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Technical Information
Tankside Monitor NRF81

Tank Gauging



Application

Tankside Monitor NRF81 is a robust gateway for collecting and integrating tank gauging data in storage and process applications. It fulfills the exacting demands of tank inventory management, inventory control, custody transfer, loss control, total cost saving, and safe operation.

Typical areas of application

- Hydrostatic Tank Gauging
- Hybrid Tank Measurement Systems

Your benefits

- SIL2 certified
- SIL2 as per IEC 61508, SIL3 for homogeneous or diverse redundancy
- Up to 6 SIL relay outputs
- Wide range of output signals including V1, Modbus RS 485, and HART protocol
- Integration of e.g. temperature, water level, pressure, overfill prevention sensor
- Robust IP66/68, NEMA Type 4X/6P enclosure, stainless steel or aluminum
- Operation and display in a wide variety of local languages

Endress+Hauser
People for Process Automation

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Document information

Symbols

Safety symbols

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

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

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

NOTICE
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

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

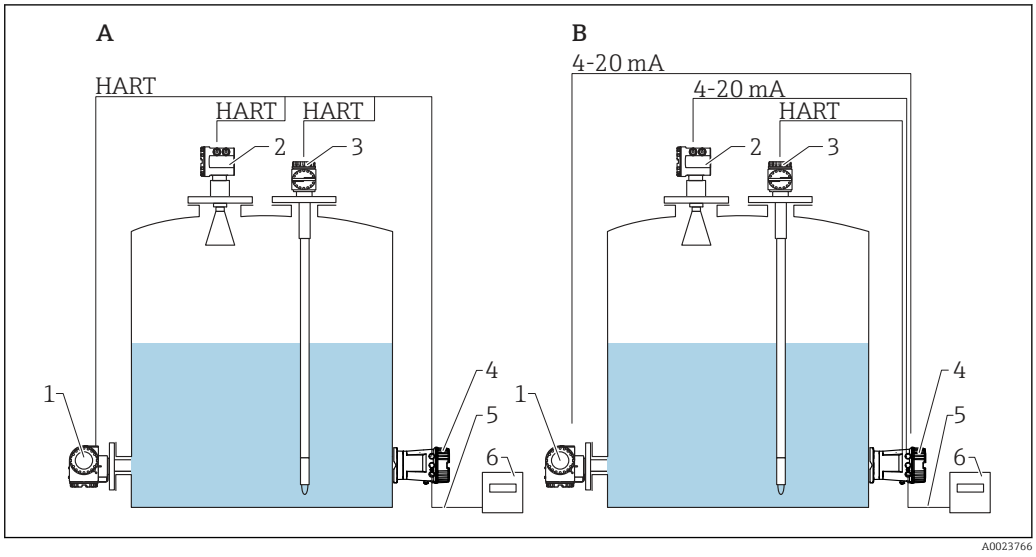
⚠ → **Safety instructions**
Observe the safety instructions contained in the associated Operating Instructions

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

Function and system design

Integration of tank sensors

The Tankside Monitor is a field device for the integration of tank sensors into tank inventory systems. It is typically installed at the bottom of the tank and allows access to all connected tank sensors. All measured and calculated values can be displayed at the on-site display. Via a field communication protocol, they can be transferred to an inventory control system.



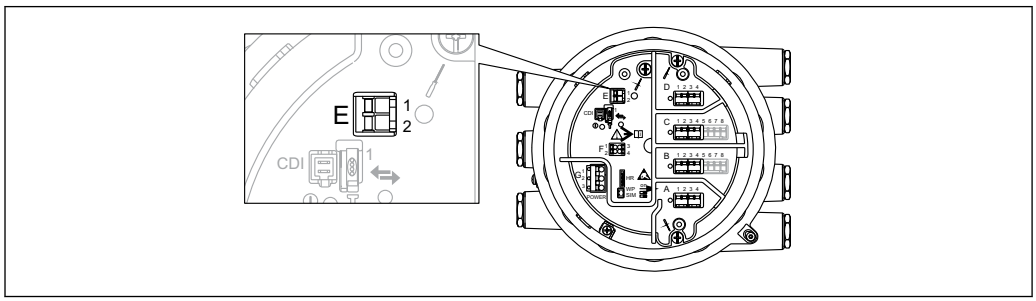
1 *Integration of tank sensors with Tankside Monitor (Example)*

A HART multidrop mode
B HART and analog mode
1 Pressure transmitter
2 Level radar
3 Average temperature transmitter
4 Tankside Monitor
5 Field protocol transmits data to an inventory control system
6 Inventory control system (e.g. Tankvision NXA820 or Tankvision Professional NXA85)

Typical values measured by the sensors are:
- Level
- Spot temperature
- Average temperature
- Water level
- Pressure
- Secondary level value (for critical applications)

Input/output

HART Ex ia/IS active input



A0027364

2 *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.
- **Micropilot S FMR53x**
  The calculated distance correction factor or distance correction value is sent to the Micropilot. Micropilot uses this value to indicate the corrected level at its local display.

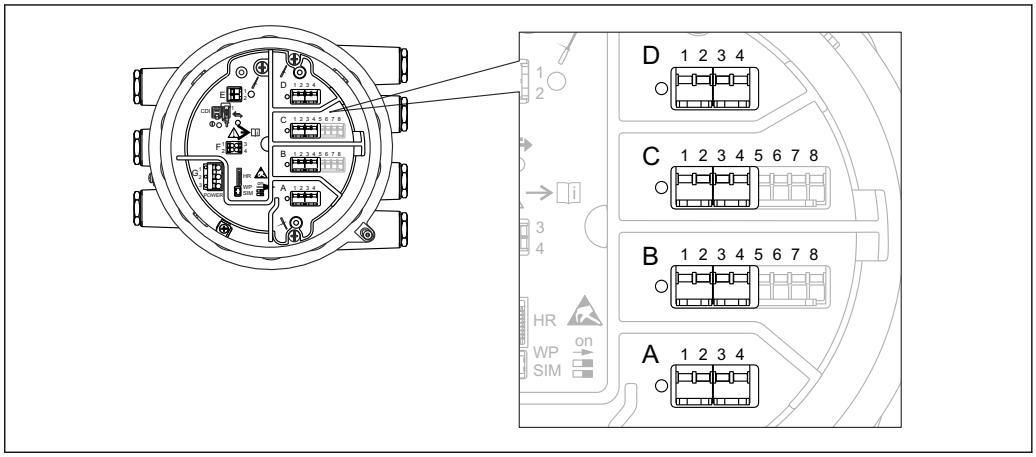
Technical data

- Transmitter power supply voltage
  23.0 V - 380 Ω · I_{load}
- Maximum load
  500 Ω 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



3 *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.

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.

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"

NRF81 - xxxx XX xx xx ...
040

O [1]	N [2]	T [3]	S [4]
Modbus RS485 [5]			
A1	1	4	→ 10
V1 [5]			
B1	1	4	→ 11
4-20mA HART Ex d/XP [5]			
E1	1	8	→ 13
4-20mA HART Ex i/IS [5]			
H1	1	8	→ 13
WM550 [5]			
C1	1	4	→ 12

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 I/O Analogue"

NRF81 - xxxx xx XX xx ...
050

Ordering feature 050: "Secondary I/O 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 → 13
- 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 → 13
- 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 → 13
- 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 → 13
- 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 → 13
- Type of I/O module:
  none
  - Option
    X0
  - Number of I/O modules
    0
  - Number of terminals
    0
  - Technical data -

Ordering feature 060: "Secondary I/O Digital Ex d/XP"

NRF81 - xxxx xx xx XX ...
060

Ordering feature 060: "Secondary I/O Digital Ex d/XP"

- 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 → 15
- 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 → 15
- 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 → 15
- Type of I/O module:
  1x "Modbus RS485"
  - Option
    B1
  - Number of I/O modules
    1
  - Number of terminals
    3 x 4
  - Technical data → 10
- 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
    → 10
    → 15
- 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
    → 10
    → 15

- Type of I/O module:
  1 x "WM550"
  - Option
    E1
  - Number of I/O modules
    1
  - Number of terminals
    1 x 4
  - Technical data → 12
- 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 → 12
- 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 → 12
- 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

Transmission distance
Maximum 1 200 m (3 900 ft)

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 [1] 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^2 (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 Micropilot S FMR5xx
- The auxiliary energy for the Micropilot S can be supplied by the analogue I/O module
- The calculated distance correction factor or distance correction value is sent to the Micropilot. Micropilot uses this value to indicate the corrected level at its local display.

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

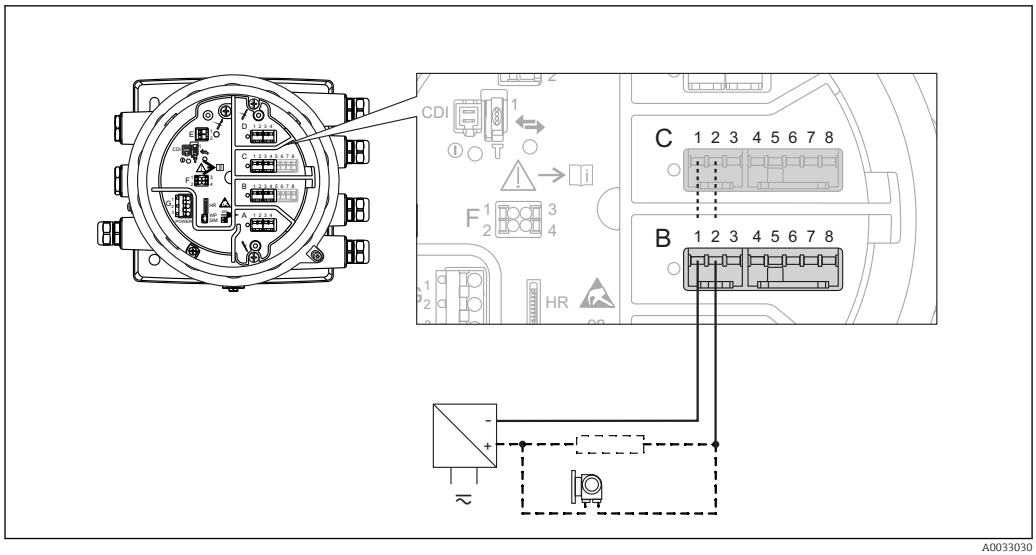
Output current
3 to 24 mA

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 [2)]
- Maximum terminal voltage
  29 V [2)]

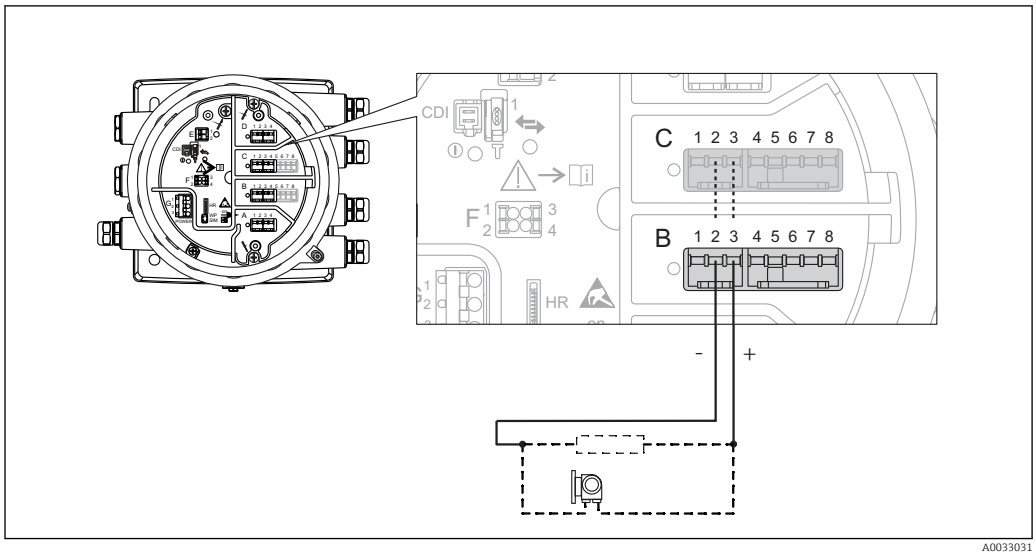
2) Observing these values is mandatory in order to ensure correct measured value information.



4 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 V - 360 Ω · I_{load}
- Transmitter power supply voltage
  (Ex i/IS)
  20.0 V - 360 Ω · I_{load}
- Output load
  max. 500 Ω including signal line [3)]



5 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

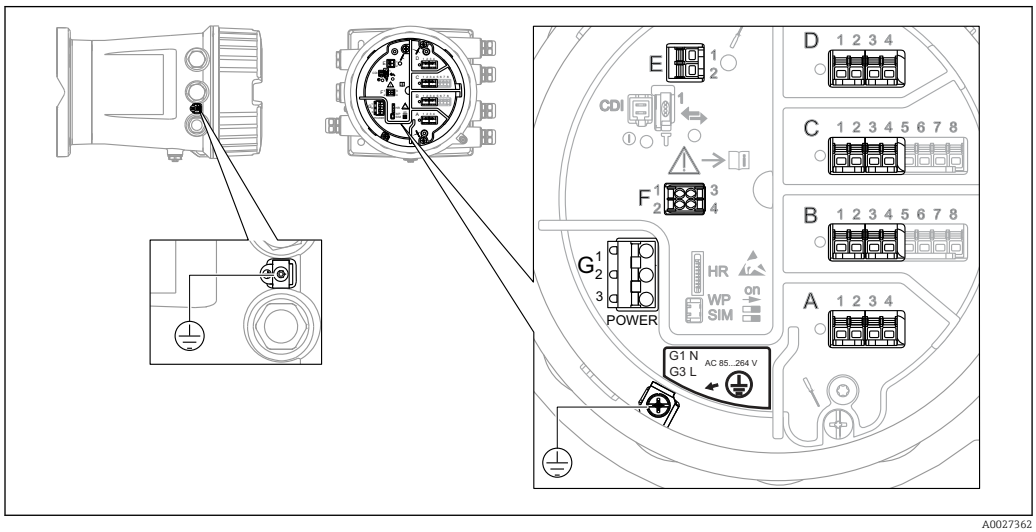
Output
- Relay switching power for resistive load
  - 30 V_{DC} @ 2 A
  - 250 V_{DC} @ 0.1 A
  - 250 V_{AC} @ 2 A
- Relay type
  - normally open;
  - can be set to "normally closed" by a software option [4)]

Input
- Maximum pick-up voltage
  - 250 V_{AC}
  - 250 V_{DC}
- Minimum pick-up voltage
  - 25 V_{AC}
  - 5 V_{DC}
- 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



6 Terminal compartment (typical example) and ground terminals

Housing thread
The threads of the electronics and connection compartment can be coated with an anti-friction coating.
The following applies for all housing materials:
Do not lubricate the housing threads.

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.

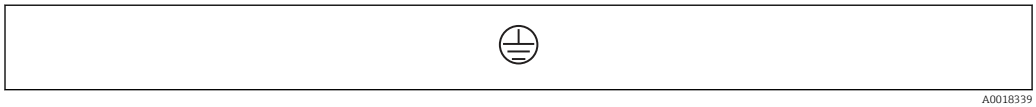
Terminal area E
Module: HART Ex i/IS interface
- E1: H+
- E2: H-

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

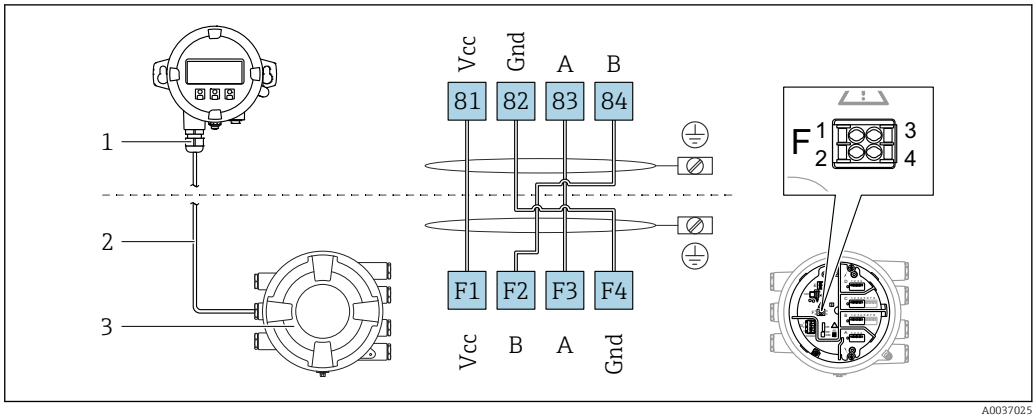
Terminal area G (for Low voltage DC power supply)
- G1: L-
- G2: not connected
- G3: L+

Terminal area: Protective ground
Module: Protective ground connection (M4 screw)



7 Terminal area: Protective ground

Remote display and operating module DKX001



8 *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)

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

- 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_{AC} (- 15 % + 10 %) = 85 to 264 V_{AC} , 50/60 Hz

Low voltage AC power supply:
Operational value:
65 V_{AC} (- 20 % + 15 %) = 52 to 75 V_{AC} , 50/60 Hz

Low voltage DC power supply:
Operational value:
24 to 55 V_{DC} (- 20 % + 15 %) = 19 to 64 V_{DC}

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" [1]	Cable entries (with blind plugs) [2]
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-xxxxxxxxxxxxA...
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 JPN Ex approval, cable glands are attached to the device (see position 010 of the order code). These cable glands must be used.
Tankside Monitor NRF81-TA...

Cable specification

Terminals

Wire cross section 0.2 to 2.5 mm² (24 to 13 AWG)
Use for terminals with function: Signal and power supply
- Spring terminals (NRF81-xx1...)
- Screw terminals (NRF81-xx2...)

Wire cross section max. 2.5 mm² (13 AWG)
Use for terminals with function: Ground terminal in the terminal compartment

Wire cross section max. 4 mm² (11 AWG)
Use for terminals with function: Ground terminal at the housing

Power supply line

Standard device cable is sufficient for the power line.

HART communication line

- Standard device cable is sufficient if only the analog signal is used.
- 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: ≤ 120 Ω
- Capacitance between lines: ≤ 0.3 µF

WM550 communication line

- 2-wire twisted pair, unscreened cable
- Cross section minimum 0.5 mm² (20 AWG)
- Maximum total cable resistance: ≤ 250 Ω
- Cable with low capacitance

Overvoltage protection

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

10 kA, 8/20 µs, 10 pulses according to IEC 60060-1 / DIN 60079-14

Overvoltage category

Overvoltage category II

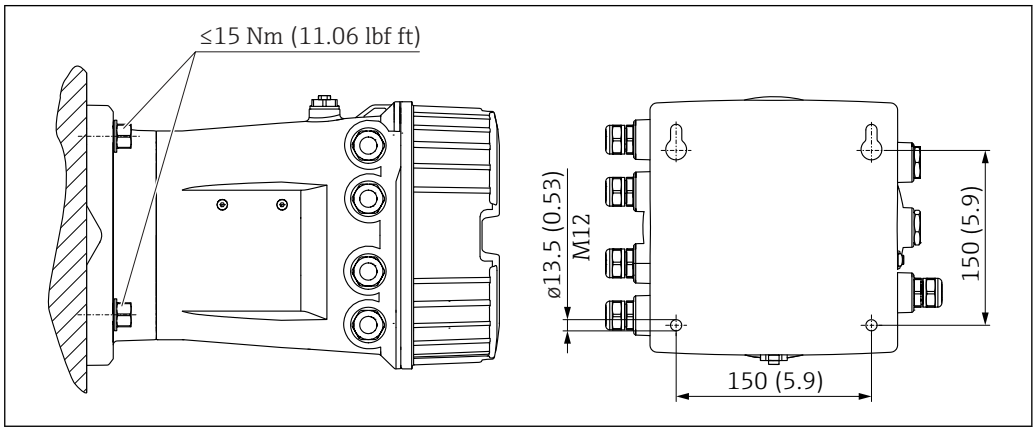
Pollution degree

Pollution degree 2

Installation

Installation conditions

Wall mounting



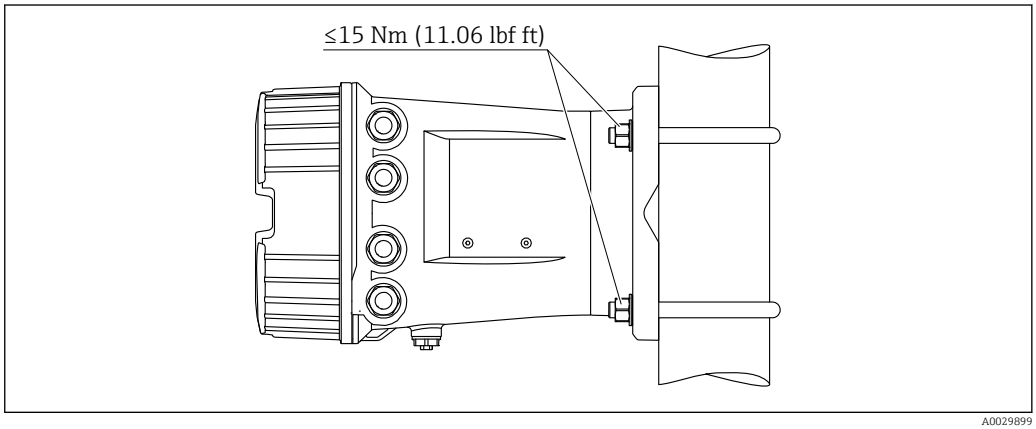
9 Wall mounting of the Tankside Monitor

Pipe mounting

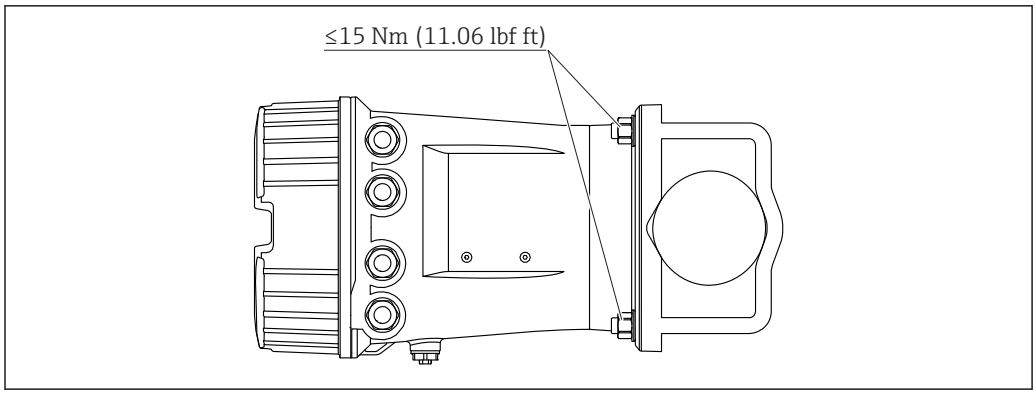
A mounting kit consisting of two brackets and four nuts can be ordered with the device. It can be used for mounting the Tankside Monitor on horizontal or vertical pipes.

Ordering feature 620 "Accessory enclosed"

- PV
  Mounting kit, pipe, DN32-50 (1-1/4" - 2")
- PW
  Mounting kit, pipe, DN80 (3")



10 Mounting of the Tankside Monitor at a vertical pipe



11 Mounting of the Tankside Monitor at a horizontal pipe

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.

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

- IP66/68 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 $(m/s^2)^2$/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

Maximum use altitude

2 000 m (6 561.68 ft) above sea level

Custody transfer approval

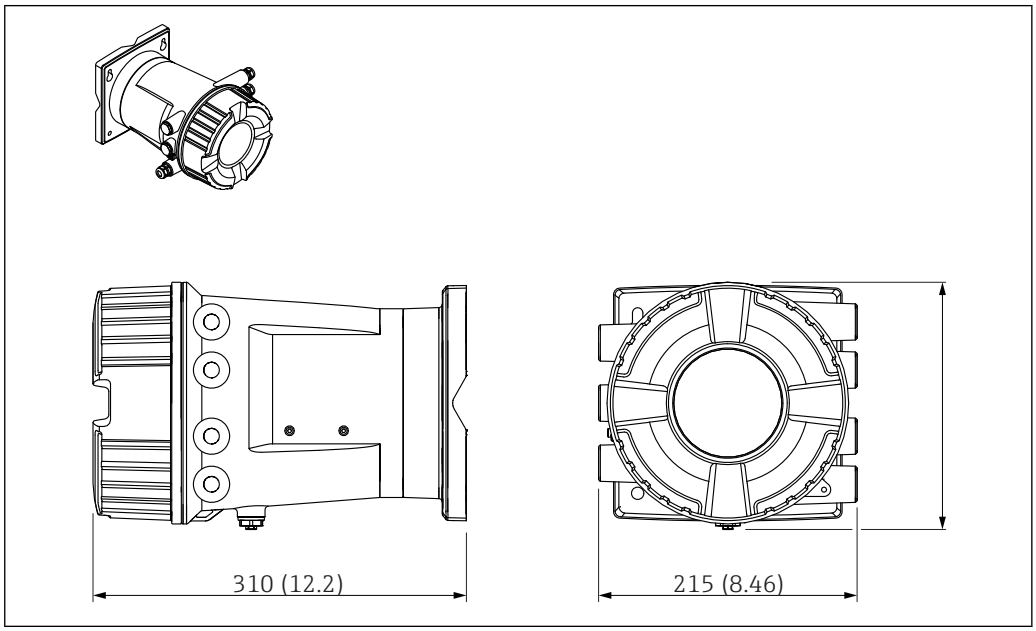
Options of ordering feature 590 "Additional Approval"

- **LK**
  NMi witnessed initial verification accuracy, Weight + Measure approval
- **LL**
  PTB witnessed initial verification accuracy, Weight + Measure approval
- **LN**
  LNE witnessed initial verification accuracy, Weight + Measure approval
- **LO**
  *NMi type approval
- **LP**
  *PTB type approval
- **LQ**
  *LNE type approval
- **LT**
  METAS, custody transfer
- **LU**
  BEV, custody transfer

Mechanical construction

Dimensions

Housing



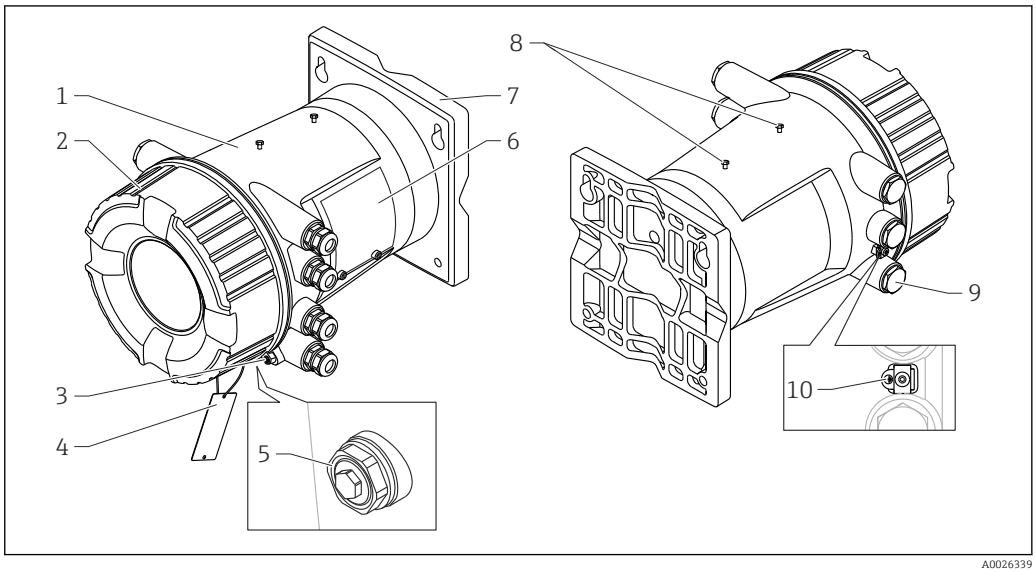
12 *Dimensions of Tankside Monitor NRF81; unit of measurement: mm(in); adapters for cable entries are not taken into account in this drawing.*

Weight

Housing with electronics: approx. 12 kg (26 lb)

Materials

Materials of housing



1 Housing
2 Cover
3 Cover lock
4 Tag for measuring point label
5 Pressure release stopper
6 Nameplate
7 Mounting plate
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** RAL 7035 (grey): AC 43000 T6; AlSi10Mg (< 0,1 % Cu)
- **Stainless steel** 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
316L (1.4404)

6 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

7 Mounting plate
- **Aluminum** housing type: AC 43000 T6
- **Stainless steel** housing type: 316L (1.4404)

8 Dummy screws for weather protection cover
- Screw: A4-70
- O-ring: EPDM

9 Dummy plug, cable gland or adapter [5)]
- 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)

5) Depending on device version

Operability

Operating concept

Operator-oriented menu structure for user-specific tasks
- Commissioning
- Operation
- Diagnostics
- Expert level

Operating languages
- English
- Chinese
- German
- Japanese
- Spanish

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

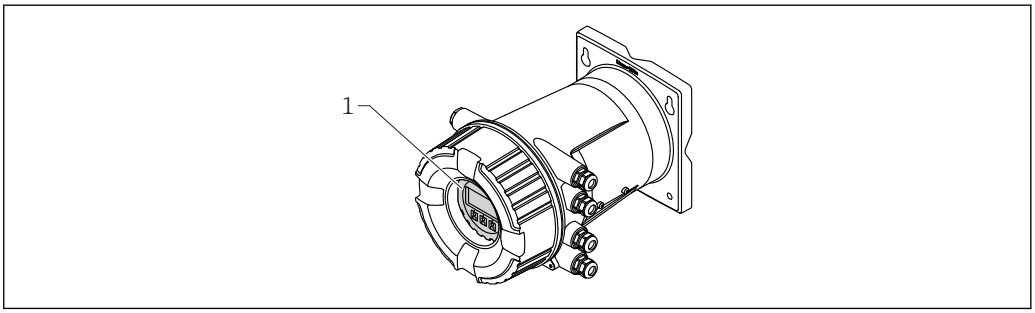
Reliable operation
Standardized operation at the device and in the operating tools

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



13 Local operation of the Tankside Monitor NRF81

1 Display and operating module

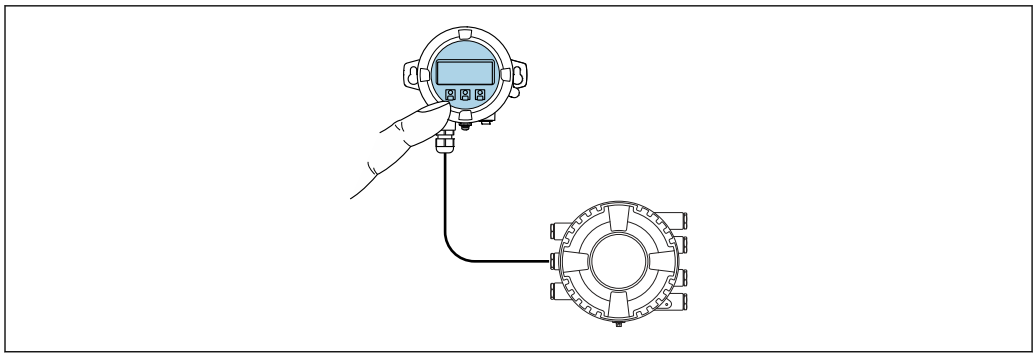
Display elements
- 4-line display
- White background lighting; switches to red in event of device errors
- Format for displaying measured variables and status variables can be individually configured
- Permitted ambient temperature for the display: –20 to +70 °C (–4 to +158 °F)
  The readability of the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

Operating elements
- External operation via touch control; 3 optical keys: ⊕, ⊖, E
- 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

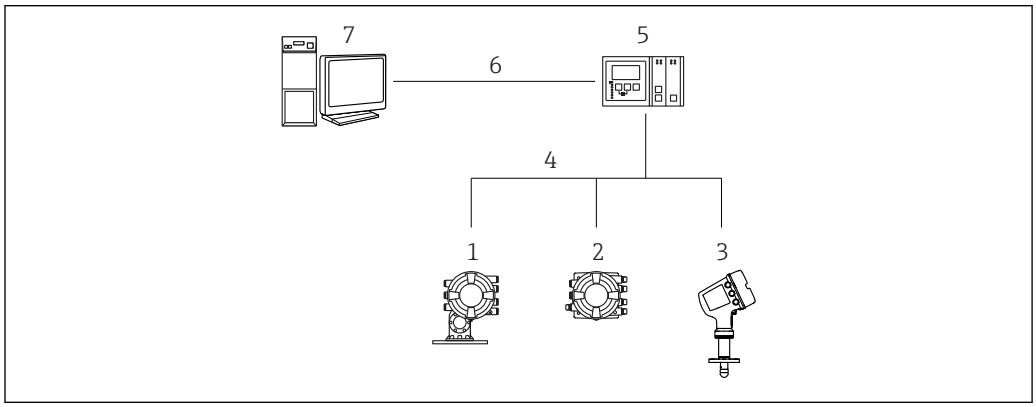
14 *Operation via remote display and operating module DKX001*

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

- 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

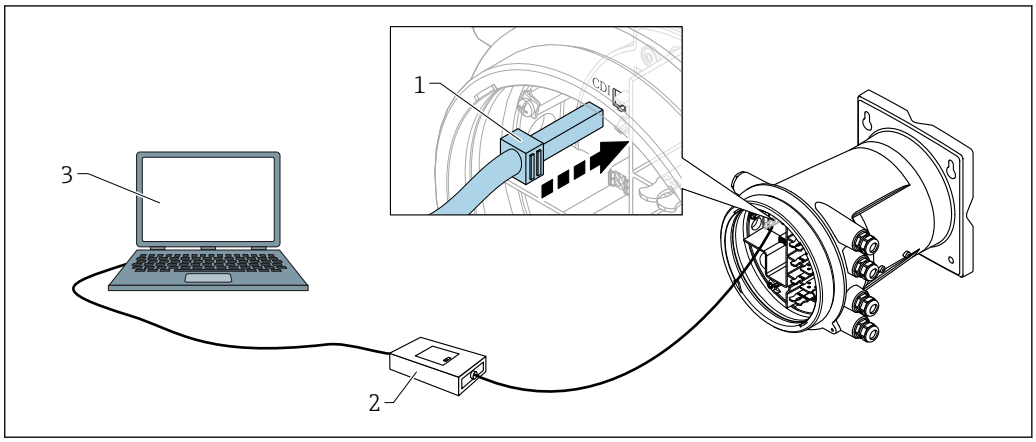


A0025621

15 *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



16 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

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

CE mark

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

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

RCM 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 bear the RCM marking on the nameplate.



A0029561

Ex approval

Certificates are available online for the following approval types.

- AEx
- ATEX
- FM C/US
- EAC Ex
- IEC Ex
- JPN Ex
- KC Ex [6)]

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":
SD01929G (NRF81)

WHG

DIBt: Z-65.16-588

6) KC approval is covered with IEC Ex approval.

Weight & Measure approval

- OIML R85 (2008)
- NMi
- PTB
- PAC
- WELMEC

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.

Non-ionizing radiation protection

According to guideline 2004/40/EG-ICNIRP Guidelines EN50371

Test, certificate

Ordering feature 580 "Test, Certificate"	Designation
JA	3.1 Material certificate, wetted metallic parts, EN10204-3.1 inspection certificate
KE	Pressure test, internal procedure, inspection certificate
KS	Welding documentation, wetted/pressurized seams

Other standards and guidelines

Industry standards

- Directive 2011/65/EU: "Restriction of Hazardous Substances" (RoHS)
- Directive 2014/32/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 NE043: "Standardization of the Signal Level for the Failure Information of Digital Transmitters"
- NAMUR NE107: "Self-Monitoring and Diagnosis of Field 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 2014/32/EC of the European Parliament and of the Council of 26 February 2014 on measuring instruments
- PTB-A-5.01: "Automatic level measuring devices for stationary storage containers"

Ordering information

Ordering information

Detailed ordering information is available from your nearest sales organization www.addresses.endress.com or in the Product Configurator at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

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

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

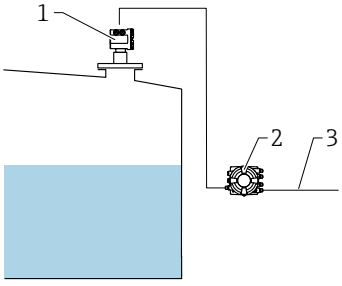
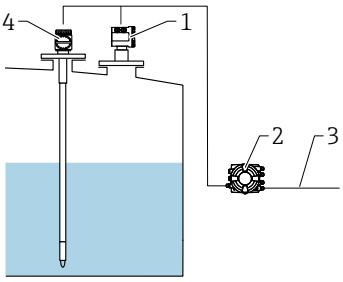
Advanced tank measurement methods

The device software provides the following tank measurement methods:
- Direct level measurement → 31
- Hybrid tank measurement system (HTMS) → 32
- Hydrostatic tank gauging (HTG) → 33
- Hydrostatic tank shell correction (HyTD) → 35
- Thermal tank shell correction (CTSh) → 35

Direct level measurement

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

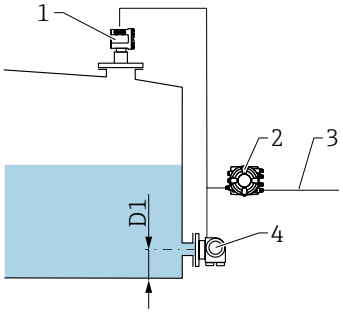
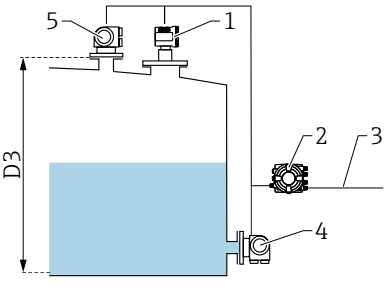
Direct level measurement modes

Measuring mode	Installation example	Measured variables	Calculated variables
Level only	 A0023756 *1 Level transmitter (e.g. typically FMR540, FMR51,.. but not NMR8x or NMS8x)* *2 Tankside Monitor* *3 To inventory management system*	Level	None
Level + temperature	 A0023757 *1 Level transmitter (e.g. typically FMR540, FMR51,.. but not NMR8x or NMS8x)* *2 Tankside Monitor* *3 To inventory management system* *4 Temperature (spot or average)*	▪ Level ▪ Temperature (spot or average)	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.

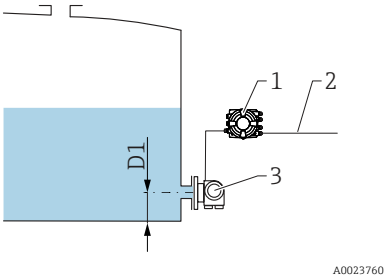
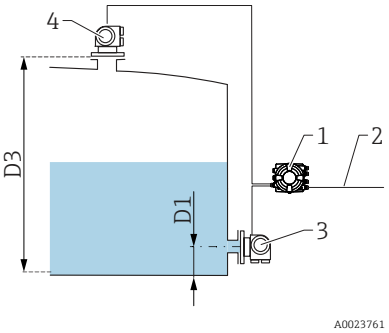
HTMS measuring modes

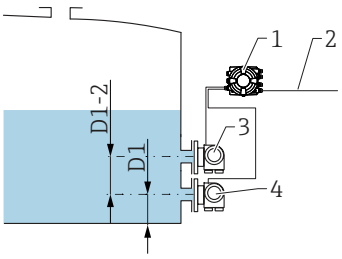
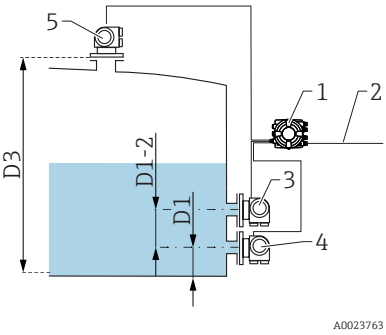
Measuring mode	Installation example	Measured variables	Calculated variables
HTMS + P1 This mode should be used in atmospheric (i.e. non-pressurized) tanks	 *1 Level transmitter (e.g. typically FMR540, FMR51,.. but not NMR8x or NMS8x)* *2 Tankside Monitor* *3 To inventory management system* *4 Pressure transmitter (bottom)*	▪ Level ▪ Bottom pressure (at position *D1*)	Density of the medium
HTMS + P1 + P3 This mode should be used in non- atmospheric (i.e. pressurized) tanks	 *1 Level transmitter (e.g. typically FMR540, FMR51,.. but not NMR8x or NMS8x)* *2 Tankside Monitor* *3 To inventory management system* *4 Pressure transmitter (bottom)* *5 Pressure transmitter (top)*	▪ Level ▪ Bottom pressure (at position *D1*) ▪ Top pressure (at position *D3*)	Density of the medium

Hydrostatic tank gauging (HTG)

HTG uses one, two or three pressure measurements at different positions to calculate the tank contents and (optionally) the density of the medium.

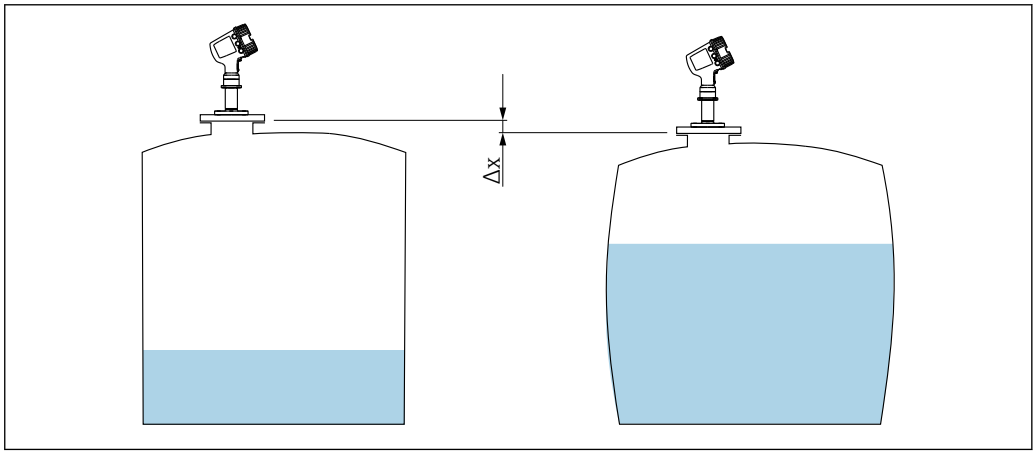
HTG measuring modes

Measuring mode	Installation example	Measured variables	Calculated variables
HTG P1 This mode should be used in atmospheric (i.e. non-pressurized) tanks	 *1 Tankside Monitor* *2 To inventory management system* *3 Pressure transmitter (bottom)*	Bottom pressure (at position *D1*) The density of the medium must be entered manually.	Level
HTG P1 + P3 This mode should be used in non-atmospehric (i.e. pressurized) tanks	 *1 Tankside Monitor* *2 To inventory management system* *3 Pressure transmitter (bottom)* *4 Pressure transmitter (top)*	▪ Bottom pressure (at position *D1*) ▪ Top pressure (at position *D3*) The density of the medium must be entered manually.	Level

Measuring mode	Installation example	Measured variables	Calculated variables
HTG P1 + P2 This mode should be used in atmospheric (i.e. non-pressurized) tanks	 *1 Tankside Monitor* *2 To inventory management system* *3 Pressure transmitter (middle)* *4 Pressure transmitter (bottom)*	▪ Bottom pressure (at position *D1*) ▪ Middle pressure (at position *D2*)	▪ Level ▪ Density of the medium
HTG P1 + P2 + P3 This mode should be used in non-atmospehric (i.e. pressurized) tanks	 *1 Tankside Monitor* *2 To inventory management system* *3 Pressure transmitter (middle)* *4 Pressure transmitter (bottom)* *5 Pressure transmitter (top)*	▪ Bottom pressure (at position *D1*) ▪ Middle pressure (at position *D2*) ▪ Top pressure (at position *D3*)	▪ Level ▪ 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.



17 *Movement Δx 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.

Level reference check (LRC)

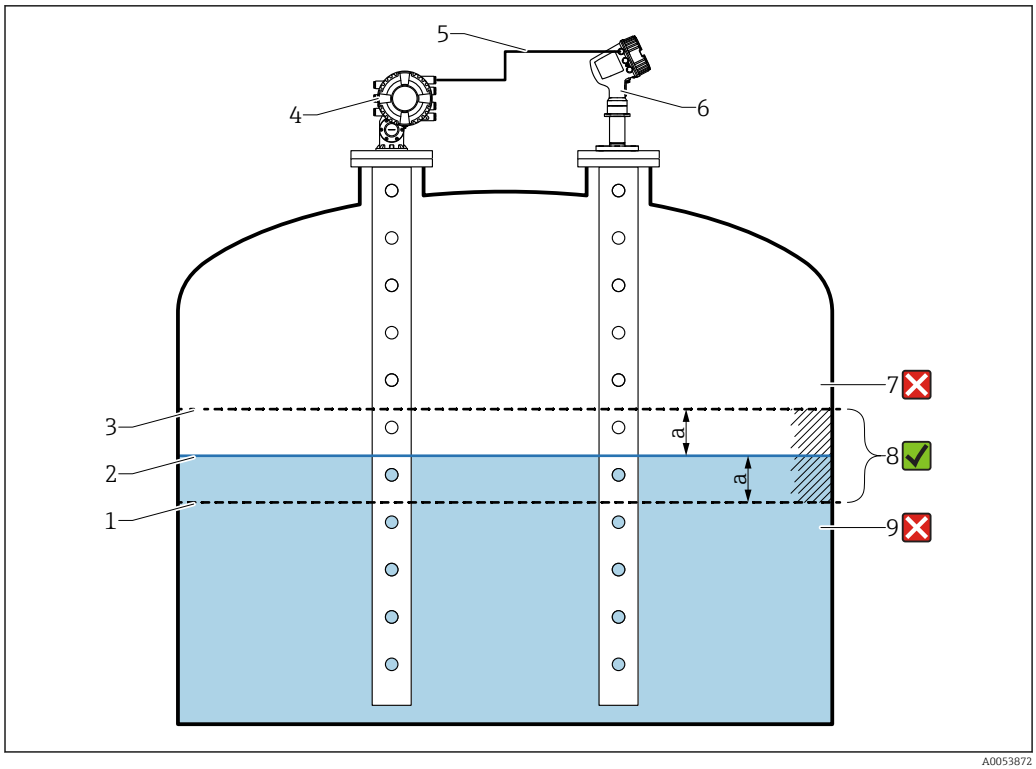
For tanks where a manual dipping cannot be performed the level gauge can be verified by means of the LRC function.

If the measured level value is not verified by the LRC function applied, the device will issue an error message regarding the measured level.

This reference check is recommended for liquefied gas applications.

LRC with reference level

The radar device compares it's own level reading with the level reading of another level gauge (e.g. Proservo NMS8x). Based on a configurable deviation value (**Allowed difference** parameter), a continuous check is performed.



18 *Application example with Proservo NMS8x*

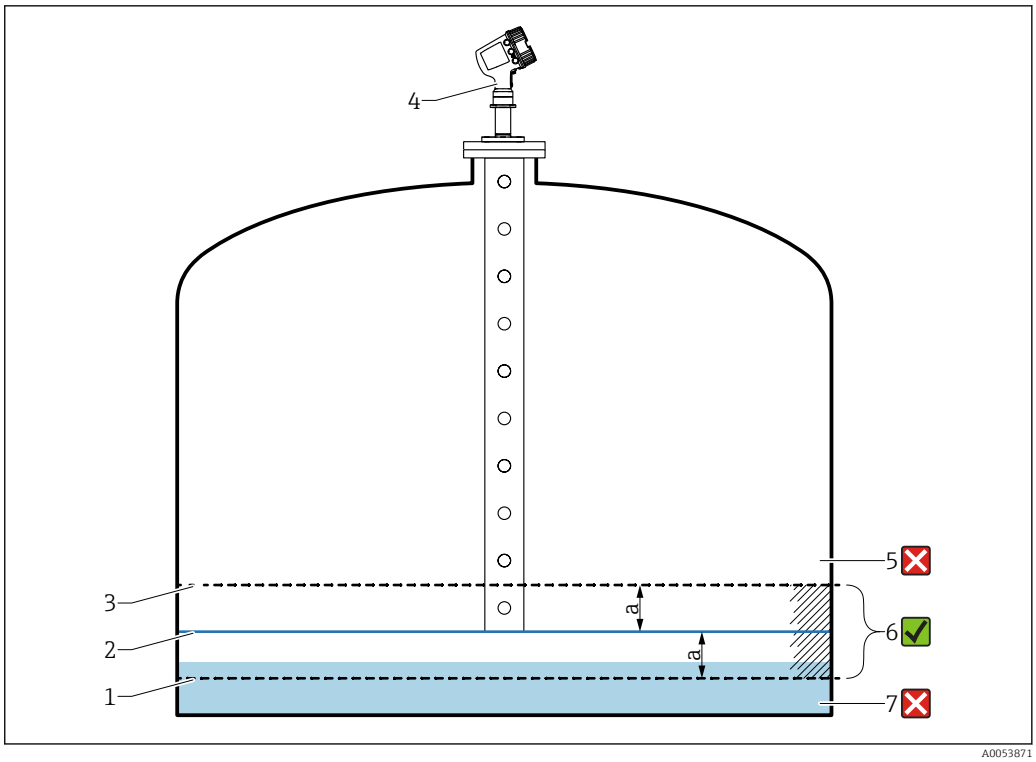
1 *Lower limit of deviation value "a" as configured in radar level gauge*
2 *Reference value: Measured level as provided by level gauge Proservo NMS8x*
3 *Upper limit of deviation*
4 *Proservo NMS8x provides the reference value*
5 *Level gauges are interconnected via HART interface*
6 *Radar level gauge with configured deviation value "a" for "Allowed difference" parameter*
7 *The measured level is greater than reference value plus deviation value "a": Level value is not verified*
8 *The measured level is within or equal to the limits defined by the deviation value "a": Level value is verified*
9 *The measured level is less than reference value minus deviation value "a": Level value is not verified*

Properties
- Frequency: The reference check is performed continuously every 60 seconds.
- Tolerance: Via the **Check fail threshold** parameter, a configurable number of failures is allowed before the status switches to failed.
- Connection: The level reference device is connected via an optional HART I/O board. See ordering feature 050: "Secondary I/O Analogue".

LRC with point reference

Mechanical parts in the tank can be used as reference points to perform a reference measurement. The reference distance can be saved to the device. Based on a configurable deviation value (**Allowed difference** parameter), a manual check can be started.

A closed cut off ball valve or a fixed reference ring at the end of a stilling well are examples for suitable reference measurement installations.

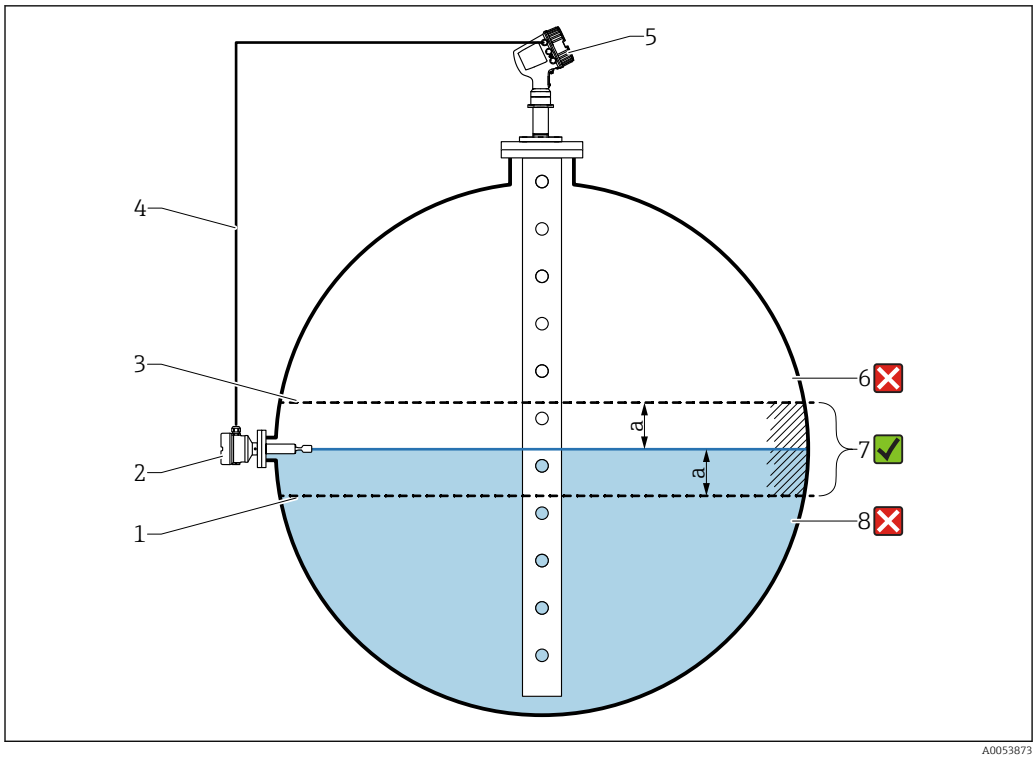


19 *Application example with fixed reference point at the end of the stilling well*

1 *Lower limit of deviation value "a" as configured in radar level gauge*
2 *Reference value: Distance from radar level gauge to object fixed to stilling well*
3 *Upper limit of deviation*
4 *Radar level gauge with configured deviation value "a" for "Allowed difference" parameter*
5 *The measured level is greater than reference value plus deviation value "a": Level value is not verified*
6 *The measured level is within or equal to the limits defined by the deviation value "a": Level value is verified*
7 *The measured level is less than reference value minus deviation value "a": Level value is not verified*

LRC with reference switch

A level switch (e.g. Liquiphant FTLx) can be mounted within the tank. The check can be performed continuously, each time the level switch is activated or deactivated. The measured level should remain within a configurable deviation.



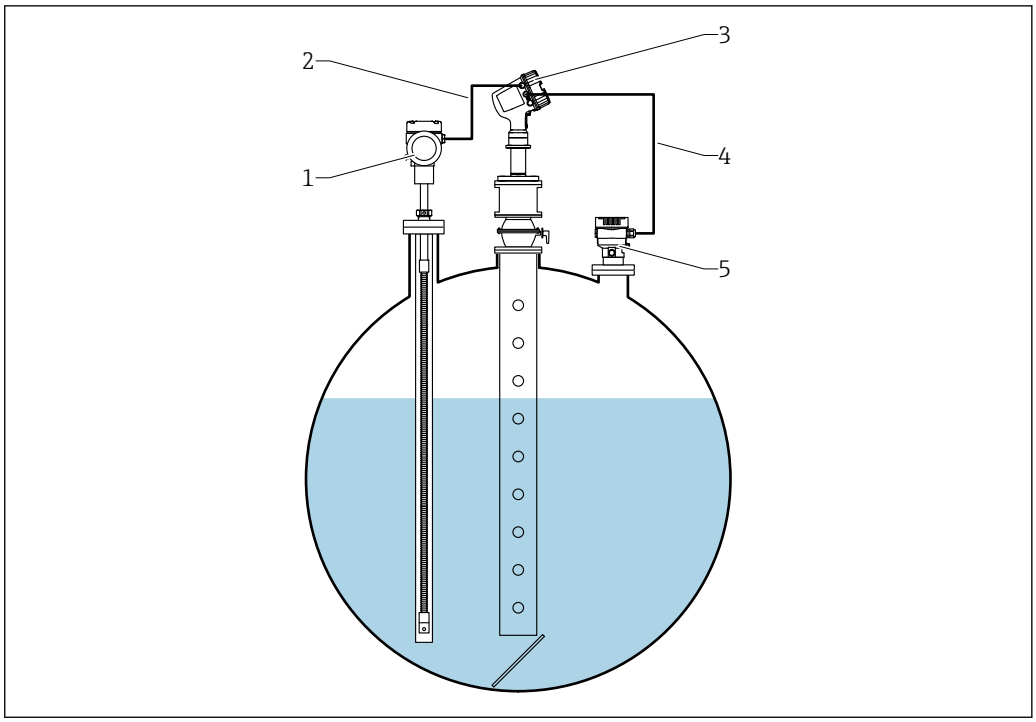
20 *Application example with level switch*

1 *Lower limit of deviation value "a" as configured in radar level gauge*
2 *Reference value: The switching point of an installed level switch represents the reference value for verification*
3 *Upper limit of deviation*
4 *Level switch and level gauge are interconnected via a digital I/O board*
5 *Radar level gauge with configured deviation value "a" for "Allowed difference" parameter*
6 *The measured level is greater than reference value plus deviation value "a": Level value is not verified*
7 *The measured level is within or equal to the limits defined by the deviation value "a": Level value is verified*
8 *The measured level is less than reference value minus deviation value "a": Level value is not verified*

Properties
- Modes: The device can be set to monitor the switching point while filling or draining the tank.
- Connection: The level switch is connected via a digital I/O board.
  See ordering feature 060: "Secondary I/O Digital Ex d/XP".

Gas phase correction for liquefied gases (CLG)

The gas phase in pressurized tanks has a direct impact on the distance determination for time-of-flight sensors. This feature corrects the influences of the vapor phase based on its pressure, temperature and composition.



1 *Prothermo temperature measurement device, equipped with thermowell or protective pipe*
2 *HART connection*
3 *Radar level gauge Micropilot NMR84*
4 *HART connection*
5 *Digital pressure transmitter*

The vapor pressure and temperature measurement devices need to be connected via an optional HART I/O board.

Vapor phase composition

The vapor phase composition is entered manually via the display or an asset management software (e.g. DeviceCare).

The correction function can be set to the following values:
- Off
- **Pure gas** option: 1 main gas component
- **Mix of two gases** option: 2 main components with defined share
- **Mix of three gases** option: 3 main components with defined share
- **Mix of four gases** option: 4 main components with defined share

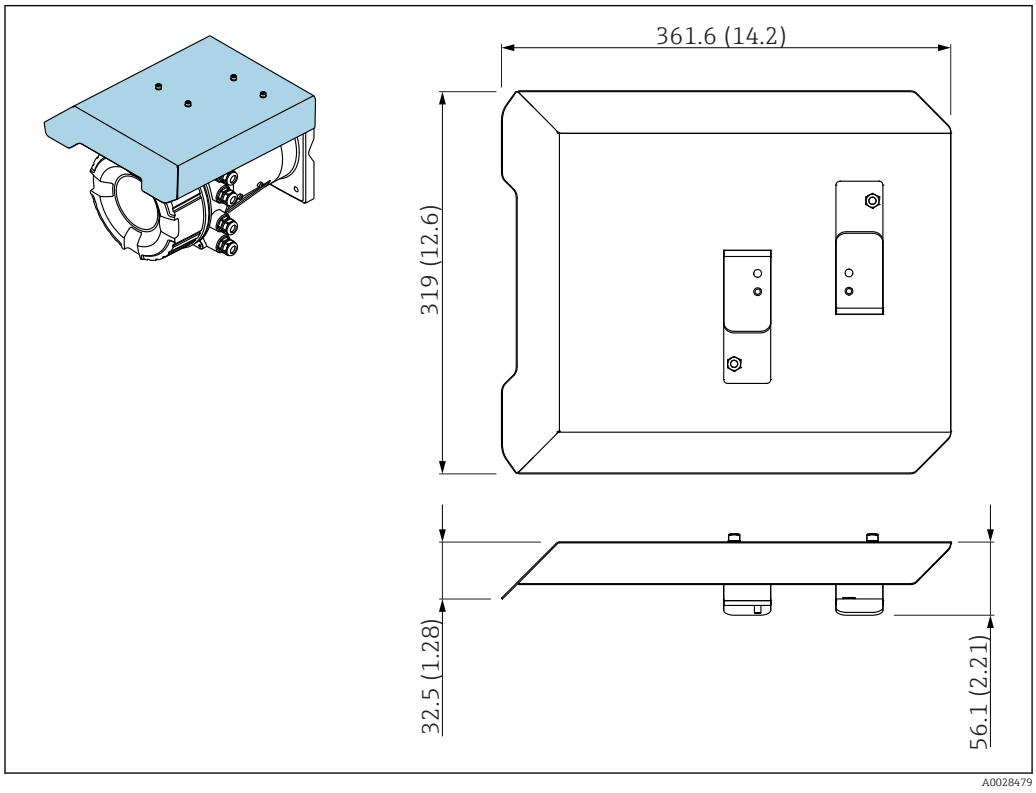
The share is entered in percent (i. e. mixture of 2 gases with 25 and 75 percent) or in amounts (i. e. mixture of 2 gases with 1 amount and 3 amounts), no unit required.

The gas components can either be selected from a predefined list or defined by the user to use a different gas component. In that case the refractive index for the component has to be entered.

Accessories

Device-specific accessories

Weather protection cover



21 Weather protection cover; dimensions: mm (in)

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)

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_{AC}, 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_{AC}, 50 to 60 Hz, 0.375 A, 15 W
- Several approvals for the hazardous area

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. 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

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):

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

Technical Information (TI)	**Planning aid** 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.
Brief Operating Instructions (KA)	**Guide that takes you quickly to the 1st measured value** The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	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 **Expert** menu). The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
Description of Device Parameters (GP)	The Description of Device Parameters provides a detailed explanation of each individual parameter in the 2nd part of the operating menu: the **Expert** 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.
Safety Instructions (XA)	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.
Installation instructions (EA)	Installation Instruction are used to replace a faulty unit with a functioning unit of the same type.

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Endress+Hauser

People for Process Automation