

Note the terminal numbers when plugging in: 1 ... 6 below, 7 ... 15 above.
The special design ensures that the terminal block with the power supply connection cannot be inserted on the low-voltage side of the ZAD 423.

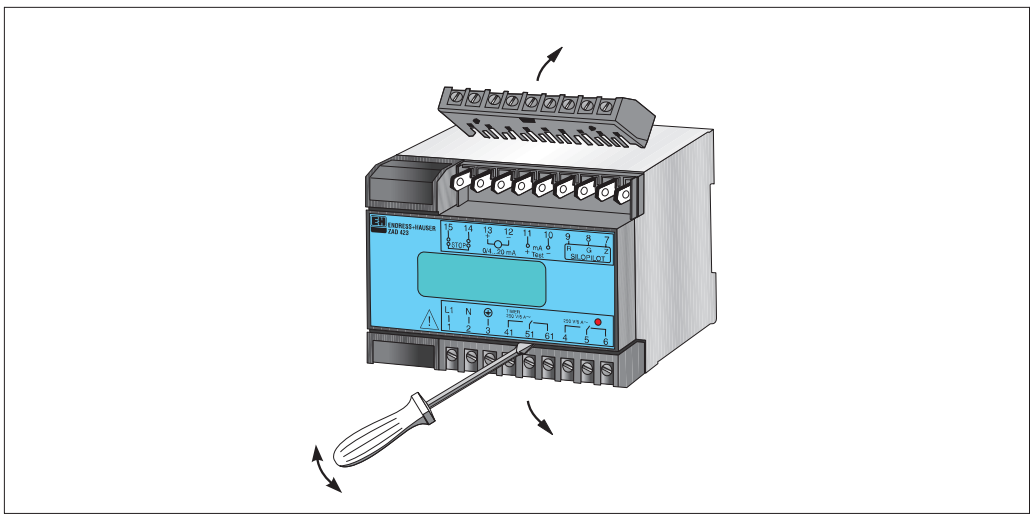


Fig. 14
Removing terminal blocks

See Fig. 15.
Plugging the instrument on the standard rail, see Section 4.2 "Mounting".

Removing the instrument from the standard rail

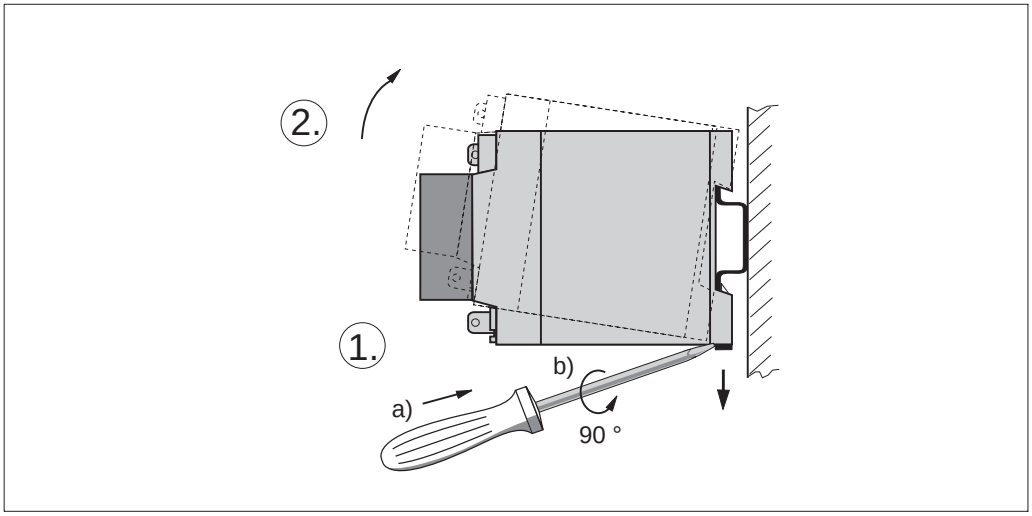


Fig. 15
Removing the instrument from the standard rail

See Fig. 16.
Ensure that the name plate of the housing is upwards when inserting.

Removing the electronics from the housing

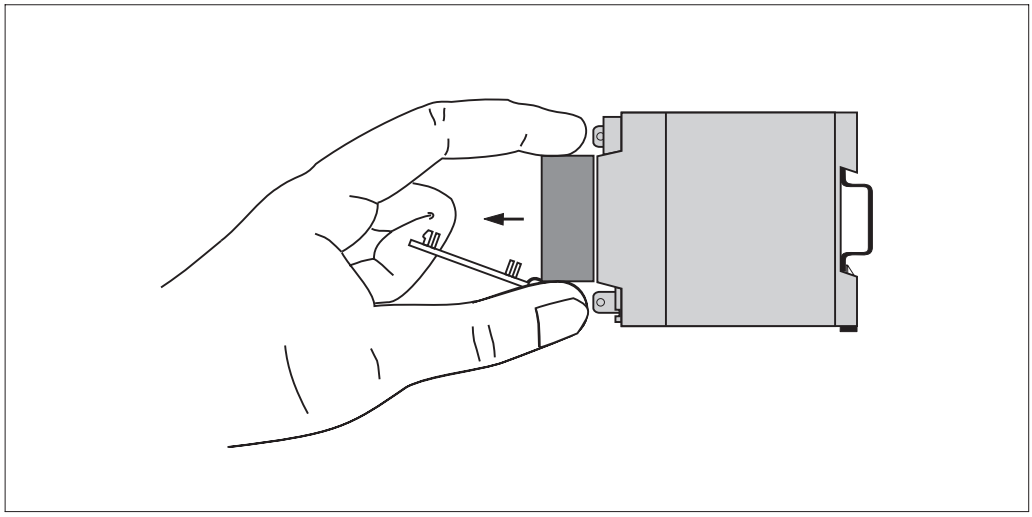


Fig. 16
Removing the electronics from the housing

See Fig. 17.
The integrated fine-wire fuse is on the board next to the transformer.
Use only a suitable fine-wire fuse.
See label on the transformer and spare part list.

Replacing the fuse

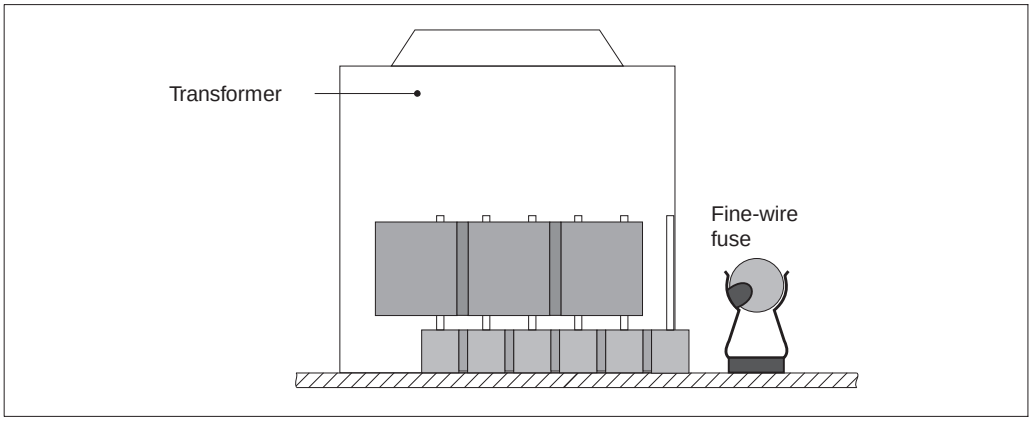


Fig. 17
Replacing the fuse

Changing the voltage

See Fig 18.

The voltage ranges can be changed:

Voltage	180 … 253 V	<--- change-over to --->	90 … 140 V
Fine-wire fuse	50 mA	<--- replace with --->	160 mA

Voltage	38 … 53 V	<--- change-over to --->	21 … 28 V
Fine-wire fuse	200 mA	<--- replace with --->	500 mA

Voltage ranges can be changed by changing the position of the jumper block on the board in front of the transformer:
- Remove the green jumper block from the six-pin plug and press it fully down onto the plug as shown in Fig. 18.
- Replace the fine-wire fuse for one appropriate to the new voltage range.

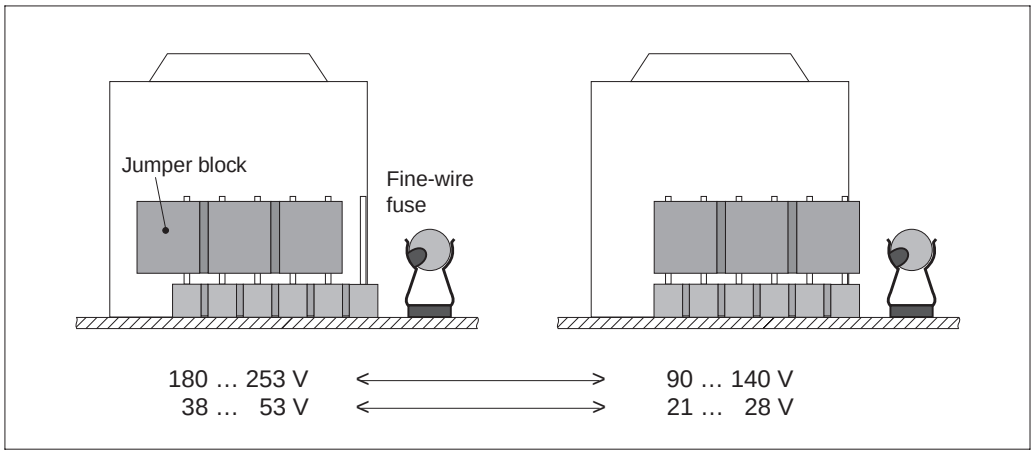


Fig. 18
Changing the voltage range and replacing the fine-wire fuse

8.4 Checking

When an error has been remedied,
- Press the start pushbutton **S** for a min. 3 s

When the test run is successfully completed, the measuring system is ready for operation.

In the event that the level display, analogue signal or the relay status display is incorrect, check all settings on the ZAD 423 controller (H 1 to H 9).

8.5 Returning for repair

General information:
When returning an instrument to Endress+Hauser for repair, please note the following:

Cleaning

Remove all residue which may be present.
This is especially important if the medium is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.
No instrument should be returned to us without first completely removing all dangerous material as it can, e.g. penetrate into scratches or diffuse through plastic.

Information on material and its defect

Please enclose with the instrument:
- an exact description of the material in which the sensor was used
- a description of the properties of the material
- a brief description of the fault.

When sending back a ZAD 423 controller we also require:
- the complete order designation of the Silopilot FMM to which it was connected.

This information enables us to diagnose the error and therefore reduce your costs.

Thank you for your co-operation.

8.6 Disposal

Packing

All sales and transportation packaging used by Endress+Hauser complies with the German packaging regulations covering its re-use and recycling.

Instruments

For a small charge, Endress+Hauser will accept all instruments originally produced by its product centres for recycling as specified by German regulations on the disposal of electronic waste.
Before returning, please carefully remove any residue from the sensors if the material is dangerous to health.
Delivery, carriage paid, to Endress+Hauser, Hauptstraße 1, 79689 Maulburg, Germany.

9 Technical Data

General specifications

Manufacturer	Endress+Hauser GmbH+Co.
Instrument family	Silopilot
Designation	ZAD 423 controller
Function	Controlling a Silopilot FMM and signal evaluation

Application

Level measurement with the Silopilot electromechanical level system	Regular request for the height in a silo, preferably bulk solids; Digital display of height, converting the digital signal into an analogue signal for remote transmission, registering of limit status

Operation and system design

Measuring principle	Measuring the free space from the silo roof to the surface of the material in pre-defined intervals. Converting the intervals into a digital display of height and into a level or free-space-proportional analogue signal
Modularity	Level measuring system, consisting of: Silopilot FMM on the silo and the ZAD 423 controller in the control room
Signal processing	Countdown of the pulse step values coming from the Silopilot, stored until the next measurement cycle
Galvanic isolation	Between power supply and electronics; between electronics and relay contacts

Input

Measured value	Number of pulses / height in subdivided steps
Measuring range	1 … 9999 pulses, for every Silopilot FMM version

Output

Output signal	On the display: digital display of level Analogue signal for remote transmission: 0 / 4 … 20 mA for 0 … 100 % of level, Can be inverted for displaying free space
Signal on fault	Adjustable: –10 % (–2 / +2.4 mA) or 110 % (22 mA) or unchanged
Load	Max. 500 Ω, including cable
Limit signal, Fail-safe circuit	Potential-free changeover contact, maximum contact load U~ 250 V, I~ 6 A, P~ 1500 VA at cos φ = 1, 750 VA at cos φ ≥ 0.7 U⎓ 250 V, I⎓ 6 A, P⎓ 200 W Minimum or maximum quiescent current protection
Start signal for Silopilot	Potential-free changeover contact, maximum contact load U~ 250 V, I~ 6 A, P~ 1500 VA at cos φ = 1, 750 VA at cos φ ≥ 0.7 U⎓ 250 V, I⎓ 6 A, P⎓ 200 W Pulse width 350 ms

Accuracy

Reference conditions	Temperature T = 20 °C,
Measured error	Digital display: max. 1 pulse Analgoue output: < 0.4 %
Repeatability	< 0,1 %
Hysteresis	< 0.1 %
Settling time	Approx. 3 s after the end of the counting pulse from the Silopilot
Long-term drift	Analogue output: < 0.1 %

Installation

Operating conditions

Mounting	On 35 x 7.5 or 35 x 15 rail standard to EN 50022 in a control cabinet or protective housing

Continued next page

(Operating conditions continued)

Environmental conditions

Ambient temperature range	For single mounting: –20 °C … +60 °C *(0 … 140 °F)* For row mounting: –20 °C … +50 °C *(0 … 120 °F)* In protective housing: –20 °C … +50 °C *(0 … 120 °F)*
Limiting temperature range	–25 °C … +70 °C *(–10 … 160 °F)*
Storage temperature range	–40 °C … +85 °C *(–40 … 180 °F)*
Climatic class	Class C, climatic protection to EN 68068, EN 60721
Ingress protection	Housing IP 40, terminals IP 20 to EN 60529
Vibration resistance	To IEC 68, Part 2-6, 10 … 55 Hz, 0.15 mm
Electromagnetic compatibility	Interference immunity to EN 50082-2 and industrial standard NAMUR (field strength 10 V/m), Interference emission to EN 50081-1

Mechanical construction

Design	Minipac housing, 100 mm wide, for row mounting on a standard rail
Dimensions	See dimensional sketch on Page 7
Weight	0.5 kg (1.1 lbs)
Materials	Housing ABS Terminal blocks ABS Front panel PA
Electrical connection	One terminal block for connecting the signal cables with function low voltage, one terminal block for connecting the power supply and relay contacts: for max. 2.5 mm^2 strands in end sleeves A 2.5 - 7 to DIN 46228. Cable: commercial installation cable

User interface

Display field	LCD, 4 characters, 12 mm high, for digital display of level in preset units of length Bargraph, 40 mm long, for analogue display 0 … 100 % Symbols for showing the control field, time switching mode, start-up and faults
LED	1 red LED for showing relay status
Pushbuttons	3 pushbuttons to select one of 10 control fields and to enter calibrating values 1 pushbutton for manual start-up of the Silopilot behind the folding front panel to protect against unauthorised use
Quick operating instructions	On the reverse of the front panel

Power supply

Power supply, versions	180 … 253 V, 50 / 60 Hz; <--- switchable ---> 90 … 140 V, 50 / 60 Hz 38 … 53 V, 50 / 60 Hz; <--- switchable ---> 21 … 28 V, 50 / 60 Hz
Power consumption	< 2 W

Certificates and approvals

CE Mark	The device fulfils the legal requirements of the EU directives: Directive 89/336/EEC (electromagnetic compatibility) Directive 73/23/EEC (directive on low voltages)

Ordering

Product designation	See Product Structure on Page 8
Accessories	Standard rail 35x7.5, 100 mm wide Order No. 917256-0001 Protective housing IP 55 for 1 unit Order No. 917081-0000 Isolator HAA 420 TSP in Minipac housing Order No. 208330-0000 (Direct current isolator without power supply for input/output signal 0/4 … 20 mA)
Supplementary documentation	Mounting accessories for Minipac instruments Technical Information TI 009F/00/de General Information for EMC (Test procedures, installation) Technical Information TI 241F/00/de

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