

PiLoTREK

WE-200

2-wire compact 80 GHz non-contact radar
level transmitters

User's and programming manual
3rd edition



Manufacturer:

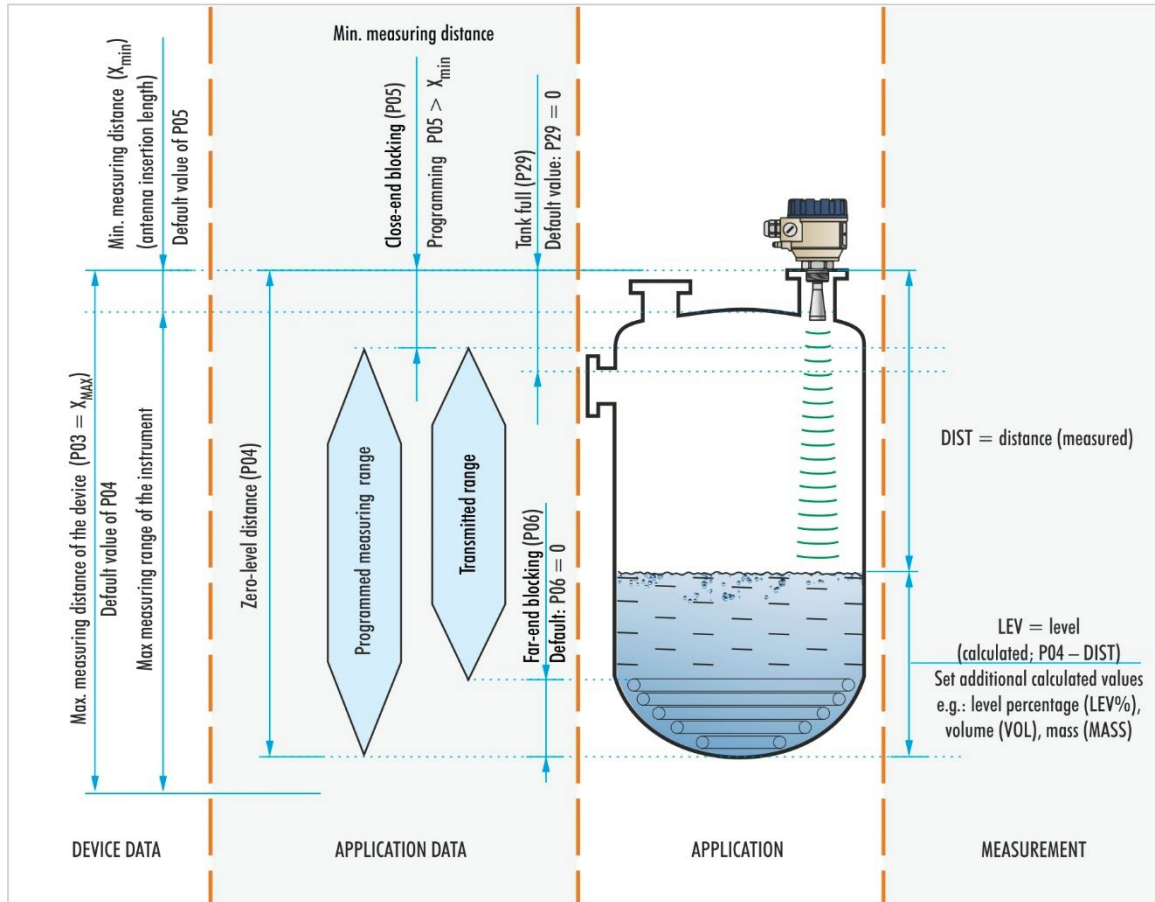
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BASIC CONCEPTS AND ELEMENTS








| Certificates | | Reference document number |
|---|--|---------------------------|
|  | ATEX, Certificate No.: BKI24ATEX0001 X | wes200hu23p02-b |
|  | IECEX, Certificate No.: ... | |
|  | ANATEL, Certificate No.: 04179-24-16612 | wps200br24p01-b |
|   | INMETRO, Certificate No.: DNV 24.0166 X. | wps200br24p01-b |

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1. INTRODUCTION

Application

The new PiloTREK WE–200 compact non-contact radar level transmitters use the most advanced industrial measurement technology: 80 GHz FMCW radar. Compared to lower frequencies (5...12 GHz and 25 GHz), 80 GHz radar has the main advantages of a smaller antenna size, better focusability, and a narrow beam angle.

It uses the latest technology to measure liquids, masses, emulsions, and other chemicals widely used in, for example, the water industry, food industry, energy industry, pharmaceutical industry, and chemical industries, providing measurement results with millimeter accuracy.

It can also measure materials prone to vapor formation and liquids with a gas blanket. Since the propagation of millimeter waves does not require a medium, it can also be used in a vacuum.

The device can also be operated with HART® compliant NIVELCO EView2, MultiCONT universal process controller, and PACTware™ software, or programmed via Bluetooth® communication with the new MobileEView app.

Operating principle

The PiloTREK WE–200 level transmitter is a frequency-modulated continuous wave (FMCW) radar operating at 80 GHz (W-band).

Depending on the measured medium, part of the energy of the frequency-modulated wave emitted by the antenna of the level transmitter is reflected from the measured surface.

The electronics module calculates the distance of the reflecting surface from the frequency shift proportional to the flight time of the reflected signal with high accuracy and converts it into a signal proportional to distance, level, or volume. The propagation speed of the millimeter-wave signal in air, gases, and vacuum is virtually the same regardless of temperature and pressure, so these factors do not significantly affect the accuracy of the measurement.

The signal strength of the reflected millimeter waves depends largely on the measured medium's dielectric constant (DC = relative dielectric constant ϵ_r [specific gravity]). Therefore, the maximum measuring distance achieved may decrease accordingly. Choosing an antenna with a larger diameter, thus higher gain, is recommended for measuring mediums with a low dielectric constant.

2. ORDER CODE (NOT ALL COMBINATIONS ARE AVAILABLE)

PiloTREK W - - *

| VERSION | CODE | ANTENNA / HOUSING | CODE | ANTENNA TYPE | CODE | MEASUREMENT RANGE | CODE | PROCESS CONNECTION | CODE | OUTPUT / CERTIFICATES | CODE | |
|-----------------------|------|---|------|---------------|------|-------------------------------|------|---|------|-----------------------|----------------------------|---|
| Transmitter | E | PP / Plastic (PBT) | P | 80 GHz / Horn | 2 | 10 m (33 ft) | 1 | 1" BSP ⁽³⁾ | 2 | 4...20 mA | HART® | 4 |
| Transmitter + Display | G | 1.4571 / Plastic (PBT) | M | | | 20 m (66 ft) | 2 | 1" NPT ⁽³⁾ | 3 | | HART® / Ex ia IIC | 8 |
| | | 1.4571 / Aluminum | S | | | 30 m (98.5 ft) ⁽²⁾ | 3 | 1½" BSP ⁽⁴⁾ | 4 | | HART® + Bluetooth® | B |
| | | 1.4571 / Stainless steel | K | | | | | 1½" NPT ⁽⁴⁾ | 5 | | HART® + BT® / Ex ia IIC | E |
| PVDF / Plastic (PBT) | V | Ø75 mm (2½") / prepared for flange ⁽⁵⁾ | 8 | | | | | HART® + Relay | H | | | |
| | | PVDF / Aluminum | B | | | | | Prepared for welded flange ⁽⁶⁾ | S | | HART® + Bluetooth® + Relay | R |
| | | PVDF / Stainless steel | W | | | | | | | | | |
| | | PTFE / Plastic (PBT) ⁽¹⁾ | F | | | | | | | | | |
| | | PTFE / Stainless steel ⁽¹⁾ | L | | | | | | | | | |

* For explosion-proof devices, the article number is followed by "Ex" on the data plate!

⁽¹⁾ Up to 20 m (66 ft) measuring range.

⁽²⁾ Under development

⁽³⁾ Only for 10 m (33 ft) measuring range.

⁽⁴⁾ For 10 and 20 m (66 ft) measuring range.

⁽⁵⁾ Only for 30 m (98.5 ft) measuring range, and encapsulated variants.

⁽⁶⁾ 10 m (33 ft), 20 m (66 ft) types with 1½" antenna (from DN40), 30 m (98.5 ft) types with Ø75 mm (2½") antenna (from DN80).

| Available accessories | Order code |
|---|------------|
| Display unit | SAP-300-0 |
| HART®-USB modem | SAT-304-0 |
| HART®-USB/Bluetooth® modem | SAT-504-□ |
| HART®-USB/RS485 modem | SAK-305-2 |
| HART®-USB/RS485 modem / Ex ia G | SAK-305-6 |
| Process connections ⁽⁷⁾ | |
| DIN and ANSI flanges | MFT-□□□-□ |
| DN40 Milch connection (DIN 11851) | |
| Seals ⁽⁷⁾ | |
| EPDM | |
| FFKM | |

⁽⁷⁾ The requirement for the above-mentioned technological connections and seals must be specified in the order.

3. TECHNICAL DATA

3.1. General

| PiloTREK W□□-2□□-□ | | | |
|------------------------------------|---------------------|--|---|
| Measured and derived values | | Measured value: distance; derived values: level, volume, weight, flow | |
| Signal frequency | | 77...81 GHz (W-band) | |
| Resolution | | 0.1 mm | |
| Supply voltage | | 12...36 V DC | |
| Output | Analog | 4...20 mA; (3.9...20.5 mA); $R_{Lmax} = (U_S - 12 V) / 0.02 A$ | |
| | Digital | Bluetooth® LE 5.1 (optional), HART® interface, HART® loop resistor $\geq 250 \Omega$ | |
| | Service interface | Compatible with SAT-506-0 | |
| | Display | SAP-300 – graphic display unit | |
| | Relay (optional) | SPDT 30 V / 1 A DC; 42 V / 0.5 A AC | |
| Measuring frequency | | ~ 1/s | |
| Process pressure | | Depends on type, see table (3.2) | |
| Standard version | Process temperature | -40...+80 °C (-40...+176 °F) | |
| | Ambient temperature | -40...+70 °C (-40...+158 °F); with display unit: -20...+70 °C (-4...+158 °F) | |
| High-temperature version | Process temperature | -40...+200 °C (-40...+392 °F) ⁽¹⁾ | |
| | Process temperature | -40...+60 °C (-40...+140 °F); with display unit: -20...+60 °C (-4...+140 °F) | |
| Seal | | FPM (Viton®), optionally: EPDM, FFKM Perfluoroelastomer (Kalrez® 6375) | |
| Ingress protection | | IP66 / IP67 | |
| Electrical connection | | 2× M20×1.5 cable gland + 2× internally threaded ½" NPT connection, cable outer diameter: Ø6...12 mm (Ø.24... Ø.47") (shielded cable is recommended), wire cross-section: 0.5...1.5 mm² (AWG20...AWG15) | |
| Electrical protection | | Class I overvoltage protection; (Class III [SELV]) | |
| Electronics housing ⁽²⁾ | | Fiberglass-reinforced plastic (PBT) | Painted aluminum Stainless steel 1.4571 (316Ti) |
| Weight | | 0.6...0.8 kg (1.32...1.76 lb) | 1.1...2 kg (2.43...4.4 lb) 2.4...2.9 kg (5.3...6.4 lb) |

⁽¹⁾ High-temperature version with metal housing and stainless steel antenna only

⁽²⁾ According to order code.

3.2. Type-Specific Data

| Antenna type | ENCAPSULATED ANTENNA (W□P, W□V, W□F) | | | | STAINLESS STEEL ANTENNA (W□S, W□M, W□K) | | |
|---|--------------------------------------|--------------------------------|-----------------|---------------------|---|--------------------------------|-----------------|
| Antenna size | Ø1" W□□-212-□ W□□-213-□ | Ø1½" W□□-2□4-□ W□□-2□5-□ | | Ø75 mm W□□-238-□ | Ø1" W□□-212-□ W□□-213-□ | Ø1½" W□□-2□4-□ W□□-2□5-□ | |
| Antenna material | PP, PVDF, PTFE | | | PP/PVDF | 1.4571 (316Ti) stainless steel | | |
| Dead zone ⁽¹⁾ | 0 m (0 ft) | | | | | | |
| Max. measuring distance ⁽²⁾ | 10 m (33 ft) | 10 m (33 ft) | 20 m (66 ft) | 30 m (98.5 ft) | 10 m (33 ft) | 10 m (33 ft) | 20 m (66 ft) |
| Accuracy ⁽³⁾ | ±4 mm (±0.16") | | ±2 mm (±0.079") | ±2 mm (±0.079") | ±4 mm (±0.16") | | ±2 mm (±0.079") |
| Antenna insertion length ⁽⁴⁾ | 56 mm (2.2") | 70 mm (2.76") | | 115 mm (4.53") | 69 mm (2.72) | 80 mm (3.15") | |
| Process pressure | -1...3 bar (-14.5...43.5 psi) | | | | -1...25 bar (-14.5...362.6 psi) | | |
| Beam angle (-3 dB) | 12° | 7° | | 4° | 12° | 7° | |
| Process connection | 1" BSP / NPT | 1½" BSP / NPT | | flange | 1" BSP / NPT | 1½" BSP / NPT | |

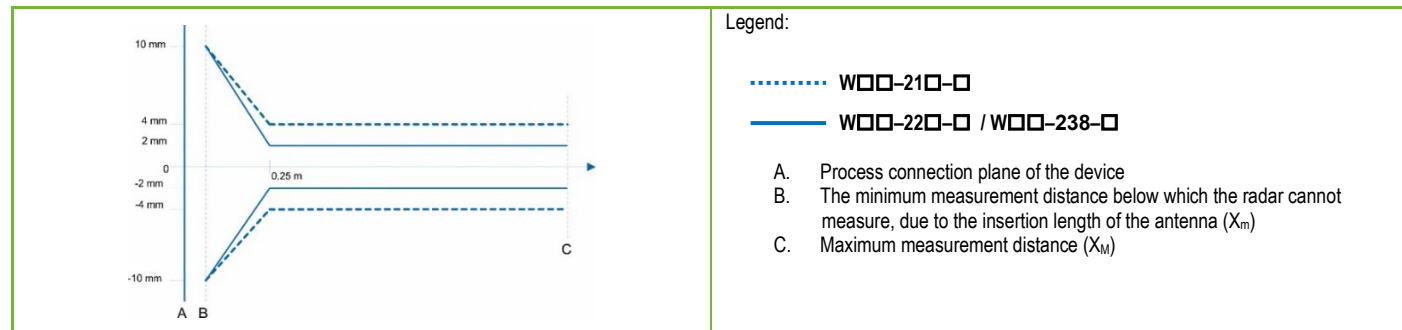
⁽¹⁾ From the tip of the antenna, if dielectric constant (ϵ_r) < 80.

⁽²⁾ May be limited for media with low dielectric constants or non-vertical or non-planar surfaces.

⁽³⁾ With an ideal reflecting surface, according to IEC 62828-1, an accuracy of ±2 mm (±0.079") is not guaranteed for Region 3 and Region 4 settings.

⁽⁴⁾ From process connection.

3.3. Linearity error



3.4. Dimensions

| Encapsulated antenna, plastic housing (WQP, WQV, WQF) | | Stainless steel antenna, stainless steel housing (WQK) | |
|---|-------------------------------|--|-------------------------------|
| Ø1" WQP-212-□ / WQP-213-□ | Ø1½" WQP-2□4-□ / WQP-2□5-□ | Ø1" WQK-212-□ / WQK-213-□ | Ø1½" WQK-2□4-□ / WQK-2□5-□ |
| | | | |
| Stainless steel antenna, aluminum housing (WQS) | | Stainless steel antenna, plastic housing (WEM) | |
| Ø1" WQS-212-□ / WQS-213-□ | Ø1½" WQS-2□4-□ / WQS-2□5-□ | Ø1" WQM-212-□ / WQM-213-□ | Ø1½" WQM-2□4-□ / WQM-2□5-□ |
| | | | |

3.5. Explosion Protection, Designation, Limit Values

3.5.1. ATEX Intrinsically safe protection (Ex ia) – ATEX Certificate No.: BKI24ATEX0001 X

| APPLICATION GROUP | | IIC | IIIC |
|--|----------------------|--|---|
| Standard version | | WE□-□□□-8 Ex / WG□-□□□-8 Ex | |
| Ex marking (ATEX) | | II 1G Ex ia IIC T6 Ga | II 1D Ex ia IIIC T85°C Da |
| High-temperature version | | WH□-□□□-8 Ex / WJ□-□□□-8 Ex | |
| Ex marking (ATEX) | | II 1G Ex ia IIC T6...T3 Ga | II 1D Ex ia IIIC T85°C...T180°C Da |
| Ex power supply, intrinsically safety data ⁽¹²⁾ | | Ui = 30 V, Ii = 100 mA, Pi = 0,75 W Ci ≤ 12 nF, Li ≤ 250 µH | Ui = 30 V, Ii = 140 mA, Pi = 1 W Ci ≤ 12 nF, Li ≤ 250 µH |
| Supply voltage | | 12...30 V DC | |
| Electrical connection | Cable entry | 2× M20×1.5 cable glands + 2× internally threaded ½" NPT connection | |
| | Cable outer diameter | Ø6...12 mm (Ø0.25...0.5") | |
| | Wire cross-section | 0.5...1.5 mm² (AWG20...15) | |
| Temperature limit data | | See tables in section 3.5.2. | |

⁽¹²⁾ In IIB applications, Ex power supply data for IIIC can be used.

3.5.2. Temperature limit data for ATEX (Ex ia) approved models

| Temperature data | Standard version WE□-2□□-8 Ex / WE□-3□□-8 Ex, WG□-2□□-8 Ex / WG□-3□□-8 Ex | High-temperature version WH□-2□□-8 Ex / WH□-3□□-8 Ex, WJ□-2□□-8 Ex / WJ□-3□□-8 Ex | | | |
|---|---|---|-------------------|-------------------|-------------------|
| | Ex ia IIC, Ex ia IIIC | Ex ia IIC, Ex ia IIIC | | | |
| | T6 T85°C | T6 T85°C | T5 T100°C | T4 T135°C | T3 T180°C |
| Highest process temperature | +80 °C (+176 °F) | +80 °C (+176 °F) | +100 °C (+212 °F) | +135 °C (+275 °F) | +180 °C (+356 °F) |
| Highest surface temperature at the process connection | +70 °C (+158 °F) | +70 °C (+158 °F) | +100 °C (+212 °F) | +135 °C (+275 °F) | |
| Highest ambient temperature | +70 °C (+158 °F) | +70 °C (+158 °F) | +70 °C (+158 °F) | +60 °C (+140 °F) | |

3.5.3. IECEx intrinsically safe protection (Ex ia) – IECEx certificate No.:

| APPLICATION GROUP | | IIC | IIIC |
|---|----------------------|--|---|
| Standard version | | WE□-□□□-8 Ex / WG□-□□□-8 Ex | |
| Ex marking (IECEx) | | Ex ia IIC T6 Ga | Ex ia IIIC T85°C Da |
| High-temperature version | | WH□-□□□-8 Ex / WJ□-□□□-8 Ex | |
| Ex marking (IECEx) | | Ex ia IIC T6...T3 Ga | Ex ia IIIC T85°C...T180°C Da |
| Ex power supply, intrinsically safety data ⁽¹⁾ | | U _i = 30 V, I _i = 100 mA, P _i = 0,75 W C _i ≤ 12 nF, L _i ≤ 250 μH | U _i = 30 V, I _i = 140 mA, P _i = 1 W C _i ≤ 12 nF, L _i ≤ 250 μH |
| Supply voltage | | 12...30 V DC | |
| Electrical connection | Cable entry | 2× M20×1.5 cable glands + 2× internally threaded ½" NPT connection | |
| | Cable outer diameter | Ø6...12 mm (Ø0.25...0.5") | |
| | Wire cross-section | 0.5...1.5 mm² (AWG20...15) | |
| Temperature limit data | | See tables in section 3.5.4. | |

⁽¹⁾ In IIB applications, Ex power supply data for IIIC can be used..

3.5.4. Temperature limit data for IECEx (EX IA) approved models

| Temperature data | Standard version | High-temperature version | | | |
|---|---|---|-------------------|-------------------|-------------------|
| | WE□-2□□-8 Ex / WE□-3□□-8 Ex, WG□-2□□-8 Ex / WG□-3□□-8 Ex | WH□-2□□-8 Ex / WH□-3□□-8 Ex, WJ□-2□□-8 Ex / WJ□-3□□-8 Ex | | | |
| | Ex ia IIC, Ex ia IIIC | Ex ia IIC, Ex ia IIIC | | | |
| Temperature class | T6 T85°C | T6 T85°C | T5 T100°C | T4 T135°C | T3 T180°C |
| Highest process temperature | +80 °C (+176 °F) | +80 °C (+176 °F) | +100 °C (+212 °F) | +135 °C (+275 °F) | +180 °C (+356 °F) |
| Highest surface temperature at the process connection | +70 °C (+158 °F) | +70 °C (+158 °F) | +100 °C (+212 °F) | +135 °C (+275 °F) | |
| Highest ambient temperature | +70 °C (+158 °F) | +70 °C (+158 °F) | +70 °C (+158 °F) | +60 °C (+140 °F) | |

3.5.5. INMETRO intrinsically safe protection (Ex ia) –INMETRO certificate No.: DNV 24.0166 X

| APPLICATION GROUP | | IIC | IIIC |
|--|----------------------|--|---|
| Standard version | | WE□-□□□-8 Ex / WG□-□□□-8 Ex | |
| Ex marking (INMETRO) | | Ex ia IIC T6 Ga | Ex ia IIIC T85°C Da |
| High-temperature version | | WH□-□□□-8 Ex / WJ□-□□□-8 Ex | |
| Ex marking (INMETRO) | | Ex ia IIC T6...T3 Ga | Ex ia IIIC T85°C...T180°C Da |
| Ex power supply, intrinsically safety data ⁽¹⁾ | | Ui = 30 V, Ii = 100 mA, Pi = 0,75 W Ci ≤ 12 nF, Li ≤ 250 µH | Ui = 30 V, Ii = 140 mA, Pi = 1 W Ci ≤ 12 nF, Li ≤ 250 µH |
| Supply voltage | | 12...30 Vcc | |
| Electrical connection | Cable entry | 2× M20×1.5 cable glands + 2× internally threaded ½" NPT connection | |
| | Cable outer diameter | Ø6...12 mm (Ø0.25...0.5") | |
| | Wire cross-section | 0.5...1.5 mm² (AWG20...15) | |
| Temperature limit data | | See tables in section 3.5.6. | |

⁽¹⁾ In IIB applications, Ex power supply data for IIIC can be used.

3.5.6. Temperature limit data for INMETRO (Ex ia) approved models

| Temperature data | Standard version WE□-2□□-8 Ex / WE□-3□□-8 Ex, WG□-2□□-8 Ex / WG□-3□□-8 Ex Ex ia IIC, Ex ia IIIC | High-temperature version WH□-2□□-8 Ex / WH□-3□□-8 Ex, WJ□-2□□-8 Ex / WJ□-3□□-8 Ex Ex ia IIC, Ex ia IIIC | | | |
|---|--|--|-------------------|-------------------|-------------------|
| | T6 T85°C | T6 T85°C | T5 T100°C | T4 T135°C | T3 T180°C |
| | | | | | |
| Highest process temperature | +80 °C (+176 °F) | +80 °C (+176 °F) | +100 °C (+212 °F) | +135 °C (+275 °F) | +180 °C (+356 °F) |
| Highest surface temperature at the process connection | +70 °C (+158 °F) | +70 °C (+158 °F) | +100 °C (+212 °F) | +135 °C (+275 °F) | |
| Highest ambient temperature | +70 °C (+158 °F) | +70 °C (+158 °F) | +70 °C (+158 °F) | +60 °C (+140 °F) | |

3.6. Accessories

- Warranty card
- User and programming manual
- EU Declaration of Conformity
- Two M20×1.5 cable glands
- Flat seal (if applicable)
- SAP-300 display unit (if ordered)

3.7. Conditions for safe operation

Compliance with technological process conditions

- If the device is installed in a place subject to overvoltage, the device must be protected with at least class II surge protection!
- The device must be connected to the earth of the EP network via its earth screw.



The cable extending from the device must be fixed and relieved of any tension!



The device may only be powered from a Category 1 (SELV/PELV) power supply unit!

Compliance with local rules and regulations

The PiloTREK WE-200 is a Local Positioning Radar (LPR) and must be mounted in a fixed, antenna-down position. In addition, the following two restrictions on antenna placement and height from the ground must be observed:

- a separation distance of 4 km (2.48 miles) from radio astronomy sites operating in the frequency band 75...85 GHz, unless specifically authorized by the ruling national regulatory authority.
- At a distance of between 4 and 40 km (2.48 and 24.8 miles) from any radio astronomy site, the height of the radar above ground level must not exceed 15 m (49.2 ft).

Compliance with Ex requirements

- Intrinsically safe devices may only be operated from a circuit that complies with the technical data of the device and is marked [Ex ia IIC] or [Ex ia IIB].
- The device may contain components capable of being electrostatically charged! The presence of electrostatic charges can cause sparks and ignition, so electrostatic charges must be prevented entirely in potentially explosive (Ex) atmospheres!
- The device must only be installed in an environment that is free from direct air currents and any other charging effects. Except in the case of application group III, if the conductivity of the particulate matter is greater than $>10^{-9}$ S (at 50±5% relative humidity) or $>10^{-11}$ S (at 30±5% relative humidity).
- Extreme care must be taken during maintenance when there may be explosive residue in the process tank. The device may only be touched in an explosive (Ex) environment with a wet antistatic cloth!

3.8. Maintenance, repair, and storage conditions

The **PiloTREK WE-200** does not require regular maintenance. However, there may be cases where the sensor head needs to be cleaned of material deposits. Clean the device carefully, without scratching or pressing the radiating surface.

All repairs, whether covered by warranty or not, must be carried out by NIVELCO.

The device returned for repair must be cleaned by the user, all chemical deposits must be removed, and the device must be disinfected before sending it back. In addition, the return package must include a properly filled [Returned Equipment Handling Form](#) (B0407/C, download it from our website), in which the sender declares that the device is free of all contamination and substances hazardous to health.

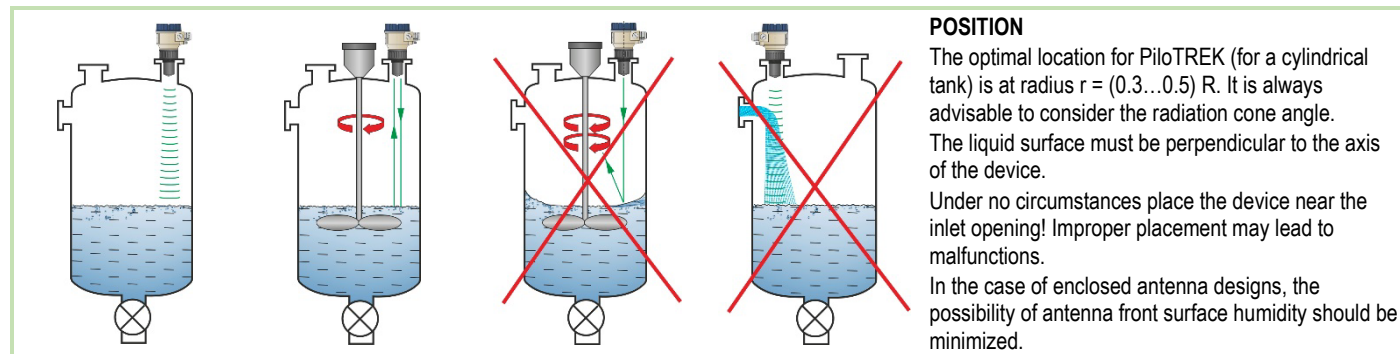
If the device is not used, store it within the ambient temperature specified in the technical data, with a maximum humidity of 98%.

3.9. Firmware update

The device's firmware is continuously maintained, considering user feedback and needs. If you want to update the firmware, use the built-in update communication port to upgrade to the latest version. To update, you need the NiFlash Light program; contact your local NIVELCO partner! In addition, the SAT-506-0 eLink communication adapter is required to upgrade the firmware.

4. INTEGRATION INTO THE TECHNOLOGICAL PROCESS

4.1. Level measurement applications

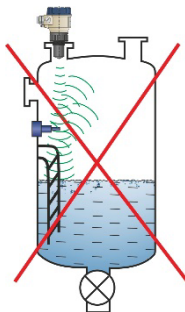


OBSTACLES

It is essential to avoid objects (pipes, ladders, structural elements, thermometers, etc.) entering the radiation cone.

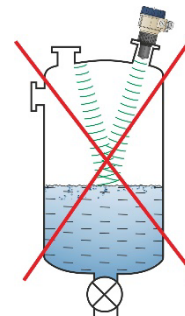


CAUTION! Up to 4 interfering echoes can be blocked by programming in the PiloTREK WE-200 threshold settings!



ALIGNMENT

The plane of the process connection must be parallel to the measured surface within $\pm 2...3^\circ$.



GAS / VAPOR

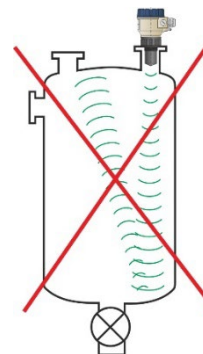
In a closed (especially outdoors, exposed to direct sunlight) tank, vapors/gases above the liquid may reduce the millimeter-wave signal transmission.

EMPTY TANK

Especially in the case of tanks with convex or conical bottoms or tanks with equipment (e.g., heating element, mixing paddle) at the bottom, the device may indicate an incorrect level when draining completely.

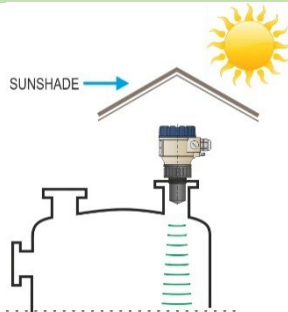
It is because the tank bottom or objects at the bottom of the tank scatter or reflect the millimeter waves emitted to a certain extent, or the lower signal level of the scattered radiation interferes with itself in the tank.

At least 100 mm (3.9") of liquid must cover these interfering devices or the convex or conical tank bottoms for a reliable measurement.



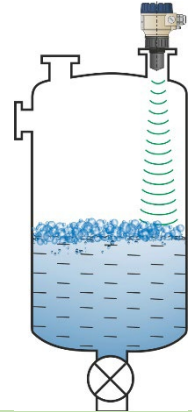
TEMPERATURE

The transmitter must be protected from direct sunlight to avoid exceeding the highest permitted temperature.



FOAM

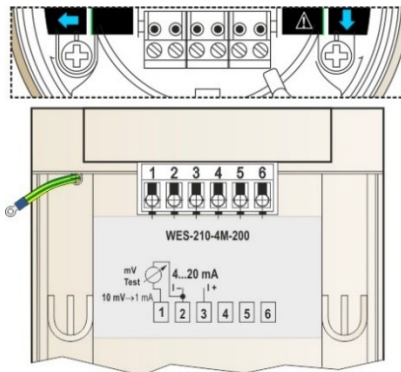
Foam on the measured surface may prevent millimeter-wave level measurement. Therefore, if possible, the sensor must be installed in a place under which foam formation is the least.



4.2. Flow measurement applications

- The device can measure flow in open channels with the flumes described in Chapter 5.7.
- The sensor must be placed as close to the surface as the maximum measured level and the dead zone of the sensor allow.
- The sensor must be placed in the longitudinal axis of the flume, at a location determined by the characteristics of the flume. This point is marked on the Parshall flumes sold by NIVELCO.
- Foam may form on top of the flowing liquid, which may compromise the measurement. Therefore, the liquid's surface opposite the sensor face must be exposed for a suitable echo.
- The sensor must be fixed so that its position cannot change.
- The proper construction of the section before and after the measuring channel is extremely important for an accurate measurement.
- The measurement accuracy based on volume flow change depends on the size and shape of the flume (channel, valve) used and the surface of the flowing liquid (rippling, foaming). Therefore, flow measurement accuracy inevitably falls short of level measurement accuracy.
- The sensor must be protected from direct sunlight with a shielding roof to avoid temperatures higher than permitted.

4.3. Wiring



1. Remove the cover of the device housing.
2. Insert the cable through the cable gland into the terminal block.
3. Strip approximately 80 mm (3.15") of the insulation of the cable and remove approximately 4 mm of the insulation of the wires. Cut the shielding of the signal cable.
4. Connect to points 2 and 3 of the terminal block according to the marked polarity.
5. Pull the cable back with about 10 mm (0.4") of the cable insulation remaining in the cable gland. Tighten the socket locking nuts with two wrenches.
6. Arrange the wiring in the housing.
7. Put the cover back on.



In non-explosive atmospheres, the device must be operated only from an galvanically isolated power supply!

For devices used in hazardous areas, the requirements in section "3.7 Conditions for safe operation" must be observed when selecting the power supply.

The insulation test with a test voltage of 500 V AC is prohibited due to the internal electronic overvoltage protection!

Connecting (grounding) to an equipotential network (EPH)

Earthing connector (EP) on the side of the device housing, maximum conductor cross-section: 4 mm² (AWG12).

The instrument housing must be earthed to a $R < 1 \Omega$ resistive earth.

The shield of the measuring cable must be grounded in the instrument room.

The measuring cable should not be routed near high-power cables, as shielding does not protect against switching harmonics.



Electrostatic Discharge (E.S.D.)

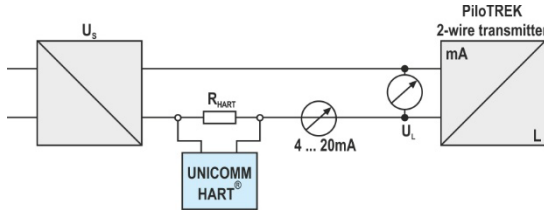


The device is protected against 4 kV E.S.D.

Warning! The internal protection of the instrument against ESD cannot protect the entire measuring system against electrostatic discharge. In all cases, it is the user's responsibility to ensure the grounding of the tank and the measured material.



Designing a measuring network



| | |
|---|---|
| Power supply | |
| Nominal voltage | 24 V DC |
| Maximum voltage (U_{in}): | 36 V DC |
| Minimum voltage (U_{in}): | Depends on the load impedance. (See diagram) |
| Loop resistance, R_{loop} | $R_{HART} + R_{cable} + R_{ammeter}$ |
| Minimum R_{HART} | 0 Ω |
| Maximum R_{HART} | 750 Ω |
| R_{HART} resistance for HART® communication | 250 Ω (recommended) |

Line "A": minimum voltage at the input terminals of the device

Line "B": minimum supply voltage (voltage across the device and the 250 Ω loop resistor)

Example for calculating the supply voltage:

The required minimum supply voltage at $I_{min} = 4$ mA:

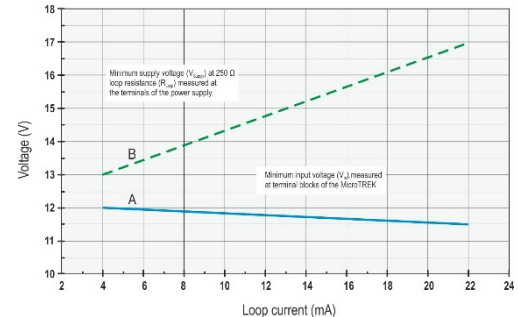
$$U_{supply\ min.} = U_{input\ min.} + (I_{min} * \text{loop resistance}) = 11.5\text{ V} + (4\text{ mA} * 0.25\text{ k}\Omega) = 12.5\text{ V}$$

the required minimum supply voltage at $I_{max} = 22$ mA:

$$U_{supply\ min.} = U_{input\ min.} + (I_{min} * \text{loop resistance}) = 11.5\text{ V} + (22\text{ mA} * 0.25\text{ k}\Omega) = 18.5\text{ V}$$

Therefore, in the case of a loop resistance of 250 Ω , the 17 V supply voltage is just sufficient for the whole 4...20 mA in the measurement range.

In hazardous areas, the data and requirements for designing the network may be different. When designing the measurement network, take into account the data and requirements in "3.5. Explosion Protection, Designation, Limit Values" and "3.7. Conditions for safe operation".



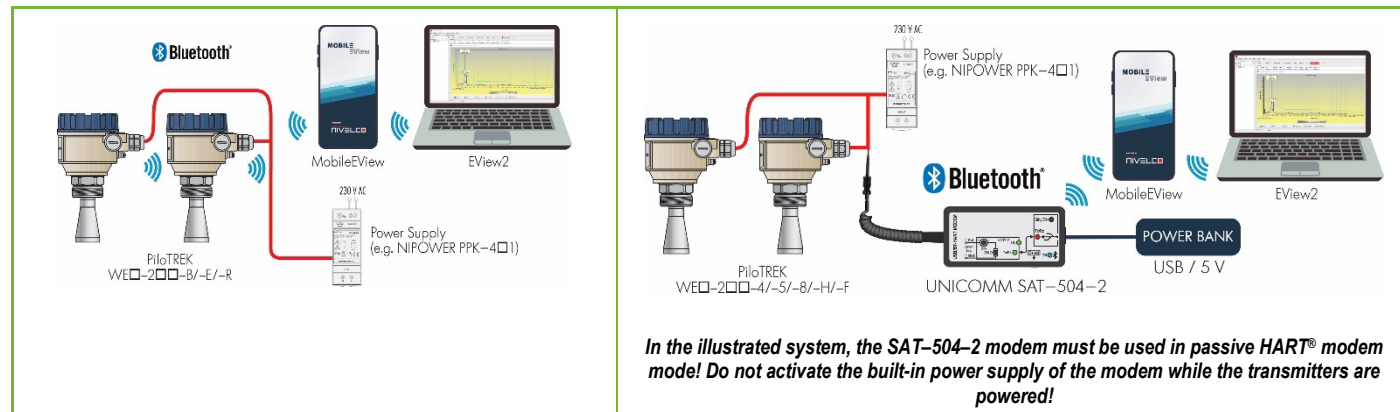
4.4. Available user interfaces

The device can be programmed using the following tools:

| | |
|--|---|
| MultiCONT universal process controller | Ordered separately. Display |
| HART® USB modem (e.g. SAT-504) | Ordered separately. See Chapter 7 "EView2 user manual." |
| SAP-300 display unit | Ordered separately. See Chapter 8 "Programming with SAP-300 display unit" |

4.5. Bluetooth® communication

The Bluetooth® option on the PiloTREK W-200 Series allows for convenient device setup and diagnostics via the NIVELCO MobileEView app for Android or iOS or the free EView2 software download for laptops.



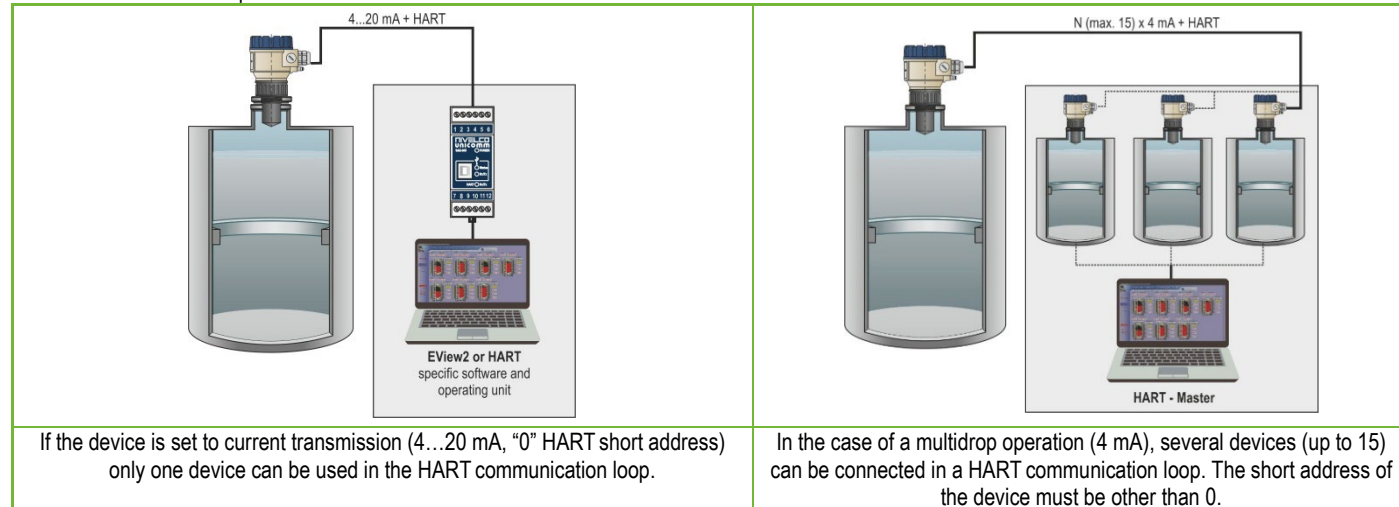
4.6. BUS (HART®) communication

The output of the device can be used as:

- Current loop and HART®
- Multidrop, HART® protocol

The EView2 software and the MultiCONT universal process controller support both modes. In accordance with the Rosemount Standard, HART® communication can be used between the PiloTREK as a “slave” and the HART® master as a point-to-point connection.

Communication can be implemented in two modes.



4.7. Commissioning and setting up

The factory default settings are suitable for checking functionality and simple measurement tasks but the device's full potential can only be used with the correct programming tailored to the requirements of the measured process. Therefore, to get to know the operational characteristics thoroughly and solve complex measuring tasks, it is necessary to read the chapters about programming.

Caution! The instrument starts with a current consumption of 3.5 mA (parameter P12c) after power-on and, after successful initialization, maintains the set error current of 3.8 mA (see parameter P12a) at the output until the first successful measurement!

5. PROGRAMMING

The HART interface of the **PiloTREK WE-200** lets the user to access and program all device parameters. The parameter set can be accessed in three ways:

- SAP-300 plug-in display unit. See Chapter 8 for manual and menu map.
- EView2 software. See Chapter 7 for manual.
- NIVELCO **MultiCONT** multi-channel process controller. See [MultiCONT User Manual](#).

These methods differ in many aspects. This programming guide only discusses the method involving EView2. For detailed information, refer to the descriptions of the particular access methods or the user manuals.

Some rarely used parameters cannot be set directly from the graphical interface. Instead, they can be changed referring to the parameter number at the following path.

| |
|----------------------------|
| EView2 |
| Advanced mode → Parameters |

5.1. Configuring the measurement

P00: d c b a Unit system, default units, regional parameter

FACTORY DEFAULT: 0000

*If parameter P00 is changed, the device reverts the entire parameter set to the factory default values of the new unit system.
Therefore, all parameters must be set again!*

| a | Mode |
|---|------------------|
| 0 | Normal |
| 1 | High-sensitivity |

| SAP-300 | EView2 | MultiCONT |
|---------------------------|------------------------------|-----------------------------------|
| BASIC SETUP → APPLICATION | Application → Operating mode | App. parameters → P00 Application |

| b | Unit (by "c") | |
|---|------------------|---------------|
| | Metric (EU) | Imperial (US) |
| 0 | m | ft |
| 1 | cm | inch |
| 2 | mm | inch |

| SAP-300 | EView2 | MultiCONT |
|---|---------------------------------|-----------------------------------|
| BASIC SETUP → UNITS → ENGINEERING UNITS → DISTANCE UNITS | Application → Engineering units | App. parameters → P00 Application |

| c | Regio / Unit system | Regional parameter |
|-------------------|---------------------|--|
| 0 | EU / Metric | EU, United Kingdom, Albania, Andorra, Azerbaijan, Australia, Belarus, Bosnia and Herzegovina, Canada, Liechtenstein, Moldova, Monaco, Montenegro, New Zealand, North Macedonia, Norway, San Marino, Saudi Arabia, Serbia, Switzerland, Turkey, Ukraine |
| 1 | US / Imperial | United States |
| 2 | Region 2 / Metric | Brazil, Japan, South Korea, Taiwan, Thailand |
| 3 | Region 2 / Imperial | |
| 4 ⁽¹³⁾ | Region 3 / Metric | India, Malaysia, South Africa |
| 5 ⁽¹³⁾ | Region 4 / Metric | Russia, Kazakhstan |

⁽¹³⁾ The accuracy of ± 2 mm is not guaranteed for Region 3 and Region 4 settings.

| SAP-300 | EView2 | MultiCONT |
|---|----------------------------------|-----------------------------------|
| BASIC SETUP → UNITS → ENGINEERING SYSTEM | Application → Calculation system | App. parameters → P00 Application |

| d | Temperature unit |
|---|------------------|
| 0 | °C |
| 1 | °F |

| SAP-300 | EView2 | MultiCONT |
|--|---|-----------------------------------|
| BASIC SETUP → UNITS → ENGINEERING UNITS → TEMPERATURE UNITS | Measurement configuration → Temperature | App. parameters → P00 Application |

P01: d c b a Output source

FACTORY DEFAULT: 1011

P01ba defines the source of the primary output value (HART – PV), which also defines the value transmitted on the analog current output. The device automatically selects the measurement mode according to the selected output source. The device measures the level's distance. The other quantities are calculated based on the specified tank parameters and material characteristics.

| SV 'dc' | PV 'ba' | Output data / measuring mode | Parameters |
|--------------------|------------|------------------------------|--------------------|
| 10 | | Distance | – |
| 11 | | Level | P04 |
| 12 | | Volume | P04, P40...45 |
| 13 | | Weight | P04, P32, P40...45 |
| 14 ⁽¹⁴⁾ | | Flow | P04, P40...45, P46 |
| 15 | | Empty Volume | P04, P40...45, P47 |
| 16 | | Level% | P04 |
| 17 | | Volume% | P04, P40...45 |
| 40 | | TEMP | – |
| 41 | | TOT1 | – |
| 42 | | TOT2 | – |

⁽¹⁴⁾ Cannot be selected in Volume (12, 17), Weight (13), and Empty Volume (15) measuring modes.

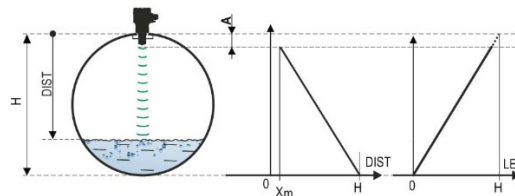
| SAP-300 | EView2 | MultiCONT |
|---|--|-------------------------------|
| MEASUREMENT CONFIGURATION → PV. Mode → SV. Mode | Measurement configuration → Measurement mode | Parameters → P01 Outp. funct. |

Distance measurement (DIST) / Level measurement (LEV)

DIST: Currently measured distance

A: Shortest measurable distance (P05)

H: Longest measurable distance, it is also the zero-level distance (P04)



Volume measurement (VOL)

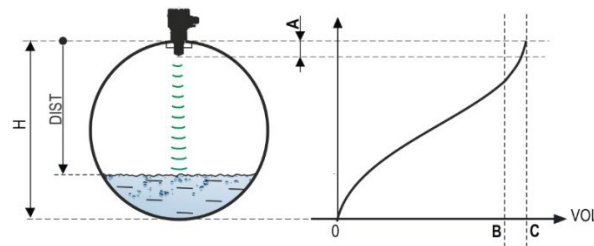
DIST: Currently measured distance

A: Shortest measurable distance

H: Zero-level distance

B: Volume associated with the highest measurable level

C: Tank's total volume



P02: d c b a Output units

FACTORY DEFAULT: 2021

The device calculates the volume, weight, and volume flow over a unit of time using a level-dependent (non-linear) function using **P40** or an output correction table (OCT). This parameter also determines the unit of measure for the "Output" column of the OCT table. The TOT value in flow measurement mode totalized (total) amount flowed. The distance, level, and temperature units can be selected in parameter P00.

| a | Weight unit | |
|---|-------------|------------|
| | Metric | US |
| 0 | kg | lb |
| 1 | ton | US ton |
| 2 | US ton | metric ton |

| SAP-300 ⁽¹⁵⁾ | EView2 | MultiCONT |
|---|--|--------------------------------|
| BASIC SETUP → UNITS → ENGINEERING UNITS → MASS UNITS | Measurement configuration → Mass Units | Parameters → P02 Output. unit. |

⁽¹⁵⁾ Appears only if an output variable (PV, SV, TV, QV) is weight!

| b | Volume | |
|---|-------------------------------|--------------------------------|
| | Metric | US |
| 0 | liter | gallon |
| 1 | hL | ft ³ |
| 2 | m ³ | barrel |
| 3 | million liter ⁽¹⁶⁾ | million gallon ⁽¹⁶⁾ |

⁽¹⁶⁾ Use is not recommended for flow measurement (in HART transmission it can only be interpreted in conjunction with reading an application-specific code). Except for MGD.

| | | |
|---|--|-------------------------------|
| SAP-300⁽¹⁷⁾ | EView2 | MultiCONT |
| BASIC SETUP → UNITS → ENGINEERING UNITS → VOLUME UNITS | Measurement configuration → Volume Units | Parameters → P02 Output. unit |

⁽¹⁷⁾ Appears only if PV, SV, TV, or QV is set to FLOW!

| c | Time |
|---|--------|
| 0 | Second |
| 1 | Minute |
| 2 | Hour |
| 3 | Day |

| | | |
|---|--|-------------------------------|
| SAP-300⁽¹⁸⁾ | EView2 | MultiCONT |
| BASIC SETUP → UNITS → ENGINEERING UNITS → TIME UNITS | Measurement configuration → Time Units | Parameters → P02 Output. unit |

⁽¹⁸⁾ Appears only if PV, SV, TV, or QV is set to FLOW!

| d | TOT | |
|---|--------------------------------|---------------------------------|
| | Metric | US |
| 0 | liter | gallon |
| 1 | hL | ft ³ |
| 2 | m ³ | barrel |
| 3 | million liters ⁽¹⁹⁾ | million gallons ⁽¹⁹⁾ |

⁽¹⁹⁾ Use is not recommended for flow measurement (in HART transmission it can only be interpreted in conjunction with reading an application-specific code). Except for MGD.

| | | |
|--|---------------------------------------|-------------------------------|
| SAP-300⁽²⁰⁾ | EView2 | MultiCONT |
| BASIC SETUP → UNITS → ENGINEERING UNITS → TOT UNITS | Measurement configuration → TOT Units | Parameters → P02 Output. unit |

⁽²⁰⁾ Appears only if PV, SV, TV, or QV is set to FLOW!

P03: Maximum sensing distance**FACTORY DEFAULT: See X_{\max} + 30 cm (1 ft).**

The maximum sensing distance measured from the process connection. The device evaluates level signals only within the specified distance. The maximum sensing distance is type-specific. See the X_{\max} column (+30 cm [+1 ft]) of the type-specific measurement distance table below. Smaller values can be set. The minimum value is parameter P05 + 30 cm (1 ft). It is not necessary to set this parameter. The device automatically selects the detection distance based on the zero-level distance specified in P04, within the limits of P03.

| Type-specific measuring distance | Minimum $X_{\min}^{(21)}$ | Maximum X_{\max} |
|---|---------------------------|--------------------|
| W□□-212-□ / W□□-213-□⁽²²⁾ | 0.056 m (2.2") | 10 m (33 ft) |
| W□□-214-□ / W□□-215-□⁽²²⁾ | 0.070 m (2.75") | 10 m (33 ft) |
| W□□-224-□ / W□□-225-□⁽²²⁾ | 0.070 m (2.75") | 20 m (66 ft) |
| W□□-212-□ / W□□-213-□⁽²³⁾ | 0.069 m (2.7") | 10 m (33 ft) |
| W□□-214-□ / W□□-215-□⁽²³⁾ | 0.080 m (3.15") | 10 m (33 ft) |
| W□□-224-□ / W□□-225-□⁽²³⁾ | 0.080 m (3.15") | 20 m (66 ft) |
| W□□-238-□⁽²²⁾ | 0.115 m (4.53") | 30 m (98.5 ft) |

⁽²¹⁾ From the plane of the process connection.

⁽²²⁾ **W□□P**, **W□□V**, **W□□F** encapsulated antenna.

⁽²³⁾ **W□□S**, **W□□M**, **W□□K** stainless steel antenna.

| | | |
|--|--|--------------------------------|
| SAP-300 | EView2 | MultiCONT |
| MEASUREMENT CONFIGURATION → → SENSING DIST. | Measurement configuration → Sensing Distance | Parameters → P03 Sensing dist. |

P04: Zero-level distance (tank height – H)**FACTORY DEFAULT: See X_{\max} in the table**

This parameter must always be set, except for distance measurement.

The zero-level distance (P04) is the distance between the sealing plane of the process connection and the designated zero level of the level measurement (e.g., the bottom of the tank). The device calculates the level value from the P04 value by subtracting the measured level distance. The device automatically sets the measuring distance within the maximum sensing distance (P03). The distance given here is denoted by 'H' in the figures and formulas. The maximum distance that can be measured (X_{\max}) is in the measuring distance table above, depending on the selected type. The set zero-level distance can be greater than the maximum measuring distance but not exceeding 60 m (200 ft).

Since the level measured by the device is the calculated difference between the P04 set for the given application and the distance (DIST) measured by the device, it is important to specify the zero-level distance (H) accurately.

| | | |
|-----------------------------------|---|--------------------------------|
| SAP-300 | EView2 | MultiCONT |
| CALCULATION → ZERO-LEVEL DISTANCE | Measurement configuration → Zero-level distance | Parameters → P04 Sensing dist. |

P05: Close-end blocking (dead-zone)**FACTORY DEFAULT: See X_{\min} in the table**

The dead-zone (starting from the process connection of the transmitter) is the range within which the device cannot measure due to its physical limitations (antenna insertion length). This is the minimum measuring distance of the device, and it is type-dependent. See the X_{\min} column of the type-specific measuring distance table above. Close-end blocking is the user-defined extension of the dead zone, within which the device does not consider any echoes. This, e.g., enables the exclusion of objects interfering with the measurement close to the sensor. Close-end blocking cannot be less than X_{\min} .

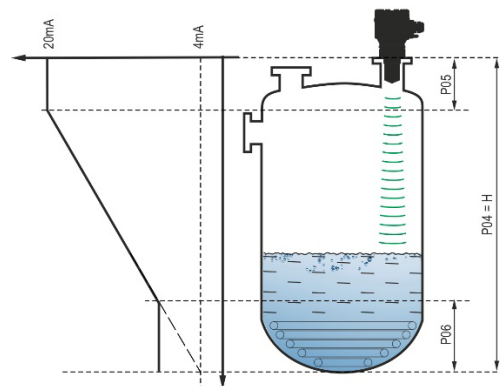
| SAP-300 | EView2 | MultiCONT |
|--|---|--------------------------------|
| MEASUREMENT CONFIGURATION → → NEAR BLOCKING | Measurement configuration → Minimum (P05) | Parameters → P05 Near blocking |

P06: Far-end blocking**FACTORY DEFAULT: 0.0**

In parameter **P06**, we can specify a level value below which the output will no longer follow any further level decrease. Far-end blocking is used when objects at the bottom of the tank (mixer, heating coil, funnel, etc.) cause measurement uncertainty within this range, e.g., because interfering echoes cannot be safely distinguished from the echoes of the measured surface. If an echo falls within the far-end blocking range ($LEV < P06$), the device sends a special signal and keeps the level value defined here on the output (see figure). The “Echo in far-end blocking range” flag (see Chapter 6.1) indicates that the echo is in the far-end blocking zone. Regardless of this, the “VALID” flag is active, but the “HOLD” flag remains inactive. Far-end blocking can be deactivated with **P06 = 0**. Min. value: 0 / max. value: $P04 - P05 - 5 \text{ cm}$ (2")

A.) Level or volume measurement

- If the level drops below the value of P06:
It keeps a level value corresponding to P06 on the output and calculates the derived values from it.
- If the level goes above the far-end blocking limit:
In level or volume measurement mode, the programmed tank dimensions are valid, so far-end blocking does not affect the measured or calculated values.

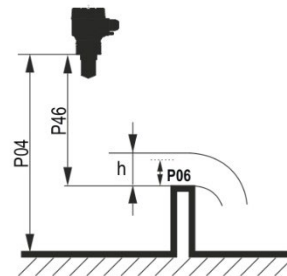


B.) Open-channel flow measurement

Far-end blocking is usually applied to those low-level values, below which exact volume flow cannot be calculated.

- *If the level in the flume drops below the blocking value:*
 - The current loop output holds the value corresponding to $Q = 0$.
 - For 0-value transmission via HART "No Flow" or for displaying 0.

• *If the level in the flume rises above the blocking value:*
Flow value is calculated using the parameters specified in the program, so remote blocking does not affect measured values.



| SAP-300 | EView2 | MultiCONT |
|---|--|-------------------------------|
| MEASUREMENT CONFIGURATION → → FAR BLOCKING | Measurement optimization → Far end (P06) | Parameters → P06 Far blocking |

5.2. Current loop output

P08: Manual output current value

FACTORY DEFAULT: 4.0

If the analog current loop output mode (**P12b**) is set to "Manual," the output current takes the value specified here, and the analog transmission switches off. A value between 3.8...20.5 mA is specified in this parameter. Caution! The device automatically switches to "Manual" current output mode when a new value is set in parameter P08. When 0 is entered, the device switches to "Automatic" current transmission mode ($P12b = 0$) and resets the value of parameter P08 to the factory setting. In HART multi-drop mode (see parameter P19), the current loop output is fixed at 4 mA, as per standard, and the manual output current value (P08) does not apply.

| SAP-300 | EView2 | MultiCONT |
|---|---|------------------------------|
| OUTPUT SETUP → ANALOG OUTPUT → → FIX CURRENT VALUE | Current output → Fix output current (P08) | Parameters → P08 Fix current |

P10: The value of the transmitted quantity assigned to 4 mA output current

FACTORY DEFAULT: 0.0

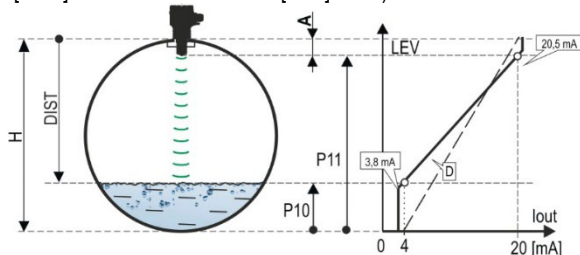
In the case of "Automatic" mode of the analog current output, it is the PV value assigned to 4 mA (usually the lower limit of the measuring range in the case of level measurement). The device scales the (HART – PV, see P01) output value to the analog current output 4...20 mA range using the values specified in parameters P10 and P11.

| SAP-300 | EView2 | MultiCONT |
|--|--|---------------------------------|
| OUTPUT SETUP → ANALOG OUTPUT → → PV VALUE OF 4 mA | Current output → Assignment of 4 mA - PV | Parameters → P10 PV assign 4 mA |

P11: The value of the transmitted quantity assigned to 20 mA output current

FACTORY DEFAULT: X_{\max}
(See table of **P03**)

In the case of “Automatic” (current transmission) mode of the analog current output, it is the PV assigned to 20 mA (usually the upper limit of the measurement range in the case of level measurement). The device scales the (HART – PV, see P01) output value to the analog current output 4...20 mA range using the values specified in parameters P10 and P11. The values can be assigned inversely. (For example, 4 mA to 1 m [3.3 ft] level and 20 mA to 10 m [33 ft] level, or vice versa 20 mA to 1 m [3.3 ft] level and 4 mA to 10 m [33 ft] level.)



A: Shortest measurable distance

D: **P10, P11** diagram valid for factory default settings

| SAP-300 | EView2 | MultiCONT |
|---|--|----------------------------------|
| OUTPUT SETUP → ANALOG OUTPUT → → PV VALUE OF 20 mA | Outputs → Current output → → Assignment of 20 mA - PV | Parameters → P11 PV assign 20 mA |

P12: - c b a Analog current loop output mode

FACTORY DEFAULT: 0000

Error current mode: the device indicates the error state on the current output according to the setting below. The error indication set as below persists until the error is cleared.

| a | Error current mode |
|---|---------------------------------|
| 0 | HOLD (holding last valid value) |
| 1 | 3.8 mA |
| 2 | 22 mA |

| SAP-300 | EView2 | MultiCONT |
|--|--|---------------------------------|
| OUTPUT SETUP → ANALOG OUTPUT → → ERROR MODE | Current output → Error indication by the current output | Parameters → P12 current output |

Analog current output mode:

| b | Analog current output mode | Description |
|---|----------------------------------|--|
| 0 | Automatic (current transmission) | The value of the output current is calculated from the measured value using the parameters P10 and P11. The output of the transmitter is active. |
| 1 | Manual | The value of the output current is not calculated from the measured value. Instead, a fixed output current (P08) is sent to the output. In this mode, the setting of the fault current mode is irrelevant. Multi-drop HART communication mode 4 mA (P19) override! |

| SAP-300 | EView2 | MultiCONT |
|--|----------------------------------|---------------------------------|
| OUTPUT SETUP → ANALOG OUTPUT → → CURRENT MODE | Outputs → Current generator mode | Parameters → P12 current output |

Startup mode: when switching on or restarting after a power failure the current is transmitted until the device starts measuring. It is recommended to set it to the fault current of the system. For periodic applications, e.g., battery operation, selecting the “Fast” recovery mode is recommended to shorten the measurement cycle time.

| c | Initial current | Resume time [s] |
|---|-------------------|-------------------------|
| 0 | < 3.8 mA (Normal) | 12...16 ⁽²⁴⁾ |
| 1 | > 22 mA (Fast) | 3...4 ⁽²⁴⁾ |

⁽²⁴⁾ Depending on the radar parameters. Note that it also depends on the conditions of use and how long after resuming operation the instrument will find an echo that can be evaluated.

| SAP-300 | EView2 | MultiCONT |
|-------------------------------|---------------------------|---------------------------------|
| BASIC SETUP → STARTUP CURRENT | Outputs → Startup current | Parameters → P12 current output |

5.3. Relay output (optional)

P13: - c b a Relay function

FACTORY DEFAULT: 0001

| a | Operating mode | Description |
|---|--|--|
| 0 | By PV (P14-P15-P16) | <p>The operating mode of the RELAY optionally built into the device can be set with this parameter. If it is set to "by PV," the RELAY operates based on the triggering (P14) and releasing (P15) values set.</p> <p>The "No ECHO" setting enables a switched (relay contact) error signal to the process controller.</p> <p>Caution! When the device is de-energized, the relay releases, so C1 is ON.</p> |
| 1 | "No ECHO" (echo loss): C1 = "On" (release) | |
| 2 | "No ECHO" (echo loss): C2 = "On" (energize) | |
| 3 | FLOW impulse (P17) | |
| 4 | C1 error (release) | |
| 9 | OFF | |

| SAP-300 | EView2 | MultiCONT |
|---|-------------------------------------|---------------------------------|
| OUTPUT SETUP → RELAY OUTPUT → → RELAY MODE | Outputs → Relay output → Relay mode | Parameters → P13 Relay function |

Operating mode: only relevant for operation by PV (P13a = 0)

| b | Function | | Programmable parameters | Description |
|---|-------------------|--|---|--|
| 0 | Hysteresis | | <p>P14, P15 At least 20 mm (0.787") hysteresis required between P14 and P15. P14 > P15 – normal operation P14 < P15 – inverted operation</p> | <p>The basic switching method of the RELAY set to "PV" mode can be adjusted.</p> |
| 1 | Window comparator | | <p>P14, P15 At least 20 mm (0.787") hysteresis required between P14 and P15. P14 > P15 – normal operation P14 < P15 – inverted operation</p> | |

| | | |
|--|--------------------------|---------------------------------|
| SAP-300 | EView2 | MultiCONT |
| OUTPUT SETUP → RELAY OUTPUT → RELAY FUNCTION | Outputs → Relay Function | Parameters → P13 Relay function |

FLOW impulse constant's (P17) unit (if P13:a = 3):

| c | Metric (EU) | Imperial (US) |
|----------|--------------------|----------------------|
| 0 | m ³ | ft ³ |
| 1 | liter | US gallon |
| 2 | liter | GB gallon |

| | | |
|--|--|---------------------------------|
| SAP-300 | EView2 | MultiCONT |
| OUTPUT SETUP → RELAY OUTPUT → → VOLUME/PULSE UNIT | Outputs → Relay output → Relay parameters → → Pulse constant unit | Parameters → P13 Relay function |

P14: Relay parameter – Relay on value **FACTORY DEFAULT: 0**

The measured PV value at which reaching the upper limit value is indicated on the RELAY output.
Adjustable value range: Value is adjustable according to PV setting range.

| | | |
|--|--|---------------------------------|
| SAP-300 | EView2 | MultiCONT |
| OUTPUT SETUP → RELAY OUTPUT → → ENERGIZED VALUE | Outputs → Relay output → Relay parameters → Energized value | Parameters → P14 Relay on value |

P15: Relay parameter – Relay off value **FACTORY DEFAULT: 0**

The measured PV value at which reaching the lower limit value is indicated on the RELAY output.
Adjustable value range: Value is adjustable according to PV setting range.

| | | |
|--|--|----------------------------------|
| SAP-300 | EView2 | MultiCONT |
| OUTPUT SETUP → RELAY OUTPUT → DEENERGIZED VALUE | Outputs → Relay output → Relay parameters → De- Energized value | Parameters → P15 Relay off value |

P16: Relay parameter – Relay delay **FACTORY DEFAULT: 0**

If the PV measurement value has reached the lower or upper switching value or an error has occurred in the case of an error signal, the actual RELAY operation is activated after this time, or after this time, a change is visible on the output.

Adjustable value range: 0...999 s.

| | | |
|-------------------------------------|----------------------------|------------------------------|
| SAP-300 | EView2 | MultiCONT |
| OUTPUT SETUP → RELAY OUTPUT → DELAY | Outputs → Relay delay time | Parameters → P16 Relay delay |

P17: Relay parameter – Flow parameter value**FACTORY DEFAULT: 1**

In the case of FLOW, the relay gives a pulse per volume unit specified here. The volume unit is set in parameter P13:c. The pulse width is 100 ms. The guaranteed maximum pulse density: < 3 seconds.

| SAP-300 | EView2 | MultiCONT |
|---|---|-----------------------------|
| OUTPUT SETUP → RELAY OUTPUT → VOLUME/PULSE VALUE | Outputs → Relay output → Relay parameters → Pulse constant | Parameters → P17 Flow pulse |

5.4. Digital communication**P19: HART short address (device address)****FACTORY DEFAULT: 0**

A unique device address by which the device is identified and managed via HART.

| a | Description |
|--------|--|
| 0 | Analog current loop output is active (current transmission via 4...20 mA) |
| 1...15 | Analog current loop inactive (no current transmission, fixed 4 mA), multi-drop |

| SAP-300 | EView2 | MultiCONT |
|--|---|--------------------------------|
| OUTPUT SETUP → DIGITAL OUTPUT → → ADDRESS | Device Identification → HART Device Short Address | Parameters → P19 Polling addr. |

5.5. Measurement optimization**P20: Damping Time****FACTORY DEFAULT: 40**

Damping time reduces unwanted fluctuations in displaying the measured data (e.g., ripples). If the level jumps, the transmitted value reaches 98% of the jump at this time. Unit: second (s). Value range: 0...999 s.

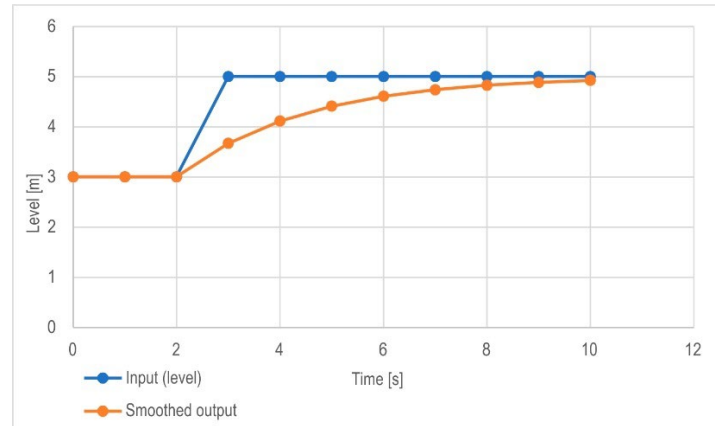
| | For testing | Recommended |
|--|-------------|-------------|
| Barely or non-volatile/waving media | 0 s | 8 s |
| Highly volatile / strongly waving liquid | >24 s | >40 s |

| SAP-300 | EView2 | MultiCONT |
|-----------------------------------|---|-------------------------------|
| MEAS. OPTIMIZATION → DAMPING TIME | Measurement optimization → Damping time | Parameters → P20 Damping time |

Damping example 1.

Damping time = 10 s

Level change (level) = 2 m (6.6 ft)



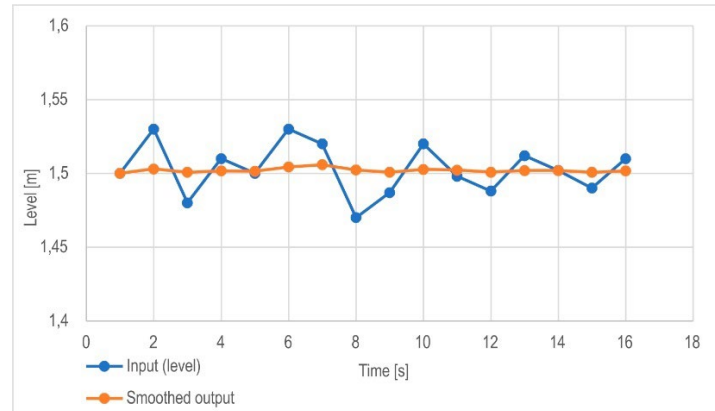
Damping example 2.

Damping time = 40 s

Level change = 2...3 cm

(0.39"...0.79") ripple

If a higher degree of undulation is expected in the measured liquid column, it is recommended to set a higher damping time. This way, the fluctuation of the value of the transmitted level can be reduced.



P22: User slope correction factor (actual/measured)**FACTORY DEFAULT: 1.0**

It corrects the transmitted quantity according to the distance. If the value measured by the device differs from the value under real conditions, this multiplier can be used to refine the result. The output value is multiplied by the number set here. By default, the multiplier (1) does not modify the output.

Value range: 0.7...10

| SAP-300 | EView2 | MultiCONT |
|-------------------------------------|--|----------------------------------|
| CALCULATION → USER SLOPE MULTIPLIER | Measurement optimization → Velocity user correction factor | Parameters → P22 User slope corr |

P25: - - - a Echo selection**FACTORY DEFAULT: 00**

The parameter P25a sets the echo selection strategy. Automatic operating mode is suitable for most applications. For special application requirements, a specific echo selection can be set as required.

| a | Echo selection within measuring window |
|---|--|
| 0 | Automatic |
| 1 | First |
| 2 | Second |
| 3 | Largest |
| 4 | Last |

| SAP-300 | EView2 | MultiCONT |
|-------------------------------------|---|---------------------------------|
| MEAS. OPTIMIZATION → ECHO SELECTION | Measurement optimization → Echo selection → → Selection of Echo... | Parameters → P25 Echo Selection |

P26/P27: Level tracking speed**FACTORY DEFAULT: 600 m/h (1 970 ft / h)**

The level tracking speed is the fastest level change speed that the device can continuously track. The device will only follow a level change slower than the set value. If the device senses a level signal change faster than this value, it assumes it is the result of a measurement error (e.g., condensation), it will not accept it, and the outputs will show the last valid value. Suppose this resulted from an incorrect measurement, and the result of the next measurement is plausible based on the set maximum speed. Then hold is canceled, and the actual measured level takes effect. If the rapid change in level was actually real, the device recalculates with each measurement whether the currently measured level is within the range determined by the product of the tracking speed and the elapsed time. If it is within the range, it cancels the hold, and the output adjusts to the new value according to the set damping parameter. Setting the level tracking speed is important when technological processes, especially during filling or discharging, produce interfering factors (e.g., ripples, foaming) that affect measurement stability. The set level tracking speed must be higher than the maximum filling/discharging speed prescribed by the technology. By entering it correctly, measurements during filling and discharging become more reliable. **Caution! In tanks with a conical or pyramidal bottom, the level change rate at the bottom of the tank increases significantly due to the shape of the tank.**

In this parameter pair, the filling and discharging speed can be set separately:

- P26 – Level rising rate (filling speed)
- P27 – Level descent rate (emptying speed)

The parameter's unit of measure: metric: [m/h]; US: [ft/h].

| SAP-300 | EView2 | MultiCONT |
|---|---|---|
| MEAS. OPTIMIZATION → LEVEL TRACK SPEED → FILLING SPEED → → EMPTYING SPEED | Measurement optimization → Level → → Level elevation rate (filling speed) Level descent rate (emptying speed) | Parameters → P26 Filling speed Parameters → P27 Emptying speed |

P28 - - b a Measurement loss handling**FACTORY DEFAULT: 0010**

Echo loss handling:

| a | Echo loss ("no-Echo") handling |
|---|---|
| 0 | Hold for the period in the P28b decade. |
| 1 | Hold (indefinitely) |
| 2 | Filling simulation (at detected speed) |
| 3 | Filling simulation (at P26/P27 maximum speed) |
| 4 | Tank empty (DIST = maximum / LEV = 0) |
| 5 | Tank full (DIST minimum / LEV = maximum) |

| SAP-300 | EView2 | MultiCONT |
|--|--|-----------------------------|
| MEAS. OPTIMIZATION → ECHO LOSS HANDLING → OUTPUT MODE | Measurement optimization → Measurement loss management → Echo loss handling | Parameters → P28 ECHO loss. |

Error indication delay:

This parameter defines the time elapsed between the occurrence of the error and the issued error signal (error current). During the delay, the output is holding the last valid measured value. The function is available for current output only if the error signal is set to a lower (3.8 mA) or upper (22 mA) error current.

When the error is gone, the device returns to measuring mode after the set delay.

| b | Error indication delay | Notes |
|---|------------------------|---|
| 0 | No delay | <p>During a short echo loss, the last value is held in transmission for a period set in P28:b. After that, it is transmitted via HART on bit 0 of DSE⁽²⁵⁾ according to P12:a on the current loop output.</p> <p>The diagram illustrates the timing of the error indication delay. It shows two parallel timelines: HART and Current Output. Both start with a 'Measured value'. When an 'Echo loss' occurs, the 'ECHO LED goes out'. The HART signal transitions to a 'Held value (P28:b)' and then to 'Error code 2'. The Current Output signal transitions to a 'Held value (P28:b)', then to 'Holding last value (P12a=0)', and finally to an 'Error current' (22 mA for P12a=2 or 3.8 mA for P12a=1). A 'NOECHO indicator' appears at the end of the delay period.</p> |
| 1 | 10 s | |
| 2 | 20 s | |
| 3 | 30 s | |
| 4 | 1 min | |
| 5 | 2 min | |
| 6 | 5 min | |
| 7 | 15 min | |

⁽²⁵⁾ DSE – “Device Specific Error” indicator bits (HART). See Chapter 6 Troubleshooting.

| SAP-300 | EView2 | MultiCONT |
|---|--|-----------------------------|
| MEAS. OPTIMIZATION → ECHO LOSS HANDLING → OUTPUT HOLD TIME | Measurement optimization → Measurement loss management → Error delay | Parameters → P28 ECHO loss. |

P29: Tank Full Limit

FACTORY DEFAULT: 0.0

As with P06, the echo is tracked below the specified distance, but the output is not tracked and a "Tank Full" flag is displayed.

Value range: 0... (P04 – 5 cm [2"])

If P29 is less than P05, the Tank Full Limit parameter is disabled.

P32: Specific density of the measured medium

FACTORY DEFAULT: 1.0

If the device is set to weight transmission, the specific density of the material (medium) stored in the tank must be entered here for the weight calculation. The value is a relative ratio number (without a unit) compared to the density of water, i.e., 1 g/cm³.

Value range: 0.01...10

| SAP-300 | EView2 | MultiCONT |
|--------------------------------|---|---------------------------------|
| CALCULATION → SPECIFIC GRAVITY | Measurement optimization → Specific gravity | Parameters → P32 Spec. gravity. |

P34: Threshold offset**FACTORY DEFAULT: 0**

It is used for simple relative modification of the acceptance threshold value set in the Echo diagram, the value range of which is -4000...+4000. It can increase (positive value) or decrease (negative value) the device's noise suppression ability compared to the default setting. If the value is 0, there is no change compared to the set threshold value. (See Chapter 7.4 Threshold mask).

| SAP-300 | EView2 | MultiCONT |
|---------------------------------------|---|--------------------------------|
| MEAS. OPTIMIZATION → THRESHOLD OFFSET | Measurement optimization → Threshold offset | Parameters → P34 Thresh. offs. |

P36: - - b a Bluetooth settings**FACTORY DEFAULT: 41**

| a | Comment |
|---|---|
| 0 | ON |
| 1 | ON for 5 minutes after Startup if no connection |
| 9 | OFF |

Bluetooth transmission power: This parameter allows you to set the output power of the Bluetooth module. The transmission power affects the available range. Please note that the range of Bluetooth® communication depends on the environmental conditions and the Bluetooth® power settings on the user side (smartphone).

| b | Bluetooth transmission power |
|---|------------------------------|
| 0 | Lowest signal strength |
| 1 | +2 dB signal strength |
| 2 | +4 dB signal strength |
| 3 | +6 dB signal strength |
| 4 | +8 dB signal strength |

5.6. Volume measurement

P40: 0 - b a Output value calculation method

FACTORY DEFAULT: 0000

A selection of typical tank shapes for volume measurement. The tank dimensions can be set using parameters P41...P45 (see figures below). In the case of the OCT setting, the tank shape must be specified in a table.

| ba | Tank shape | Parameters |
|----|--|-------------------------|
| — | Output Conversion Table (OCT) | See Chapter 5.8 |
| 00 | Vertical cylindrical tank with flat bottom | P41 |
| 10 | Vertical cylindrical container with a slightly convex bottom | P41 |
| 20 | Vertical cylindrical container with a strongly convex bottom | P41 |
| 30 | Vertical cylindrical tank with hemispherical bottom | P41 |
| 01 | Vertical cylindrical tank with a conical bottom | P41, P43, P44 |
| 02 | Vertical rectangular tank with a pyramidal bottom (see below for value b) | P41, P42, P43, P44, P45 |
| 03 | Horizontal cylindrical tank with flat bottom | P41, P42 |
| 13 | Horizontal cylindrical container with a slightly convex bottom | P41, P42 |
| 23 | Horizontal cylindrical container with a strongly convex bottom | P41, P42 |
| 33 | Horizontal cylindrical tank with hemispherical bottom | P41, P42 |
| 04 | Spherical tank | P41 |

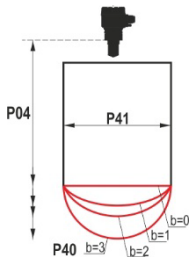
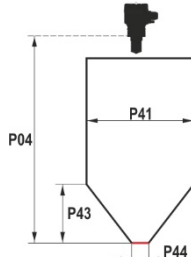
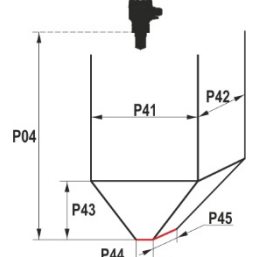
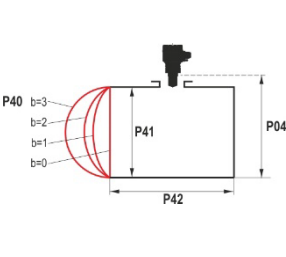
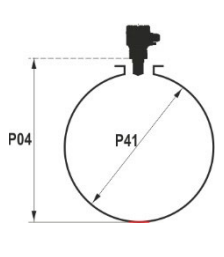
| | | |
|---------------------------------|--|------------------------------------|
| SAP-300 | EView2 | MultiCONT |
| <i>CALCULATION → TANK SHAPE</i> | <i>Tank/Silo parameters → Tank shape</i> | <i>Parameters → P40 Tank type.</i> |

| b | Tank bottom shape | Associating typical tank bottom shapes for the specific tank type to calculate the volume accurately. The exact form of the setting code can be seen in the drawings under parameters P41...45. |
|---|-------------------|---|
| 0 | Planar | |
| 1 | Slightly convex | |
| 2 | Strongly convex | |
| 3 | Hemispherical | |

| | | |
|---------------------------------|--|------------------------------------|
| SAP-300 | EView2 | MultiCONT |
| <i>CALCULATION → TANK SHAPE</i> | <i>Tank/Silo parameters → Bottom shape</i> | <i>Parameters → P40 Tank type.</i> |

P41-45: - - - Tank dimensions

These are the size parameters for the tank shape selected in parameter P40 according to the dimensions shown in the drawings below. **For proper operation, it is important to specify these dimensions accurately.**

| Vertical cylindrical tank with a convex bottom | Vertical cylindrical tank with a conical bottom | Vertical rectangular tank with a pyramidal bottom | Horizontal cylindrical tank | Spherical tank |
|---|---|---|--|---|
|  |  |  |  |  |

P47: - - - a Total tank volume

FACTORY DEFAULT: 0.0

The total tank volume is required for empty volume calculation (see parameter P01).

If one of the outputs (PV, SV, TV, or QV) is set to transmit "Ullage volume," then the total volume can be entered in this parameter to calculate the actual transmitted value. In this case, the transmitted data is the difference between the total volume and the actual medium volume. Its unit is the volume unit set in the P01b decade.

Value range: 0...999,999.

| SAP-300 | EView2 | MultiCONT |
|--------------------------|--|-------------------------------|
| CALCULATION → TANK SHAPE | Tank/Silo parameters → Total tank volume | Parameters → P47 Total volume |

5.7. Open-channel flow measurement

P40: 0 - b a Volume flow measurement options

FACTORY DEFAULT: 0000

| ba | Flume, formula, data | | | | | Parameters |
|----|--|---------|-------------------------------------|------------------------|------------------------|---------------|
| -- | Output Conversion Table, See Chapter 5.8 | | | | | |
| | NIVELCO Parshall flumes | Type | Calculation formula | Q _{min} [l/s] | Q _{max} [l/s] | "P" [cm] |
| 00 | | GPA-1P1 | $Q [l/s] = 60.87 \cdot h^{1.552}$ | 0.26 | 5.38 | 30 |
| 01 | | GPA-1P2 | $Q [l/s] = 119.7 \cdot h^{1.553}$ | 0.52 | 13.3 | 34 |
| 02 | | GPA-1P3 | $Q [l/s] = 178.4 \cdot h^{1.555}$ | 0.78 | 49 | 39 |
| 03 | | GPA-1P4 | $Q [l/s] = 353.9 \cdot h^{1.558}$ | 1.52 | 164 | 53 |
| 04 | | GPA-1P5 | $Q [l/s] = 521.4 \cdot h^{1.558}$ | 2.25 | 360 | 75 |
| 05 | | GPA-1P6 | $Q [l/s] = 674.6 \cdot h^{1.556}$ | 2.91 | 570 | 120 |
| 06 | | GPA-1P7 | $Q [l/s] = 1014.9 \cdot h^{1.56}$ | 4.4 | 890 | 130 |
| 07 | | GPA-1P8 | $Q [l/s] = 1368 \cdot h^{1.5638}$ | 5.8 | 1208 | 135 |
| 08 | | GPA-1P9 | $Q [l/s] = 2080.5 \cdot h^{1.5689}$ | 8.7 | 1850 | 150 |
| 09 | Generic Parshall flume | | | | | P46, P42 |
| 10 | Palmer-Bowlus (D/2) | | | | | P46, P41 |
| 11 | Palmer-Bowlus (D/3) | | | | | P46, P41 |
| 12 | Palmer-Bowlus (rectangular) | | | | | P46, P41, P42 |
| 13 | Khafagi-Venturi | | | | | P46, P42 |
| 14 | Weir | | | | | P46, P42 |
| 15 | Rectangular or Bazin weir | | | | | P46, P41, P42 |
| 16 | Trapezoidal weir | | | | | P46, P41, P42 |
| 17 | Special trapezoidal (4:1) weir | | | | | P46, P42 |
| 18 | V-shaped weir | | | | | P46, P42 |
| 19 | Thomson (90°) weir | | | | | P46 |
| 20 | Circular weir | | | | | P46, P41 |
| 21 | Generic formula: $Q[l/s] = P41 \cdot h^{P42}$, h [m] | | | | | P46, P41, P42 |
| 22 | Generic formula: $Q[l/s] = P41 \cdot h^{P42}$, h [P00:cb] | | | | | P46, P41, P42 |

P40: 0 - b a Volume flow measurement options (continued)

| ba | Flume, formula, data | Parameters |
|-----------|-----------------------------|-------------------|
| 30 | 4" Palmer-Bowlus (D/2) | P46 |
| 31 | 6" Palmer-Bowlus (D/2) | P46 |
| 32 | 8" Palmer-Bowlus (D/2) | P46 |
| 33 | 10" Palmer-Bowlus (D/2) | P46 |
| 34 | 12" Palmer-Bowlus (D/2) | P46 |
| 35 | 15" Palmer-Bowlus (D/2) | P46 |
| 36 | 18" Palmer-Bowlus (D/2) | P46 |
| 37 | 21" Palmer-Bowlus (D/2) | P46 |
| 38 | 24" Palmer-Bowlus (D/2) | P46 |

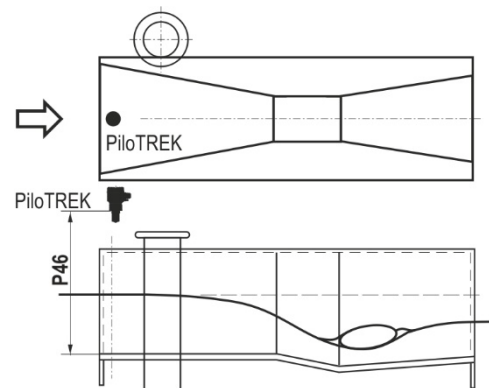
| | | |
|---------------------------------------|---|------------------------------------|
| SAP-300 | EView2 | MultiCONT |
| <i>CALCULATION → FLOW MEASUREMENT</i> | <i>Flow measurement → Open channel flow measurement methods</i> | <i>Parameters → P40 Tank type.</i> |

P40=00

NIVELCO Parshall flume (GPA1-P1 through GPA-1P9)

See details in the manual of the Parshall flume.

08



P40=09

Generic Parshall flume

 $0,305 < P42 \text{ (throat width)} < 2,44$

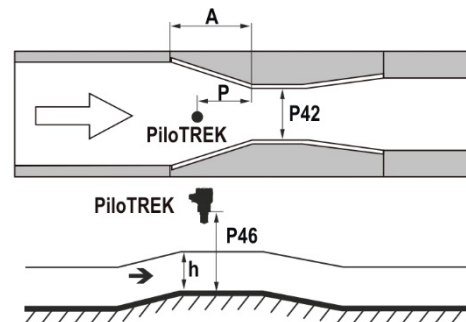
$$Q [l/s] = 372 \cdot P42 \cdot (h/0,305)^{1,569 \cdot P42^{0,026}}$$

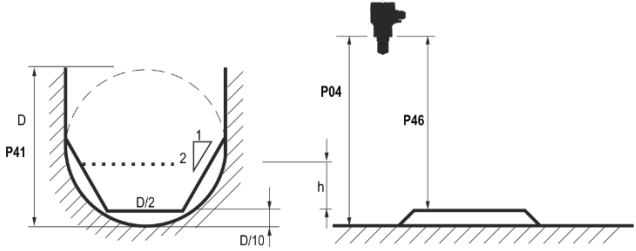
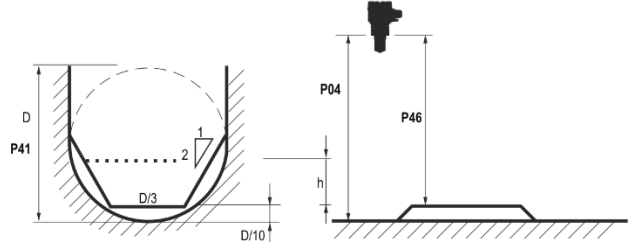
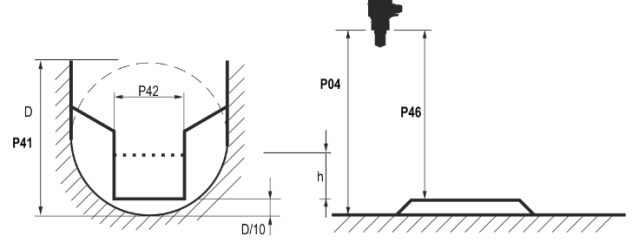
 $2,5 < P42$

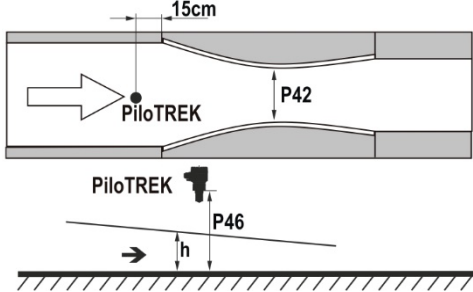
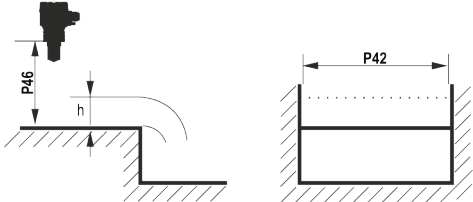
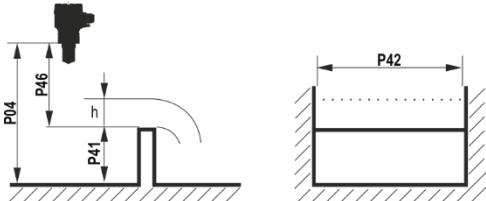
$$Q [l/s] = K \cdot P42 \cdot h^{1,6}$$

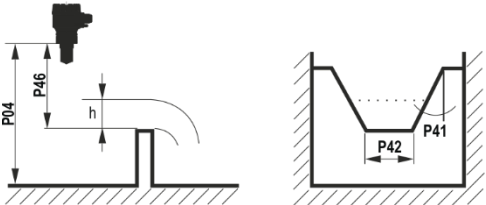


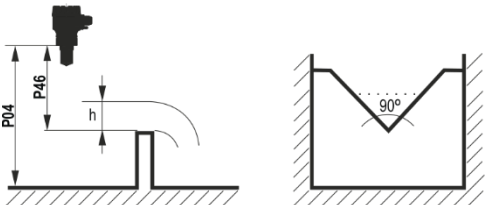
$$P = 2/3 \cdot A$$

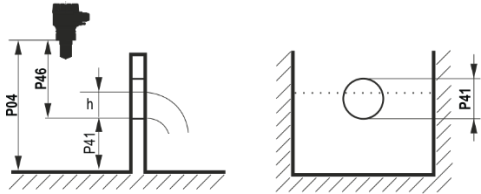
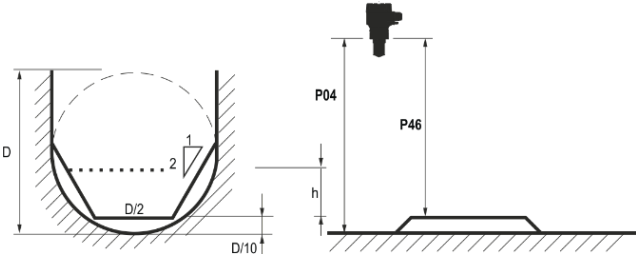
| P42 [m] | K |
|---------|-------|
| 3,05 | 2,450 |
| 4,57 | 2,400 |
| 6,10 | 2,370 |
| 7,62 | 2,350 |
| 9,14 | 2,340 |
| 15,24 | 2,320 |



| | | |
|-----------------------|--|--|
| <p>P40= 10</p> | <p>Palmer-Bowlus (D/2) flume $Q \text{ [m}^3\text{/s]} = f(h_1/P41) * P41^{2.5}$, where $h_1\text{[m]} = h+(P41/10)$ P41 [m]</p> |  |
| <p>P40= 11</p> | <p>Palmer-Bowlus (D/3) flume $Q \text{ [m}^3\text{/s]} = f(h_1/P41) * P41^{2.5}$, where $h_1\text{[m]} = h+(P41/10)$ P41 [m]</p> |  |
| <p>P40= 12</p> | <p>Palmer-Bowlus (rectangular) flume $Q \text{ [m}^3\text{/s]} = C * P42 * h^{1.5}$, where $C = f(P41/P42)$ P41 [m], P42 [m]</p> |  |

| | | |
|-----------------------|---|--|
| <p>P40= 13</p> | <p>Khafagi-Venturi flume</p> <p>$Q \text{ [m}^3\text{/s]} = 1,744 \cdot P42 \cdot h^{1,5} + 0,091 \cdot h^{2,5}$</p> <p>P42 [m]</p> <p>h [m]</p> |  |
| <p>P40= 14</p> | <p>Step-bottomed weir</p> <p>$0,0005 < Q \text{ [m}^3\text{/s]} < 1$</p> <p>$0,3 < P42 \text{ [m]} < 15$</p> <p>$0,1 < h \text{ [m]} < 10$</p> <p>$Q \text{ [m}^3\text{/s]} = 5,073 \cdot P42 \cdot h^{1,5}$</p> <p>Accuracy: $\pm 10\%$</p> |  |
| <p>P40= 15</p> | <p>Square section or BAZIN weir</p> <p>$0,001 < Q \text{ [m}^3\text{/s]} < 5$</p> <p>$0,15 < P41 \text{ [m]} < 0,8$</p> <p>$0,15 < P42 \text{ [m]} < 3$</p> <p>$0,015 < h \text{ [m]} < 0,8$</p> <p>$Q \text{ [m}^3\text{/s]} = 1,77738(1 + 0,1378h/P41) \cdot P42 \cdot (h + 0,0012)^{1,5}$</p> <p>Accuracy: $\pm 1\%$</p> |  |

| | | |
|-----------------------|---|--|
| <p>P40= 16</p> | <p>Trapezoid weir $0,0032 < Q \text{ [m}^3/\text{s]} < 82$ $20 < P41[^\circ] < 100$ $0,5 < P42 \text{ [m]} < 15$ $0,1 < h \text{ [m]} < 2$ $Q \text{ [m}^3/\text{s]} = 1,772 \cdot P42 \cdot h^{1,5} + 1,320 \cdot \text{tg}(P41/2) \cdot h^{2,47}$ Accuracy: $\pm 5\%$</p> |  |
| <p>P40= 17</p> | <p>Special trapezoid (4:1) weir $0,0018 < Q \text{ [m}^3/\text{s]} < 50$ $0,3 < P42 \text{ [m]} < 10$ $0,1 < h \text{ [m]} < 2$ $Q \text{ [m}^3/\text{s]} = 1,866 \cdot P42 \cdot h^{1,5}$ Accuracy: $\pm 3\%$</p> |  |
| <p>P40= 18</p> | <p>V-notch weir $0,0002 < Q \text{ [m}^3/\text{s]} < 1$ $20 < P42[^\circ] < 100$ $0,05 < h \text{ [m]} < 1$ $Q \text{ [m}^3/\text{s]} = 1,320 \cdot \text{tg}(P42/2) \cdot h^{2,47}$ Accuracy: $\pm 3\%$</p> |  |
| <p>P40= 19</p> | <p>THOMSON (90° notch) weir $0,0002 < Q \text{ [m}^3/\text{s]} < 1$ $0,05 < h \text{ [m]} < 1$ $Q \text{ [m}^3/\text{s]} = 1,320 \cdot h^{2,47}$ Accuracy: $\pm 3\%$</p> |  |

| | | |
|---------------------------|---|--|
| <p>P40= 20</p> | <p>Circular weir $0,0003 < Q \text{ [m}^3/\text{s]} < 25$ $0,02 < h \text{ [m]} < 2$ $Q[\text{m}^3/\text{s}] = m \cdot b \cdot D^{2,5}$, where $b = f(h/D)$ $m = 0,555 + 0,041 \cdot h/P41 + (P41/(0,11 \cdot h))$ Accuracy: $\pm 5\%$</p> |  |
| <p>P40=21</p> | <p>Generic formula: $Q \text{ [l/s]} = P41 \cdot h^{P42}$ $h \text{ [m]}$</p> | |
| <p>P40=22</p> | <p>Generic formula: $Q \text{ [l/s]} = P41 \cdot h^{P42}$ 'h' will be substituted in the unit set in P00c and P00b.</p> | |
| <p>P40=30...38</p> | <p>Palmer-Bowlus standard D/2 flume (4" ... 24") Refer to flume's user manual for details. P46 [P00c, P00b]</p> |  |

P46: - - - a Distance associated with h=0 when measuring flow

FACTORY DEFAULT: VARIES BY TYPE

P46 is the distance between the sensor's process connection and the liquid's surface, which can be measured at the limit of the start of the flow ($Q = 0$); see figures. Minimum value: $P05 + 5 \text{ cm}$ (2"). Maximum value: P03.

5.8. Output Conversion Table – OCT programming

P40: d - ☐ ☐ OCT operation

FACTORY DEFAULT: 0

| d | Output data Measurement mode | Reference |
|---|------------------------------|-----------------|
| 0 | Output Conversion Table OFF | See Chapter 5.8 |
| 1 | Output Conversion Table ON | |

An output signal of any characteristic can be assigned to the level values measured by the device. The unit of the output signal is the unit set in parameter P00 or P02 of the output data type assigned to the “HART - PV” output in parameter P01. The characteristic can be specified with a maximum of 100 points. Between the points, the device calculates the output signal from the measured level by linear interpolation and after the last point by linear extrapolation. The OCT can be used to assign the measured level to an arbitrary output signal. Its typical application is the calculation of level to volume for tanks that are not included in the tank shape list (e.g., dented) and specifying individual channel characteristics in the case of open channel flow measurement.

| | | |
|--------------------------------|---|------------------------------------|
| SAP-300 | EView2 | MultiCONT |
| <i>CALCULATION → OCT TABLE</i> | <i>OC-Table → Linearization (See Chapter 7.5)</i> | <i>Parameters → P40 Tank type.</i> |

Conditions for correct programming of data pairs

- The table must start with L(1)= 0 and R(1)= is the output quantity assigned to it.
- Column “L” may not contain identical values.
- Columns “L” and “R” can only have increasing values from top to bottom.
- If the table contains less than 100 points, column “L”, in the row following the last valuable data pair, must be 0.

| i | L (left column) MEASURED LEVEL | R (right column) OUTPUT VALUE |
|------|-----------------------------------|----------------------------------|
| 1 | 0 | R(1) |
| 2 | L(2) | R(2) |
| | L(i) | R(i) |
| nn | L(nn) | R(nn) |
| nn+1 | 0 | |
| 100 | | |

| | | |
|--------------------------------|--|------------------------------------|
| SAP-300 | EView2 | MultiCONT |
| <i>CALCULATION → OCT TABLE</i> | <i>OC-Table → OCT list (See Chapter 7.5)</i> | <i>Parameters → P40 Tank type.</i> |

5.9. Service diagnostic parameters (read only)

| | | |
|------|------|--|
| P60: | ---- | Number of operating hours since issuing [h] |
| P61: | ---- | The number of operating hours since the last power-on [h] |
| P62: | ---- | The number of operating hours of the relay (closed time of contact C2) [h] |
| P63: | ---- | The number of switching cycles of the relay |
| P64: | ---- | The current temperature of the device's electronics [°C / °F] |
| P65: | ---- | The highest temperature of the device ever measured [°C / °F] |
| P66: | ---- | The lowest temperature of the device ever measured [°C / °F] |
| P70: | ---- | Number of detected peaks (current) |
| P71: | ---- | Magnitude of selected echo (raw value) |
| P72: | ---- | The amplitude of the selected echo [dB] |
| P73: | | The distance of the selected echo [m] |
| P74: | | Echo lost/shot ratio |

5.10. Flow measurement control parameters (read only)

| | | |
|------|------|--|
| P76: | ---- | Measuring height of the flow measurement ('h' value) |
|------|------|--|

Measuring height required for flow measurement. This value is the "h" value in the flow calculation formula. (See P46)

| | | |
|------|------|---------------------------------|
| P77: | ---- | TOT1 totalizer (can be cleared) |
| P78: | ---- | TOT2 totalizer |

5.11. Output control parameters (read only)

| | | |
|------|------|---|
| P79: | ---- | Current generator re-measured output current [μA] |
| P80: | ---- | Current generator calculated output current [mA] |
| P81: | ---- | Relay output status |

5.12. Hardware / Software versions (read only)

| | | |
|---------|------|----------------------------------|
| P94/95: | ---- | Software code 2 / 3 (SLAVE MCUs) |
| P96: | ---- | Software code 3 (MAIN MCU) |
| P97/98: | ---- | Hardware identification code |

5.13. Service functions

5.13.1. Security codes

Enter and unlock the user code. The unit can be protected against unauthorized reprogramming by a four-digit pin code. If a value other than zero is entered, the code is active. Entering a zero will clear the user code! When the code is active, the unit will prompt for the code when entering the menu.

| | | |
|---------------------------------------|---------------------------|---------------------------------------|
| SAP-300 | EView2 | MultiCONT |
| <i>SERVICE → SECURITY → USER LOCK</i> | <i>Advanced → Special</i> | <i>Remote Program → Secret unlock</i> |

5.13.2. Current output test

P80: Loop current test (mA)

When the function is entered, the current value corresponding to the current being measured is displayed and output. In test mode, any value between 3.9 and 20.5 mA can be entered in this edit window. The output should then display the same current as the set value. A dialog box reminds you of the test condition. The test value will remain at the output until the warning window is exited. To exit the warning window, press E.

| | | |
|--|---------------|------------------|
| SAP-300 | EView2 | MultiCONT |
| <i>SERVICE → OUTPUT TEST → ANALOG OUTPUT</i> | — | — |

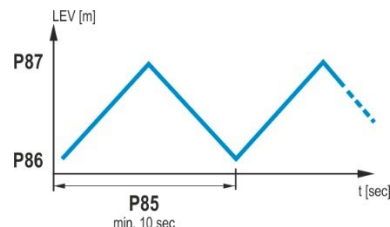
5.13.3. Simulation

This function helps the user to check the outputs and the processing device connected to it. PiloTREK can simulate a constant or a variable value of the level. The simulation level values must be within the measurement range defined by P04 and P05. To start the simulation, return to the Measurement mode. During simulation, the DIST, LEV or VOL symbols will flash. To end the simulation, set P84= 0.

P84: --- a Simulation method

FACTORY DEFAULT: 0

| a | Simulation method |
|---|---|
| 0 | No simulation |
| 1 | Triangular symbol |
| 2 | Simulate constant level: PV = value given in P86 |
| 3 | Simulation between levels P86, P87 with cycle time P85 (triangle) |
| 4 | Simulation between levels P86, P87 with cycle time P85 (square) |



| | | |
|-----------------------------------|---------------------------|------------------------------------|
| SAP-300 | EView2 | MultiCONT |
| <i>SERVICE → DIST. SIMULATION</i> | <i>Advanced → Special</i> | <i>Remote Program → Simulation</i> |

P85: DIST simulation cycle time**FACTORY DEFAULT: 0**

Simulation cycle time. Unit of measurement: seconds [s].

P86: Lower level of simulation**FACTORY DEFAULT: 0**

Unit of measurement: according to P00b.

P87: Top level of simulation**FACTORY DEFAULT: 0**

Unit of measurement: according to P00b.

P88: Total simulation time (timeout)**FACTORY DEFAULT: 10**

The simulation mode is automatically switched off after the value set here has elapsed. Unit of measurement: minutes [min]. Value range: 0...9999 min. The default value is 10 minutes.

5.13.4. Load default setting

Restores the factory settings of the unit. The values can then be modified. Loading the factory settings does not affect the measurement running in the background (it continues with the parameters set before entering the programming). Before loading the factory settings, the instrument displays a dialog box asking if you are sure you want to do this, because all user settings will be lost!

| SAP-300 | EView2 | MultiCONT |
|--|---|---------------------------------|
| <i>SERVICE → DEFAULTS → LOAD DEFAULT</i> | <i>Advanced → Parameters → Load default</i> | <i>Remote Program → Default</i> |

5.13.5. Restart

Restarting the device "Warm start". (Reloading parameters from the non-erasing memory.)

| SAP-300 | EView2 | MultiCONT |
|--------------------------|---------------------------|-----------|
| <i>SERVICE → RESTART</i> | <i>Advanced → Special</i> | — |

6. TROUBLESHOOTING

6.1. Status and error indication in HART® communication

Status and error indication in HART communication: The response code, according to the HART standard, is two 16-bit words after the "Response code" bytes, respectively "Errors and Warnings" and "Status."

| Bit № | Device Specific Error/Warning flags | Meaning, possible reason, solution |
|-------|--|---|
| 0 | No echo (<i>Warning</i>) | The device cannot detect the surface to be measured, so there is no echo or there are too many echoes due to interference. Ensure proper installation! If the problem persists, contact the dealership. |
| 1 | EEPROM is not detected (<i>Error</i>) | The parameter memory of the device is compromised. Contact dealership. |
| 2 | EEPROM checksum error detected (<i>Error</i>) | Some data stored in the device's parameter memory has been corrupted. Factory default settings are restored by the device. If the device's parameter memory fails frequently, contact the dealership. |
| 3 | OCT input side integrity error (<i>Error</i>) | The data in the left (L) column of the Output Conversion Table (OCT) is not incremental. Correct it. |
| 4 | OCT output side integrity error (<i>Error</i>) | The data in the right (R) column of the Output Conversion Table (OCT) is not incremental. Correct it. |
| 5 | OCT item count is <2 (<i>Error</i>) | Too few points are entered into the Output Conversion Table (OCT). At least two ($i \geq 2$) points (elements) must be entered. |
| 6 | Input level over the OCT input side (overload) (<i>Warning</i>) | The measured level, as the input value of the OCT, points out of the range entered in the left (L) column of the OCT. Enhance the range. |
| 7 | EEPROM reinitiated (EEPROM layout damaged or missing) (<i>Error</i>) | The data structure stored in the device's parameter memory is corrupted. The device restored the factory default settings. If the device's parameter memory fails frequently, contact the dealership! |
| 8 | — | — |
| 9 | Tank full (<i>Warning</i>) | The measured surface is too close, within the device's minimum measuring range (X_{min}). Set the close-end blocking (P05) to a smaller value, or change the technology to ensure that the surface to be measured does not come so close to the sensor of the device. |
| 10 | Echo in far blocking range (<i>Warning</i>) | The measured surface is too far, outside the device's maximum measuring range (X_{max}). Set the far-end blocking (P05) to a larger value, or change the technology to ensure that the surface to be measured does not get so far from the sensor of the device. |
| 11 | — | — |
| 12 | One or more slave controller(s) failure! (<i>Error</i>) | One of the device's auxiliary controllers has failed. The probability of a firmware error is high. Performing a complete firmware update with NiFlash (including synchronization) may solve the problem. If unsuccessful, contact the dealership. |
| 13 | Relay failure (<i>Error</i>) | If the device has an optional relay, it is faulty. Contact the dealership. |
| 14 | Parameter table integrity error (<i>Error</i>) | The value of one or more parameters is not consistent with the associated parameters. Correct the parameter value. |

| Bit № | Device Specific Error/Warning flags | Meaning, possible reason, solution |
|-------|-------------------------------------|---|
| 15 | Sensor failure (Error) | The radar sensor is faulty. There can be several reasons for this, e.g., the data connection with the radar sensor unit is inadequate or insufficient energy available for the measurement. The terminal voltage of the device must be above the prescribed minimum in all circumstances! Check the voltage conditions of the loop by measurement and change it as necessary so that the electrical conditions for the terminals of the device are met. Contact the dealership if the power supply voltage level is correct and the error persists. |

| Bit № | Device-Specific Status flags (DSS) | Explanation |
|-------|--|--|
| 0-2 | PV value type (DIST, LEV, VOL, MASS, FLOW, LEV%, VOL%, ...) | The type of the primary transmitted value (PV) by P01a. |
| 3 | Manual programming is active (Status) | The device is in manual programming mode. (Only on devices (WG□) featuring a display.) |
| 4 | Remote programming is active (Status) | The device is in remote programming mode. |
| 5 | Simulation is active (Warning) | The device is in simulation mode. Caution! The output value is independent of the measured value. |
| 6 | User password is set (Status) | Password protection is active. |
| 7 | Relay energized (Status) | Relay is energized. |
| 8 | User lock is active (Status) | User lock is active. The parameters are protected by a password set by the user. |
| 9 | Factory lock is active (Status) | Factory lock is active. The factory default settings and calibration data are locked. |
| 10 | SAP display is connected (Status) | A display is connected to the device. (Only on devices (WG□) featuring a display.) |
| 11 | Diagnostic mode is active (Status) | The device is in diagnostic mode. |
| 12 | HOLD (Warning) | The transmitted value is on hold. |
| 13 | Calibration mode is active (Status) | The device is in calibration mode. |
| 14 | Valid (Status) | The transmitted value is refreshed and valid. |
| 15 | HS communication mode is active (Status) | The device is in high-speed communication mode. |

6.2. Typical application errors

| Error | Possible cause | Solution |
|--|---|---|
| The transmitted value takes a value from a close range (most often around 0.2 m [7.8"]). | Condensation or dirt on the antenna. | Clean the antenna or use a threshold mask to block the interfering echo. |
| The measured value does not change despite the level change. | This typically happens when echo loss occurs. In most cases, this is: <ul style="list-style-type: none">– during foaming of the medium– dirt on the antenna– excessive waves– incorrect max. (P03) measurement setting– it can happen in cases of echo below the threshold curve. | Remove dirt from the antenna. Check the surface of the medium to be measured, if necessary, take measures to reduce foaming or ripples! Check threshold settings. See Chapter 7.3! Check the P03 maximum measuring distance setting. |

7. EView2 INSTRUCTIONS

If necessary, install the [EView2 HART configuration software](http://www.nivelco.com) (hereafter EView2) as described in Chapter 3 of the program's manual. The software can be downloaded from www.nivelco.com.

Electrical connections: Start the program and search for the transmitter with the program (for more information, see also EView2 user manual, Chapter 4).

From the devices found during the detection, select the device you want to configure or program and open the "device programming" window of the device (Chapters 4.4 and 4.5 of the EView2 user manual). All the necessary parameters and function settings can be changed with EView2.

This chapter only describes the specific functions related to PiloTREKs and two programming examples.

For assistance with connection issues to your PC, please refer to the EView2 User Manual for further information.



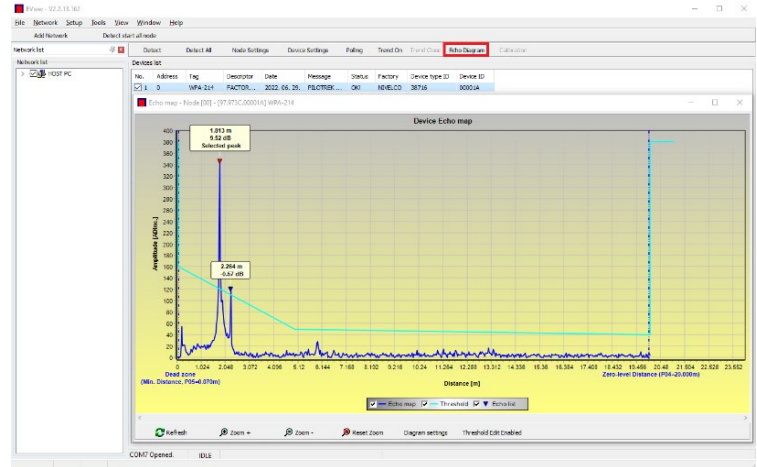
7.1. Device Status Window

To invoke the "Device Status Window" in EView2, right-click on the device line in the "Device List" in the main window and select the "Show Device Status Window" menu item in the popup window. This window shows the status and error messages of the PiloTREK. (See Chapter 6.1) The "Device Status Window" can also be summoned in the "Polling" window by activating the corresponding check box.

7.2. Echo Diagram (oscilloscope function)

Click the “Echo Diagram” button in EView2 to display the device's Echo Diagram. A window called “Echo map” will appear. This diagram shows the reflection curve measured by the device. In addition, this window can be used to adjust the threshold level. To update the chart or read the data, press the “Refresh” button on the bottom line of the window (or press the F4 key).

After a successful reading, an echo graph similar to the attached “Echo Diagram” appears. The displayed information content can be selected in the legend. The “Echo list” displays the location and data of the echo peaks evaluated by the device, of which the selected level signal is marked with the inscription “Selected peak.”



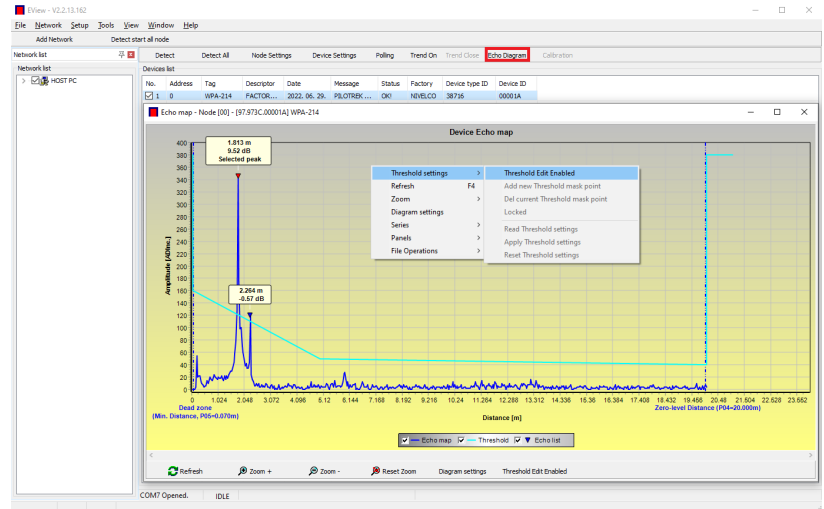
7.3. Threshold settings

The function is intended for advanced users. Incorrect setting may render the device unable to measure!

The purpose of the threshold value and the threshold line is to mask unwanted echoes from the measurement. Echo peaks below the threshold level are not taken into account in the evaluation. Setting the threshold may be necessary if the device selects the wrong echo peak as the level, for example because there is an interfering object in the path of the ultrasound during the measurement. Before changing the threshold curve, it is recommended to minimize interfering echoes by selecting the correct installation location of the device.

The threshold can be edited in the Echo diagram window of the EView2 software. In addition, the height of the entire threshold can be adjusted in a simplified way with the P34 “Threshold offset” parameter among the measurement optimization parameters. The main threshold line is used to trace the general shape of the echo curve. Threshold highlights, also known as threshold masks, are available to mask interfering echo peaks protruding from the curve.

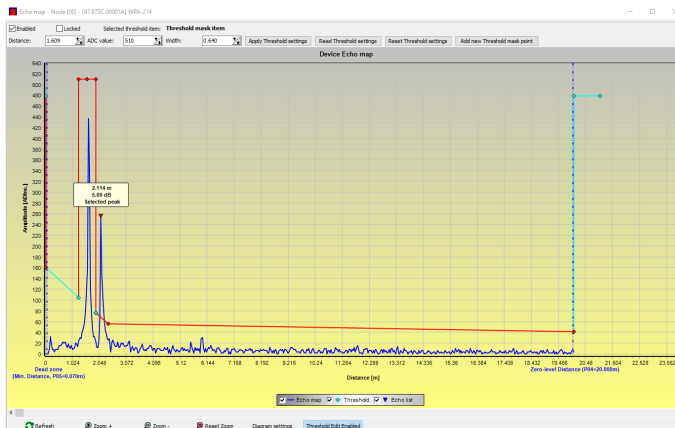
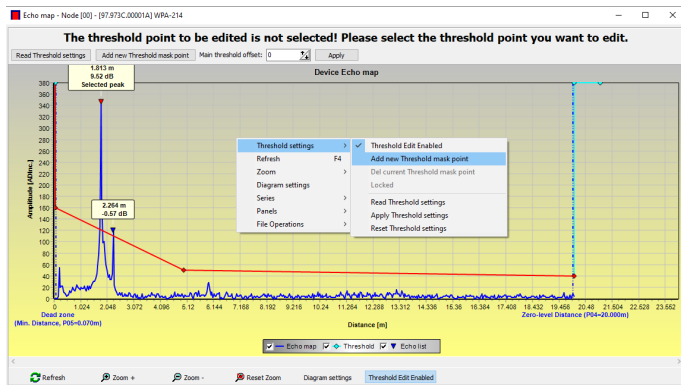
The threshold editing mode can be activated either by selecting “Threshold Edit Enable” in the bottom menu bar or by selecting “Threshold settings” → “Threshold Edit Enable” in the context menu that appears when clicking the right mouse button. In this case, the threshold editing function bar appears in the upper half of the window, and the editable points are marked red on the threshold curve. If no editable point is selected, the “Threshold offset” can be set in the function bar, so the height of the basic threshold curve consisting of three points is the same. If an editable point is selected by clicking the left mouse button, its position can also be altered separately.



Threshold points can also be moved with the mouse by clicking and holding the left mouse button over the selected point. The changes only take effect in the device after pressing the “Apply Threshold settings” button, which can also be found in the threshold editing function bar or the context menu. To display the evaluation corresponding to the new threshold, refresh the chart with the “Refresh” button in the bottom menu bar (or the F4 function key).

7.4. Threshold mask

The “Threshold Mask” function masks an echo peak that interferes with the measurement. To do this, after pressing the “Add new threshold mask” button in the threshold editing function bar, click the left mouse button in the diagram over the position where you want to place the threshold highlight, or if using the context menu, click with the right mouse button on the desired position, then select the “Add new threshold mask” function. The position and width of the threshold mask can also be adjusted afterwards in the threshold editing function bar by selecting the center point of the highlight as described above. In the case of graphic editing, its position and height can be adjusted by dragging the center point, and its width can be adjusted by dragging the corner point. A total of 4 threshold highlights can be defined. If there are more interfering echoes than 4, it is better to choose another mounting position.



Caution! The “Cursor On” function does not provide an exact value. It only calculates the value of a given point based on the graphical representation.

The threshold highlight can be deleted by selecting its center point, or turning the “Enabled” switch off in the threshold editing function bar, or selecting the “Del current threshold mask” function in the context menu. Until the changes are applied to the device with the “Apply Threshold settings” function, it uses the previous (current) threshold settings, which can be read with the “Read Threshold settings” function. The factory default settings can be restored with the “Reset Threshold Settings” function.

7.5. The output conversion table (OCT) – (EView2 OC-Table)

The output conversion table (OCT) is active if table correction is selected in parameter P40. See Chapters 5.7, 5.8, and 5.9. The OCT is filled in using the EView2 software. The conversion table is usually used for volume measurement but can also be used for weight or flow measurement.

This table assigns different output values to the measured levels. The value on the left is always the measured level (relative to the zero-level distance (P04) setting), and the value on the right is the output value for the particular level. The unit associated with the output value is determined by the setting of the “Output source” (P01, HART - PV) and “Output units” (P02) parameters.

The output value is determined by linear interpolation between two value pairs, so the accuracy of the conversion depends on the density of the associated value pairs. After the last pair of points, the output value is calculated by linear extrapolation. The maximum number of pairs is 100.

More information:

- Each new level value entered must be greater than the previous one.
- Take heed that the units in the table are always interpreted by the device according to the currently set units of measure. Therefore, the OCT must always be filled in with values corresponding to the set units.
- Caution! When using the conversion table, the setting of the current output (P10/P11) is also interpreted according to the value range (and measurement unit) defined on the left side of the table. Accordingly, the appropriate setting of the P10/P11 parameters is recommended after uploading the table.
- If the conversion table is filled in incorrectly, the output (transmitted) value will not be correct either!

A user-defined conversion table (e.g., “level - volume”) can be created using EView2 as follows:

To fill in or set the output conversion (OC) table of the device, go to the “Device Settings” → “OC-Table” tab in EView2. Upload or modify the table according to “EView2 Instructions for Use – Chapter 6.4.” If the appropriate changes have been made in the table and it has been filled in correctly, press the “Send” button on this page (“OC-Table” tab) on the right side under the “Get” button to download the table to the device.

In the following example, five-point programming is presented, example: “Level - Volume” conversion

| Step | Action | Entered data / chosen value |
|------|--|--|
| 1 | In EView2, open the “Device Settings” window of the given device. | |
| 2 | Go to the point called “Application” and select the unit system (“Calculation system”). | Metric (EU) |
| 3 | Select a length unit (Engineering Unit). | m |
| 4 | Go to “Measurement configuration” and select “Measurement mode (PV source): volume transmission” from the list. | Volume |
| 5 | Select a volume unit in the “Volume Units” section. | m ³ |
| 6 | Go to “Measuring distances” and enter the tank height in the field named “Zero-level dist.” (Click on the field and enter the value). | 6.00 m |
| 9 | Press the “Send” button in the lower right corner of the window to download the new values to the device. | Wait until the download process is complete. |
| 10 | Go to the point called “OC-Table.” Fill in the table called “OCT list” with the appropriate values. A maximum of 100 points can be entered. Each level and volume point must be entered. Each subsequent point must be larger than the previous one. New lines can be created by pressing the “Ctrl + Insert” key combination or selecting “Add new item” in the popup menu of the right mouse button. A line can be deleted by pressing the “Ctrl + D” keys together. | See the following table (Example for completing OCT) |
| 11 | To download the table to the device, press the “Send” button located on this page (“OC-Table” tab) on the right side under the “Get” button. | |

Example of filling out the OCT

| Point | Level (Source column) | Volume (Output column) |
|-------|-----------------------|------------------------|
| 1 | 0.0 m (0.0 ft) | 0.0 m³ (0.0 ft³) |
| 2 | 0.20 m (0.66 ft) | 0.5 m³ (17.6 ft³) |
| 3 | 0.75 m (2.46 ft) | 1.0 m³ (35.3 ft³) |
| 4 | 1.00 m (3.30 ft) | 1.5 m³ (53 ft³) |
| 5 | 5.60 m (18.37 ft) | 16.8 m³ (593.3 ft³) |

Example of setting 4...20 mA current output (using EView2)

| Step | Action | Entered data / value |
|------|--|----------------------|
| 1 | Go to "Outputs" and set "Current generator mode" to "Auto" (default setting) | Auto |
| 2 | In the "Error indication ..." field, set the error status to the appropriate mode (default setting). | Hold- |
| 3 | Select "Assignment of 4 mA – PV (P10)" and enter the volume value corresponding to the output current value of 4 mA. | 0.5 m³ (17.6 ft³) |
| 4 | Select "Assignment of 20 mA – PV (P11)" and enter the volume value corresponding to the output current value of 20 mA. | 16.80 m³ (593.3 ft³) |
| 5 | Press the "Send" button in the lower right line of the window to download the new values to the device. | |
| 6 | Press the "X" close button to exit the device settings window. | |

7.6. Programming example 1 – configuring level measurement (using EView2)

Configuring level measurement in a 9 m (29.5 ft) tank (example). Level measurement is the factory default mode, it is sufficient to enter only the actual tank height (P04 = 9.0 m [29.5 ft]). The max. measuring length of the WE-200 radar configured by the manufacturer is 10.0 m (33 ft), so it covers the required 9 m (29.5 ft).

| Step | Action | Entered data / value |
|------|--|--|
| 1 | Open the "Device Settings" window corresponding to the given device in EView2. | The program reads and displays the device settings. |
| 2 | Select "Measurement configuration." | |
| 3 | Click on "Zero-level dist." (Zero-level distance) field. | Data in the field: 10.000 [m] (33.000 [ft]) |
| 4 | Enter the new value. | 9,000 [m] (29.500 [ft]) |
| 5 | Press the "Send" button in the lower right corner of the window to download the new value to the device. | The device will work according to the new settings after the download is complete. |
| 6 | Press the "X" close button to exit the device settings window. | |

7.7. Programming example 2 – configuring the current loop output (using EView2)

Custom scale setting: Example: 4 mA indicates the 1 m level [3.3 ft], 20 mA indicates the full tank, for example 8 m (26.2 ft) maximum level, upper error current.
 Set current range 4...20 mA with 22 mA error indication.
 Choose a suitable minimum and maximum value for the scale of the measurement.

| Step | Action | Entered data / value |
|------|--|---|
| 1 | In EView2, open the "Device Settings" window corresponding to the given device. | The program reads the device settings and displays them. |
| 4 | Select "Outputs" | |
| 5 | Select the "Error indication ..." drop-down list. | The field will read "Hold" |
| 6 | Select the new setting value (22 mA) in the drop-down list. | The field will read "22 mA" |
| 7 | Select the "Assignment of 4 mA – PV" data field. | The field will read "0.000 [m]" (0.000 [ft]) |
| 8 | Enter the new value. This sets the level corresponding to the 4-mA minimum output (1 m). | The field will read "1.000 [m]" (3.300 [ft]) |
| 9 | Select the "Assignment of 20 mA – PV" data field. | The field will show the maximum measuring distance by default. |
| 10 | Switch to 8.000 m (26.20 ft). This sets the level corresponding to the 20-mA maximum output (8 m [26.2 ft]). | The field will read "8.000 [m]" (26.20 [ft]) |
| 11 | Press the "Send" button in the lower right line of the window to download the new values to the device. | After the download is complete, the device will use the new settings. |
| 12 | Press the "X" close button to exit the device settings window. | |

8. PROGRAMMING WITH SAP-300 DISPLAY UNIT

The main parameters of PiloTREK can also be set using the SAP-300 display unit. By default, the display shows the primary measurement result (from which the output current is calculated). In addition to the measurement value displayed in large figures, a bar graph representing the output current value is also shown on the right. Programming is done via a text menu. Use the \ominus / \oplus / \odot / \otimes keys to navigate through the menu.

8.1. SAP-300 display unit

Display: 64 × 128 dot matrix LCD, with symbols, units, and column diagram

Ambient temperature: -20...+65 °C (-4...+149 °F)

Housing material: PBT fiberglass-reinforced plastic (DuPont®)

The SAP-300 is a plug-in module with an LCD (universal – can be used in other NIVELCO devices, provided that the device's software supports SAP-300).

Caution!

The SAP-300 is based on LCD technology, do not expose the SAP-300 to prolonged heat or sunlight as the display may be damaged.

If it is not possible to protect the PiloTREK from sunlight or if the PiloTREK is to be used outside the operating temperature range of the SAP-300, do not leave the SAP-300 in the PiloTREK!



8.2. The PiloTREK during programming

By default, the PiloTREK displays the main measurement data on the SAP-300 display (hereafter referred to as the display).

To enter the programming menu, press the \ominus button. Use the \oplus / \odot buttons to navigate between the menu items.

You can also enter the selected menu item by pressing the \ominus button. To return to the previous menu level, press the \oplus button.

The buttons only work when the SAP-300 is present!

While using the menu, the instrument continues measuring without interruption. Any setting changes made in the menu will take effect when you exit the menu. If the PiloTREK menu is not exited, the PiloTREK will automatically return to the measurement display state after 30 minutes. Any changes made in the menu will then be ignored.

If the SAP-300 is unplugged from PiloTREK, PiloTREK will automatically exit the menu and ignore any changes made to the menu. Since programming with the SAP-300 (manual programming) and remote programming via HART (REMOTE MODE) create a competing situation, only one mode can be used at a time.

Manual programming has priority!

During manual programming, the device sends a "device busy" signal to the HART master (HART Response code: 32 - Device is busy).

In remote programming mode, REM appears on the top right of the display. In this case, manual programming of the device is disabled, and the menu cannot be accessed.





If no SAP-300 is connected, the LEDs will become visible, the COM LED will flash to indicate HART communication, and the VALID LED will indicate if the data measured by the device is valid.

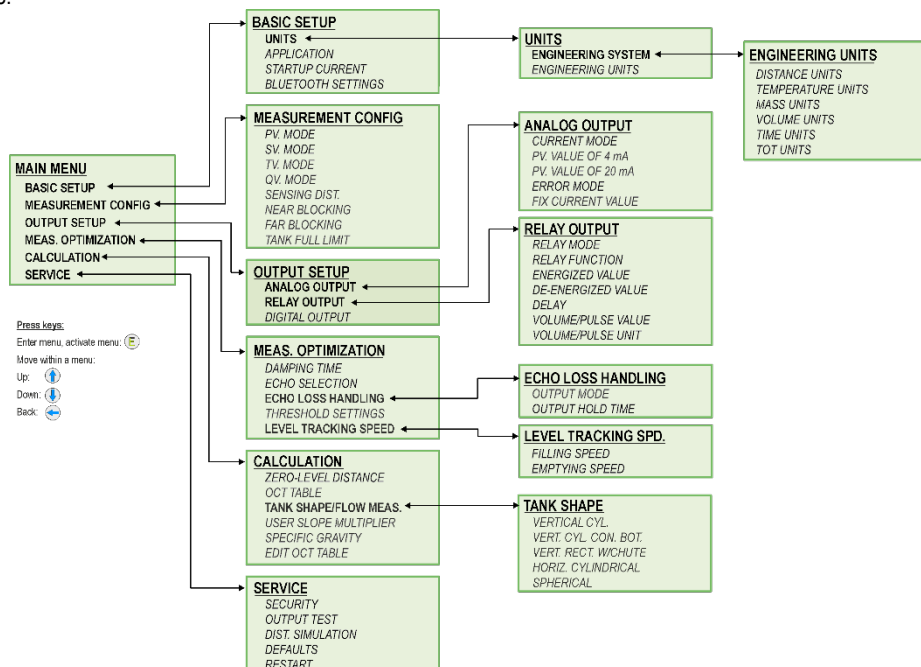
8.3. Manual programming

While on a submenu item, pressing the  button will change the parameter or access an additional submenu.

There are two modes:

Text list: It can be navigated like the menu list. Accept selection by pressing , and discard it by pressing the  button.

Editable number field: It is used to edit numeric values. Editing is assisted by a cursor (inverse character). The number on the cursor position can be changed with the  /  keys (no over-, under-, or underflow between characters). The cursor can be moved to the left with the  arrow key (max. 9 characters space, including the decimal point). When you reach the end of the field, the cursor returns to the first position on the right. The modification is completed by pressing the  button. PiloTREK will then check the value entered, and if it is not correct, the message "WRONG VALUE!" will appear on the bottom line.



9. PARAMETER LIST

| Pr. | Page | Name | Value | | | | Pr. | Page | Name | Value | | | |
|-----|------|---|-------|---|---|---|-----|------|---|-------|---|---|---|
| | | | d | c | b | a | | | | d | c | b | a |
| P00 | 22 | Unit system, default unit, region parameter | | | | | P22 | 36 | User Slope Correction Factor | | | | |
| P01 | 24 | Output source | | | | | P23 | | — | | | | |
| P02 | 24 | Output units | | | | | P24 | | — | | | | |
| P03 | 26 | Maximum sensing distance | | | | | P25 | 36 | Echo selection | | | | |
| P04 | 26 | Zero-level distance (tank height – H) | | | | | P26 | 37 | Level rise speed (filling speed) | | | | |
| P05 | 28 | Close-end blocking (dead-zone) | | | | | P27 | 37 | Level drop speed (discharging speed) | | | | |
| P06 | 28 | Far-end blocking | | | | | P28 | 37 | Measurement loss management | | | | |
| P07 | | — | | | | | P29 | 38 | Tank Full Limit | | | | |
| P08 | 29 | Manual output current value | | | | | P30 | | — | | | | |
| P09 | | — | | | | | P31 | | — | | | | |
| P10 | 29 | Output value assigned to 4 mA | | | | | P32 | 38 | Density of the measured medium | | | | |
| P11 | 30 | Output value assigned to 20 mA | | | | | P34 | 39 | Threshold offset | | | | |
| P12 | 30 | Analog current loop output's mode | | | | | P36 | 39 | BLE settings | | | | |
| P13 | 32 | Relay output | | | | | P40 | 40 | Tank shape | | | | |
| P14 | 33 | Relay parameter – Trigger value | | | | | P41 | 44 | Tank dimensions / Volume flow options | | | | |
| P15 | 33 | Relay parameter – Release value | | | | | P42 | 44 | Tank dimensions / Flume – weir dimensions | | | | |
| P16 | 34 | Relay parameter – Delay | | | | | P43 | 44 | Tank dimensions / Flume – weir dimensions | | | | |
| P17 | 34 | Relay parameter – Flow parameter value | | | | | P44 | 44 | Tank dimensions / Flume – weir dimensions | | | | |
| P18 | | — | | | | | P45 | 44 | Tank dimensions / Flume – weir dimensions | | | | |
| P19 | 34 | HART address | | | | | P46 | 48 | The distance to the surface without flow | | | | |
| P20 | 34 | Damping Time | | | | | P47 | 41 | Total tank volume | | | | |
| P21 | | — | | | | | | | | | | | |

| Pr. | Page | Name | Pr. | Page | Name |
|-----|------|--|-----|------|--|
| P60 | 50 | Number of operating hours since issuing [h] | P80 | 50 | Current generator calculated output current [mA] |
| P61 | 50 | The number of operating hours since the last power-on [h] | P81 | 50 | Status of relay outputs |
| P62 | 50 | The number of operating hours of the signal detector (closed time of contact C2) [h] | P82 | — | — |
| P63 | 50 | The number of switching cycles of the relay | P83 | — | — |
| P64 | 50 | The current temperature of the electronics [°C / °F] | P84 | 51 | Simulation method |
| P65 | 50 | The highest temperature of the device ever measured [°C / °F] | P85 | 52 | DIST simulation cycle time |
| P66 | 50 | The lowest temperature of the device ever measured [°C / °F] | P86 | 52 | Lower level of simulation |
| P67 | — | — | P87 | 52 | Top level of simulation |
| P68 | — | — | P88 | 52 | Total simulation time (timeout) |
| P69 | — | — | P89 | — | — |
| P70 | 50 | Number of detected peaks (current) | P90 | — | — |
| P71 | 50 | Magnitude of selected echo [raw value] | P91 | — | — |
| P72 | 50 | Amplitude of selected echo [dB] | P92 | — | — |
| P73 | 50 | Distance of selected echo [m] | P93 | — | — |
| P74 | 50 | Echo lost / shot rate | P94 | 50 | Software identifier (RADAR) |
| P75 | — | — | P95 | 50 | Software identifier (COPROC) |
| P76 | 50 | Measuring height of the flow measurement (read only) (LEV) | P96 | 50 | Software identifier (MAIN MCU) |
| P77 | 50 | TOT1 totalizer (clearable) | P97 | 50 | Special config mode (read only) |
| P78 | 50 | TOT2 totalizer | P98 | 50 | Hardware code (read only) |
| P79 | 50 | Current generator re-measured output current [μA] | P99 | — | — |

wes200en24p03

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Information is accurate to the best of NIVELCO's knowledge.

We reserve the right to change specifications at any time.