

Ultrasonic Level Measurement *nivopuls FDU 10 S*

**Non-invasive limit switch for liquids
with separate electronics unit
Suitable for use in explosion hazardous areas**



Nivopuls FDU 10 S

Application

The Nivopuls FDU 10 S is a level limit switch for thin liquids, suspensions and emulsions, which is attached externally to the vessel wall and has a separate electronics unit. It is not suitable for liquids which tend to build-up and applications in which a gas film adheres to the inside wall. Gas bubbles within the liquid have no effect on measurement. The measurement method is suitable for metal, enamelled, glass and plastic vessels, not, however, vessels made of PVDF or PTFE, with double walls or with plastic linings.

Features and Benefits

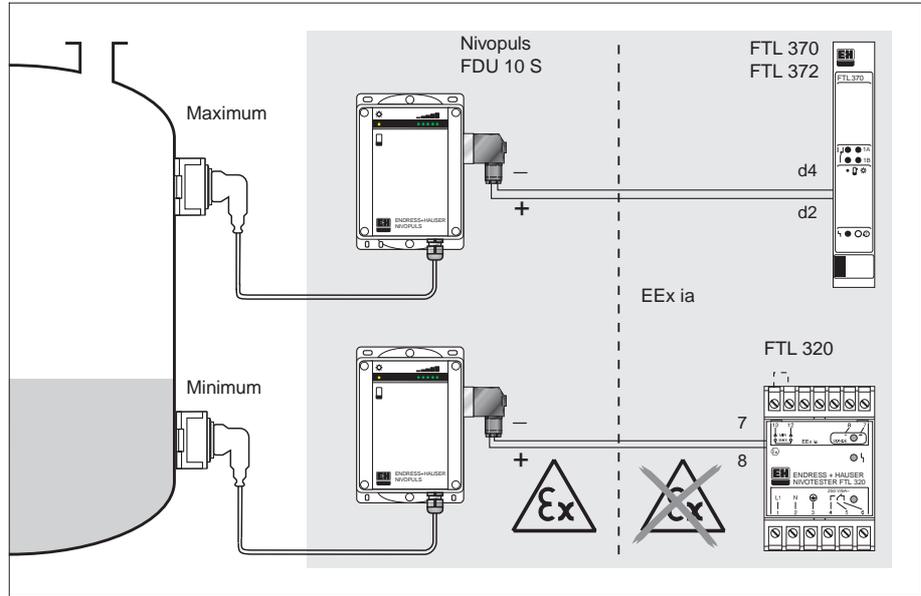
- Limit detection through the vessel wall:
 - simple installation
 - no process connection
 - measurement independent of process pressure
- No contact with the product:
 - no corrosion
 - suitable for sanitary applications, e.g. foodstuffs and pharmaceuticals
- For thin liquids:
 - viscosity up to 50 mm²/s (cSt),
 - temperature up to 60°C
- Separate electronics unit for mounting up to 2 m from measuring point
- Certificate:
 - EEx ia IIB T6
 - FM/CSA Class I...III, Div. 1, Group C...G

Endress + Hauser

Nothing beats know-how



Measuring System



Measuring system and electrical connection

Components

The measuring system comprises the Nivopuls FDU 10 S, attached to the vessel at a position suitable for minimum or maximum level detection, the separate electronics unit as well as a Nivotester FTL 320 or FTL 370/372 switching unit with relay.

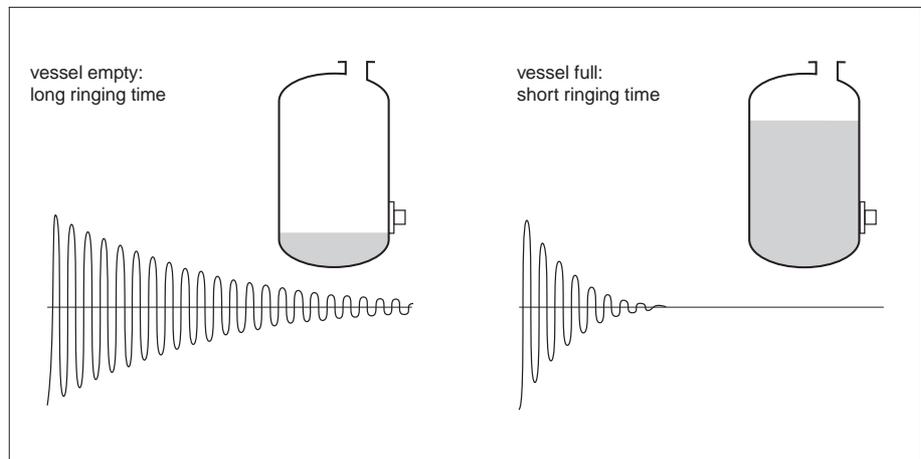
Nivopuls units with certificate can be used in explosion hazardous areas; the Nivotester must always be installed in a safe area.

Electrical Connection

The Nivotester provides the Nivopuls with intrinsically safe power via a two-wire connection, max. length 900 m or 25 Ω per core. An empty/full indication in the form of a PFM-signal is returned along the same line.

The sensor is permanently connected to the electronics with a 2 m cable.

Measurement Principle



Basic principle of ultrasonic resonance method

Ultrasonic Resonance Principle

The Nivopuls FDU 10 S operates on the ultrasonic resonance principle. The sensor, which is acoustically coupled to the vessel wall by means of a coupling paste, generates a short ultrasonic pulse, which causes a local resonance in the vessel wall. When the pulse ends, the resonance dies away, whereby the ringing time depends upon whether or

not liquid is to be found immediately behind the sensor. The sensor, which now operates as a receiver, measures the ringing time and generates an empty or full signal as appropriate.

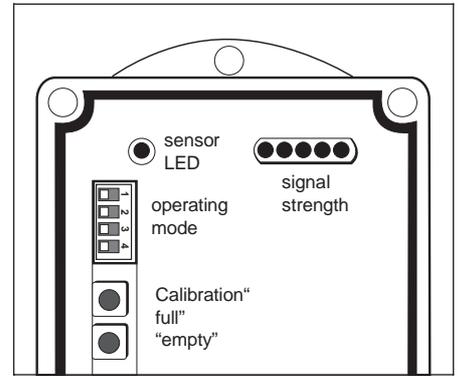
The signal is evaluated by a Nivotester FTL switching unit.

Operating and Display Elements

Operation

The user interface of the Nivopuls is of simple design. The operating elements include:

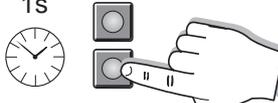
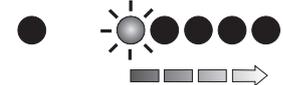
- Two keys within the housing, which allow an empty and full calibration, in any order, when the vessel is filled to the appropriate level.
- A DIP switch which determines the evaluation mode and function of the LED display.



Operating elements

The display elements are clearly visible, even with closed housing.

- A yellow sensor LED indicates the state of the sensor: on = uncovered, off = covered
- A green LED chain indicates the signal strength in normal operation or the calibration status during calibration.

Step	Key	LEDs
 <p>1 Reset</p>	<p>5 s</p> 	 <p>after 5 s</p> 
 <p>2 Empty calibration</p>	<p>1s</p> 	 <p>1-2 min.</p> 
 <p>3 Full calibration</p>	<p>1s</p> 	 <p>3-4 min.</p> 
 <p>4 Operation</p>		

Calibration sequence

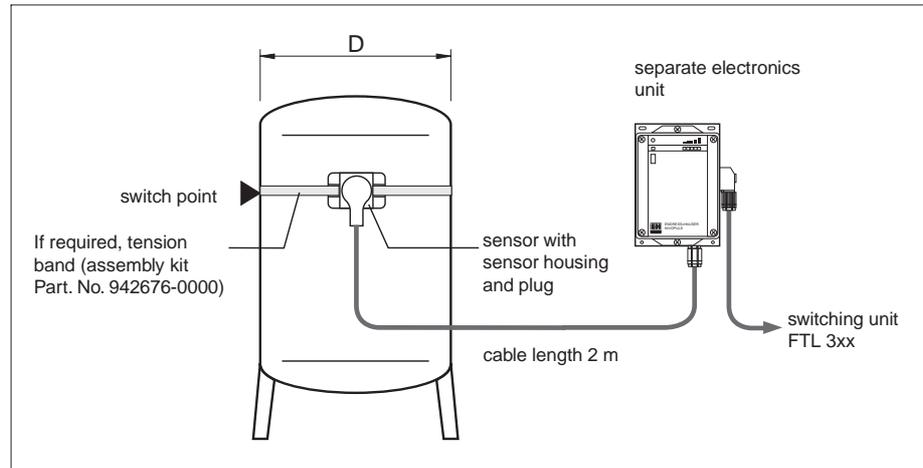
- LED off
- ⊙ LED flashes
- LED on
- ▬▬▬▬➔ LEDs light successively during calibration

Installation

The remote electronics unit is mounted on a wall or pipe (with mounting set). The sensor housing can be attached to the vessel wall or pipe by means of:

- adhesive or
- a tension band

The most suitable mounting method for each application can be found in the table below. Both are suitable for standing and horizontal cylinders



Mounting the measuring system

Pipe/tank dimensions		Material	Sensor housing fastening	
	D		adhesive	tension band
Pipes + tanks	$\varnothing > 200$	Steel + glass	yes	up to 2 m
Pipes + tanks	$\varnothing > 200$	Plastic	yes	up to 2 m

Selection table for mounting method

Adhesive

Suitable adhesive is supplied. For the sensor housing, this may be replaced by any other appropriate type. For the sensor itself, however, any substitute must ensure good acoustic coupling. Two-component and moisture-curing adhesives are not suitable (bubble formation).

Electronics Unit

Mount the remote electronics unit at a suitable location close to the sensor

- the sensor cable is 2 m long
- the operating temperature of the electronics unit is $-20^{\circ}\text{C} \dots +80^{\circ}\text{C}$.

There are two possibilities for mounting:

- wall mounting, see page 6 for dimensions
- pipe mounting using pipe mounting set, comprising bracket, backing plate and screws, PN 942676-1100, see diagram.

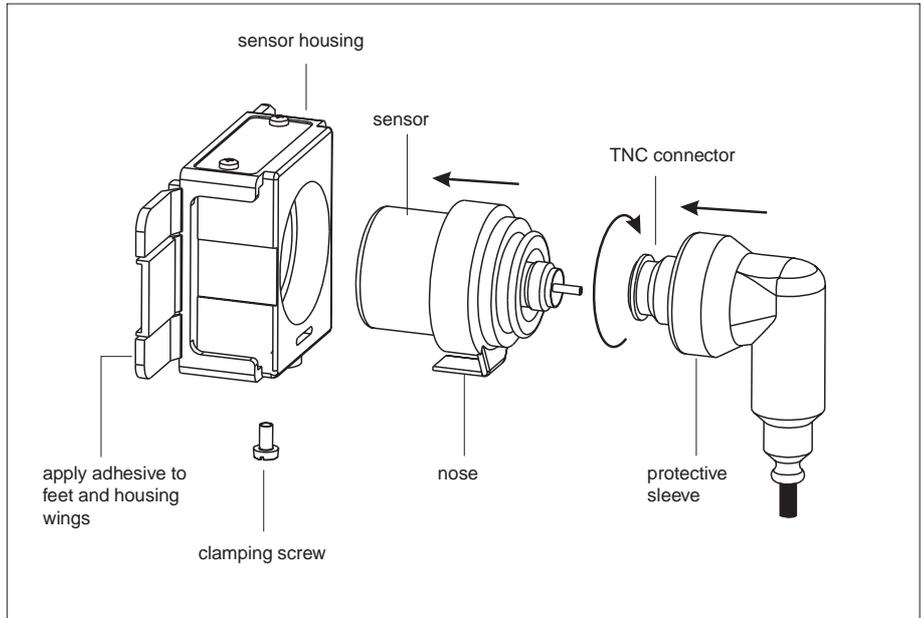
Note!

Extending or shortening the sensor cable will detrimentally affect the electromagnetic compatibility of the measuring system.

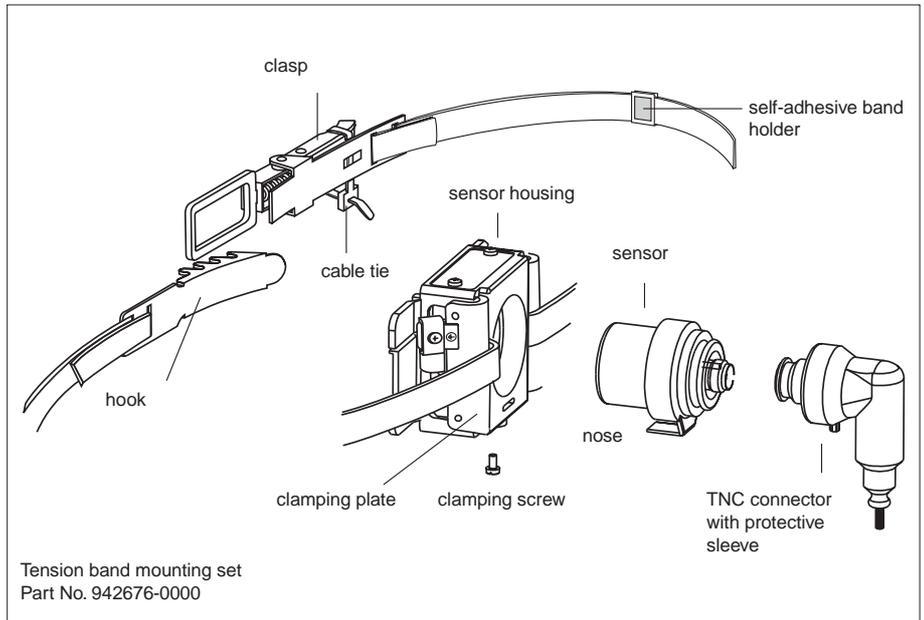


Note!

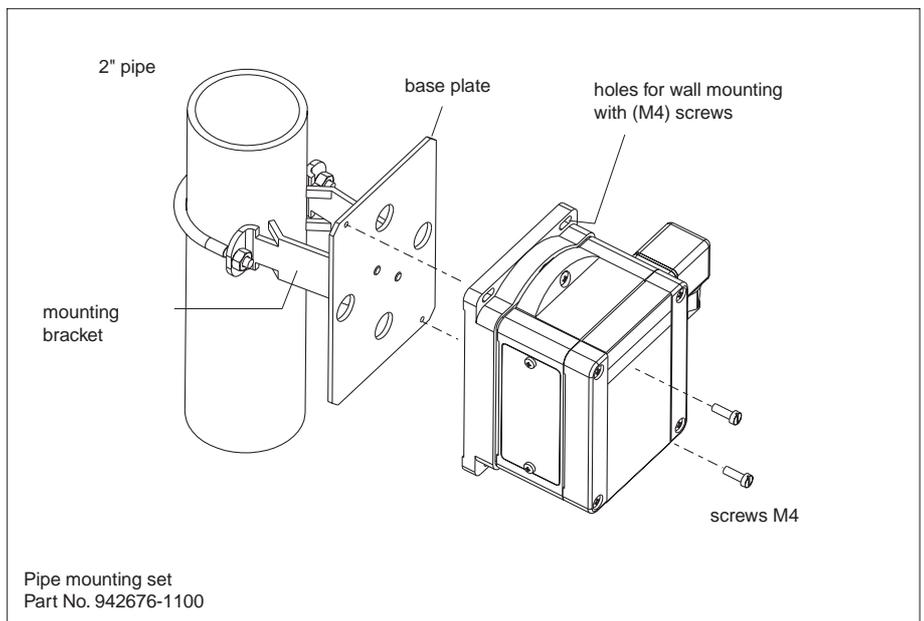
Installation



Fastening with adhesive

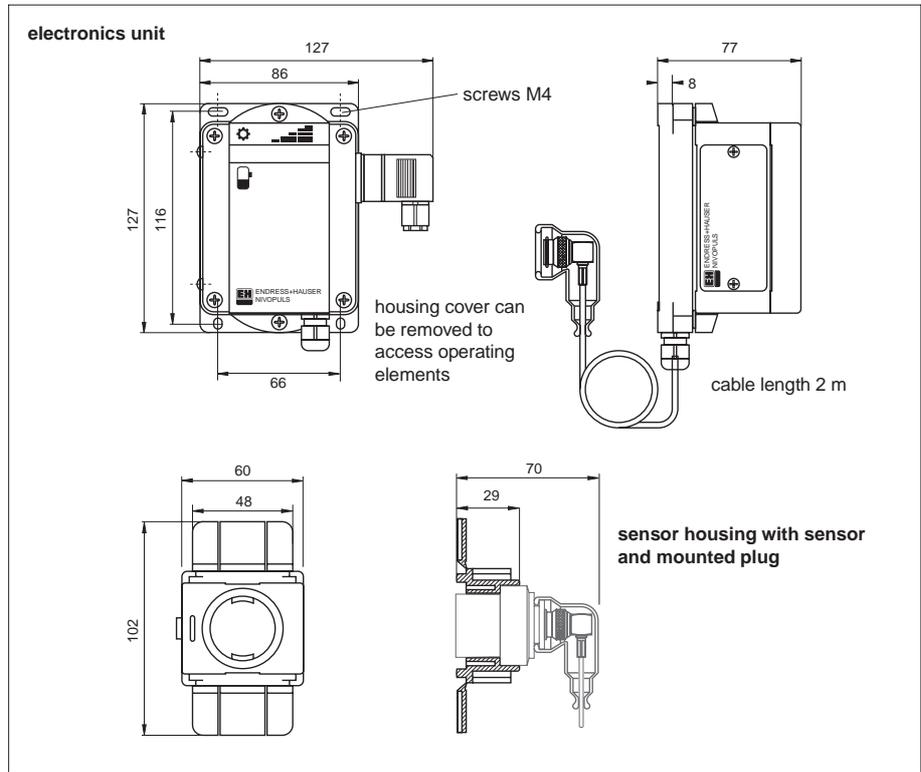


Fastening with tension band and adhesive



Installing the electronic housing with pipe mounting set

Technical Data



Dimensions in mm

Application

Application	Non-invasive level limit switch for thin liquids, suspensions, or emulsions
Designation	Nivopuls FDU 10 S
Manufacturer	Endress+Hauser

Function and System Design

Measurement principle	Ultrasonic resonance principle
Measuring system	Nivopuls ultrasonic sensor, electronics unit, with switching unit Nivotester FTL 320 or Nivotester FTL 370/372
Operating frequency	Type 1: 0.9...1.6 MHz; Type 2: 0.7...1.2 MHz; Type 3: 0.25...0.45 MHz, see Product Structure

Input

Measured variable	Level limit detected by the ringing time of a short ultrasonic pulse, compared to one obtained with empty and full vessel.
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Output

Output signal	Status "full" or "empty" as pulse frequency modulated signal for switching unit
Output on alarm	PFM signal adopts alarm status (recognised by Nivotester).

Accuracy

Reference conditions	Temperature $T = +20\text{ °C}$, operating pressure $p_e = 1\text{ bar}$, flat, vertical metal wall
Response time	Less than 3 s for liquids with viscosity approx. $50\text{ mm}^2/\text{s}$ (cSt); less than 1 s for liquids with viscosity approx. $5\text{ mm}^2/\text{s}$ (cSt)
Switch point	Determined by mounting position of sensor, however, always in lower half of sensor head.
Measured error	$\pm 5\text{ mm}$ of absolute position
Reproducibility	$\pm 3\text{ mm}$ of absolute position
Effect of ambient temperature	$\pm 7\text{ mm}$ of absolute position over operating temperature range

Operating Conditions

Installation

Position	Vertical on flat walls or standing cylinders Horizontal on horizontal cylinders Sensor head in contact with wall (adhesive or tension band) Acoustic coupling through adhesive
Vessel material	Metal, enamelled metal, glass and plastic vessels, however, not for materials PVDF and PTFE, double-walled vessels and vessels with plastic linings.
Wall thickness	Metal and glass: 2...15 mm; Plastic and fibreglass-reinforced plastic 1...10 mm

Environment

Ambient temperature	Sensor: -20 °C...+60°C for adhesive supplied; Electronics: -20 °C...+80 °C
Limiting temperature range	Sensor: -20 °C...+60 °C, dependent on adhesive Electronics: -20 °C...+80 °C
Storage temperature	Sensor and electronics: -40 °C...+100 °C
Climatic class	IEC 68, Part 2-38 as Fig. 2a
Ingress protection	Electronics: IP 65 with housing closed, IP 20 with housing open for calibration
Vibrational strength	IEC 68, Part 2-6
Electromagnetic compatibility	Interference emission to EN 50 081-1, Interference immunity to EN 50 082-2 and NAMUR industrial standard

Medium

Limiting product temperature	-20 °C...+100 °C, -20 °C...+60 °C for adhesive supplied
Viscosity	Thin liquids, emulsions, suspensions and liquefied gas, up to 50 cSt

Mechanical Construction

Design	See diagram, page 6
Weight	Sensor with housing: approx. 0.12 kg Electronics unit: approx. 0.5 kg
Material	Sensor housing: plastic PBT-FR; sensor PEEK Electronics unit housing: PBT-FR; base plate: PPS Tension band with accessories: stainless steel 1.4301 Pipe mounting set: 1.4301
Electrical connection	Two-wire cable with plug connection, max. length 900 m and/or max. resistance 25 Ω pro Ader

User Interface

Display	1 status LED for empty and full indication 1 LED chain comprising LEDs for signal strength
Operation	2 keys for "empty" and "full" calibration DIP switches for evaluation mode and LED control

Power

Power supply	Provided by Nivotester FTL 320 or 370/372 switching unit
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Certificates and Approvals

Explosion protection (all in preparation)	Europe: Cenelec EEx ia IIB North America: FM Class 1, Div. 1, Group C...G CSA Class 1, Div. 1, Group C...G
CE Mark	By attaching the CE Mark, Endress+Hauser confirms that the Nivopuls FDU 10 S fulfils all legal requirements of the relevant EU directives

Ordering Information

Ordering information	See Product Structure, page 8
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Product Structure

Nivopuls FDU 10 S	
Certificate	
1 No certificate	
2 Cenelec EEx ia IIB T6	
3 CSA Class I...III, Div. 1, Groups C, D, G and Coal Dust	
4 FM Class I...III, Div. 1, Groups C...G	
Housing	
1 Plastic housing, cable gland Pg11	
2 Plastic housing, cable gland NPT 1/2"	
9 Other housing	
Sensor: Vessel Material and Wall Thickness	
1 Metal and glass, 2...3 mm und 4...7 mm	
2 Metal and glass, 3...4 mm und 7...15 mm	
3 Plastic 1...10 mm	
9 Other sensor	
FDU 10 S-	Product designation

Accessories	Part No.
Tension band set (hook and clasp, clamping plates and band),	942 676-0000
Pipe mounting set (mounting bracket, base plate, screws)	942 676-1100

Supplementary Documentation

- Nivopuls FDU 10 System-Information SI 025/00/e
- Nivopuls FDU 10 C Compact version Technical Information TI 248/00/en
- Switching Unit Nivotester FTL 320 Technical Information TI 203/00/en
- Switching Unit Nivotester FTL 370/372 Technical Information TI 198/00/en

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