

# Technical Information

## Micropilot NMR81

### Tank Gauging



#### Application

Micropilot NMR8x Series intelligent tank gauges are designed for high accuracy liquid level measurement in storage and process applications. They fulfill the exacting demands of tank inventory management, inventory control, custody transfer, loss control, total cost saving, and safe operation.

#### Typical areas of application

- Precise level measurement of oil (fuels), chemicals, and alcohol in free space
- Tank mounted intelligence makes NMR8x ideal for single or multi-task installations, measuring the liquid level and integrating a wide range of tank sensor measurement functions including: Liquid level, Water level, Temperature and Pressure.

#### Your benefits

- SIL2/3 certified as per IEC 61508 (Minimum, Maximum, Continuous level)
- Measures liquid level to an accuracy of +/- 0.5 mm (0.02 in) and integrates temperature, water level, pressure, overfill prevention sensor
- Robust IP66/68, NEMA Type 4x/6P enclosure, stainless steel or aluminum and with 2" (50mm) to 4" (100mm) antennas
- Wide range of output signals including V1, Modbus RS 485, and HART protocol
- Suitable for atmospheric and high pressure applications up to 16 bar/1.6 MPa/ 232 psi

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## Document information

### Symbols used

#### Safety symbols



This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.



This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.



This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.



This symbol contains information on procedures and other facts which do not result in personal injury.

#### Electrical symbols



Alternating current



Direct current and alternating current



Direct current



Ground connection

A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.

#### ⊕ Protective earth (PE)

Ground terminals that must be connected to ground prior to establishing any other connections.

The ground terminals are located on the interior and exterior of the device:

- Interior ground terminal: protective earth is connected to the mains supply.
- Exterior ground terminal: device is connected to the plant grounding system.

#### Tool symbols



Phillips head screwdriver



Flat blade screwdriver



Torx screwdriver



Allen key



Open-ended wrench

#### Symbols for certain types of information and graphics

##### ✓ Permitted

Procedures, processes or actions that are permitted

##### ✓✓ Preferred

Procedures, processes or actions that are preferred

##### ✗ Forbidden

Procedures, processes or actions that are forbidden

##### i Tip

Indicates additional information



Reference to documentation



Reference to graphic



Notice or individual step to be observed

1., 2., 3.

Series of steps



Result of a step



Visual inspection



Operation via operating tool



Write-protected parameter

1, 2, 3, ...

Item numbers

A, B, C, ...

Views



**Safety instructions**

Observe the safety instructions contained in the associated Operating Instructions



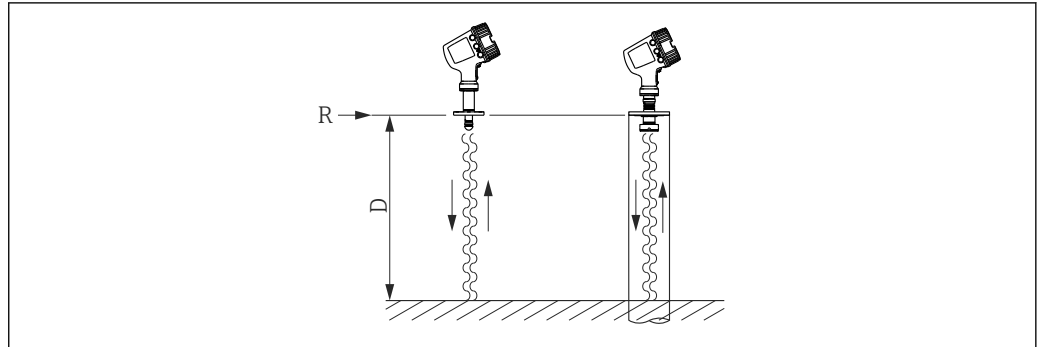
**Temperature resistance of the connection cables**

Specifies the minimum value of the temperature resistance of the connection cables

## Function and system design

### Measuring principle

Micropilot is a directional level radar, operating based on the "Frequency-Modulated Continuous Wave" principle (FMCW). The radar emits a precise crystal-oscillated, continuously varying frequency wave from the antenna. The wave is reflected off the product surface and received again by the radar system.



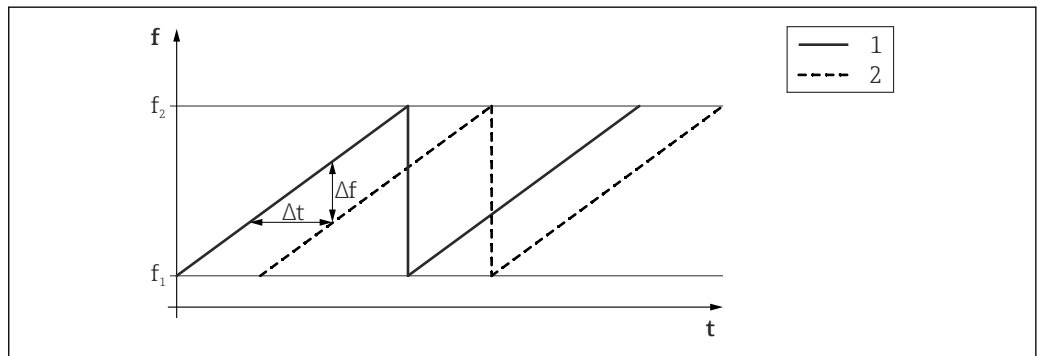
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1 FMCW principle: Emission and reflection of the continuous wave.

R Reference point of the measurement

D Distance between R and the product surface

The frequency of this wave is precisely modulated in the form of a sawtooth signal between two limit frequencies  $f_1$  and  $f_2$ :



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2 FMCW principle: Results of the frequency modulation

1 Emitted signal

2 Received signal

Thus, at any given time the frequencies of the emitted and the received signal differ by

$$\Delta f = k \Delta t$$

where  $\Delta t$  is the transit time and  $k$  is the known slope of the frequency modulation.

$\Delta t$ , on the other hand, is determined by the distance  $D$  between the reference point  $R$  and the product surface:

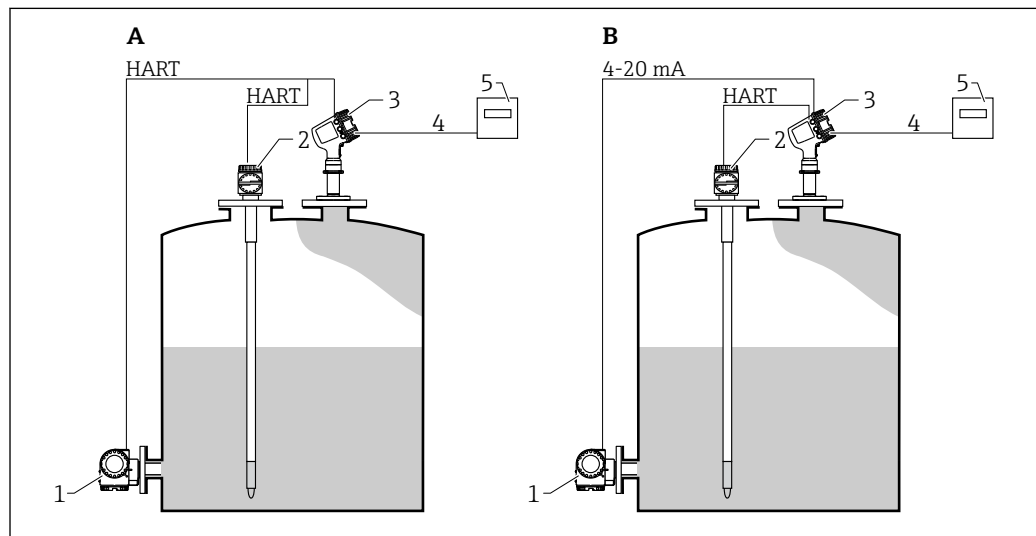
$$D = (c \Delta t) / 2$$

where  $c$  is the speed of propagation of the wave.

In summary,  $D$  can be calculated from the measured frequency shift  $\Delta f$ .  $D$  is then used to calculate the contents of the tank.

## Integration of tank sensors

In addition to measuring the level, the device can also be used for the integration of tank sensors into tank inventory systems. All measured and calculated values can be displayed at the built-in display. Via a field communication protocol, they can be transferred to an inventory control system.



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3 Integration of tank sensors with Micropilot (Example)

A HART multidrop mode

B HART and analog mode

1 Pressure transmitter

2 Average temperature transmitter

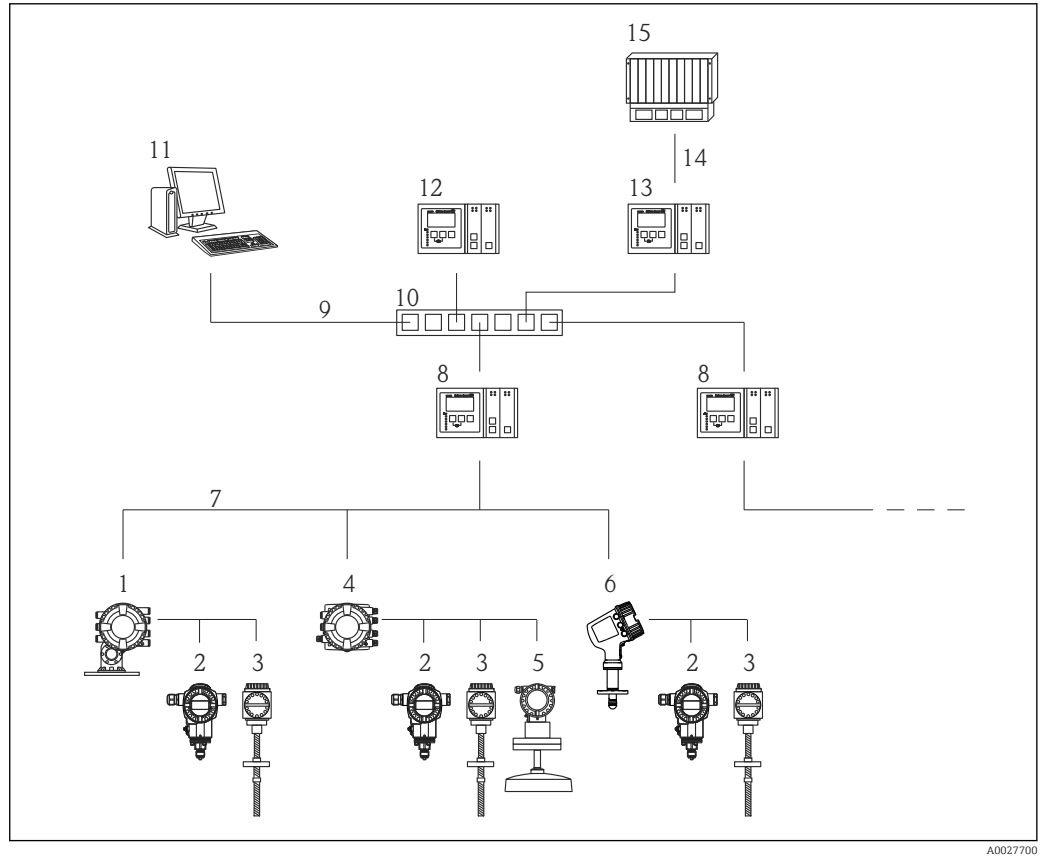
3 Micropilot

4 Field protocol transmits data to an inventory control system

5 Inventory control system (e.g. Tankvision NXA820 or Tankvision Professional NXA85)

## Measuring system

- From single tank level measurement to the largest oil refinery applications, Endress+Hauser tank gauging devices are an integral part of tank farm management solutions. A wide variety of data output protocols are available for seamless integration into many commonly used systems.
- A primary example is Tankvision from Endress+Hauser. Tankvision is a scalable system offering local tank management for multiple loops via Modbus or V1 protocols. Accumulated data is available to DCS and other plant management systems via a Host Link.



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4 Integration of tank gauging devices into an inventory management system (typical example)

- 1 Proservo NMS8x
- 2 Pressure transmitter (e.g. Cerabar)
- 3 Temperature transmitter (e.g. Prothermo)
- 4 Tankside Monitor NRF81
- 5 Micropilot S FMR5xx
- 6 Micropilot NMR8x
- 7 Field protocol (e.g. Modbus, V1)
- 8 Tankvision Tank Scanner NXA820
- 9 Ethernet
- 10 Ethernet switch
- 11 Internet Browser
- 12 Tankvision Data Concentrator NXA821
- 13 Tankvision Host Link NXA822
- 14 Modbus
- 15 DCS or PLC

## Input/output

### Level measurement

#### Measured variable

The measured variable is the distance between a reference point (mounting flange) and a reflective surface (e.g. product surface).

#### Maximum measuring range


The maximum measuring range depends on the dielectric constant  $\epsilon_r$  of the measured medium and on the size of the antenna:


A <sup>1)</sup>	B <sup>2)</sup>		
	50 mm (2 in)	80 mm (3 in)	100 mm (4 in)
1.4 to 1.9 <sup>3)</sup>	4 m (13 ft)	15 m (49 ft)	25 m (82 ft)
1.9 to 4	8 m (26 ft)	30 m (98 ft)	50 m (164 ft) <sup>4)</sup>
4 to 10	20 m (66 ft)	60 m (197 ft) <sup>4)</sup>	70 m (230 ft) <sup>4)</sup>
> 10	30 m (98 ft)	70 m (230 ft) <sup>4)</sup>	70 m (230 ft) <sup>4)</sup>

- 1) Dielectric constant  $\epsilon_r$
- 2) Antenna
- 3) For the measurement of absorbing gases either use a guided radar measuring device, measuring devices with a different measuring frequency or another measuring principle.
- 4) For devices with Weight+Measure approval: Maximum measuring range: 30 m (98 ft)


 For dielectric constants (DC values) of many media commonly used in various industries refer to:

- the Endress+Hauser DC manual (CP01076F)
- the Endress+Hauser "DC Values App" (available for Android and iOS)

 For devices with Weight+Measure approval (option NTA, NTC, PTA or PTC of ordering feature 150 "Accuracy, Weight + Measure Approval"): Maximum measuring range: 0.8 to 30 m (2.6 to 98 ft)

 The actual usable measuring range depends on additional criteria like the mounting location or possible interference reflections.

 Minimum distance from flange to product surface: 0.8 m (2.6 ft)

 For the measurement of absorbing gases either use a guided radar measuring device, measuring devices with a different measuring frequency or another measuring principle.

This is the case for the following media, i. e.:

- Aceton
- Methyl chloride
- Methylethylketone
- Propylen oxide
- VCM (vinyl chloride monomere)

Contact Endress+Hauser, if you need to measure in one of these media. Together, we will find the solution for your measuring task.

#### Operating frequency

D <sup>1)</sup>	O <sup>2)</sup>
NMR81	approx. 80 GHz

- 1) Device
- 2) Operating frequency

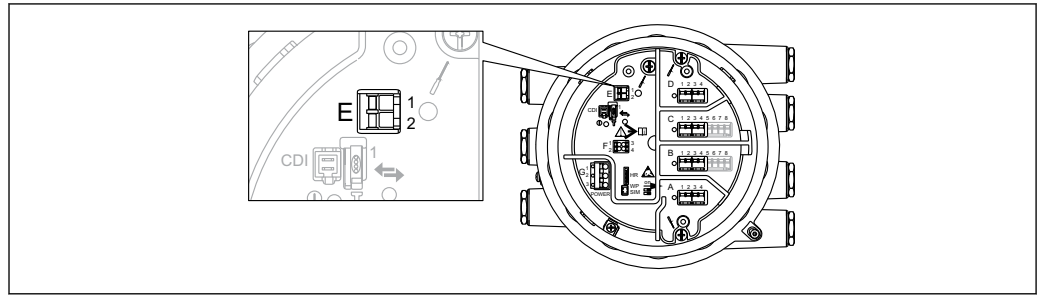


**Transmitting power**

<b>D <sup>1)</sup></b>	<b>P1 <sup>2)</sup></b>	<b>P2 <sup>3)</sup></b>	<b>A <sup>4)</sup></b>
NMR81	6.3 mW	1.8 mW	63 µW

- 1) Device
- 2) Generated Peak Pulse Power
- 3) Radiated Peak Pulse Power
- 4) Average output power

## HART Ex ia/IS active input



5 HART Ex ia/IS active input

E1 HART +

E2 HART -

The device has a HART Ex ia/IS active input. Additional features are provided if the following Endress+Hauser devices are connected:

**Prothermo NMT**

The measured level is transmitted to the Prothermo. Prothermo uses this level to calculate the average temperature of the product.

**Technical data**

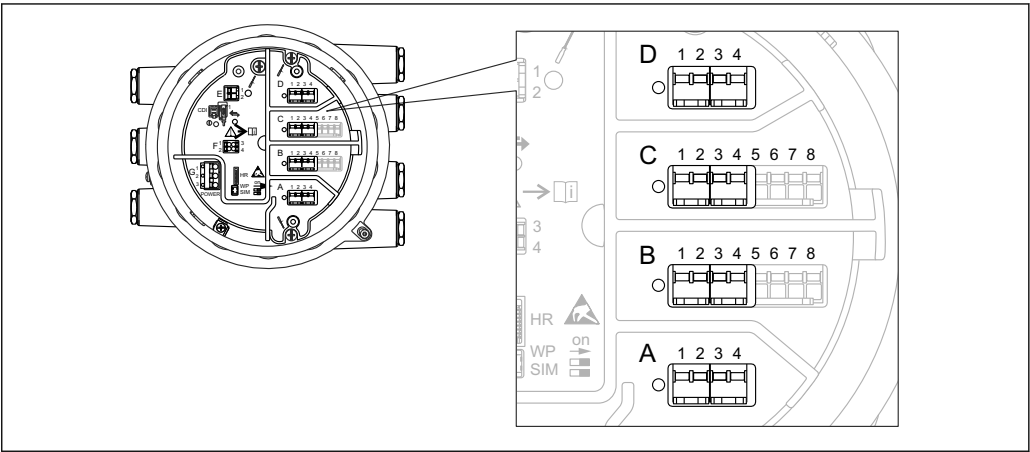
- Transmitter power supply voltage  
23.0 V -  $380 \Omega \cdot I_{load}$
- Maximum load  
500  $\Omega$  including signal line
- Maximum current of all connected devices  
24 mA



The HART Ex ia/IS active input is available by default. It needs not to be chosen explicitly when ordering a device.

I/O modules

Overview



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6 Position of the I/O modules in the terminal compartment

The terminal compartment contains up to four I/O modules, depending on the order code.

- Modules with four terminals can be in any of these slots.
- Modules with eight terminals can be in slot B or C.

**i** The exact assignment of the modules to the slots is dependent on the device version. For a detailed description refer to the Operating Instructions of the device in question.

- i** The following restrictions apply when selecting the modules:
- The device may contain a maximum of four I/O modules.
  - A maximum of two I/O modules with 8 terminals is possible.

Ordering feature 040: "Primary Output"

NMx8x - xxxx <u>XX</u> xx xx ... 040			
O <sup>1)</sup>	N <sup>2)</sup>	T <sup>3)</sup>	S <sup>4)</sup>
Modbus RS485 <sup>5)</sup>			
A1	1	4	→ 14
V1 <sup>5)</sup>			
B1	1	4	→ 15
4-20mA HART Ex d/XP <sup>5)</sup>			
E1	1	8	→ 16
4-20mA HART Ex i/IS <sup>5)</sup>			
H1	1	8	→ 16
WM550 <sup>5)</sup>			
C1	1	4	→ 15

- 1) Option
- 2) Number of I/O modules
- 3) Number of terminals
- 4) Technical data
- 5) Type of I/O module

Ordering feature 050: "Secondary IO Analogue"

NMx8x - xxxx xx <u>XX</u> xx ... 050
---









**Ordering feature 050: "Secondary IO Analogue"**




- Type of I/O module:  
1 x "Ex d/XP 4-20mA HART + RTD input"
  - Option  
A1
  - Number of I/O modules  
1
  - Number of terminals  
1 x 8
  - Technical data → 16
- Type of I/O module:  
2 x "Ex d/XP 4-20mA HART + RTD input"
  - Option  
A2
  - Number of I/O modules  
2
  - Number of terminals  
2 x 8
  - Technical data → 16
- Type of I/O module:  
1 x "Ex i/IS 4-20mA HART+ RTD input"
  - Option  
B1
  - Number of I/O modules  
1
  - Number of terminals  
1 x 8
  - Technical data → 16
- Type of I/O module:  
2 x "Ex i/IS 4-20mA HART+ RTD input"
  - Option  
B2
  - Number of I/O modules  
2
  - Number of terminals  
2 x 8
  - Technical data → 16
- Type of I/O module:  
1 x "Ex i/IS 4-20mA HART + RTD input"  
1 x "Ex d/XP 4-20mA HART + RTD input"
  - Option  
C2
  - Number of I/O modules  
2
  - Number of terminals  
2 x 8
  - Technical data → 16
- Type of I/O module:  
none
  - Option  
X0
  - Number of I/O modules  
0
  - Number of terminals  
0
  - Technical data -

**Ordering feature 060: "Secondary IO Digital Exd"**

NMx8x - xxxx xx xx <u>XX</u> ... 060
---

**Ordering feature 060: "Secondary IO Digital Exd"**

- Type of I/O module:  
1 x "2x relay + 2x discrete I/O"
  - Option  
A1
  - Number of I/O modules  
1
  - Number of terminals  
1 x 4
  - Technical data →  18
- Type of I/O module:  
2 x "2x relay + 2x discrete I/O"
  - Option  
A2
  - Number of I/O modules  
2
  - Number of terminals  
2 x 4
  - Technical data →  18
- Type of I/O module:  
3 x "2x relay + 2x discrete I/O"
  - Option  
A3
  - Number of I/O modules  
3
  - Number of terminals  
3 x 4
  - Technical data →  18
- Type of I/O module:  
1x "Modbus RS485"
  - Option  
B1
  - Number of I/O modules  
1
  - Number of terminals  
3 x 4
  - Technical data →  14
- Type of I/O module:  
1x "Modbus RS485"  
1 x "2x relay + 2x discrete I/O"
  - Option  
B2
  - Number of I/O modules  
2
  - Number of terminals  
2 x 4
  - Technical data  
→  14  
→  18
- Type of I/O module:  
1x "Modbus RS485"  
2 x "2x relay + 2x discrete I/O"
  - Option  
B3
  - Number of I/O modules  
3
  - Number of terminals  
3 x 4
  - Technical data  
→  14  
→  18

- Type of I/O module:
  - 1 x "WM550"
  - Option
    - E1
  - Number of I/O modules
    - 1
  - Number of terminals
    - 1 x 4
  - Technical data →  15
- Type of I/O module:
  - 1 x "WM550"
  - 1 x "2x relay + 2x discrete I/O"
  - Option
    - E2
  - Number of I/O modules
    - 2
  - Number of terminals
    - 2 x 4
  - Technical data →  15
- Type of I/O module:
  - 1 x "WM550"
  - 2 x "2x relay + 2x discrete I/O"
  - Option
    - E3
  - Number of I/O modules
    - 3
  - Number of terminals
    - 3 x 4
  - Technical data →  15
- Type of I/O module:
  - none
  - Option
    - X0
  - Number of I/O modules
    - 0
  - Number of terminals
    - 0
  - Technical data -

#### **"Modbus RS485": Technical data**

Number of units

Maximum 15 instruments per loop

Baud rate: Selectable

- 600 bit/s
- 1 200 bit/s
- 2 400 bit/s
- 4 800 bit/s
- 9 600 bit/s
- 19 200 bit/s

Parity: Selectable

- Odd
- Even
- None

Cable

3-wire, with screening

The screening must be connected inside the housing

Termination resistors

To be set as required in specific environments

Topology

- Serial bus
- Tree structure

Transmission distance

Maximum 1 200 m (3 900 ft) including limbs or branches;

branches under 3 m (9.8 ft) are negligible

Instrument address

Each transmitter has an individual bus address configured in the software of the transmitter

Isolation

Bus inputs are electrically isolated from the other electronics

Error on alarm

Error message classified according to NAMUR NE 107

#### **"V1": Technical data**

Number of units

Maximum 10 instruments per loop

Baud rate: Selectable

3 300 bit/s

Cable

- 2-wire twisted pair, screening recommended
- 2-wire, unscreened

Termination resistors

Not required

Topology

- Serial bus
- Tree structure

Transmission distance

Maximum 6 000 m (19 700 ft)

Instrument address

Each transmitter has an individual bus address configured in the software of the transmitter

Isolation

Serial communication circuit isolated from other circuits

Error on alarm

Error message classified according to NAMUR NE 107

#### **WM550: Technical data**

Number of units

Maximum 15 <sup>1)</sup> instruments per loop

Baud rate: Selectable

- 600 bit/s
- 1 200 bit/s
- 2 400 bit/s
- 4 800 bit/s

Cable

- 2-wire twisted pair, unscreened (recommended)
- 2-wire, screened or unscreened

Topology

Current loop or 2 redundant current loops (requires 2 I/O modules WM550)

Transmission distance

Maximum 7 000 m (22 967 ft)

Instrument address

Each transmitter has an individual bus address configured in the software of the transmitter

Isolation

Serial communication circuit isolated from other circuits

Error on alarm

Error message classified according to NAMUR NE 107

---

1) The maximum number of devices depends on the maximum output voltage of the master and the voltage drop of slaves. For NXA820 with Nxx8x devices, a maximum number of 12 devices is guaranteed

**"4-20mA HART" I/O module (Ex d/XP or Ex i/IS): Technical data****General data**

Number of units

Maximum 6 instruments per loop

Baud rate: Selectable

1 200 bit/s

Cable

- 2-wire twisted pair, screened

- Core cross section: 0.2 to 2.5 mm<sup>2</sup> (24 to 13 AWG)

Topology

- Serial bus

- Tree structure

Transmission distance

Maximum 1 200 m (3 900 ft)

Instrument address

Each transmitter on a signal loop has an individual bus address. This is defined within the transmitter software and / or auxiliary configuration environment such as host system or Field Communicator 475.

Isolation

Bus inputs are electrically isolated from the other electronics

**Input data**

Input operating modes

- 4..20mA input (1 external device)

- HART master+4..20mA input (1 external device)

- HART master (up to 6 external devices)

Internal load (to ground)

400 Ω

Measuring range

0 to 26 mA

Accuracy

±15 µA (after linearization and calibration)

Connection of a Prothermo NMT

The measured level is transmitted to the Prothermo. Prothermo uses this level to calculate the average temperature of the product.

Connection of a RTD temperature probe

2-, 3- or 4-wire connection

**Output data**

Output operating modes

- 4..20mA output

- HART slave +4..20mA output

Output current

3 to 24 mA

Accuracy

±15 µA (after linearization and calibration)

Error on alarm

HART error message classified according to NAMUR NE 107

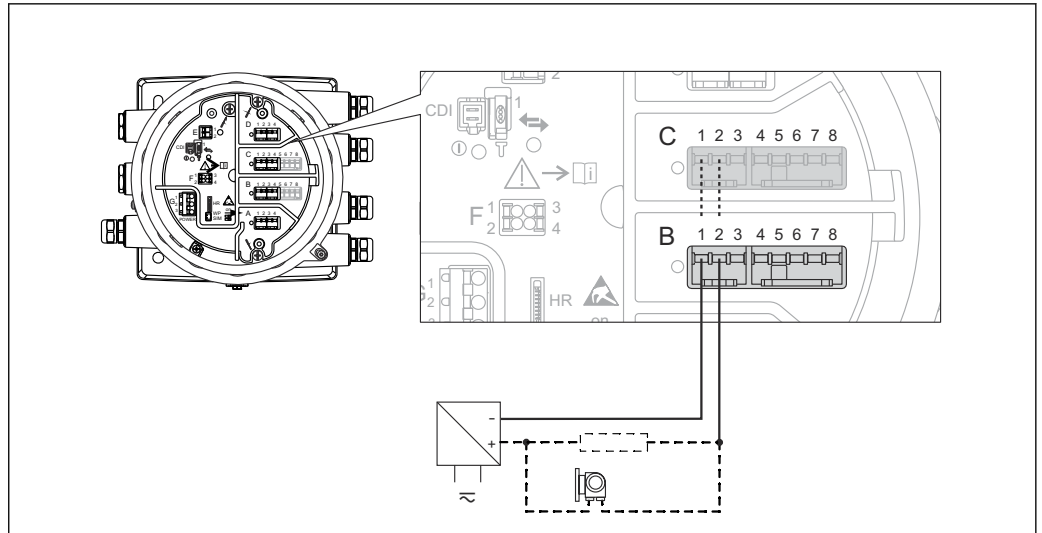
**Data for passive usage (input or output)**

- Minimum terminal voltage  
10.4 V<sup>2)</sup>

- Maximum terminal voltage  
29 V<sup>2)</sup>

2) Observing these values is mandatory in order to ensure correct measured value information.



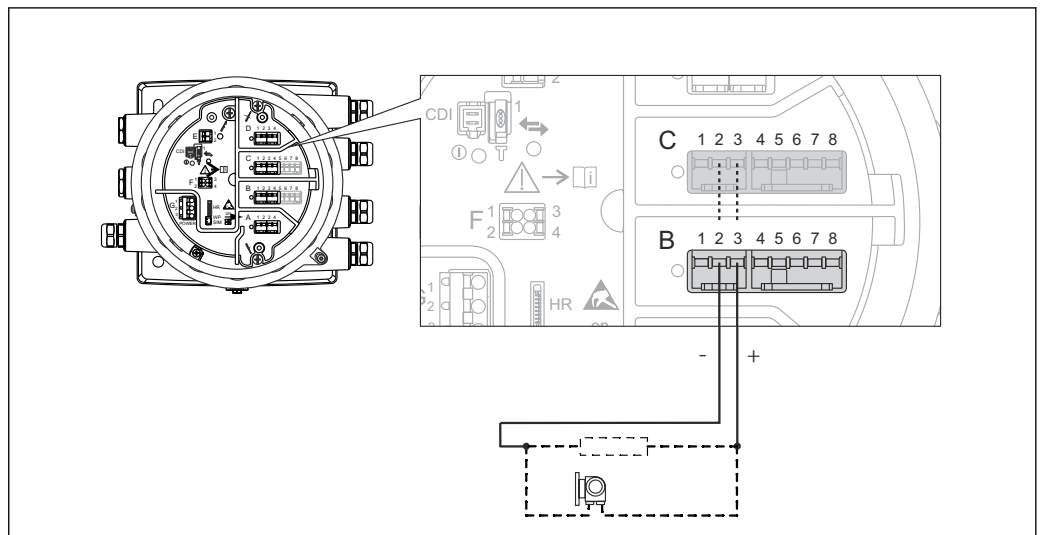


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7 Passive input or output: Use terminals 1 and 2

#### Data for active usage (input or output)

- Transmitter power supply voltage  
(Ex d/XP)  
 $18.5 \text{ V} - 360 \Omega \cdot I_{\text{load}}$
- Transmitter power supply voltage  
(Ex i/IS)  
 $20.0 \text{ V} - 360 \Omega \cdot I_{\text{load}}$
- Output load  
max.  $500 \Omega$  including signal line <sup>3)</sup>



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8 Active input or output: Use terminals 2 and 3

3) Observing this value is mandatory in order to ensure correct measured value information.

**"Digital I/O module": Technical data****Output**

- Relay switching power for resistive load
  - 30 V<sub>DC</sub> @ 2 A
  - 250 V<sub>DC</sub> @ 0.1 A
  - 250 V<sub>AC</sub> @ 2 A
- Relay type
  - normally open;
  - can be set to "normally closed" by a software option <sup>4)</sup>

**Input**

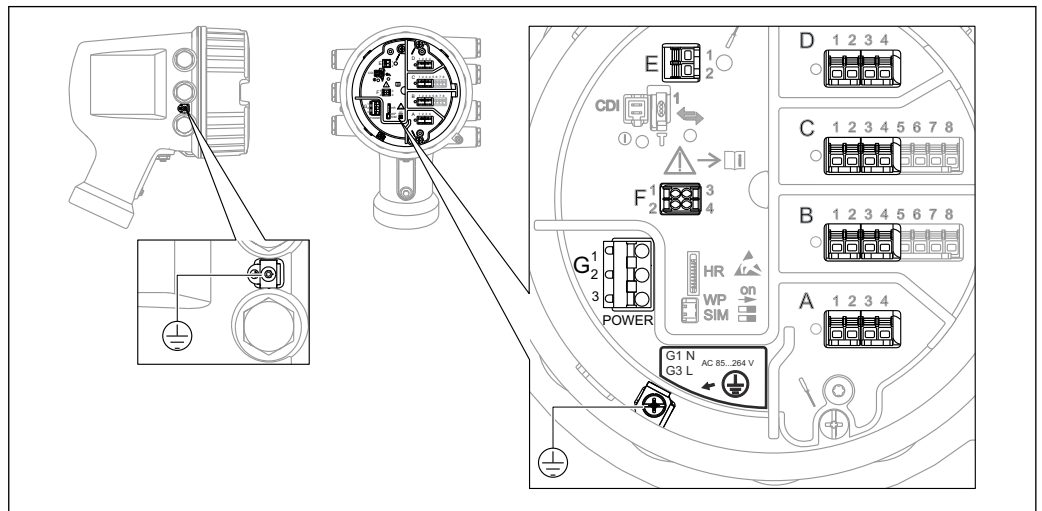
- Maximum pick-up voltage
  - 250 V<sub>AC</sub>
  - 250 V<sub>DC</sub>
- Minimum pick-up voltage
  - 25 V<sub>AC</sub>
  - 5 V<sub>DC</sub>
- Current consumption at maximum voltage
  - ≤ 1 mA (DC)
  - ≤ 2 mA (AC)

---

4) In case of a power supply failure, the switching state is always "open", irrespective of the selected software option.

## Power supply

### Terminal assignment



A0026372

9 Terminal compartment (typical example) and ground terminals

#### Terminal area A/B/C/D (slots for I/O modules)

Module: Up to four I/O modules, depending on the order code

- Modules with four terminals can be in any of these slots.
- Modules with eight terminals can be in slot B or C.



The exact assignment of the modules to the slots is dependent on the device version. For a detailed description refer to the Operating Instructions of the device in question.

#### Terminal area E

Module: HART Ex i/IS interface

- E1: H+
- E2: H-

#### Terminal area F

Remote display

- F1:  $V_{CC}$  (connect to terminal 81 of the remote display)
- F2: Signal B (connect to terminal 84 of the remote display)
- F3: Signal A (connect to terminal 83 of the remote display)
- F4: Gnd (connect to terminal 82 of the remote display)

#### Terminal area G (for High voltage AC power supply and Low voltage AC power supply)

- G1: N
- G2: not connected
- G3: L

#### Terminal area G (for Low voltage DC power supply)

- G1: L-
- G2: not connected
- G3: L+

#### Terminal area: Protective ground

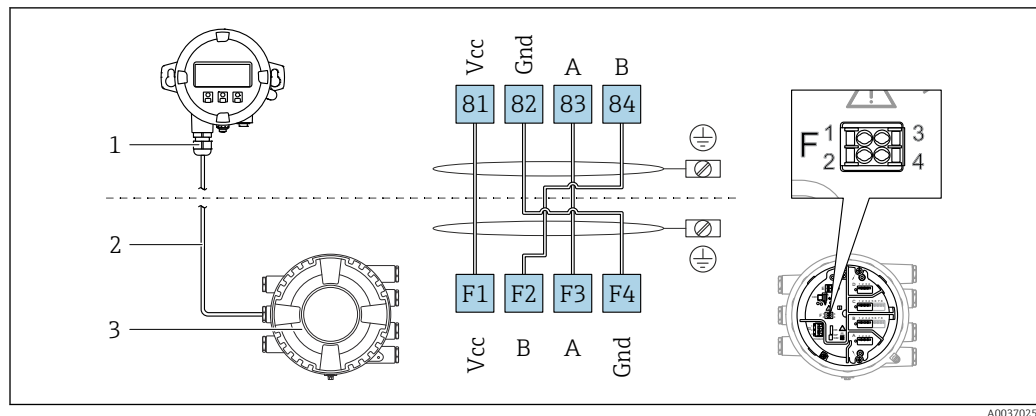
Module: Protective ground connection (M4 screw)



A0018339

10 Terminal area: Protective ground

## Remote display and operating module DKX001



11 Connection of the remote display and operating module DKX001 to the Tank Gauging device (NMR8x, NMS8x or NRF8x)

- 1 Remote display and operating module
- 2 Connecting cable
- 3 Tank Gauging device (NMR8x, NMS8x or NRF8x)

**i** The remote display and operating module DKX001 is available as an accessory. For details refer to SD01763D.

- i**
  - The measured value is indicated on the DKX001 and on the local display and operating module simultaneously.
  - The operating menu cannot be accessed on both modules at the same time. If the operating menu is entered in one of these modules, the other module is automatically locked. This locking remains active until the menu is closed in the first module (back to measured value display).

## Supply voltage

**High voltage AC power supply:**

Operational value:

100 to 240 V<sub>AC</sub> (- 15 % + 10 %) = 85 to 264 V<sub>AC</sub>, 50/60 Hz

**Low voltage AC power supply:**

Operational value:

65 V<sub>AC</sub> (- 20 % + 15 %) = 52 to 75 V<sub>AC</sub>, 50/60 Hz

**Low voltage DC power supply:**

Operational value:

24 to 55 V<sub>DC</sub> (- 20 % + 15 %) = 19 to 64 V<sub>DC</sub>

## Power consumption

Maximum power varies depending on the configuration of the modules. The value shows maximum apparent power, select the applicable cables accordingly. The actual consumed effective power is 12 W.

**High voltage AC power supply:**

28.8 VA

**Low voltage AC power supply:**

21.6 VA

**Low voltage DC power supply:**

13.4 W

## Cable entries

Ordering feature 090 "Electrical Connection" <sup>1)</sup>	Cable entries (with blind plugs) <sup>2)</sup>
A	7 x thread M20
B	7 x thread M25
C	7 x thread G1/2
D	7 x thread G3/4
E	7 x thread NPT1/2
F	7 x thread NPT3/4

- 1) Position 090 of the order code, e.g. NMx8x-xxxxxxxxxxxxxA...
- 2) The entries NOT having I/O modules inside will be directly assembled with 316L blind plugs without adapters. For details of module positions, refer to the chapter for "Slots for I/O modules" in Operating Instructions.



For the following devices with TIIS Ex d approval, cable glands are attached to the device (see position 010 of the order code). These cable glands must be used.

- Micropilot NMR81-TA...
- Micropilot NMR81-TC...
- Micropilot NMR81-TE...

## Cable specification

## Terminals

**Wire cross section 0.2 to 2.5 mm<sup>2</sup> (24 to 13 AWG)**

Use for terminals with function: Signal and power supply

- Spring terminals (NMx8x-xx1...)
- Screw terminals (NMx8x-xx2...)

**Wire cross section max. 2.5 mm<sup>2</sup> (13 AWG)**

Use for terminals with function: Ground terminal in the terminal compartment

**Wire cross section max. 4 mm<sup>2</sup> (11 AWG)**

Use for terminals with function: Ground terminal at the housing

**Power supply line**

Standard device cable is sufficient for the power line.

**Analog signal lines**

Screened cable must be used for:

- the 4 to 20 mA signal lines.
- the RTD connection.

**Digital I/O signal lines**

- Shielded cable is recommended if using the relays.
- Observe the grounding concept of the plant.

**HART communication line**

Shielded cable is recommended if using the HART protocol. Observe the grounding concept of the plant.

**Modbus communication line**

- Observe the cable conditions from the TIA-485-A, Telecommunications Industry Association.
- Additional conditions: Use shielded cable.

**V1 communication line**

- 2-wire twisted pair, screened or unscreened cable
- Resistance in one cable:  $\leq 120 \Omega$
- Capacitance between lines:  $\leq 0.3 \mu\text{F}$

**WM550 communication line**

- 2-wire twisted pair, unscreened cable
- Cross section minimum 0.5 mm<sup>2</sup> (20 AWG)
- Maximum total cable resistance:  $\leq 250 \Omega$
- Cable with low capacitance

---

**Overvoltage protection**

On the communication and power lines; according to IEC 60060-1 / DIN 60079-14:

10 kA, 8/20  $\mu$ s, 10 pulses according to IEC 60060-1 / DIN 60079-14

## Performance characteristics

<b>Sampling rate</b>	$> 3.3 \text{ s}^{-1}$								
<b>Reference operating conditions</b>	<p>According to OIML R85 (2008)</p> <ul style="list-style-type: none"> <li>■ Temperature: <math>-25</math> to <math>+55 \text{ °C}</math> (<math>-13</math> to <math>131 \text{ °F}</math>)</li> <li>■ Atmospheric pressure</li> <li>■ Relative humidity (air): <math>65 \text{ %} \pm 15 \text{ %}</math></li> <li>■ Medium with good reflectivity and calm surface</li> <li>■ Signal beam hits the tank wall only at one side</li> <li>■ No major interference reflections inside the signal beam</li> </ul>								
<b>Measured value resolution</b>	$\leq 0.1 \text{ mm}$ ( $0.004 \text{ in}$ )								
<b>Maximum measured error</b>	<p>The following values are valid for a measuring distance up to <math>30 \text{ m}</math> (<math>100 \text{ ft}</math>)</p> <table border="1"> <thead> <tr> <th>Ordering feature 150 "Accuracy, Weight + Measure Approval"<sup>1)</sup></th><th>Maximum measured error</th></tr> </thead> <tbody> <tr> <td> <ul style="list-style-type: none"> <li>■ ITA: Maximum performance, 10-point calibration certificate</li> <li>■ NTA: Maximum performance, NMI type approval</li> <li>■ PTA: Maximum performance, PTB type approval</li> </ul> </td><td><math>\pm 0.5 \text{ mm}</math> (<math>\pm 0.02 \text{ in}</math>)</td></tr> <tr> <td> <ul style="list-style-type: none"> <li>■ ITC: Standard version, 10-point calibration certificate</li> <li>■ NTC: Custody transfer type approval according to NMI</li> <li>■ PTC: Custody transfer type approval according to PTB</li> </ul> </td><td><math>\pm 1 \text{ mm}</math> (<math>\pm 0.04 \text{ in}</math>)</td></tr> <tr> <td> <ul style="list-style-type: none"> <li>■ ICR: Standard version, w/o calibration certificate</li> <li>■ ICW: Standard version, 3-point calibration certificate</li> <li>■ ICX: Standard version, 5-point calibration certificate</li> </ul> </td><td><math>\pm 1 \text{ mm}</math> (<math>\pm 0.04 \text{ in}</math>)</td></tr> </tbody> </table> <p>1) Position 21 to 23 in the order code (e.g. NMR8x-xxxxxxxxxxxxxxxxxxxxxICR...)</p>	Ordering feature 150 "Accuracy, Weight + Measure Approval" <sup>1)</sup>	Maximum measured error	<ul style="list-style-type: none"> <li>■ ITA: Maximum performance, 10-point calibration certificate</li> <li>■ NTA: Maximum performance, NMI type approval</li> <li>■ PTA: Maximum performance, PTB type approval</li> </ul>	$\pm 0.5 \text{ mm}$ ( $\pm 0.02 \text{ in}$ )	<ul style="list-style-type: none"> <li>■ ITC: Standard version, 10-point calibration certificate</li> <li>■ NTC: Custody transfer type approval according to NMI</li> <li>■ PTC: Custody transfer type approval according to PTB</li> </ul>	$\pm 1 \text{ mm}$ ( $\pm 0.04 \text{ in}$ )	<ul style="list-style-type: none"> <li>■ ICR: Standard version, w/o calibration certificate</li> <li>■ ICW: Standard version, 3-point calibration certificate</li> <li>■ ICX: Standard version, 5-point calibration certificate</li> </ul>	$\pm 1 \text{ mm}$ ( $\pm 0.04 \text{ in}$ )
Ordering feature 150 "Accuracy, Weight + Measure Approval" <sup>1)</sup>	Maximum measured error								
<ul style="list-style-type: none"> <li>■ ITA: Maximum performance, 10-point calibration certificate</li> <li>■ NTA: Maximum performance, NMI type approval</li> <li>■ PTA: Maximum performance, PTB type approval</li> </ul>	$\pm 0.5 \text{ mm}$ ( $\pm 0.02 \text{ in}$ )								
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<ul style="list-style-type: none"> <li>■ ICR: Standard version, w/o calibration certificate</li> <li>■ ICW: Standard version, 3-point calibration certificate</li> <li>■ ICX: Standard version, 5-point calibration certificate</li> </ul>	$\pm 1 \text{ mm}$ ( $\pm 0.04 \text{ in}$ )								
<b>Hysteresis</b>	$0.2 \text{ mm}$ ( $0.008 \text{ in}$ )								
<b>Repeatability</b>	$0.2 \text{ mm}$ ( $0.008 \text{ in}$ )								
<b>Linearity</b>	Within maximum measured error								
<b>Long-term drift</b>	Within the specified error of measurement								
<b>Influence of ambient temperature</b>	Within the specified accuracy according to OIML R85 (2008)								

# Installation

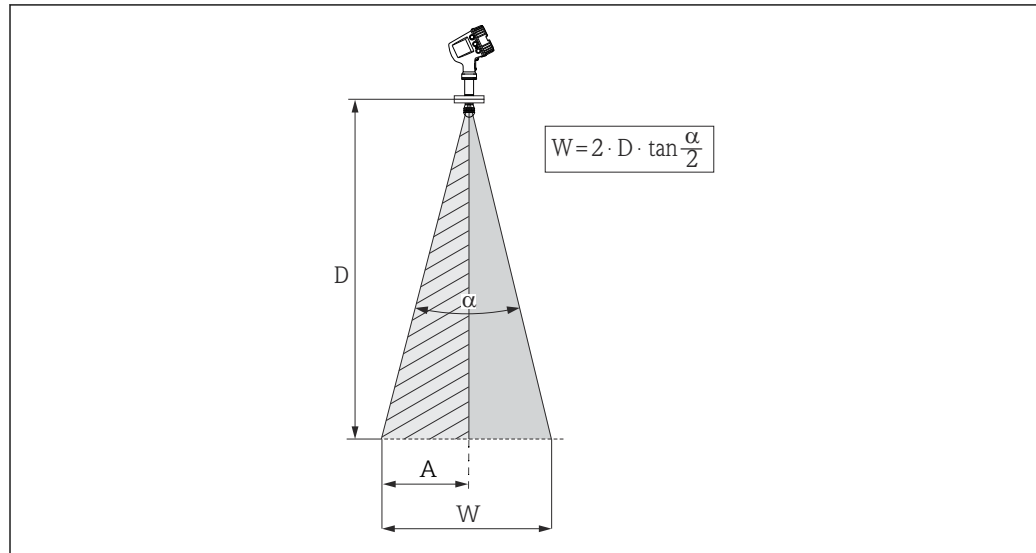
## Installation conditions

### Mounting position


#### General conditions

- Do not install in the centre of the tank.
- Do not install above a filling stream.
- Avoid any tank installations (e.g. limit switches, temperature probes) within in the signal beam.

#### Emitting angle



A0042277

 12 Relationship between beam angle  $\alpha$ , distance  $D$  and beam diameter  $W$ . Distance  $A$  is the minimum distance to the tank wall (or other installations). Distance  $A$  equals the half of beam diameter  $W$

The beam angle is defined as the angle  $\alpha$  where the energy density of the radar waves reaches half the value of the maximum energy density (3-dB-width). Microwaves are also emitted outside the signal beam and can be reflected off interfering installations.

Beam diameter **W** as a function of beam angle  $\alpha$  and measuring distance **D**:

NMR81			
S <sup>1)</sup>	50 mm (2 in)	80 mm (3 in)	100 mm (4 in)
$\alpha$ <sup>2)</sup>	7°	4°	3°
D <sup>3)</sup>	W <sup>4)</sup>		
5 m (16 ft)	0.61 m (2 ft)	0.35 m (1.1 ft)	0.26 m (0.9 ft)
10 m (33 ft)	1.22 m (4 ft)	0.7 m (2.3 ft)	0.52 m (1.7 ft)
15 m (49 ft)	1.83 m (6 ft)	1.05 m (3.4 ft)	0.79 m (2.6 ft)
20 m (66 ft)	2.44 m (8 ft)	1.4 m (4.6 ft)	1.05 m (3.4 ft)
25 m (82 ft)	3.05 m (10 ft)	1.74 m (5.7 ft)	1.31 m (4.3 ft)
30 m (98 ft)	3.66 m (12 ft)	2.09 m (6.9 ft)	1.57 m (5.2 ft)

- 1) Antenna size
- 2) Beam angle
- 3) Measuring distance
- 4) Beam diameter

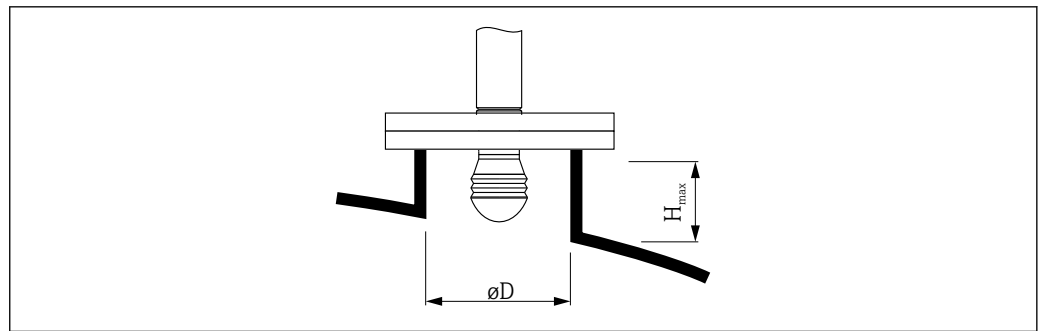


## Minimum distance (A) to tank wall or other installations

NMR81			
<b>S</b> <sup>1)</sup>	50 mm (2 in)	80 mm (3 in)	100 mm (4 in)
<b><math>\alpha</math></b> <sup>2)</sup>	7°	4°	3°
<b>D</b> <sup>3)</sup>	<b>A</b> <sup>4)</sup>		
5 m (16 ft)	0.31 m (1 ft)	0.17 m (0.6 ft)	0.13 m (0.4 ft)
10 m (33 ft)	0.61 m (2 ft)	0.35 m (1.1 ft)	0.26 m (0.9 ft)
15 m (49 ft)	0.92 m (3 ft)	0.52 m (1.7 ft)	0.39 m (1.3 ft)
20 m (66 ft)	1.22 m (4 ft)	0.7 m (2.3 ft)	0.52 m (1.7 ft)
25 m (82 ft)	1.53 m (5 ft)	0.87 m (2.9 ft)	0.65 m (2.1 ft)
30 m (98 ft)	1.83 m (6 ft)	1.05 m (3.4 ft)	0.79 m (2.6 ft)

- 1) Antenna size  
 2) Beam angle  
 3) Measuring distance  
 4) Minimum distance

## Mounting nozzle




A0032956

ØD Inner nozzle diameter  
 $H_{max}$  Maximum nozzle length

ØD <sup>1)</sup>	M ( $H_{max}$ ) <sup>2)</sup>		
	50 mm (2 in) <sup>3)</sup>	80 mm (3 in) <sup>4)</sup>	100 mm (4 in) <sup>5)</sup>
> 45 mm (1.77 in); ≤ 75 mm (2.95 in)	600 mm (24 in)	-	-
> 75 mm (2.95 in); ≤ 95 mm (3.74 in)	1000 mm (40 in)	1700 mm (68 in)	-
> 95 mm (3.74 in); ≤ 150 mm (5.91 in)	1250 mm (50 in)	2150 mm (86 in)	2850 mm (114 in)
> 150 mm (5.91 in)	1850 mm (74 in)	3200 mm (128 in)	4300 mm (172 in)

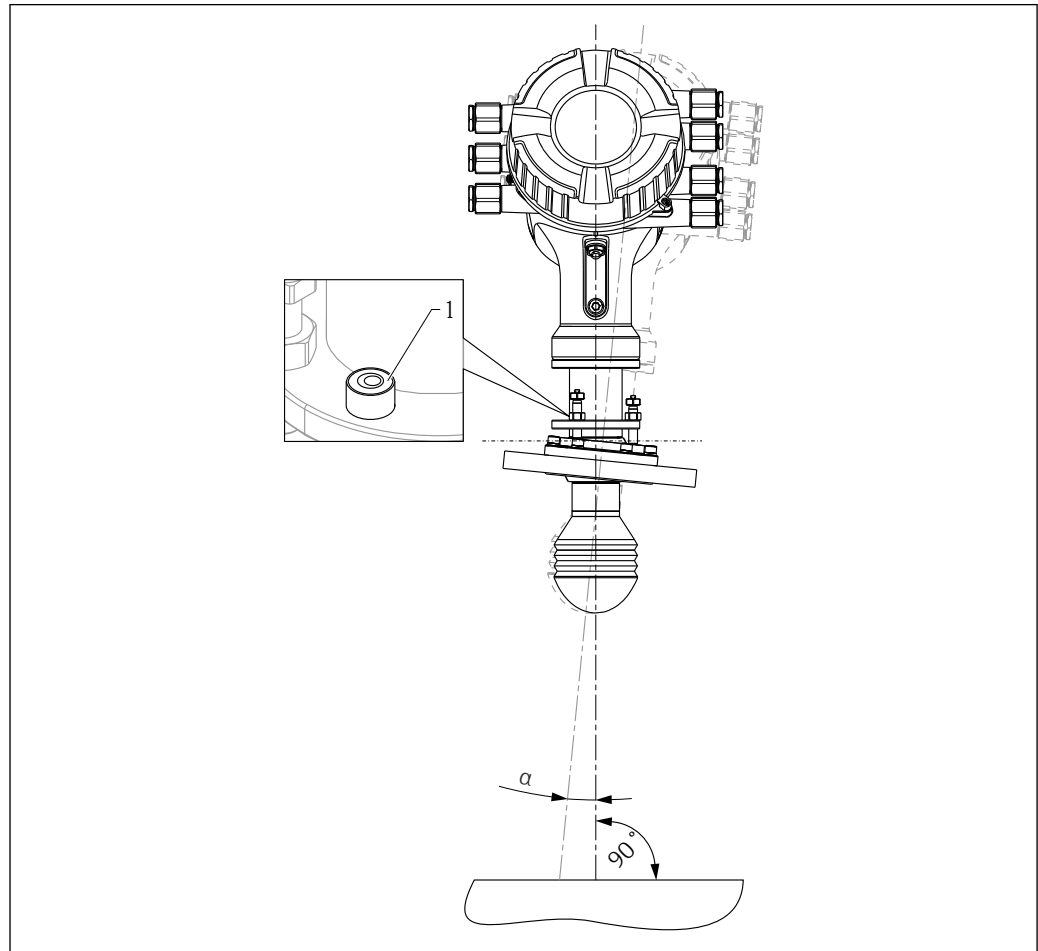
- 1) Inner nozzle diameter  
 2) Maximum nozzle length ( $H_{max}$ ). In case of longer nozzles, a reduced measuring performance is to be expected.  
 3) Feature 100 of the product structure: Antenna AB  
 4) Feature 100 of the product structure: Antenna AC  
 5) Feature 100 of the product structure: Antenna AD

### Vertical alignment of the 50mm(2") and 80mm(3") antenna


For optimum measuring accuracy the antenna must be installed at right angles to the medium surface. An adjustable seal is available for the alignment →  50.

### Vertical alignment of the 100mm(4") antenna

For optimum measuring accuracy the antenna must be installed at right angles to the medium surface. For this purpose the 100mm(4") antenna always has an alignment unit. A level tool indicating the correct alignment is attached to the alignment tool.




A0027776

 13 Alignment unit of the 100mm(4") antenna

1 Level tool indicating the correct alignment

$\alpha$  Alignment angle;  $\alpha_{max} = 25^\circ$

## Environment

Ambient temperature range	Device	-40 to +60 °C (-40 to +140 °F)
	Display module	-20 to +70 °C (-4 to +158 °F)  The readability of the display may be impaired at temperatures outside this temperature range.

Ambient temperature limits	 The following diagrams take into account only functional aspects. There may be further restrictions for certified device versions. Please refer to the separate Safety Instructions.
----------------------------	--

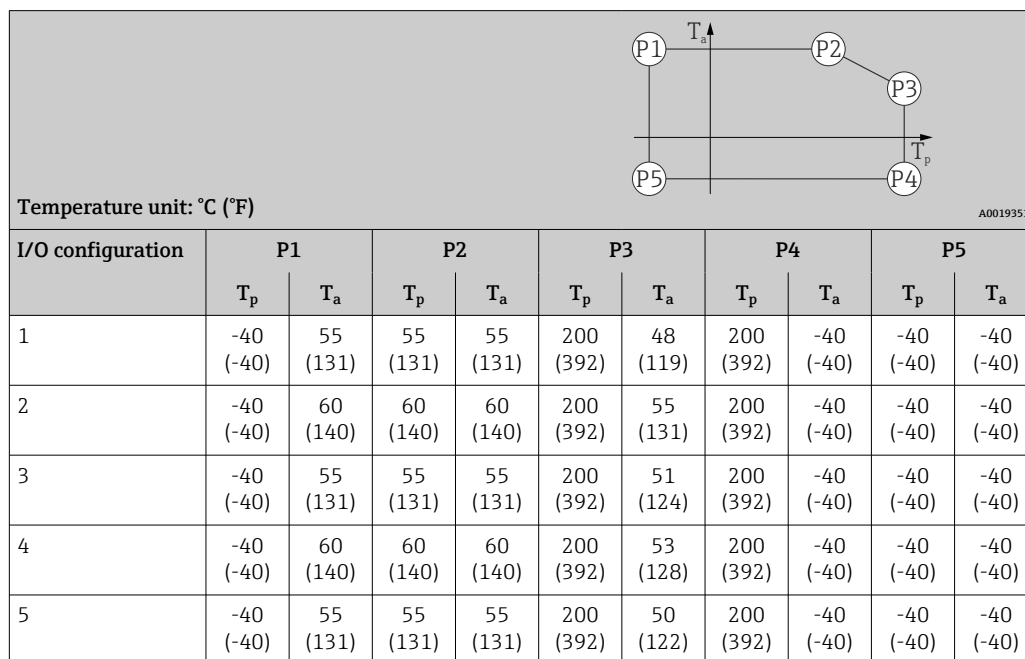
### Device configuration

The ambient temperature limits depend on the I/O modules present in the slots of the terminal compartment. Data are given for the following five typical configurations:

I/O configuration	 <small>A0023888</small>				
	1 (worst case)	✓	✓	✓	✓
	2 (best case)	-	-	-	-
	3	✓	✓	-	-
	4	✓	-	-	-
	5	✓	✓	-	✓

With a temperature ( $T_p$ ) at the process connection the admissible ambient temperature ( $T_a$ ) is reduced according to the following diagram (temperature derating):

*Ambient temperature limits for NMR81*



**Classification of environmental conditions according to DIN EN 60721-3-4**

4K5, 4K6, 4B1, 4M7, 4Z2, 4Z3, 4Z8

**Storage temperature**

-50 to +80 °C (-58 to +176 °F)

**Humidity**

≤ 95 %

**Degree of protection**

- IP68/66 according to DIN EN 60529
- Type 6P/4x according to NEMA 250

**Shock resistance**

- 30 g (18 ms) according to DIN EN 60068-2-27 (1993)
- Classification according to DIN EN 60721-3-4: 4M7

**Vibration resistance**


- 20 to 2 000 Hz, 1 (m/s<sup>2</sup>)/Hz according to DIN EN 60068-2-64 (1994)
- This corresponds to an acceleration value of 4.5 g and fulfills class 4M7 of DIN EN 60721-3-4 (1995)

**Electromagnetic compatibility (EMC)**

- Transient emissions according to DIN EN 61326, class B
- Interference resistance according to DIN EN 61326, Appendix A (Industry use) and NAMUR recommendation NE21

## Process

Process temperature range	Device	Process temperature range
	NMR81	-40 to +200 °C (-40 to +392 °F)
Process pressure range	Device	Process pressure range
	NMR81	-1 to +16 bar (-14.5 to +232 psi)
Dielectric constant	Application	Dielectric constant
	Free space	$\epsilon_r \geq 1.4$ <sup>1)</sup>

1) For the dependence of the measuring range on the dielectric constant: →  8



For dielectric constants (DC values) of many media commonly used in various industries refer to:

- the Endress+Hauser DC manual (CP01076F)
- the Endress+Hauser "DC Values App" (available for Android and iOS)

## Custody transfer approval

Ordering feature 150 "Accuracy, Weight + Measure Approval" <sup>1)</sup>	Accuracy properties
ICR	Standard version ( $\pm 1$ mm), without calibration certificate
ICW	Standard version ( $\pm 1$ mm), 3-point calibration certificate
ICX	Standard version ( $\pm 1$ mm), 5-point calibration certificate
ITA	Maximum performance ( $\pm 0.4$ mm), 10-point calibration certificate
ITC	Standard version ( $\pm 1$ mm), 10-point calibration certificate
NTA	Maximum performance ( $\pm 0.5$ mm), type approval according to NMi, OIML R85, API 3.1B, ISO4266, factory calibration certificate
NTC	Custody transfer ( $\pm 1$ mm) type approval according to NMi, OIML R85, API 3.1B, ISO4266, factory calibration certificate
PTA	Maximum performance ( $\pm 0.5$ mm), PTB type approval, factory calibration certificate
PTC	Custody transfer ( $\pm 1$ mm) type approval per PTB, factory calibration certificate

1) Position 21 to 23 in the order code (e.g. NMR8x-xxxxxxxxxxxxxxxxxxxxICR...)



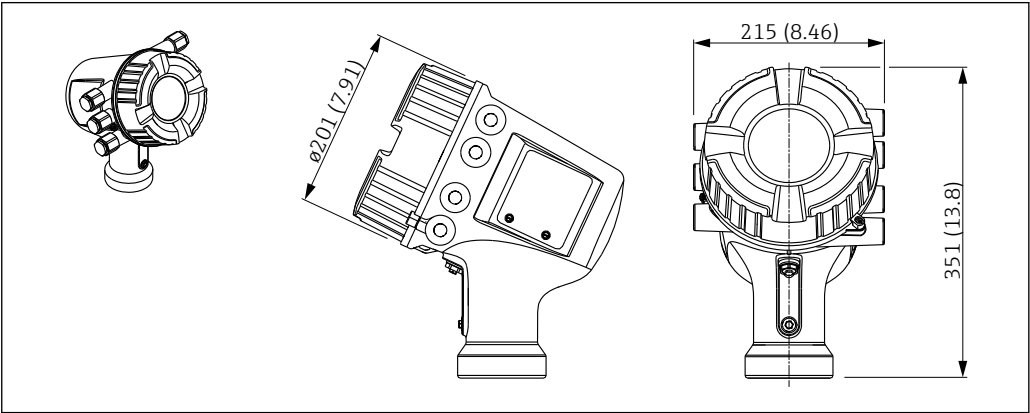
Micropilot NMR8x that are certified for Custody Transfer applications are calibrated on a certified production rig. The production rig reference standard is a laser tracker with an absolute accuracy of  $\pm 0.016$  mm and a resolution of 0.0001 mm. Calibration is performed at 10 equally-spaced measuring points over the full measuring range.

The Maximum Permissible Error (MPE) is  $\pm 0.5$  mm ( $\pm 0.02$  in) for Maximum performance models, and  $\pm 1$  mm ( $\pm 0.04$  in) for Custody transfer models. The resultant Factory Calibration Certificate is included in the scope of delivery along with the respective type approval certificate.

Mechanical construction

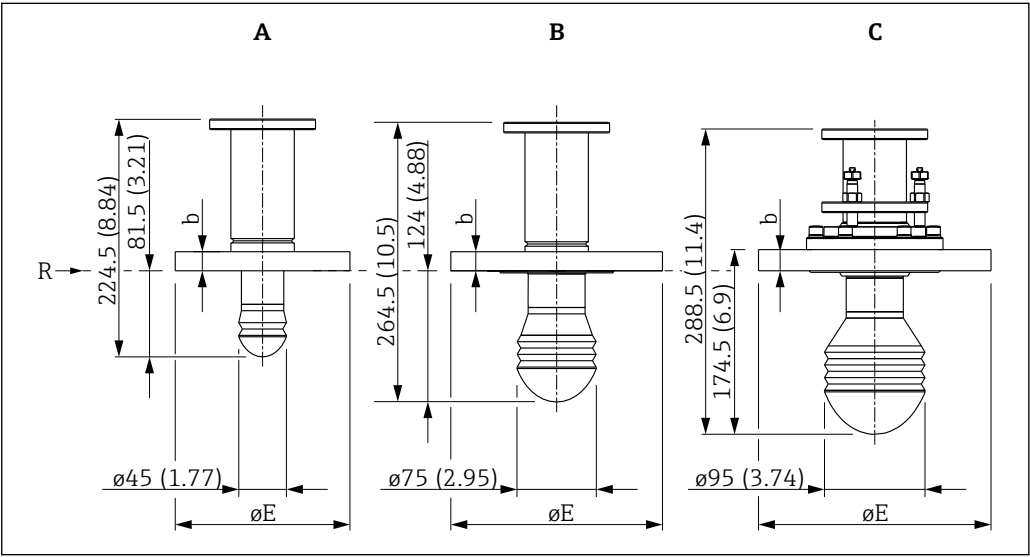
Dimensions

Housing



14 Dimensions of the electronics housing; unit of measurement: mm (in); adapters for cable entries are not taken into account in this drawing.

Process connection and sensor



15 Antenna size; unit of measurement: mm (in)

- A Antenna: 50mm/2"
- B Antenna: 80mm/3"
- C Antenna: 100mm/4"
- R Reference point of the measurement

Flanges according to ASME B16.5. Pressure rating 150 lbs

D <sup>1)</sup>	E <sup>2)</sup>					
	2"	3"	4"	6"	8"	10"
b	19.1 mm (0.75 in)	23.9 mm (0.94 in)	23.9 mm (0.94 in)	25.4 mm (1 in)	28.4 mm (1.12 in)	30.2 mm (1.19 in)
φE	φ152.4 mm (6 in)	φ190.5 mm (7.5 in)	φ228.6 mm (9 in)	φ279.4 mm (11 in)	φ342.9 mm (13.5 in)	φ406.4 mm (16 in)

1) Dimension  
2) Nominal diameter

Flanges according to ASME B16.5. Pressure rating 300 lbs

D <sup>1)</sup>	E <sup>2)</sup>					
	2"	3"	4"	6"	8"	10"
b	22.4 mm (0.88 in)	28.4 mm (1.12 in)	31.8 mm (1.25 in)	36.6 mm (1.44 in)	-	-
φE	φ165.1 mm (6.5 in)	φ209.5 mm (8.25 in)	φ254 mm (10 in)	φ317.5 mm (12.5 in)	-	-

- 1) Dimension  
2) Nominal diameter

Flanges according to EN1092-1 (suitable for DIN2527). Pressure rating PN10 and PN16 <sup>1)</sup>

D <sup>2)</sup>	E <sup>3)</sup>					
	DN50	DN80	DN100	DN150	DN200	DN250
b	18 mm (0.71 in)	20 mm (0.79 in)	20 mm (0.79 in)	22 mm (0.87 in)	24 mm (0.94 in)	26 mm (1.02 in)
φE	φ165 mm (6.5 in)	φ200 mm (7.87 in)	φ220 mm (8.66 in)	φ285 mm (11.2 in)	φ340 mm (13.4 in)	φ405 mm (15.9 in)

- 1) Ordering feature 140 (position 18 to 20 of the order code)  
2) Dimension  
3) Nominal diameter

Flanges according to EN1092-1 (suitable for DIN2527). Pressure rating PN25 and PN40 <sup>1)</sup>

D <sup>2)</sup>	E <sup>3)</sup>					
	DN50	DN80	DN100	DN150	DN200	DN250
b	20 mm (0.79 in)	24 mm (0.94 in)	24 mm (0.94 in)	28 mm (1.1 in)	-	-
φE	φ165 mm (6.5 in)	φ200 mm (7.87 in)	φ235 mm (9.25 in)	φ300 mm (11.8 in)	-	-

- 1) Ordering feature 140 (position 18 to 20 of the order code)  
2) Dimension  
3) Nominal diameter

Flanges according to JIS B2220. Pressure rating 10 K <sup>1)</sup>

D <sup>2)</sup>	E <sup>3)</sup>					
	50A	80A	100A	150A	200A	250A
b	16 mm (0.63 in)	18 mm (0.71 in)	18 mm (0.71 in)	22 mm (0.87 in)	22 mm (0.87 in)	24 mm (0.94 in)
φE	φ155 mm (6.1 in)	φ185 mm (7.28 in)	φ210 mm (8.27 in)	φ280 mm (11 in)	φ330 mm (13 in)	φ400 mm (15.7 in)

- 1) Ordering feature 140 (position 18 to 20 of the order code)  
2) Dimension  
3) Nominal diameter

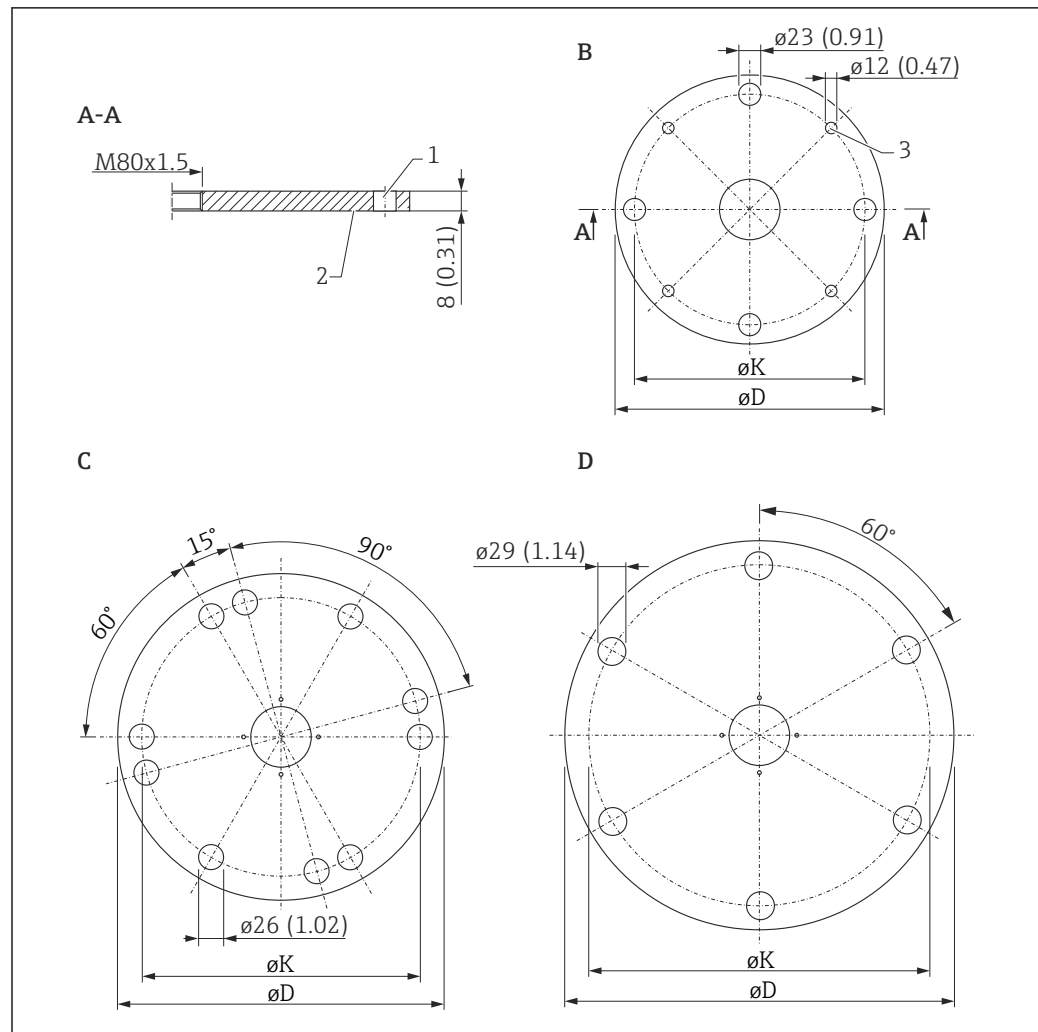


Flanges according to JPI 7S-15. Pressure rating 150 lbs (A) / 300 lbs (B) <sup>1)</sup>

<b>D</b> <sup>2)</sup>	<b>E</b> <sup>3)</sup>		
	<b>80A</b>	<b>100A</b>	<b>150A</b>
<b>A</b> <sup>4)</sup>			
b	23.9 mm (0.94 in)	23.9 mm (0.94 in)	25.4 mm (1 in)
ΦE	Φ190.5 mm (7.5 in)	Φ228.6 mm (9 in)	Φ279.4 mm (11 in)
<b>B</b> <sup>5)</sup>			
b	28.4 mm (1.12 in)	31.8 mm (1.25 in)	25.4 mm (1 in)
ΦE	Φ209.5 mm (8.25 in)	Φ254 mm (10 in)	Φ279.4 mm (11 in)

- 1) Ordering feature 140 (position 18 to 20 of the order code)
- 2) Dimension
- 3) Nominal diameter
- 4) Pressure rating 150 lbs
- 5) Pressure rating 300 lbs

## UNI flanges



A0027691

16 UNI flanges

- B UNI flange DN150/6"/150  
 C UNI flange DN200/8"/200  
 D UNI flange DN250/10"/250

## UNI flange DN150/6"/150

- Option of ordering feature 140 ("Process Connection")<sup>5)</sup>  
 RKJ
- Suitable for
  - DN150, PN10/16 (EN1092-1)
  - NPS 6" Cl. 150 (ASME B16.5)
  - 10K 150A (JIS B2220)
- $\varnothing D$   
 280 mm (11.0 in)
- $\varnothing K$   
 240 mm (9.45 in)
- Material  
 1.4301

5) Position 18 to 20 of the order code)

**UNI flange DN200/8"/200**

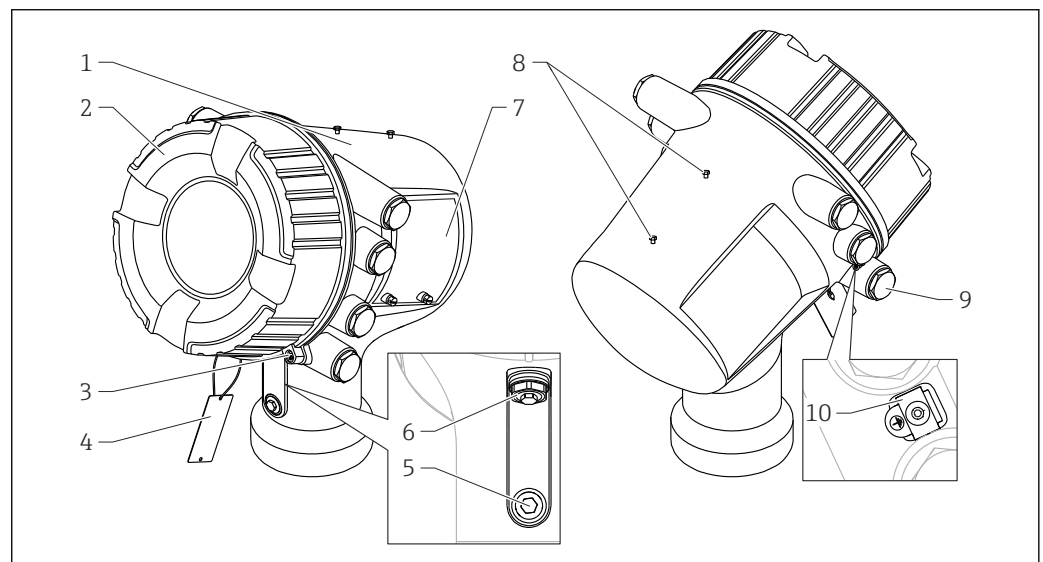
- Option of ordering feature 140 ("Process Connection") <sup>5)</sup>  
RLJ
- Suitable for
  - DN200, PN10/16 (EN1092-1)
  - NPS 8" Cl. 150 (ASME B16.5)
  - 10K 200A (JIS B2220)
- ØD  
340 mm (13.4 in)
- ØK  
294.5 mm (11.6 in)
- Material  
1.4301

**UNI flange DN250/10"/250**

- Option of ordering feature 140 ("Process Connection") <sup>5)</sup>  
RMJ
- Suitable for
  - DN250, PN10/16 (EN1092-1)
  - NPS 10" Cl. 150 (ASME B16.5)
  - 10K 250A (JIS B2220)
- ØD  
405 mm (15.9 in)
- ØK  
358 mm (14.1 in)
- Material  
1.4301

**Weight**

- Housing with electronics:
  - Aluminum housing: approx. 12 kg (26 lb)
  - Stainless steel housing: approx. 21 kg (46 lb)
- Sensor and process connection: 6 to 36 kg (13 to 80 lb); dependent on the device version

**Materials****Materials of housing**

A0027788

- 1 Housing
- 2 Cover
- 3 Cover lock
- 4 Tag for measuring point label
- 5 Pressure release stopper for Ex i/IS chamber
- 6 Pressure release stopper for Ex d/XP chamber
- 7 Nameplate
- 8 Dummy screws for weather protection cover
- 9 Dummy plug, cable gland or adapter. Depending on device version
- 10 Ground terminal

**1 Housing**

- **Aluminum** housing type, RAL 5012 (blue):
  - Housing: AC 43000 T6; AlSi10Mg (< 0,1 % Cu)
  - Coating: Polyester
- **Stainless steel** housing type: 316L (1.4404)

**2 Cover**

- **Aluminum** housing type cover, RAL 7035 (grey): AC 43000 T6; AlSi10Mg (< 0,1 % Cu)
- **Stainless steel** housing type cover: 316L (1.4404)
- Window: Glass
- Seal: FVMQ
- Thread-coating: Graphite-based lubricant varnish

**3 Cover lock**

- Capstan screw: 316L (1.4404)
- Clamp: 316L (1.4435)

**4 Tag for measuring point label**

316L (1.4404)

**5 Pressure release stopper for Ex i/IS chamber**

316L (1.4404)

**6 Pressure release stopper for Ex d/XP chamber**

- Stopper: 316L (1.4404)
- O-ring: EPDM

**7 Nameplate**

- **Aluminum** housing type:
  - Sticker: Plastic
- **Stainless steel** housing type:
  - Nameplate: 316L (1.4404)
  - Groove pins: 316Ti (1.4571)
- Sealing screw: A4
- O-ring: FKM

**8 Dummy screws for weather protection cover**

- Screw: A4-70
- O-ring: EPDM

**9 Dummy plug, cable gland or adapter <sup>6)</sup>**

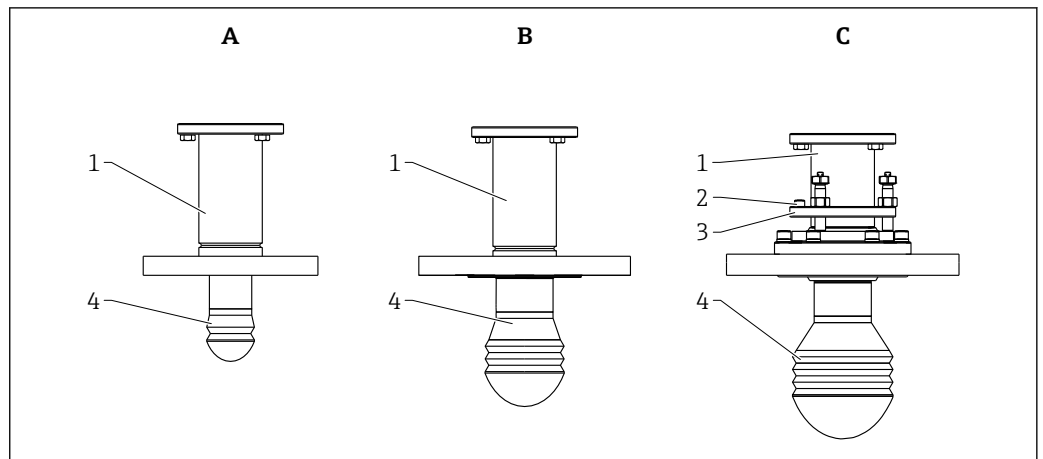
- Dummy plug
  - 1.4435
  - LD-PE
- Adapter:
  - Ms/Ni (TIIS)
  - 1.4404 (other versions)
- Seal:
  - EPDM
  - NBR
  - PTFE tape

**10 Ground terminal**

- Screw: A4-70
- Spring washer: A4
- Clamp and holder: 316L (1.4404)

6) Depending on device version

## Materials for antenna and process connection



A0026322

- 1 Shaft and flange  
 2 Level tool  
 3 Alignment unit  
 4 Lens antenna

**1 Shaft and flange**

- Shaft and flange: 316L (1.4404)
- Screws to housing: A2
- Spring washer: 316L (1.4404)
- Insulating sleeve: PPS-GF40
- Set screw: A4

**2 Level tool**

303 (1.4305)

**3 Alignment unit**

- Locking unit: 316L (1.4404)
- Seal: FKM/FFKM/HNBR
- Locking screws: A4
- Adjusting bolts: 316 (1.4401)
- Nuts for adjusting bolts: A4
- Capstan head screw: A2;  
secured by thread-locking fluid

**4 Lens antenna**

- Lens: PTFE
- Seal: FKM/FFKM/HNBR

## Operability

### Operating concept

#### Operator-oriented menu structure for user-specific tasks

- Commissioning
- Operation
- Diagnostics
- Expert level

#### Operating languages

- English
- German
- Japanese



Feature 500 of the product structure determines which of these languages is preset on delivery.

#### Quick and safe commissioning

- Guided menus ("Make-it-run" wizards) for applications
- Menu guidance with brief explanations of the individual parameter functions

#### Reliable operation

Standardized operation at the device and in the operating tools

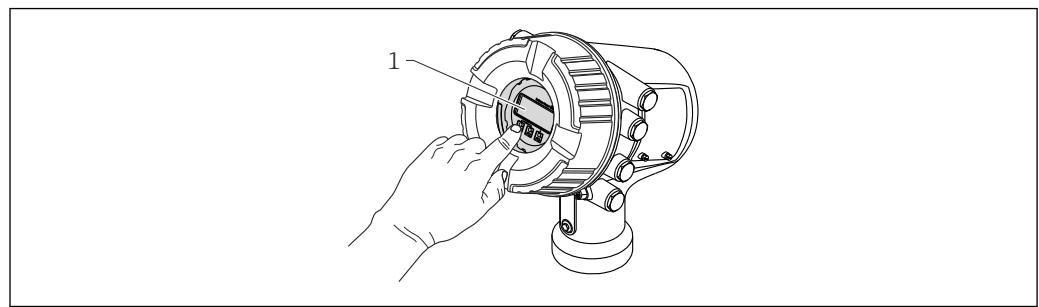
#### Efficient diagnostics increase measurement reliability

- Remedy information is integrated in plain text
- Diverse simulation options

### Operating options

- Local display; operation via the local display is possible without opening the device.
- Tank Gauging system
- Plant Asset Management tool (e.g. FieldCare); connected via
  - HART
  - Service port (CDI)

### Local operation



A0023753

17 Local operation of the Micropilot NMR81/NMR84

1 Display and operating module

#### Display elements

- 4-line display
  - White background lighting; switches to red in event of device errors
  - Format for displaying measured variables and status variables can be individually configured
  - Permitted ambient temperature for the display: -20 to +70 °C (-4 to +158 °F)
- The readability of the display may be impaired at temperatures outside the temperature range.

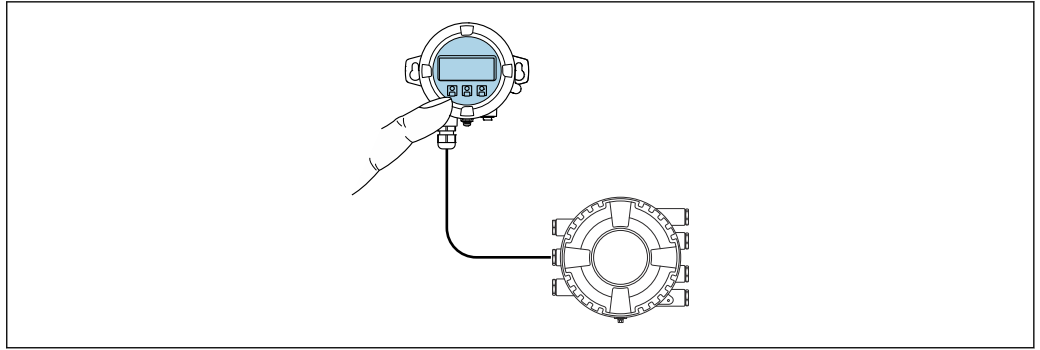
#### Operating elements

- External operation via touch control; 3 optical keys:
- Operating elements also accessible in various hazardous areas

#### Remote display and operating module DKX001

The display and operating elements correspond to those of the display module.

Depending on the installation location, the remote display module DKX001 provides better access to the operating elements than the display on the device.



A0042197

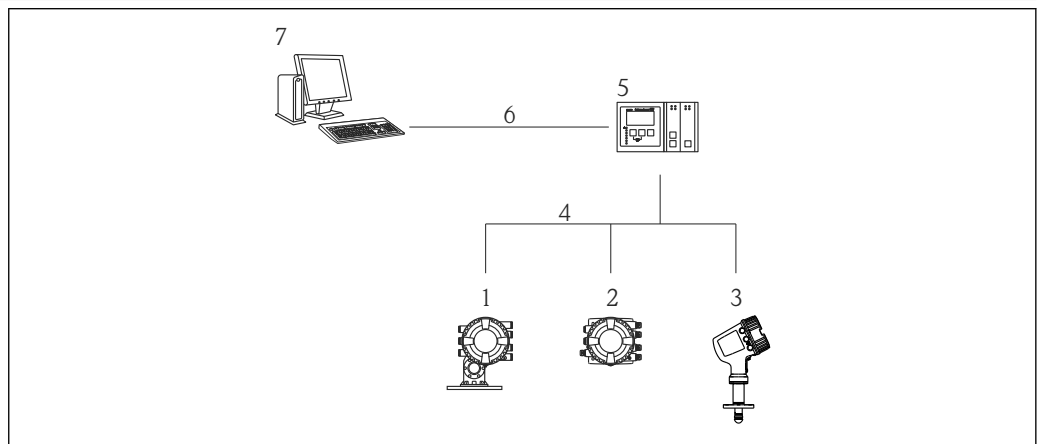
18 Operation via remote display and operating module DKX001

**i** The remote display and operating module DKX001 is available as an accessory. For details refer to SD01763D.

- i**
  - The measured value is indicated on the DKX001 and on the local display and operating module simultaneously.
  - The operating menu cannot be accessed on both modules at the same time. If the operating menu is entered in one of these modules, the other module is automatically locked. This locking remains active until the menu is closed in the first module (back to measured value display).

The housing material of the display and operating module DKX001 can be selected in the order code. There are 2 options : alu and stainless steel.

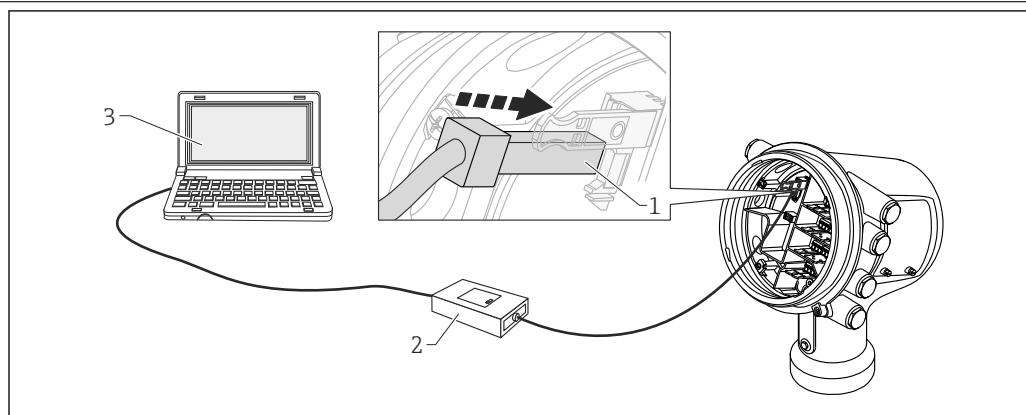
## Remote operation



A0025621

19 Remote operation of Tank Gauging devices

- 1 Proservo NMS8x
- 2 Tankside Monitor NRF81
- 3 Micropilot NMR8x
- 4 Field protocol (e.g. Modbus, V1)
- 5 Tankvision Tank Scanner NXA820
- 6 Ethernet
- 7 Computer with operating tool (e.g. FieldCare)

**Operation via service interface**

A0023737

**20 Operation via service interface**

- 1 Service interface (CDI = Endress+Hauser Common Data Interface)
- 2 Commubox FXA291
- 3 Computer with "FieldCare" operating tool and "CDI Communication FXA291" COM DTM



## Certificates and approvals



Currently available certificates and approvals can be called up via the product configurator.

### CE mark

The measuring system meets the legal requirements of the applicable EC guidelines. These are listed in the corresponding EC Declaration of Conformity together with the standards applied.

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

### RCM-Tick marking

The supplied product or measuring system meets the ACMA (Australian Communications and Media Authority) requirements for network integrity, interoperability, performance characteristics as well as health and safety regulations. Here, especially the regulatory arrangements for electromagnetic compatibility are met. The products are labelled with the RCM- Tick marking on the name plate.



A0029561

### Ex approval

Certificates are available online for the following approval types.

- AEx
- ATEX
- FM C/US
- EAC Ex
- IEC Ex
- INMETRO Ex
- JPN Ex
- KC Ex
- NEPSI



Currently available certificates and approvals can be called up via the product configurator.

Additional safety instructions must be followed for use in hazardous areas. Please refer to the separate "Safety Instructions" (XA) document included in the delivery. Reference to the applicable XA can be found on the nameplate.

### Single seal according to ANSI/ISA 12.27.01

The devices have been designed according to ANSI/ISA 12.27.01 as single seal devices, allowing the user to waive the use and save the cost of installing external secondary process seals in the conduit as required by the process sealing sections of ANSI/NFPA 70 (NEC) and CSA 22.1 (CEC). These instruments comply with the North-American installation practice and provide a very safe and cost-saving installation for pressurized applications with hazardous fluids.

Further information can be found in the Safety Instructions (XA) of the relevant devices.

### Functional Safety (SIL)

Use for level monitoring (MIN, MAX, range) up to SIL 2/3 according to IEC 61508:2010.

For details refer to the "Functional Safety Manual":  
SD01891G (NMR81, NMR84)

### WHG


DIBt: Z-65.16-588

### Weight & Measure approval

- OIML R85 (2008)
- NMi
- PTB
- PAC
- WELMEC
- GOST (in preparation)



The device has a sealable locking switch according to the Weight & Measure requirements. This switch locks all software parameters related to the measurement. The switching status is indicated on the display and via the communication protocol.

<b>Radio standard EN302372-1/2</b>	The devices are conform with the TLPR (Tanks Level Probing Radar) standard EN302372-1/2 and can always be used in closed tanks or bins. For installation, points a to f in Annex B of EN302372-1 have to be taken into account.																						
<b>FCC / Industry Canada</b>	<p>This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.</p> <p>This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) This device may not interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.</p> <p><i>Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.</i></p> <p>[Any] changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.</p>																						
<b>Non-ionizing radiation protection</b>	According to guideline 2004/40/EG-ICNIRP Guidelines EN50371																						
<b>CRN approval</b>	<p>Some device versions have a CRN approval. Devices are CRN approved if the following two conditions are met:</p> <ul style="list-style-type: none"> <li>■ The CRN approval is selected (Product structure: Feature 590 "Additional Approval", option LD "CRN")</li> <li>■ The device has a CRN approved process connection according to the following table:</li> </ul> <table border="1"> <thead> <tr> <th>Feature 140: Process Connection</th><th>Meaning</th></tr> </thead> <tbody> <tr><td>ADJ</td><td>NPS 2" Cl.150 RF, 316/316L, flange ASME B16.5</td></tr> <tr><td>AFJ</td><td>NPS 3" Cl.150 RF, 316/316L, flange ASME B16.5</td></tr> <tr><td>AGJ</td><td>NPS 4" Cl.150 RF, 316/316L, flange ASME B16.5</td></tr> <tr><td>AHJ</td><td>NPS 6" Cl.150 RF, 316/316L, flange ASME B16.5</td></tr> <tr><td>AJJ</td><td>NPS 8" Cl.150 RF, 316/316L, flange ASME B16.5</td></tr> <tr><td>AKJ</td><td>NPS 10" Cl.150 RF, 316/316L, flange ASME B16.5</td></tr> <tr><td>AQJ</td><td>NPS 2" Cl.300 RF, 316/316L, flange ASME B16.5</td></tr> <tr><td>ASJ</td><td>NPS 3" Cl.300 RF, 316/316L, flange ASME B16.5</td></tr> <tr><td>ATJ</td><td>NPS 4" Cl.300 RF, 316/316L, flange ASME B16.5</td></tr> <tr><td>AUJ</td><td>NPS 6" Cl.300 RF, 316/316L, flange ASME B16.5</td></tr> </tbody> </table> <p> ■ Process connections without CRN approval are not included in this table.</p> <p>■ CRN approved devices are marked with the registration number OF18153.5C on the nameplate.</p>	Feature 140: Process Connection	Meaning	ADJ	NPS 2" Cl.150 RF, 316/316L, flange ASME B16.5	AFJ	NPS 3" Cl.150 RF, 316/316L, flange ASME B16.5	AGJ	NPS 4" Cl.150 RF, 316/316L, flange ASME B16.5	AHJ	NPS 6" Cl.150 RF, 316/316L, flange ASME B16.5	AJJ	NPS 8" Cl.150 RF, 316/316L, flange ASME B16.5	AKJ	NPS 10" Cl.150 RF, 316/316L, flange ASME B16.5	AQJ	NPS 2" Cl.300 RF, 316/316L, flange ASME B16.5	ASJ	NPS 3" Cl.300 RF, 316/316L, flange ASME B16.5	ATJ	NPS 4" Cl.300 RF, 316/316L, flange ASME B16.5	AUJ	NPS 6" Cl.300 RF, 316/316L, flange ASME B16.5
Feature 140: Process Connection	Meaning																						
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<b>Pressure equipment with allowable pressure ≤ 200 bar (2 900 psi)</b>	<p>Pressure instruments with a flange and threaded boss that do not have a pressurized housing do not fall within the scope of the Pressure Equipment Directive, irrespective of the maximum allowable pressure.</p> <p><b>Reasons:</b></p> <p>According to Article 2, point 5 of EU Directive 2014/68/EU, pressure accessories are defined as "devices with an operational function and having pressure-bearing housings".</p> <p>If a pressure instrument does not have a pressure-bearing housing (no identifiable pressure chamber of its own), there is no pressure accessory present within the meaning of the Directive.</p>																						

**Test, certificate**

Ordering feature 580 "Test, Certificate"	Designation
JA	3.1 Material certificate, wetted metallic parts, EN10204-3.1 inspection certificate
JB	Conformity to NACE MR0175, wetted metallic parts
JE	Conformity to NACE MR0103, wetted metallic parts
KD	Helium leak test, internal procedure, inspection certificate
KE	Pressure test, internal procedure, inspection certificate
KG	PMI test (XRF), internal procedure, wetted metallic parts, inspection certificate
KP	Liquid penetrant test AD2000-HP5-3 (PT), wetted/pressurized metallic parts, inspection certificate
KQ	Liquid penetrant test ISO23277-1 (PT), wetted/pressurized metallic parts, inspection certificate
KR	Liquid penetrant test ASME VIII-1 (PT), wetted/pressurized metallic parts, inspection certificate
KS	Welding documentation, wetted/pressurized seams

**Other standards and guidelines****Industry standards**

- Directive 2002/95/EC: "Restriction of Hazardous Substances Directive" (RoHS)
- Directive 2004/22/EC: "Measuring Instruments Directive" (MID)
- IEC61508: "Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems" (SIL)
- NACE MR 0175, NACE MR 0103: "Sulfide stress cracking resistant metallic materials for oilfield equipment"
- API Recommended Practice 2350: "Overfill Protection for Storage Tanks in Petroleum Facilities"
- API MPMS: "Manual of Petroleum Measurement Standards"
- EN 1127: "Explosive atmospheres - Explosion prevention and protection"
- IEC 60079: "Equipment protection"
- EN 1092: "Flanges and their joints"
- EN 13463: "Non-electrical equipment for use in potentially explosive atmospheres"
- TIA-485-A: "Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems"
- IEC61511: "Functional safety - Safety instrumented systems for the process industry sector"
- IEEE 754: "Standard for Binary Floating-Point Arithmetic for microprocessor systems"
- ISO4266: "Petroleum and liquid petroleum products - measurement of level and temperature in storage tanks by automatic methods"
- ISO6578: "Refrigerated hydrocarbon liquids - Static measurement - Calculation procedure"
- ISO 11223: "Petroleum and liquid petroleum products - Determination of volume, density and mass of the contents of vertical cylindrical tanks by Hybrid Tank Measurement Systems"
- ISO15169: "Petroleum and liquid petroleum products - Direct static measurement - Measurement of content of vertical storage tanks by hydrostatic tank gauging"
- JIS K2250: "Petroleum Measurement Tables"
- JIS B 8273: "Bolted flange for pressure vessels"
- G.I.I.G.N.L.: "LNG Custody transfer handbook"
- NAMUR NEO43: "Standardization of the Signal Level for the Failure Information of Digital Transmitters"
- NAMUR NE107: "Self-Monitoring and Diagnosis of Field Devices"
- PTBA-A-4.2: "Volume measuring devices for liquids in a stationary condition - Storage containers and their measuring devices"

**Metrological standards**

- OIML R85 (2008) "Requirements for ambient temperature low -25 °C (-13 °F) and ambient temperature high +55 °C (+131 °F)
- "Mess- und Eichverordnung" (Calibration regulations for the Federal Republic of Germany)
- Directive 2004/22/EC of the European Parliament and of the Council of 31 March 2004 on measuring instruments

## Ordering information

### Ordering information

Detailed ordering information is available for your nearest sales organization [www.addresses.endress.com](http://www.addresses.endress.com) or in the Product Configurator under [www.endress.com](http://www.endress.com) :

1. Click Corporate
2. Select the country
3. Click Products
4. Select the product using the filters and search field
5. Open the product page

The Configuration button to the right of the product image opens the Product Configurator.

#### **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

### Calibration certificate

A calibration certificate is included if one of the following options is selected in ordering feature 150 ("Accuracy, Weight + Measure Approval" <sup>1)</sup>).

Option of ordering feature 150 "Accuracy, Weight + Measure Approval" <sup>1)</sup>	Meaning	Number of calibration points
ICW	Standard version, 3-point calibration certificate	3
ICX	Standard version, 5-point calibration certificate	5
ITA	Maximum performance, 10-point calibration certificate	10
ITC	Standard version, 10-point calibration certificate	10
NTA	Maximum performance, NMI type approval acc. to OIML R85, API 3.1B, ISO 4622, factory calib. certificate	10
NTC	Custody transfer, NMI type approval acc. to OIML R85, API 3.1B, ISO 4622, factory calib. certificate	10
PTA	Maximum performance, PTB type approval, factory calib. certificate	10
PTC	Custody transfer, PTB type approval, factory calib. certificate	10

1) Positions 21 to 23 of the order code

-  The calibration points are evenly spaced and spread over the calibration range of 30 m (98 ft).
- The calibration points are checked under reference conditions.

### Marking





Option of ordering feature 895 "Marking"	Meaning
Z1	Tagging (TAG)
Z2	Bus address

Optionally, the device can be ordered with a specific tagging and/or bus address according to the table above. When the respective option is selected, the tag or bus address must be defined in an additional specification.

## Application packages

### Advanced tank measurement methods

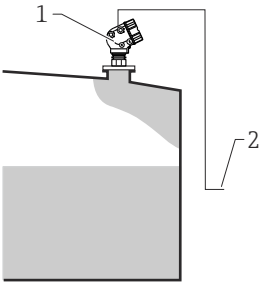
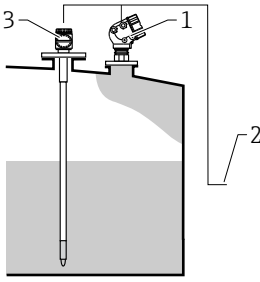
The device software provides the following tank measurement methods:

- Direct level measurement →  46
- Hybrid tank measurement system (HTMS) →  47
- Hydrostatic tank shell correction (HyTD) →  48
- Thermal tank shell correction (CTSh) →  48

### Direct level measurement

If no advanced tank measurement methods have been selected, level and temperature are measured directly.


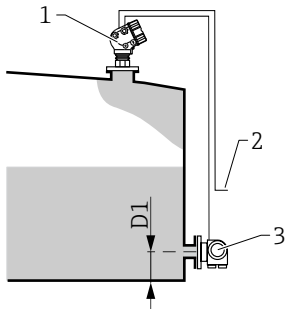

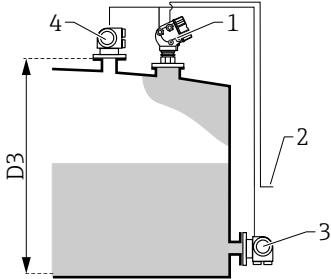
### Direct level measurement modes

Measuring mode	Installation example	Measured variables	Calculated variables
Level only	 <p style="text-align: right;">A0027111</p> <p>1 Micropilot 2 To inventory management system</p>	Level	None
Level + temperature	 <p style="text-align: right;">A0027112</p> <p>1 Micropilot 2 To inventory management system 3 Temperature transmitter (point or average)</p>	<ul style="list-style-type: none"> <li>■ Level</li> <li>■ Temperature (point or average)</li> </ul>	None

Hybrid tank measurement system (HTMS)

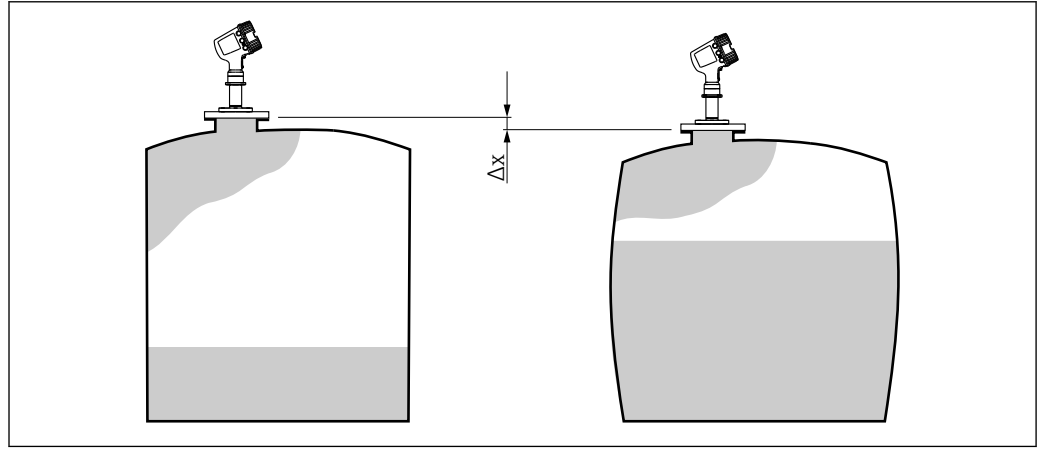
HTMS uses level and pressure measurements to calculate the contents of the tank and (optionally) the density of the medium.

HTMS measuring modes

Measuring mode	Installation example	Measured variables	Calculated variables
<div>HTMS + P1</div> <div> This mode should be used in atmospheric (i.e. non-pressurized) tanks</div>	<div></div> <div>A0027113</div> <div>1 Micropilot 2 To inventory management system 3 Pressure transmitter (bottom)</div>	<ul style="list-style-type: none"><li>■ Level</li><li>■ Bottom pressure (at position D1)</li></ul>	Density of the medium
<div>HTMS + P1 + P3</div> <div> This mode should be used in non- atmospheric (i.e. pressurized) tanks</div>	<div></div> <div>A0027114</div> <div>1 Micropilot 2 To inventory management system 3 Pressure transmitter (bottom) 4 Pressure transmitter (top)</div>	<ul style="list-style-type: none"><li>■ Level</li><li>■ Bottom pressure (at position D1)</li><li>■ Top pressure (at position D3)</li></ul>	Density of the medium

### Hydrostatic tank shell correction (HyTD)

The hydrostatic tank shell correction can be used to compensate for vertical movement of the Gauge Reference Height due to bulging of the tank shell caused by the hydrostatic pressure exerted by the liquid stored in the tank. The compensation is based on a linear approximation obtained from manual hand dips at several levels distributed over the full range of the tank.



A0023774

21 Movement  $\Delta x$  of the Gauge Reference Height due to the bulging of the tank shell caused by hydrostatic pressure

### Thermal tank shell correction (CTSh)

The thermal tank shell correction can be used to compensate for vertical movement of the Gauge Reference Height due to temperature effects on the tank shell or stilling well. The calculation is based on the thermal expansion coefficients of steel and on insulation factors for both the dry and wetted part of the tank shell.



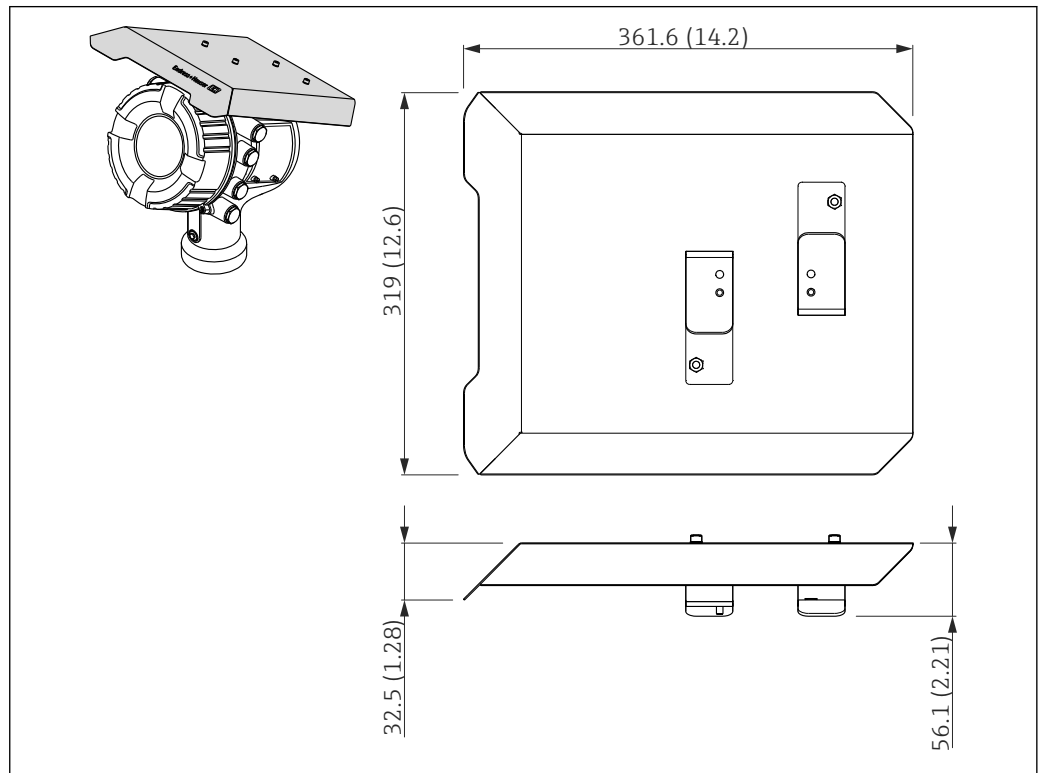
- This correction is recommended for any tank gauge operating at conditions deviating considerably from the conditions during calibration and for extremely high tanks. For refrigerated, cryogenic and heated applications this correction is highly recommended.
- Wire length can also be corrected with the parameters related to CTSh.



## Accessories

### Device-specific accessories

### Weather protection cover



22 Weather protection cover; dimensions: mm (in)

A0028019

### Materials

- Protection cover and mounting brackets

Material

316L (1.4404)

- Screws and washers

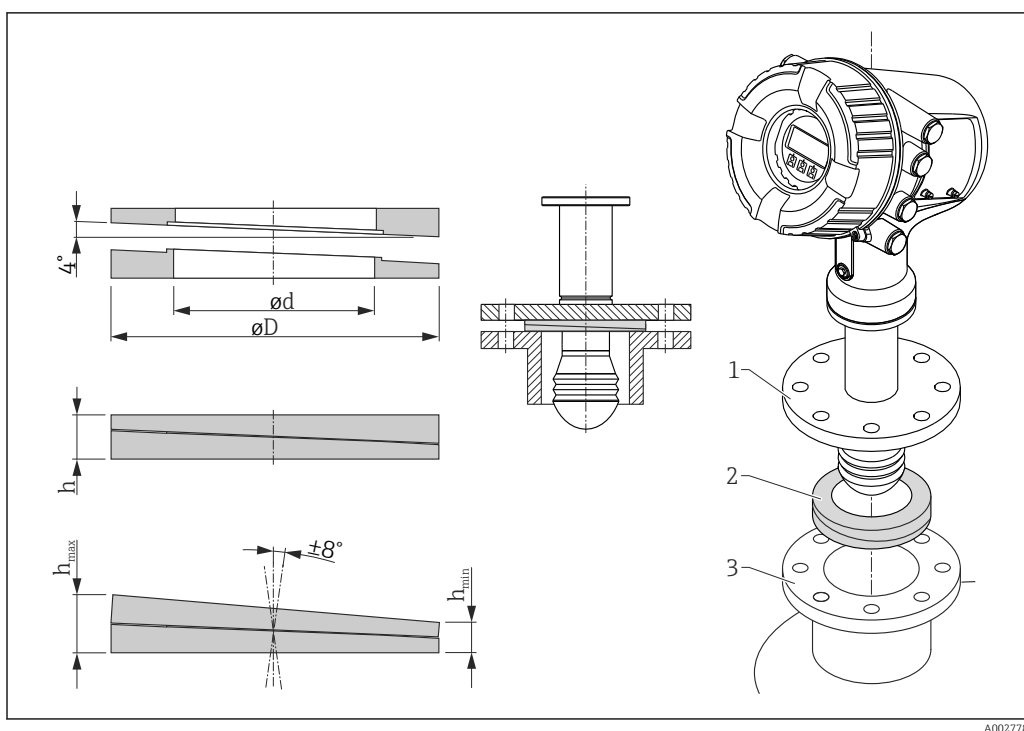
Material

A4



- The weather protection cover can be ordered together with the device:  
Ordering feature 620 "Accessory Enclosed", option PA "Weather Protection Cover")
- It can also be ordered as an accessory:  
Order code: 71292751 (for NMR8x and NRF8x)

## Adjustable seal



A0027787

23 Adjustable seal used to align the device by  $\pm 8^\circ$

P <sup>1)</sup>	620 <sup>2)</sup>		
	PS	PT	PU
OC <sup>3)</sup>	71285499	71285501	71285503
C <sup>4)</sup>	<ul style="list-style-type: none"> <li>■ DN50 PN10-40</li> <li>■ ASME 2" 150lbs</li> <li>■ JIS 50A 10K</li> </ul>	DN80 PM10-40	<ul style="list-style-type: none"> <li>■ ASME 3" 150lbs</li> <li>■ JIS 80A 10K</li> </ul>
L <sup>5)</sup>	100 mm (3.9 in)	100 mm (3.9 in)	100 mm (3.9 in)
S <sup>6)</sup>	M14	M14	M14
M <sup>7)</sup>	FKM	FKM	FKM
P <sup>8)</sup>	-0.1 to +0.1 bar (-1.45 to +1.45 psi)		
T <sup>9)</sup>	-40 to +80 °C (-40 to +176 °F)		
ØD	105 mm (4.13 in)	142 mm (5.59 in)	133 mm (5.24 in)
Ød	60 mm (2.36 in)	89 mm (3.5 in)	89 mm (3.5 in)
h	16.5 mm (0.65 in)	22 mm (0.87 in)	22 mm (0.87 in)
h <sub>min</sub>	9 mm (0.35 in)	14 mm (0.55 in)	14 mm (0.55 in)
h <sub>max</sub>	24 mm (0.95 in)	30 mm (1.18 in)	30 mm (1.18 in)

- 1) Property
- 2) Ordering feature 620 "Accessory Enclosed". With this ordering feature the adjustable seal is supplied together with the device.
- 3) This order code must be used if the adjustable seal is ordered separately.
- 4) Compatible with
- 5) Length of screws
- 6) Size of screws
- 7) Material
- 8) Process pressure
- 9) Process temperature

**Communication-specific accessories****WirelessHART adapter SWA70**

- Is used for the wireless connection of field devices
- The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks



For details, see Operating Instructions BA00061S

**Gauge Emulator, Modbus to BPM**

- Using the protocol converter, it is possible to integrate a field device into a host system even if the field device does not know the communication protocol of the host system. Eliminates vendor lock-in for field devices.
- Field communication protocol (field device): Modbus RS485
- Host communication protocol (host system): Enraf BPM
- 1 measuring device per Gauge Emulator
- Separate power supply: 100 to 240 V<sub>AC</sub>, 50 to 60 Hz, 0.375 A, 15 W
- Several approvals for the hazardous area

**Gauge Emulator, Modbus to TRL/2**

- Using the protocol converter, it is possible to integrate a field device into a host system even if the field device does not know the communication protocol of the host system. Eliminates vendor lock-in for field devices.
- Field communication protocol (field device): Modbus RS485
- Host communication protocol (host system): Saab TRL/2
- 1 measuring device per Gauge Emulator
- Separate power supply: 100 to 240 V<sub>AC</sub>, 50 to 60 Hz, 0.375 A, 15 W
- Several approvals for the hazardous area

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**Service-specific accessories****Commubox FXA195 HART**

For intrinsically safe HART communication with FieldCare via the USB interface



For details, see "Technical Information" TI00404F

**Commubox FXA291**

Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop

Order number: 51516983



For details, see "Technical Information" TI00405C

**DeviceCare SFE100**

Configuration tool for HART, PROFIBUS and FOUNDATION Fieldbus field devices

DeviceCare is available for download at [www.software-products.endress.com](http://www.software-products.endress.com). You need to register in the Endress+Hauser software portal to download the application.



Technical Information TI01134S

**FieldCare SFE500**

FDT-based plant asset management tool

It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.



Technical Information TI00028S

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**System components****RIA15**

Compact process display unit with very low voltage drop for universal use to display 4 to 20 mA/HART signals



Technical Information TI01043K

**Tankvision Tank Scanner NXA820 / Tankvision Data Concentrator NXA821 / Tankvision Host Link NXA822**

Inventory Management System with completely integrated software for operation via standard web browser



Technical Information TI00419G

## Documentation

The following documentation types are available in the Downloads area of the Endress+Hauser website ([www.endress.com/downloads](http://www.endress.com/downloads)):



For an overview of the scope of the associated Technical Documentation, refer to the following:

- *W@M Device Viewer* ([www.endress.com/deviceviewer](http://www.endress.com/deviceviewer)): Enter the serial number from nameplate
- *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2D matrix code (QR code) on the nameplate

<b>Technical Information (TI)</b>	<b>Planning aid</b> The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
<b>Brief Operating Instructions (KA)</b>	<b>Guide that takes you quickly to the 1st measured value</b> The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
<b>Operating Instructions (BA)</b>	The Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.  It also contains a detailed explanation of each individual parameter in the operating menu (except the <b>Expert</b> menu). The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
<b>Description of Device Parameters (GP)</b>	The Description of Device Parameters provides a detailed explanation of each individual parameter in the 2nd part of the operating menu: the <b>Expert</b> menu. It contains all the device parameters and allows direct access to the parameters by entering a specific code. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
<b>Safety Instructions (XA)</b>	Depending on the approval, the following Safety Instructions (XA) are supplied with the device. They are an integral part of the Operating Instructions.  The nameplate indicates the Safety Instructions (XA) that are relevant to the device.
<b>Installation instructions (EA)</b>	Installation Instruction are used to replace a faulty unit with a functioning unit of the same type.

## Registered trademarks

### FieldCare®

Registered trademark of the Endress+Hauser Process Solutions AG, Reinach, Switzerland

### Modbus®

Registered trademark of SCHNEIDER AUTOMATION, INC.

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[www.addresses.endress.com](http://www.addresses.endress.com)

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