TI00380F/00/EN/16.25-00
71714111
2025-08-01

Technical Information
Nivotester FTC325

Capacitance

Level switch with intrinsically safe signal circuit for connection to capacitance sensors

Application area

- Point level measurement in liquid tanks and bulk solids silos, also in hazardous areas
- For sensors in Zone 0 or Zone 20
- Liquid detection in pipes for dry-run protection of pumps
- Overfill protection system in tanks with flammable or non-flammable water-polluting liquids
- Two-point control (Δs with 3-wire) and point level measurement with a switching device
- International explosion protection certificates, overfill protection system, WHG (optional)

Benefits

- Intrinsically safe signal circuit [Ex ia] for use of sensors in hazardous areas
- Compact housing for simple side-by-side installation on standard DIN rails in cabinet
- Calibration at the touch of a button
- High degree of functional safety thanks to fail-safe PFM or 3-wire technology and a verifiable relay function
- Easy wiring thanks to plug-in terminal blocks
- Limit value and fault-signaling relay

Endress+Hauser
People for Process Automation

Table of contents

About this document

Symbols

Safety symbols

DANGER
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

WARNING
This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

CAUTION
This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE
This symbol alerts you to a potentially harmful situation. Failure to avoid this situation can result in damage to the product or something in its vicinity.

Electrical symbols

Double or reinforced insulation
Protection between mains circuit and output voltage

Symbols for certain types of Information

Tip
Indicates additional information

Reference to documentation

Symbols in graphics

A, B, C ... View

1, 2, 3 ... Item numbers

Graphic conventions

- Installation, explosion and electrical connection drawings are presented in simplified format
- Devices, assemblies, components and dimensional drawings are presented in reduced-line format
- Dimensional drawings are not to-scale representations; the dimensions indicated are rounded off to 2 decimal places
- Unless otherwise described, flanges are presented with sealing surface form EN1091-1, B2; ASME B16.5, RF; JIS B2220, RF

Function and system design

Function

The probe and counterpotential (or vessel/ground tube) form a capacitor whose capacitance is influenced by the level.

PFM (pulse-frequency modulation)

The FEI57 electronic insert converts the change in capacitance to a change in frequency, which switches the output relay in the Nivotester FTC325 PFM.

3-wire

The FEI53 electronic insert converts the change in capacitance to a voltage signal, which switches the output relay in the Nivotester FTC325 3-wire device.

Signal transmission

The signal input of the Nivotester is galvanically isolated from the mains and the output.

PFM

The Nivotester supplies intrinsically safe direct current to the capacitance sensor via a two-wire cable. From the sensor, it receives a frequency which signals whether or not the point level has been

reached. The sensor superimposes current pulses (PFM signals) with a pulse width of approx. 200 µs and a current of approx. 10 mA on the supply current. The measuring capacitance is in the range from 5 to 500 pF or 5 to 1600 pF. This corresponds to a transmission frequency of 185 to 60 Hz.

3-wire

The Nivotester supplies direct current to the capacitance sensor via a two-wire cable. Via a third wire, the Nivotester receives a voltage signal, which signals whether or not the point level has been reached. The measuring capacitance is in the range from 10 to 350 pF. This corresponds to a voltage of 3 to 12 V.

Signal analysis

The Nivotester evaluates the frequency or the voltage signal, and switches the output relay for the level alarm. Two yellow LEDs on the front of the Nivotester indicate the current switch status of the relay (energized or de-energized).

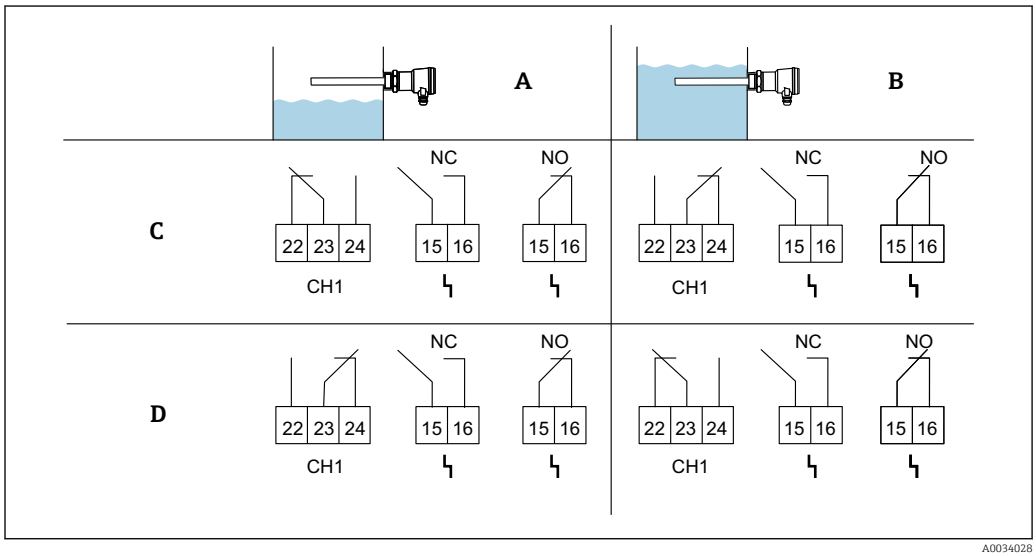
Safety mode

The choice of safety mode ensures that the relay always works with quiescent current safety.

- MAX = maximum detection: the relay de-energizes when the level exceeds the switch point (probe is covered), a fault occurs or the power supply fails. Used for overfill protection system, for instance.
- MIN = minimum detection: the relay de-energizes when the level falls below the switch point (probe is uncovered), a fault occurs or the power supply fails. Used for dry-run protection, for instance.

PFM

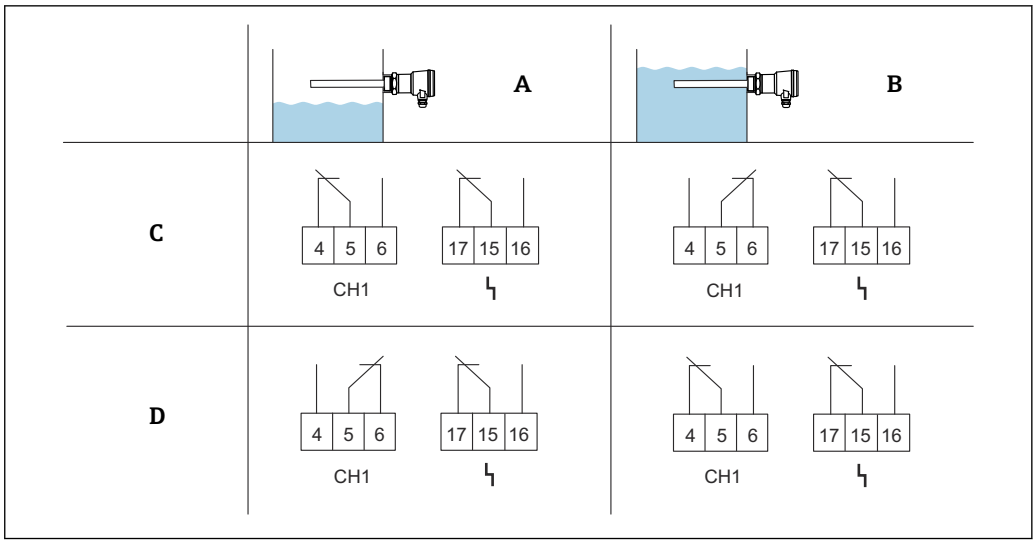
Point level detection depending on the level and fail-safe mode



A Level indication: probe is uncovered
B Level indication: probe is covered
C MAX fail-safe mode
D MIN fail-safe mode

3-wire

Point level detection depending on the level and fail-safe mode



A Level indication: probe is uncovered
B Level indication: probe is covered
C MAX fail-safe mode
D MIN fail-safe mode

Function monitoring

To increase operational safety, the Nivotester is equipped with a function monitoring system. A fault causes the relay for the level alarm and the alarm relay to de-energize and is indicated by the red LED.

A fault is reported if the Nivotester no longer receives a current pulse, e.g. in the event of

- a short circuit
- The signal line to the sensor is interrupted
- The sensor electronics are defective
- The input circuit of the Nivotester is defective

After calibration, every additional change to the device configuration causes the relay to de-energize. A fault message is indicated by the red LED.

Calibration button (red)

Calibration is carried out automatically by pressing the calibration button.

Test button/correction button (green) only for FTC325 PFM

- Function checking of the output relay and fault-signaling relay
- Confirms a change in the operating mode, e.g., if the switching delay changes after initial calibration. This corrects the operating mode without the need to perform a recalibration. The modified settings are saved by pressing the button.

Additional switch functions

- Adjustable switching delay 0 to 45 s: allows the delayed switching of the relay when the probe is covered or uncovered. In the opposite direction, each switching delay is 0.2 s.
- Two-point control (Δs, 3-wire) → 📄 5
- Potentiometer (control dial) for shifting the switch point: enables the safe operation of the system, even with media that are prone to form buildup.

Measuring system

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

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

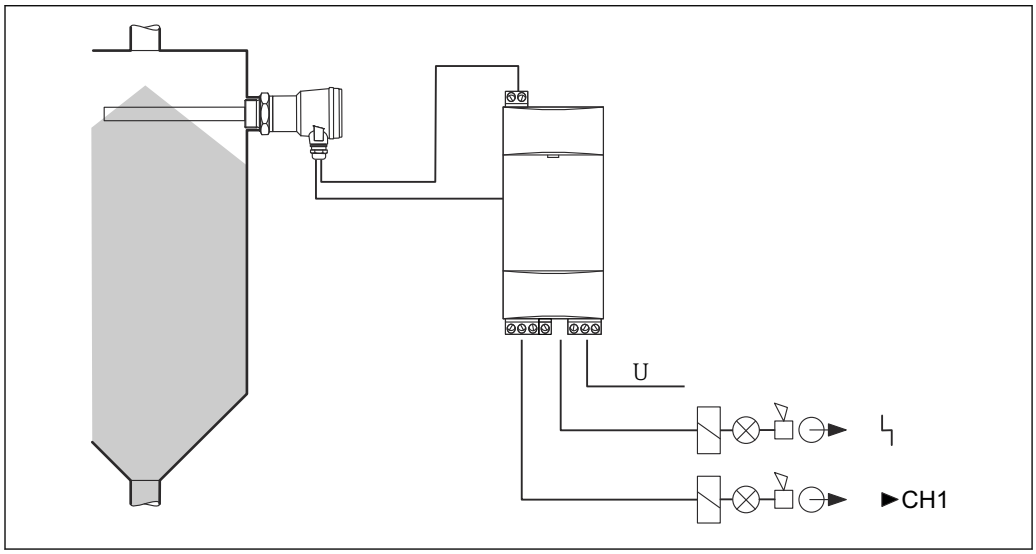
Probe design

Examples of media	εr	Conductivity	Buildup	Probe design			
				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	high	low	✔	✔	–	✔
			heavy	–	✔	–	✔
Sludge	>3	high	very heavy	–	✔	–	✔

Nivotester FTC325 PFM

The measuring system consists of the following components:

- Sensor
  - Capacitance probe
  - Electronic insert FEI57S
- Nivotester FTC325 PFM
- Control or signal units

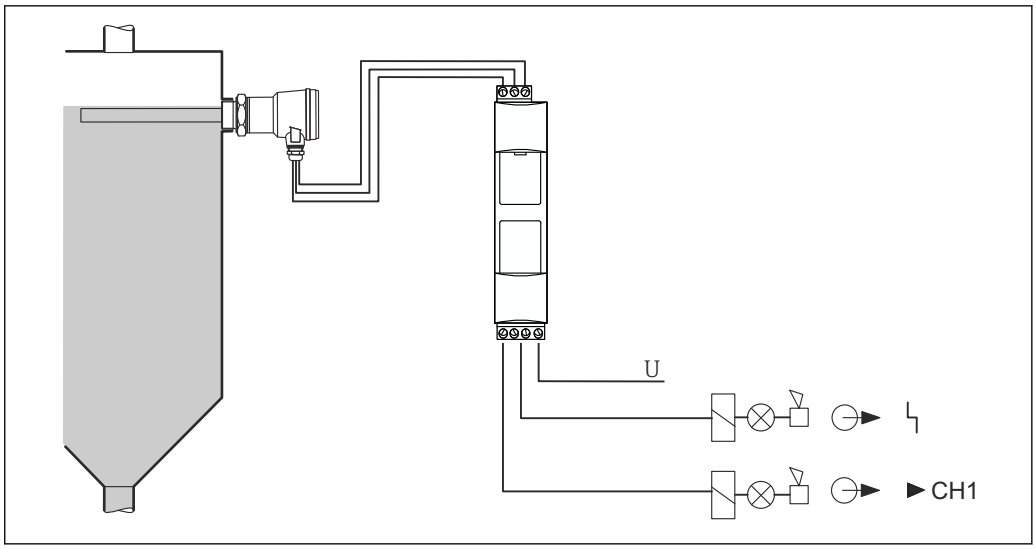


1 *Partially or fully insulated probe*

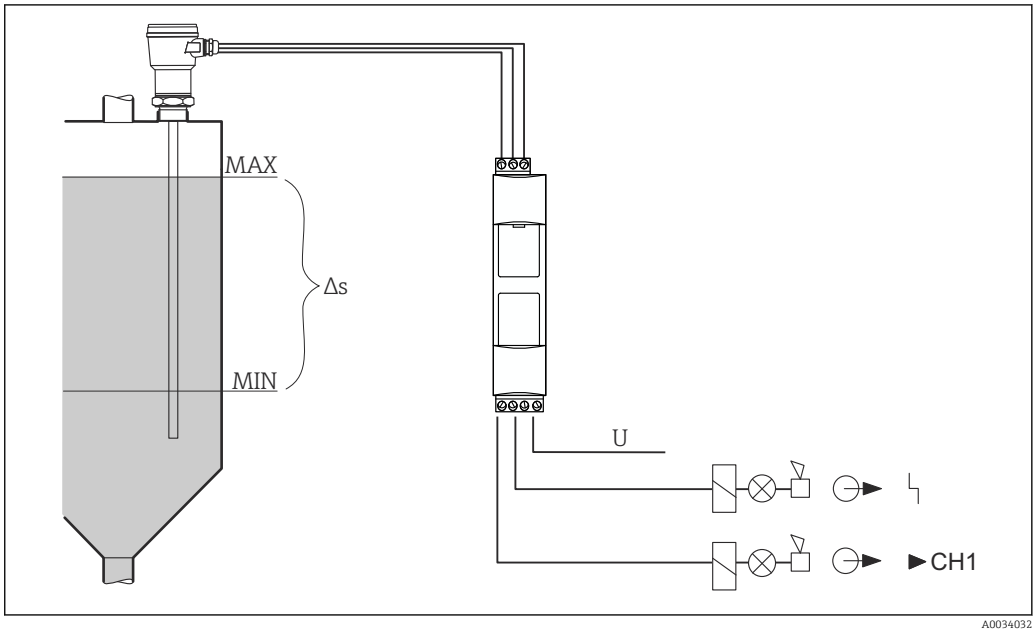
Nivotester FTC325 3-wire

The measuring systems consist of the following components:

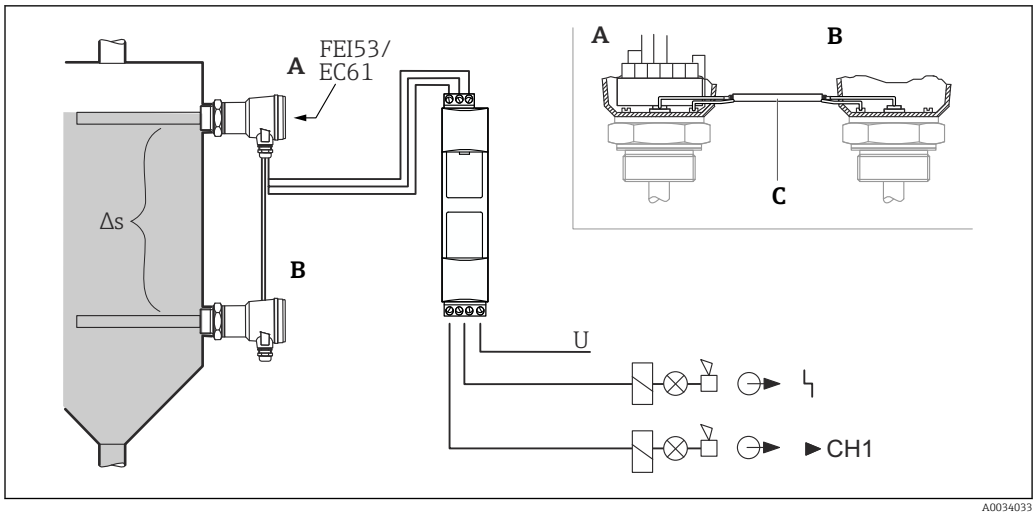
- Sensor
  - 1 to 2 capacitance probes
  - Electronic insert FEI53
- Nivotester FTC325 3-wire
- Control or signal units



2 *Partially or fully insulated probe*



3 *Two-point control with fully insulated probe*



4 *Two-point control with 2 fully or partially insulated probes (A, B) and an electronic insert FEI53 The probes are connected by a coaxial cable (C).*

Input

Measured variable

The point level signal is triggered, depending on the operating mode as minimum detection (MIN) or maximum detection (MAX), when the fill level crosses the relevant point level.

Measuring range

The measuring range depends on the installation location of the sensors.

Input signal

FTC325 PFM
- Galvanically isolated from power supply and output
- Type of protection: intrinsic safety [Ex ia] IIC
- Connectable sensors and electronic insert FEI57S:
  - Liquicap M FTI51, FTI52
  - Solicap M FTI55, FTI56
  - Solicap S FTI77
- Sensors powered by Nivotester FTC325 PFM
- Connection cable: two-wire
  Shielding not required, except in the event of strong electromagnetic interference (see also Electromagnetic compatibility → 12)
- Cable length/cable resistance: 1000 m (3281 ft)/max. 25 Ω per wire
- Signal transmission: pulse-frequency modulation (PFM)

FTC325 3-wire
- Galvanically isolated from power supply and output
- Type of protection: version for non-hazardous area
- Connectable sensors and electronic insert FEI53:
  - Liquicap M FTI51, FTI52
  - Solicap M FTI55, FTI56
  - Solicap S FTI77
- Sensors powered by Nivotester FTC325 3-wire
- Connection cable: three-wire
  Shielding not required, except in the event of strong electromagnetic interference (see also Electromagnetic compatibility → 12)
- Cable length/cable resistance: 1000 m (3281 ft)/max. 25 Ω per wire
- Signal transmission: voltage change is transmitted via a separate wire

Please refer to the relevant certificates for additional information on the use of the sensors in the hazardous area .

Output

Output signal

- Relay output: a potential-free change-over contact for the level alarm
- Quiescent current fail-safe mode: MIN/MAX safety can be selected with DIP switch
- Fault-signaling relay: potential-free change-over contact for fault signaling; only two contacts are available with the PFM version (specify NC (normally-closed contact) or NO (normally-open contact) when ordering a PFM device)
- Switching delay: approx. 0 to 45 s
  Depending on the setting, the relay switches when the probe is covered or uncovered
- Relay contact switching capacity:
  AC voltage (AC)
  U ~ maximum 250 V
  I ~ maximum 2 A
  P ~ maximum 500 VA for cos φ ≥0.7
  Direct current (DC)
  U = maximum 40 V
  I = maximum 2 A
  P = maximum 80 W
- Operating life: at least 10^5 switching operations with maximum contact load
- Function indicator: LEDs for operation, level alarm and fault
  Is lit as long as the probe is covered.

Overvoltage category in accordance with IEC 61010

II

Protection class

II (double or reinforced insulation)

Signal on alarm

Level relay per channel dropped out; fault signaled by red LEDs, fault-signaling relay dropped out

Galvanic isolation

All input and output channels and relay contacts are galvanically isolated from each other. If the power supply circuit or the fault-signaling relay contacts is/are simultaneously connected to functional extra-low voltage, safe galvanic isolation is guaranteed up to a voltage of AC 150 V.

Power supply

Electrical connection

Sensor operation in the hazardous area

Observe all national explosion protection regulations concerning the type and installation of intrinsically safe signal cabling.

Please refer to the Safety Instructions for the maximum permissible values for capacitance and inductance.

Connecting the sensors

The removable terminal blocks are color-coded into intrinsically safe and non-intrinsically safe terminals. This difference helps to ensure safe wiring.

Upper, blue terminal blocks for use in hazardous areas

Two-wire connection cable between the Nivotester and sensor, e.g. commercially available installation cable or wires in a multi-core cable for measurement purposes

Use a shielded cable in the event of strong electromagnetic interference, e.g. from machines or radio equipment. Only connect the shield to the grounding terminal in the sensor. Do not connect it to the Nivotester.

Connecting the signal and control units

Lower, gray terminal blocks for non-hazardous areas

The relay function depends on the level and fail-safe mode. If a device with high inductance (e.g. contactor or solenoid valve) is connected, a spark arrester must be provided to protect the relay contact.

Connecting the supply voltage

Green terminal block at bottom

A fuse is integrated into the power supply circuit. An additional fine-wire fuse is not necessary. The Nivotester is equipped with reverse polarity protection.

Supply voltage

Alternating current version

Voltage range: AC 85 to 253 V, 50/60 Hz

Low voltage versions

- Voltage range: AC 20 to 30 V/DC 20 to 60 V
- D/C power supply: maximum 100 mA
- Permissible residual ripple within tolerance: U_{ss} = maximum 2 V

Power consumption

AC
Maximum 6.0 VA

DC
Maximum 2.0 W (with U_{min} 20 V)

Performance characteristics

Switch-on behavior

Correct switch status after power supply switched on: 10 to 40 s, depending on the connected sensor.

Installation

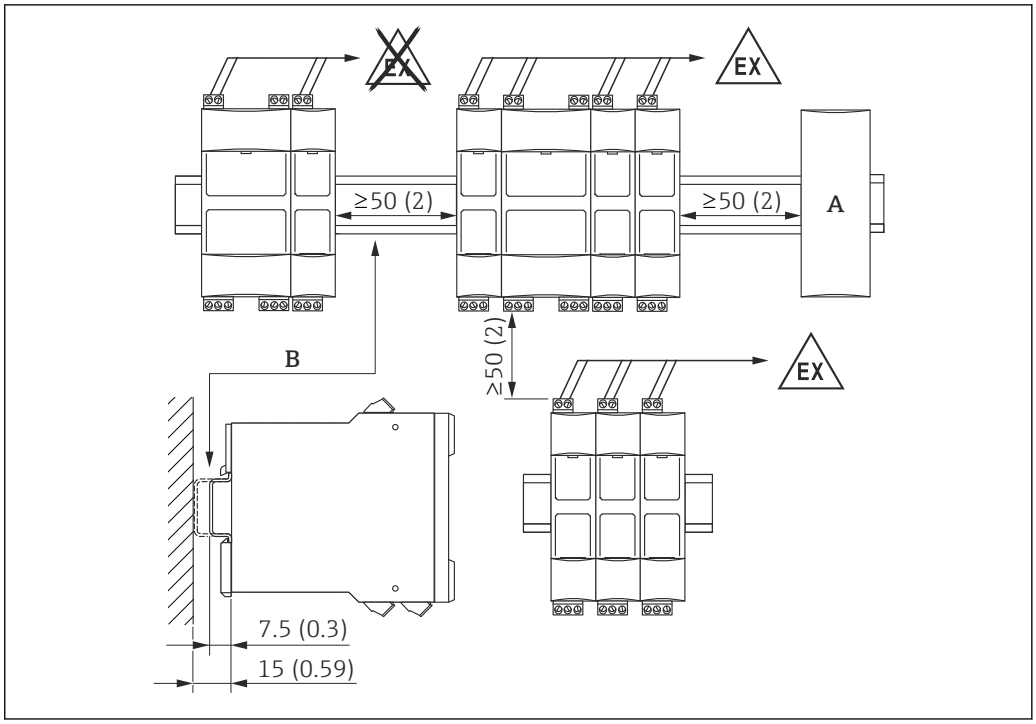
Installation point

- The device must be housed in a cabinet or protective housing outside the hazardous area.
- Mount the devices so that they are protected against weather and impact. Avoid exposure to direct sunlight.
- A protective housing (IP66) for up to four Nivotester FTC325 3-wire or two FTC325 PFM devices is available for outdoor installation .

Orientation

A horizontal installation ensures better dissipation of heat than a vertical orientation.

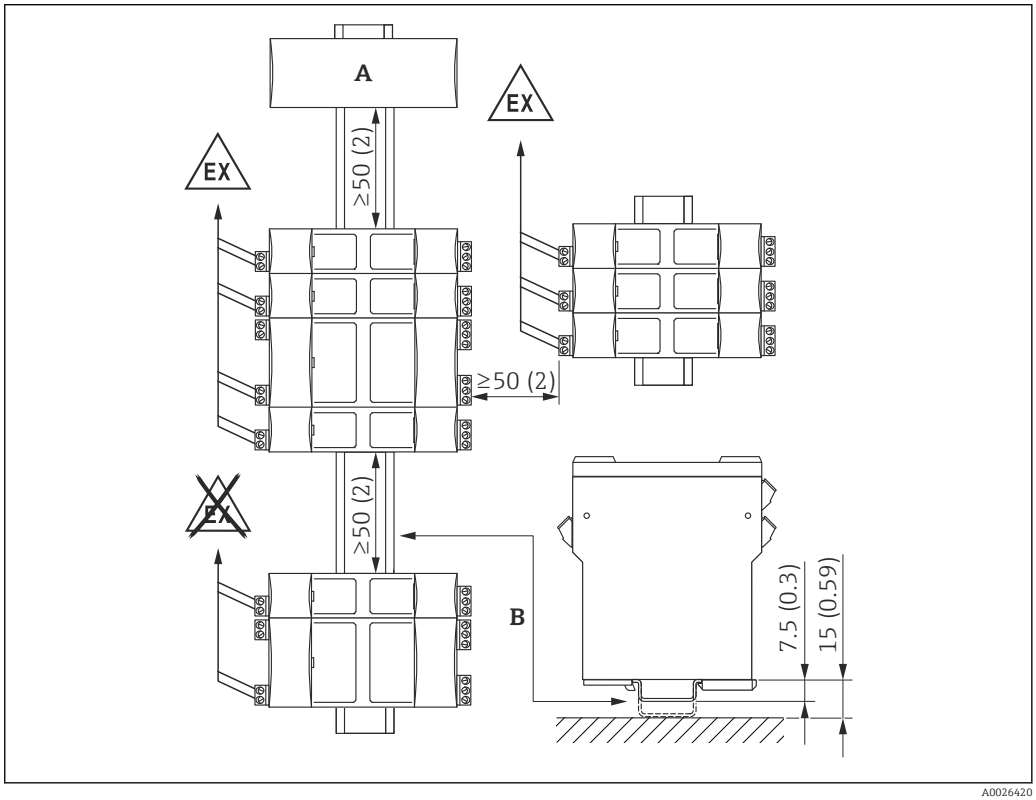
Horizontal orientation



5 *Minimum distance for horizontal orientation. Unit of measurement mm (in)*

A Connection of another device type
B DIN rail in accordance with EN 60715 TH35-7.5/15

Vertical orientation



6 *Minimum distance for vertical orientation.*

A Connection of another device type
B DIN rail in accordance with EN 60715 TH35-7.5/15

Environment

Ambient temperature range

- Installation of an individual device: −20 to +60 °C (−4 to 140 °F)
- Side-by-side installation without lateral spacing: −20 to +50 °C (−4 to +122 °F)
- Installation in protective housing: −20 to +40 °C (−4 to +104 °F)
  A maximum of four Nivotester FTC325 3-wire or two FTC325 PFM devices may be installed in a protective housing.
- Storage temperature: −25 to +85 °C (−13 to 185), preferably 20 °C (68 °F)

Climate and mechanical application class

3K3 and 3M2 in accordance with IEC 60721-3-3

Operating height

As per IEC 61010-1 Ed.3:
Up to 2 000 m (6 500 ft) above sea level

Relative humidity

5 to 85 %

Pollution degree

Pollution degree 2 as per IEC 61010-1

Degree of protection

- IP20 (as per IEC 60529)
- IK06 (as per IEC 62262)

Shock resistance

EN 60068-2-27: a = 150 m/s^2 t = 11 ms, 3 axes x 2 directions x 3 shocks

Vibration resistance

EN 60068-2-64: a(RMS) = 28 m/s^2, f = 5 to 2000 Hz, t = 3 axes x 2 h

Electromagnetic compatibility (EMC)

- Interference emission according to EN 61326, Class A equipment.
- Interference immunity according to EN 61326; Annex A (Industrial) and NAMUR Recommendation NE 21 (EMC)

This device does not require maintenance work.

Mechanical construction

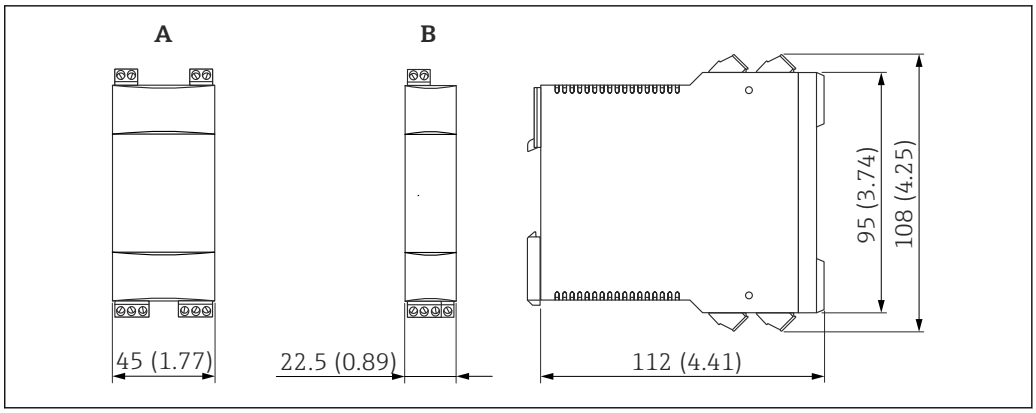
Design, dimensions

Dimensions

The following dimensions are rounded values. As a result, there may be deviations from the specifications in the Product Configurator at www.endress.com.

To view CAD data:

1. Enter www.endress.com in your web browser.
2. Search for the device.
3. Select the "Configuration" button.
4. Configure the device.
5. Select "CAD drawings".



Dimensions mm (in)
A Nivotester FTC325 PFM
B Nivotester FTC325 3-wire

Weight

- PFM: approx. 250 g (8.81 oz)
- 3-wire: approx. 148 g (5.22 oz)

Materials

- Housing: polycarbonate PC
- Front cover: polypropylene PP
- Fixing slide to secure to DIN rail: polyamide PA6

Terminals

PFM

- 2 screw terminals: sensor power supply
- 3 screw terminals: level relay
- 2 screw terminals: fault-signaling relay
- 2 screw terminals: power supply

3-wire

- 3 screw terminals: sensor power supply + signal
- 4 screw terminals:
  - 3 limit relays
  - 1 for contact 3 of the fault-signaling relay
- 4 screw terminals:
  - 2 AC/DC power supply
  - 2 fault-signaling relays

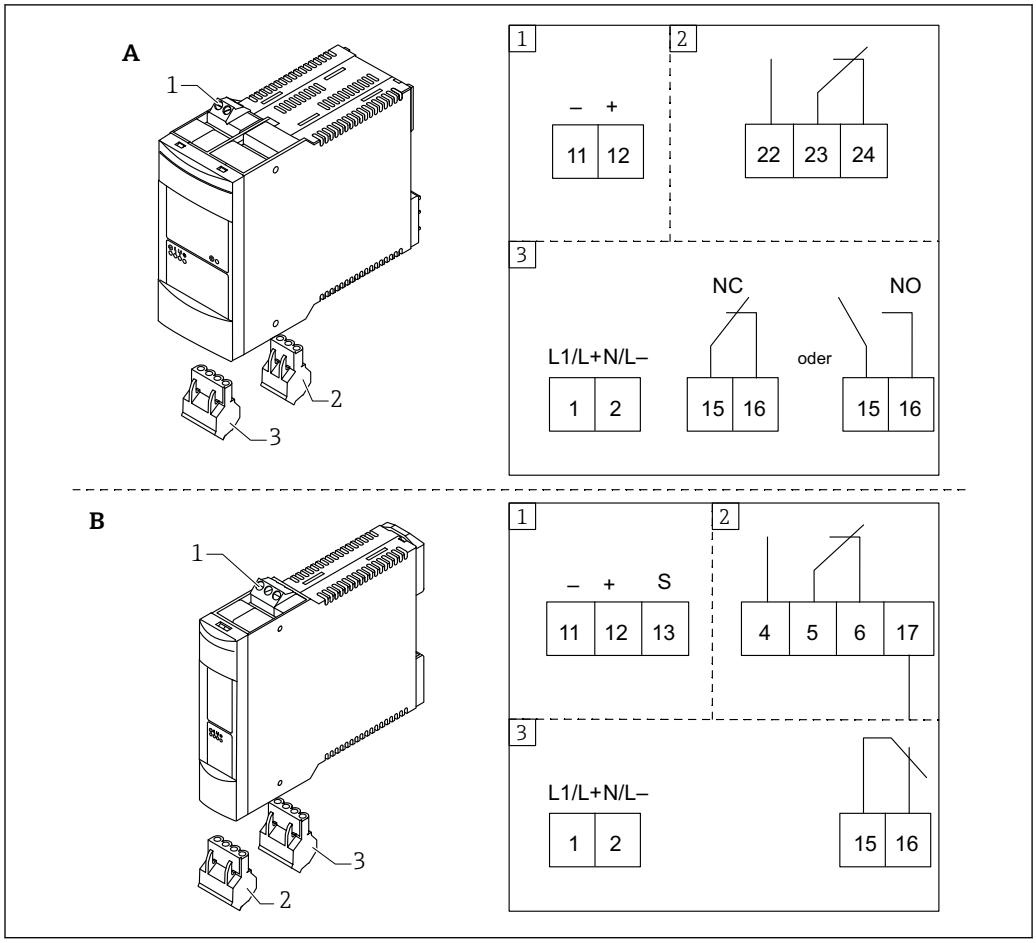
Connection cross-section

Maximum 1 x 2.5 mm^2 (14 AWG) or 2 x 1.5 mm^2 (16 AWG)

Connecting cable

Strip the cable ends (maximum 7 mm (0.03 in))

Terminal assignment



A PFM
B 3-wire
1 Sensor power supply
2 Level relay
3 Power supply / fault-signaling relay

Display and user interface

Operation concept

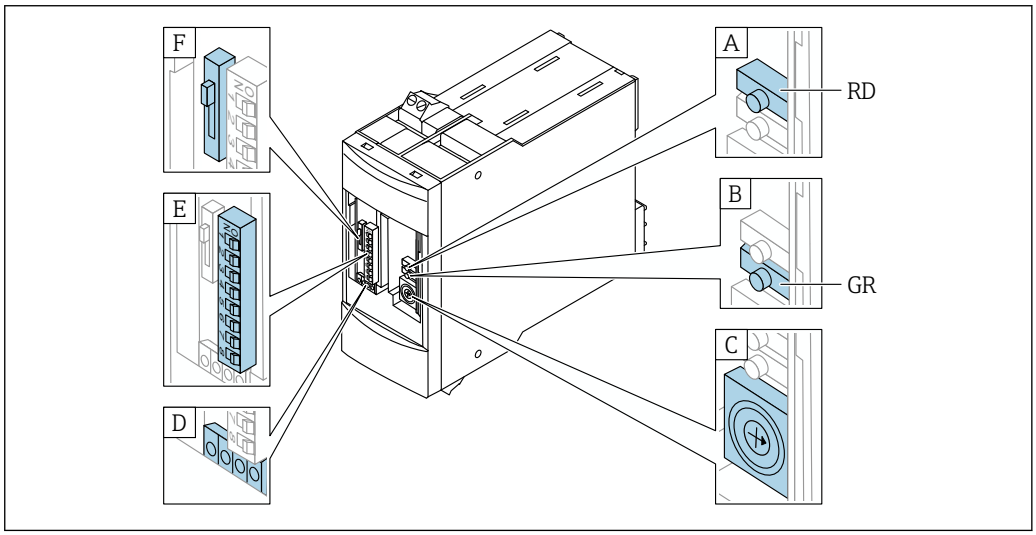
Onsite configuration with DIP switches behind fold-down front panel

Display elements

LEDs
- Green LED: ready for operation
- Red LED: fault signaling
- Yellow LED (left): level relay energized
- Yellow LED (right): probe uncovered or covered
  Level signaling independent of the selected fail-safe mode

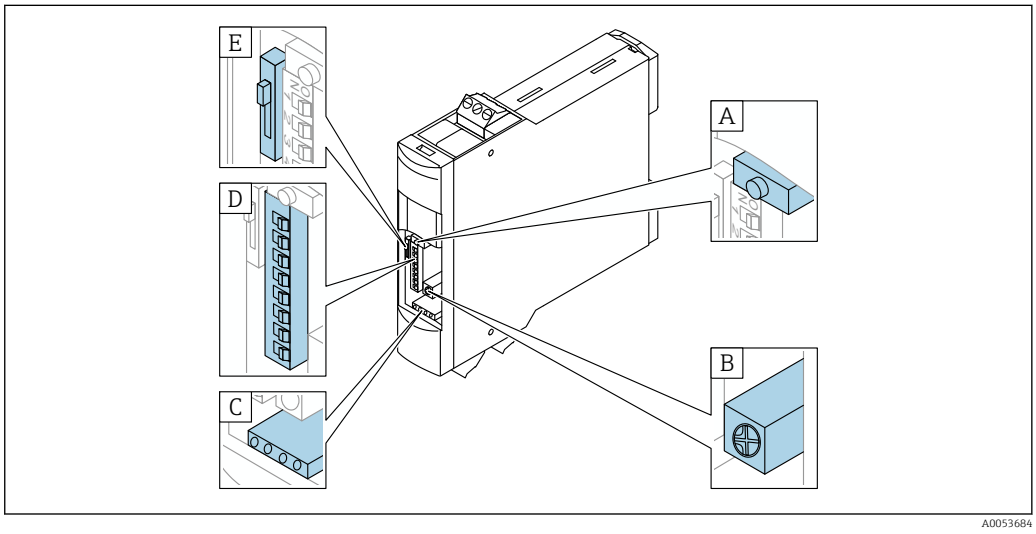
Operating elements

PFM



A Calibration button (red)
B Test and correction key (green)
C Control dial for switch point shift for buildup compensation (16-stage)
D LEDs
E DIP switch
F Switch for calibration mode (probe covered or uncovered)

3-wire



A Calibration button (red)
B Control dial for switch point shift for buildup compensation (infinitely variable)
C LEDs
D DIP switch
E Switch for calibration mode (probe covered or uncovered)

Ordering information

Detailed ordering information is available from your nearest sales organization www.addresses.endress.com or in the Product Configurator at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.

3. Select **Configuration**.

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: direct input of information specific to the measuring point, such as the 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

Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

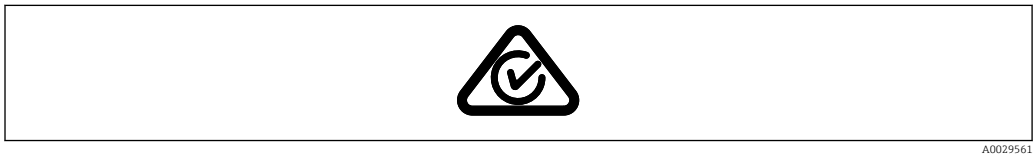
CE mark

The measuring system meets the legal requirements of the applicable EU directives. These are listed in the corresponding EU Declaration of Conformity together with the standards applied.

The manufacturer confirms successful testing of the device by affixing to it the CE mark.

RCM marking

The supplied product or measuring system meets the ACMA (Australian Communications and Media Authority) requirements for network integrity, interoperability, performance characteristics as well as health and safety regulations. Here, especially the regulatory arrangements for electromagnetic compatibility are met. The products bear the RCM marking on the nameplate.



A0029561

Ex-approval

The Endress+Hauser sales center can provide information on the hazardous area versions currently available. All the data that are relevant for explosion protection are provided in separate documents which can be supplied on request

Type of protection

Applies for PFM
- II(1)G [Ex ia Ga] IIC
- II(1)D [Ex ia Da] IIIC

Overfill protection system

WHG (FTC325 PFM only)

External standards and guidelines

The applicable European guidelines and standards can be found in the relevant EU Declarations of Conformity.

- IEC 60721-3-3: Classification of environmental conditions
- IEC 60529: Degrees of protection provided by enclosures (IP code)
- IEC 61010: Protection measures for electrical equipment for measurement, control, regulation and laboratory procedures
- IEC 61326: Interference emission (Class A equipment), interference immunity (Appendix A - Industrial environment)

Accessories

Protective housing

The protective housing with IP66 protection is fitted with an integrated DIN rail. The protective housing can be closed with a transparent cover and lead-sealed.

- Dimensions in mm (in) B/H/D: 180/182/165 (7.1/7.2/6.5)
- Part number: 52010132

Documentation

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the device version:

Document type	Purpose and content of the document
Technical Information (TI)	**Planning aid for your device** The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	**Guide that takes you quickly to the 1st measured value** The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	**Your reference document** The Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	**Reference for your parameters** The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
Safety instructions (XA)	Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. These are an integral part of the Operating Instructions. The nameplate indicates which Safety Instructions (XA) apply to the device.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is a constituent part of the device documentation.

www.addresses.endress.com

Endress+Hauser

People for Process Automation