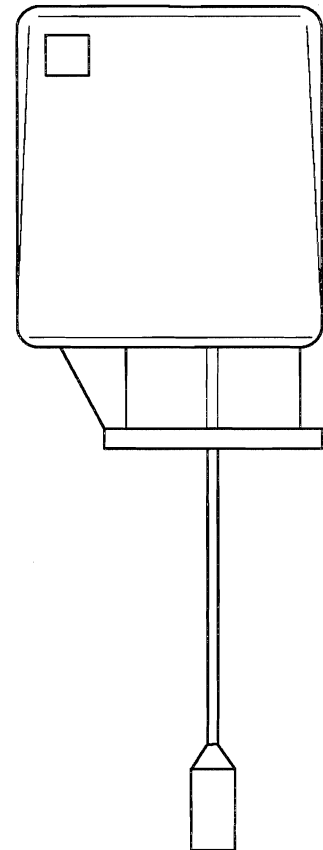
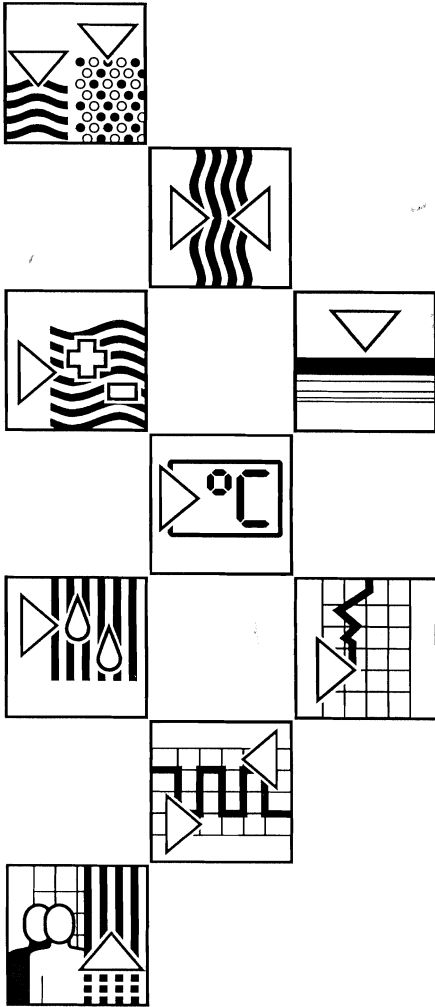


silopilot FMM 460/460 Z Level Measurement

Montage- und Betriebsanleitung
Installation and Operating Instructions



Endress + Hauser

Nothing beats know-how



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Application

The SILOPILOT FMM 460 is an electromechanical level measurement system. (See Fig 1).

The sensing weight which touches the material determines the application. Different types of sensing weight are used for measuring the level of materials in bunkers and silos. These can be powdery, fine or coarse-grained solids. Depending on the version and equipment, the SILOPILOT FMM 460 is used for measurement in silos or tanks with operating temperatures up to 60 °C or pressures up to 2 bar.

The FMM 460 Z version of the SILOPILOT can also be used in flammable dusts designated as explosion-hazardous area, Zone 10 and 11.

The references made in the following text to "bunker", "silo" or "vessel" are identical:
the vessel in which material is measured.

A complete measuring system consists of:

- SILOPILOT FMM 460 with sensing weight
- start button or timer
- the electromechanical counter ZCD 155 or ZCD 151
- and/or a digital/analogue converter + memory ZAD 184

Function

A measuring tape with a sensing weight attached to the end is lowered into a bunker. When the weight touches the surface of the material, the tape slackens and the motor reverses.

The weight then returns to its original position.

While the weight is being lowered, the SILOPILOT emits pulses corresponding to the length of the extended tape.

The pulses are recorded on an electromechanical counter or the digital/analogue converter + ZAD 184 memory.

The measurement is stored until the next measuring cycle.

This is initiated by the start button or timer.

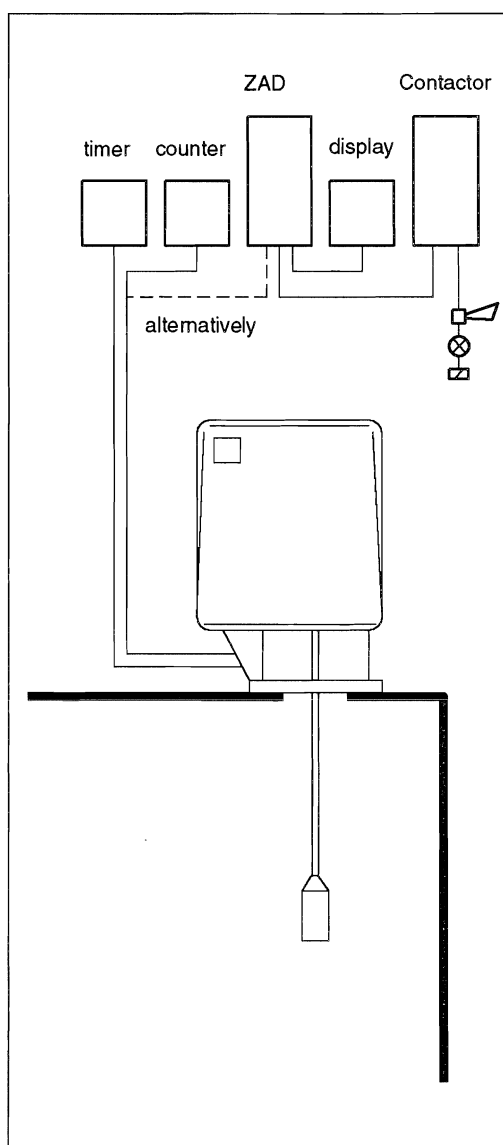


Fig. 1
FMM 460
Connections

Instrument versions

The use of various options enables combinations of both electrical and mechanical modular components to be selected specific to the application.

SILOPILOT FMM 460									
Certificates, Assessments									
R	Standard (non-certified)								
Y	others								
Counting steps / Measuring tape									
1	dm/stainless steel								
2	dm/nylon								
3	1/10 foot/stainless steel.								
4	1/10 foot/nylon .								
9	others								
Instrument heating									
A	none								
B	heating 220V, 50/60Hz 40 W								
C	heating 110V, 50/60Hz 40 W								
Y	others								
Minimum fail-safe function									
0	no presetting								
1	setting at xx, x meter								
2	setting at xx, x feet								
9	other								
Signal function									
A	non signal function								
B	signal of upper position								
C	signal of tape breakage (with 220V only)								
D	signal of upper position + tape breakage (with 220V)								
Y	other								
Sun protective cover									
0	no sun cover								
1	with sun cover								
9	other								
Power supply									
J	AC 240V, 50/60Hz								
H	AC 230V, 50/60Hz								
A	AC 220V, 50/60Hz								
G	AC 127V, 50/60Hz								
F	AC 115V, 50/60Hz								
B	AC 110V, 50/60Hz								
D	AC 24V, 50/60Hz								
Y	others								
Sensing weight									
0	no weight								
1	(PVC (red), sensing weight								
2	PE (white), sensing weight								
3	PA (black), sensing weight								
4	Umbrella PE/sail cloth								
5	Umbrella PA/sail cloth								
9	others								
For connecting to									
A	ZCD 155 or ZCD 151, /= 42 V								
B	ZCD 155 or ZCD 151, 34 V								
C	digital/analog memory ZAD 184								
Y	others								
FMM 460									

SILOPILOT FMM 460 Z

Certificates, Assessments
 D BVS approval dust-Ex Zone
 Y others

Counting steps / Measuring tape

1 dm/stainless steel
 3 1/10 foot/stainless steel
 9 others

Instrument heating

A none
 B heating 220V, 50/60Hz
 C heating 110V, 50/60Hz
 Y others

Minimum fail-safe function

0 no presetting
 1 setting at xx, x meter
 2 setting at xx, x foot
 9 others

Signal function

A no signal function
 B signal of upper position
 C signal of tape breakage (with 220V only)
 D signal of upper position + tape breakage (with 220V only)
 Y others

Sun protective cover

0 no sun cover
 1 with sun cover
 9 other

Power supply

J AC 240V, 50/60Hz
 H AC 230V, 50/60Hz
 A AC 220V, 50/60Hz
 G AC 127V, 50/60Hz
 F AC 115V, 50/60Hz
 B AC 110V, 50/60Hz
 D AC 24V, 50/60Hz
 Y other

Sensing weight

0 without weight
 3 PA (black), sensing weight
 5 umbrella, PA / sail cloth
 9 other

. For connection to

. A ZCD 155 or ZCD 151, /= 42V
 . B ZCD 155 or ZCD 151, 24V
 . C digital/analogue memory ZAD 184
 . Y other

FMM 460										
---------	--	--	--	--	--	--	--	--	--	--

Sensing weights for the FMM 460, FMM 460 Z

Standard weight in PVC or PE for the FMM 460

Application:

With light bulk solids, mainly fine-grained, with powdery characteristics, e.g. fodder.

For foodstuffs, e.g. salad oil, the PE weight must be used. (not suitable for dust explosion hazardous area, Zone 10).

Weight: 920 g

Standard weight for the FMM 460 Z

The standard weight for the FMM 460 Z is of PA (Vestamid^R) with $R_0 \leq 10^9 \Omega$

Weight: 920 g

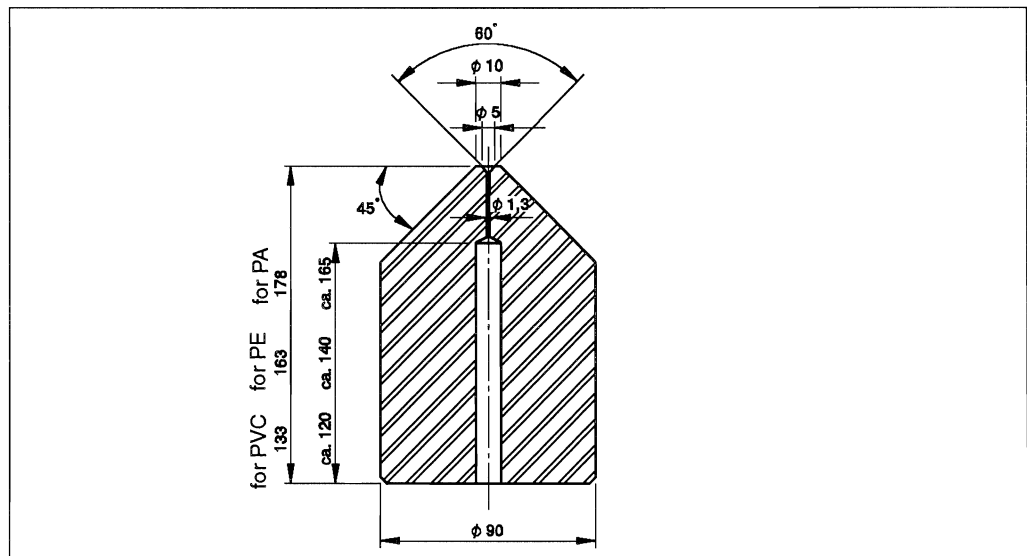


Fig. 2
FMM 460
Standard weight

Umbrella weight in PA/PE for the FMM 460, FMM 460 Z

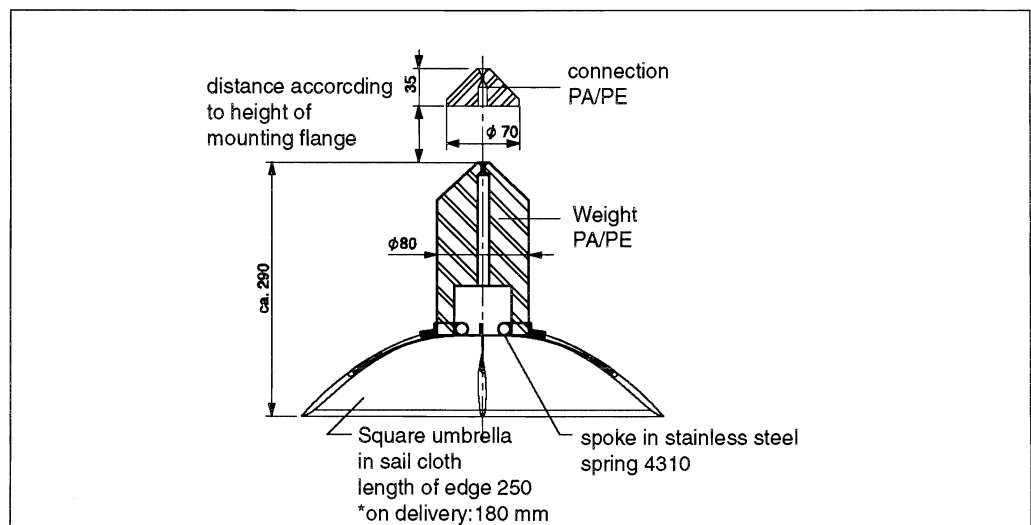


Fig. 3
FMM 460
Umbrella weight

Application:

For very light, loose solids such as flour, coal dust etc. an umbrella weight in PA only may be used with the FMM 460 Z (Ex Zone 10/11).

The FMM 460 may be used with either a PA or PE weight.

The umbrella weight has a large square surface area to prevent it sinking into the material being measured. It can be folded so that it fits through the DN 100 flange.

Installation

Selecting the installation site

Select an installation position on the silo roof where inflowing or falling material cannot damage the measuring tape. Take into consideration the shape and position of the inflow cone and the outflow funnel in the vessel. See Fig. 4 and Fig. 5
 The sensing path should not cross internal fixtures which may touch the tape when the weight swings.

Preparing the installation

The SILOPILOT FMM 460 DN 100 PN 16 DW 2501 is mounted on a counter flange or a flange of the same dimensions. This flange must be mounted exactly horizontal and the pipe onto which it is welded should be exactly vertical. The pipe should be as short as possible.

Installing a plastic pipe with throat and pipe flange is recommended with an especially thick silo roof and long pipes (Fig. 6). This prevents damage to the sensing weight or to the tape caused by the sharp edges of the roof. In this particular case the buffer cone must be removed when using an umbrella weight.

(Fig. 3)

If the instrument is in direct sunlight, then a protective cover should be used either in the form of a sun roof (Fig. 7) or as a protective sun hood.

In countries with generally high temperatures, (by the equator, in the desert), a protective sun cover is recommended as shown in Fig. 7. If high condensation is present, then installing a thermostatically controlled electrical heating system for the housing is recommended. See instrument versions, Pages 4 + 5.

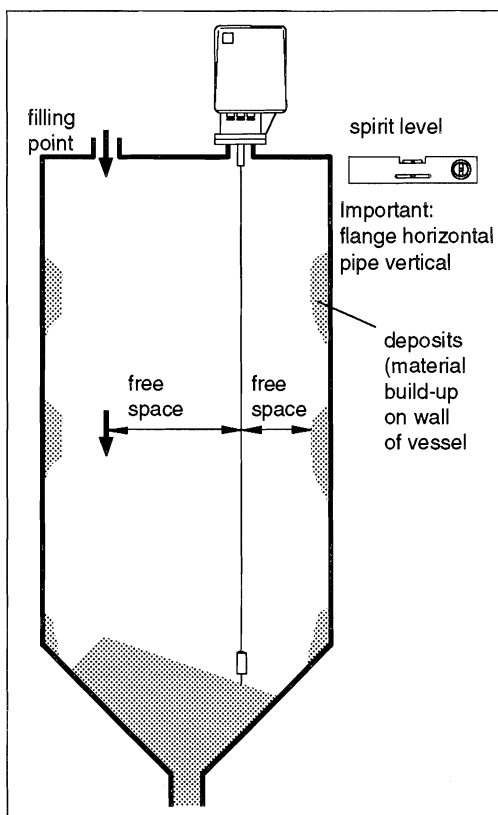


Fig. 4
 FMM 460
 Installation with material build-up

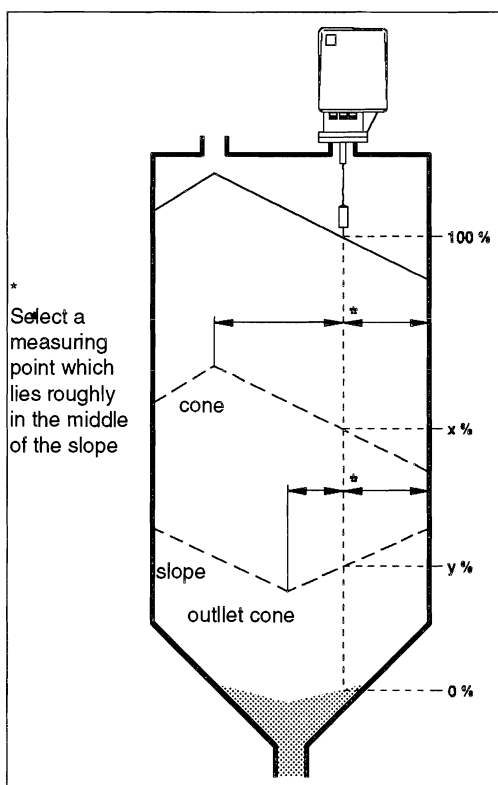


Fig. 5
 FMM 460
 Installation
 Taking account of the filling cone

Installing the SILOPILOT

Put a gasket on the flange (especially if there is pressure in the silo). Carefully insert the sensing weight into the flange and pipe. Place the SILOPILOT on the flange and tighten using the 4 bolts.

Note the position of the cable glands for electrical connections.

When using an umbrella weight, fold it up and then pass it through the DN 100 flange. (also see Fig. 8)

Mounting on a collar with a narrow entrance (e.g. Fig. 6)

Remove the housing cover (see Page 10).

Turn the fan wheel until the sensing weight can be pulled away from the FMM to a distance of 0.5 m. Separate the measuring tape above the buffer cone.

Pass the tape through the entrance and then fasten the umbrella weight to it with a knot.

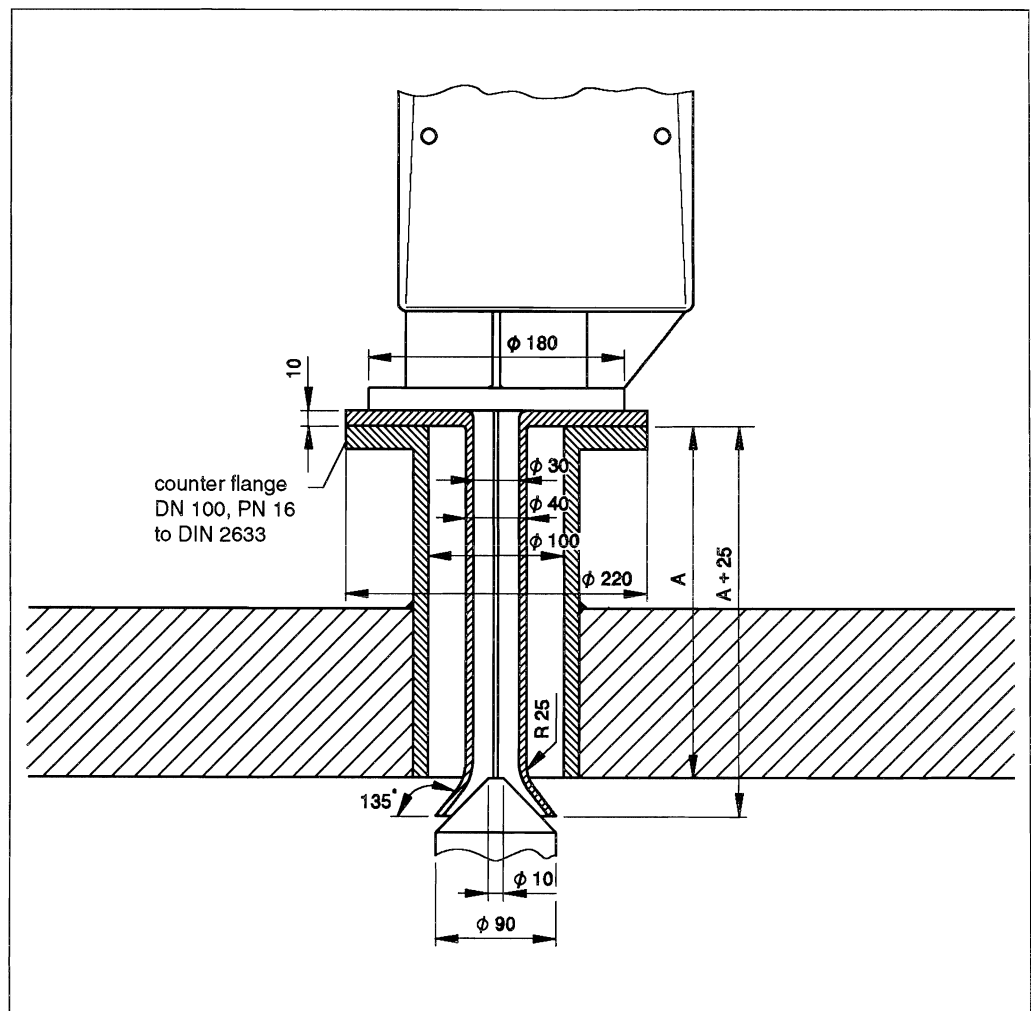


Fig. 6
Mounting in higher silo
roofs

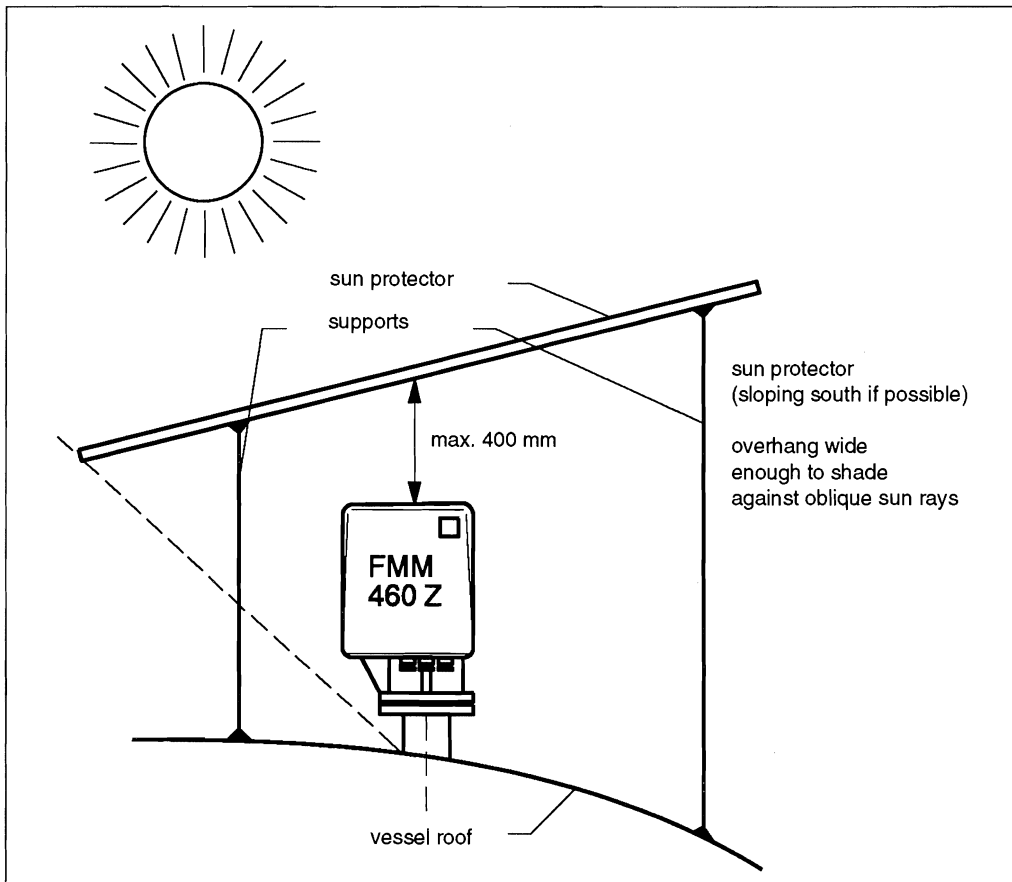


Fig. 7
Sun protective cover for the FMM 460

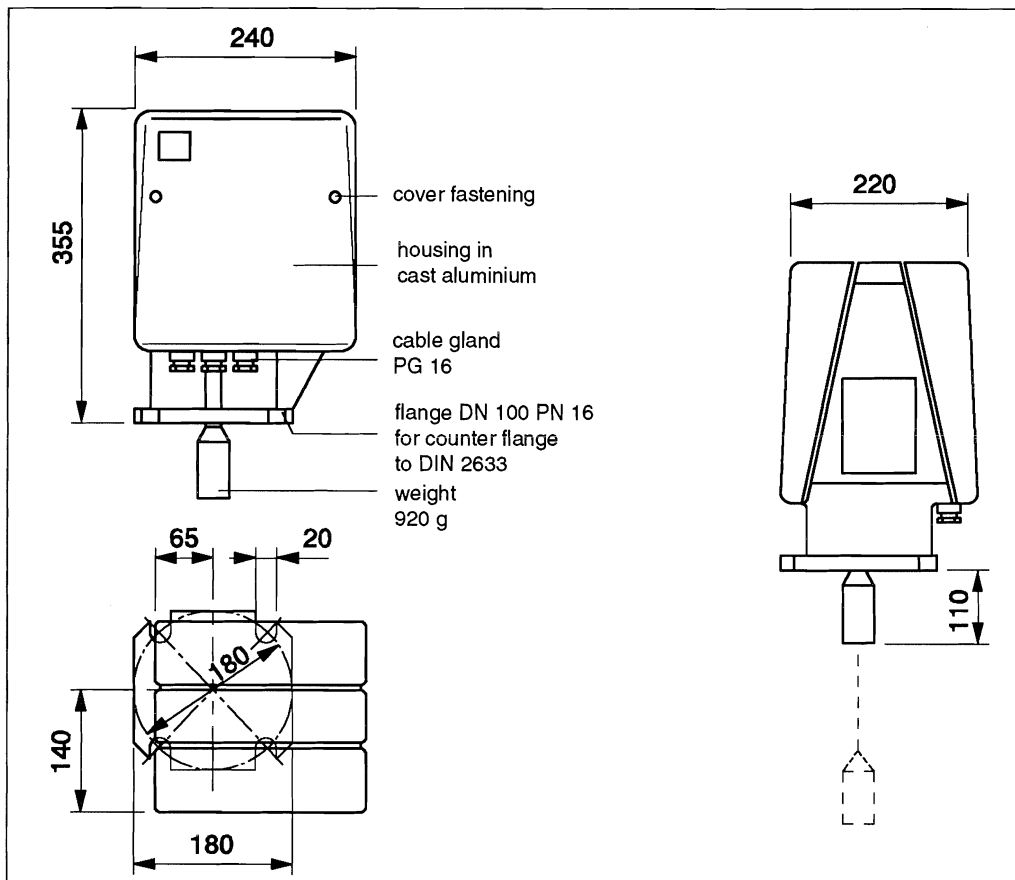


Fig. 8
Dimensions of the FMM 460

Electrical Connections

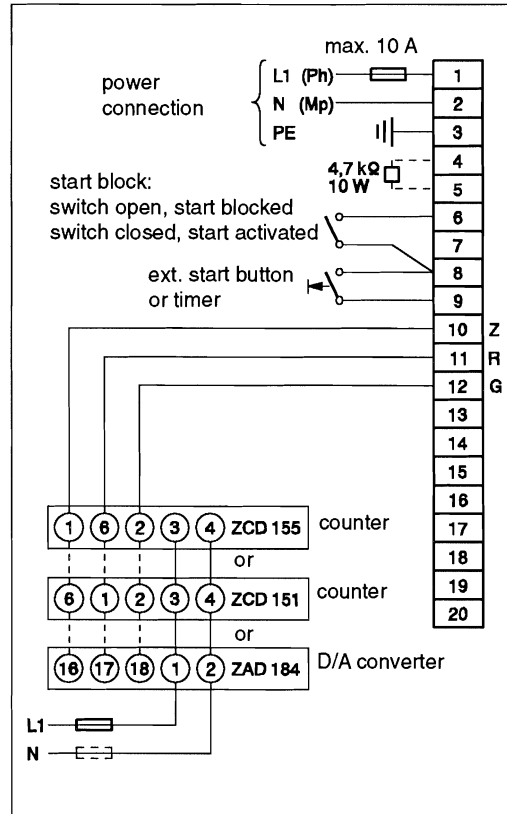


Fig. 9
Connecting diagram for counter

Open the cover with an Allen key (5 AF) and remove.

Remove transport packing (foam plastic).

Electrical connections are carried out according to the connection diagram (Fig. 9), using the terminal strip facing the housing wall.

Note the voltage and frequency ratings on the nameplate and adhesive label Fuse protection of the power cabling is maximum 10 A.

Before connecting the electro-mechanical counter, ensure that

- all external voltages are turned off,
- the drive used for the counter is correct, i.e. the voltage rating indicated by a cross (Fig. 10).

The external start button or the contact of the timer is connected to Terminals 8 and 9.

Warning: An AC voltage of 220 V is present between these terminals.

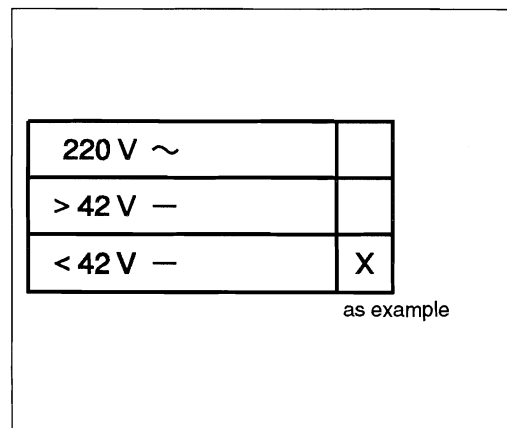


Fig. 10
Rating plate showing the voltage of the counter unit

The connecting cables should be as short as possible.

It is possible that the programmer of the FMM 460 Z can be activated by the AC current flowing through the cabling capacitance alone if the total cable length is greater than 250 m. By connecting a 4.7 kOhm, 10 W resistor to Terminals 4 and 5, the maximum permitted cable length can be extended to 3000 m. (Wire cross section 1.5 mm²)

Note: Terminals 4 and 5 are already connected by internal wiring. Please ensure that these are not loosened when connecting the resistor.

The counter and ZAD 184 are not to be connected in parallel to Terminals 10 to 12 (special version on request).

Connecting diagram for the counter

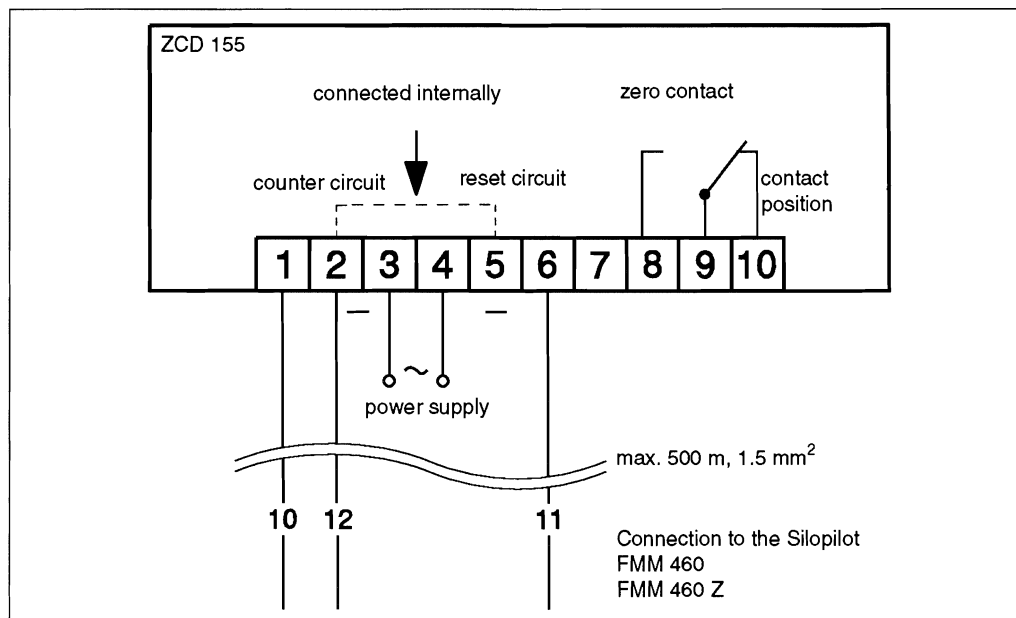


Fig. 11
Connecting diagram of the ZCD 155 counter

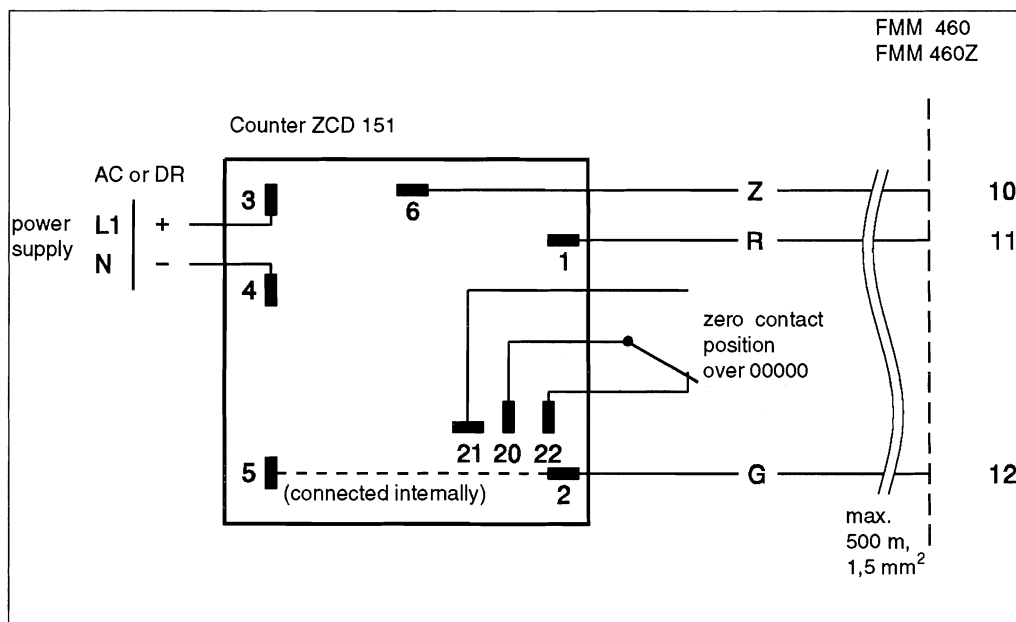


Fig. 12
Connecting diagram of the ZCD 151 counter

See Tech. documentation

08.78.01/2C and 11.73.04/2e for further information

Connecting diagram for the ZAD 184, see TI 11.73.14b

Connecting diagram for the Timer ZS 421 see TI 013 F/00/e.

Operation

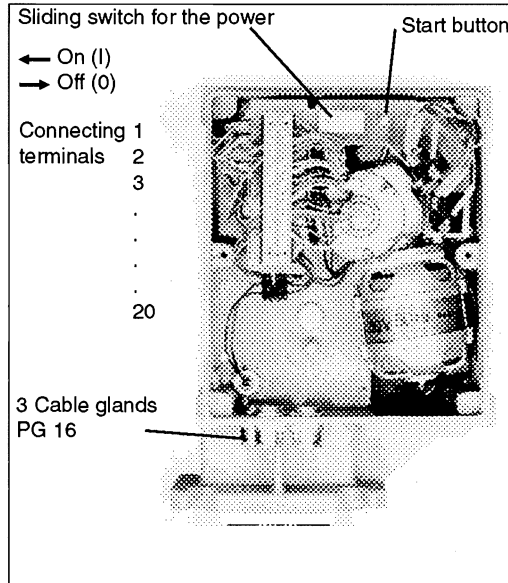


Fig. 13
Operating elements
in the Silopilot

Turning on the power

Set the sliding power switch to the off position (0). Switch on the power supply for the counters, timer, Silopilot etc.

Starting the measuring cycle

Briefly press the white start button (see Fig. 13). As the weight descends, the red LED flashes and, when a counter is connected, also shows the counting steps.

Calibrating the minimum level

A defined minimum level or distance to the vessel floor can be calibrated as follows.

The sensing weight is lowered into an empty vessel by pressing the start button. When the weight reaches either the minimum level selected or the floor, switch off the unit by means of the sliding switch (Fig. 13). "0" is visible. Lift up the measuring tape a little distance until a tape loop can be put through one of the two boreholes which are displaced by 180° (Fig. 14) on the edge of the tape spool. Fasten this loop under the bolt near the borehole. This prevents the weight entering the outlet cone.

Switch on the instrument using the sliding switch ("I" is visible). The sensing weight is raised.

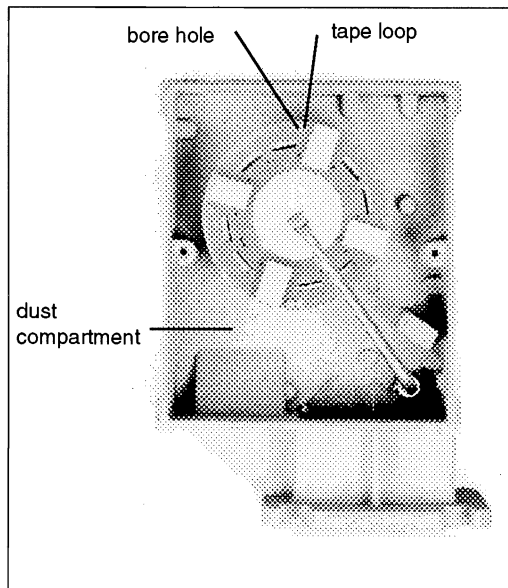


Fig. 14
View of dust compartment

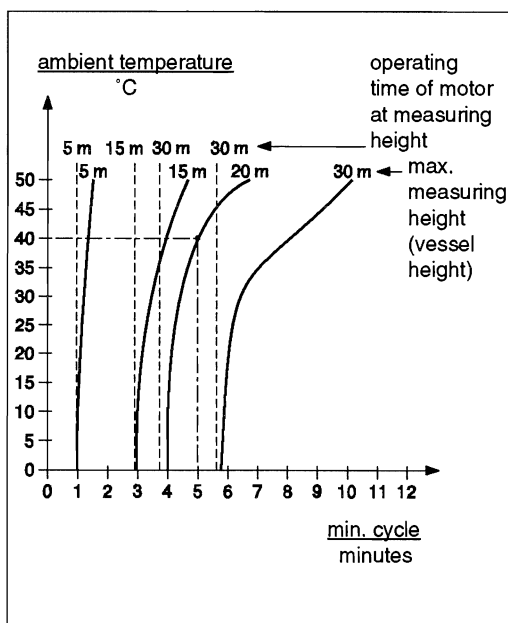


Fig. 15
Sampling cycle as a function of
ambient temperature and measu-
ring height

Final touches

Pull the cable glands tight and also seal them if necessary (open at installation).

Carefully put the cover on the instrument and screw tightly.

If necessary, fit the protective sun cover and attach springs.

Set timers or adjust the digital/analogue converter + memory. (see TI 11.73.14b)

Setting the timer (see TI 02.85.01/1)

Set the timer to the required measuring frequency.

Refer to Fig. 15

Technical Data

Measuring range:

max. 30 m

Measuring error:

max. 1 pulse

Pulse output:

one pulse per 10 cm or per 1/10 foot

Other versions on request

Power supply:

refer to instrument versions/power supply

Heating voltage:

220V 50/60 Hz or 110V 50/60 Hz

Power consumption:

approx. 40 VA

Housing and flange:

Cast aluminium (G-AL)

Measuring tape FMM 460 Z:

Corrosion-resistant steel tape \varnothing 1 mm

Option (not for Zone 10)

Oil-resistant nylon tape \varnothing 1 mm

Material of sensing weights:

refer to instrument versions/sensing weight

Max. gauge pressure p_e :

2 bar in Silo

Protection conforming to DIN 40050:

Dust compartment FMM 460 IP 55

Dust compartment FMM 460 Z IP 65

Control compartment IP 55

Permissible temperature by instrument:

-15° C ... + 50° C (heating required below -10° C)

in vessel: -15° C ...+60° C

Mean tape speed:

approx. 18 cm/s at 50 Hz (when raising or lowering)

Lifting force:

approx. 14 N, automatic motor shut-off with overstraining, automatic cut-in when strain removed

Mounting:

flange to fit counter flange DN 100, PN 16 DIN 2633

Total weight:

approx. 15 kg

Maintenance

The motor and gear box require no maintenance as these components are greased for their operating life.

If the material causes build-up, then the sensing weight must occasionally be cleaned so that the weight on the tape is not too great.

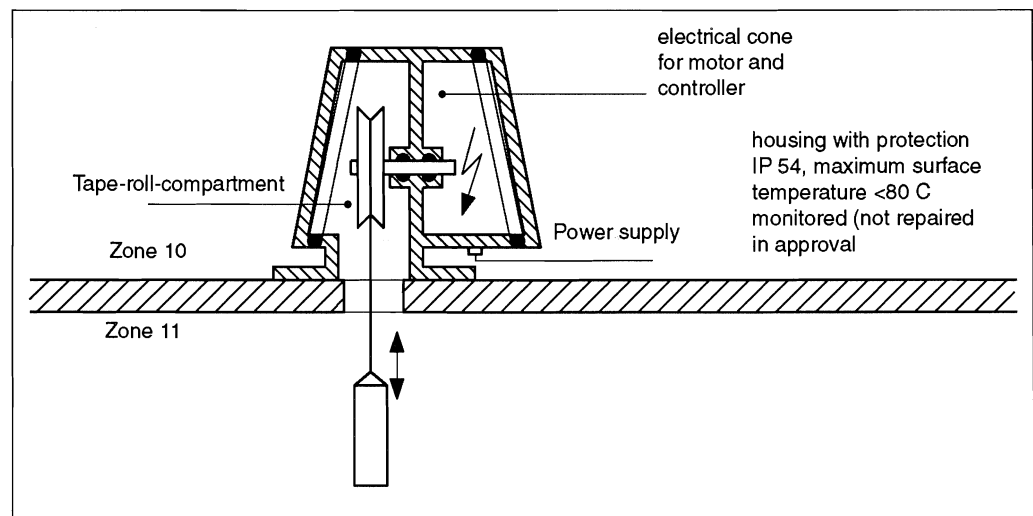
(A material build-up of 0.5 kg is permissible)

With materials which give rise to dust, the dust compartment of the SILOPILOT should be regularly blown out with compressed air (< 0.6 bar). With materials containing iron, metal dust in the dust compartment can settle on the magnets used for counting. The magnets should then be regularly cleaned.

Once dust-Ex instruments have been overhauled or repaired, a check test must be made in accordance with ElexV, 9 Sections 1 and 2. With the FMM 460 unit, this work can be carried out without check testing.

Section (1) If an electrical unit, a part of which has explosion protection, has been repaired or overhauled, it may only then be operated after an authorized specialist has determined that its design fulfils the requirements laid down in the regulations and after he has supplied either a certificate or given the instrument a mark of conformity.

Section (2) Section 1 does not apply if a unit is overhauled or repaired by the manufacturer and is then given a check test whereby the manufacturer then states that its design fulfils the requirements laid down in the regulations.



*Fig. 16
Tape roll path (Zone 10);
dust-tight separation between Zone 10 and Zone 11 as well as to electrical motor and control compartment.
Housing cover and spring entry comply with at least IP 65
maximum surface temperature P* (monitored)*

Cleaning the dust compartment

Opening the instrument:

Loosen the four cover screws with an Allen key (5 AF) and remove both covers. (Fig. 8)

One wall of the instrument contains the tape roll with the rolled up tape, the counting disk with magnets fixed with screws and the reed switch.

On the other side is the power switch, next to it the internal start button, the terminal block, behind this the wiper switch, and the suspended and freely swinging motor and finally the end switch.

Cleaning the dust compartment

The frequency of cleaning depends on the type of material it is used with.

Dust deposits are best blown out with compressed air.

If the electrical connecting walls of the instrument become dirty then the PG glands and the covering gasket should be checked and replaced if necessary.

Troubleshooting

1.) Instrument does not function

- a) Check the power source and cabling
- b) The power switch is in the "off" position
- c) Motor is faulty - check the thermopiles
 - Motor spool and therefore cable fuses are burnt out
 - Max. end switch out of alignment
- d) Start lock open (Fig. 9 Terminals 6 + 7)

2.) Sensing weight cannot be raised

- a) Weight submerged
- b) Weight too heavy, build up of material

3.) Motor operates continuously

- a) Tape breakage
- b) Spring broken or clamping sleeve loose (in tape roll)

4.) Counter does not count or counts inaccurately:

- a) Check reed contact (1 Ohm) when closed
- b) Wiper switch Contact D is faulty
- c) Magnet holder broken off

5.) Tape slips out of tape roll

- a) Flange is not horizontal

Repair

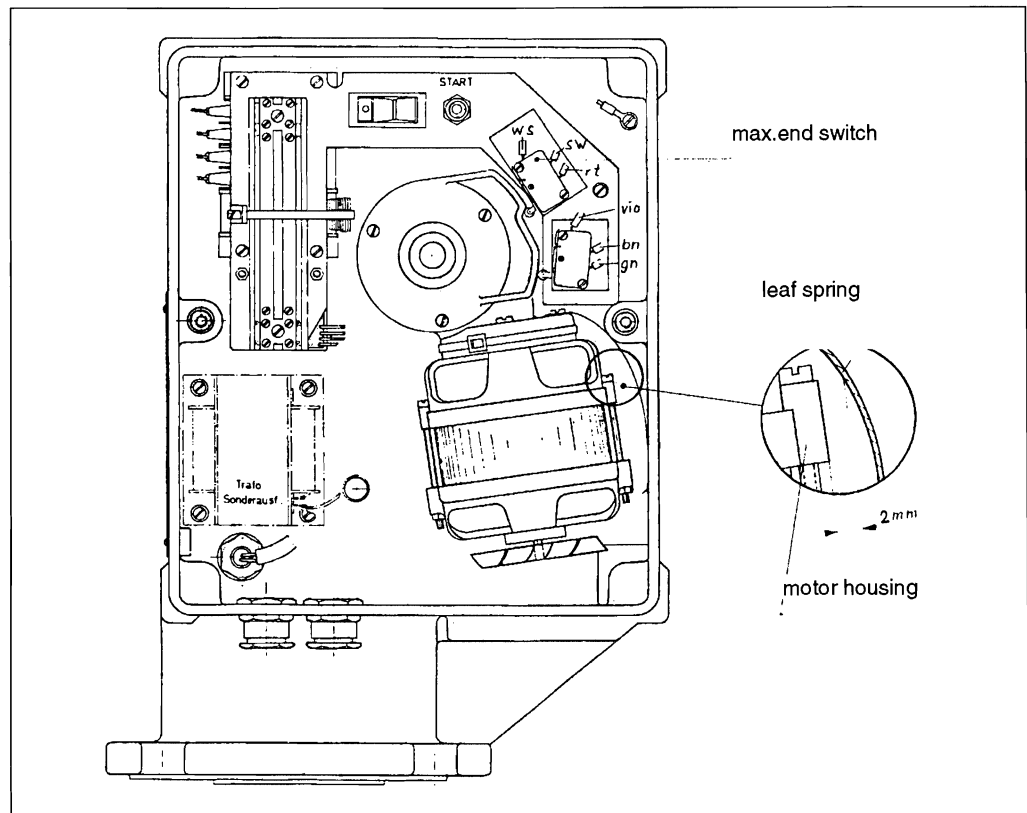


Fig. 17
Position of max. end switch

Replacing the max. end switch

To open the housing see Page 16

1. Swivel the motor to the right with approx. 2 mm between the motor housing and plate spring.
Hold the motor in this position.
2. Slide the loosened max. end switch in order to position it so that the lever of the microswitch shows the correct position on the switching gate.
Now adjust the microswitch so that it switches correctly. The connections 0 (red) and 2 (black) must be open.
3. Twisting the switching gate activates the microswitch.
In the compressed state, the level must still have a play of min. 1 mm.

This ensures that the switch is not under mechanical stress and cannot move over a period of time.

4. After adjustment the tops of the retaining screws are to be sealed with lacquer!

Replacing the slack tape switch

To open the housing see Page 16

Slack tape switch

1. Swivel the motor to the left with approx. 5 mm between the motor housing and wiper.
Hold the motor in this position.
2. Slide the loosen slack tape switch in order to position it so that the lever of the microswitch shows the correct position on the switching gate.
Now adjust the microswitch so that it switches.
The connections 0 (green) and 2 (brown) must be open.
3. Twisting the switching gate activates the microswitch.
In the compressed state, the lever must still have a play of min. 1 mm.
This ensures that the switch is not under mechanical stress and cannot move over a period of time.
4. After adjustment, the tops of the retaining screws are to be sealed with lacquer!

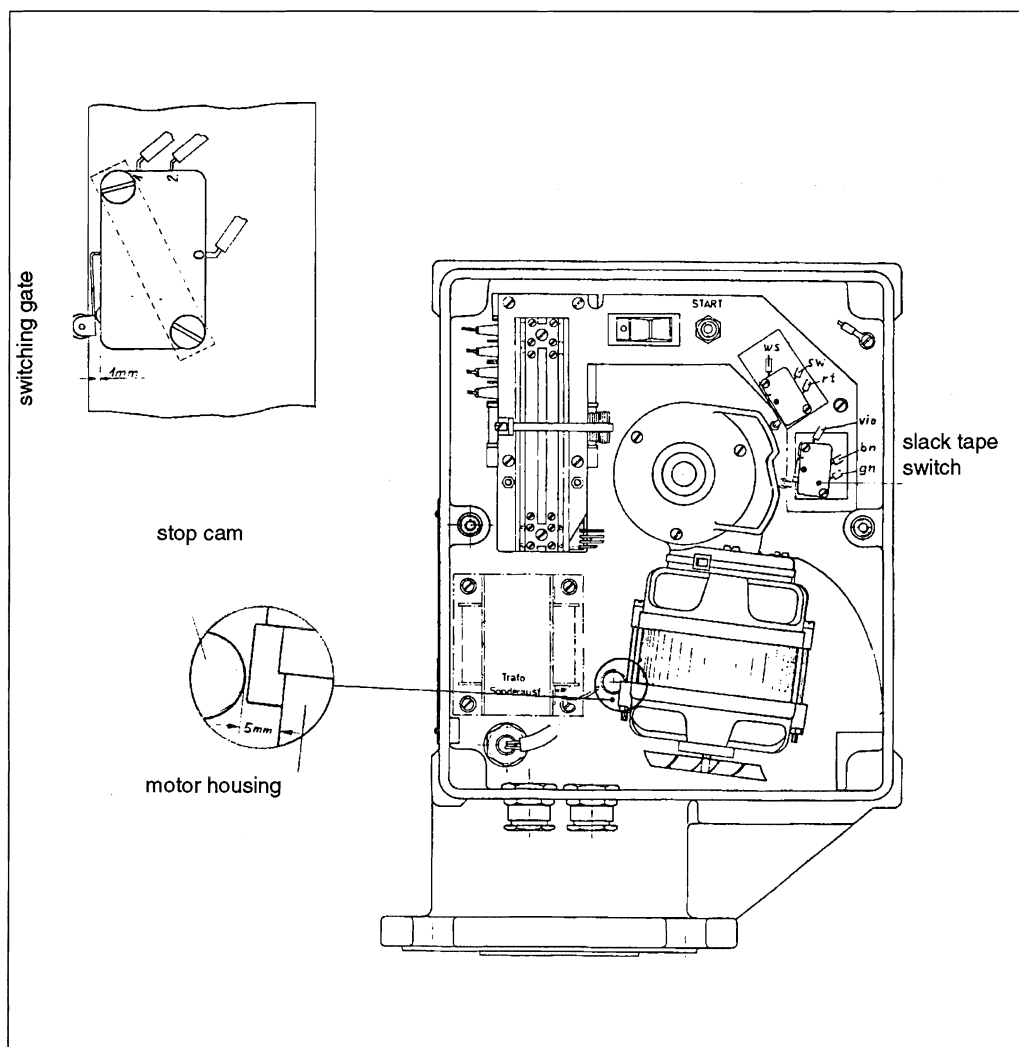


Fig. 18
Slack tape switch

Replacing the gear motor To open the housing see Page 16

1. Disconnect all five cables of the motor from the terminal strip,

Terminal
 7 = black
 9 = black

Thermopile

13 = red
 14 = green
 15 = yellow

Motor power supply

2. Remove the tape roll (refer to Replacing the tape roll)
3. Loosen the cylindrical screws of the spindle washer and carefully tap out the gear shaft with a rubber hammer.
 With old instruments the spindle washer is within the motor compartment, above the gears, and fastened by two screws.
4. Lightly grease the spindle of the new motor (e.g. universal grease BP Energrease LS 2) and carefully insert it through the bearing;
 take care when handling the microswitch (mech. damage).

With Z instruments, both bearings in the shell must be also packed with Loctite to increase sealing characteristics.

Please note that, according to the Ex regulations, this gland must be checked for air tightness.

5. Screw on the spindle washer again and connect the motor to the terminal strip.
 Orient the cable so that no looping or pinching occurs. Carry out a trial run.

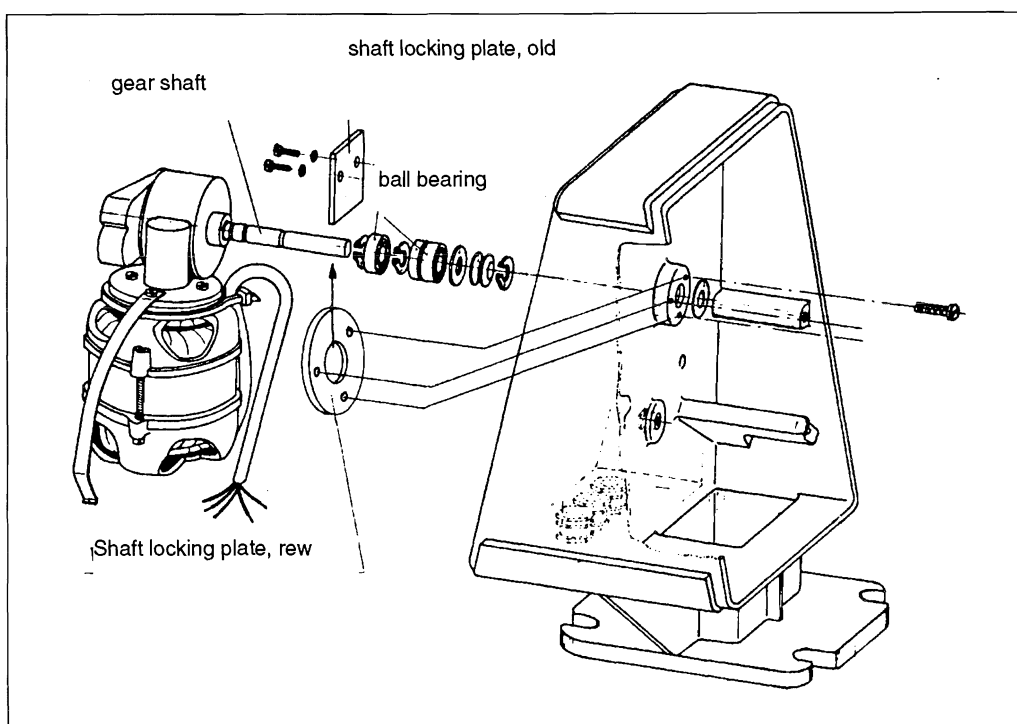


Fig. 19
 Installing the motor

Mechanical shock on the sensing weight can lead to tape breakage and overstretching of the spiral springs.
The entire tape roll should then be replaced.

Replacing the tape role

To open the housing see Page 16

1. Remove the holding clamp. Swivel out the counting pipe screws and counter.
2. Unscrew the counting disk (4 x M 4 screws)
3. Now loosen the clamping sleeve which is now visible (2 x 3 AF Allen screws).

Note:

The spiral spring under strain may cause injury if it suddenly unwinds!

4. Remove the tape roll with the clamping sleeve and spiral spring from the gear spindle.
Do not mislay loose components (centering sleeve, washers)!
5. Lightly grease all new moving parts if required (e.g. general purpose grease BP Energrease LS 2), and slide the tape roll on the spindle.
6. Put the spiral spring in the groove of the clamping sleeve and tightly screw the sleeve onto the spindle (any position).
7. Fasten the sensing weight onto the tape (double knotted) and carry out a trial run.
8. Screw on the counting disk to the tape roll (bore holes for the tape loops coincide),
Screw on counting initiator and adjust.

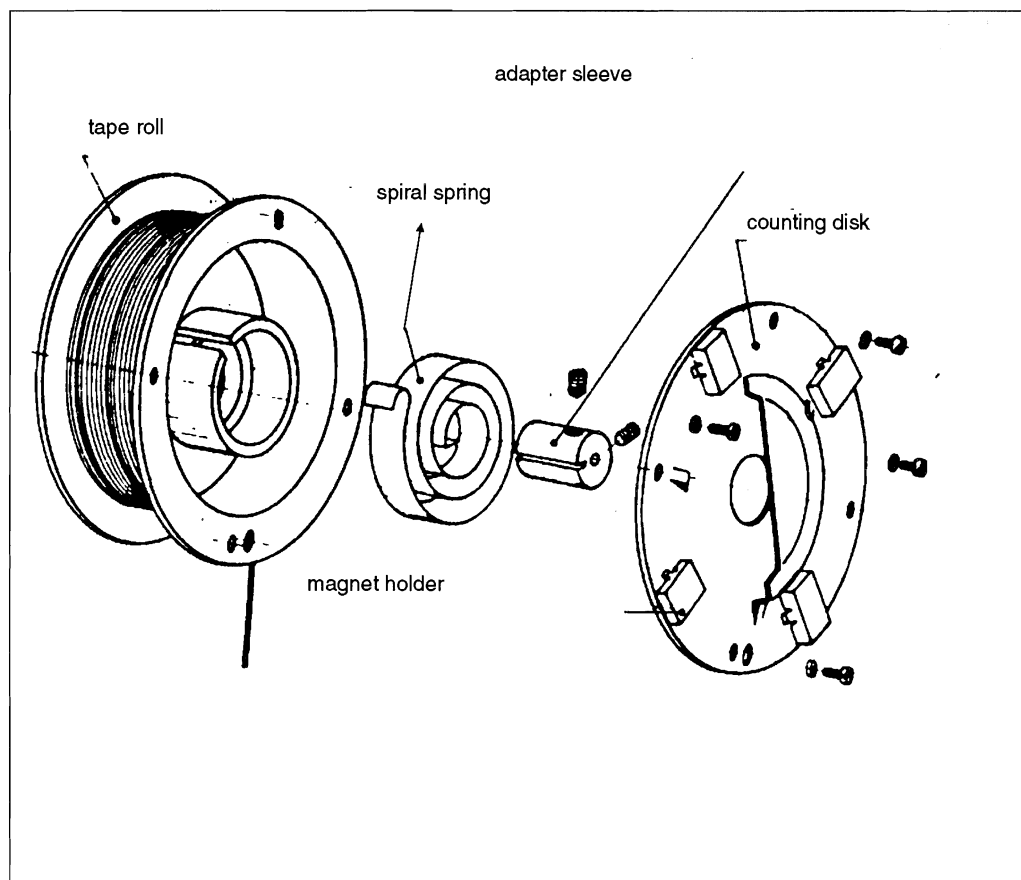


Fig. 20
Tape roll

Replacing the counting tube

To open the housing area see Page 16

The fuse is externally situated in a grey PVC housing underneath the wiper switch. The rating of this fuse is found beneath its screw connection.

- The angled pipe with the reed contact is attached to the centre of the counting disk by bending and fixed with a spring clip.
- The correct distance to the magnet holder is made by a slight bending of the pipe.
- The distance should, like the standard version be 2 mm + 0.5 mm, - 1 mm.

For this adjustment the gland screw does not have to be loosened.

Note:

If the counting activator is to be exchanged, then the tightness of the gland must be checked and conform to Ex regulations concerning tightness.

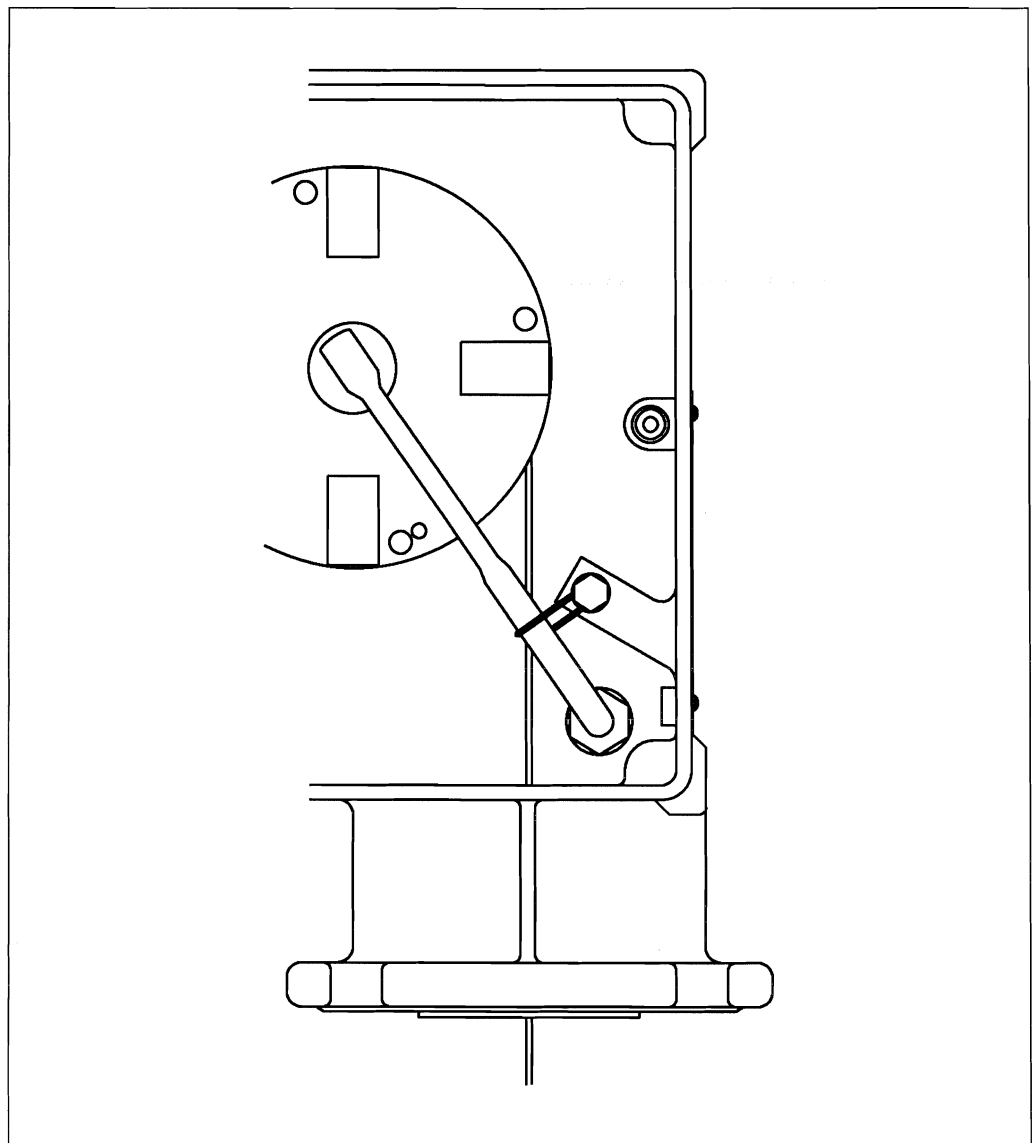
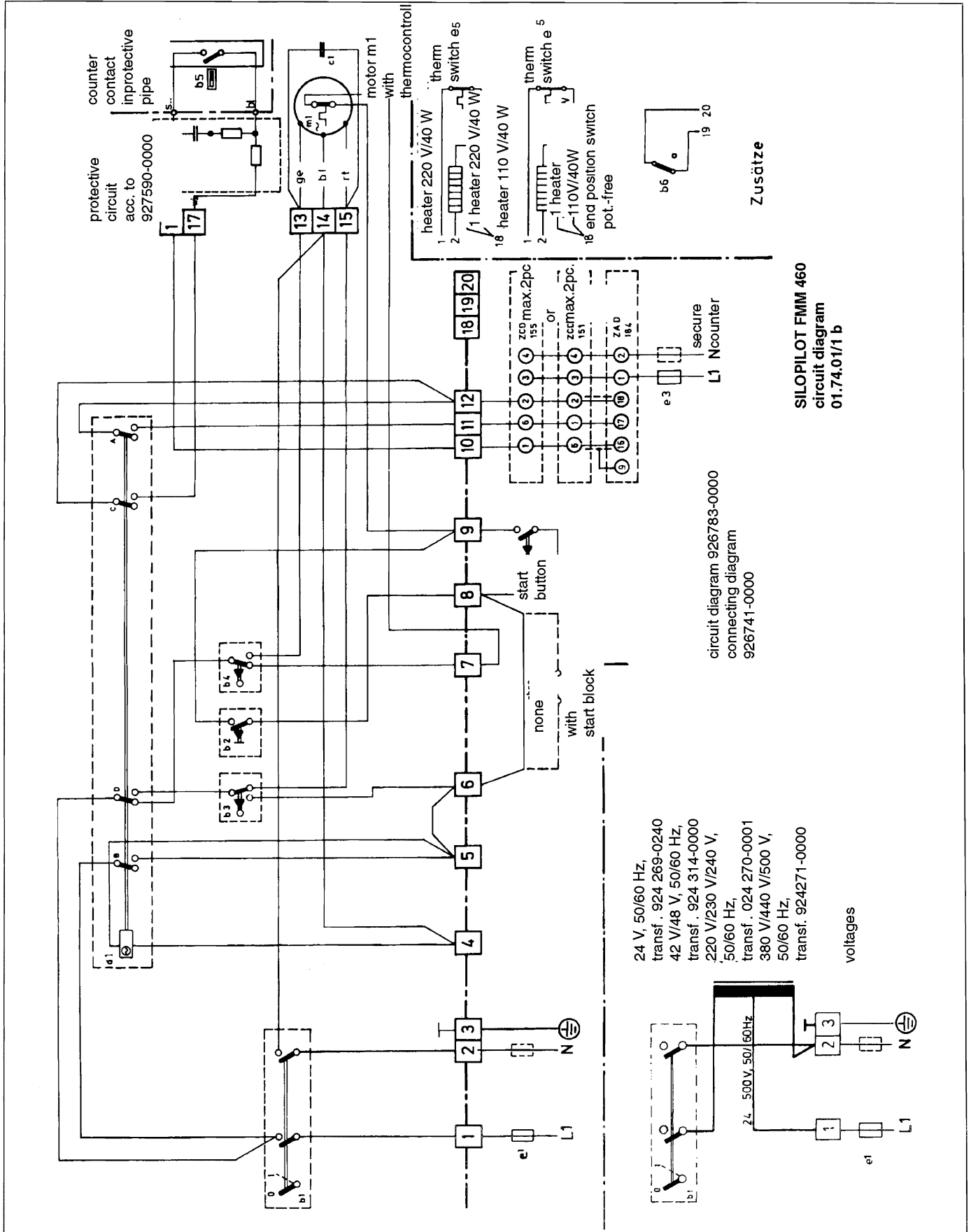


Fig. 21
Position of counting tube

Connecting Diagram for the FMM 460 tape breakage alarm



Connecting Diagram for the FMM 460 tape breakage alarm

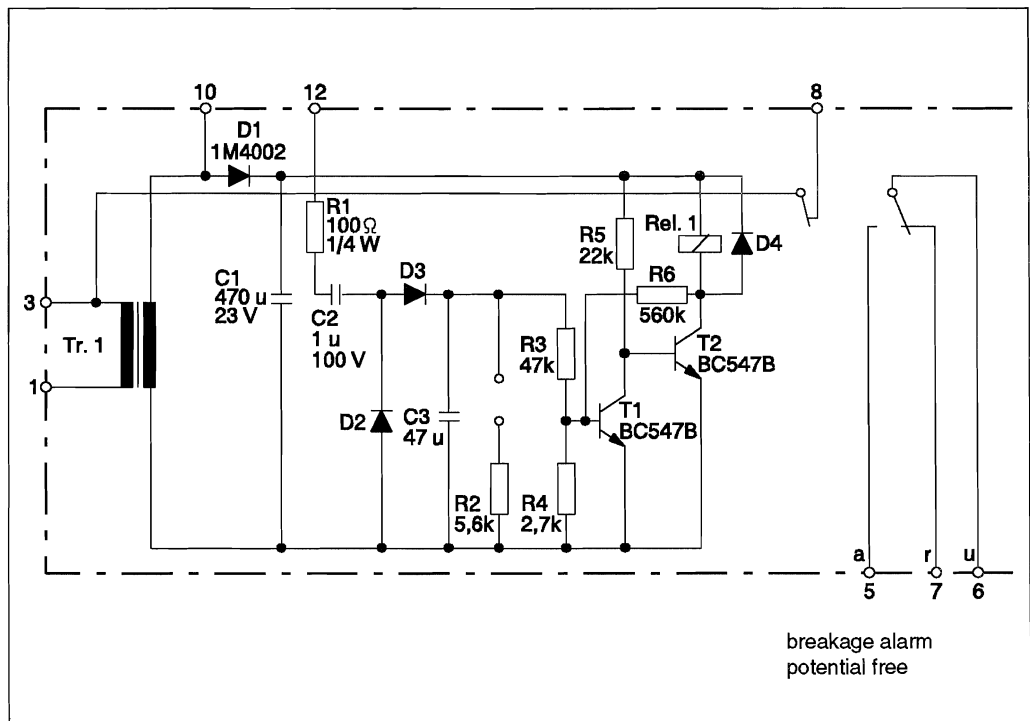


Fig. 22
Tape breakage alarm

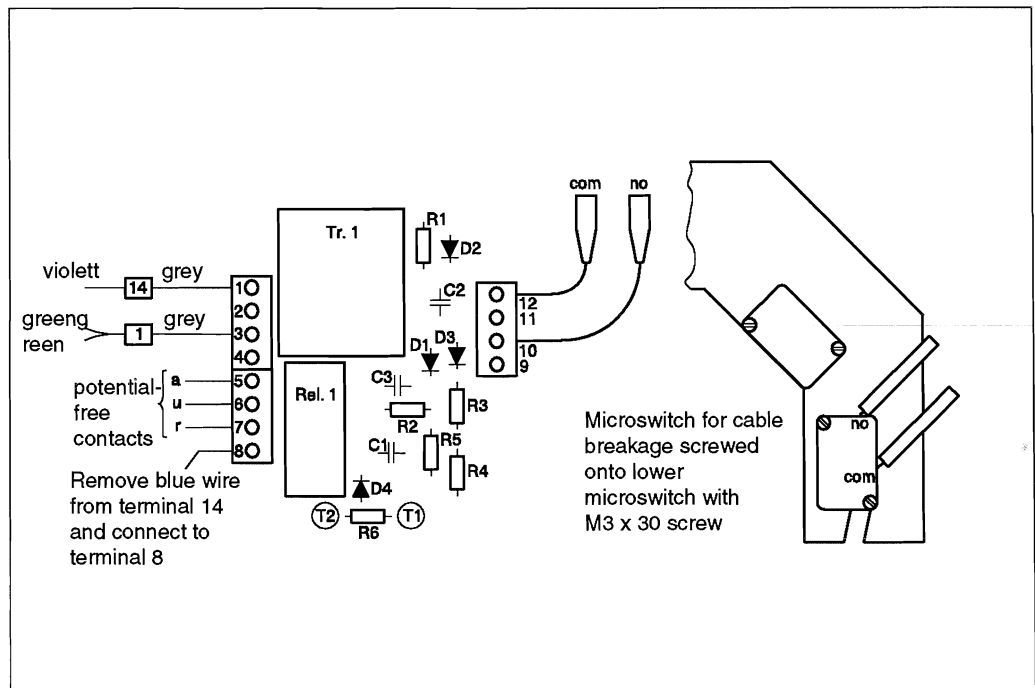


Fig. 23
Microswitch
for tape breakage

Function description

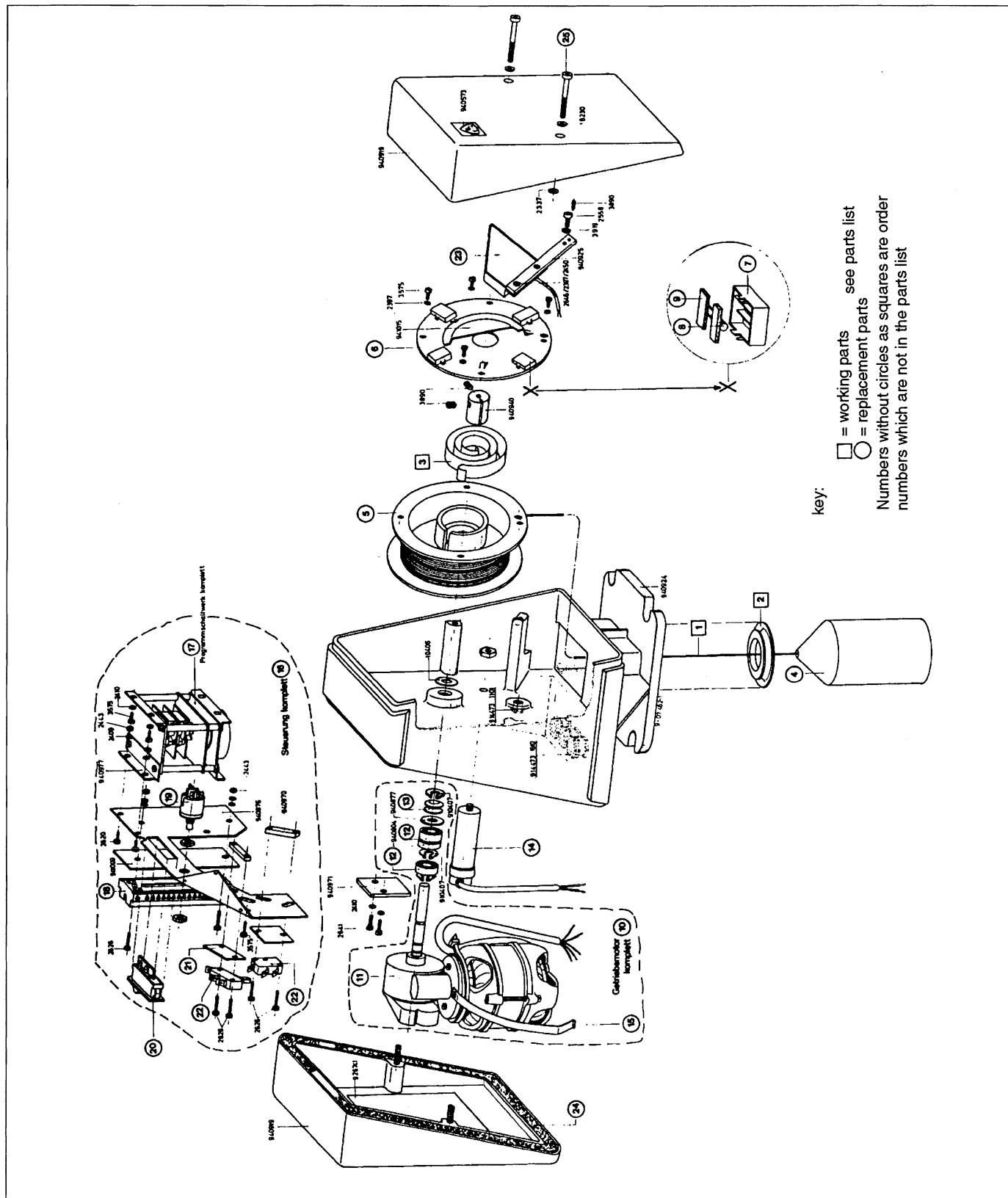
If the tape breaks then the unit switches to raising the tape. The microswitch mounted on the slack tape switch in a "piggyback" fashion initiates the tape breakage mode which switches off the motor after approx. 3 sec.

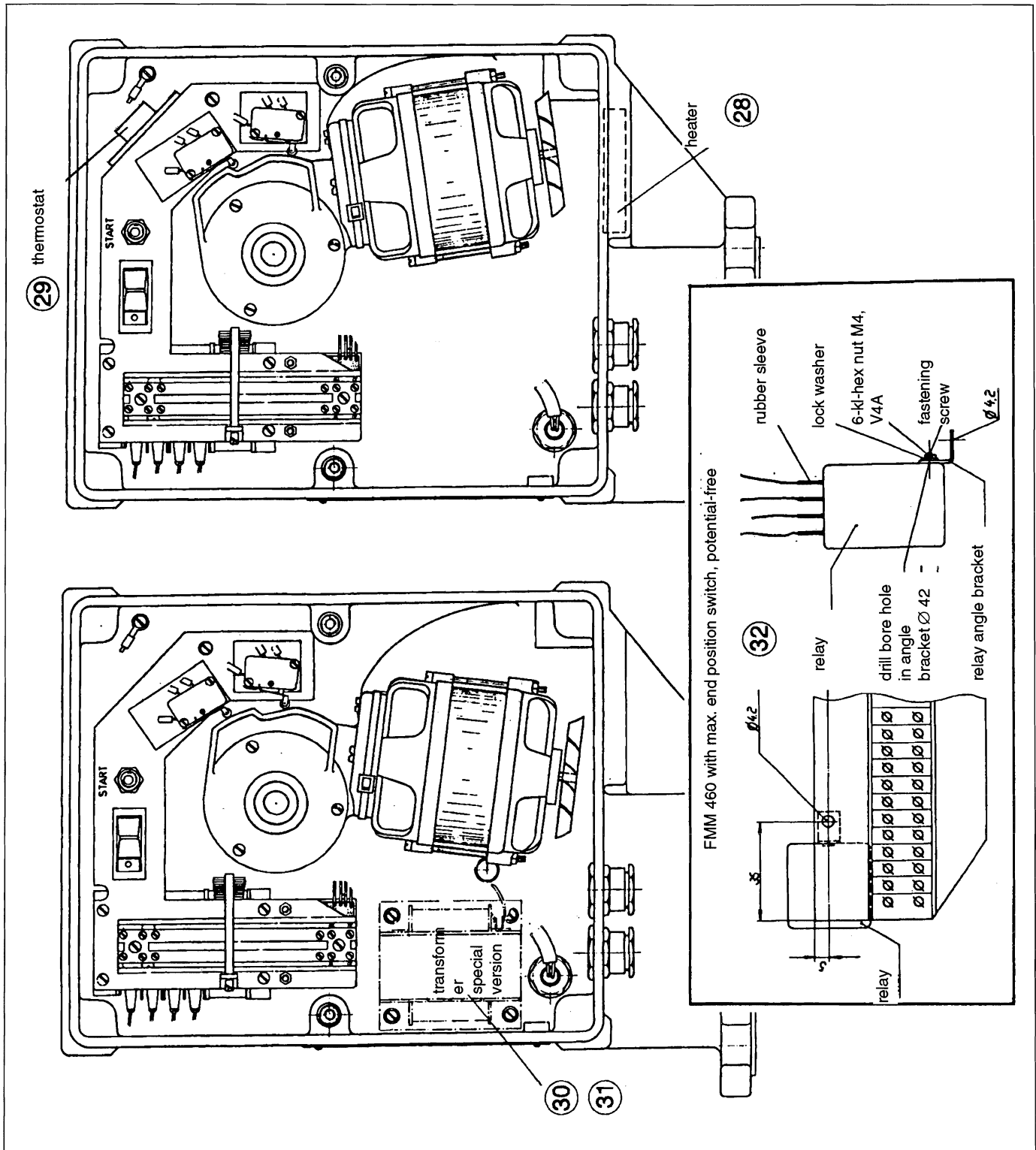
A voltage-free signal is available on the subboard at Terminals 5, 6 and 7.

The contact can withstand a load of up to a max. 250 V, max. 1 A, max. 150 VA.

Spare Parts

SILOPILOT FMM 460 / FMM 460 Z
 (Valid as of 01.01.87)





(Valid as of 01.01.82)

Item	Part	Order No.
1	Tape (standard length 32.0 meter) Material Nylon, price per meter	003972-0000
1a	Tape (standard length 32.0 meter) Material stainless steel	504164-0000
2	Cable entry	940973-0000
3	Spiral spring	940941-0000
4	Sensing weight PVC (red)	940933-0000
4a	Sensing weight PE (white)	940933-0001
4b	Sensing weight for FMM 460 Z PA (black)	940933-0002
4c	Umbrella weight PE/sail cloth	941022-0000
4d	Umbrella weight for FMM 460 Z	941022-0001
5	Tape roll complete with nylon tape (32.0 meter) for dm counting	940928-0000
5a	Tape roll complete with nylon tape (32.0 meter) for 1/10 foot counting	940928-0001
5b	Tape roll complete with VA tape	940928-0002
5c	Tape roll complete with VA tape (32.0 meter) for 1/10 foot counting	940928-0003
5d	Tape roll complete with VA tape (32.0 Meter) for dm counting -Z version-	940928-0010
5e	Tape roll complete with VA tape (32.0 meter) for 1/10 foot counting -Z version-	940928-0011

Item	Part	Order No.
6	Counting disk complete with magnets for dm counting	940931-0000
6a	Counting disk complete with magnets for 1/10 foot counting	940931-0001
7	Magnet holder (4 are needed for dm counting, 12 are needed for 1/10 foot counting)	940861-0000
8	Rod magnet (4 are needed for dm counting, 24 are needed for 1/10 foot counting)	950600-0000
9	Tesamoll strip (meter price) (8 are needed for dm counting, 24 each 30 mm are needed for 1/10 foot counting)	008565-0000
10	Gear motor 220 V, 50/60 Hz, complete consisting of: gear motor 2 bearings 6000 Z V-Ring V 10	941032-0000
11	Bearings 6000 Z	008343-0000
12	V-Ring V 10	009087-0000
13	Capacitor 400 V, 1,4 uF	940939-0000
14	Sheet ring	940926-0000
15	Control unit complete	941007-0010
16	Programming switch unit complete	940997-1000
17	Terminal strip 20-pole	009891-0000
18	Pushbutton	008992-0000
19	Sliding switch	009893-0000
20	Insulating spacer for microswitch	941031-0000
21	Microswitch	010037-0000
22	Counting relay	041243-0000
23	Bracket for counting relay complete	510322-0000
24	Fuse for counting relay smaller than 42 V	941248-0001

Item.	Part	Order No.
24a	Fuse for counting relay greater than 42 V	941248-0000
24b	Fuse for counting relay 220 V	941248-0002
25	Sponge rubber seal for cover L = 1000 mm	003022-0000
26	Cylindrical screw M 6-50 for cover	010408-0000
27	Heater complete	941019-0000
28	Flat heating element 220 V, 40 W	940297-0001
29	Thermoswitch	940937-0000
30	Transformer for voltage 24 V, 50/60 Hz	924269-0240
31	Transformer for voltage 110 V/115 V/127 V/230 V/240 V, 50/60 Hz	924270-0001
32	End switch complete	941033-0000

When using Z instruments with flammable materials (Area Ex-Zone 0,1,10 or 11), once parts have been replaced in the original system, a new check test must be carried out.