

## Level Limit Switch *nivotester FTL 325 N*

**Single channel and three channel isolating amplifier with NAMUR input for connecting any NAMUR measuring sensor**



### Application

- Level limit detection in liquid tanks and hazardous areas
- For FM / CSA Division 1 (Zone 0 or Zone 20) measuring sensors
- Liquid detection in pipes for dry running protection for pumps
- Over-spill protection for tanks with combustible or noncombustible which are dangerous to the environment
- Two-point control and level limit detection with one switching unit

### Features and benefits

- Intrinsically safe signal circuits (FM IS) for problem-free use of measuring sensors in explosion hazardous areas
- High functional safety through
  - line monitoring through to sensor
  - corrosion monitoring on tuning fork of the Liquiphant M and Liquiphant S (high temperature) measuring sensors
- Compact housing for simple series installation on standard rails in control room cabinets
- Simple wiring using plug-in terminal blocks
- NAMUR interface to EN 50227 (DIN 19234; NAMUR) or IEC 60947-5-6 or IEC 60947-5-6 to connect NAMUR sensors or electronic inserts

**Endress + Hauser**

The Power of Know How



## Function and system design

### Measuring principle

#### Signal transmission

The intrinsically safe signal input of the Nivotester FTL 325 N limit switch is galvanically isolated from the power supply and signal output.

The Nivotester supplies a DC voltage to the Liquiphant M and Liquiphant S measuring sensors with electronic inserts FEL 56 and 58, or a sensor specified to EN 50227 (DIN 19234; NAMUR) or IEC 60947-5-6 via a two-wire loop. At the same time, a control current is transferred along the same supply line.

The control current ranges from  $< 1.2 \text{ mA}$  to  $> 2.1 \text{ mA}$  depending on the switching status.

#### Signal evaluation

The Nivotester measures and evaluates the control current which is transferred along the power supply line of the sensors. The level alarm relay signals if the measuring sensor is covered or free. An LED on the front panel of the Nivotester indicates the switching status of the relay. Faults, such as a line interruption or short circuit, are also displayed.

#### Fail-safe circuit

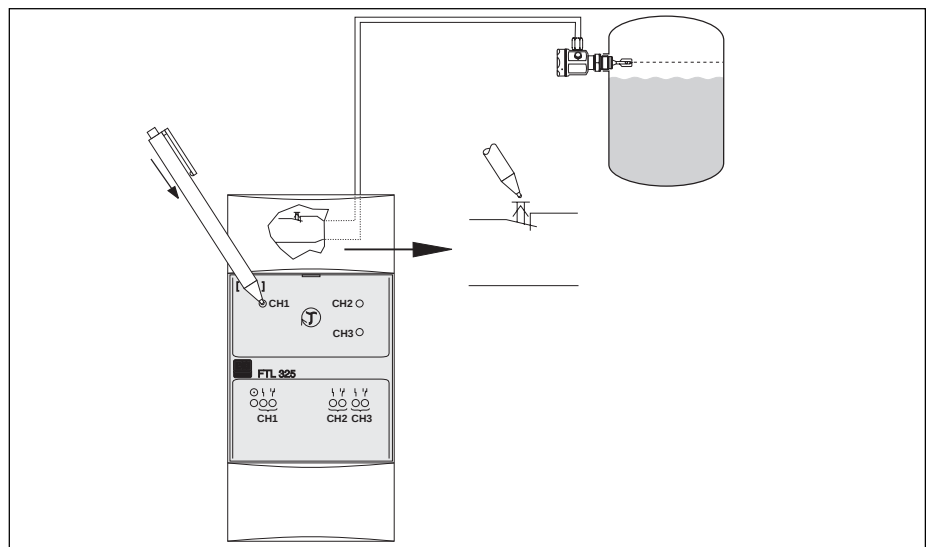
By correctly selecting the fail-safe circuit, you can ensure that the relay always operates in a de-energized state. The error current signal of the connected sensor ( $< 1.2 \text{ mA}$  or  $> 2.1 \text{ mA}$ ) for each channel can be set with the DIL switches on the Nivotester. This means that the isolating amplifier can be used for any application at the required operational safety level.

Combined with a level limit switch, the de-energized state is defined as follows:

- Maximum fail-safe: the relay de-energizes when the switching point is exceeded (measuring sensor covered), or a fault occurs, or the power supply fails
- Minimum fail-safe: the relay de-energizes when the material drops below the switching point (measuring sensor uncovered), or a fault occurs, or the power supply fails

#### Function monitoring

To increase operational safety, the Nivotester is equipped with a function monitoring system. A fault is indicated by an LED and causes the level alarm relay to de-energize in the affected channel. A fault is signalled when the Nivotester receives no more control signals. This occurs, for example, in the event of a short-circuit, an interruption in the signal line to the measuring sensor, vibration forks become corroded, or a defect in the Nivotester input circuit. The function of each channel can be monitored by pressing the test button (on the front cover of the Nivotester), which when pressed, interrupts the power supply to the sensor.



Two-point control (Δs)

Two-point control is possible in one tank using the multichannel Nivotester (e.g. for pump control). The switching hysteresis is specified by the installation location of the two measuring sensors.

NAMUR Module

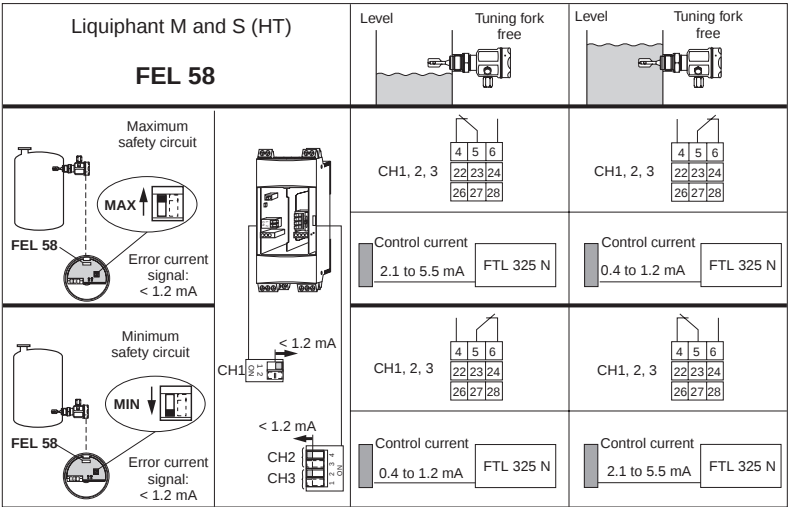
The FTL 325 N is equipped with a NAMUR interface to EN 50227 (DIN 19234; NAMUR) or IEC 60947-5-6. This means that the control signals generated by any measuring sensor (according to NAMUR recommendations) can be evaluated by the Nivotester.

**NOTE:** NAMUR = Normen AusschcuS fur MeS und Regel-technik; Standardisation Association for Measurement and Control in chemical and pharmaceutical industries.

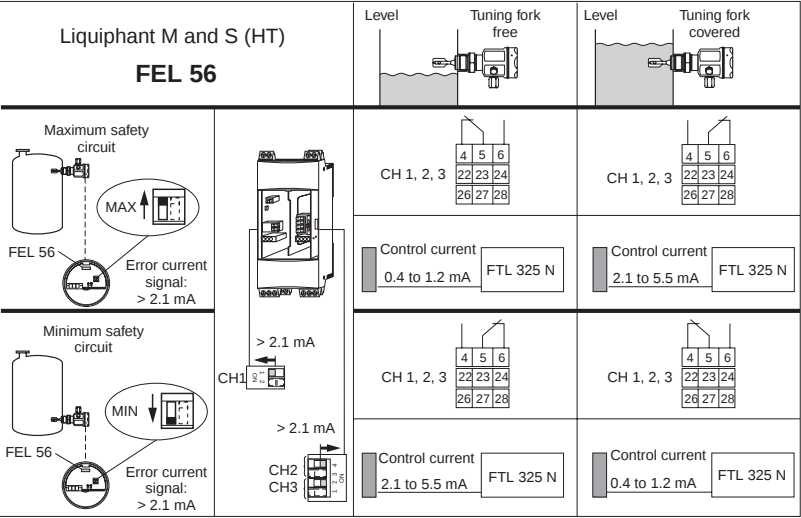
The following Endress+Hauser level limit switches are specified to EN 50227 (DIN 19234; NAMUR) or IEC 60947-5-6 and can be connected to the Nivotester:

- Liquiphant M with FEL 56 or FEL 58 electronic insert
- Liquiphant S (high-temperature) with FEL 56 or FEL 58 electronic insert

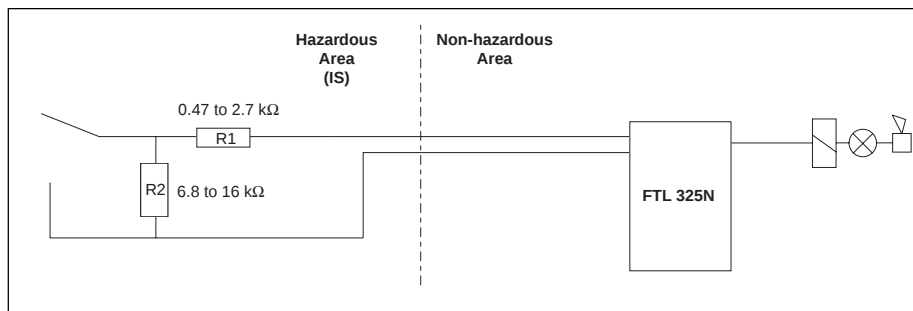
All sensors specified to EN 50227 and contact switches with the appropriate resistance circuit can be connected to the Nivotester. When contact switches are used without resistance circuit, alarm detection for short-circuit and signal line interruption can be switched off for the appropriate channel.



Function of the level limit switch and the current pulse, dependent on level and fail-safe circuit.



Function of the level limit switch and the current pulse, dependent on level and fail-safe circuit.



Contact switch with appropriate resistance circuit.

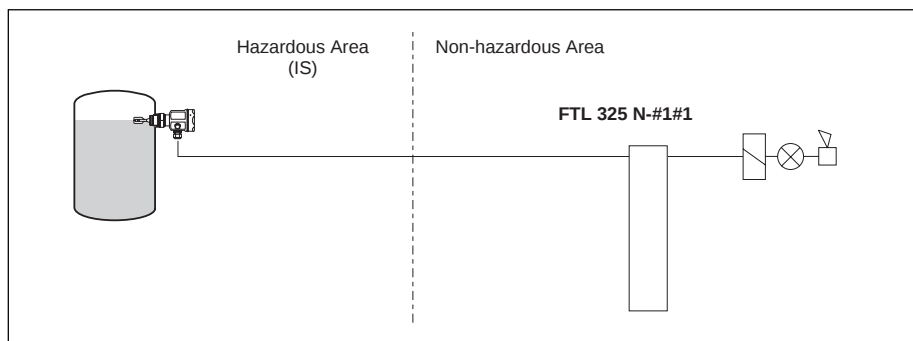
## Measuring system

A measuring device consists of one to three measuring sensors, a 1, 2 or 3 channel Nivotester and control or signal devices. A Liquiphant M or S with FEL 56 / 58 electronic inserts can be used as a measuring sensor. Alternatively, any number of sensors specified to NAMUR or contact switches with appropriate resistance circuit can be used.

### Single channel Nivotester FTL 325 N-#1#1

The measuring device of the single channel instrument consists of:

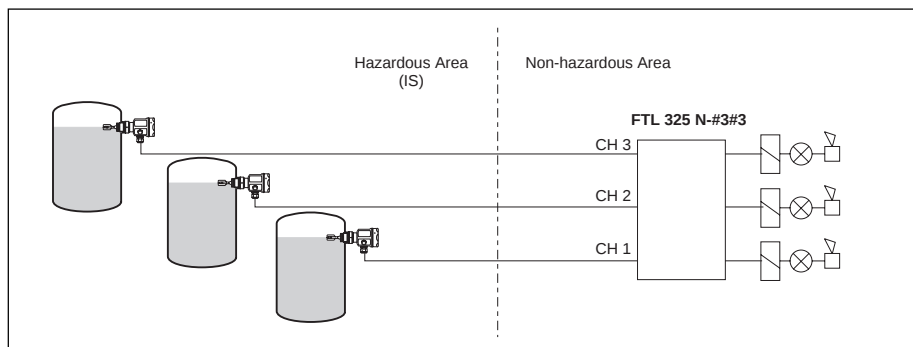
- One measuring sensor
- Single channel Nivotester
- Control or signal devices



### Three channel Nivotester FTL 325 N-#3#3

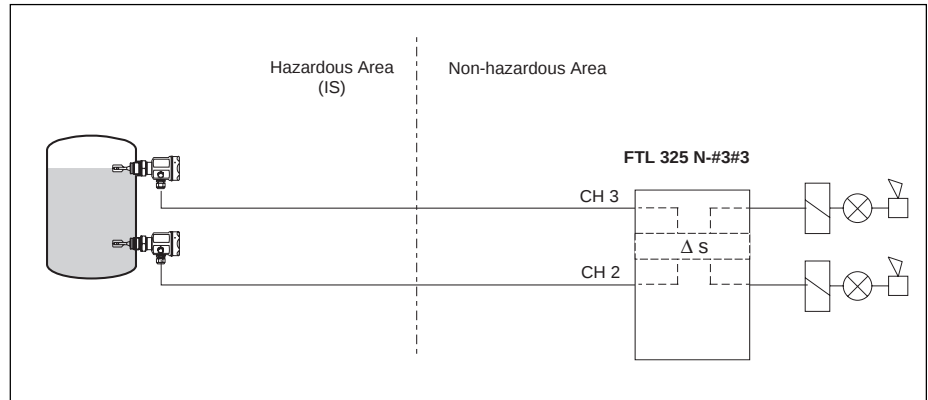
There are five possible variants of measuring devices with the three channel unit.

1. When all three single channels are used for measuring the level limit, the measuring device consists of:
  - Three measuring sensors
  - Three channel Nivotester
  - Control or signal devices



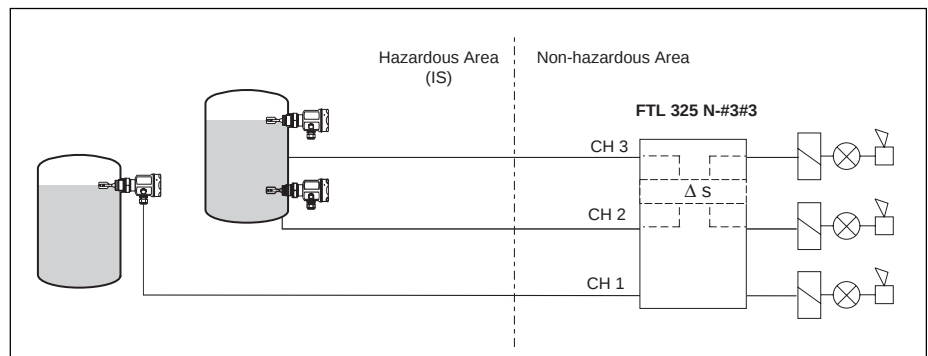
2. When channels two and three are used for two-point control  $\Delta s$ , the measuring device consists of:

- Two measuring sensors
- Three channel Nivotester
- Control or signal devices



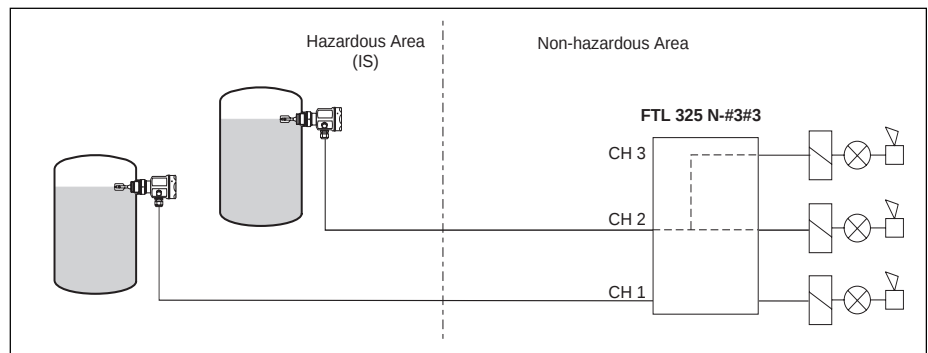
3. When channels two and three are used for two-point control  $\Delta s$ , and channel one for overspill protection, the measuring device consists of:

- Three measuring sensors
- Three channel Nivotester
- Control or signal devices



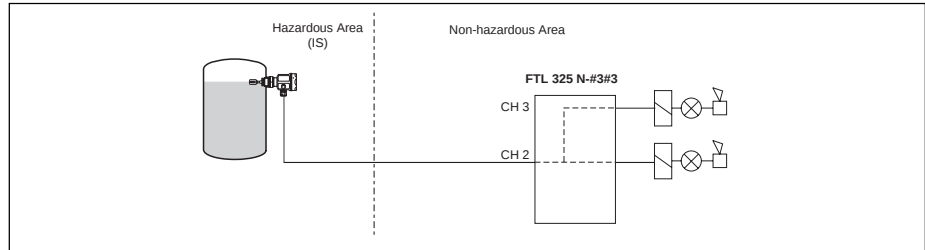
4. When channel two is used for measuring the level limit with two level limit relays and channel one is used for measuring other level limits, the measuring device consists of:

- Two measuring sensors
- Three channel Nivotester
- Control or signal devices



5. When channel two is used for measuring the level limit with two level limit relays, the measuring device consists of:

- One measuring sensor
- Three channel Nivotester
- Control or signal devices



**NOTE:** Since channel one is not used, the alarm must be switched to "OFF".

## Input parameters

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Measured variable</b> | The limit signal can be triggered at minimum or maximum height as required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Measuring range</b>   | The measuring range is dependent on the installation location of the sensors.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Input signal</b>      | <ul style="list-style-type: none"> <li>• Input for FTL 325N: galvanically isolated from power supply and output.</li> <li>• Protection type: FM Intrinsically Safe, Class I, II, III; Division 1, Groups A-G. CSA Intrinsically Safe, Class I, II, III; Division 1, Groups A-G.</li> <li>• Connectable measuring sensors: <ul style="list-style-type: none"> <li>- Liquiphant M FTL 50/51, FTL 50 H/51 H, FTL 51 C with electronic insert FEL 56 or FEL 58.</li> <li>- Liquiphant S (HT) FTL 70/71 with electronic insert FEL 56 or FEL 58.</li> <li>- Any number of sensors specified to EN 50227 (DIN 19234; NAMUR) or IEC 60947-5-6.</li> <li>- Contact switches with appropriate resistance circuit.</li> </ul> </li> <li>• Measuring sensor power supply: from FTL 325 N Nivotester.</li> <li>• Connecting line: two-wire, shielding not required.</li> <li>• Line resistance: maximum 25 <math>\Omega</math> per wire.</li> <li>• Signal transmission: current signal on power supply line.</li> <li>• Control current range: &lt; 1.2 mA / &gt; 2.1 mA.</li> <li>• Line interruption monitoring: &lt; 200 <math>\mu</math>A and short-circuit &gt; 6.1 mA (can be switched off).</li> </ul> <p>Further details for installing measuring sensors outside explosion hazardous zones can be found in the appropriate certificates.</p> |

## Output parameters

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Output signal</b> | <ul style="list-style-type: none"> <li>• Relay output per channel: one potential-free relay contact for the level alarm.</li> <li>• De-energized current safety circuit: the function of the de-energized current safety circuit is dependent on the setting made on the electronic insert FEL 56 or 58 sensors and on selection of the error current signal on the Nivotester.</li> <li>• Switch delay: approximately 0.5 seconds.</li> <li>• Switching power of the relay contacts: <ul style="list-style-type: none"> <li><i>AC version</i></li> <li>V ~ maximum 253 V</li> <li>I ~ maximum 2 A</li> <li>P ~ maximum 500 VA at <math>\cos \varphi \geq 0.7</math> (power factor)</li> <li><i>DC version</i></li> <li>V = maximum 40 V</li> <li>I = maximum 2 A</li> <li>P = maximum 80 W</li> </ul> </li> <li>• Life: at least <math>10^5</math> switching operations at maximum contact load.</li> <li>• Function displays: LEDs for operation, level alarm and fault.</li> </ul> |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                           |                                                                                             |
|---------------------------|---------------------------------------------------------------------------------------------|
| <b>Fault signal</b>       | Relay de-energized, fault is indicated by red LEDs                                          |
| <b>Galvanic isolation</b> | All input and output channels and relay contacts are galvanically isolated from each other. |

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## Power supply

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### Electrical connection

#### Terminal blocks

The removable terminal blocks are separated into intrinsically safe connections (at the top of the unit) and non-intrinsically safe connections (at the bottom of the unit). Terminal blocks are different colors to easily distinguish between the two types. Blue blocks are for the intrinsically safe section and grey for the non-intrinsically safe blocks. This ensures safety when wiring unit.

#### Connecting the measuring sensor

(the upper, blue terminal blocks)

The two-wire connecting line between the Nivotester and the Liquiphant, Nivopuls or Soliphant measuring sensor can either be a commercially available installation cable or wires in a multi-wire cable for instrumentation purposes. Line resistance may be a maximum of 25  $\Omega$  per wire. If strong electromagnetic interference is expected, e.g. from machines or radio devices, a shielded cable must be used. Only connect the shield to the ground connection, and not to the Nivotester.

#### Using the measuring system in explosion hazardous areas

Please observe all local codes and regulations on explosion protection concerning the type and installation of intrinsically safe signal wiring. Please refer to the Safety Instruction XA 134F for maximum permissible values of capacitance and inductance.

#### Connecting signal and control devices

(the lower, grey terminal blocks)

The relay function is dependent on the level and fail-safe circuit. If an instrument is connected at high inductance (e.g. contactor, solenoid valve, etc.), a spark suppressor must be installed to protect the relay contact.

#### Connecting the supply voltage

(the lower, grey terminal blocks)

For voltage variations, refer to the Ordering Information section. A fuse is built into the power supply current circuit. This eliminates the need to connect a fine-wire fuse in series. The Nivotester is equipped with reverse polarity protection.

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|                            |                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Power supply</b>        | <p>AC version:</p> <ul style="list-style-type: none"><li>• 85 to 253 VAC, 50/60 Hz</li></ul> <p>DC version:</p> <ul style="list-style-type: none"><li>• 20 to 60 VDC</li><li>• DC supply, maximum 60 mA (one channel unit)</li><li>• DC supply, maximum 115 mA (three channel unit)</li><li>• Permissible residual ripple within tolerance: <math>V_{pp}</math> = maximum 2 V</li></ul> |
| <b>Power consumption</b>   | <p>AC version:</p> <ul style="list-style-type: none"><li>• 1.75 W maximum (one channel unit)</li><li>• 2.25 W maximum (three channel unit)</li></ul> <p>DC version:</p> <ul style="list-style-type: none"><li>• 1.2 W maximum, at <math>V_{min}</math> 20 V (one channel unit)</li><li>• 2.25 W maximum, at <math>V_{min}</math> 20 V (three channel unit)</li></ul>                    |
| <b>Setting time/length</b> | Final switching status after switching on the power supply, approximately 10 to 20 seconds, depending on the connected measuring                                                                                                                                                                                                                                                        |

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## Operating conditions, installation

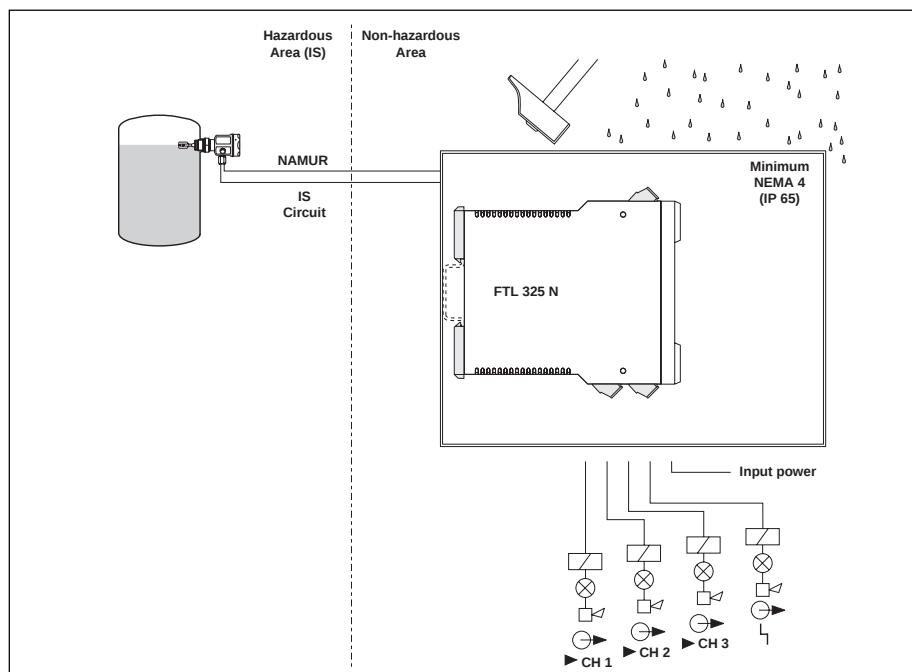
### Installation guidelines

#### Operating location

The Nivotester must be housed in a cabinet outside the explosion hazardous area. A protective housing, NEMA 4 (IP 65) is available which can house up to four single channel units or two three channel units for outdoor installation.

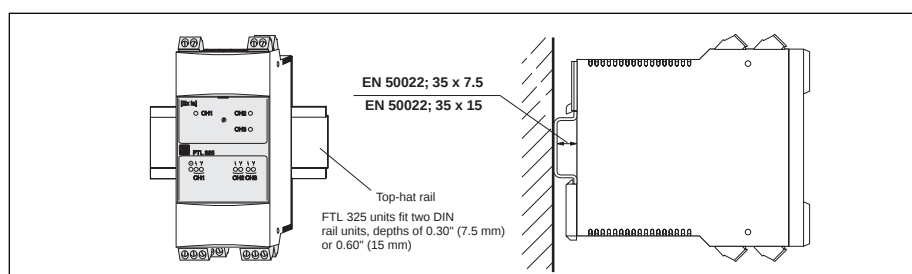
#### NOTE:

Select a mounting location which protects the units from weather and impacts. Do not install in direct sunlight, especially in warm climates.



#### Installation position

Mount the unit vertical on a DIN top-hat rail.



## Operating conditions, ambient

### Ambient temperature

Single installation: -4° to +140°F (-20° to +60°C)  
 Rail mounting, without gaps: -4° to +122°F (-20° to +50°C)  
 Storage temperature: -4° to +140°F, preferably at 68°F (-20° to +60°C, preferably +20°C)  
 Installation in protective housing: -4° to +104°F (-20° to + 40°C)

### Climatic class

3K3 and 3M2, according to EN 60721-3-3

### Ingress protection

NEMA 1 (IP 20)

### Electromagnetic compatibility (EMC)

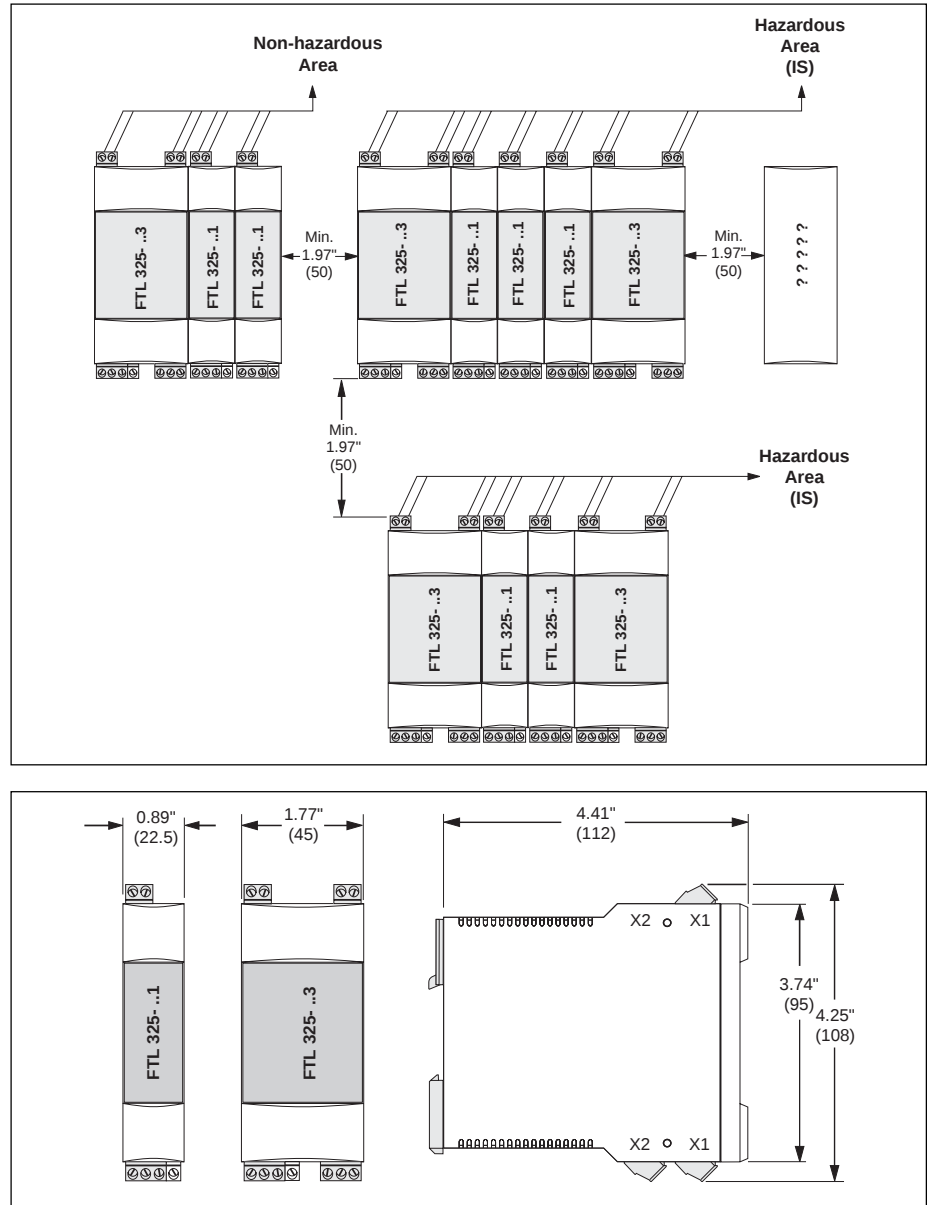
Interference emission to EN 61326, Class B apparatus  
 Interference emission to EN 61326, Appendix A (industry) and NAMUR Recommendation NE 21 (EMC)

## Mechanical construction

### Dimensions

### Mounting distances

All dimensions are in inches (mm)



### Materials

Housing: Polycarbonate, light grey, RAL 7035

Front cover: Polyamid PA6, blue

Rear connection (for top-hat DIN rail): Polyamid PA 6, black, RAL 9005

Installation: on top-hat DIN rail, 35 x 7.5 mm or 35 x 15 mm to EN 50022

### Weight

Single channel: approximately 5.2 oz. (148 g)

Three channel: approximately 8.8 oz. (250 g)

## Connection terminals

### Single channel

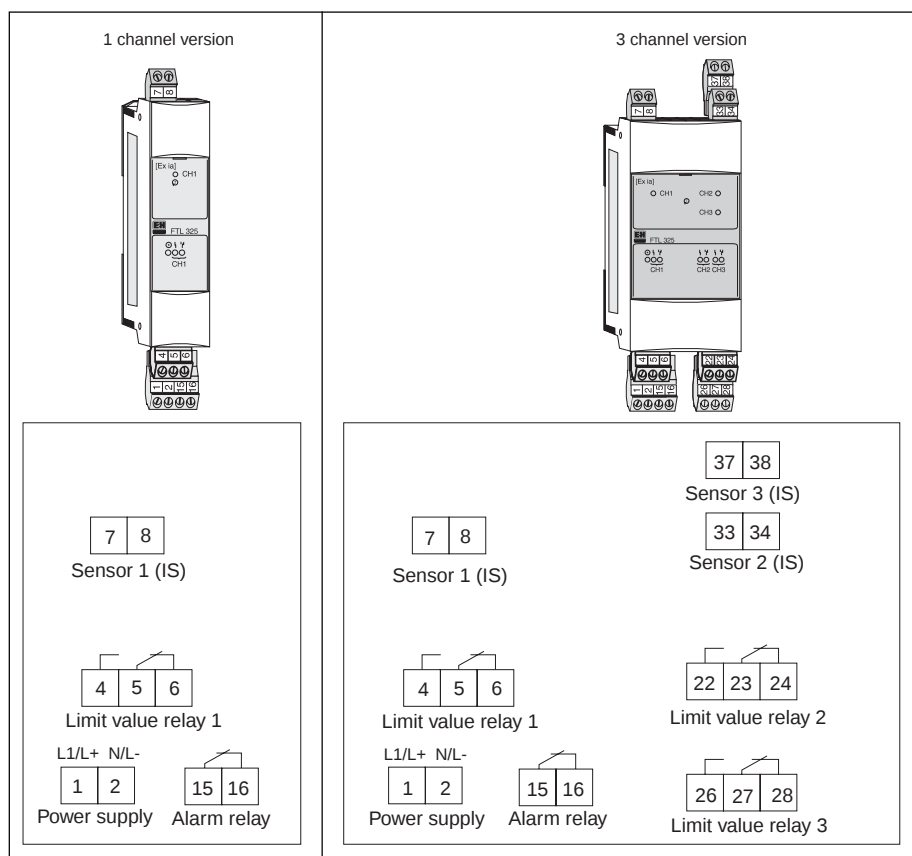
- 2 screw terminals, sensor power supply
- 3 screw terminals, limit value relay
- 2 screw terminals, SPST fault signal relay
- 2 screw terminals, power supply

### Three channel

- 3 x 2 screw terminals, sensor power supply, channel 1 to 3
- 3 x 3 screw terminals, limit value relay LV-REL 1 to 3
- 2 screw terminals, SPST fault signal relay
- 2 screw terminals, power supply

### Connection cable cross section

- maximum for single core, 0.004 in<sup>2</sup> (2.5 mm<sup>2</sup>) or two core 0.002 in<sup>2</sup> (1.5 mm<sup>2</sup>)



## Display and user interface

### Operating concept

On-site setting with switches located behind hinged front panel (refer to graphic, page 11).

### Display elements

- Green LED, standby
- One red LED per channel for fault signaling
- One yellow LED per channel for relay energized

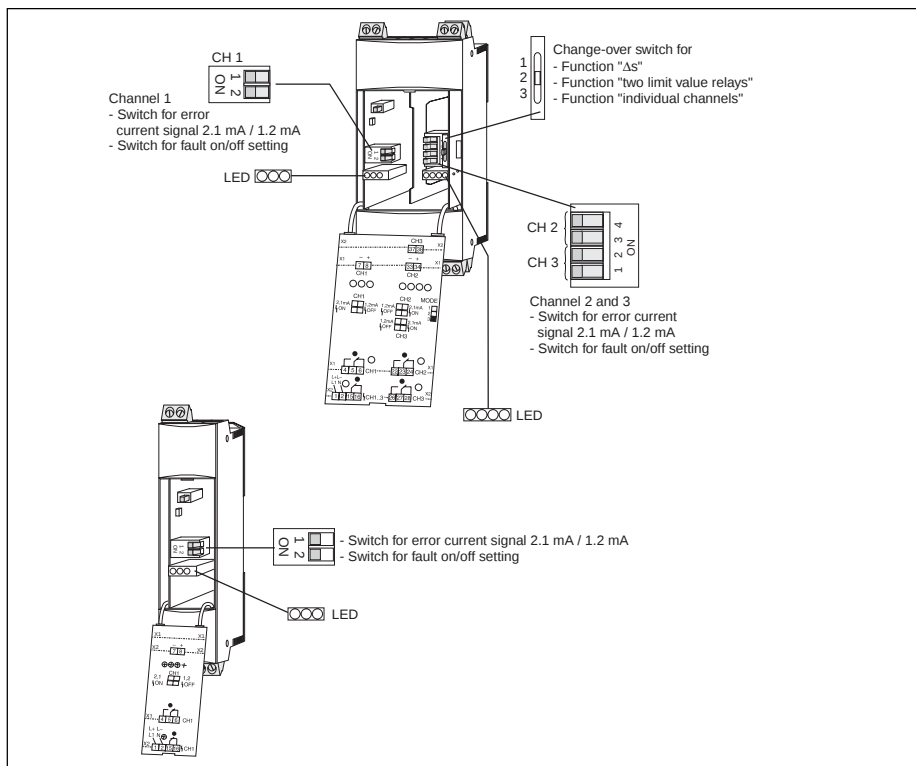
## Operating elements

### One channel unit

- Switch for fault current signal 2.1 mA / 1.2 mA
- Switch for fault on/off setting

### Three channel unit

- Switch for fault current signal 2.1 mA / 1.2 mA
- Switch for fault on/off setting
- Switch for "Single Channel" function (up to three channels)
- Switch for "Δs"
- Switch for one channel with "two parallel switched limit value relays"



## Certificates and approvals

### CE mark

By attaching the CE mark, Endress+Hauser confirms that the instrument fulfills all the requirements of the relevant EC directives

### Hazardous area approvals

FM approved intrinsically safe, Class I, II, III; Division 1, Groups A-G  
CSA intrinsically safe, Class I, II, III; Division 1, Groups A-G

### Other standards and guidelines

- EN 50227 (DIN 19234; NAMUR) or IEC 60947-5-6, Interface (level limit) to NAMUR Recommendations
- EN 60529, type of ingress protection for housing
- EN 61010, safety specifications for electrical measurement, control and laboratory instruments
- EN 61326, interference emission (Class B apparatus), interference immunity (Appendix A - Industry)

## Accessories

### Protective housing

Protective housing, NEMA 4 rated (IP 66) equipped with integrated top-hat rail for mounting Nivotester unit(s), clear plastic cover which can be lead-sealed.  
7.09" W x 7.17" H x 6.50" D (180 x 182 x 165 mm).  
Part Number: 52010132

## Supplementary documentation

- ☐ Liquiphant M FTL 50/51, FTL 50H/51H measuring sensor for level limit detection in liquids: TI 328F/24/ae
- ☐ Liquiphant M FTL 51C measuring sensor for level limit detection in liquids with corrosion-resistant coating: TI 347F/24/ae
- ☐ Liquiphant S FTL 70/71 measuring sensor for level limit detection in high temperatures up to 536°F (280°C): TI 354F/24/ae
- ☐ Protective housing: TI 355F/01/en
- ☐ Operating instructions, FTL 325 single channel: KA 170F/00/a6
- ☐ Operating instructions, FTL 325 three channel: KA 171F/00/a6

## Ordering information

### Nivotester FTL 325 N

FTL 325 N - 

|   |   |   |   |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
|---|---|---|---|

- 1 Certificates
  - O FM IS Cl. I, II, III; Div. 1, Grps. A-G
  - S CSA IS Cl. I, II, III; Div. 1, Grps. A-G
- 2 Version
  - 1 Top-hat rail installation, single channel
  - 3 Top-hat rail installation, three channel
- 3 Voltage supply
  - A 85 to 253 VAC, 50/60 Hz
  - E 20 to 30 VAC / 20 to 60 VDC
- 4 Output
  - 1 1 level relay, SPDT; 1 alarm relay, SPST
  - 3 3 level relays, SPDT; 1 alarm relay, SPST



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