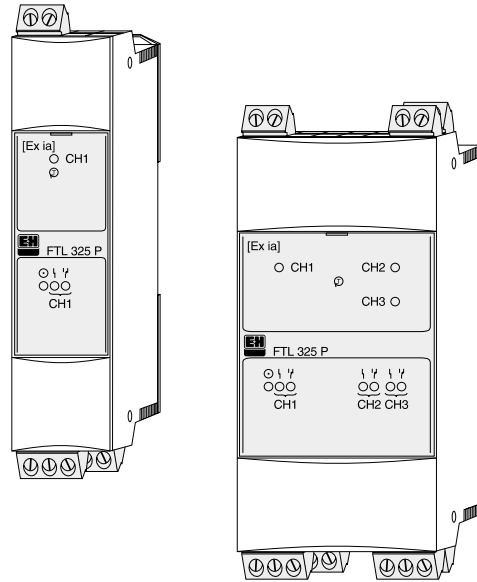


# Level Limit Switch *nivotester FTL 325 P*

With intrinsically safe signal circuit for connection to the Liquiphant and Soliphant measuring sensor



## Application

- Level limit detection in liquid tanks, bulk material silos, and in 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
- Application in safety related systems with requirements for functional safety up to SIL 3 in accordance with ANSI/ISA S84.01 and IEC 61508

## Features and benefits

- Intrinsically safe signal circuits (FM IS) for problem-free use of measuring sensors in explosion hazardous areas
- High functional SIL safety through
  - fault-free PFM technology
  - line monitoring through to sensor
  - corrosion monitoring on tuning fork of the Liquiphant M and S (HT) measuring sensor
- Compact housing for simple series installation on standard rails in control room cabinets
- Simple wiring using plug-in terminal blocks
- Simple interactive test by connecting a Liquiphant M or S (high temperature) push button operation
- Full system test, from isolating amplifier through to measuring sensor

Endress + Hauser

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## Function and system design

### Measuring principle

#### Signal transmission

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

The Nivotester powers the Liquiphant or Soliphant measuring sensors with a two-wire DC loop and receives a frequency which signals whether or not the limit has been reached. The power supply is superimposed with the current pulses (PFM signals) from the measuring transmitter. The pulse width is approximately 200  $\mu$ s and a current strength of approximately 10 mA.

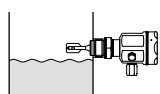
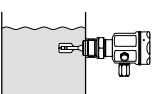

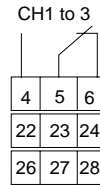
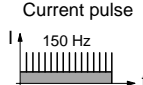
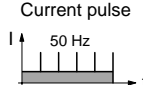
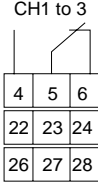

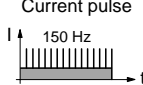
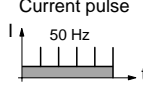
#### Signal evaluation

The Nivotester evaluates the frequency and switches the output relay for the level alarm. The relay switching state is displayed by a yellow LED on the front panel of the Nivotester.

#### Fail-safe circuit

By correctly selecting the fail-safe circuit, you can ensure that the relay always operates in a de-energized state.

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

Level	 Tuning fork uncovered	 Tuning fork covered
Maximum safety circuit		
		
Minimum safety circuit		
		

*Function of the level limit signal and the current pulse are dependent on level and fail-safe circuit.*

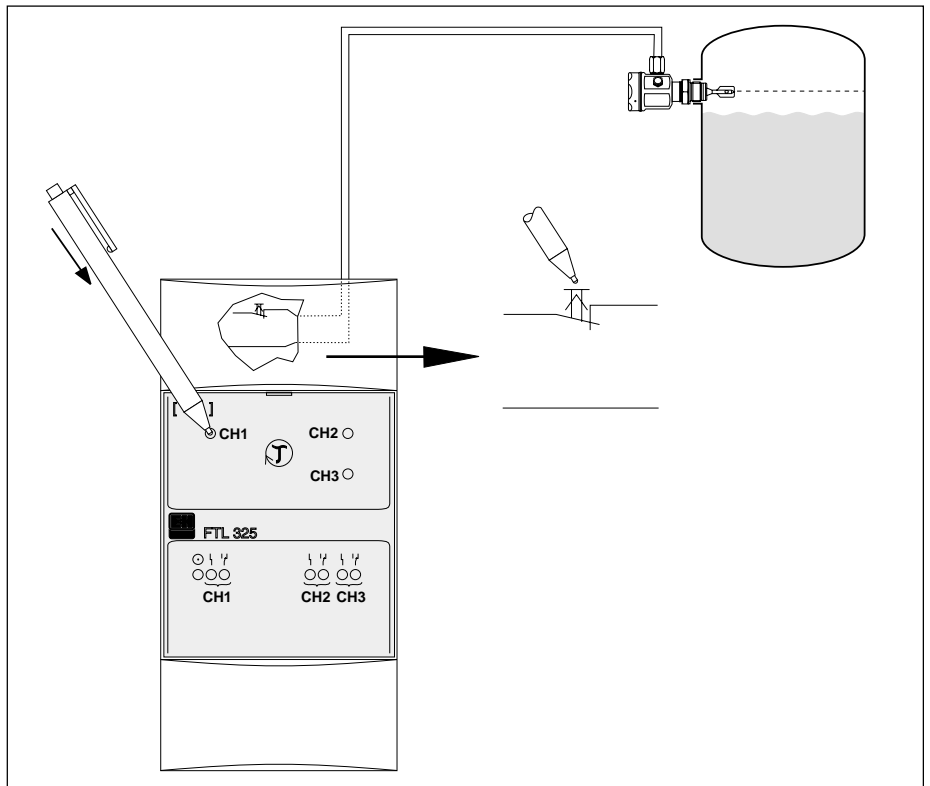
For application with requirements for functional safety in accordance to ANSI/ISA S84.01 and IEC 61508 (SIL), please note Safety Manual SD 111F. Refer to Special Documentation SD 128F/00/en for an overview of Safety Instrumentation Systems.

### Functional monitoring

To increase operating safety, the Nivotester is equipped with a function monitoring system. A fault is indicated by a red LED and causes the level alarm relay in the affected channel as well as the fault alarm relay to de-energize. A fault is signalled when the Nivotester receives no more current pulses. This could occur, for example, in the event of a short-circuit, an interruption in the signal line to the sensor, excessive corrosion to the Liquiphant forks, a defect in the sensor electronics or a defect in the input circuit of the Nivotester. The function of each channel can be monitored by pressing the test button (on the front of the Nivotester). The test button interrupts the power supply to the sensor.

### Simplified interval testing for Liquiphant M and S (HT)

Regular function checks are a requirement for overspill protection systems. The Nivotester and downstream sensors, a function test can be performed without starting up or removing the sensor. A test button on the front panel is available for each signal input. Pressing the test button interrupts the power supply, and when the button is released, power is returned to the sensor and electronic insert and the test phase begins. Further information is available in the KA 147F operating instructions.



### Two-point control

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

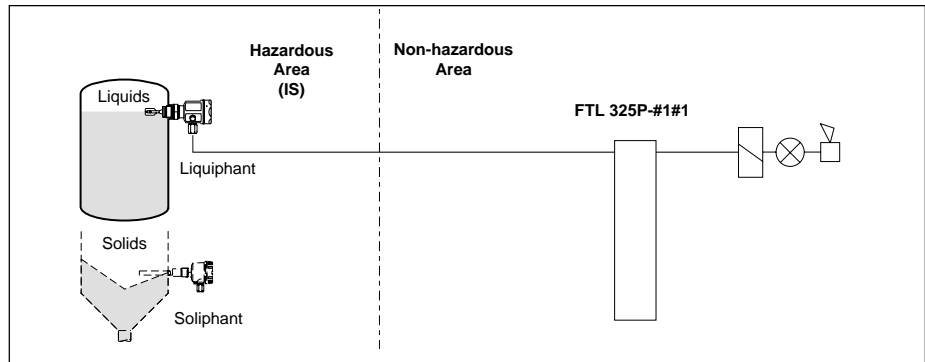
## Measuring system

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 57 electronics, or Soliphant with FEL 37 electronics, can be used as the measuring sensors.

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

The measuring device of the single channel instrument consists of:

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

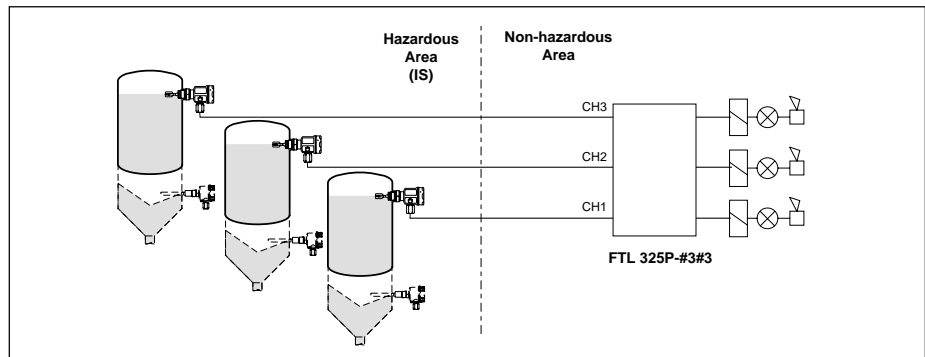


### Three channel Nivotester FTL 325 P-#3#3

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

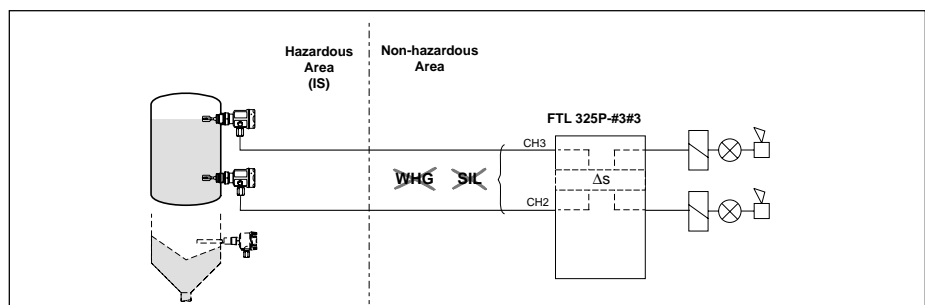
1. When all three single channels are used for measuring the level limit, the measuring device consists of:

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

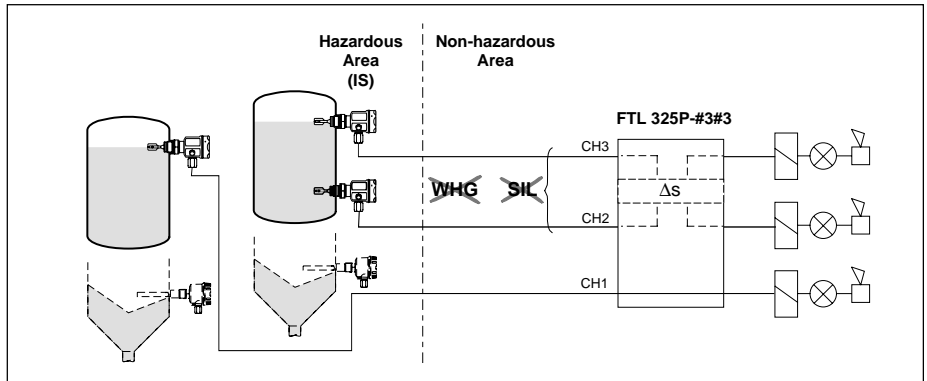


2. When channels two and three are used for two-point control  $\Delta s$ , the measuring device consists of:

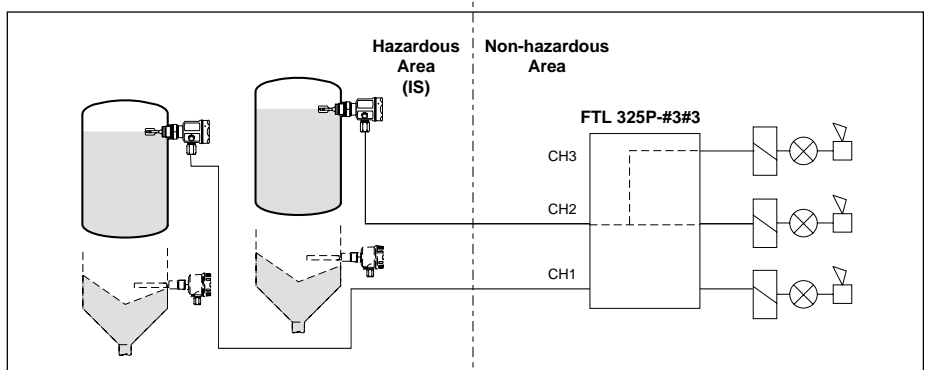
- Two measuring sensors
- Three channel Nivotester
- Control or signal devices



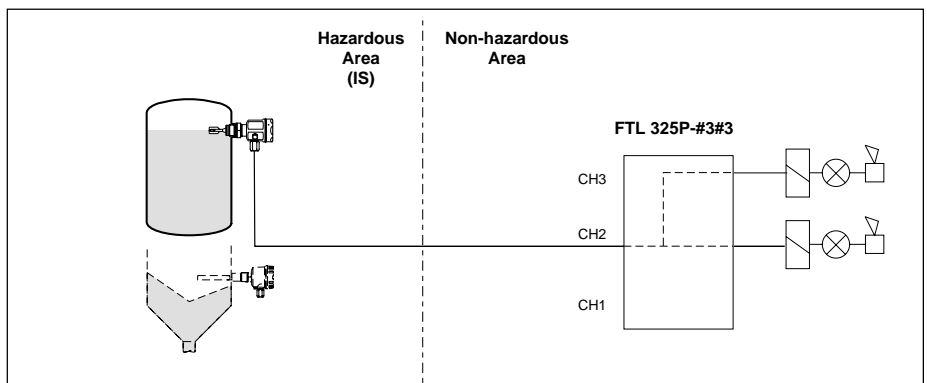
3. When channels two and three are used for two-point control  $\Delta s$ , and channel one for overspill protection, the measuring device consists of:
- Three measuring sensors
  - Three channel Nivotester
  - Control or signal devices



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 325P: 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 57.</li> <li>- Liquiphant II FDL 30, 31 with electronic insert FEL 37</li> <li>- Liquiphant S (HT) FTL 70/71 with electronic insert FEL 57.</li> <li>- Soliphant FTM 30S, 31S, and 32S with electronic insert FEM 37</li> </ul> </li> <li>• Measuring sensor power supply: from FTL 325 P 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: pulse frequency modulation (PFM)</li> </ul>

## 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: minimum/maximum safety selectable with DIL switch</li> <li>• Common fault signal relay: potential-free relay contact for fault signalling, of which only two contacts are routed out</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>	Level limit relay de-energized; fault is indicated by red LEDs, fault signal relay de-energized.
<b>Galvanic isolation</b>	All input and output channels and relay contacts are galvanically isolated from each other.

## Power supply

### 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 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 133F 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.

### Power supply

AC version:

- 85 to 253 VAC, 50/60 Hz

DC version:

- 20 to 60 VDC
- DC supply, maximum 75 mA (one channel unit)
- DC supply, maximum 165 mA (three channel unit)
- Permissible residual ripple within tolerance:  $V_{pp} = \text{maximum } 2 \text{ V}$

### Power consumption

AC version:

- 1.7 W maximum (one channel unit)
- 4.2 W maximum (three channel unit)

DC version:

- 1.5 W maximum, at  $V_{\min} 20 \text{ V}$  (one channel unit)
- 3.3 W maximum, at  $V_{\min} 20 \text{ V}$  (three channel unit)

### Setting time/length

Final switching status after switching on the power supply, approximately 10 to 40 seconds, depending on the connected measuring. Note the self-test function of the FEL 57 electronic insert for the Liquiphant M and S units.

## Operating conditions, installation

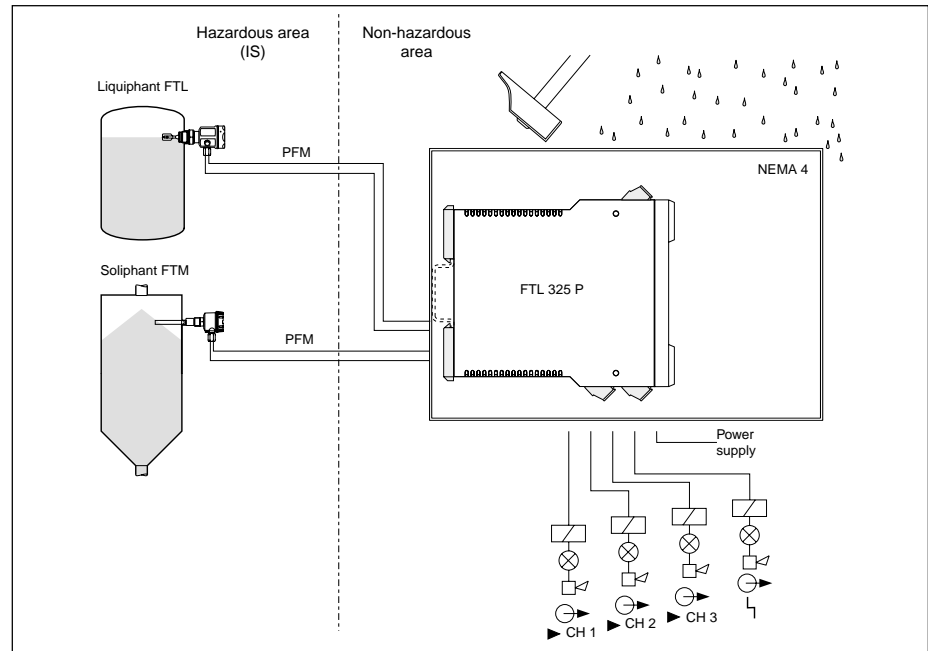
### Installation guidelines

#### 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.

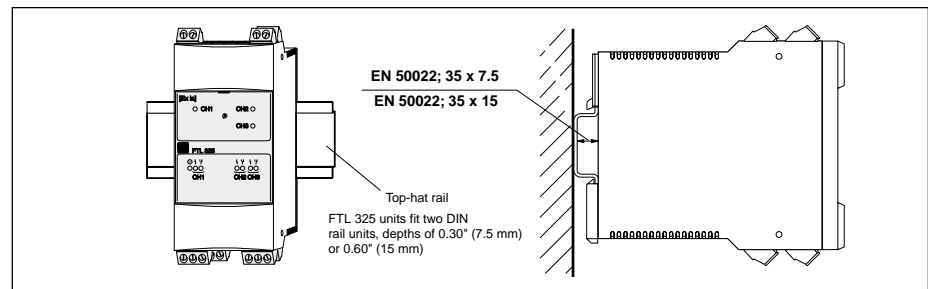
#### NOTE:

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)

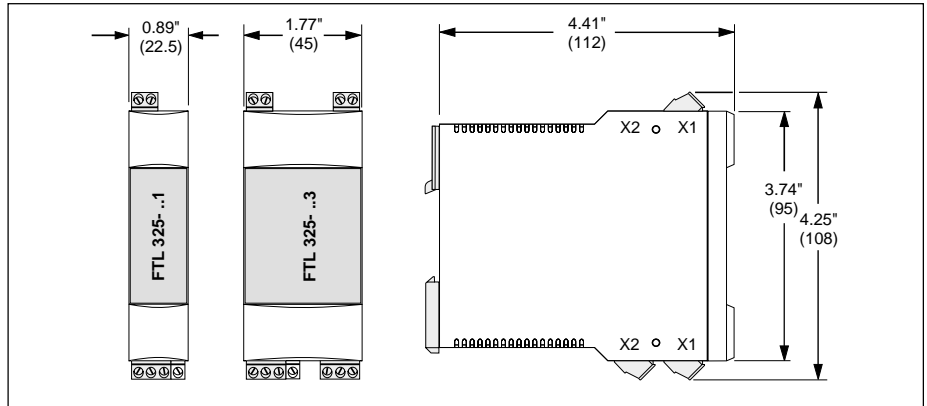
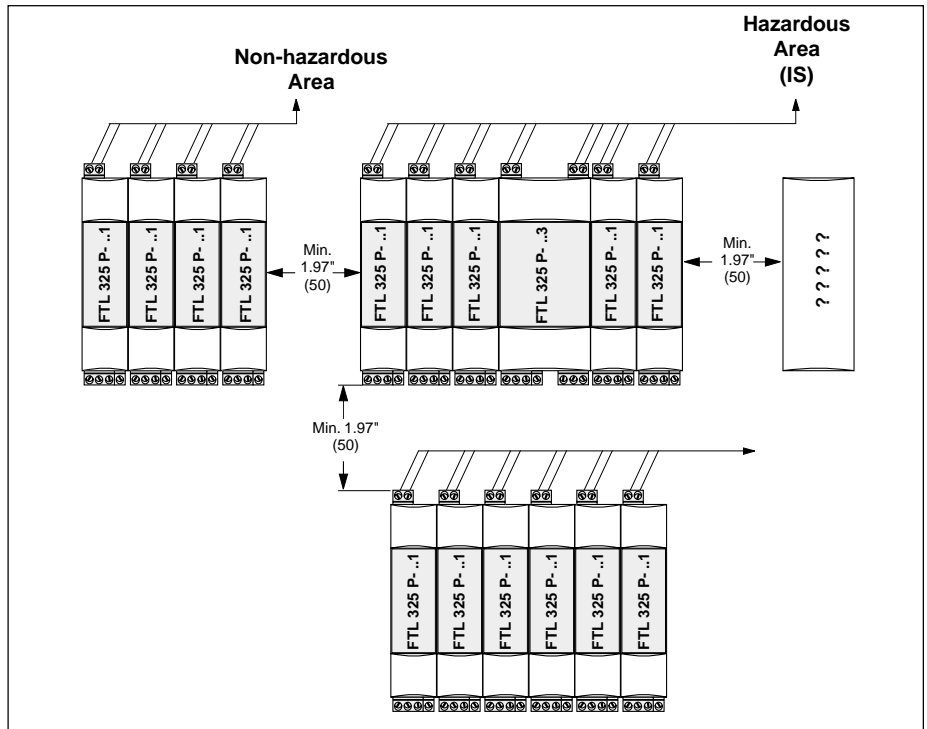


## Mechanical construction

### 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

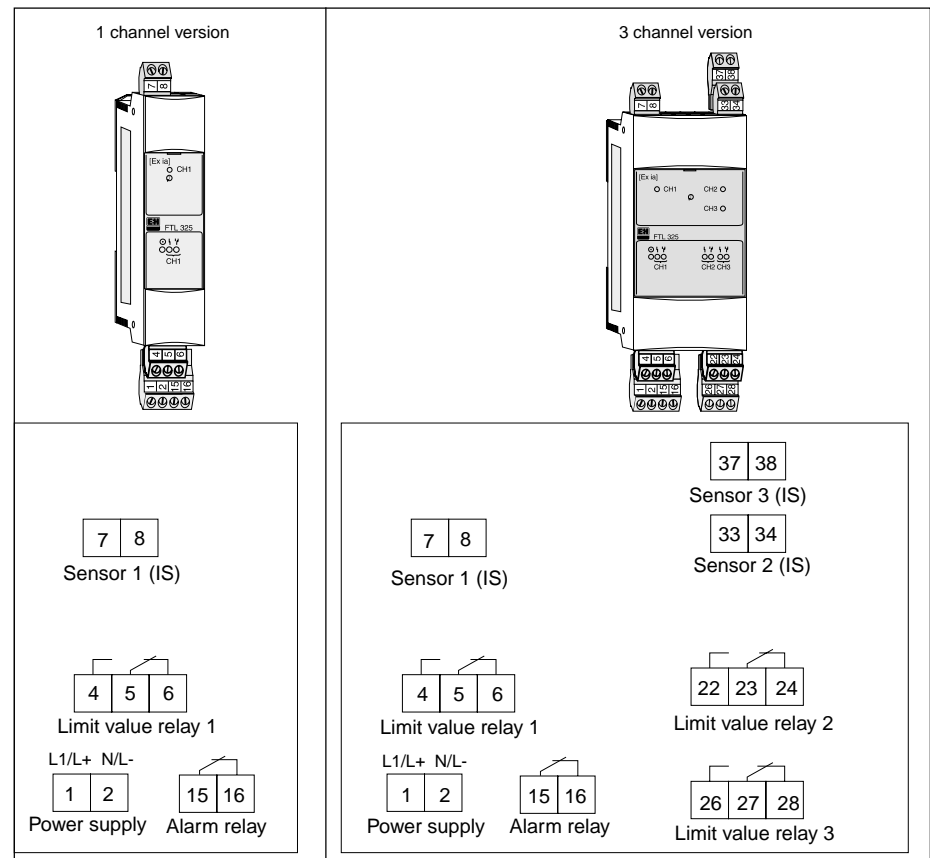
- 2 screw terminals, sensor power supply
- 3 screw terminals, limit value relay
- 2 screw terminals, fault signal relay
- 2 screw terminals, power supply

### 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, 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 signalling
- One yellow LED per channel for relay energized (level alarm)

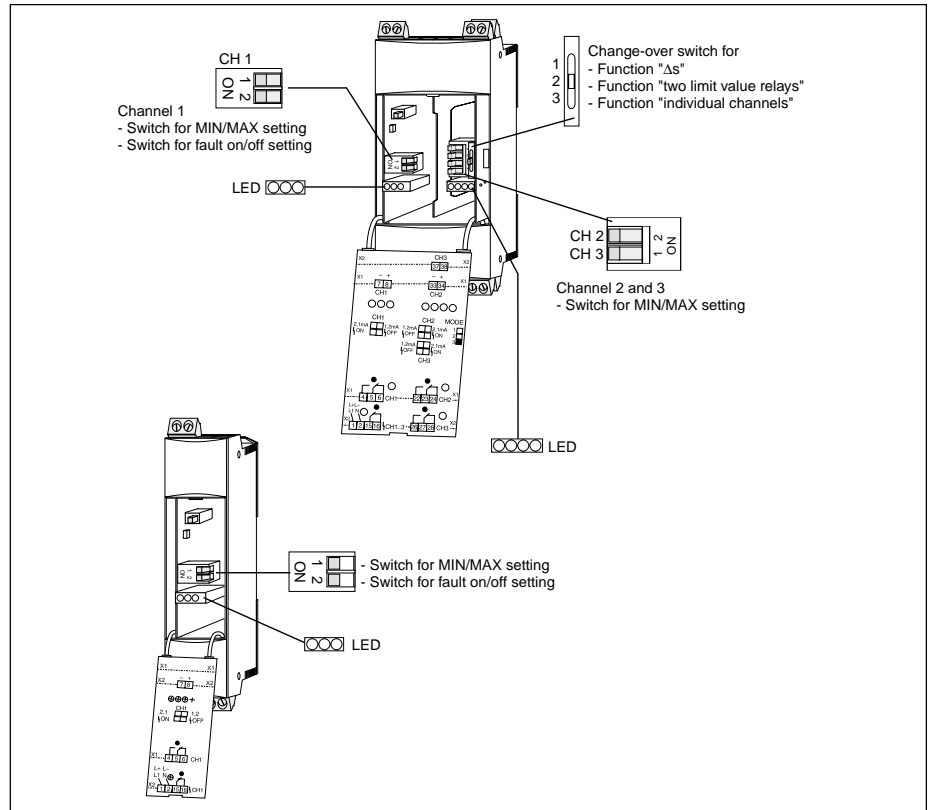
**Operating elements**

**One channel unit**

- Switch for min/max setting
- Switch for with or without fault signalling on CH1

**Three channel unit**

- Switch for min/max setting on CH2
- Switch for min/max setting on CH3
- 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**

<b>CE mark</b>	By attaching the CE mark, Endress+Hauser confirms that the instrument fulfills all the requirements of the relevant EC directives
<b>Hazardous area approvals</b>	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
<b>Overspill protection</b>	WHG
<b>Functional safety</b>	SIL 1 / SIL 2 / SIL 3 or AK 2 to 6 connected with FEL 57 insert for protection functions for overspill protection
<b>Other standards and guidelines</b>	<ul style="list-style-type: none"> <li>• EN 60529, type of ingress protection for housing</li> <li>• EN 61010, safety specifications for electrical measurement, control and laboratory instruments</li> <li>• EN 61326, interference emission (Class B apparatus), interference immunity (Appendix A - Industry)</li> <li>• IEC 61508 certified (ANSI/ISA S84.01), functional safety of safety-relevant electrical/electronic/programmable electronic systems (E/E/PES). EIN V 19250, fundamental safety aspects for measurement and control equipment.</li> </ul>

## 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: 52009107

## 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
- Soliphant II, FTM 30S/31S/32S measuring sensor for level limit detection in bulk solids: TI 249F/24/ae
- Protective housing: TI 355F/01/en
- Operating instructions, FTL 325 single channel: KA 167F/00/a6
- Operating instructions, FTL 325 three channel: KA 168F/00/a6
- Special documentation, Safety Integrity Level (SIL): SD 128F/00/en

## Ordering information

### Nivotester FTL 325 P

FTL 325 P -

- 1 Certificates
  - O FM IS Cl. I, II, III; Div. 1, Grps. A-G
  - P FM IS Cl. I, II, III; Div. 1, Grps. A-G, SIL 2 (IEC61508)
  - S CSA IS Cl. I, II, III; Div. 1, Grps. A-G
  - T CSA IS Cl. I, II, III; Div. 1, Grps. A-G, SIL 2 (IEC61508)
- 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

For application and selection assistance, in the U.S.  
call 888-ENDRESS

For total support of your installed base, 24 hours  
a day, in the U.S. call 800-642-8737

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