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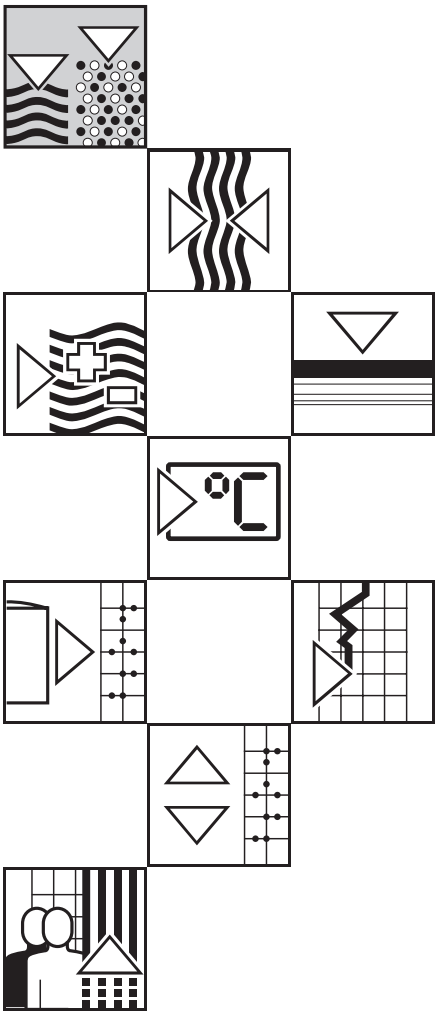
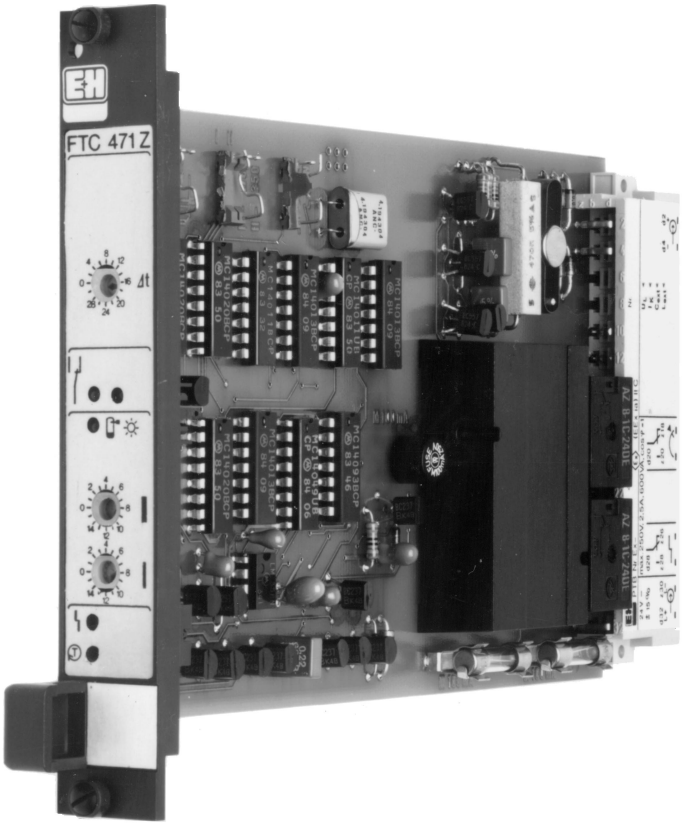
015582-1000

nivotester
FTC 470 Z, FTC 471 Z
Level measurement

Operating Instructions



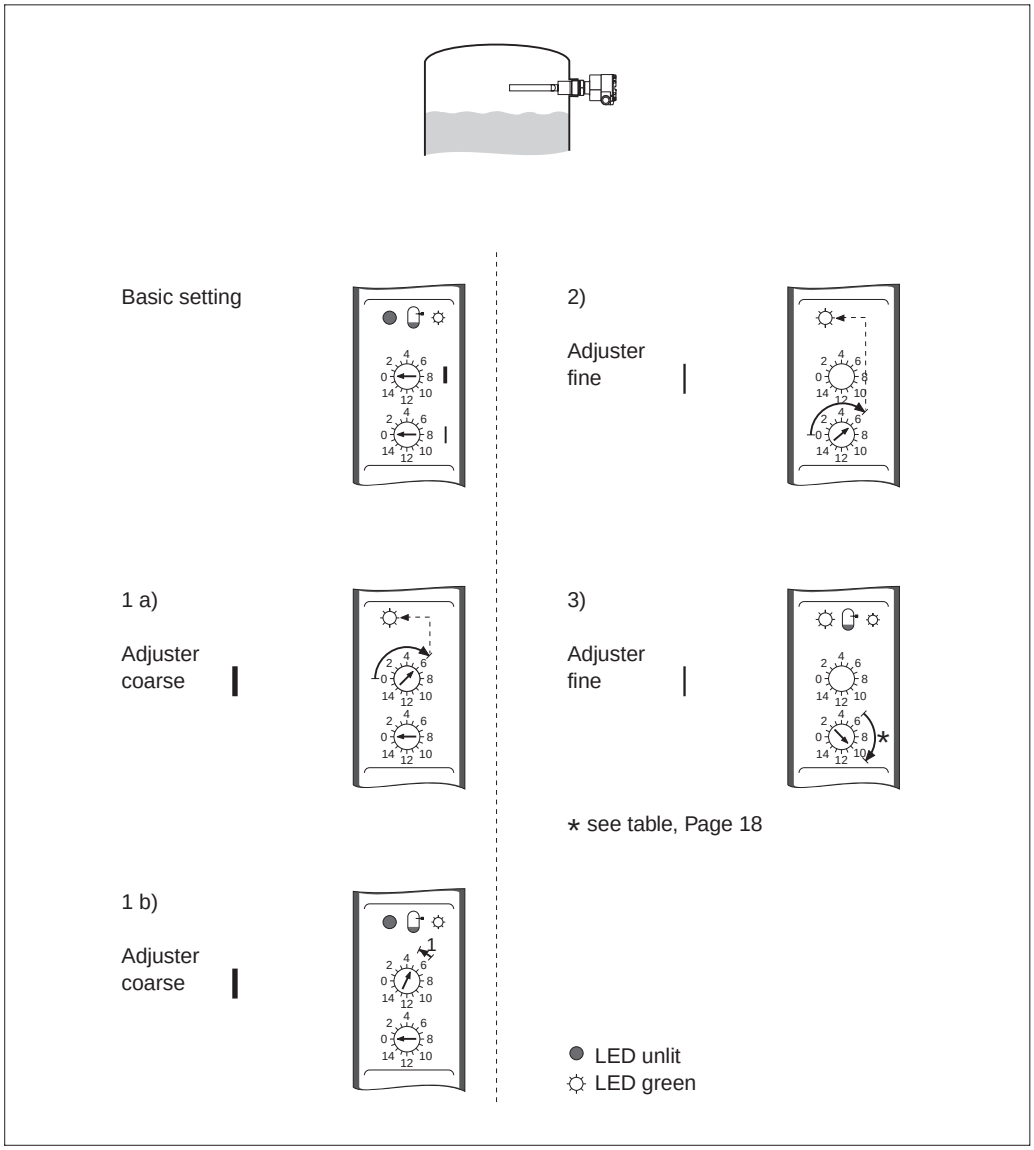


Endress + Hauser

The Power of Know How

Short Instructions

Calibration with a free probe.



See Page 14 onwards for other types of calibration.

Table of Contents

1 Notes on Safety

1.1 Special notes on safety

Approved usage

The Nivotester FTC 470 Z / 471 Z is a level limit switch for connecting to capacitive probes used in the level limit detection of liquids and solids, including those operating in explosion-hazardous areas.
See Technical Data and Certificates 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 explosive atmosphere.
For this reason, the instrument must be installed, connected, operated and maintained by personnel that are authorised 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.

Explosion-hazardous area

If the probe is to be installed in an explosion hazardous area, then the specifications in the certificate as well as all national regulations must be observed.

- Ensure that technical personnel are sufficiently trained.
- All measurement and safety regulations which apply to the measuring point are to be observed.

1.2 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 in the margin.

Safety conventions

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 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.

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 or its cabling laid in an explosion hazardous area.
	**Explosion hazardous area** Symbol used in drawings to indicate explosion hazardous areas. – Devices located in explosion hazardous areas and wiring for such instruments must conform with the stated type of protection.
	**Safe area (non-explosion hazardous area)** Symbol used in drawings 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 (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 Nivotester FTC 470 Z / 471 Z is a level limit switch for connecting to capacitive probes used in the level limit detection of liquids and solids, including those operating in explosion-hazardous area Zone 0 and dust-explosive area Zone 20.
The measuring system is certified as an overspill protection device for flammable liquids (German VbF regulations) and for non-flammable water polluting liquids (German WHG regulations).

Nivotester FTC 470 Z for applications where rapid switching is required.
Nivotester FTC 471 Z with adjustable switching delay for applications where rapid switching is not immediately desired when reaching the limit value.

2.1 Measuring system

Components of the measuring system:
- Nivotester FTC 470 Z or FTC 471 Z level limit switch
- Sensor:
  – capacitive probe with electronic insert (transmitter) EC 17 Z or
  – capacitive probe with electronic insert (transmitter) EC 16 Z for use in media that produce a strong build up.

At high probe temperatures the electronic insert can be installed in a separate housing (HTC 17 Z or HTC 16 Z).

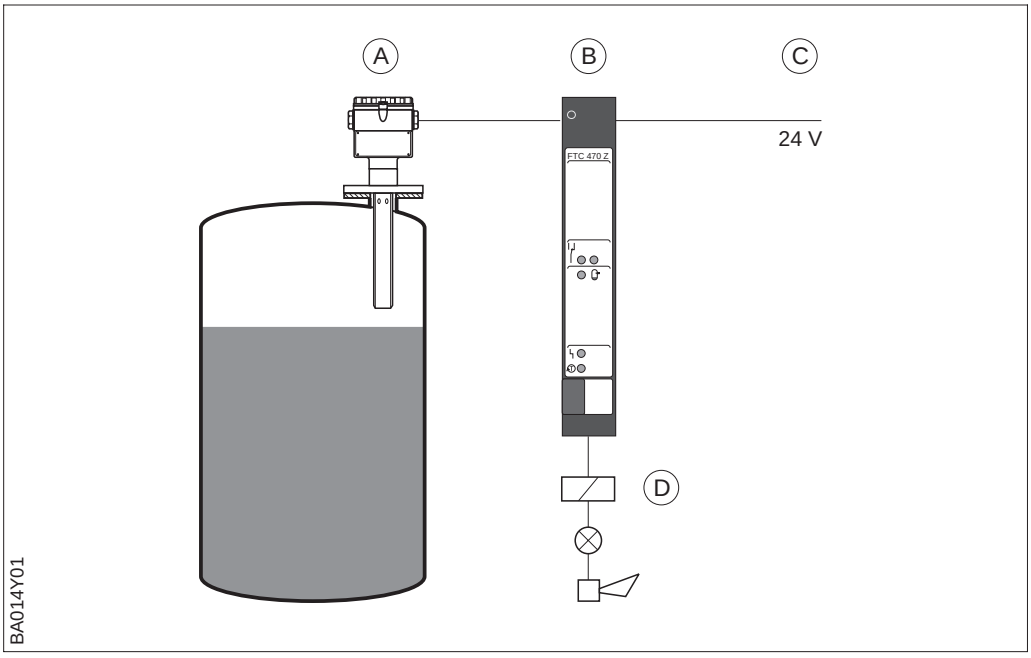


Fig. 1
A Capacitive probe with the EC… Z electronic insert

B Nivotester FTC 470 Z or FTC 471 Z

C Power supply 24 V

D External control or signalling units

2.2 Operating principle

Please refer to the appropriate Technical Information brochure for the operating principle of capacitive limit detection using electronic insert EC 16 Z or EC 17 Z.

The intrinsically safe input on the Nivotester FTC 470 Z / 471 Z is galvanically isolated from the other circuits by a DC/DC converter.
The Nivotester supplies direct current to the EC 16 Z or EC 17 Z transmitter (electronic insert) via a two-wire cable. It receives from the electronic insert a frequency signal which is inversely proportional to the level.
Current pulses of approx. 12 mA, approx. 200 µs wide are superimposed by the transmitter. The Nivotester evaluates the frequency and causes the level alarm relay to energise at a preset limit. The switching mode of the relay and the status of the sensor are indicated on the front panel by LEDs.
See Fig. 11, Page 19 for relay operation and LED function in connection with the input signal and safety mode.

Selecting the fail-safe mode ensures that the level alarm relay always operates with quiescent current:

- *Minimum fail-safe mode*
  The relay de-energises when the level falls **below** the switchpoint (red LED lights up), a fault alarm is indicated or the power supply fails.
- *Maximum fail-safe mode*
  The relay de-energises when the level rises **above** the switchpoint (red LED lights up), a fault alarm is indicated or the power supply fails.

The Nivotester has a function monitoring system to increase operating safety.
The fault alarm relay and the level alarm relay will de-energise and the red LEDs light up if there is a short circuit, breakage of the cable to the electronic insert or if important components in the electronic insert or the Nivotester input are faulty.

Note for option “Transistor output”:
In switching mode “relay de-energised” the transistors are blocked.

The Nivotester FTC 471 Z also has an adjustable 0…30 s switching delay and the possibility for selecting whether the relay should switch after a delay when the sensor is covered or free. Conversely, the switching delay is 0.5 s.

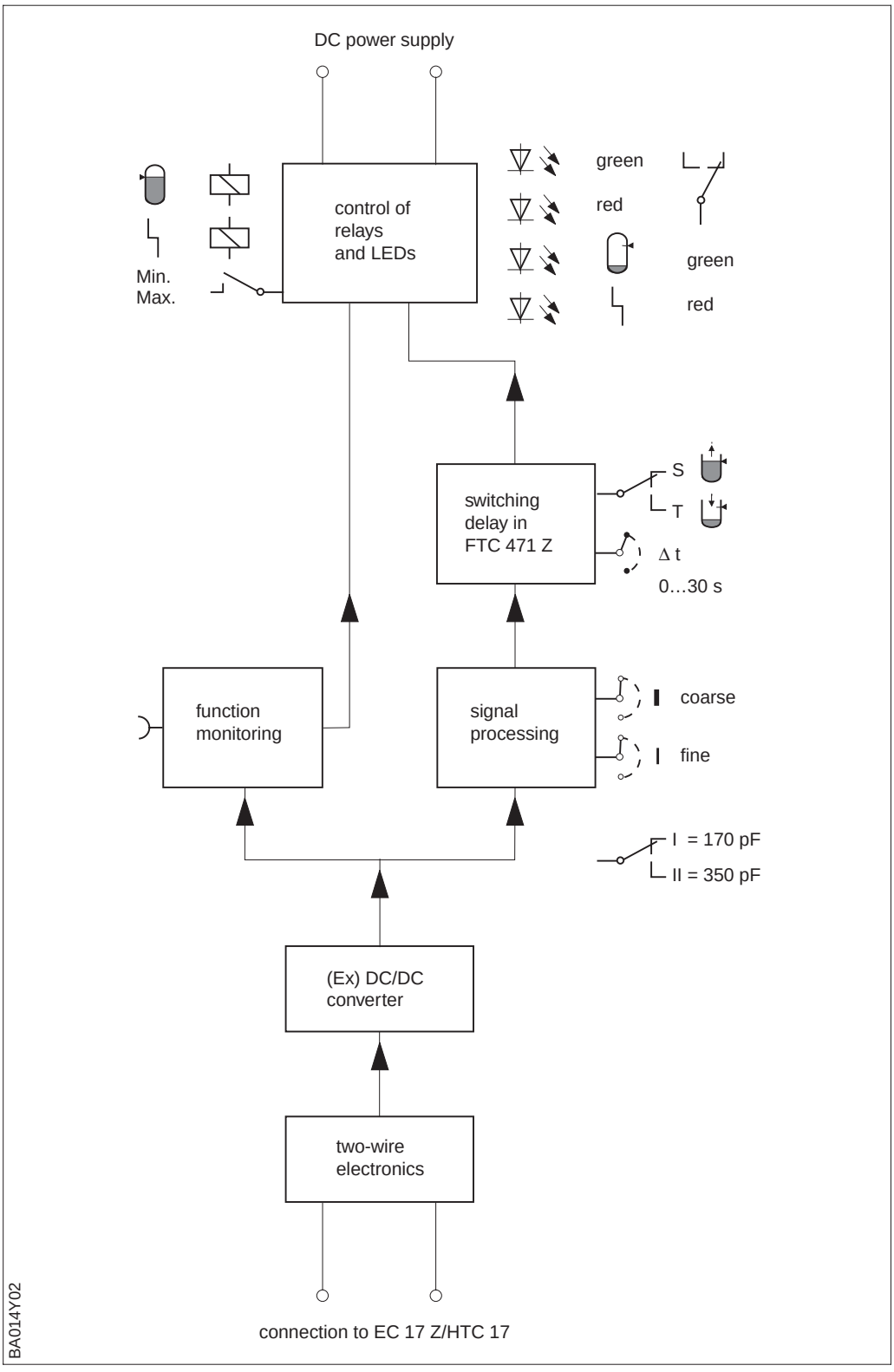


Fig. 2
Block diagram
FTC 470 Z / 471 Z

3 Mounting

3.1 Planning

Types of mounting and process conditions

The Nivotester FTC 470 Z / 471 Z Racksyst plug-in board must be mounted outside the explosion hazardous area in a Monorack or assembly rack.
Protective housings with IP 55 ingress protection are available for mounting in the open, e.g. Monorack protective housing or Racksyst field housing.

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

Use of probes in the explosion-hazardous area

If the probe is used in the explosion-hazardous area and the Nivotester is not mounted in a rack supplied by Endress+Hauser, then it is best to order a suitable female multipoint connector for the Nivotester FTC 470 Z / 471 Z. This strip is only partially equipped with connections and has a separation chamber for intrinsically safe signal cables which complies with the creep and air paths required.
The coding pins are also supplied. If none of the components supplied by E+H are to be used, then all local explosion regulations must be observed when mounting and connecting the Nivotester. See also Fig. 3.

3.2 Mounting

Coding pins

Insert the coding pins in the correct place in the female connecting strip in the assembly rack or Monorack. A distinction is made here between the relay output and the transistor output (open collector). The coding pins ensure that only a Nivotester FTC 470 Z or FTC 471 Z can be plugged in. This prevents damage to the instrument and faulty functioning of the system.
Slide the Nivotester into its appropriate slot only after the assembly rack, field housing or Monorack has been fully wired up.

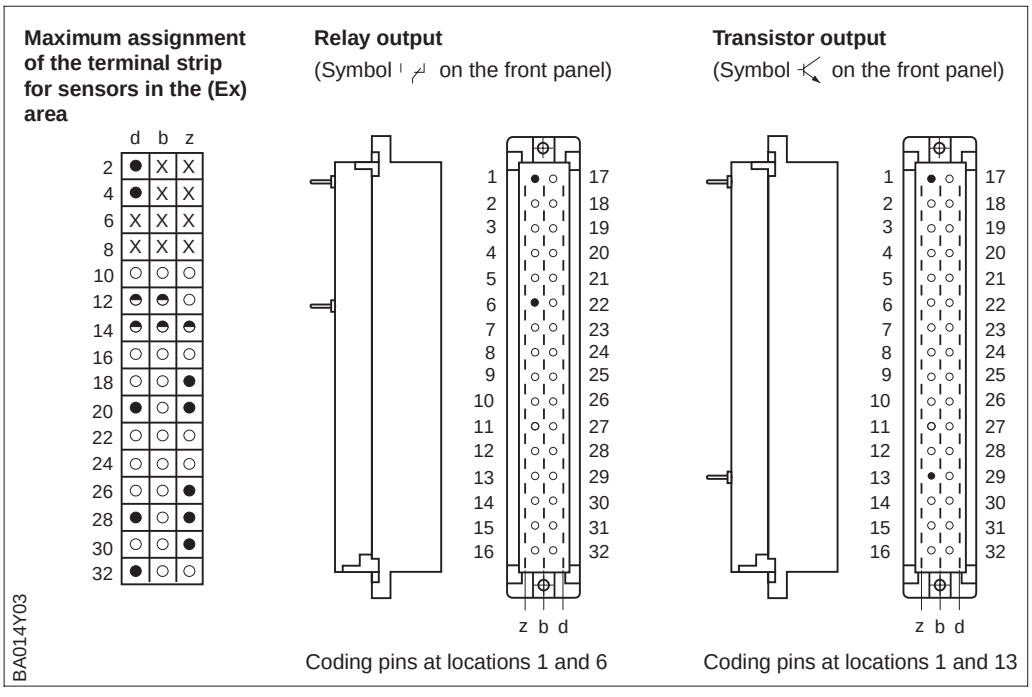


Fig. 3
Arrangement of connections and coding pins in the female multipoint connector for the Nivotester FTC 470 Z / 471 Z level limit switch

● = assigned pins
◓ = not to be used for lugs
X = remove pins

4 Electrical Connection

The Nivotester may only be connected by suitably qualified personnel.

Connections

The Nivotester FTC 470 Z / 471 Z has a DIN 41 612, Format F, strip with coded holes for electrical connections. See Fig. 4 for connection and wiring of the female connector in the assembly rack.

Connecting the power supply

Connection to 24 V direct voltage. No special fuse is needed since fine-blow fuses are incorporated in the instrument. The fuses F2 and F3 blow on reverse polarity. Reference zero (⊥) is connected to the minus pole (L–) of the supply voltage.

Connecting the probe to the electronic insert

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

Hinweis!

Note!
See Technical Information TI 241F/00/en for general installation instructions with strong interference sources.

If grounding the cable screening at both ends is not possible then the screening should be grounded at the probe housing (vessel potential).

Installing the probe in the explosion hazardous area:
Observe all appropriate explosion protection regulations for laying intrinsically safe cabling.

Select the correct bridge on the EC 17 Z electronic insert:
– Bridge 4-5 for standard applications,
– Bridge 3-4 if conductive build-up on the sensor is expected.

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

Connecting signal and control systems

Note operation of instrument depending on input signal and safety mode (Fig. 11) and the maximum load of the outputs (relay contact or transistor).
In the case of fault and on power failure both relays – level alarm and fault alarm – are de-energised.

Note for option “Transistor output”:
In switching mode “relay de-energised” the transistors are blocked.

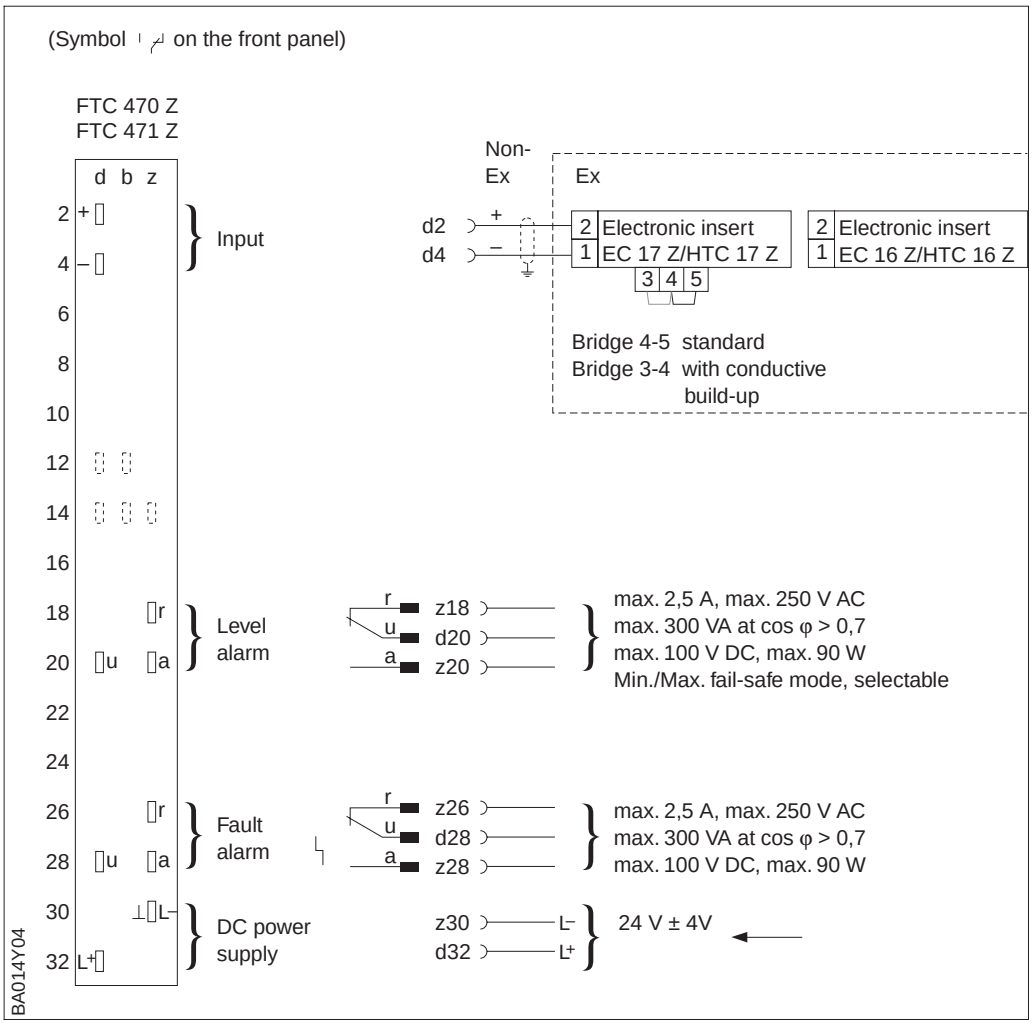


Fig. 4
The electrical connection of Nivotester FTC 470 Z / 471 Z showing the contact blades of the male multipoint or the connection side of the female connector in the rack

Relay contacts:
r = NC (normally closed)
u = C (common)
a = NO (normally open)

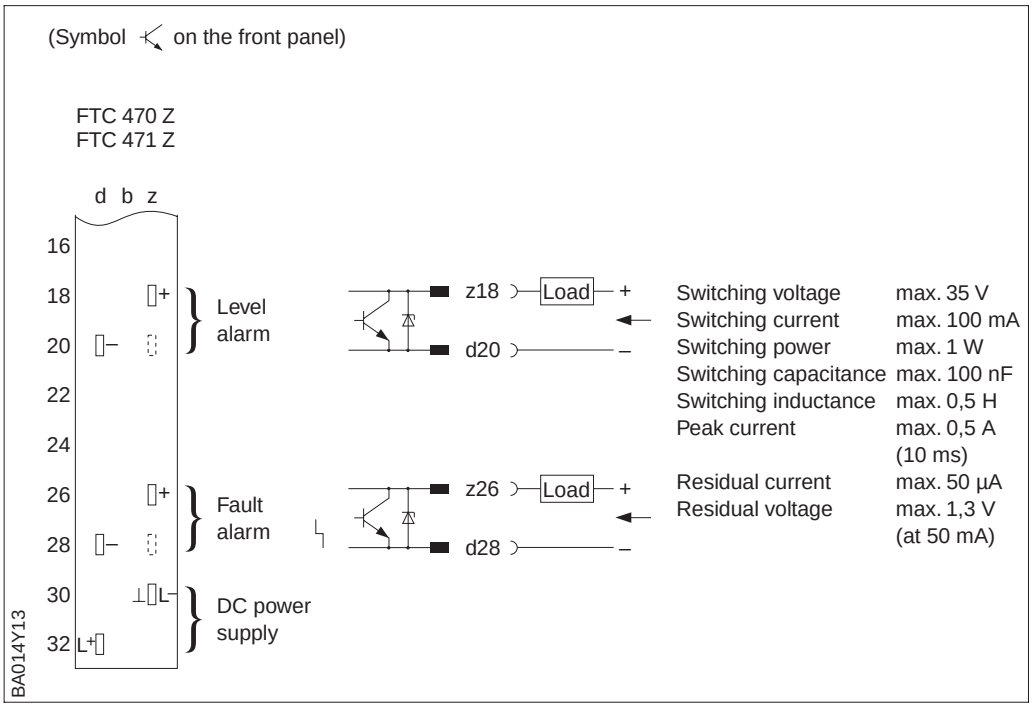


Fig. 5
Connection of version with transistor output (open collector)

5 Adjustments

Carry out the following adjustments before inserting the board into the rack.

The blue hook switches are located on the printed circuit, at the top close to the front panel. See also Fig. 5.

Selecting the safety mode

The function of the minimum/maximum safety mode is described under the section “Operating principle” and shown in Fig. 11.

Switch open: Minimum fail-safe mode
Switch closed: Maximum fail-safe mode

If the Nivotester FTC 470 Z / FTC 471 Z is used for overspill protection, then the switch should be closed.

Selecting the range

If a short sensor with a built-in electronic insert is mounted laterally in the vessel, and its initial capacitance (sensor free) is less than 170 pF, then Range 1 should be selected.
Range II should be selected only for long, vertical sensors (with ground tube) or for horizontal sensors with ground tube, connected with a coaxial cable to the HTC… Z electronic insert in a protection housing and which has an initial capacitance greater than 170 pF.

Selecting the switching delay on the FTC 471 Z

The user must decide whether the relay, irrespective of safety mode, should switch with a delay when the sensor is covered or when it is free. Conversely, the relay switches almost without delay.
Switch to “S” = Delay when sensor is covered
Switch to “T” = Delay when sensor is free

Setting the switching delay on the FTC 471 Z

Using the adjuster Δt on the front panel, the switching delay for the level alarm can be increased in 2 second steps up to a maximum of 30 seconds.
The switching delay has no effect on the switching time of the function monitoring.

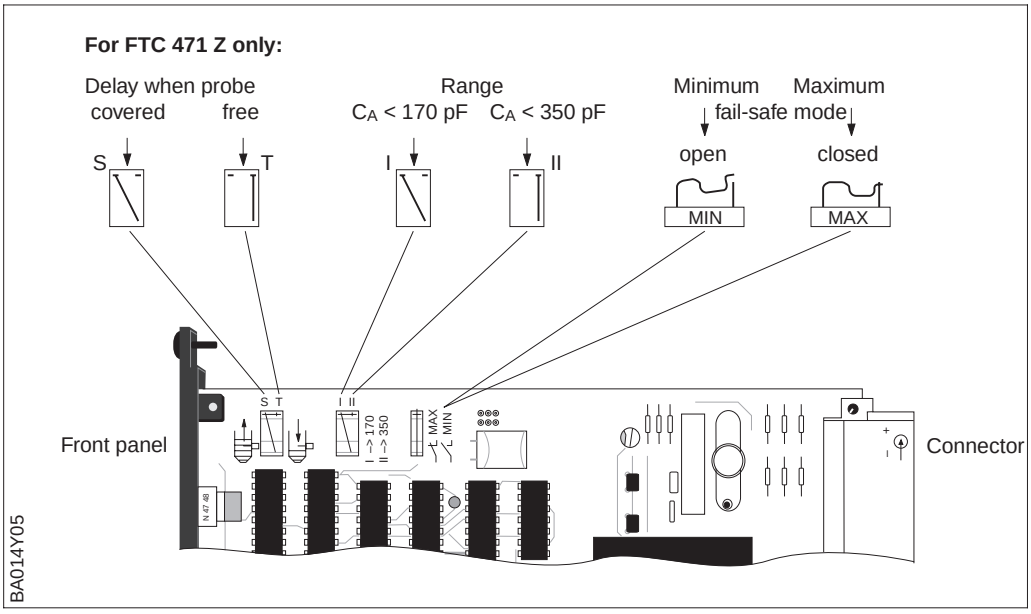


Fig. 6
Adjustment elements on the printed circuit board for type of delay, range, fail-safe mode

6 Calibration

Calibration can be carried out with the probe covered or free.
All calibration elements are located on the front panel, i.e. they should be adjusted through the front panel. See Fig. 6.
The selected safety mode and switching delay do not affect calibration.

Preparation

Insert the Nivotester FTC 470 Z / FTC 471 Z into the rack and switch on the power supply.

When calibrating, pay attention only to the **lower** green LED on the front panel of the Nivotester.

Turn both adjusters for coarse and fine calibration to 0.
The green LED does not light up.

Check the level in the vessel.

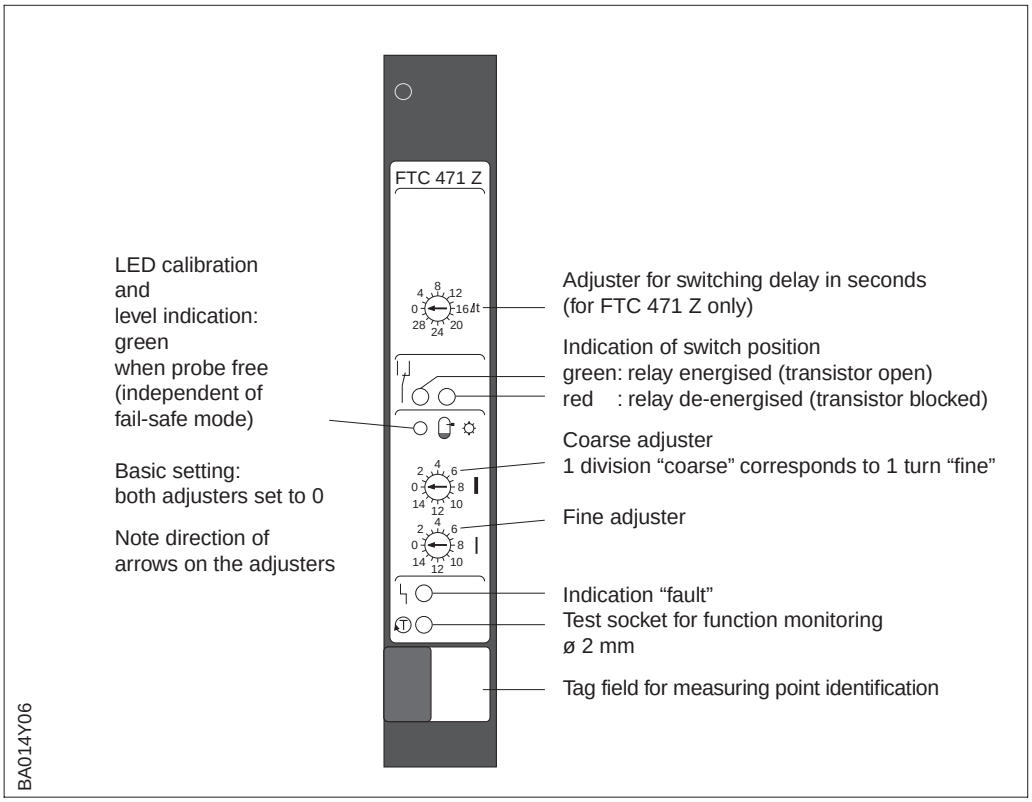


Fig. 7
Calibration elements

Types of adjustment

Four types of calibration can be carried out:
A Calibration with the sensor free
(when the vessel cannot be filled for calibration)
B Calibration with the sensor covered
(when the vessel cannot be emptied for calibration)
C Calibration with a vertically mounted probe with a switchpoint that can be varied
(when the vessel can be filled exactly to the switching point for calibration)
D Calibration with a free **and** covered probe for maximum switching safety
(when the vessel can easily be filled and emptied for calibration
where a change in level near to the switching point is sufficient)

A Calibration with a free probe

1. Turn the adjuster for **coarse** calibration slowly one division at a time clockwise until the green LED lights up, then turn it back one division (LED goes out). If the green LED does not light up by division 15, then remove the Nivotester, select Range II and repeat calibration with the coarse calibration adjuster.

2. Turn the adjuster for **fine** calibration slowly one division at a time clockwise until the green LED lights up.

3. Turn the adjuster for **fine** calibration a few divisions further; see table on Page 18. If the adjuster exceeds division 0, also turn the adjuster for **coarse** calibration **one** division clockwise.

The green LED lights up.

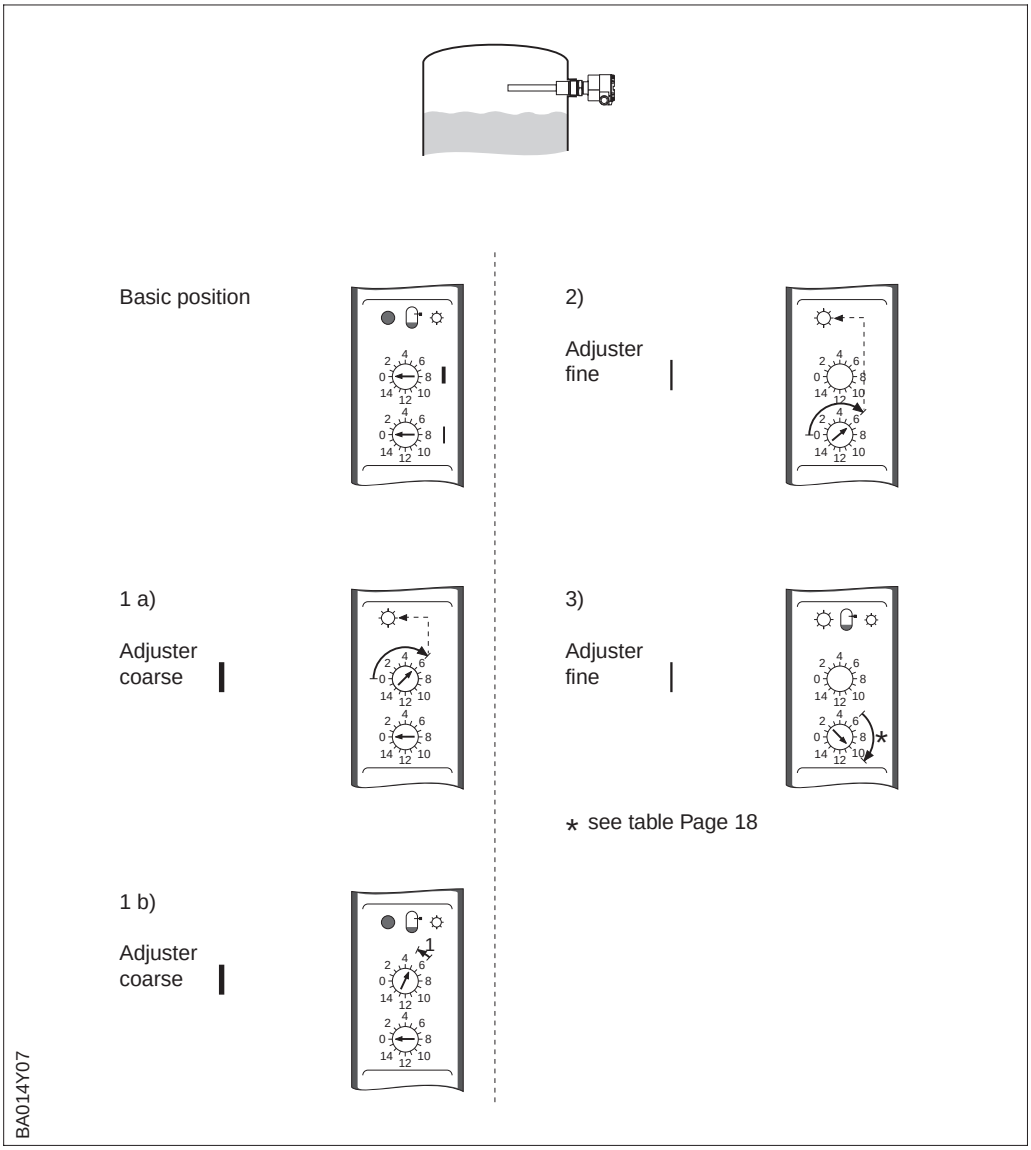


Fig. 8
Calibration with a free probe

B Calibration with a covered probe

1. Turn the adjuster for **coarse** calibration slowly division by division clockwise until the green LED lights up, then turn it back one division (LED goes out).
   If the green LED does not light up by division 15 in Range I, then remove the Nivotester, select Range II and repeat calibration with the coarse calibration adjuster.
   If the green LED does not light up by division 15 in Range II, then calibration can only be carried out when the probe is free.

2. Turn the adjuster for **fine** calibration slowly division by division clockwise until the green LED lights up again, then turn it one division back (LED goes out).

3. Turn the adjuster for **fine** calibration a few divisions counter-clockwise; see table on Page 18.
   If the adjuster exceeds division 0, also turn the adjuster for coarse calibration one division counter-clockwise.

The green LED does not light up.

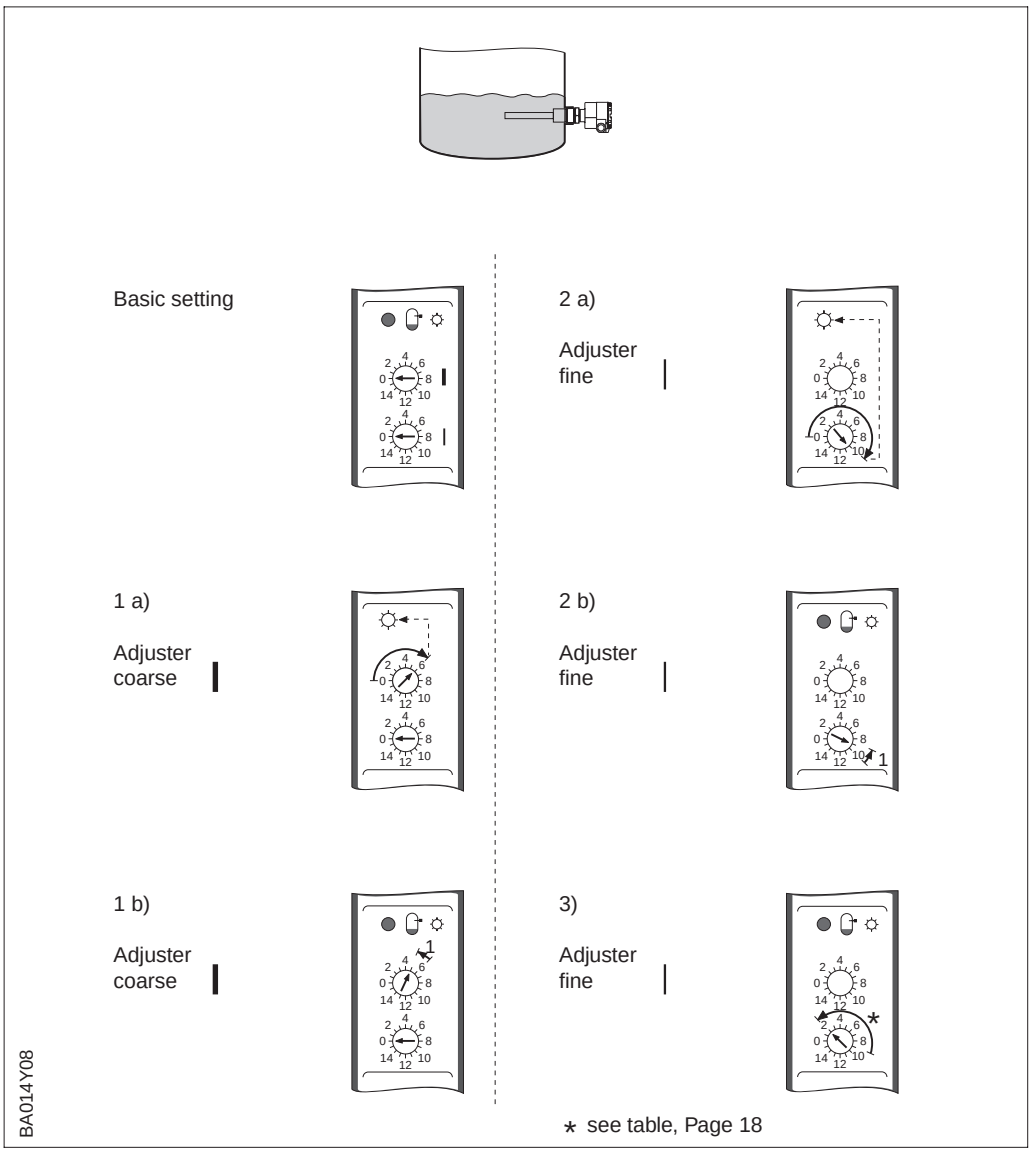


Fig. 9
Calibration with covered probe

C Calibration with a vertical probe

1. Fill the vessel exactly to the required switchpoint.
2. Turn the adjuster for **coarse** calibration slowly division by division clockwise, until the green LED lights up, then turn it back one division (LED goes out). If the green LED does not light up by division 15, then remove the Nivotester, select Range II and repeat calibration with the coarse calibration adjuster.
3. Turn the adjuster for **fine** calibration slowly division by division clockwise until the green LED lights up – calibration is now finished.

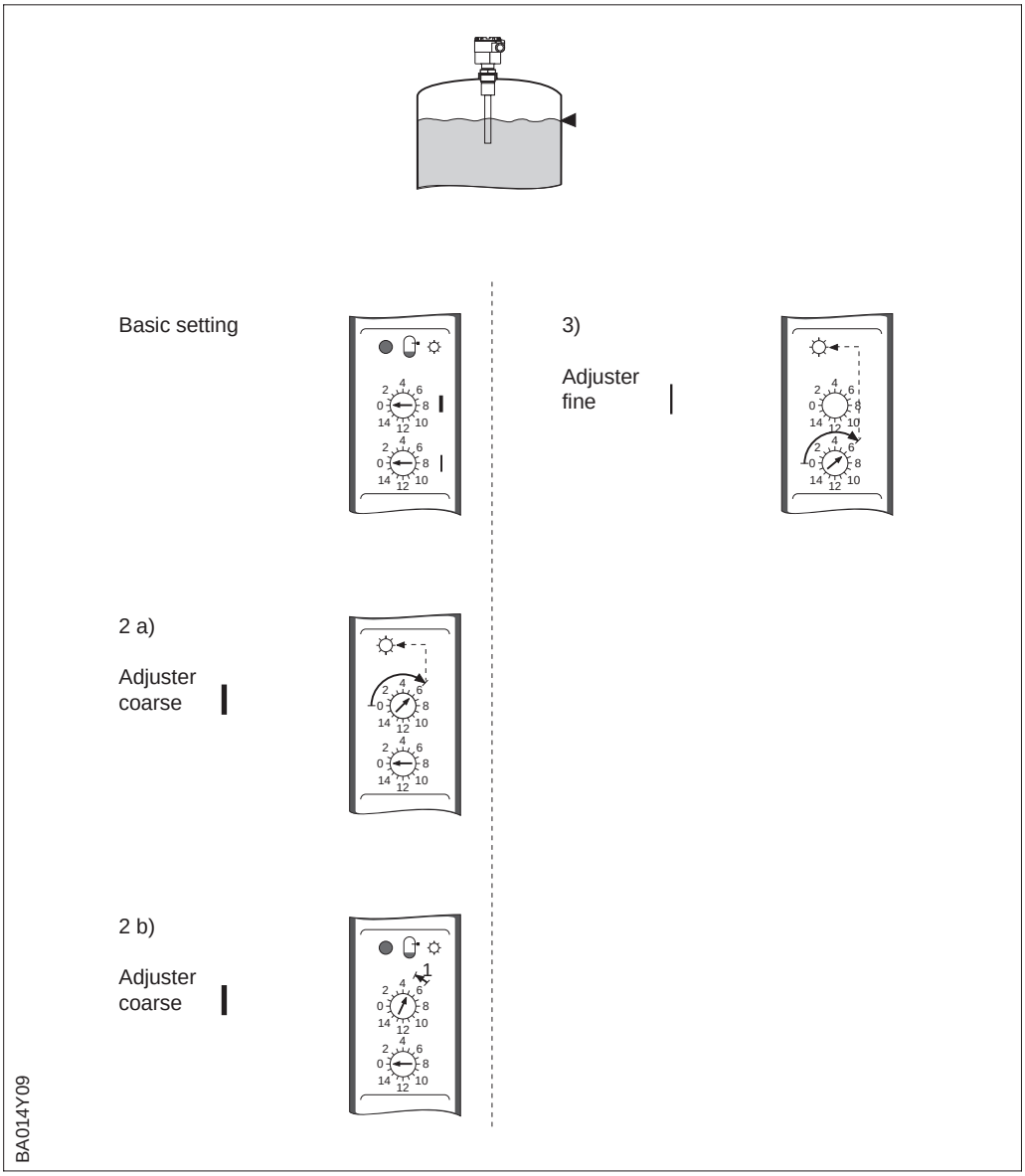


Fig. 10
Calibration with probe mounted vertically

D Calibration with a free **and** covered probe

This method of calibration is recommended if the level in the vessel can be changed at the switchpoint level, i.e. at the level of the laterally installed sensor:

1. Calibration with a free probe. Carry out Points 1 and 2 and note adjuster position.
2. Calibration with probe covered. Carry out Points 1 and 2 and note adjuster position.
3. Turn the adjuster to the midpoint of both switch positions.
   Note that one turn of the adjuster for fine calibration is equivalent to one division on the adjuster for coarse calibration. (16 fine divisions = 1 coarse division).

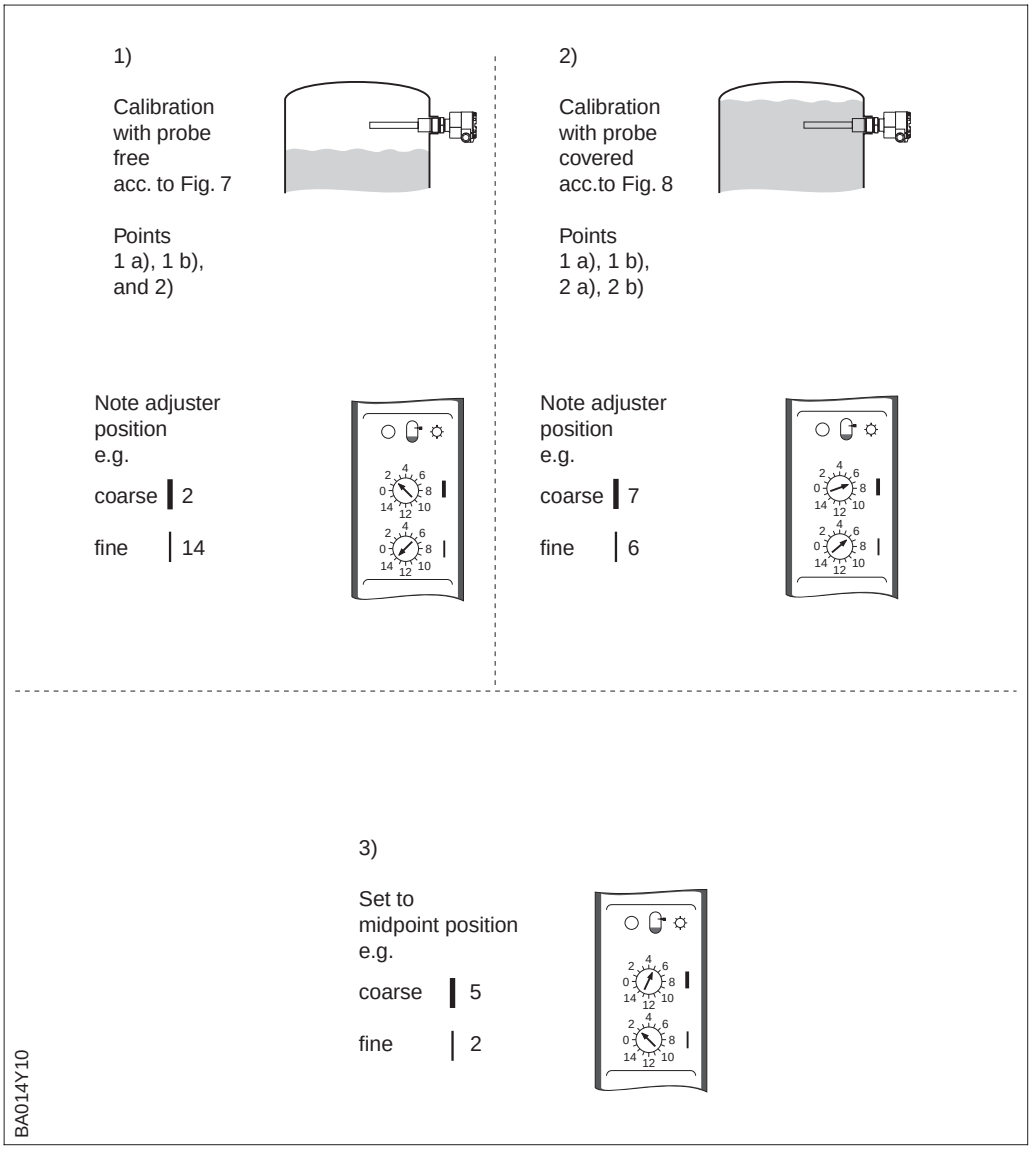


Fig. 11
Calibration with a free **and** covered probe

Switchpoint shift (offset)

Switchpoint shift for calibrating with free and covered probe (Calibration A or B)

Application criteria								Turn adjuster for fine calibration by … divisions
Material				Type of probe				
Example	Relative dielectric constant	Conductivity	Tending to cause build-up	Insulation		Ground tube		
				full	partial	with	without	
Solvents Engine fuels	< 3	low	low	X	X	X		3… 4
Dry bulk solids	< 3	low	low		X		X	2… 3
Moist bulk solids	> 3	medium	medium	X	X		X	6… 8
Aqueous liquids and alcohols	> 3	high	low	X	X		X	6…10
			strong		X		X	14…16
Sludges	> 3	high	very strong		X		X	16…18 and Bridge 3-4 on EC 17 Z

Checking switch function

If, after calibrating with a free probe (A) or a covered probe (B), the operator wants to check that the Nivotester switches at the correct switchpoint, then the level should be raised slightly above the switchpoint and allowed to fall below the switchpoint (or vice versa).
This check is recommended if a high value in the table is used as the switchpoint shift (offset).

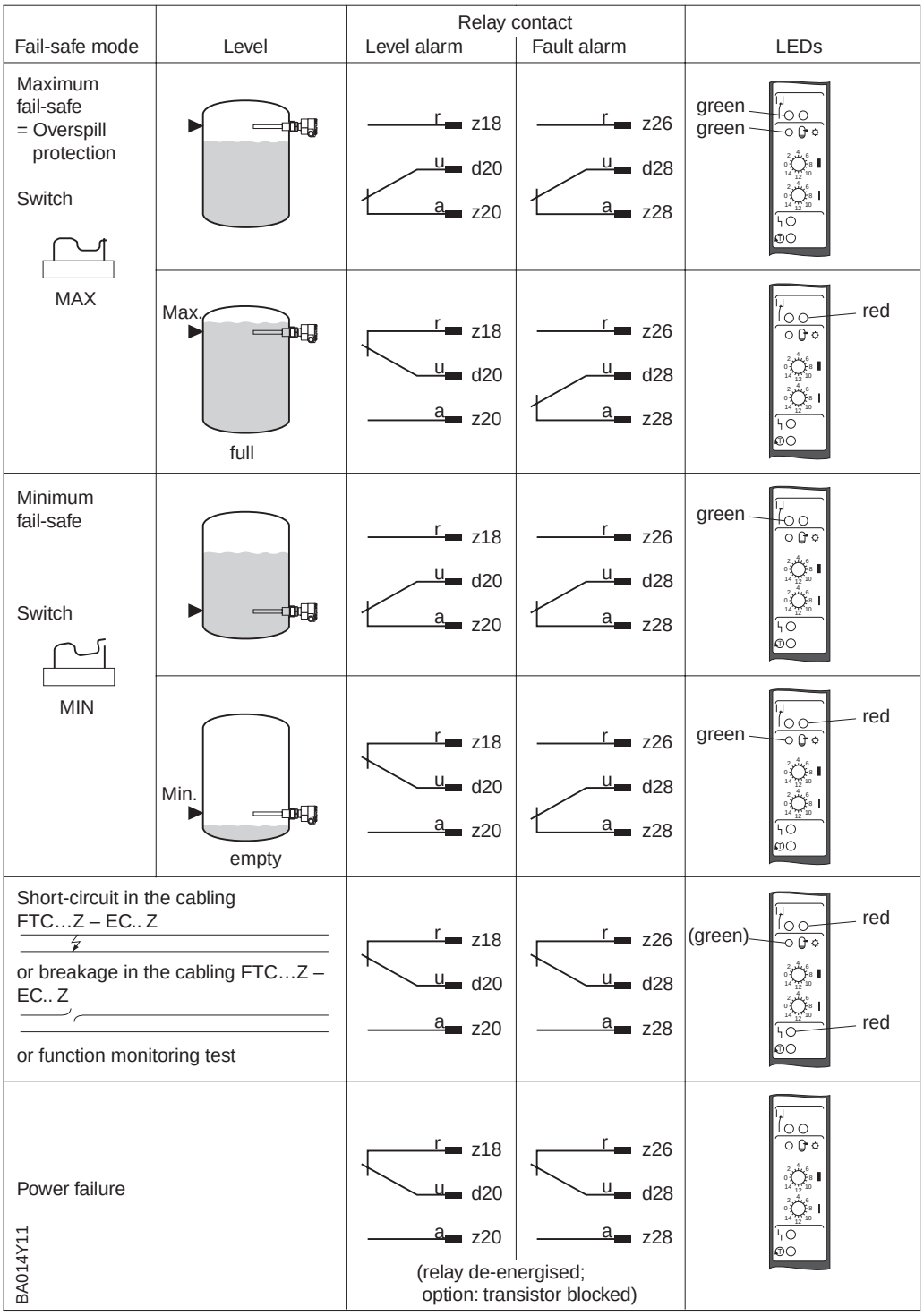


Fig. 12
Operation of the relays and LEDs as a function of level and fail-safe mode

Relay contacts:
r = NC (normally closed)
u = C (common)
a = NO (normally open)

7 Maintenance

Testing function monitoring

To test function monitoring, insert a test plug ø 2 mm or a piece of wire 2.5 mm^2 (AWG 12) into the test socket. After a short time, the red LEDs light up and the relays de-energise.

8 Disposal

Packaging

All sales and transportation packaging used by Endress+Hauser complies with 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 centers 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

Nivotester FTC 470 Z and FTC 471 Z

Construction:	Racksyst plug-in card to DIN 41494, Part 2 and 4; d = 160, h = 100 (European standard size)
Connector:	Male multipoint connector to DIN 41612, Part 3, Type F
Front panel:	Black plastic with blue operating field, handle and tag area
Width:	4 HP (20 mm)
Type of protection to DIN 40050:	Front panel IP 20, plug-in card IP 00
Dimensions:	See Fig. 12
Weight:	0.18 kg (0.4 lbs)
Permissible ambient temperature:	0 °C…+70 °C (30 °F…160 °F)
Storage temperature:	–20 °C…+85 °C (0 °F…185 °F)
Power supply:	24 V
Tolerance:	±4 V
Superposed ac:	±4 V (within tolerance)
Power supply dc:	approx. 70 mA, max. 76 mA
Integrated fine-wire fuses:	2 x 100 mA medium slow blow (blow on reversed polarity)

Input

galvanically isolated from other circuits

Ignition protection:	[EEx ia] IIC
Power supply for electronic insert EC… Z:	10.6 V…12.2 V
Operating current (base current):	4 mA…10 mA
Short-circuit current:	max. 40 mA continuous
Connection cable:	Two-core (screened)
Cable resistance:	Max. 25 Ω per core
Signal transmission:	Pulse Frequency Modulation (PFM)
Pulse current:	approx. 10…18 mA, superposed on base current
Pulse width:	approx. 200 µs
Transmission frequency:	185 Hz…116 Hz, corresponding to 20 pF…350 pF for C_A (35 Hz with partially insulated sensor in conductive material)
Transmitters:	EC 16 / 17 Z electronic insert HTC 16 / 17 Z (in protective housing)

Outputs

Relays:	1 relay each with potential-free change-over contact for level alarm and fault alarm
Max. contact ratings:	U~ : 250 V, U– : 100 V, I≈ : 2.5 A, P~ : 300 VA. cos φ > 0.7, P– : 100 W
Fail-safe mode for level alarm:	Minimum/maximum fail-safe mode, selectable

Outputs (continued)

Switching delay:	approx. 0.5 s
Switching hysteresis:	approx. 0.8 pF when C_A = 40 pF, approx. 1.2 pF when C_A = 350 pF
Function annunciators:	3 LEDs on front panel
Fault annunciator:	LED on front panel
Transistor output (option):	by optocouppler separated open collector output instead of relay

Nivotester FTC 471 Z

Level limit switch with adjustable switching delay

Type of switching:	When probe free or covered, switchable
Switching delay times:	0…30 s in 2-s steps, adjustable

Electromagnetic compatibility

Interference Emission to EN 61326, Electrical Equipment Class A
Interference Immunity to EN 61326

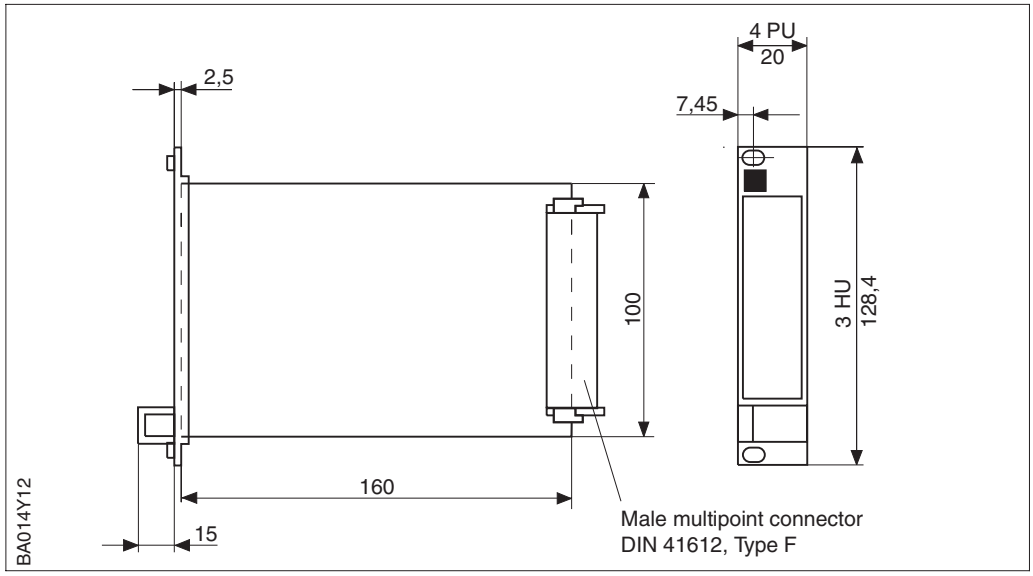


Fig. 13
Nivotester FTC 470 / 471 Z
Dimensions in mm

100 mm = 3.94 in

FTC 470 Z Level limit switch
FTC 471 Z Level limit switch with adjustable switching delay

Certificate
A ATEX II (1) GD [EEx ia] IIC, WHG
C CSA, Class I, Group A-D; Class II, Group E-G
K TIIS, Ex ia IIC T3
Y Special version

Version
0 RACKSYST plug-in card, 4 PU
9 Special version

Power supply
E Power supply 20…28 V DC
Y Special version

Switch output; Limit signal and fault indication
0 Output: 1 relay, volt free SPDT
3 Output: 1 open collector
9 Special version

FTC 47x Z- [ ][ ][ ][ ][ ] Product designation

Product structure

10 Supplementary Documentation

- ❑ Electronic insert EC 16 Z
  Technical Information TI 170F/00/en
- ❑ Electronic insert EC 17 Z
  Technical Information TI 268F/00/en
- ❑ Electronic insert in separate housing HTC 16 Z
  Technical Information TI 171F/00/en
- ❑ Separate housing for electronic insert
  Technical Information TI 228F/00/en
- ❑ EMC test documentation
  Technical Information TI 241F/00/en

Europe

Austria
❏ Endress+Hauser Ges.m.b.H.
Wien
Tel. (01) 88056-0, Fax (01) 88056-35

Belarus
Belorgsintez
Minsk
Tel. (0172) 263166, Fax (0172) 263111

Belgium / Luxembourg
❏ Endress+Hauser S.A./N.V.
Brussels
Tel. (02) 2480600, Fax (02) 2480553

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Tel. (02) 652809, Fax (02) 652809

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❏ Endress+Hauser GmbH+Co.
Zagreb
Tel. (01) 6601418, Fax (01) 6601418

Cyprus
I+G Electrical Services Co. Ltd.
Nicosia
Tel. (02) 484788, Fax (02) 484690

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Praha
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Budapest
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Kiev
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❏ Endress+Hauser Beijing Office
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❏ Endress+Hauser India Branch Office
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Tehran
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Amman
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Jeddah
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Sydney
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New Zealand
EMC Industrial Instrumentation
Auckland
Tel. (09) 444922 9, Fax (09) 444 1145

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D-Weil am Rhein
Germany
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