Technical Information
Nivotester FTL325P

Vibronic

Level detector with intrinsically safe signal circuit for connection to Liquiphant and Soliphant sensors

Application

- Point level detection 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 prevention in tanks with flammable or non-flammable water-polluting liquids
- Two-point control and point level detection in one switching unit
- Application in safety systems with functional safety requirements up to SIL 3 in accordance in IEC 61508 when using the Liquiphant M/S with electronic insert FEL57

Your benefits

- Intrinsically safe signal circuits [Ex ia] for use of sensors in hazardous areas
- Compact housing for simple side-by-side installation on standard DIN rails in cabinet
- Easy connection with plug-in terminal blocks
- Simple proof testing according to WHG with a Liquiphant M/S connected: one-touch operation
- High proof test coverage: from the Nivotester to the sensor and downstream plant units

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Table of contents

Document information

Document conventions

Symbols for certain types of information

Symbol	Meaning
	**Tip** Indicates additional information.
	**Reference to page** Refers to the corresponding page number.

Symbols for graphics

Symbol	Meaning
1, 2, 3 ...	Item numbers
A, B, C, ...	Views

Function and system design

Measuring principle

Signal transmission

The intrinsically safe signal inputs of the Nivotester are galvanically isolated from the mains and the output.

The Nivotester supplies direct current to the sensors, e.g. Liquiphant M/S, via a two-wire loop and receives a frequency signaling whether or not the point level has been reached. Current pulses (PFM signals = pulse-frequency modulation) from the transmitter with a pulse width of approx. 200 µs and a current strength of approx. 10 mA are superimposed on the power supply.

Signal evaluation

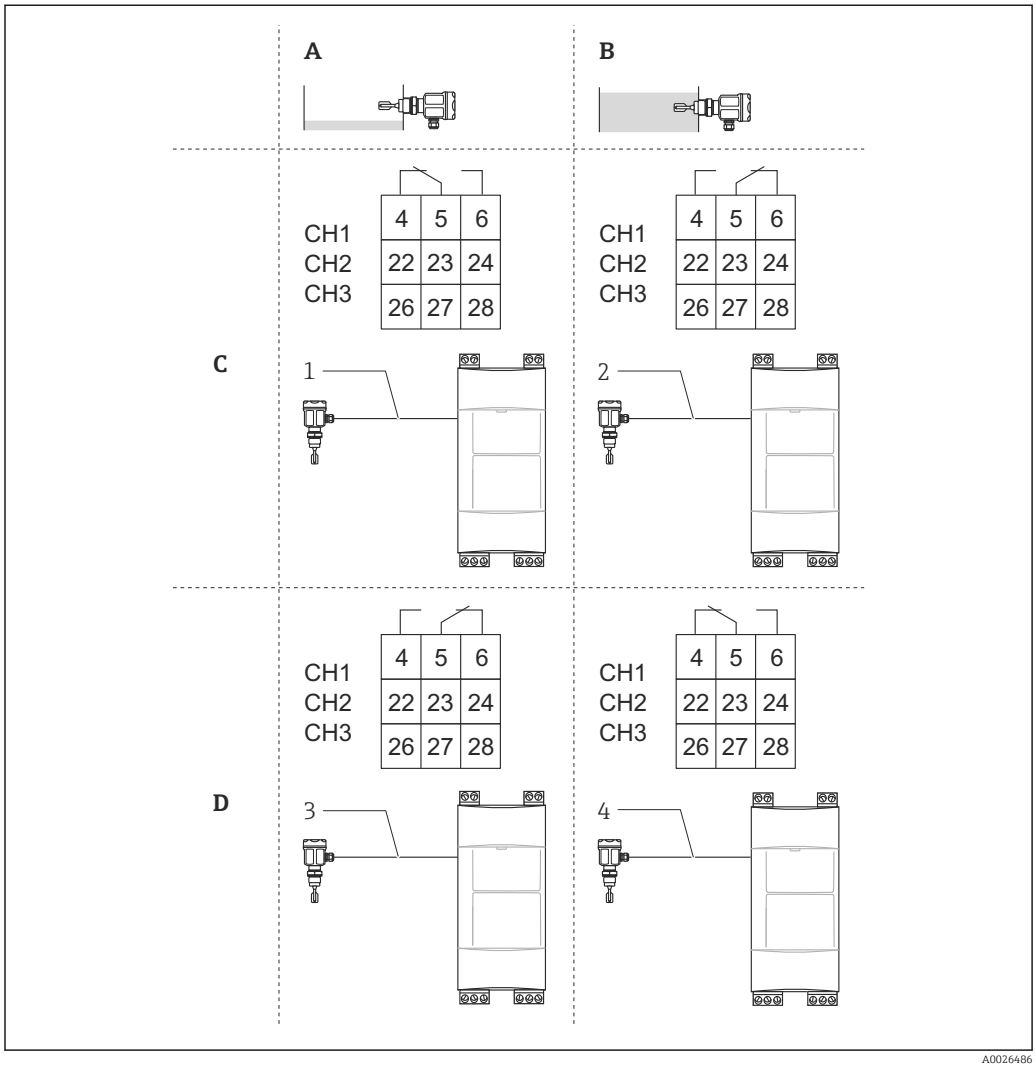
The Nivotester evaluates the frequency and switches the output relay for the level alarm. A yellow LED on the front panel of the Nivotester indicates the relay switching state.

Fail-safe mode

By selecting the correct fail-safe mode, you ensure that the relays always operate with quiescent current safety.

- MAX = maximum safety: the relay drops out when the switch point is exceeded (sensor is covered), a fault occurs or the power supply fails.
- MIN = minimum safety: the relay drops out when the switch point is undershot (sensor is not covered), a fault occurs or the power supply fails.

Point level detection and pulse-frequency modulation (PFM) as a function of the level and fail-safe mode



A Tuning fork not covered
B Tuning fork covered
C MAX fail-safe mode at Nivotester
D MIN fail-safe mode at Nivotester
1 PFM approx. 150 Hz
2 PFM approx. 50 Hz
3 PFM approx. 150 Hz
4 PFM approx. 50 Hz

For applications with functional safety requirements in accordance with IEC 61508 (SIL), please refer to the Functional Safety Manual → 17, "Documentation" section.

Function monitoring

To increase operational safety, the Nivotester is equipped with a function monitoring system. As there is a proof test button for every channel, function monitoring can be performed separately. The power supply to the sensor is interrupted during this process.

The red LED on the front panel indicates that a fault has occurred that causes the relays for the level alarm and fault signaling system to drop out.

A fault is signaled when the Nivotester stops receiving current pulses. This can happen, for example, in the event of:

- A short-circuit, or if the signal line to the sensor is disconnected
- Sensor corrosion
- Defective electronics in the sensor
- A defective Nivotester input circuit.

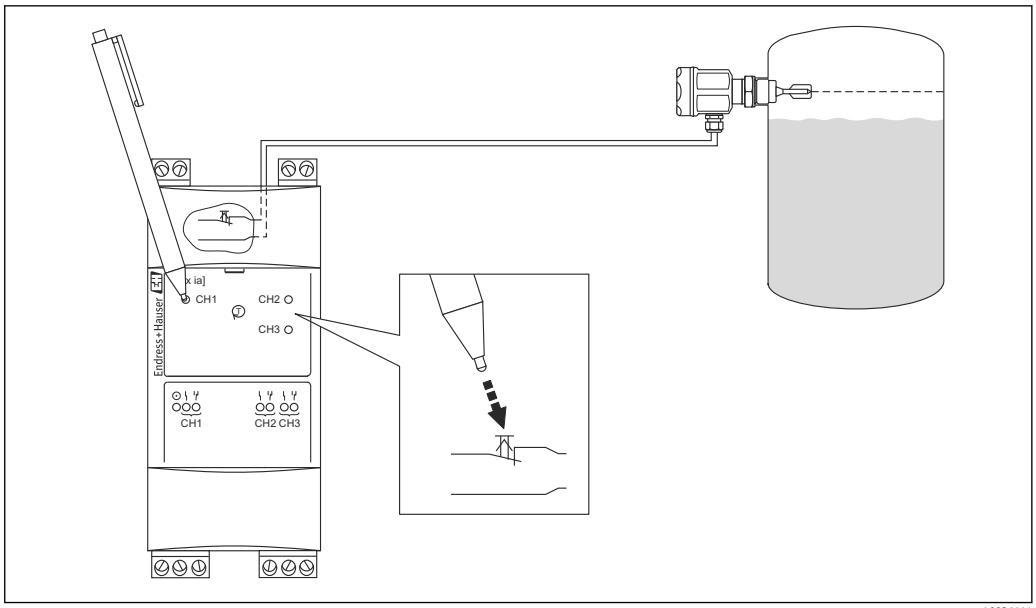
Easy proof testing with Liquiphant M and Liquiphant S

Overfill prevention systems must undergo regular function checks.

For the Nivotester and the downstream plant units, there is the possibility of performing the function test without having to start up or remove the sensor.

One proof test button for each individual signal input is located on the front panel of the Nivotester. Pressing the button interrupts the power supply. When the button is released, the power supply is returned to the Liquiphant and the FEL57 electronic insert and the test sequence commences.

For detailed information on proof testing, see KA00147F → 17, "Documentation" section.



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Two-point control (Δs)

Two-point control in a tank is possible with the 3-channel Nivotester (e.g. for pump control). The installation location of the sensors defines the switching hysteresis.

Measuring system

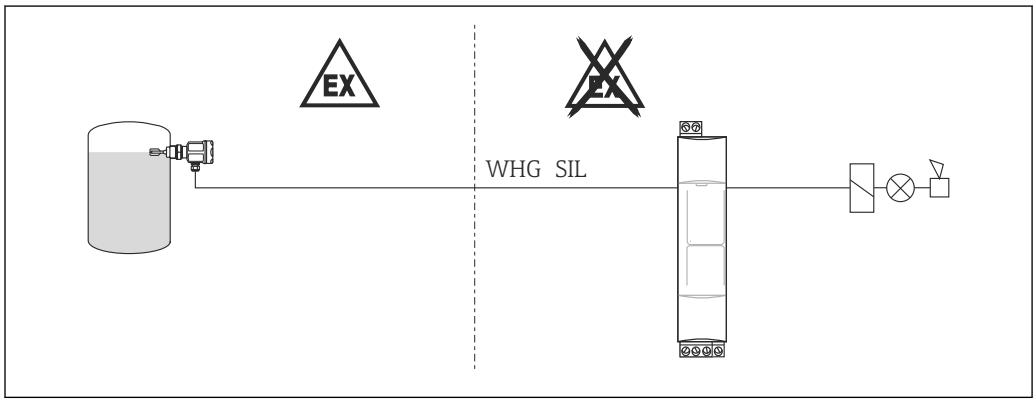
The measuring system can consist of the following components:

- 1 to 3 sensors, e.g. Liquiphant M/S
- 1-channel or 3-channel Nivotester
- Control or signal devices

If the device is used in safety-related systems in accordance with SIL 1, SIL 2 and SIL 3, comply with the requirements set down in the specific documentation. See the → 17 "Documentation" section.

1-channel Nivotester

- 1 sensor
- 1-channel Nivotester
- Control or signal devices



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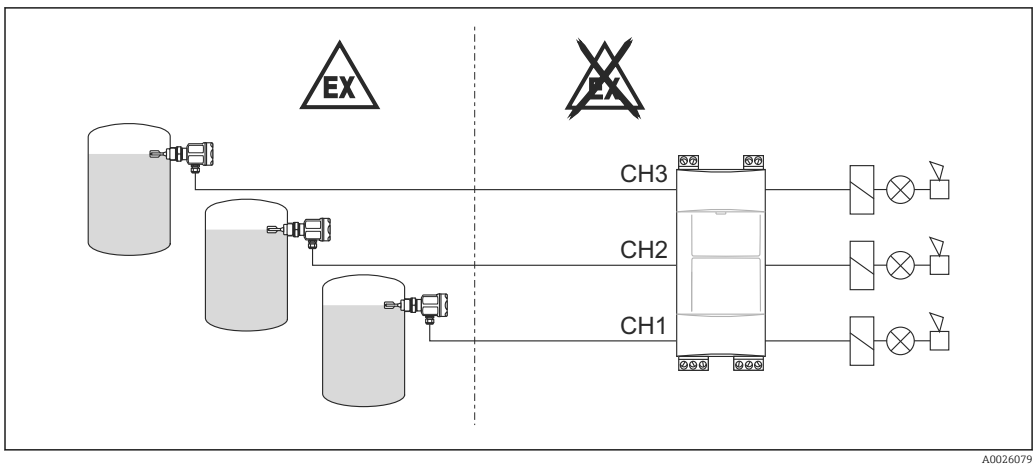
3-channel Nivotester

1. The 3 individual channels are used for point level measurement

- 3 sensors
- 3-channel Nivotester
- Control or signal devices



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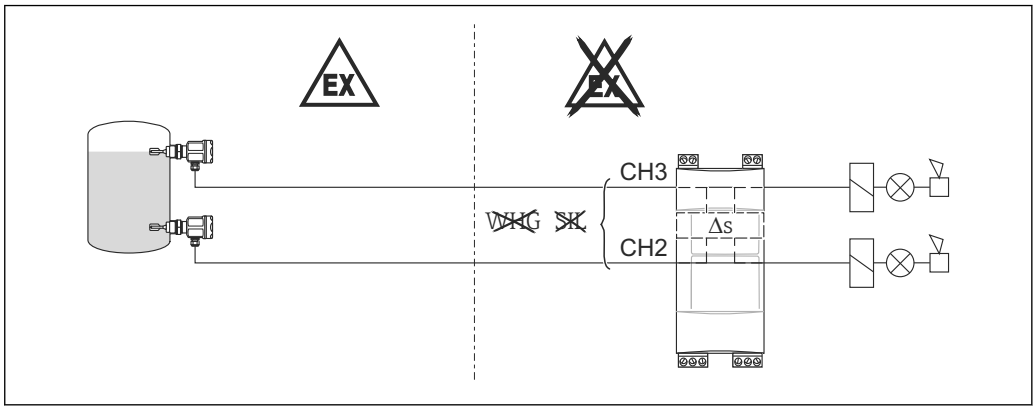
2. Channels CH2 and CH3 are used for two-point control Δs

- 2 sensors
- 3-channel Nivotester
- Control or signal devices

If channel CH1 is not used, the alarm must be switched "off".



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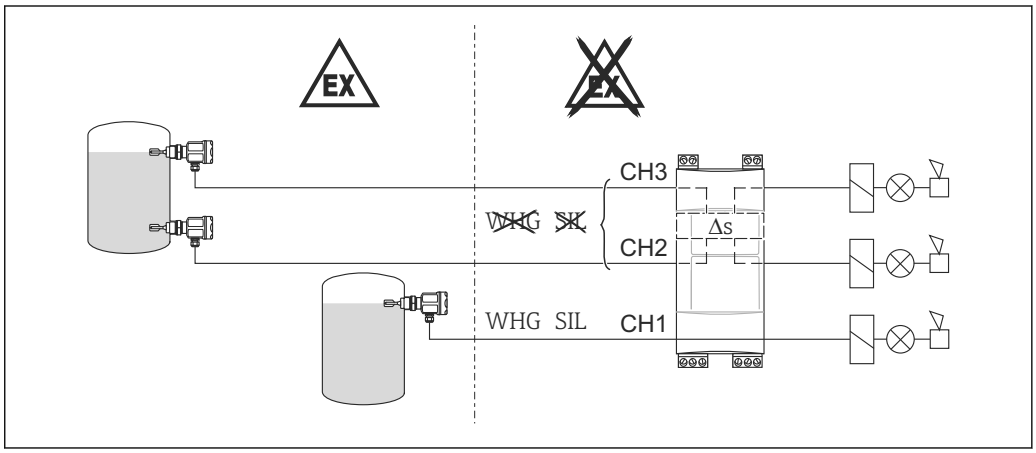
3. Channels CH2 and CH3 are used for two-point control Δs and channel CH1 is used for overfill prevention

- 3 sensors
- 3-channel Nivotester
- Control or signal devices



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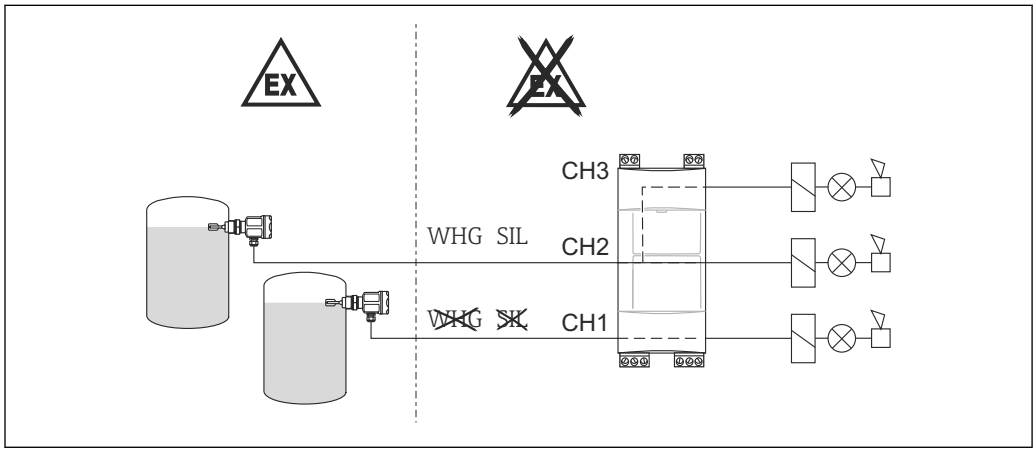
4. Channel CH2 is used for point level measurement with two level relays and channel CH1 is used for additional point level measurement

- 2 sensors
- 3-channel Nivotester
- Control or signal devices



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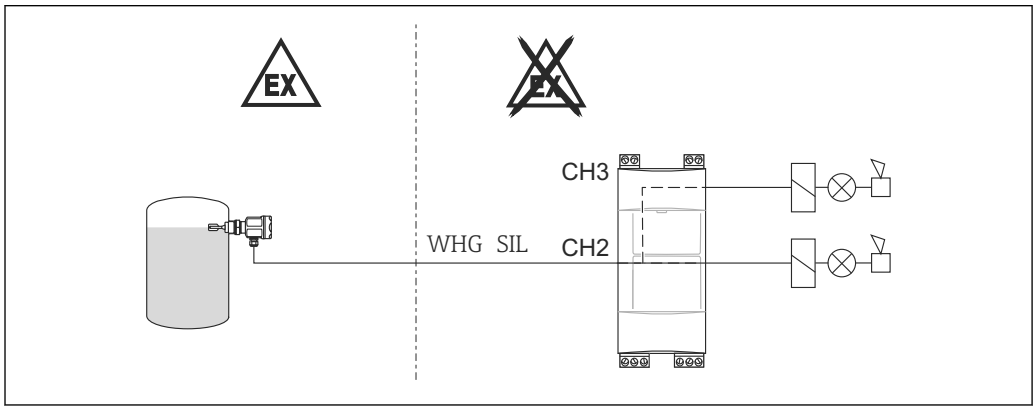
5. Channel CH2 is used for point level measurement with two level relays

- 1 sensor
- 3-channel Nivotester
- Control or signal devices

If channel CH1 is not used, the alarm must be switched "off".



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Input

Measured variable

The point level signal is triggered at MIN level or MAX level, depending on the setting.

Measuring range

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

Input signal

- Galvanically isolated from power supply and output
- Type of protection: intrinsic safety [Ex ia] IIC
- Suitable sensors for connection:
  - Liquiphant M FTL50(H), FTL51(H), FTL51C with FEL57
  - Liquiphant S FTL70/71 with FEL57
  - Soliphant M FTM50, FTM51, FTM52 with FEM57
- Sensors powered by Nivotester
- Connection cable: twin-core, shield not required
- Cable length/cable resistance: 1000 m (3281 ft)/max. 25 Ω per core
- Signal transmission: pulse-frequency modulation (PFM)

Additional information on the use of the sensors in the hazardous area is provided in the appropriate certificates. See the → 17 "Documentation" section.

Output

Output signal

- Relay output per channel: a potential-free changeover contact for the level alarm
- Quiescent current fail-safe mode: MIN/MAX safety can be selected with DIL switch
- 1 fault-signaling relay for channels 1, 2 and 3 (1 potential-free changeover contact, but it is only possible to connect to two contacts)
- Switching delay: approx. 0.5 s
- Operating life: at least 10^5 switching operations with maximum contact load
- Function indicator: LEDs for operation, level alarm and fault
- Relay contact switching capacity:
  Alternating voltage (AC)
  U ~ maximum 250 V
  I ~ maximum 2 A
  P ~ maximum 500 VA with cos φ ≥ 0.7
  Direct current (DC)
  U = maximum 40 V
  I = maximum 2 A
  P = maximum 80 W

Overvoltage category according to EN 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 simultaneously functional low voltage is connected to the power supply circuit or to the relay contacts, safe galvanic isolation is guaranteed up to a voltage of 150 V_{AC}.

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.

The maximum permissible values for capacitance and inductance are provided in the Safety Instructions → 🖹 17, see the "Documentation" section.

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.

Blue terminal blocks at top for hazardous area

Twin-core connection cable between the Nivotester and sensor, e.g. commercially available instrument cable or cores 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

Gray terminal blocks at bottom for the non-hazardous area

The relay function depends on the level and fail-safe mode. If a device is connected at high inductance (e.g. contactor, solenoid valve etc.), a spark arrester must be installed 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 has reverse polarity protection.

Supply voltage

Alternating current version (AC)

Voltage range: 85 to 253 V_{AC}, 50/60 Hz

Direct current range (DC)

- Voltage range: 20 to 30 V_{AC}/ 20 to 60 V_{DC}
- D/C power supply:
  - 1-channel: maximum 85 mA
  - 3-channel: maximum 200 mA
- Permissible residual ripple within tolerance: U_{ss} = maximum 2 V

Power consumption

AC
- 1-channel: maximum 2.0 W
- 3-channel: maximum 4.2 W

DC
- 1-channel: 1.7 W (with U_{min} 20 V)
- 3-channel: 4.0 W (with U_{min} 20 V)

Performance characteristics

Switch-on behavior

Correct switch state after power-up: 10 to 40 s, depends on the connected sensor.

Installation

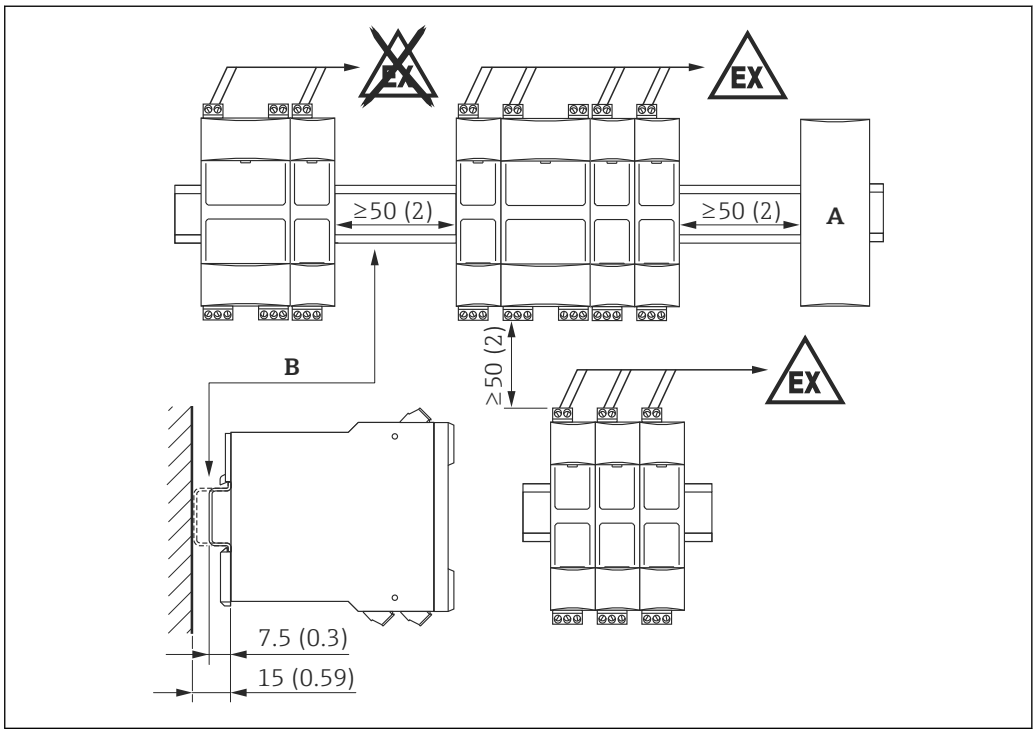
Mounting location

- The Nivotester must be housed in a cabinet outside the hazardous area.
- The devices must be mounted in such a way that they are protected from impact and weather conditions. Where possible, mount the device in a location where it is not exposed to direct sunlight, particularly in warm climates.
- A protective housing (IP65) for up to four 1-channel or two 3-channel Nivotesters is available for outdoor installation, see → 16 "Accessories" section.

Orientation

Horizontal orientation

Horizontal installation ensures better dissipation of heat and is therefore the preferred orientation.



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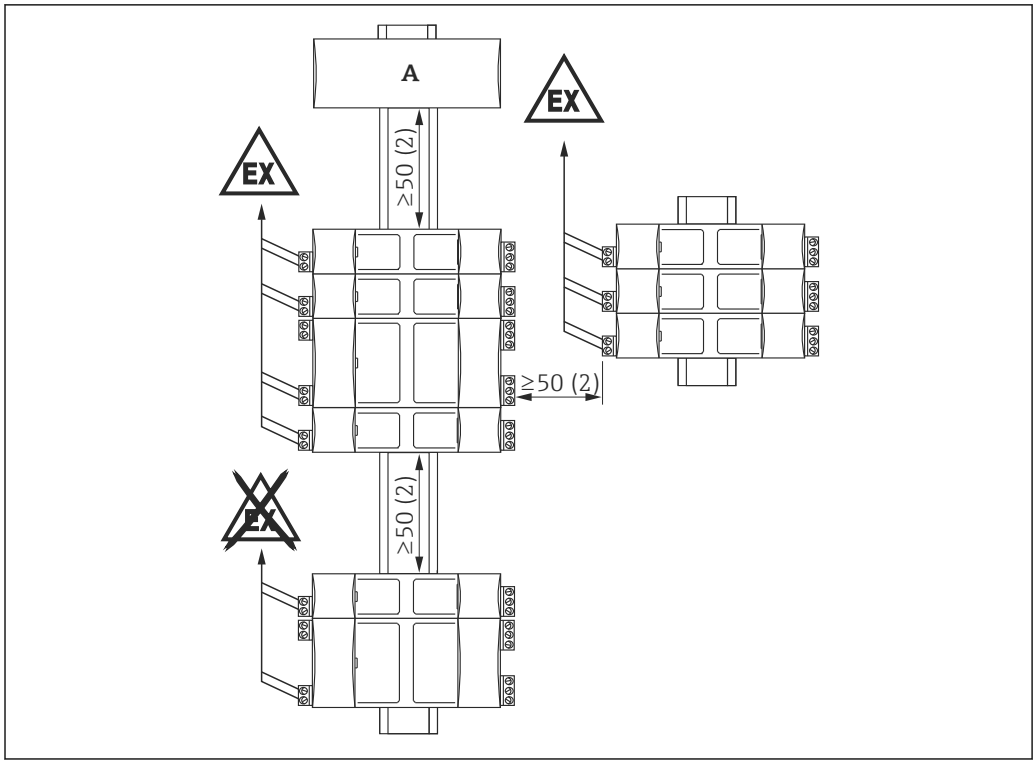
Dimensions mm (in)

A Connection of another device type

B DIN rail in accordance with EN 60715 TH35-7.5/15

Vertical orientation



Dimensions mm (in)
A Connection of another device type

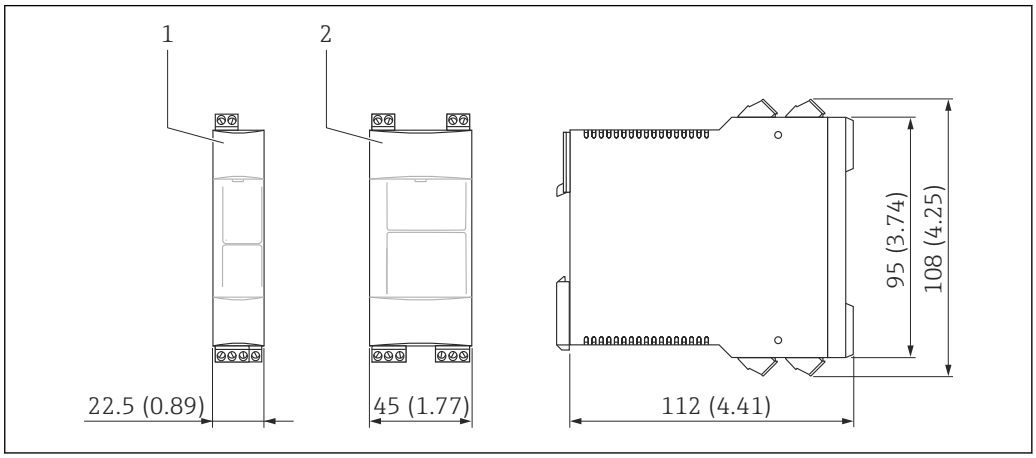
Environment

Ambient temperature range	▪ For single installation: –20 to +60 °C (–4 to 140 °F) ▪ For side-by-side installation without lateral spacing: –20 to +50 °C (–4 to +122 °F) ▪ For installation in protective housing: –20 to +40 °C (–4 to +104 °F) Up to four 1-channel or two 3-channel Nivotesters or a maximum of two 1-channel Nivotesters plus one 3-channel Nivotester fit in a protective housing. ▪ Storage temperature: –20 to +85 °C (–4 to 185), preferably at 20 °C (68 °F)
Climate and mechanical application class	3K3 and 3M2 in accordance with IEC/EN 60721-3-3
Degree of protection	▪ IP20 (as per IEC/EN 60529) ▪ IK06 (as per IEC/EN 62262)
Electromagnetic compatibility (EMC)	▪ Interference emission according to EN 61326, Class A equipment ▪ Interference immunity according to EN 61326; Annex A (Industrial) and NAMUR Recommendation NE21 (EMC)

Mechanical construction

Design, dimensions

Dimensions



Dimensions mm (in)
1 1-channel Nivotester
2 3-channel Nivotester

Weight

- 1-channel: approx. 148 g (5.22 oz)
- 3-channel: approx. 250 g (8.81 oz)

Materials

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

Terminals

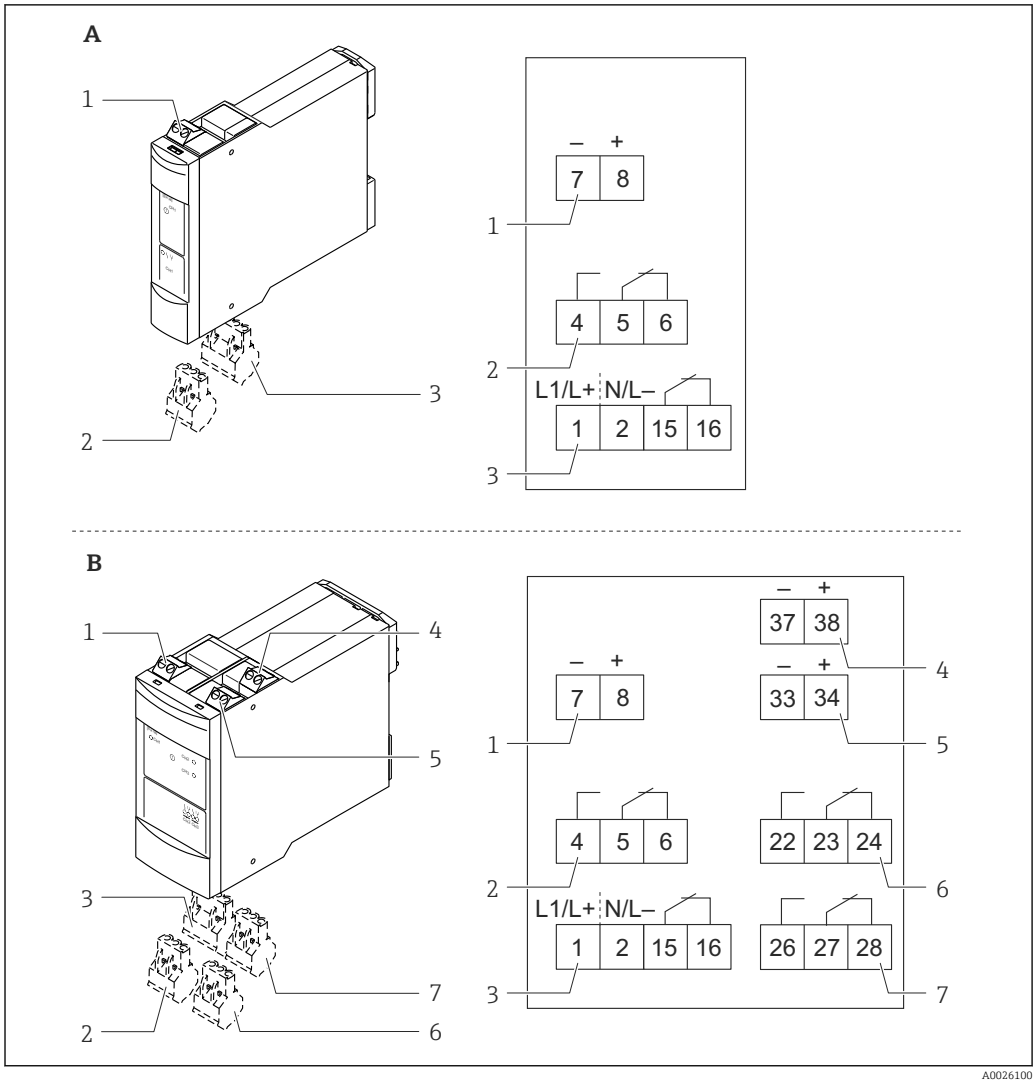
1-channel
- 2 screw terminals: sensor power supply
- 3 screw terminals: level relay
- 2 screw terminals: fault-signaling relay
- 2 screw terminals: power supply

3-channel
- 3x2 screw terminals: sensor power supply, channel 1 to 3
- 3x3 screw terminals: level relay, channel 1 to 3
- 2 screw terminals: fault-signaling relay
- 2 screw terminals: power supply

Connection cross-section

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

Terminal assignment



A 1-channel Nivotester
B 3-channel Nivotester
1 Sensor 1 (Ex ia)
2 Level relay 1
3 Power supply / fault-signaling relay
4 Sensor 3 (Ex ia)
5 Sensor 2 (Ex ia)
6 Level relay 2
7 Level relay 3

Operability

Operating concept

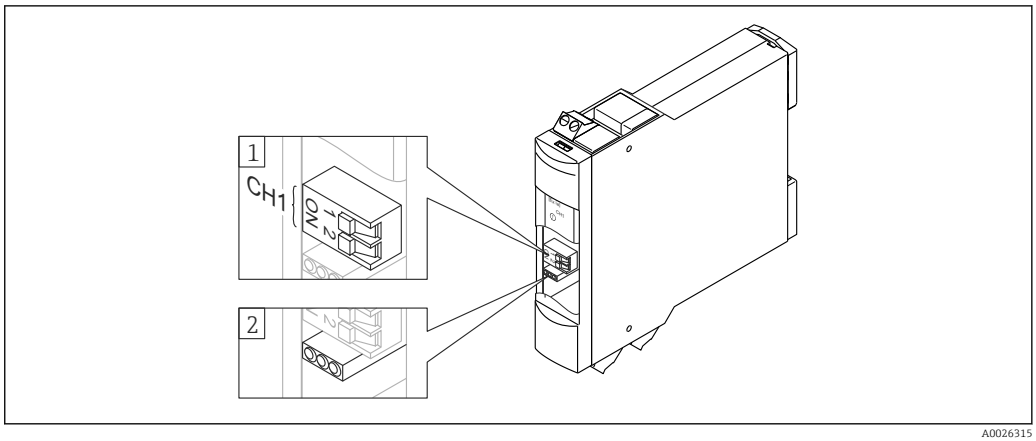
Onsite configuration with DIL switches behind fold-down front panel

Display elements

Light emitting diodes (LEDs)
- Green light emitting diode: operational
- One red LED per channel: fault signal
- One yellow LED per channel: level relay picked up

Operating elements

1-channel Nivotester



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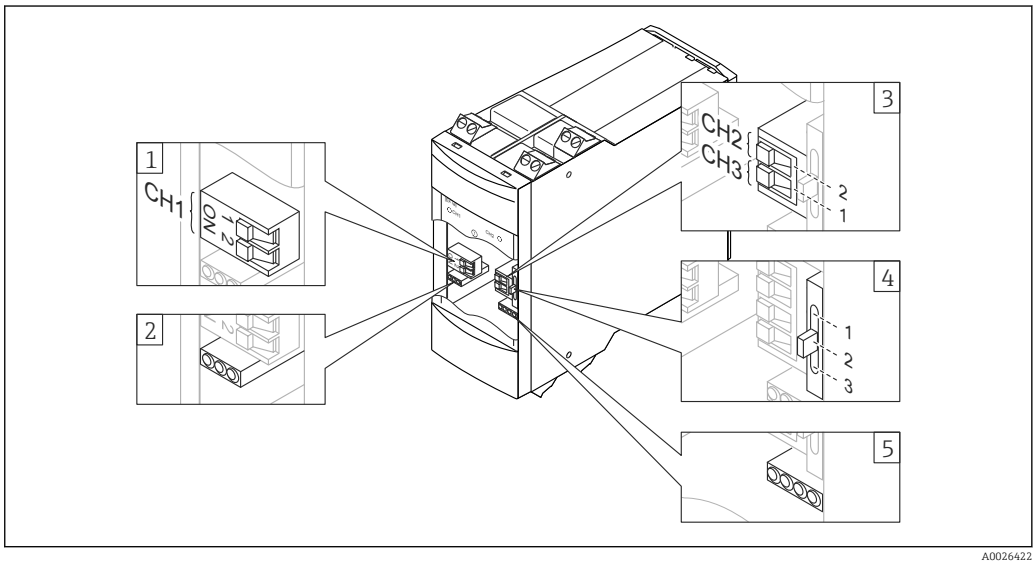
1 DIL switch: MAX/MIN position (1), error on/off position (2)
2 Light emitting diodes (LEDs)

3-channel Nivotester



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1 DIL switch: MAX/MIN position (1), error on/off position (2)
2 Light emitting diodes (LEDs)
3 DIL switch: MAX/MIN position
4 Switch for functions: Δs, e.g. pump control (1), two level relays (2), individual channels (3)
5 Light emitting diodes (LEDs)

Certificates and approvals

CE mark

The measuring device is in conformity with the statutory requirements of the applicable EC Directives. These are listed in the corresponding EC Declaration of Conformity along with the standards applied.

Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

RCM-Tick mark

The measuring device complies with the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

Ex approval

The Endress+Hauser sales center can provide information on the hazardous area versions currently available. All explosion protection data are provided in separate documents which are available upon request → 🖹 17, see the "Documentation" section.

Type of protection

II(1)G [Ex ia Ga] IIC

II(1)D [Ex ia Da] IIIC

Overfill prevention

- WHG
- Leak approval

Other standards and guidelines

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

- IEC/EN 60721-3-3: Classification of environmental conditions
- IEC/EN 60529: Degrees of protection provided by enclosures (IP code)
- IEC/EN 61010: Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC/EN 61326: Interference emission (class A equipment), interference immunity (Appendix A - Industrial)
- IEC 61508: Functional safety of safety-related electric/electronic/programmable electronic systems (E/E/PES)

Functional safety

SIL 1, SIL 2, SIL 3 for protective functions as overfill prevention and SIL 1, SIL 2 as minimum monitoring in conjunction with FEL57. See the Functional Safety Manual → 🖹 17, "Documentation" section!

Ordering information

Detailed ordering information is available from the following sources:

- In the Product Configurator on the Endress+Hauser website: www.endress.com → Select your country → Products → Select measuring technology, software or components → Select the product (picklists: measurement method, product family etc.) → Device support (right-hand column): Configure the selected product → The Product Configurator for the selected product opens.
- From your Endress+Hauser Sales Center: www.addresses.endress.com

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 with IP66 ingress protection is equipped with an integrated DIN rail and is closed by a transparent cover which can also be 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 also available in the Download Area of the Endress+Hauser web site: www.endress.com → Download

Operating Instructions

Document code	Contents
▪ KA00167F/00/A6 ▪ KA00168F/00/A6 ▪ KA00147F/00/A6	▪ Nivotester FTL325P with PFM input, 1-channel ▪ Nivotester FTL325P with PFM input, 3-channel ▪ Liquiphant M FTL50(H), FTL51(H) FTL51C; Liquiphant S FTL70/71 With electronic insert FEL57 → self-test (proof test)

Technical Information

Document code	Contents
TI00328F/00/EN	Liquiphant M FTL50(H), FTL51(H), sensor for point level detection in liquids
TI00347F/00/EN	Liquiphant M FTL51C, sensor for point level detection in liquids with highly corrosion-resistant coating
TI00354F/00/EN	Liquiphant S FTL70/71, sensor for point level detection in liquids for medium temperatures up to 280 °C
TI00392F/00/EN	Soliphant M FTM50/51/52, universal point level switch for fine-grained bulk solids, also for dust incendive hazard areas
TI00367F/00/EN	Protective housing → system components for DIN rail housing

Functional safety (SIL)

Document code	Contents
SD00111F/00/EN	Nivotester FTL325P+Liquiphant M/S+FEL57; MAX detection, HW-V01.00
SD00231F/00/EN	Nivotester FTL325P+Liquiphant M/S+FEL57; MIN detection, HW-V01.00
SD01508F/00/EN	Nivotester FTL325P+Liquiphant M/S+FEL57; MAX/MIN detection, HW-V02.00
SD00207F/00/EN	Nivotester FTL325P+Soliphant M+FEM57; MAX detection, HW-V01.00+HW-V02.00

WHG

Document code	Contents
ZE00233F/00/EN	Liquiphant M FTL50(H), FTL51(H) FTL51C / Liquiphant S FTL70/71; General approval by the building authorities Z-65.11-230 (DIBt), overfill prevention
ZE00271F/00/EN	Liquiphant M FTL50(H), FTL51(H) FTL51C / Liquiphant S FTL70/71; Z-65.40-446 leak

Certificate

Depending on the approval, Safety Instructions are also supplied with the device. They are an integral part of the Operating Instructions. The options in question can be selected in the product structure, "approval" order code.

Document code	Approval	Option
XA00133F/00/A3	ATEX: II (1) G [Ex ia Ga] IIC; II (1) D [Ex ia Da] IIIC IECEx: [Ex ia Ga] IIC; [Ex ia Da] IIIC	F
	ATEX: II (1) G [Ex ia Ga] IIC; II (1) D [Ex ia Da] IIIC IECEx: [Ex ia Ga] IIC; [Ex ia Da] IIIC, SIL	H
XA00526F/00/A3	ATEX: II 3 (1) G Ex nA nC [Ex ia Ga] IIC T4 Gc IECEx: Ex nA nC [Ex ia Ga] IIC T4 Gc, SIL	G
XA00396F/00/B2	NEPSI: [Ex ia Ga] IIC; [Ex ib Gb] IIC	M
	NEPSI: [Ex ia Ga] IIC; [Ex ib Gb] IIC, SIL	N

Document code	Approval	Option
XA01340F/00/EN	INMETRO: [Ex ia Ga] IIC	1
	INMETRO: [Ex ia Ga] IIC, SIL	2
ZD00071F/00/EN	FM: Class I, II, III Division 1 or 2 Groups A- G Class I, Zone 0 AEx ia IIC	O
	FM: Class I, II, III Division 1 or 2 Groups A- G Class I, Zone 0 AEx ia IIC, SIL	P
ZD00072F/00/EN	CSA: Class I, II, III Division 1 or 2 Groups A- G Class I, Zone 0 Ex ia IIC Class I Division 2 Groups A - D	S
	CSA: Class I, II, III Division 1 or 2 Groups A - G Class I, Zone 0 Ex ia IIC, SIL Class I Division 2 Groups A - D	T

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