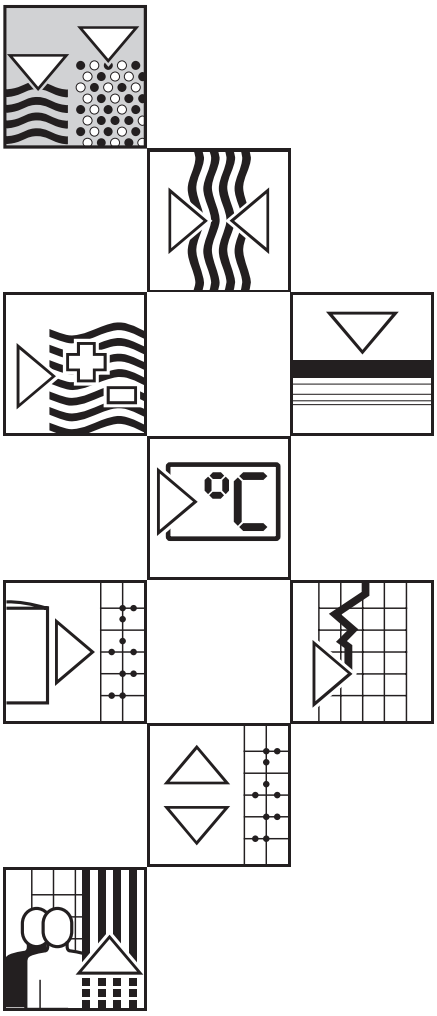
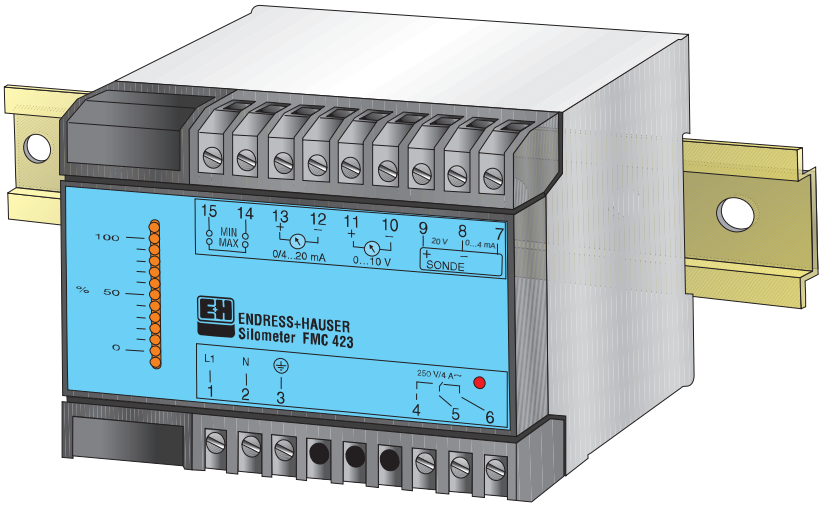
BA 067F/00/en/09.98
015585-1000

silometer
FMC 423
Level measurement

Operating Instructions



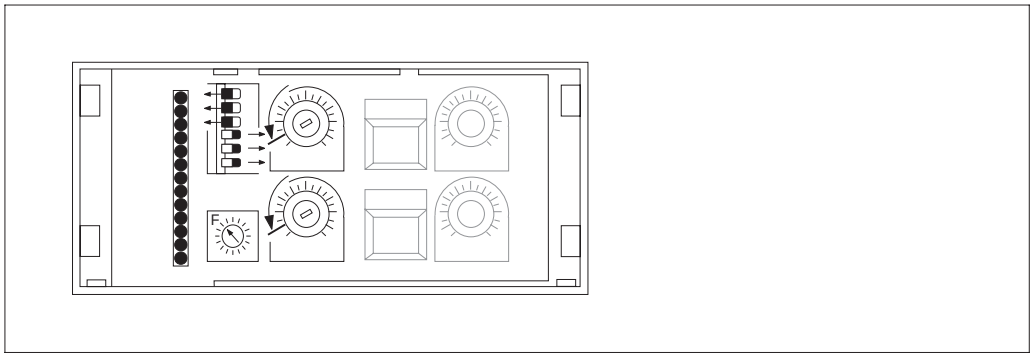


Endress + Hauser

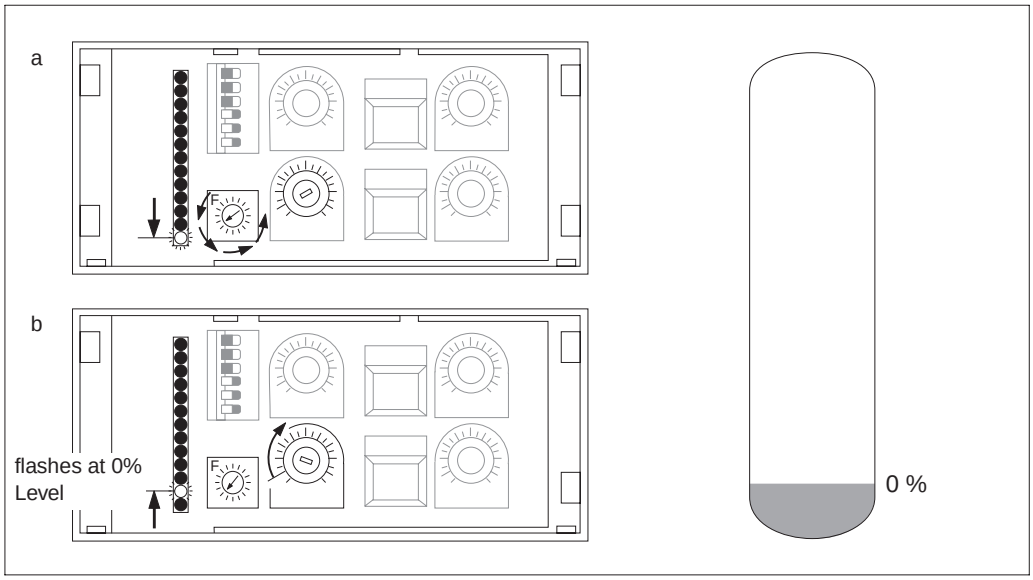
The Power of Know How

Short Instructions

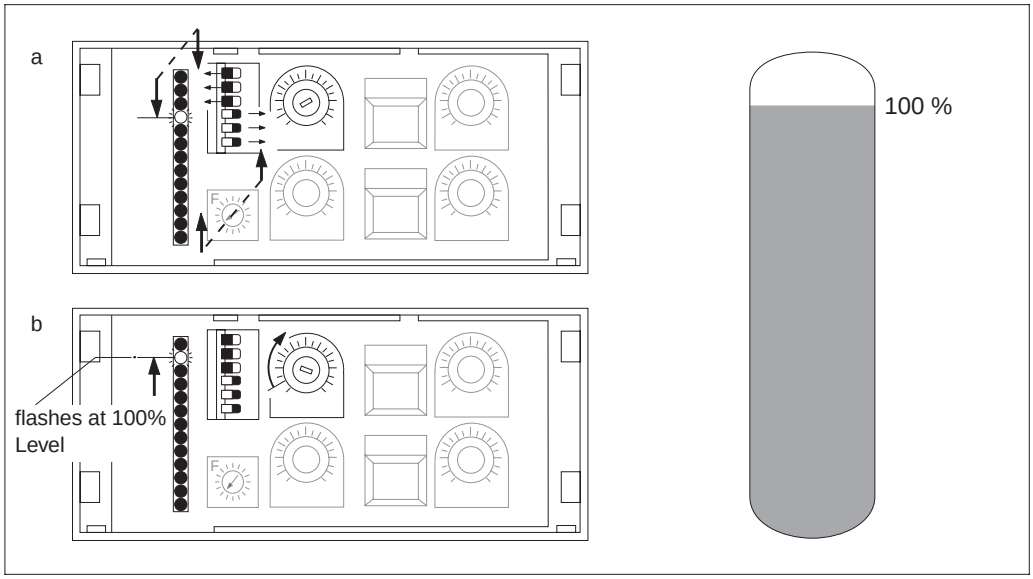
Calibrating the analogue output



1. Basic settings



2. Calibration with **empty** vessel (zero point calibration)



3. Calibration with **full** vessel (span calibration)

Adjusting the limit switch Page 17.

Table of Contents

1 Notes on Safety

1.1 Special notes on safety

Approved usage

The Silometer FMC 423 is designed for continuous level measurement in liquids and is to be installed in non-explosion hazardous areas.
See Technical Data for limit values.

Installation, commissioning, operation

The device has been designed to operate safely in accordance with current technical, 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 explosion in an ignition-hazardous atmosphere.
For this reason, the instrument must be installed, connected, operated and maintained by personnel that are authorized by the user of the facility and who are suitably qualified. The manual must have been read and understood, and the instructions followed. Modifications and repairs to the device are permissible only when they are expressly approved in the manual.

1.2 General notes on safety

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 in the margin

Safety conventions

Symbol	Meaning
 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 function of the instrument.
 Warning!	**Warning!** A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument.

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 (functioning ground 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. neutral star or equipotential line according to national or company practice.

2 Application

The Silometer FMC 423 is designed for continuous level measurement and limit detection in liquid tanks.

The complete programme of capacitance and hydrostatic probes (pressure sensors) enables measurement to be carried out:
- in aggressive media
- at high pressures and in vacuum
- at high and low temperatures
- in high and low viscous liquids
- in media tending to form build-up

etc.

2.1 The Measuring System

Components of the measuring system:
- Transmitter: Silometer FMC 423
- Sensor:
  - capacitive probe with electronic insert (transmitter) EC 11 Z or EC 72 Z or
  - hydrostatic probe (pressure sensor) Deltapilot S with transmitter FEB 11 or FEB 11 P

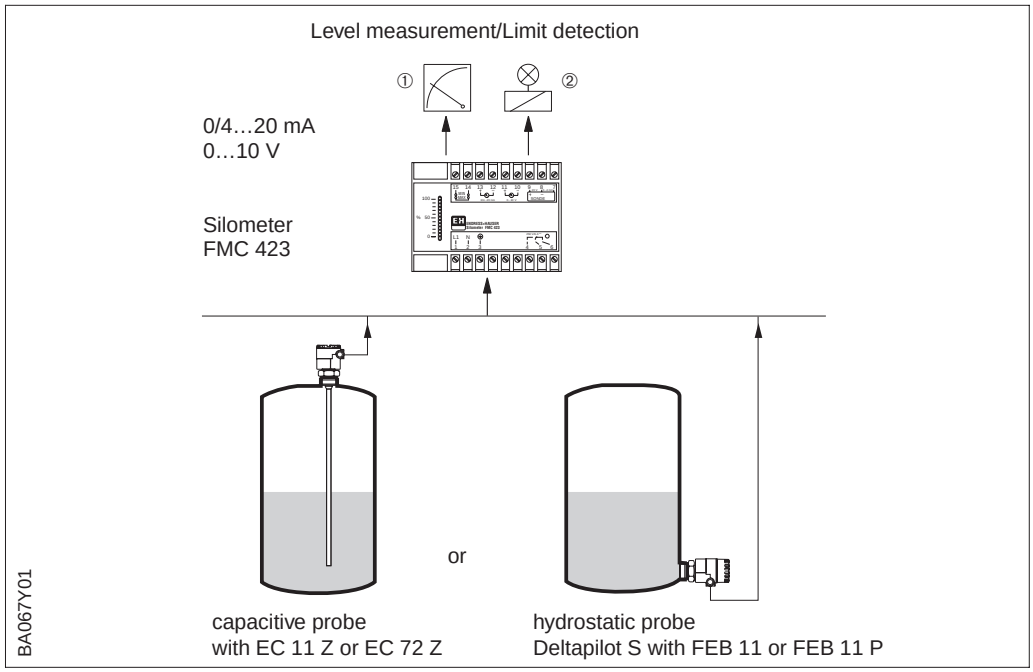


Fig. 1
The measurement system

① Level-proportional analogue output signal current and voltage
② Switching output for limit signal or two-point control

2.2 Function

The Silometer FMC 423 supplies the sensor with its integrated transmitter with direct current and receives from it a level-proportional signal of approx. 0…4 mA.
The standardised signals 0…10 V and 0…20 mA (or 4…20 mA) are available at the Silometer output for remote display of the level.

The LED row on the front panel of the Silometer FMC 423 shows the level in 10% steps and can be used for exact empty and full calibration without using other devices.

The Silometer FMC 423 also has a switching output as well as analogue outputs. The upper switchpoint can be set between 2% and 100%, the lower switchpoint between 0% and the upper switchpoint, with the smallest switchpoint difference being 2%.

The instrument can be operated in maximum or minimum fail-safe mode:
- *Minimum fail-safe mode*
  The relay de-energises when the level falls below the lower switchpoint or the power supply fails.
- *Maximum fail-safe mode*
  The relay de-energises when the level exceeds the upper switchpoint or the power supply fails.
  An LED indicates the switching status.

3 Mounting

Silometer FMC 423

- Compare the product designation on the nameplate of your instrument with that of the product structure (see below) to ensure that the correct instrument is being mounted.
- Install the Silometer in a control cabinet or in a protective housing (accessory).
- Observe the permissible ambient temperature (see technical data) and the minimum distance between instruments (Fig. 2).

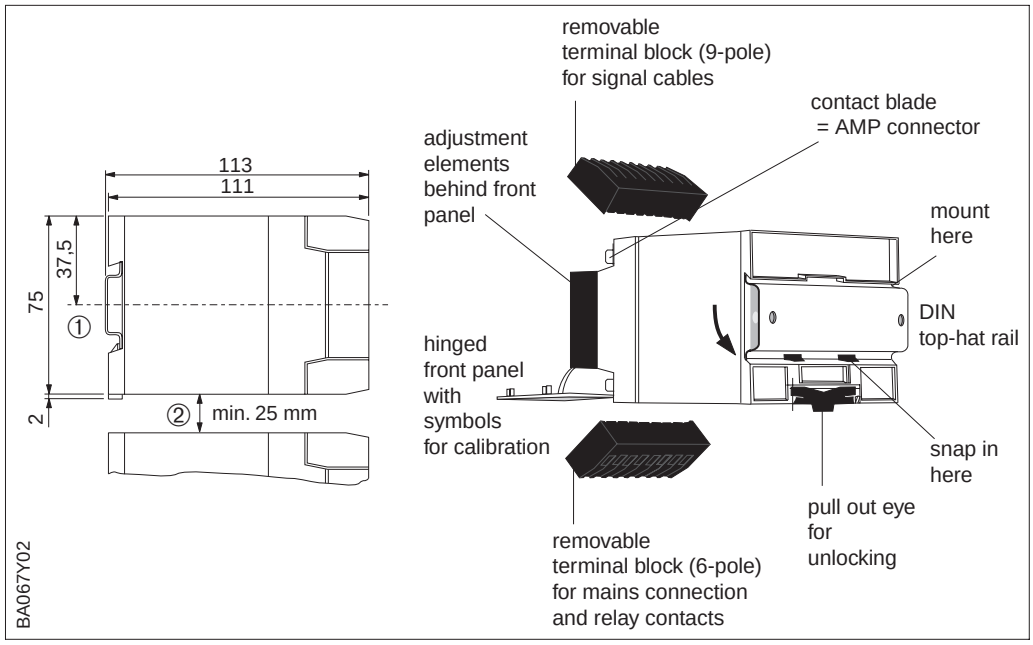


Fig. 2
left:
Dimensions in mm
of the Silometer
in Minipac version
Housing width: 100 mm
① Mounting on a DIN top-hat rail 35 x 7.5 or 35 x 15
② Observe minimum interval to the next row of instruments above and below

right:
Silometer FMC 423
Mounting, removal

100 mm = 3.94 in

Probes

Note the mounting recommendations in the Technical Information brochures for the probes.

FMC 423 Silometer

Certificates, Approvals
R Standard (not certified)
C CSA version

Version
0 Minipac housing, 100 mm, with terminal strip
9 Other

Power Supply
J AC 240 V, 50/60 Hz
A AC 220…230 V, 50/60 Hz
F AC 115 V, 50/60 Hz
B AC 110 V, 50/60 Hz
D AC 24 V, 50/60 Hz
E DC 16…32 V
Y Other

Analogue Outputs
1 0/4…20 mA, 0…10 V
9 Other

Limit Signal
A Potential-free change-over contact

FMC 423 - [ ][ ][ ][ ][ ][ ] Product designation

Product structure

4 Electrical Connection

The Silometer may only be connected by trained personnel.

Use screened three-core cable, cable resistance max. 25 Ω.

Connect the probe with the electronic insert

Note!
General installation instructions with strong interference sources, see Technical Information TI 241F/00/en.

Note!

If grounding the cable screening at both ends is not possible then ground the screening preferably at the probe housing (vessel potential).

After connecting, screw down the cover of the probe securely and seal the cable entry tightly.

Connecting the signal outputs

Analogue signal
You may connect as many peripheral instruments as required to the 0…10 V voltage output, such as voltmeters, plotters, limit signal switches, etc. in parallel provided the total load resistance is larger than 5 kΩ. The voltage output is resistant to short-circuiting.
You may connect as many peripheral instruments as required in series to the 0…20 mA or 4…20 mA current output, such as ammeters, plotters, controllers, etc. provided the total load resistance is smaller than 500 Ω.

Note!
The current and voltage outputs are galvanically connected, i.e. only one of the two outputs may be grounded (current *or* voltage output).

Note!

The signal outputs are galvanically isolated from the vessel by a capacitor and are potential-free. They are also galvanically isolated from the power supply.

Limit signal
The maximum load of the potential-free change-over contact is given in the technical data. Connecting an instrument with high inductance:
Ensure a spark-quenching device is connected to protect the relay contact.
A fine-wire fuse (dependent on the load connected) can protect the relay contact on short-cicuiting.
Note that the function limit switch is dependent on the fail-safe mode
(See Fig. 3 on Page 10).
Select the fail-safe mode by means of a jumper on the upper terminal block:
- No jumper between Terminal 14 and 15:
  Minimum fail-safe mode = the relay de-energises when the level falls below the lower switchpoint or the power supply fails.
- Jumper between Terminal 14 and 15:
  Maximum fail-safe mode = the relay de-energises when the level exceeds the upper switchpoint or the power supply fails.

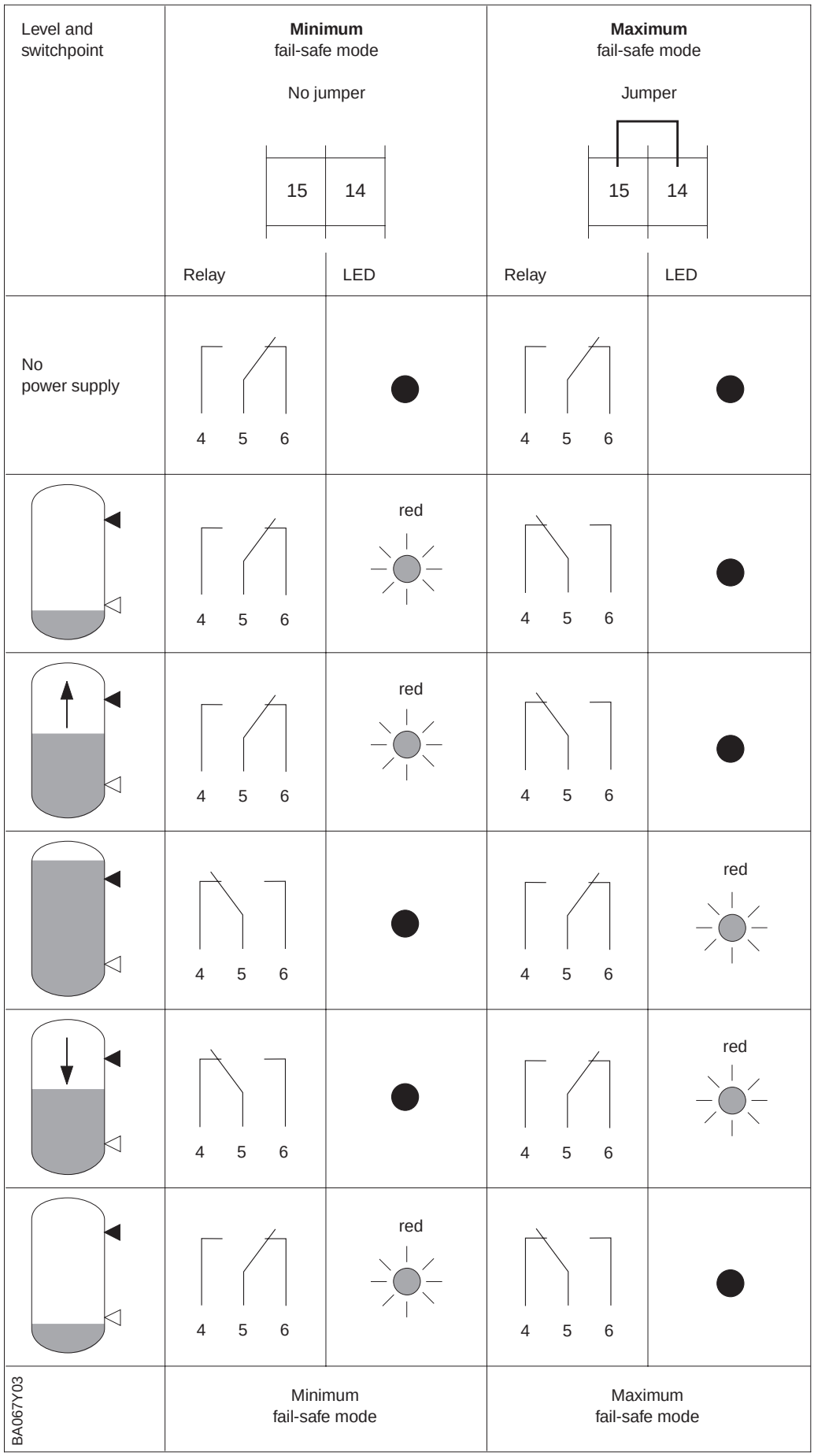


Fig. 3
Function of the relay and LED as a function of the level and fail-safe mode for two-point function;
◀ upper switchpoint (full)
◁ lower switchpoint (empty)

With single-point function the lower switchpoint is not in use

Changing the power supply

Ensure that the power voltage agrees with that stated on the nameplate on top the housing and check the power voltage at the mounting point.
The power voltage in the instrument can be altered as required depending on the version delivered.

① Remove the terminal blocks (Points a and b)
② Open the front panel (Points c and d)
③ Remove the instrument from the housing: hold by the lower and upper black plastic part and pull forward with sufficient force.

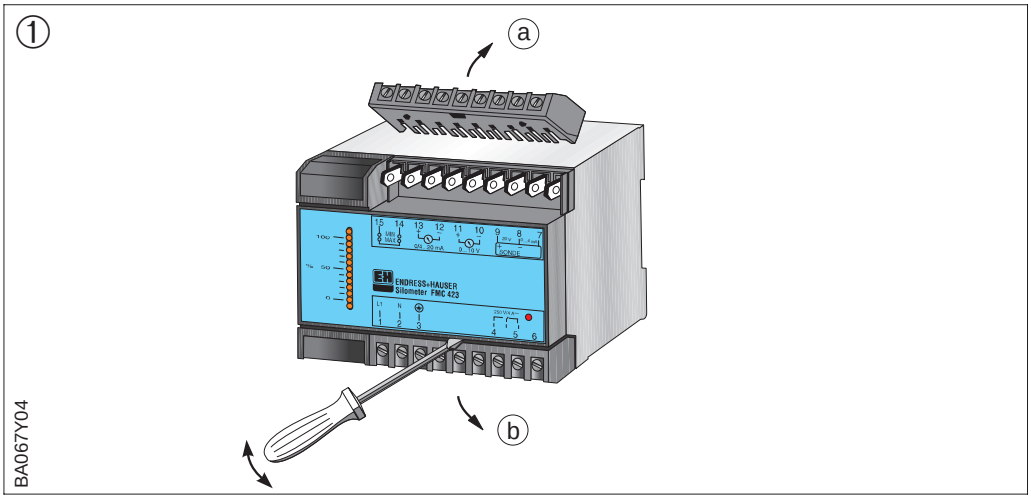


Fig. 4
Removing the terminal blocks

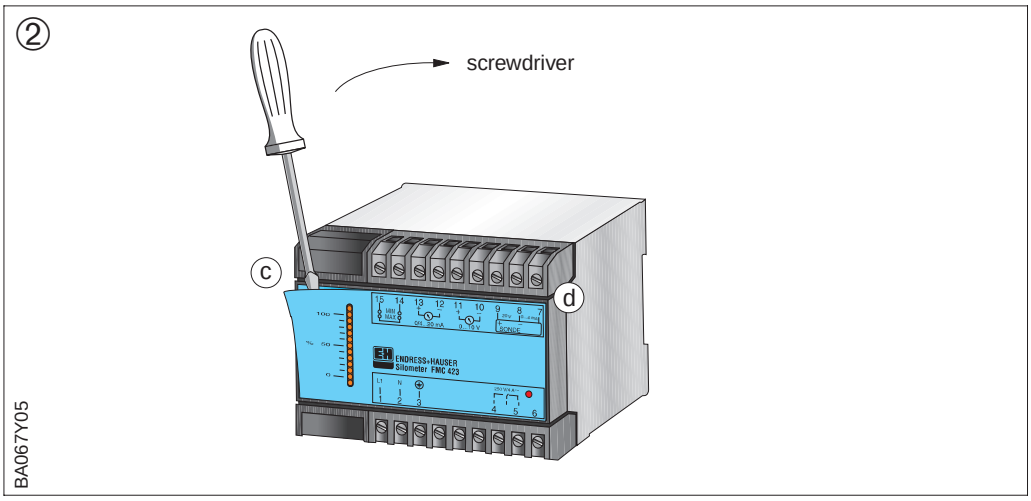


Fig. 5
Opening the front panel

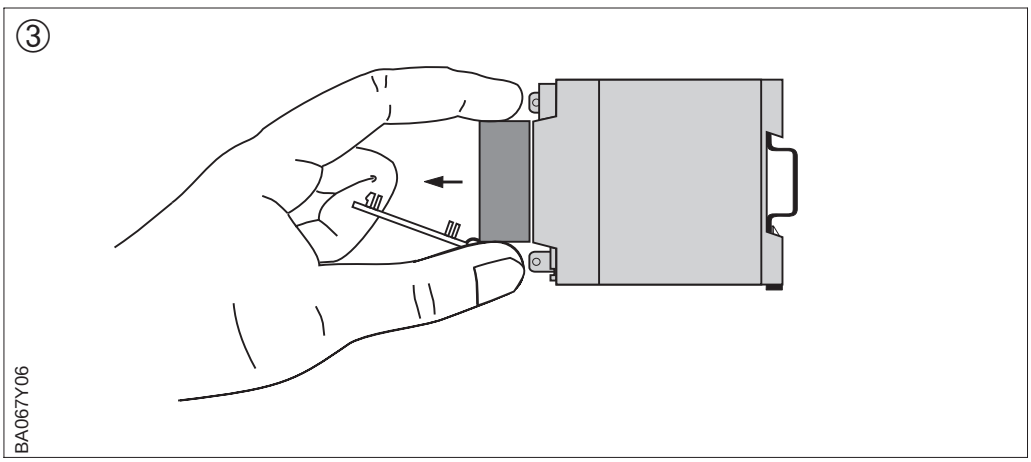
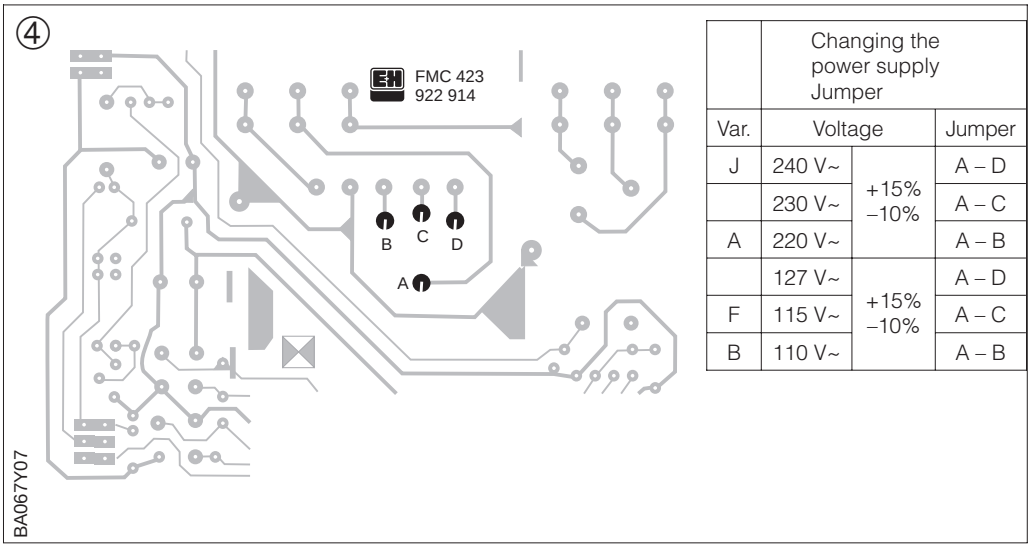


Fig. 6
Removing the instrument from the housing

④ Resolder jumper for power supply

- Assemble the instrument
- Change the power supply specifications on the nameplate



	Changing the power supply Jumper		
Var.	Voltage		Jumper
J	240 V~	+15% –10%	A – D
	230 V~		A – C
A	220 V~		A – B
	127 V~	+15% –10%	A – D
F	115 V~		A – C
B	110 V~		A – B

Fig. 7
Changing the power voltage by soldering jumper onto the circuit board.
Versions ("Power supply") see Product Structure on Page 8
Versions J and A can be set to an AC voltage between 220 V and 240 V, versions F and B to an AC voltage between 110 V and 127 V.

Connect the power supply

Ensure a mains switch and fine-wire fuse are connected near to the instrument.

Recommended fine-wire fuse:

Voltage	Fuse
U= 16 V… 32 V	500 mA, slow-blow
U~ 24 V	500 mA, slow-blow
U~ 110 V…240 V	100 mA, slow-blow

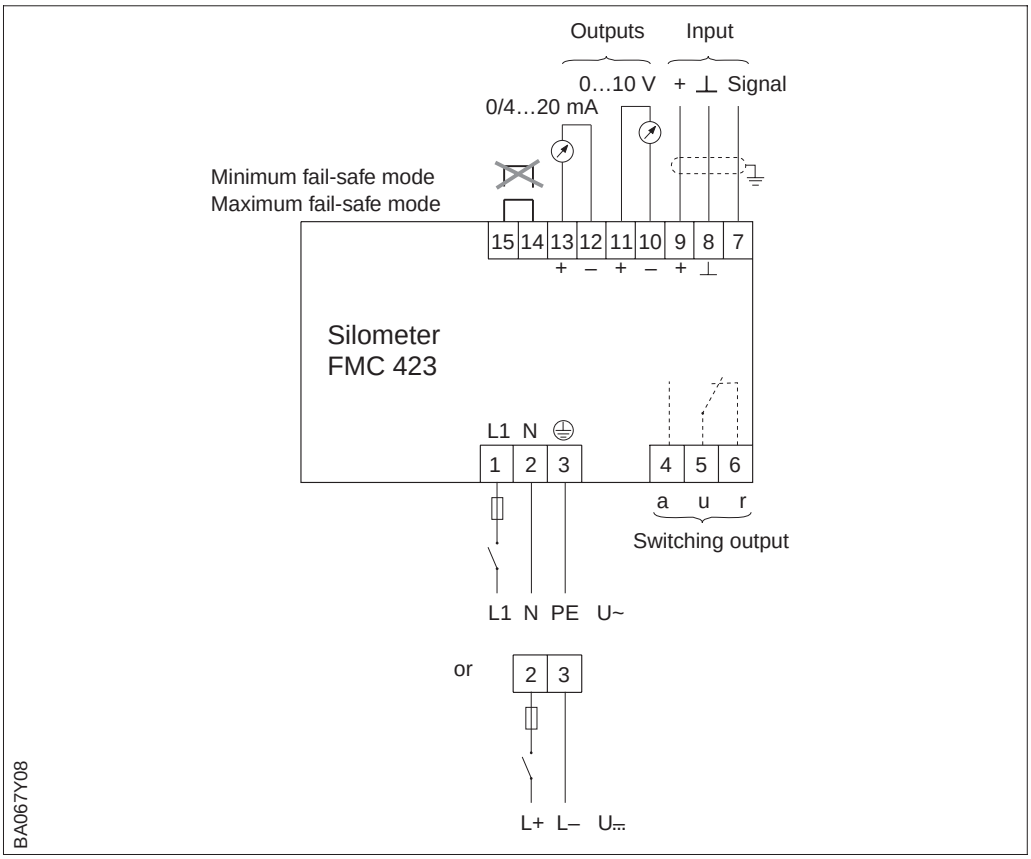


Fig. 8
Main connections FMC 423

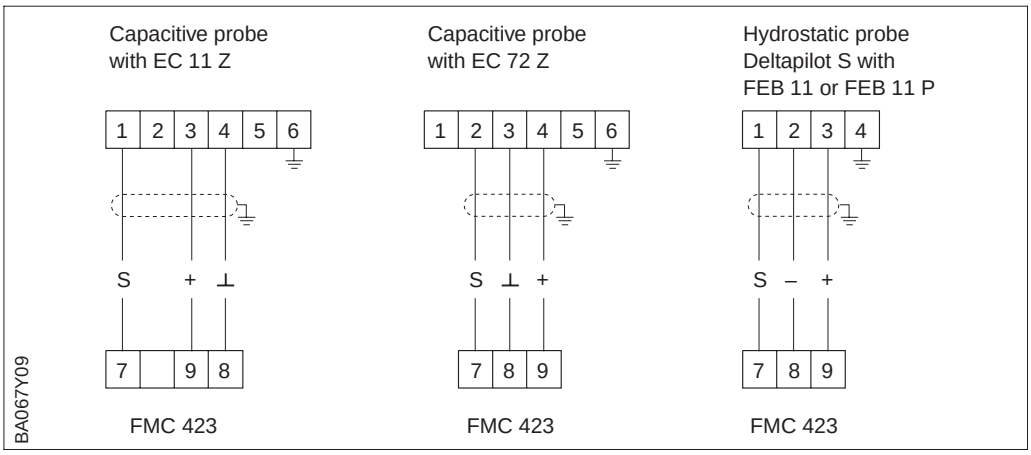


Fig. 9
Connecting probes
to the Silometer (input)

5 Calibration

5.1 Preparing for calibration

Switch on the power supply to the Silometer.

Note!

Note!
Turn off any regulation and control devices until the Silometer is calibrated in order to avoid unchecked processes.

The calibration elements (see Fig. 10) are easily accessible by opening the front panel.

Selecting the output current

Check whether the switch for the output current is in the right position (Abb. 10)
Switch closed: 0…20 mA
Switch open: 4…20 mA

Adjustable measuring ranges

The measurement current is adjusted that the Silometer FMC 423 receives from a transmitter built into a capacitive probe or a Deltapilot.
With capacitive probes a test current of 1 µA is equivalent to approx. 1 pF probe capacitance.
With Deltapilot a test current of 1.5 mA is equivalent to approx. the nominal pressure (max. measuring range).

The zero can be set with an input current between 40 µA and 360 µA during the empty calibration.
The span can be set for full calibration with a change in current between 20 µA and approx. 4 mA during the full calibration.

Zero point and measuring range calibration have no effect on one another.

Caution!

Caution!
Calibrate the instrument first with an empty and then with a full vessel or if this is not possible, with a partially filled vessel.

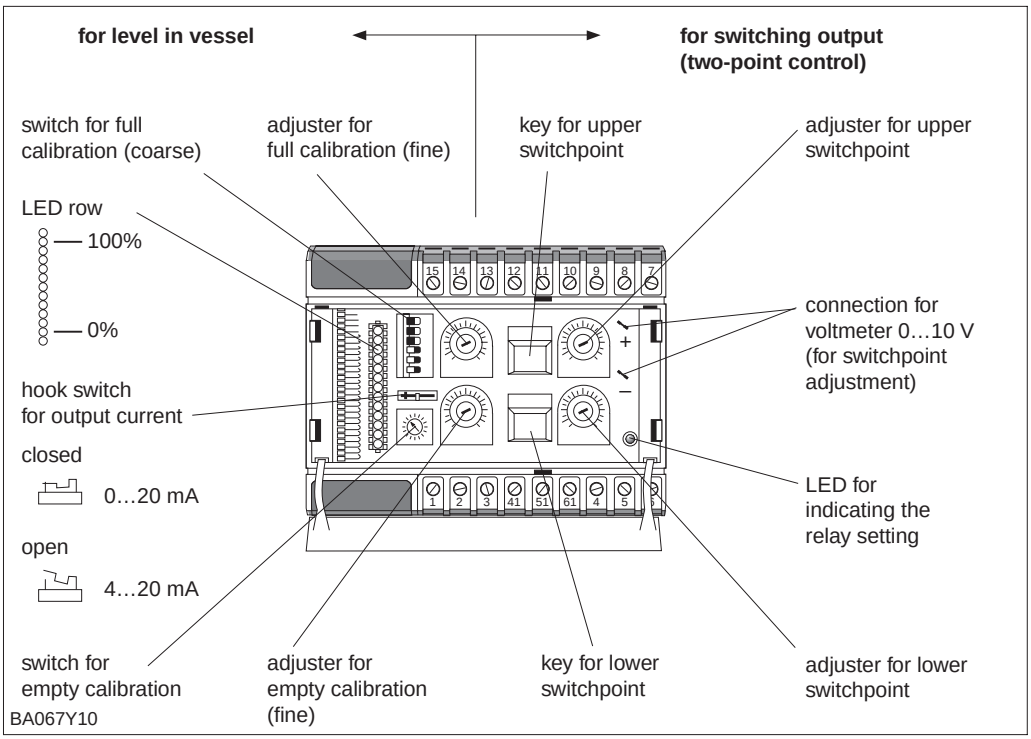


Fig. 10
Adjusting elements

Basic settings

- Turn both (fine) adjusters for empty and full calibration anticlockwise to the left stop.
- On the upper switch block, switch the 3 lower switches to the right and the 3 upper switches to the left (mid amplification).
- Turn the lower switch to "F".

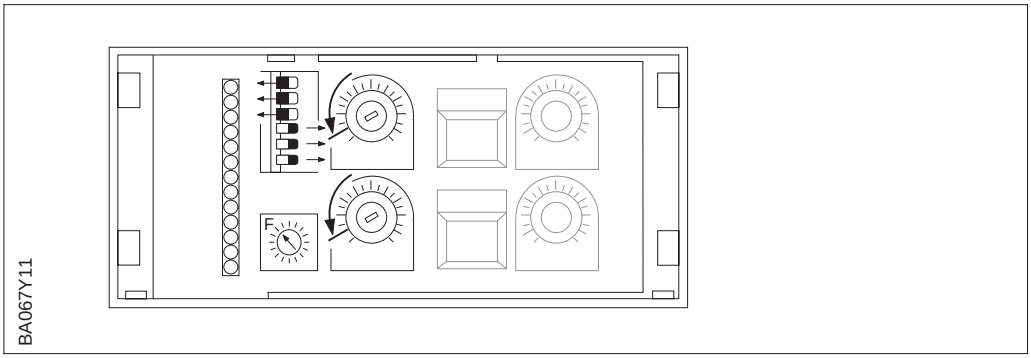


Fig. 11
Basic settings

5.2 Calibration with an empty vessel (0%)

a) Turn the lower switch by steps anticlockwise until the display is below 0 (the lowest LED in the row lights up).
b) Turn the (fine) adjuster for empty calibration clockwise until the second lowest LED flashes.

- In level measurement with capacitance probes, you can raise the amplification to check the settings by switching the three upper switches on the upper switch block to the right.
  If necessary, make a minor correction of the zero point with the (fine) adjuster for empty calibration.
- Until the vessel is filled and full adjustment carried out, you can set the measuring range (amplification) as required:
  – All switches on the upper switch block switched to the right (maximum amplification, display exceeds 100%) on filling
  – All switches on the upper switch block switched to the left (minimum amplification, display changes only slightly on filling)
  – Set in the middle according to experience gained in practice

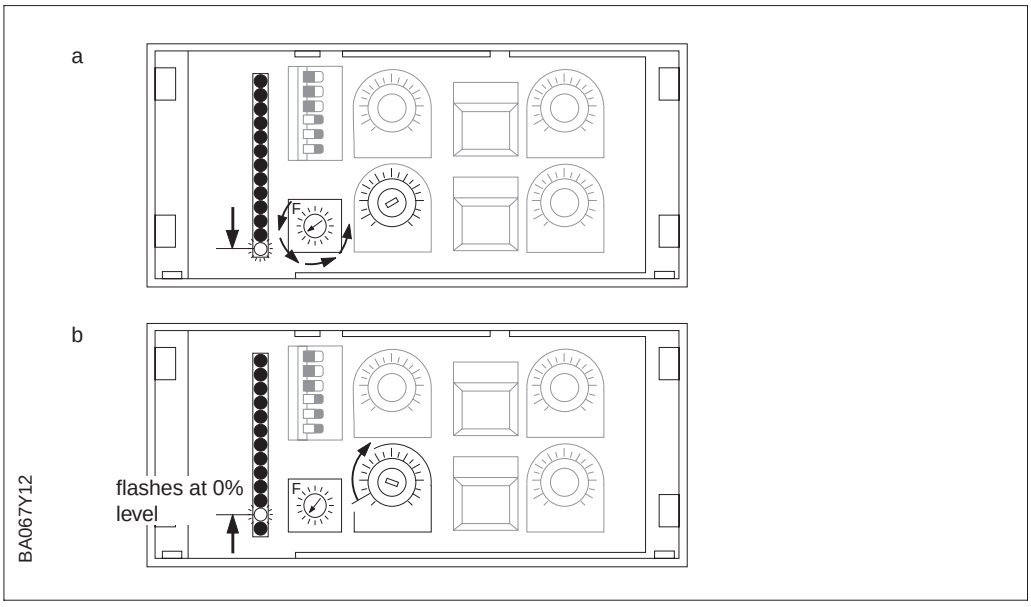


Fig. 12
Calibration with an empty vessel (zero point calibration)

5.3 Calibration with a full vessel

Calibration with a 100% full vessel

If the vessel is exactly 100% full, calibration can be carried out very simply using the diode at 100% (second from top in the LED row).

- Set the switches in the upper switch block for full calibration and turn the (fine) adjuster for full calibration until the LED for 100% flashes.

  If, starting from the top, you switch the switches one after the other to the left, the display will fall.
  If, starting from the bottom, you switch the switches one after another to the right, the display will rise.
  Intermediate values can be set with the (fine) adjuster for full adjustment.

Calibration with a partially full vessel

If the vessel cannot be completely filled, an accurate display instrument (0…10 V, R_i > 5 kΩ) must be connected to the soldering points behind the front panel. 0…10 V corresponds to 0…100% level.

- By means of the switches on the upper switch block for full calibration and the (fine) adjuster for full calibration, move the display to the reading corresponding to the level (e.g. to 8.5 V for 85% level).
  If, starting from the top, you switch the switches one after the other to the left, the display will fall.
  If, starting from the bottom, you switch the switches one after another to the right, the display will rise.
  Intermediate values can be set with the (fine) adjuster for full calibration.

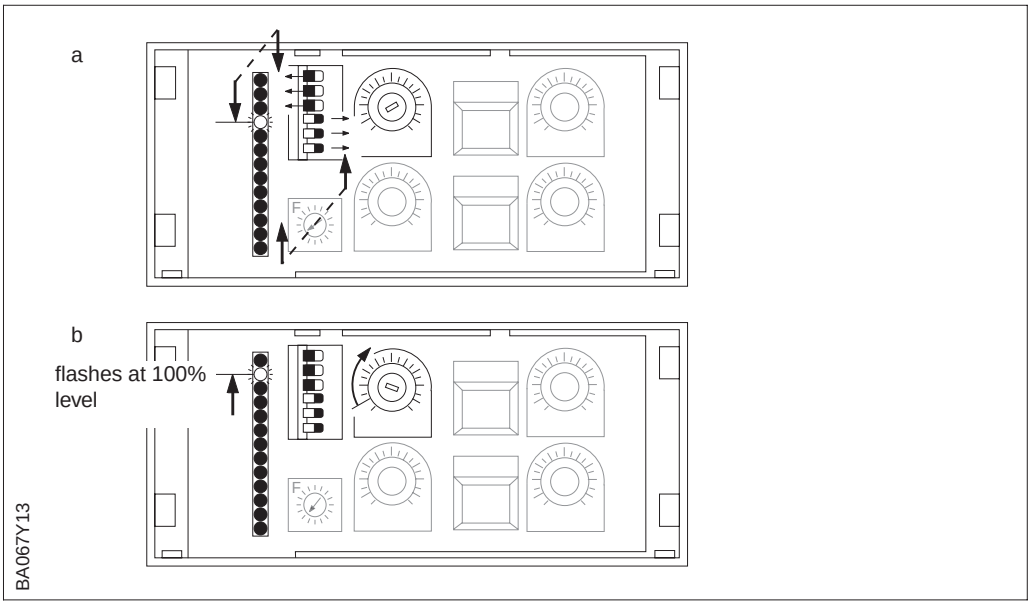


Fig. 13
Calibration with a full vessel (setting the span)

5.4 Calibrating the limit switch

Connect a voltmeter (range 10 V DC = 100%, Ri > 5 kΩ) to the terminal pins behind the front panel

Calibration with single-point function

1. Turn the lower adjuster clockwise to the right stop
2. Press the upper green button and, by using the upper adjuster, move the display of the voltmeter to the desired switch point.

The switchpoint difference (hysteresis) is approx. 1%.

Calibration with two-point function

1. Press the upper green button and with the upper adjuster move the display of the voltmeter to the desired upper switchpoint (2…100%).
2. Press the lower green button and, by using the lower adjuster, move the display of the voltmeter to the desired lower switch point (0…98%).

The switchpoint difference should not be set smaller than 2%.

Note
In two-point operation the reading of the lower adjuster must always be smaller than that of the upper adjuster.

Note!

When you press one of the green buttons, the selected switchpoint will also be displayed in the LED row.

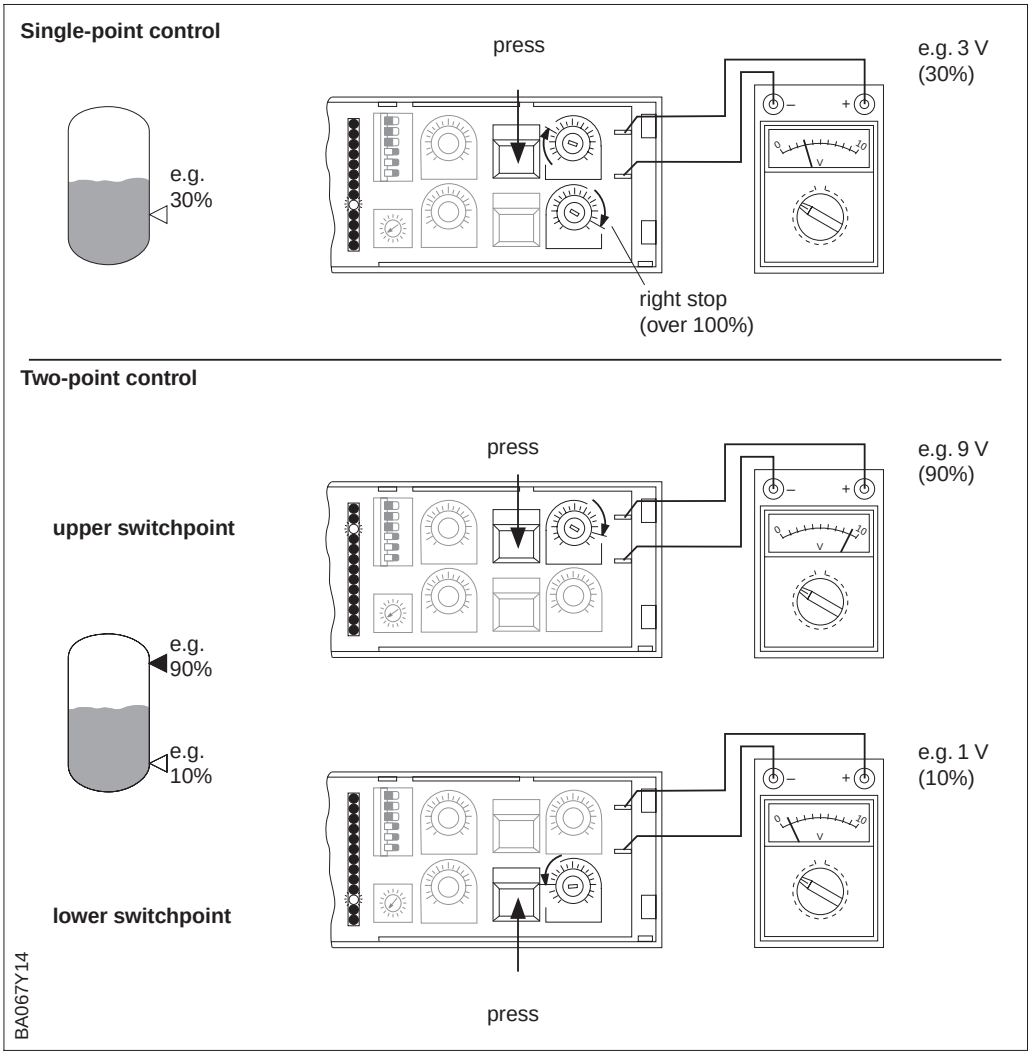


Fig. 14
Setting the limit switch

6 Technical Data

Construction	Housing:	Row housing (Minipac design) in light grey plastic, front panel blue
	Mounting:	on DIN top hat rail according to EN 50022-35 x 7.5 or EN 50022-35 x 15
	Dimensions:	see Page 8, Fig. 2
	Housing width:	100 mm
	Weight:	0.5 kg
	Type of protection to DIN 40050:	Housing IP 40, Terminals IP 20
	Permissible ambient temperature:	–20..+60 °C (0..140 °F) for single mounting –20..+50 °C (0..120 °F) for row mounting without interval –20..+85 °C (0..185 °F) for storage
Electrical connection	Terminals:	Removable terminal blocks, non-interchangeable, black; 1 x 6-pole, 1 x 9-pole
	Max. cross section:	(fine-wire) 1 x 0.5 mm^2 to 1 x 2.5 mm^2 or 2 x 0.5 mm^2 to 2 x 1.5 mm^2
	Without terminals:	Flat plug 0.8 x 6.3 to DIN 46244
	Power supply connection, AC:	220 V, –10% … 230 V, +10%, 50/60 Hz
	Versions, AC:	240 V, 115 V, 110 V, 24 V, each +15%, –10%, 50/60 Hz
	Version, DC:	16…32 V, protected against reversed polarity, by DC/DC transformer galvanically isolated from the power supply
	Power consumption:	max. 3.4 W (6,4 VA)
	Sensors:	See Measuring System
	Connection cable to sensor:	3-core, screened, max. 25 Ω per core.
	Power supply for sensors:	approx. 20 V (from Silometer FMC 423)
	Adjustable input signals for zero point:	approx. 40… 360 µA (approx. 30…350 pF for capacitive measurement)
	for measuring span:	approx. 20…4000 µA (equiv. to pF)
Electromagnetic compatibility	EN 61326-1	Class B devices
Signal outputs	Analogue signal	
	Voltage:	0…10 V, R_L min. 5 kΩ
	Current:	0…20 mA, switchable to 4…20 mA, R_L max. 500 Ω
	Setting time:	0.5 s typical for an input signal step of 1 mA
	Linearity error, effects of power supply and load:	< 0.5% (voltage output)
Switching output	Calibration range :	0…100%
	Relay output:	1 relay with potential-free change-over contact, switchpoint difference can be set between 2% and 98% Minimum/maximum fail-safe mode, selectable
	Switching capacity	
	AC:	max. 4 A, max. 250 V, max. 500 VA, cos φ > 0.7
	DC:	max. 4 A, max. 100 W to 48 V, max. 50 W to 250 V

7 Supplementary Documentation

❑ System components Minipac
Technical Information TI 009F/00/en

❑ Electronic inserts EC 11 Z, EC 72 Z
Technical Information TI 270F/00/en

❑ Electronic inserts FEB 11/11 P
Technical Information TI 257F/00/en

8 Replacing an instrument

The Silometer FMC 423 can be easily replaced without loosening the individual wires:

- Switch off power supply
- Remove terminal blocks, see Fig. 4 on Page 11
- Pull eye on the housing of the instrument downwards for unlocking with a screwdriver and remove the Silometer from the DIN top hat rail. See Fig. 6 on Page 11
- Clip the new instrument onto the DIN top hat rail
- Insert terminal blocks and snap in
- Carry out settings as for the old instrument
- A calibration must always be carried out after replacing a Silometer or electronic insert due to the tolerances of the new module

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