

Technical Information

Nivotester FTC625

Level limit switch

With Intrinsically Safe Signal Circuit for Connection to a Capacitance Sensor



Applications

- Level limit detection in tanks containing liquids and silos containing bulk solids. For capacitance level probes, which may also be applied in hazardous areas of category ATEX II (1) GD
- Overspill protection for tanks containing flammable or non-flammable fluids hazardous to water
- Dry running protection for pumps

Your benefits

- Intrinsically safe signal circuit [Ex ia] IIC for using sensors in hazardous areas
- Calibration using operating keys
- High functional safety thanks to:
 - Fail-safe PFM technology
 - Cable monitoring up to sensor with FEI57S or EC27Z
 - Checkable relay function using operating keys
- Compact housing for easy series mounting on standard DIN rail in the cabinet
- Pluggable terminal blocks make wiring easy
- RS485 interface for connection, e.g. by Fieldgate technology, for remote monitoring
- RS232 diagnosis socket with connection to, for example, ToF Tool for reading out data
- Can be used also with EC16Z and EC17Z
- Permanent self-monitoring with FEI57S and EC27Z
- Protection against maloperation and manipulation
 - Every change in the switch setting triggers a red LED signal and a fault message
- Full- or empty push button calibration

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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. The electronic insert converts the capacitance change into a PFM frequency change, which switches the output relay in the Nivotester FTC625.

Signal transmission

The Nivotester FTC625 limit switch's intrinsically safe signal input is galvanically isolated from the mains and from the output.

The Nivotester supplies the capacitance sensor with power via a two-wire cable with direct current and receives a frequency from it which signals whether the level limit has been reached or not. Here, the transmitter superimposes current pulses (PFM signals) with a pulse width of approx. 200 μ s and an amperage of approx. 10 mA on the supply current.

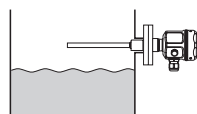
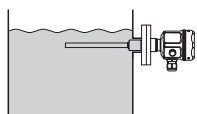
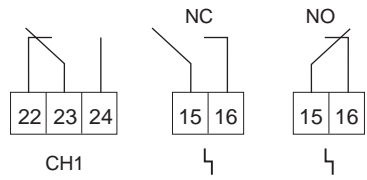
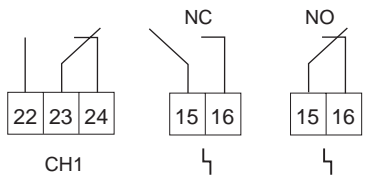
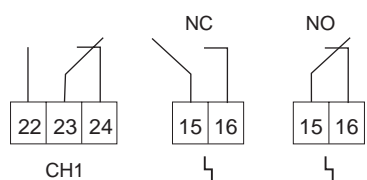
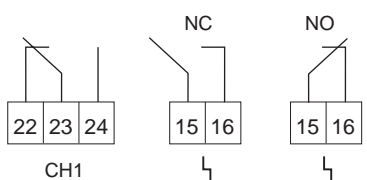
Signal analysis

The Nivotester analyses the frequency and switches the output relay for the level alarm. The switching state of the relay is displayed on the front panel of the Nivotester by means of a yellow light emitting diode (left).

Fail-safe circuit

Selecting the correct fail-safe circuit ensures that the relay always works in quiescent current fail-safe mode.

- Maximum fail-safe mode: the relay de-energises when the level rises above the switch point (sensor covered), a fault occurs or the power fails.
- Minimum fail-safe mode: the relay de-energises when the level falls below the switch point (sensor uncovered), a fault occurs or the power fails.

Level	 Probe uncovered	 Probe covered
Maximum safety circuit		
Minimum safety circuit		

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Function of the limit 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-energises the relay for the level alarm and the alarm relay. A fault is indicated if the Nivotester does not receive any more current pulses. 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

Permanent function monitoring is implemented by the FEI57S and EC27Z electronic insert. Here, the Nivotester sends a test pulse to the FEI57S or EC27Z, which then returns it. This occurs in one second cycles. If the frequency measurement is interrupted, the Nivotester triggers the alarm.



Note!

The Nivotester FTC625 was optimised for the new electronic inserts of Liquicap M and Solicap M series. From the software version (SV) 1.4 the Nivotester is fully compatible with the FEI57S.

The function alarm priority (only in conjunction with FEI57S or EC27Z) ensures that a limit indication is not signalled before a fault message. With this setting you ensure that a fault message has the first priority.

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

Calibration key (red)

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

Adjustable switching delay and switch point shift

- An adjustable switching delay of 0...45 s allows for the relay to be switched with a delay when covering or uncovering the probe. In the opposite direction, each switching delay is 0.2 s.
- A 16-stage switch point shift allows for safe system operation even when using media that are prone to build-up.

The test/correction key (green):

- 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.

Diagnosis plug (RS232)

The RS232 interface serves as a PC interface and enables on-site operation using a laptop in conjunction with a ToF Tool.

RS485 interface

The RS485 interface enables, for example, connection to a Fieldgate, with which remote monitoring can also be performed via the Internet. This remotely monitors the probe frequency, for example in order to receive a message by e-mail should build-up occur and to initiate a new calibration.

Measuring system

A measuring system consists of a capacitance sensor, a Nivotester FTC625 and the control or signal instruments.

The following sensors can be used in conjunction with the electronic inserts (EC) listed.

- Liquicap M with FEI57S
- Solicap M (FEI55, FEI56) with FEI57S
- Solicap M* (FTC51, FTC52, FTC53) with EC17Z
- Multicap T* with EC17Z
- Multicap Classic* with EC16Z, EC17Z, EC27Z
- Multicap EA* with EC17Z
- High-temperature probes* (HT) 11500, T12656, T12892 with EC17Z, EC27Z

* Phase-out: december 2007

Probe construction

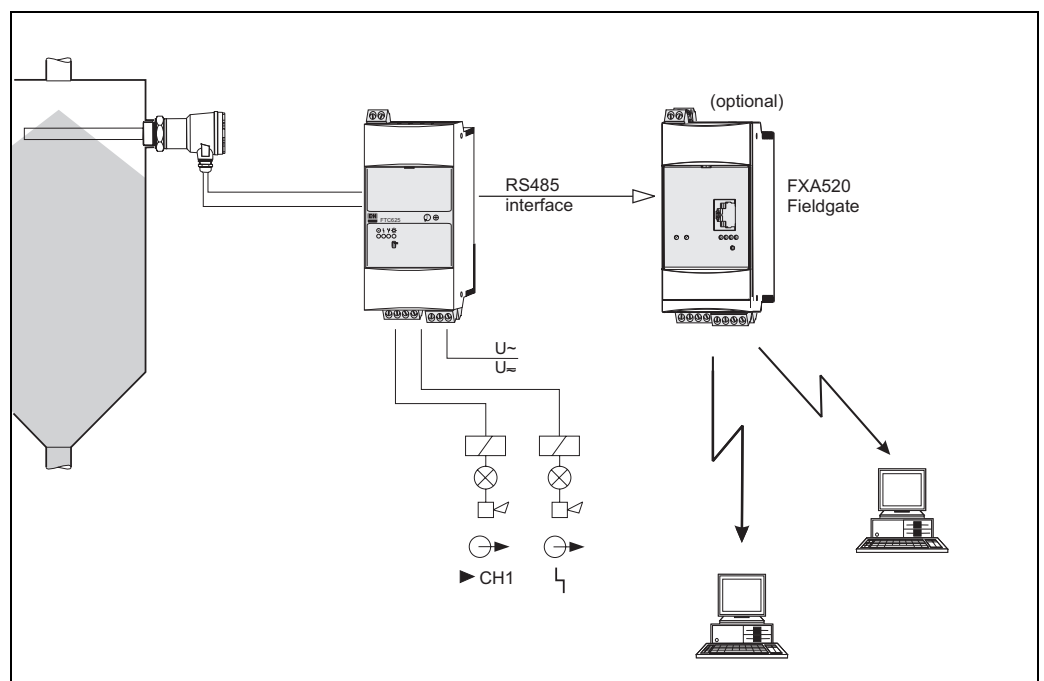
Example: Material	ϵ_r	Conductivity	Build-up	Type of probe mounting			
				full insulation	partial insulation	with ground tube	without ground tube
Solvents, fuels	< 3	low	low	✓	✓	✓	–
Dry bulk solids	< 3	low	low	–	✓	–	✓
Moist bulk solids	> 3	average	average	✓	✓	–	✓
Aqueous liquids and alcohols	> 3	strong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

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Nivotester FTC625

The measuring system consists of:

- Sensor
 - capacitance probe
 - electronic insert
 - FEI57S or EC27Z with cable monitoring
 - EC16/17Z without cable monitoring
- Nivotester FTC625
- Control or signal instruments



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Input

Measured variable	The limit signal is generated at minimum or maximum level, depending on the selection
Measuring range	The measuring range is dependent on the mounting location of the probes.
Input signal	<ul style="list-style-type: none">■ FTC625 input: galvanically isolated from power supply and output■ Type of protection: intrinsic safety [EEx ia] IIC■ Connectable sensors:<ul style="list-style-type: none">Liquicap M with FEI57SSolicap M (FEI55, FEI56) with FEI57SSolicap M* (FTC51, FTC52, FTC53) with EC17ZMulticap T* with EC17ZMulticap Classic* with EC16Z, EC17Z, EC27ZMulticap EA* with EC17ZHigh-temperature probes (HT)* 11500, T12656, T12892 with EC17Z, EC27Z■ Sensor's power supply: from Nivotester FTC625■ Connecting cable: two-wire, screening not required, except for strong electromagnetic interferences (see also page 6)■ Cable resistance: max. 25 Ω per wire■ Signal transmission: pulse-frequency modulation (PFM) <p>* Phase-out: december 2007</p>

Output

Output signal	<ul style="list-style-type: none">■ Relay output: a potential-free change-over contact for the level alarm■ RS485 interface for connection to, for example, Fieldgate (remote monitoring)■ Quiescent current fail-safe circuit: minimum/maximum fail-safe mode can be selected using the DIL switch■ Alarm relay: potential-free change-over contact for fault indication, only two contacts made (NC or NO contact)■ Switching delay: 0...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 VI~ maximum 2 AP~ maximum 500 VA at $\cos \varphi \geq 0.7$ U- maximum 40 VI- maximum 2 AP- maximum 80 W <ul style="list-style-type: none">■ Service life: at least 10^5 switching cycles at maximum contact load■ Function indicator: light emitting diodes for operation/communication, level alarm, fault and level signal (lights up as long as the probe is covered)
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Signal on alarm	Limit relay de-energised; fault indication via red LED, alarm relay de-energised
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Galvanic isolation	All input and output channels and relay contacts are galvanically safe isolated from each other. When making a simultaneous connection from the power supply circuit to the function's extra-low voltage or to the alarm relay's contacts, safe galvanic isolation is guaranteed up to a voltage of 150 V AC.
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Overvoltage category as per EN 61010	II
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Protection class	II (double or increased insulation)
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Power supply

Electrical connection

Terminal blocks

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 colour-coded. Blue is for the intrinsically safe area and grey for the non-intrinsically safe area. These distinctions allow for safe cable routing.

Sensor connection

(To the upper, blue terminal blocks).

Use a usual commercial instrument cable or multi-core cable for measuring purposes for the two-wire connecting cable between the Nivotester FTC625 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 screened cable must be used. Only connect the screening to the grounding connection in the sensor, not to the Nivotester.

Using the sensor in hazardous areas

Compliance with the national explosion protection regulations for the design and routing of the intrinsically safe signal cable is mandatory.

High-reliability values for capacitance and inductance are contained in Safety Instructions XA 195F.

Connection of signal and control instruments

(To the lower, grey 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.

Supply voltage connection

(To the lower, grey terminal blocks)

For voltage versions, see the Ordering information.

A fuse (T 200mA) is built in to 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...253 V, 50/60 Hz

Direct current version (DC):

- Voltage range: 20...30 V AC / 20...60 V DC
- Power supply direct current: maximum 100 mA
- Permitted residual ripple within the tolerance: $U_{\text{ss}} = \text{maximum } 2 \text{ V}$

Power consumption

AC version

maximum 6.0 VA

DC version

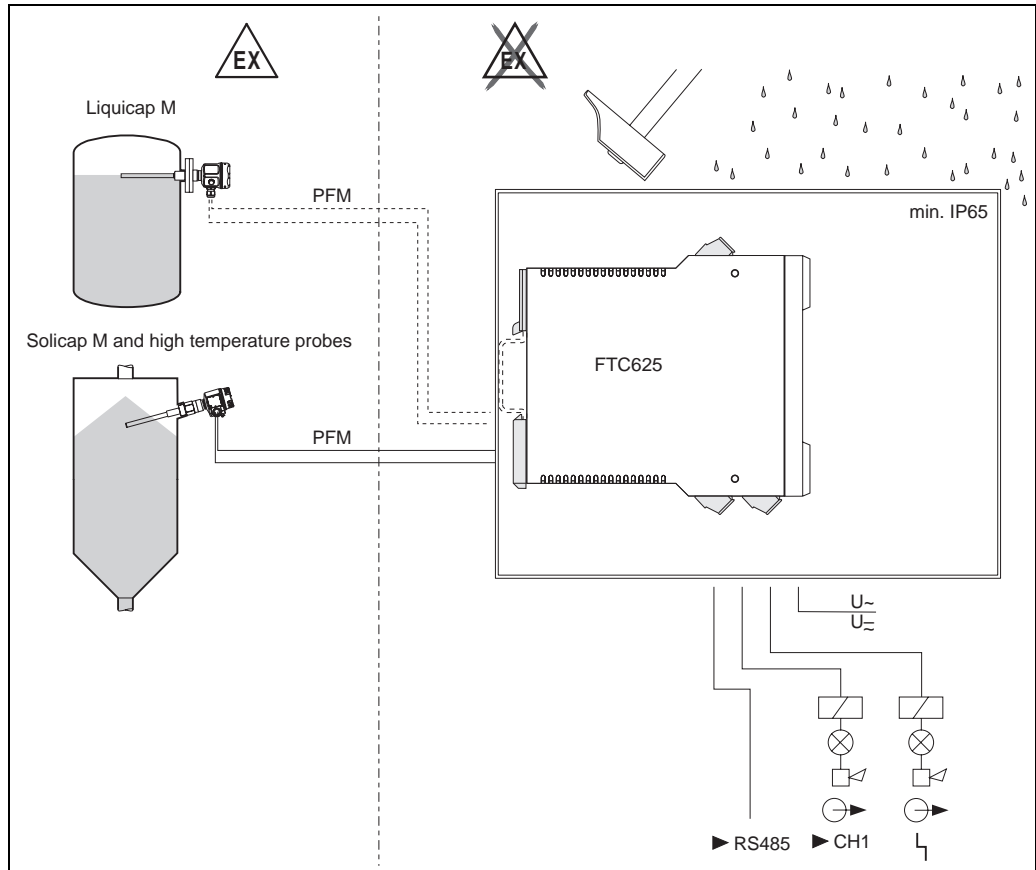
maximum 2.0 W (at $U_{\text{min}} 20 \text{ V}$)

Operating conditions (installation conditions)

Installation instructions

Installation location

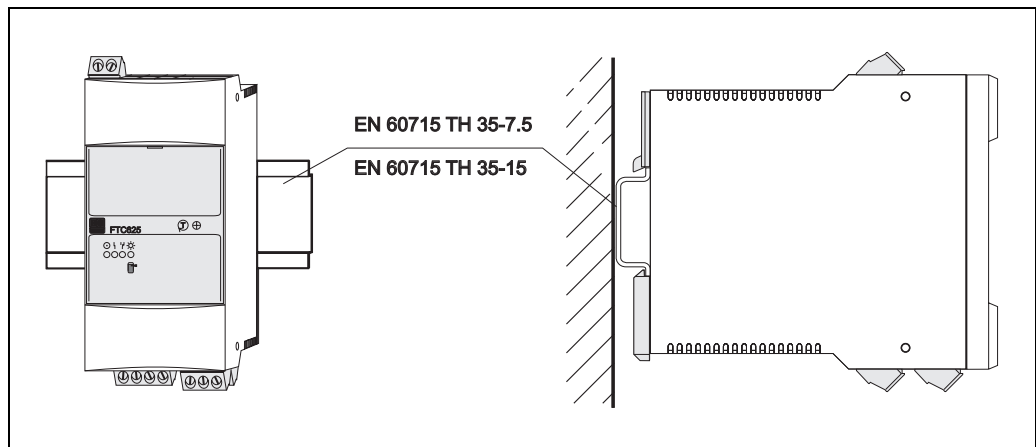
The Nivotester must be housed outside of hazardous areas in a cabinet. For installation outdoors, there is also a protective housing (IP65 - see Accessories) for up to three Nivotester FTC625 available.



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Orientation

Vertical on DIN rail (EN 60715 TH 35).



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Operating conditions (environmental conditions)

Installation location Cabinet or protective housing

Permitted ambient temperatures

For single mounting

- -20 °C...+60 °C

For series mounting without lateral spacing

- -20 °C...+50 °C

Storage temperature

- -25 °C...+85 °C (preferably at +20 °C)

Installation in protective housing

- -20 °C...+40 °C
- No more than three Nivotesters can be installed into one protective housing



Caution!

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.

Climatic and mechanical application class

3K3
As per DIN EN 60721-3-3
3M2
As per DIN EN 60721-3-3

Degree of protection

IP20

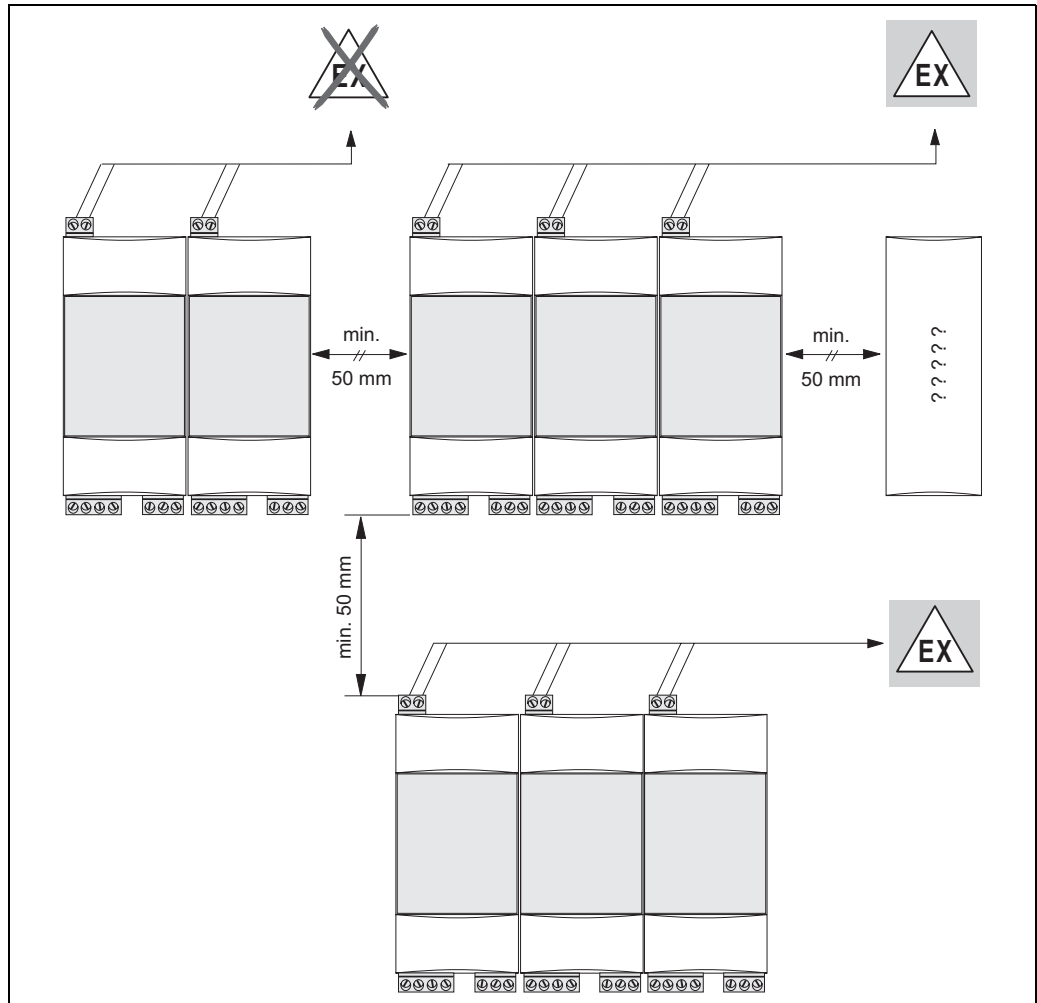
Electromagnetic Compatibility (EMC)

Interference emission as per EN 61326; Equipment Class B
Interference immunity as per EN 61326; Appendix A (industrial applications) and NAMUR Recommendation NE 21 (EMC)

Mechanical construction

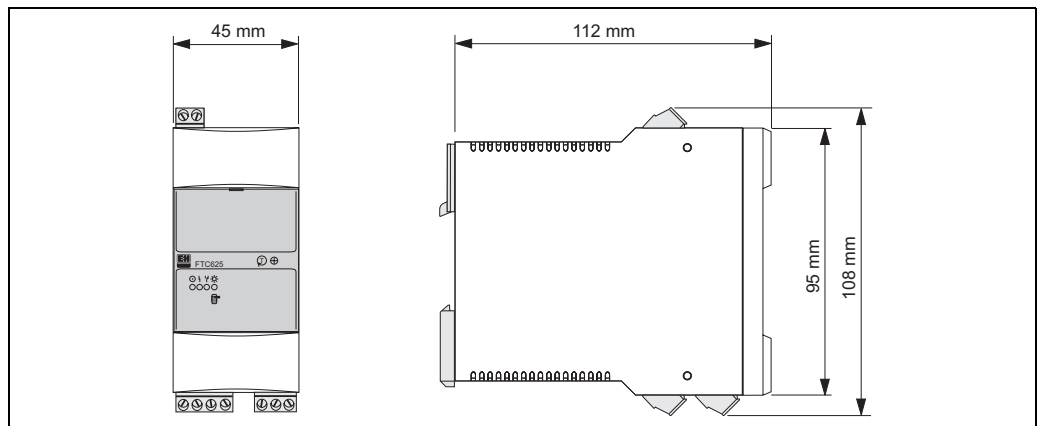
Design, dimensions

- Housing: row housing made of plastic
- Mounting: on DIN rail as per EN 60715 TH 35-7.5 or EN 60715 TH 35-15
- Degree of protection as per EN 60529; IP20



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Dimensions



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Note!
100 mm = 3.94 in

Weight approx. 250 g

Materials

Housing

- Polycarbonate
Colour: light grey, RAL 7035

Front cover

- Polypropylene PPN
Colour: blue

Fixing bracket (for securing on the DIN rail)

- Polyamide PA6
Colour: black, RAL 9005

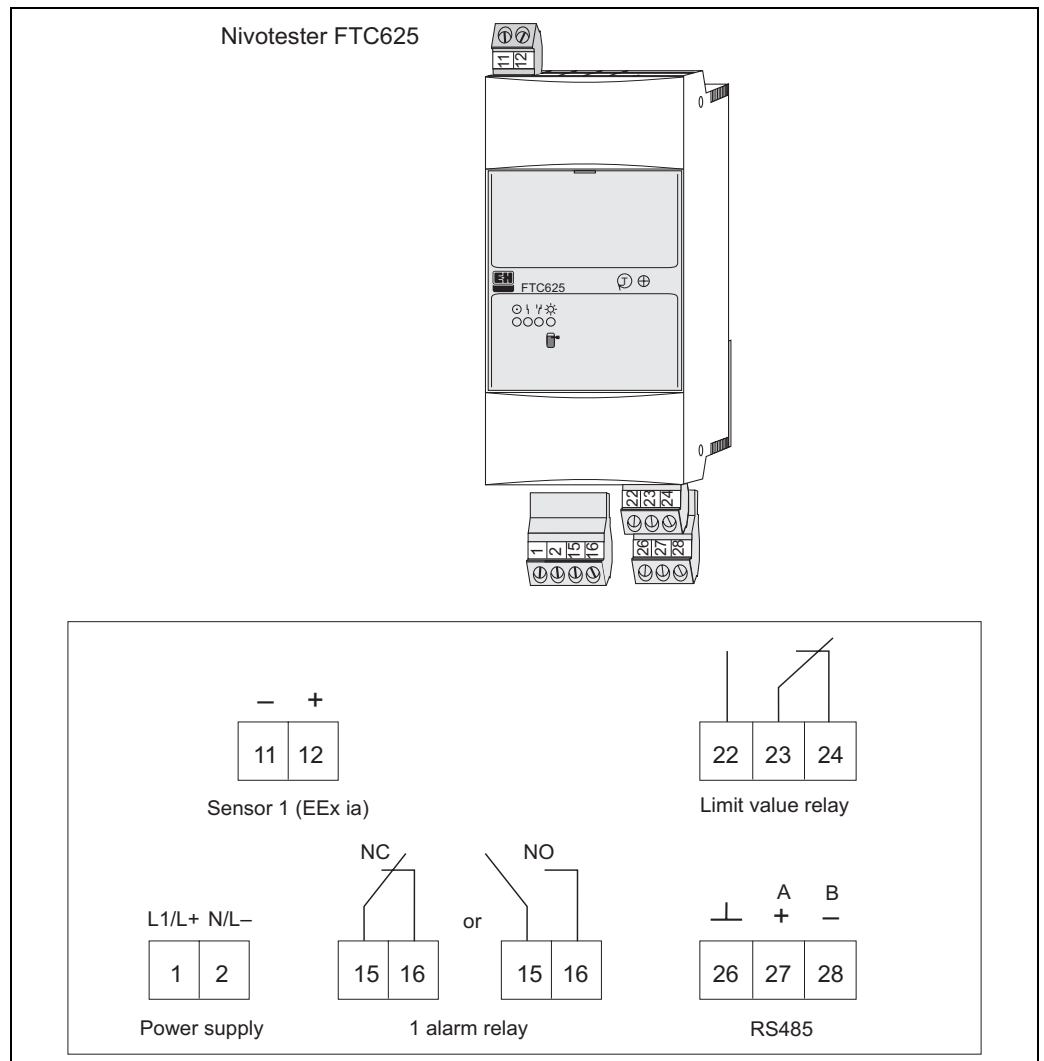
Terminals

Nivotester FTC625

- 2 screw terminals: probe supply
- 3 screw terminals: limit relay
- 2 screw terminals: alarm relay
- 2 screw terminals: power supply
- 3 screw terminals: RS485 interface

Connection cross-section

maximum 1 x 2.5 mm or 2 x 1.5 mm



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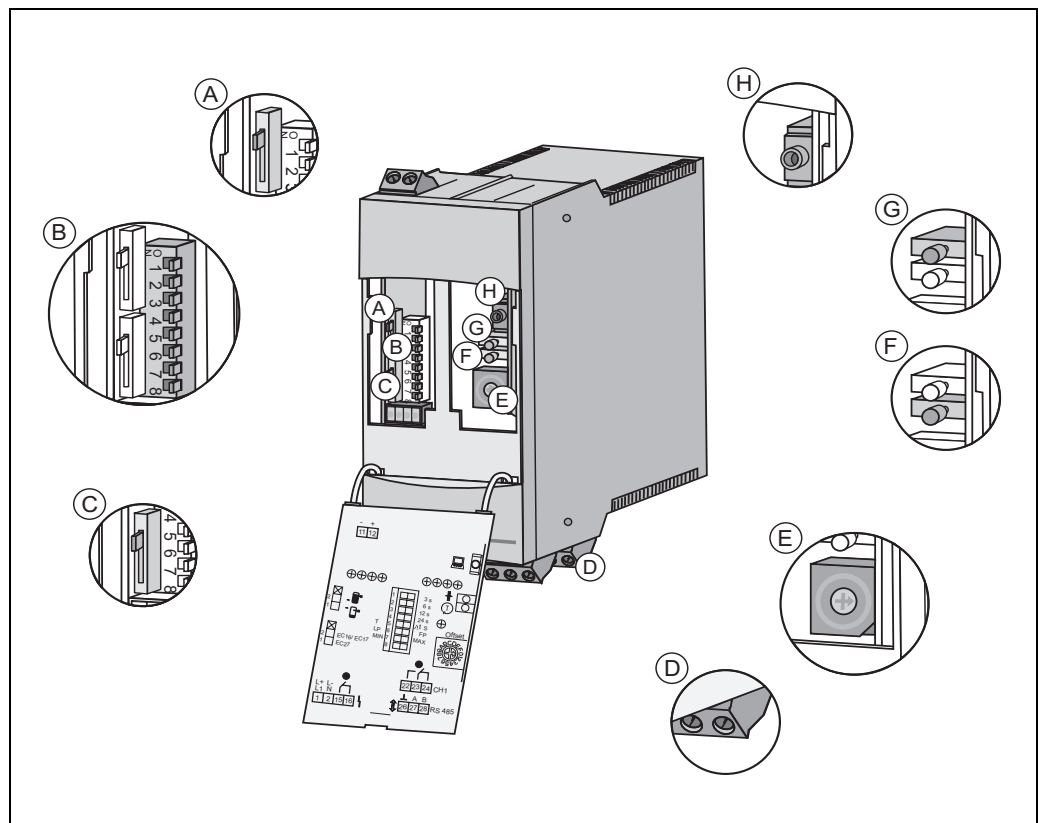
Human interface

Display elements

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

Operating elements

- A Calibration for covered or uncovered probe
- B DIL switches 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: only with FEI57S or EC27Z - level limit indication immediately or after functional test
DIL switch 7: min/max fail-safe mode
DIL switch 8: no function
- C Sensor selection: FEI57S, EC27Z or EC16Z, EC17Z
- D RS485 interface
- E Switch point shift for build-up compensation (16-stage)
- F Correction key (green)
- G Calibration key (red)
- H Diagnosis socket (RS232/ToF Tool)



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Operating concept

On-site configuration with switches behind the folding front panel

Remote operation

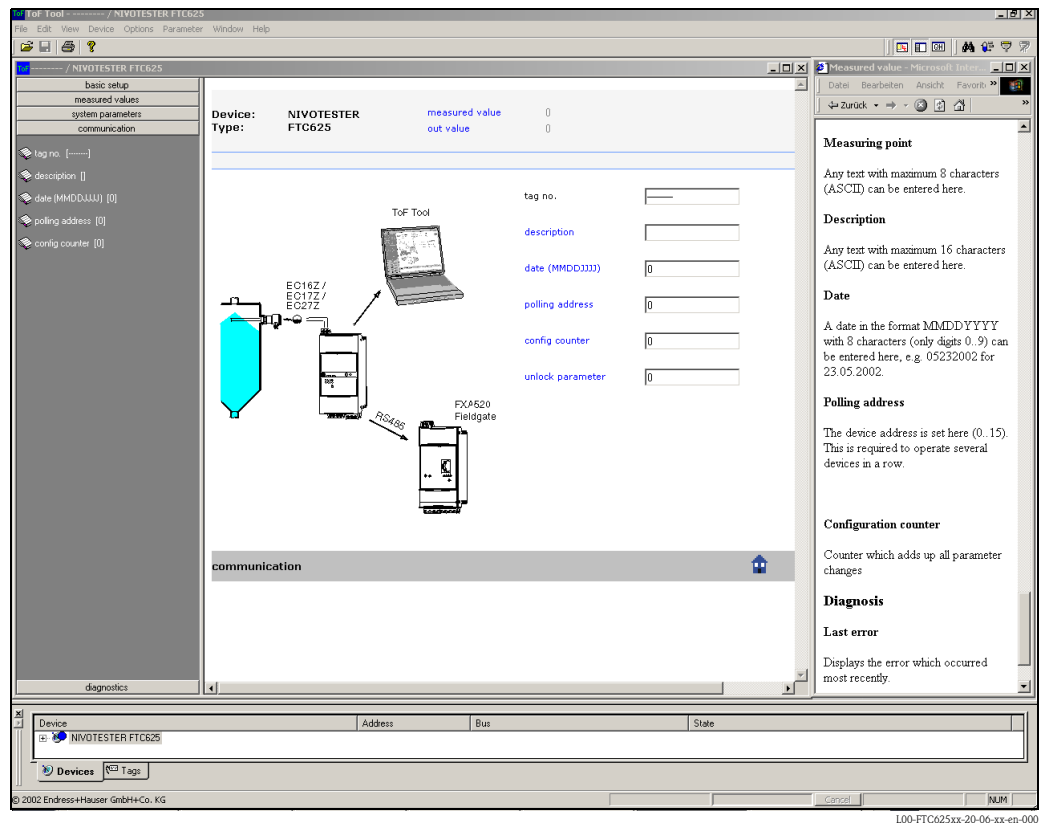
Operation with ToF Tool

The ToF Tool is a graphic operating program for measuring devices from Endress+Hauser. It serves to support the commissioning, data storage, signal analysis and documentation of the measuring point. Supported operating systems: Win95, Win98, WinNT4.0, Win2000 and XP.

The ToF Tool supports the following functions:

- Reading out configuration data and performing remote calibration
- Performing remote calibration
- Loading and saving device data (upload/download)
- Measuring point documentation

Menu-guided commissioning:



Certificates and approvals

CE mark	The Nivotester meets all the statutory requirements arising from EC directives. Endress+Hauser confirms the successful testing of the device by affixing the CE symbol.
Ex approval	Endress+Hauser Sales Centers provide information about the currently available versions for use in hazardous areas (ATEX EEx ia IIC; FM IS; CSA IS) All the relevant data for explosion protection is contained in separate Ex documentation (see: Supplementary Documentation), which can be requested.
Type of protection	[EEx ia] IIC
Overspill protection	WHG
Other standards and regulations	Other standards and regulations which were complied with during the conception and development of the Nivotester FTC625. <ul style="list-style-type: none"> ■ 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 (Appendix A - industrial applications)

Ordering information

Nivotester FTC625	10	Certificates						
		C	ATEX II (1) GD [EEx ia] IIC, WHG					
		D	FM IS Cl. I, II, III Div. 1 Group A-G					
		E	CSA IS Cl. I, II, III Div. 1 Group A-G					
		Y	Special version					
		20	Version					
		1	Rail mounting 1-channel 45 mm					
		9	Special version					
	30	Power supply						
		A	Power supply 85...253 V AC, 50/60 Hz					
		B	Power supply 20... 30 V AC / 20... 60 V DC					
		Y	Special version					
	40	Output						
		1	1x level SPDT + 1x alarm SPST NC (Normal closed)					
		2	1x level SPDT + 1x alarm SPST NO (Normal open)					
		9	Special version					
	50	Additional option						
		1	Additional option not selected					
		9	Special version					
	FTC625						Complete product name	

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: 180 / H: 182 / D: 165

Technical Data:

- Ingress protection (EN 60529): IP66
- Lower housing section: fibre-glass reinforced polycarbonate, grey
- Upper housing section: polycarbonate, transparent
- Cover screws: PA, 4 pieces, 2 of which are sealing
- Seal: PU seal
- Top-hat rail (EN 50022): galvanized
- Cable entries: 5 pieces M 20x1,5
- Part number: 52010132

Cable

Cable for connecting the Nivotester FTC625 to a PC (RS232/3.5 mm jack plug)

- Part number: 52013982
(included in delivery)

Supplementary Documentation

System Information (SI)

- Capacitance level measurement
SI001F/00

Technical Information (TI)

Capacitance measuring devices

- Liquicap M, FTI51, FTI52
TI417F/00
- Solicap M, FTI55, FTI56
TI418F/00
- Solicap M, FTC51, FTC52, FTC53
TI362F/00
- Multicap T (America), DC12TA, DC11/16/21/26TAN, DC11/16/21/26TAS
TI239F/00
- Multicap T (Europe), DC12TE, DC11/16/21/26TEN, DC11/16/21/26TES
TI240F/00
- Multicap Classic DC11
TI169F/00
- Multicap Classic DC16
TI096F/00
- Multicap Classic DC21
TI208F/00
- High-temperature probe (HT), 11500ZM
TI161F/00
- High-temperature probe (HT), T12656
TI117F/00
- High-temperature probe (HT), T12892
TI118F/00
- Double rod probe 11304Z
TI052F/00

-
- Nivector FTC968, FTC968Z
TI037F/00

Electronic inserts

- EC16Z
TI170F/00
- EC17Z
TI268F/00
- EC27Z
TI269F/00

Protective housing

- Protective housing
TI367F/00

Fieldgate

- FXA320, FXA520
TI369F/00

Operating Instructions (KA)

- Nivotester FTC625
KA194F/00

Certificates

ATEX:

- Nivotester FTC625
XA195F/00

WHG (DIBt):

- Nivotester FTC625
ZE211F/00

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Endress+Hauser 