

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
- Overflow protection for tanks containing flammable or non-flammable fluids hazardous to water
- Dry running protection for pumps
- Two-point control (Δ 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

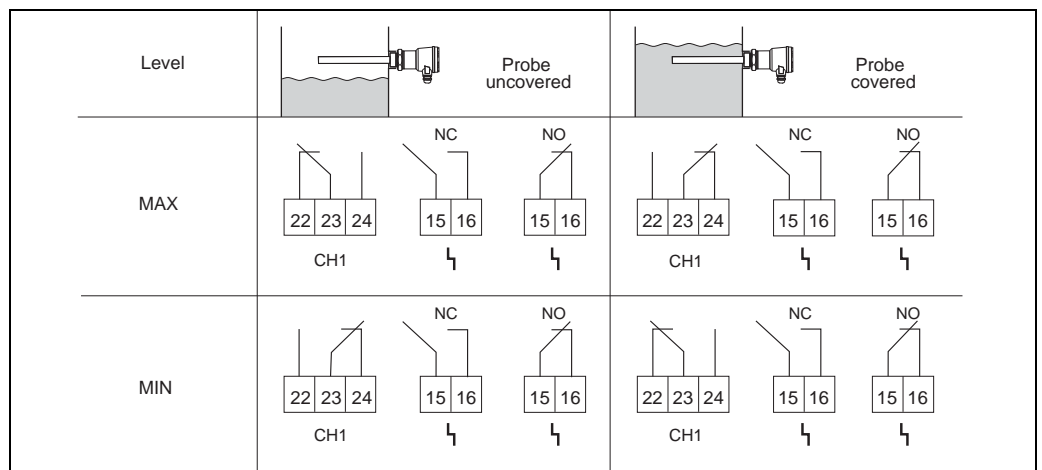
The Nivotester analyses the frequency or the voltage signal, and switches the output relay for the level alarm. The switching state of the relay (energized or de-energized) is displayed on the front panel of the Nivotester by means of two yellow light emitting diodes.

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.

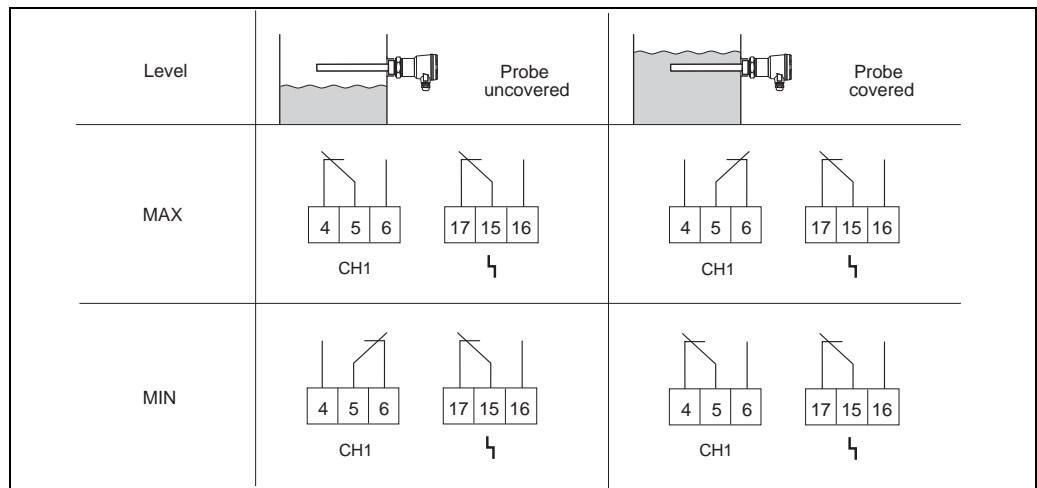
PFM



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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 (Δs 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

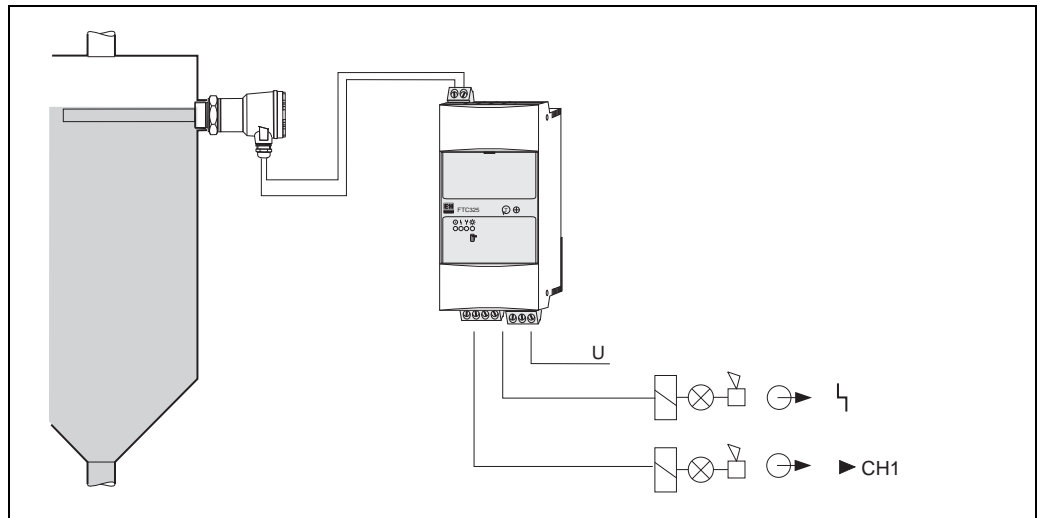
Probe construction

Example: Material	ϵ_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	–	✓	–	✓

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

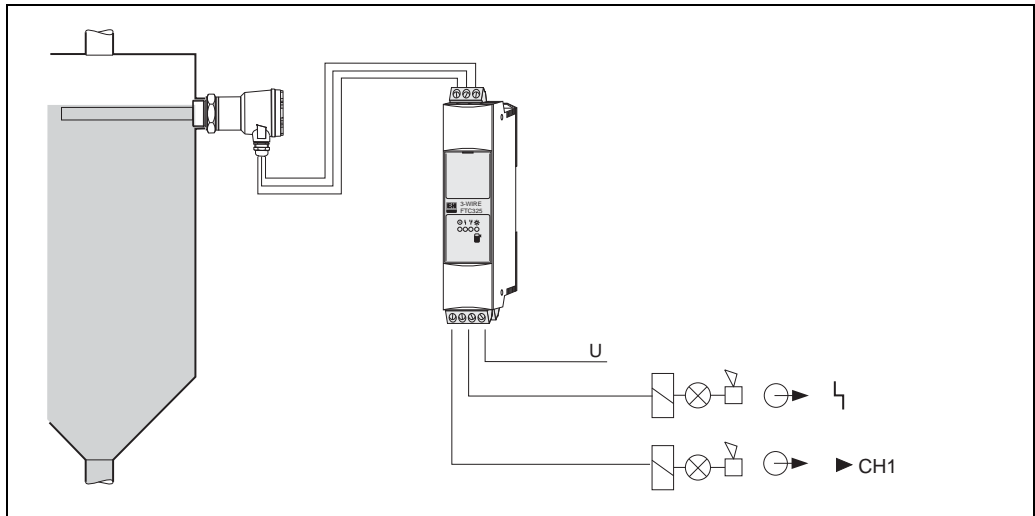
Point level detection with FTC325 PFM



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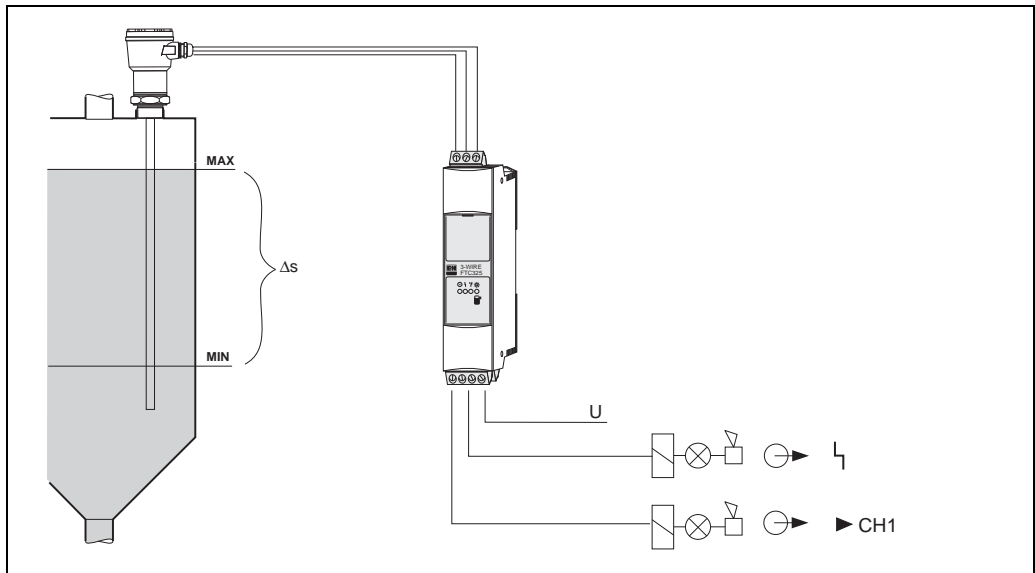
Partially or fully insulated probe

Point level detection with FTC325 3-WIRE



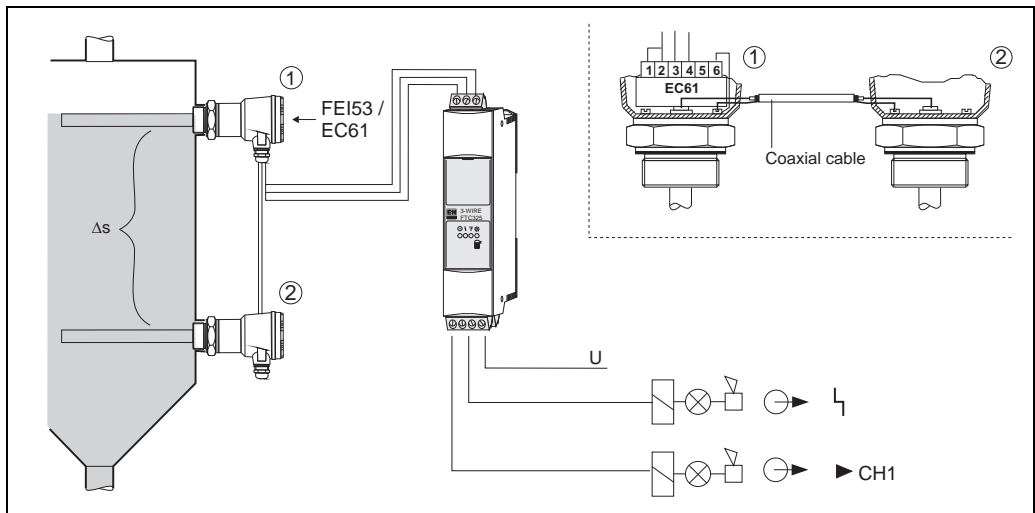
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Partially or fully insulated probe



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Two-point control with fully insulated probe



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

Input

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

Output

Output signal	<p>FTC325 PFM and FTC325 3-WIRE</p> <ul style="list-style-type: none"> ■ Relay output: a potential-free change-over contact for the level alarm ■ Quiescent current fail-safe circuit: MIN/MAX fail-safe mode can be selected using the DIL switch ■ 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) ■ Switching delay: 0 to 45 s Relay switches when covering or uncovering the probe, depending on the setting ■ Switching capacity of relay contacts: <ul style="list-style-type: none"> U~ maximum 253 V I~ maximum 2 A P~ maximum 500 VA at $\cos \varphi \geq 0.7$ <p style="margin-left: 40px;">U- maximum 40 V I- maximum 2 A P- maximum 80 W</p> <ul style="list-style-type: none"> ■ Service life: at least 10^5 switching cycles at maximum contact load ■ Function indicators: light emitting diodes for operation, level alarm, fault and level signal (lights up as long as the probe is covered)
Signal on alarm	Limit relay de-energized; fault indication via red LED, alarm relay de-energized
Galvanic isolation	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.
Overvoltage category as per EN 61010	II
Protection class	II (double or increased insulation)

Power supply

Electrical connection	<p>Terminal blocks</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>Sensor connection</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 Ω 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>Use of measuring cell in potentially explosive atmospheres</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>Connection of signal and control instruments</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} = maximum 2 V

Power consumption

AC version

maximum 6.0 VA

DC version

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

Installation

Installation instructions

Installation location

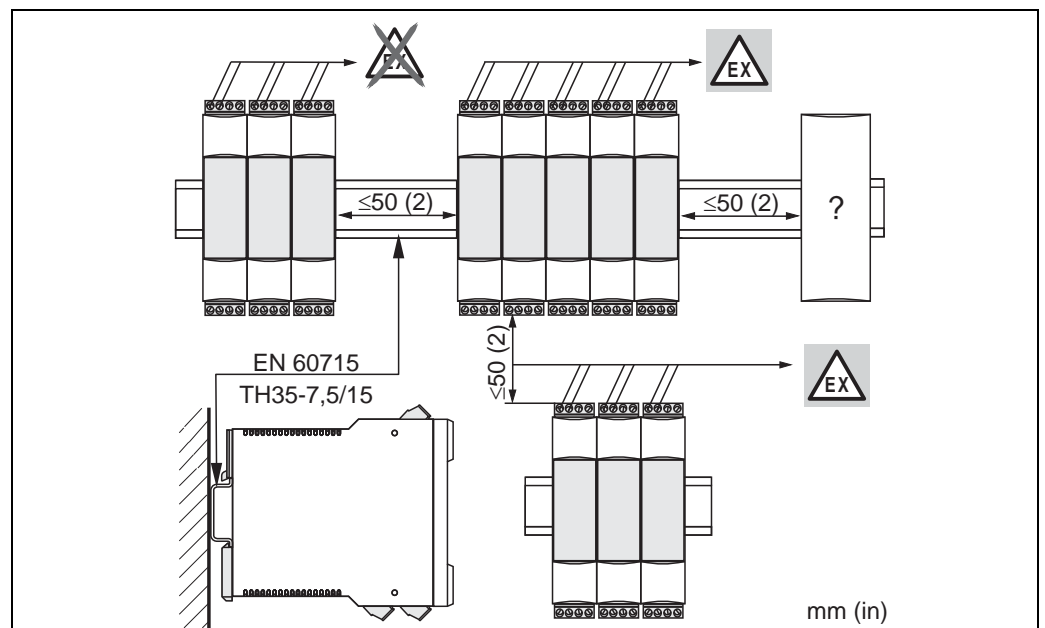
The Nivotester must be housed outside of hazardous areas in a cabinet. A protective housing (→ 14 "Accessories") is also available for installation outdoors.



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



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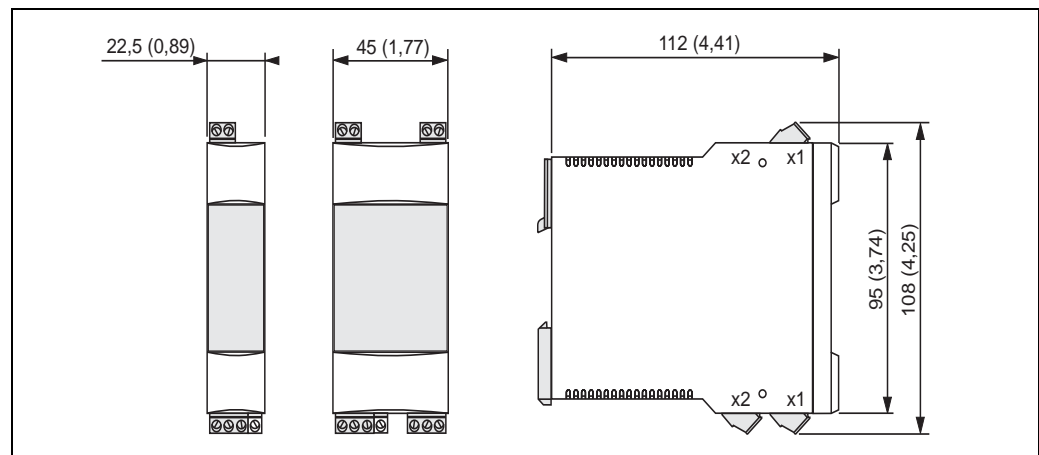
Environment

Ambient temperatures	<ul style="list-style-type: none"> ■ For single mounting: -20 to +60 °C (-4 to +140 °F) ■ For series mounting without lateral spacing: -20 to +50 °C (-4 to +122 °F) ■ Storage temperature: -25 to +85 °C (-77 to +185 °F) ■ Installation of a maximum of three Nivotester devices in the protective housing: -20 to +40 °C (-4 to +104 °F)
Climatic and mechanical application class	<p>3K3: in accordance with DIN EN 60721-3-3 3M2: in accordance with DIN EN 60721-3-3</p>
Degree of protection	IP20 (as per EN 60529)
Electromagnetic compatibility (EMC)	<p>Interference emission to EN 61326; Equipment Class B Interference immunity to EN 61326; Annex A (Industrial) and NAMUR Recommendation NE 21 (EMC)</p>

Mechanical construction

Design, dimensions

Dimensions: 3-WIRE PFM



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Note!
mm (in)

Weight approx. 250 g (8.81 oz)

Materials

- Housing: polycarbonate, light gray (RAL 7035)
- Front cover: polypropylene PPN, blue
- Fixing bracket for securing on the DIN rail: polyamide PA6, black (RAL 9005)

Terminals

Nivotester FTC325 PFM

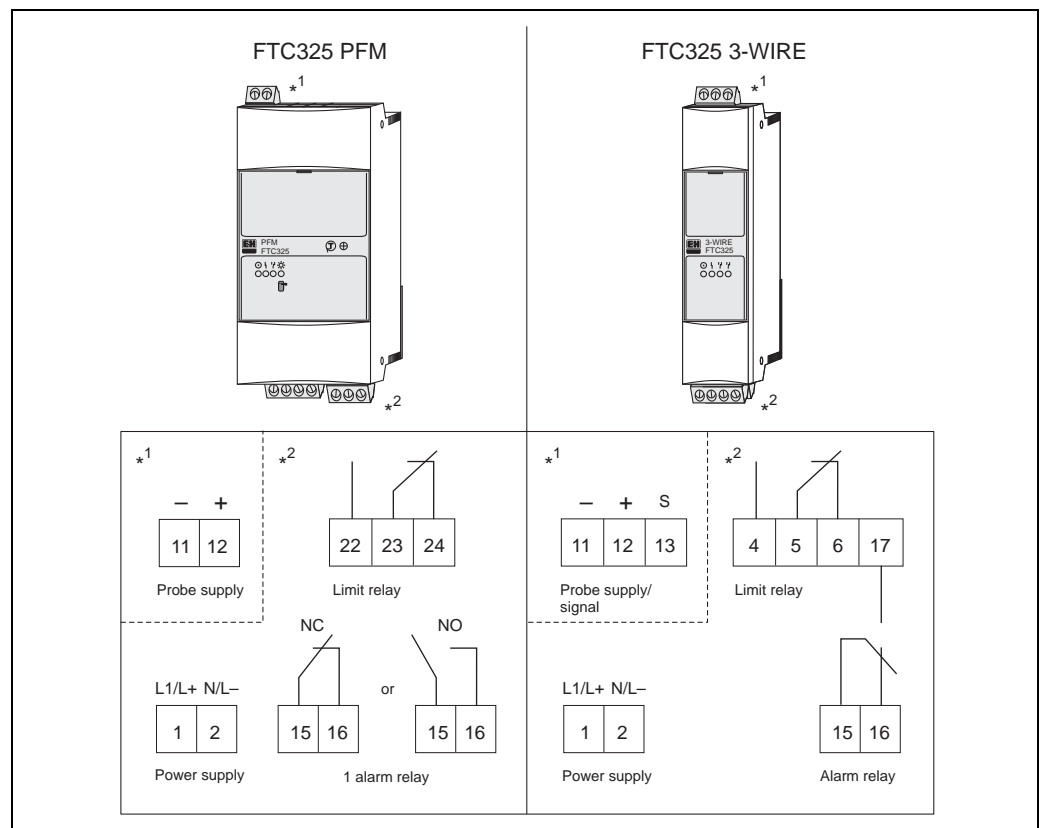
- 2 screw terminals: probe supply
- 3 screw terminals: limit relay
- 2 screw terminals: alarm relay
- 2 screw terminals: power supply

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)



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Operability

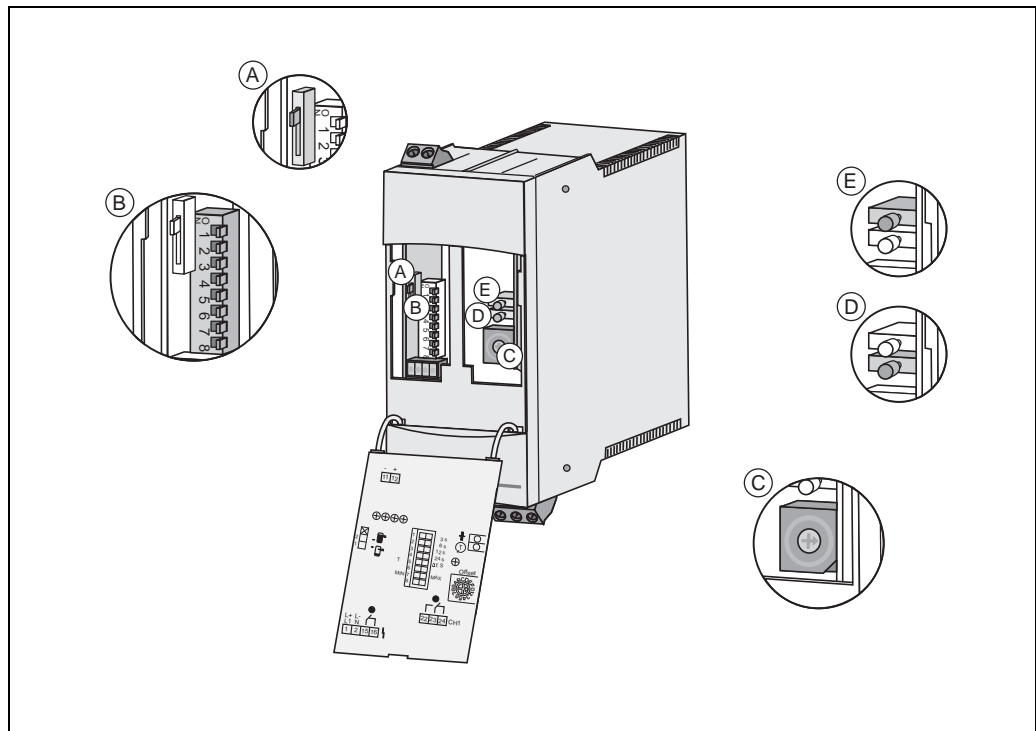
Operating concept Onsite configuration with switches behind the folding front panel

- 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)

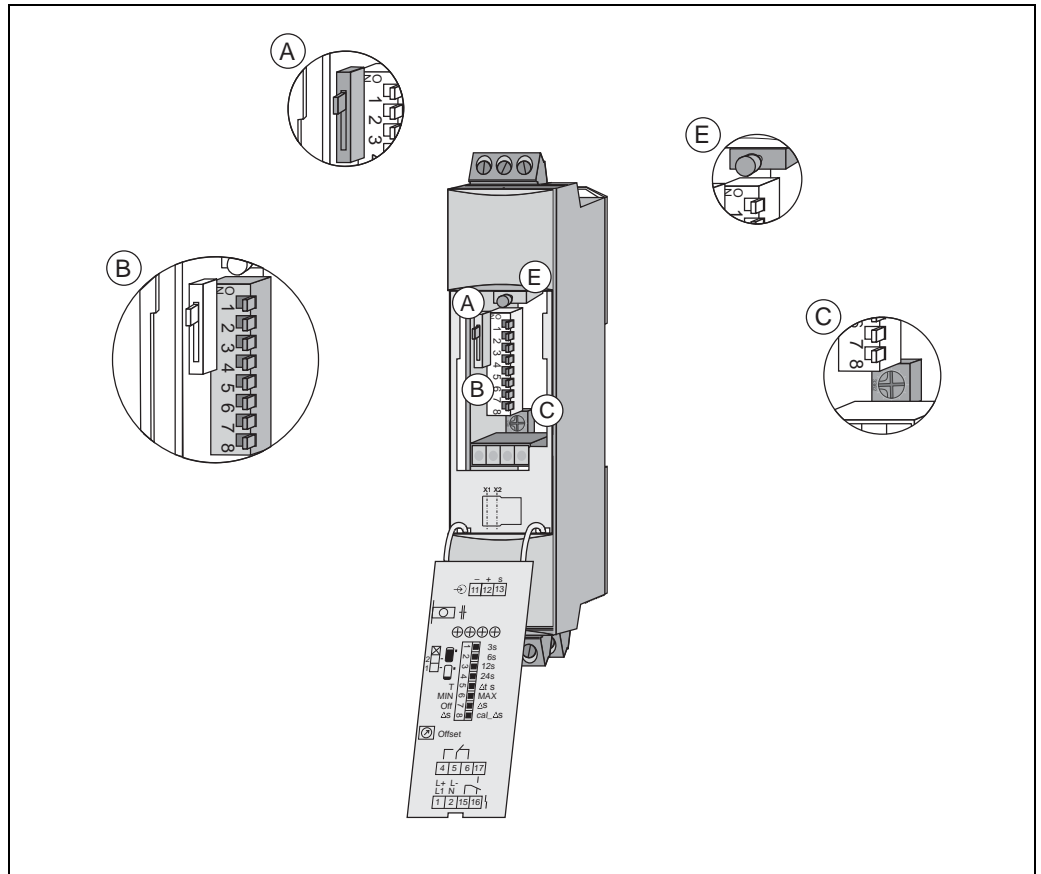


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Operating elements

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)



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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 → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center: 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

Operating manual (KA)

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

Certificates (only for PFM)

ATEX:

- Nivotester FTC325, FTC625
XA00195F/00

WHG (DIBt):

- Nivotester FTC325
ZE00211F/00

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