



Level



Pressure



Flow



Temperature

Liquid  
Analysis

Registration

Systems  
Components

Services



Solutions

## Technical Information

# Nivotester FTC325

Point level switch

With intrinsically safe signal circuit for connection to a capacitance sensor



### Applications

- Point level detection in tanks containing liquids and silos containing bulk solids. For capacitance sensors, which may also be used in hazardous areas of category ATEX II (1) GD
- Overfill protection for tanks containing flammable or non-flammable fluids hazardous to water
- Dry running protection for pumps
- Two-point control ( $\Delta$ s with 3-WIRE)

### Your benefits

- Intrinsically safe signal circuit [EEx ia] IIC for using sensors in hazardous areas
- Calibration using operating keys
- High functional safety thanks to:
  - fail-safe pulse-frequency modulation (PFM) or 3-WIRE technology
  - Checkable relay function
- Compact housing for easy series mounting on a standard DIN rail in the cabinet
- Pluggable terminal blocks make wiring easy
- Can be used with FEI57S (PFM), FEI53 (3-WIRE)
- Limit value and alarm relay
- WHG approval (PFM)
- Protection against maloperation and manipulation
  - each change of the device configuration leads to signaling via the red LED and a fault message

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## Function and system design

### Measuring principle

#### Function

Probe and tank (or ground tube/counterpotential) form a capacitor whose capacitance changes with the level of the product.

PFM	3-WIRE
The electronic insert FEI57 converts the change of capacitance into a change of frequency, which switches the output relay in the Nivotester FTC325 PFM.	The electronic insert FEI53 converts the change of capacitance into a voltage signal, which switches the output relay in the Nivotester FTC325 3-WIRE.

#### Signal transmission

The signal input of the Nivotester FTC325 point level switch is galvanically isolated from the power supply and from the output.

PFM	3-WIRE
The Nivotester supplies the capacitance sensor with intrinsically safe direct current via a two-wire cable and from there receives a frequency, which signals whether the point level has been reached or not. Here, the transmitter superimposes current impulses (PFM signals) with a pulse width of approx. 200 µs and a current intensity of approx. 10 mA on the supply current. The measuring capacitance lies in the range from 20 pF to 350 pF. This corresponds to a transmission frequency of 185 Hz to 116 Hz.	The Nivotester supplies the capacitance sensor with direct current via a two-wire cable and receives the voltage signal via a third wire, which signals whether the point level has been reached or not. The measuring capacitance lies in the range from 10 pF to 350 pF. This corresponds to a voltage of 3V to 12V.

#### Signal evaluation

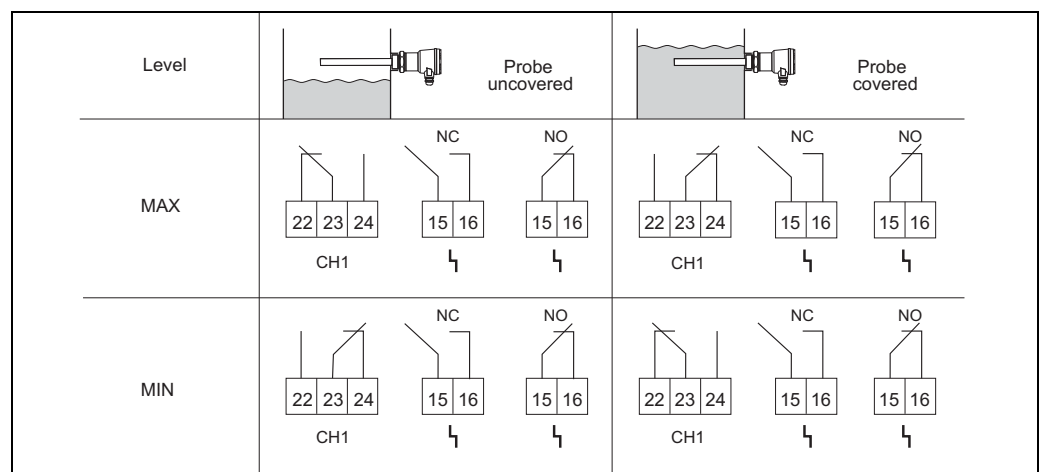
The Nivotester analyses the frequency or the voltage signal, and switches the output relay for the level alarm. The switching state of the relay (energized or de-energized) is displayed on the front panel of the Nivotester by means of two yellow light emitting diodes.

#### Fail-safe circuit

The choice of fail-safe circuit affects how the relay works in quiescent current fail-safe mode.

- MAX = Maximum fail-safe mode: the relay de-energizes when the level rises above the switch point (probe covered), a fault occurs or the power fails. For use with overflow protection, for instance.
- MIN = Minimum fail-safe mode: the relay de-energizes when the level falls below the switch point (probe uncovered), a fault occurs or the power fails. For use with dry running protection or pump protection, for instance.

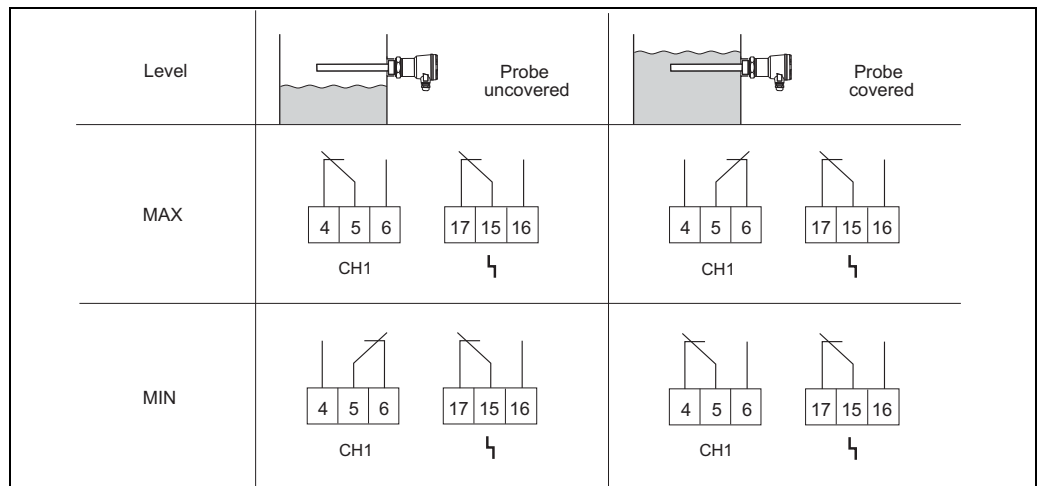
#### PFM



L00-FTC325xx-15-06-xx-en-001

Function of the point level indicator dependent on the level and fail-safe circuit.

**3-WIRE**



L00-FTC325xx-15-06-xx-est-002

Function of the point level indicator dependent on the level and fail-safe circuit.

**Function monitoring**

To increase operational safety the Nivotester is equipped with a function monitoring facility. A fault is displayed by the red light emitting diode and de-energizes the relay for the level alarm and the alarm relay. A fault is reported if the Nivotester is no longer receiving a measuring signal. This occurs, for example, when:

- there is a short-circuit
- the signal line to the sensor is interrupted
- the sensor electronics are defective
- the Nivotester's input switching is defective

After calibration, every further change to the device configuration de-energizes the relay. A fault message is signaled via the red LED.

**Calibration key (red)**

Calibration is carried out automatically by means of operating keys. This makes setting via rotary switches inapplicable.

**The test/correction key (green – FTC325 PFM only):**

- allows for a function check of the output relay and alarm relay.
- confirms a change in the operating mode - e.g. by changing the switching delay after initial calibration. This enables a correction of the operating mode without requiring recalibration. The changed settings are saved by pressing the operating key.

**Additional switch functions**

- An adjustable switching delay of 0 to 45 s allows for the relay to be switched with a delay when the probe is covered or uncovered. In the opposite direction, each switching delay is 0.2 s.
- Two-point control ( $\Delta s$  function, FTC325 3-WIRE) → 6
- A potentiometer (rotary switch) for shifting the switch point allows safe operation of the system, even with media that are prone to buildup.

**Measuring device**

A simple measuring system consists of a capacitance sensor, a Nivotester FTC325 and the control or signal instruments. The following sensors can be used in conjunction with the electronic inserts (FEIx) listed.

	FTC325 PFM	FTC325 3-WIRE
Liquicap M FTI51, FTI52 with	FEI57S	FEI53
Solicap M FTI55, FTI56 with	FEI57S	FEI53
Solicap S FTI77 with	FEI57S	FEI53

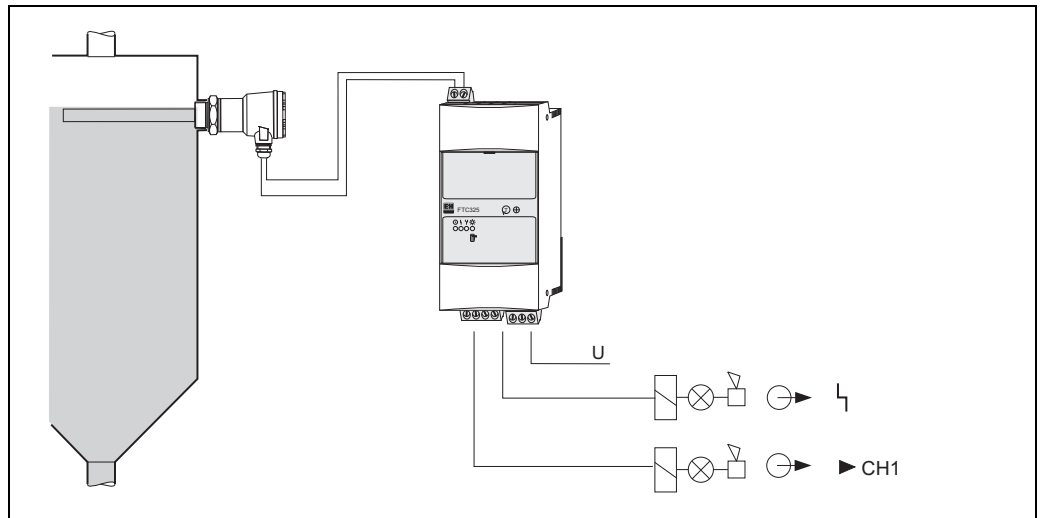
**Probe construction**

Example: Material	$\epsilon_r$	Conductivity	Build-up	Type of probe mounting			
				full insulation	partial insulation	with ground tube	without ground tube
Solvents, fuels	< 3	low	low	✓	✓	✓	–
Dry bulk solids	< 3	low	low	–	✓	–	✓
Moist bulk solids	> 3	average	average	✓	✓	–	✓
Aqueous liquids and alcohols	> 3	strong	low	✓	✓	–	✓
			strong	–	✓	–	✓
Sludge	> 3	strong	very strong	–	✓	–	✓

L00-FTCo25xx-05-06-xx-en-000

Nivotester FTC325 PFM	Nivotester FTC325 3-WIRE
The measuring system consists of: <ul style="list-style-type: none"> <li>■ Sensor                             <ul style="list-style-type: none"> <li>– capacitance probe</li> <li>– electronic insert                                     <ul style="list-style-type: none"> <li>– FEI57S</li> </ul> </li> </ul> </li> <li>■ Nivotester FTC325 PFM</li> <li>■ Control or signal instruments</li> </ul>	The measuring system consists of: <ul style="list-style-type: none"> <li>■ Sensor                             <ul style="list-style-type: none"> <li>– one or two capacitance probes</li> <li>– electronic insert                                     <ul style="list-style-type: none"> <li>– FEI53</li> </ul> </li> </ul> </li> <li>■ Nivotester FTC325 3-WIRE</li> <li>■ Control or signal instruments</li> </ul>

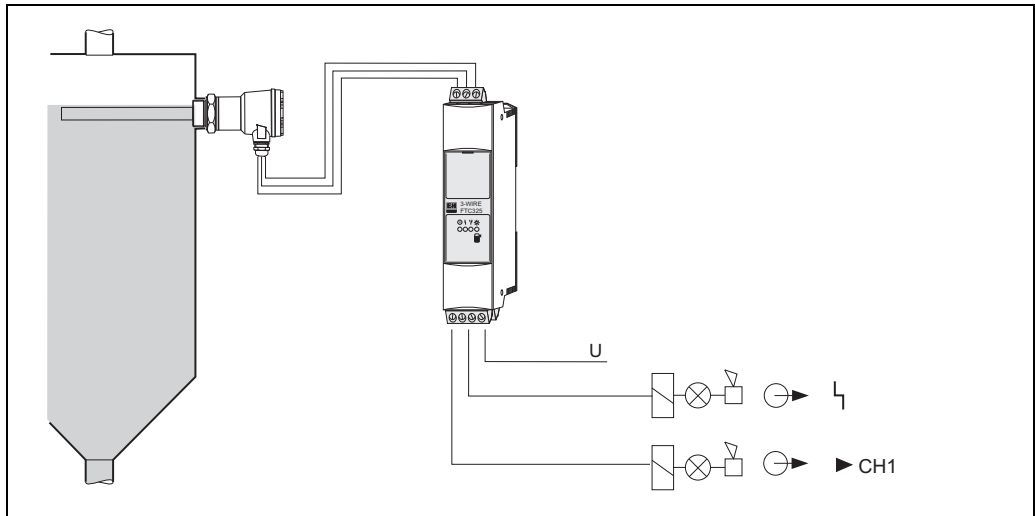
**Point level detection with FTC325 PFM**



L00-FTC325xx-14-06-xx-xx-001

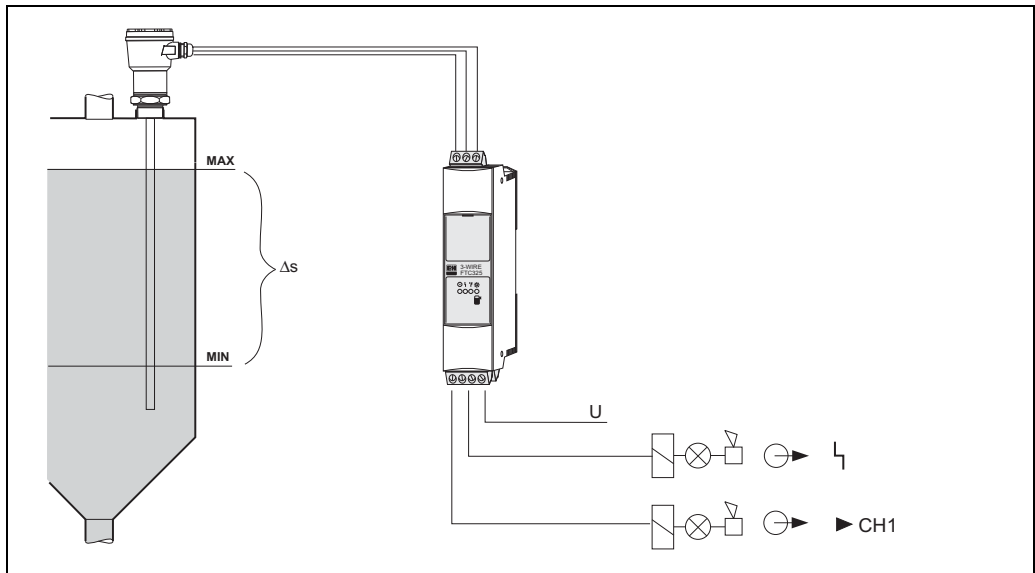
*Partially or fully insulated probe*

Point level detection with FTC325 3-WIRE



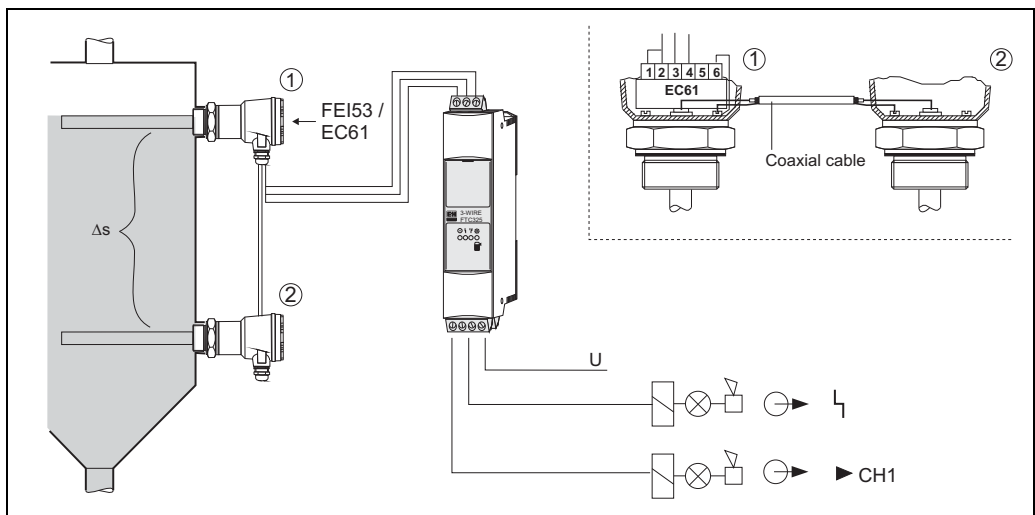
L00-FTC325xx-14-06-xx-xx-002

Partially or fully insulated probe



L00-FTC325xx-14-06-xx-xx-004

Two-point control with fully insulated probe



L00-FTC325xx-14-06-xx-xx-001

Two-point control with two fully or partially insulated probes and an electronic insert FEI53. The probes are connected by a coaxial cable.

## Input

<b>Measured variable</b>	The limit signal is generated at a MIN or MAX level, depending on the selection
<b>Measuring range</b>	The measuring range is dependent on the mounting location of the probes.
<b>Input signal</b>	<p><b>FTC325 PFM</b></p> <ul style="list-style-type: none"> <li>■ FTC325 PFM input: galvanically isolated from power supply and output</li> <li>■ Type of protection: intrinsic safety [Ex ia] IIC</li> <li>■ Connectable sensors: <ul style="list-style-type: none"> <li>Liquicap M (FTI51, FTI52) with FEI57S</li> <li>Solicap M (FTI55, FTI56) with FEI57S</li> <li>Solicap S (FTI77) with FEI57S</li> </ul> </li> <li>■ Sensor's power supply: from Nivotester FTC325 PFM</li> <li>■ Connecting cable: two-wire, shielding not required, except for strong electromagnetic interferences (see also Electromagnetic Compatibility (EMC) → 10)</li> <li>■ Cable resistance: max. 25 Ω per wire</li> <li>■ Signal transmission: pulse-frequency modulation (PFM)</li> </ul> <p><b>FTC325 3-WIRE</b></p> <ul style="list-style-type: none"> <li>■ FTC325 3-WIRE input: galvanically isolated from power supply and output</li> <li>■ Type of protection: version for non-hazardous areas</li> <li>■ Connectable sensors: <ul style="list-style-type: none"> <li>Liquicap M (FTI51, FTI52) with FEI53S</li> <li>Solicap M (FTI55, FTI56) with FEI53S</li> <li>Solicap S (FTI77) with FEI53S</li> </ul> </li> <li>■ Sensor's power supply: from Nivotester FTC325 3-WIRE</li> <li>■ Connecting cable: three-wire, shielding not required, except for strong electromagnetic interferences (see also Electromagnetic Compatibility (EMC) → 10)</li> <li>■ Cable resistance: max. 25 Ω per wire</li> <li>■ Signal transmission: voltage change is transmitted via a separate wire</li> </ul>

## Output

<b>Output signal</b>	<p><b>FTC325 PFM and FTC325 3-WIRE</b></p> <ul style="list-style-type: none"> <li>■ Relay output: a potential-free change-over contact for the level alarm</li> <li>■ Quiescent current fail-safe circuit: MIN/MAX fail-safe mode can be selected using the DIL switch</li> <li>■ Alarm relay: potential-free changeover contact for fault indication; with the PFM version, only two contacts are available (quote NC (normally closed) or NO (normally open) when ordering a PFM device)</li> <li>■ Switching delay: 0 to 45 s Relay switches when covering or uncovering the probe, depending on the setting</li> <li>■ Switching capacity of relay contacts: <ul style="list-style-type: none"> <li>U~ maximum 253 V</li> <li>I~ maximum 2 A</li> <li>P~ maximum 500 VA at <math>\cos \varphi \geq 0.7</math></li> </ul> </li> </ul> <p style="margin-left: 40px;">U- maximum 40 V I- maximum 2 A P- maximum 80 W</p> <ul style="list-style-type: none"> <li>■ Service life: at least <math>10^5</math> switching cycles at maximum contact load</li> <li>■ Function indicators: light emitting diodes for operation, level alarm, fault and level signal (lights up as long as the probe is covered)</li> </ul>
<b>Signal on alarm</b>	Limit relay de-energized; fault indication via red LED, alarm relay de-energized
<b>Galvanic isolation</b>	All input and output channels and relay contacts are provided with secure galvanic isolation from each other. In the case of simultaneous connection of the power supply circuit or the alarm relay contacts to the functional extra-low voltage, the secure galvanic isolation is guaranteed up to a voltage of 150 V AC.
<b>Overvoltage category as per EN 61010</b>	II
<b>Protection class</b>	II (double or increased insulation)

## Power supply

<b>Electrical connection</b>	<p><b>Terminal blocks</b></p> <p>The removable terminal blocks are isolated after intrinsically safe connections (top of device) and non-intrinsically safe connections (bottom of device). Furthermore, the terminal blocks are also color-coded. Blue is for the intrinsically safe area and gray for the non-intrinsically safe area. These distinctions allow for safe cable routing.</p> <p><b>Sensor connection</b></p> <p>(To the upper, blue/gray terminal blocks). Use a usual commercial instrument cable or multi-core cable for measuring purposes for the connecting cable between the Nivotester FTC325 and the sensor. Cable resistance of maximum 25 <math>\Omega</math> per wire. If strong electromagnetic interferences have to be expected, e.g. from machines or radios, a shielded cable must be used. Only connect the shielding to the grounding connection in the sensor, not to the Nivotester.</p> <p><b>Use of measuring cell in potentially explosive atmospheres</b></p> <p>Compliance with the national explosion protection regulations for the design and laying of intrinsically safe signal line is mandatory. High-reliability values for capacitance and inductance are contained in Safety Instructions XA 195F.</p> <p><b>Connection of signal and control instruments</b></p> <p>(To the lower, gray terminal blocks) The relay function must be observed dependent on the level and fail-safe circuit. If a device with high inductance (e.g. contactor, solenoid valve, etc.) is connected, a spark suppressor must be added to protect the relay contact.</p>
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**Supply voltage connection**

(To the lower, gray terminal blocks)

Voltage versions, see ordering information → 14.

A fuse (T 200 mA) is built into the power supply circuit, so that it is not necessary to pre-connect a fine-wire fuse. The Nivotester is equipped with reverse polarity protection.

**Supply voltage**

**Alternating current version (AC):**

- Voltage ranges: 85 to 253 V, 50/60 Hz

**Direct current version (DC):**

- Voltage range: 20 to 60 V
- Power supply direct current: maximum 100 mA
- Permitted residual ripple within the tolerance:  $U_{ss} = \text{maximum } 2 \text{ V}$

**Power consumption**

**AC version**

maximum 6.0 VA

**DC version**

maximum 2.0 W (at  $U_{min} 20 \text{ V}$ )

**Installation**

**Installation instructions**

**Installation location**

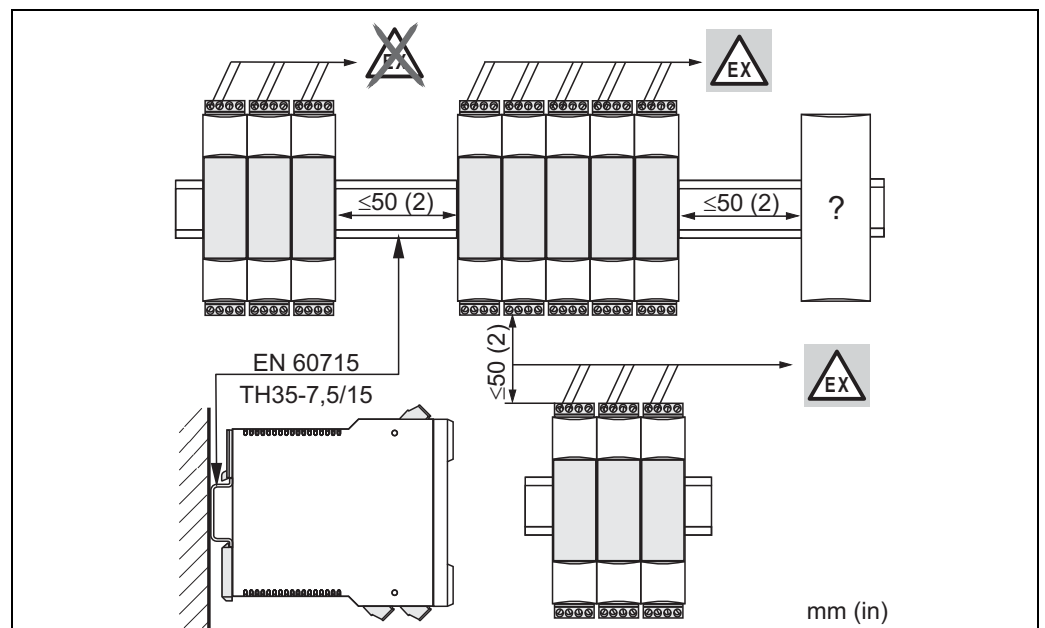
The Nivotester must be housed outside of hazardous areas in a cabinet. A protective housing (→ 14 "Accessories") is also available for installation outdoors.



Note!

The devices should be installed in locations which are protected from direct solar radiation, weather and impacts. This is of particular importance in hot climates.

**Orientation**



L00-FTW325xx-06-06-xx-xx-000



**Terminals**

**Nivotester FTC325 PFM**

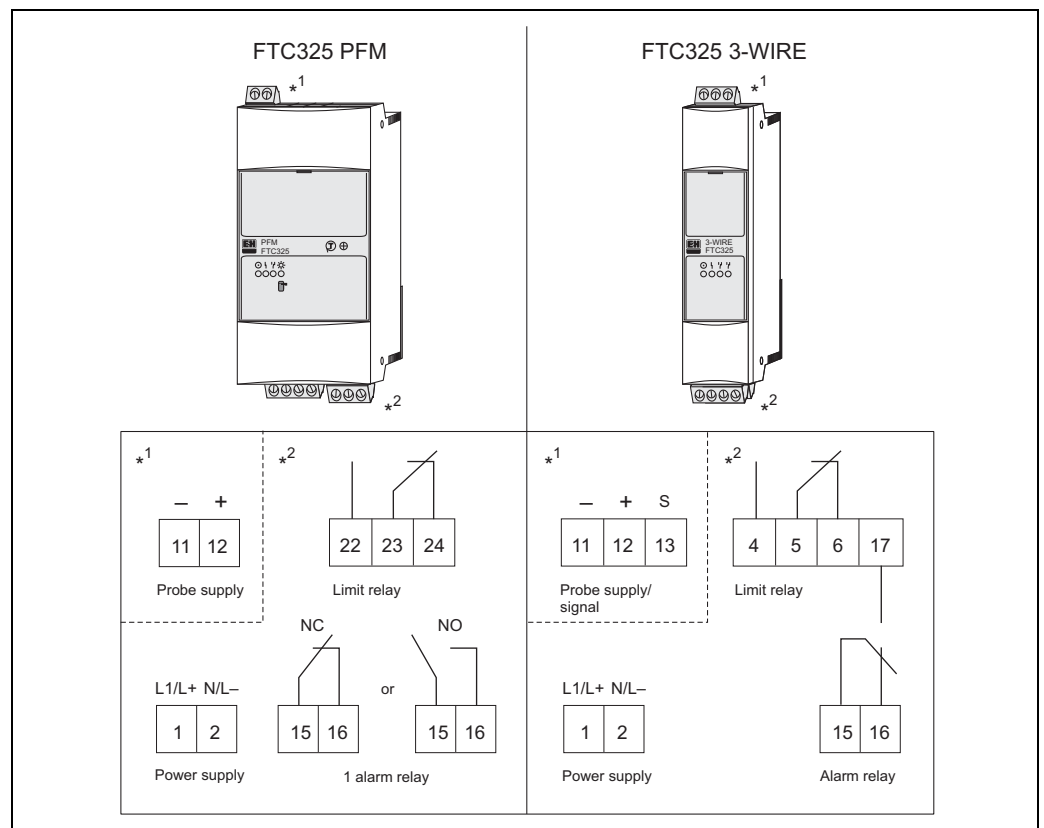
- 2 screw terminals: probe supply
- 3 screw terminals: limit relay
- 2 screw terminals: alarm relay
- 2 screw terminals: power supply

**Nivotester FTC325 3-WIRE**

- 3 screw terminals: probe supply + signal
- 4 screw terminals:
  - 3 limit value relay
  - 1 for contact 3 of the alarm relay
- 4 screw terminals:
  - 2 AC/DC supply (power supply)
  - 2 alarm relay

**Connection cross-section**

maximum 1 x 2.5 mm (0.1 in) or 2 x 1.5 mm (0.06 in)



L00-FTC325xx-04-06-xx-en-001

## Operability

**Operating concept** Onsite configuration with switches behind the folding front panel

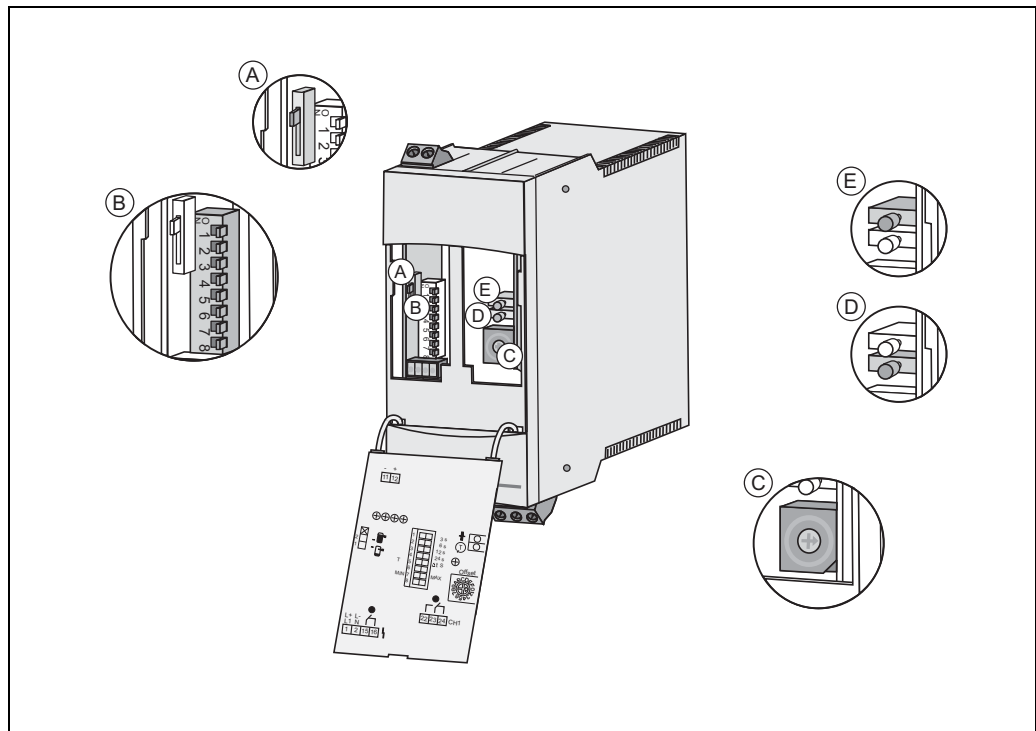
**Display elements**

1. red light emitting diode: fault indication
2. green light emitting diode: standby
3. yellow light emitting diode (left): "limit relay energized"
4. yellow light emitting diode (right): "probe uncovered/covered"  
Level indication independent of the selected fail-safe circuit

**Operating elements**

**Nivotester FTC325 PFM**

- A Calibration for covered or uncovered probe
- B DIL switch 1–4: switching delay (3 s, 6 s, 12 s, 24 s) = max. 45 s  
DIL switch 5: delay when covering or uncovering the probe  
DIL switch 6: no function  
DIL switch 7: min/max fail-safe mode  
DIL switch 8: no function
- C Switch point shift for buildup compensation (16-stage)
- D Correction key (green)
- E Calibration key (red)

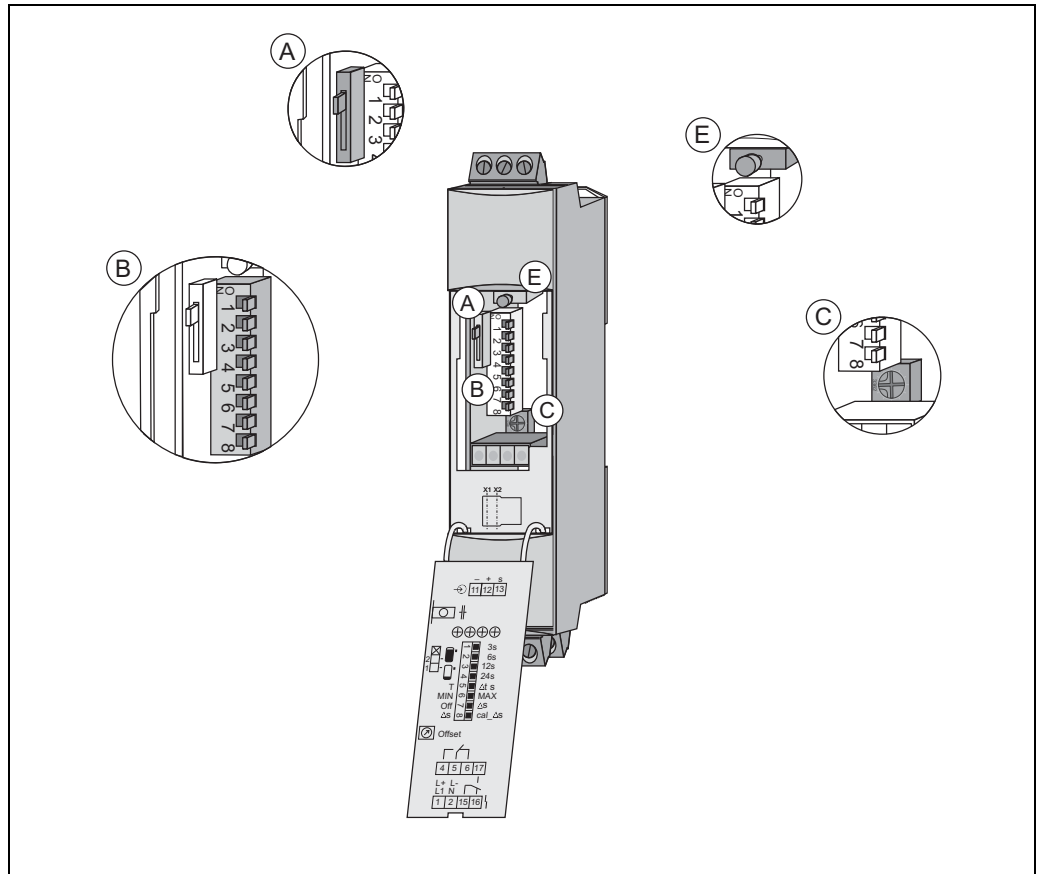


L00-FTC325xx-03-06-06-xx-001

**Operating elements**

**Nivotester FTC325 3-WIRE**

- A Calibration for covered or uncovered probe
- B DIL switch 1–4: switching delay (3 s, 6 s, 12 s, 24 s) = max. 45 s  
DIL switch 5: delay when covering or uncovering the probe  
DIL switch 6: min/max fail-safe mode  
DIL switch 7: two-position controller mode (ON/OFF)  
DIL switch 8: calibration switch points (upper/lower) for operation as two-position controller
- C Switch point shift for buildup compensation (infinitely variable)
- E Calibration key (red)



100-FTC325xx-03-06-06-xx-002

**Certificates and approvals**

**CE mark**

The device meets the legal requirements of the EC Directives.  
Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

**Ex approval**

Endress+Hauser Sales Centers provide information about the currently available versions for use in hazardous areas (ATEX Ex ia IIC; FM IS; CSA IS).

All the relevant data for explosion protection is contained in separate Ex documentation → 14 "Supplementary Documentation", which can be requested.



Note!  
Suitable for powering devices with an IP54 housing in explosive dust atmospheres.

**Type of protection**

[Ex ia] IIC (only for FTC325 PFM)

**Overfill protection**

WHG (only for FTC325 PFM)

**Other standards and guidelines**

Other standards and guidelines which were observed during the conceptual design and development of the Nivotester FTC325.

- EN 60529: Degrees of protection provided by enclosures (IP code)
- EN 61010: Safety requirements for electrical equipment for measurement, control and laboratory use
- EN 61326: Interference emission (Equipment Class B), interference immunity (Annex A - Industrial)

## Ordering information

Detailed ordering information is available from the following sources:

- In the Product Configurator on the Endress+Hauser website: [www.endress.com](http://www.endress.com) → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center: [www.endress.com/worldwide](http://www.endress.com/worldwide)

**Hinweis! Product Configurator - the tool for individual product configuration**

- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

## Accessories

**Protective housing**

The protective housing in protection class IP66 is equipped with an integrated DIN rail and closed by a transparent cover, which can also be lead-sealed.

**Dimensions:**

W/H/D: 180/182/165 (mm); 7,09/7,17/6,5 (in)

**Technical data:**

- Degree of protection (EN 60529): IP66
- Lower housing section: fiber-glass reinforced polycarbonate, grey
- Upper housing section: polycarbonate, transparent
- Cover screws: polyamide, 4 pieces, 2 of which can be lead-sealed
- Seal: PU seal
- Top-hat rail (EN 50022): galvanized
- Cable entries: 5 pieces M 20x1.5
- Part number: 52010132

## Supplementary Documentation

**System Information (SI)**

- Capacitance level measurement  
SI00001F/00

**Technical Information (TI)****Capacitance level probes**

- Liquicap M FTI51, FTI52  
TI00417F/00
- Solicap M FTI55, FTI56  
TI00418F/00
- Solicap S FTI77  
TI00433F/00

**Protective housing**

- Protective housing  
TI00367F/00

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**Operating manual (KA)**

- Nivotester FTC325 PFM  
KA00221F/00
- Nivotester FTC325 3-WIRE  
KA00222F/00

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**Certificates (only for PFM)**

**ATEX:**

- Nivotester FTC325, FTC625  
XA00195F/00

**WHG (DIBt):**

- Nivotester FTC325  
ZE00211F/00

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## Instruments International

Endress+Hauser  
Instruments International AG  
Kaegenstrasse 2  
4153 Reinach  
Switzerland

Tel.+41 61 715 81 00  
Fax+41 61 715 25 00  
[www.endress.com](http://www.endress.com)  
[info@ii.endress.com](mailto:info@ii.endress.com)

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