PiloTREK

WE–200

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

User's and Programming Manual

4th edition

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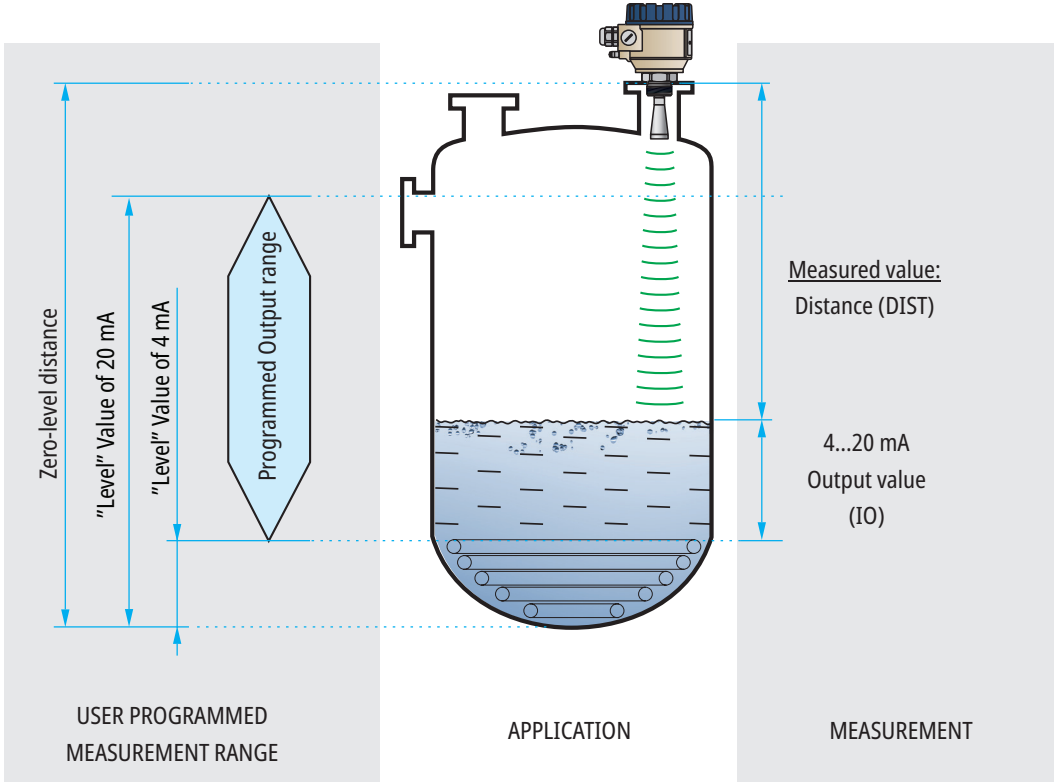
Certificates		Reference document number
	ATEX, Certificate No.: BKI24ATEX0001 X	**wes200hu23p02-b**
	IECEx, Certificate No.: ...	
	ANATEL, Certificate No.: 04179-24-16612	**wps200br24p01-b**
	INMETRO, Certificate No.: DNV 24.0166 X.	**wps200br24p01-b**


Zero-level distance
"Level" Value of 20 mA
"Level" Value of 4 mA
Programmed Output range
Measured value:
Distance (DIST)
4...20 mA
Output value
(IO)
USER PROGRAMMED
MEASUREMENT RANGE
APPLICATION
MEASUREMENT

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Thank you for purchasing a NIVELCO product.

1. INTRODUCTION

Application

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

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 (DK = relative dielectric constant ε_r). 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
Transmitter	E
Transmitter + Display	G
Transmitter, high-temperature version [1]	H
Transmitter + Display, high-temperature version [1]	J

Antenna / Housing		Code
PP	Plastic (PBT)	P
	Aluminum	A
	Stainless steel	D
Stainless steel	Plastic (PBT)	M
	Aluminum	S
	Stainless steel	K
PVDF	Plastic (PBT)	V
	Aluminum	B
	Stainless steel	W
PTFE	Plastic (PBT)	F
	Aluminum	T
	Stainless steel	L

Antenna Type	Code
80 GHz / horn	2

Measurement Range	Code
10 m (33 ft)	1
20 m (66 ft)	2
30 m (98.5 ft) [2]	3

Process Connection	Code
1" BSP [3]	2
1" NPT [3]	3
1½" BSP [4]	4
1½" NPT [4]	5
1½" TriClamp [5][3]	C
2" TriClamp [5]	D
3" TriClamp [5]	E
4" TriClamp [5]	F
Ø75 mm (2½") / prepared for flange [2][6]	8
Prepared for welded flange [7]	S

Output / Certificates		Code
4...20 mA + HART®	–	4
	Ex ia IIC	8
	Bluetooth®	B
	BT® / Ex ia IIC	E
	Relay	H
	Bluetooth® + Relay	R

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

[1] High-temperature version with metal housing and stainless steel or PTFE encapsulated antenna only.
[2] Under development.
[3] Only for 10 m (33 ft) measuring range.
[4] For 10 m (33 ft) and 20 m (66 ft) measuring range.
[5] Only for PTFE antenna version.
[6] Only 30 m (98.5 ft) and encapsulated types, flanges available from size DN80 should be ordered separately.
[7] Only for 10 m (33 ft) and 20 m (66 ft) ranges, with 1½" stainless steel antenna, flange type MF□–□□□–L to be ordered separately.

Accessories	Order code
Display unit	**SAP–300–0**
HART®–USB modem	**SAT–304–0**
HART®–USB/Bluetooth® modem	**SAT–504–□**
eLINK Module	**SAT–506–□**
HART®–USB/RS485 modem	**SAK–305–2**
HART®–USB/RS485 modem / Ex ia G	**SAK–305–6**

Process Connections [8]	Order code
DIN and ANSI flanges	**MFT–□□□–□**
DN40 Milch connection (DIN 11851)	
Seals [8]	
EPDM	
FFKM	

[8] The requirement for the above-mentioned technological connections and seals must be specified in the order.

3. TECHNICAL DATA

3.1 General Technical Data

		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	HART® interface, HART® loop resistor ≥ 250 Ω		
	Display (optional)	SAP–300–0 Plug-in graphic display unit		
	Relay (optional)	SPDT 30 V / 1 A DC; 42 V / 0.5 A AC		
	Service interface	Compatible with SAT–506–0 eLINK Module		
Connectivity		Bluetooth® LE 5.1 (optional)		
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]		
	Ambient temperature	–40...+60 °C (–40...+140 °F); with display unit: –20...+60 °C (–4...+140 °F)		
Seal		FPM (Viton®), optionally: EPDM, FFKM Perfluoro elastomer (Kalrez® 6375)		
Ingress protection		IP66 / IP67		
Electrical connection		2×M20×1.5 cable gland + 2× ½" NPT conduits, 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	∅1" W□□–212–□ W□□–213–□	∅1½" W□□–2□4–□ W□□–2□5–□		∅75 mm W□□–238–□	∅1" W□□–212–□ W□□–213–□	∅1½" 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	

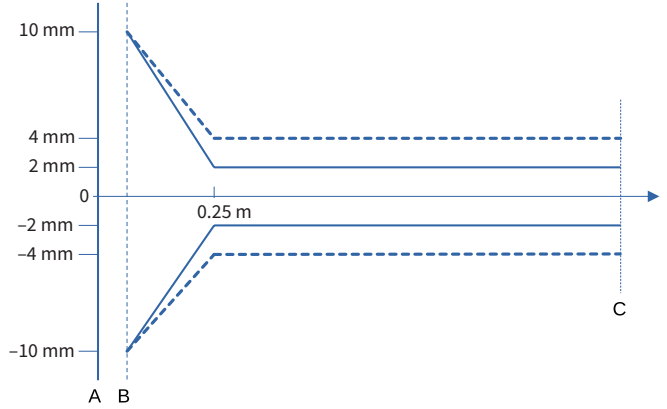
[1] From the tip of the antenna, if dielectric constant (er) < 80.

[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



Legend:

W□□–21□–□

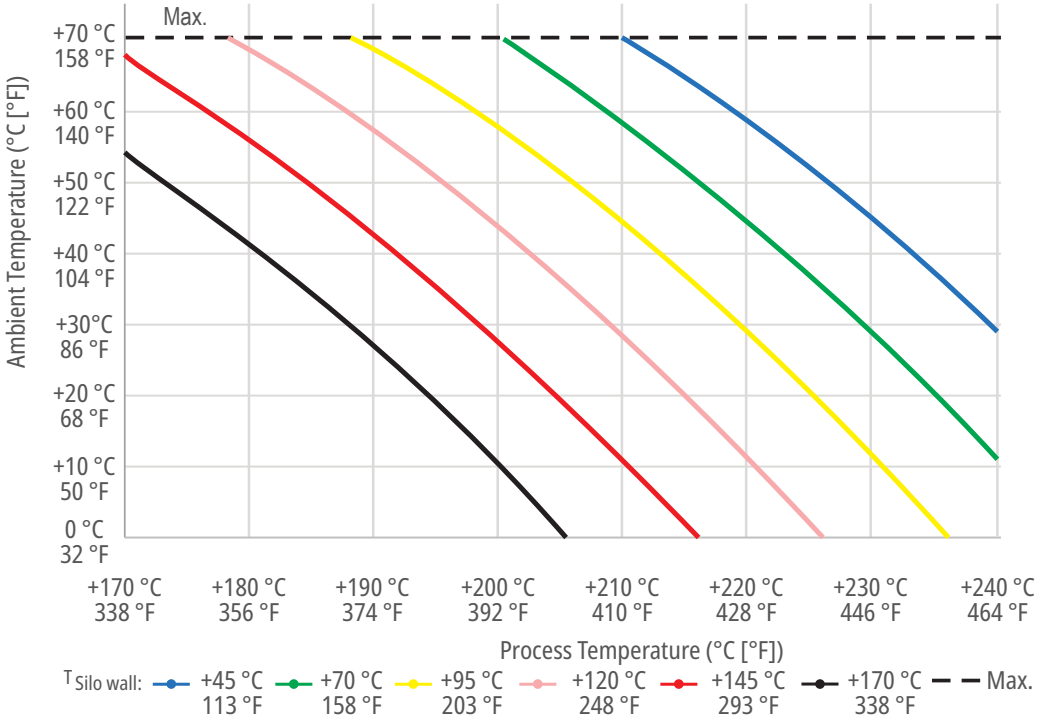
W□□–22□–□ / W□□–238–□

A – Plane of the device's process connection.

B – Minimum measurement distance (X_m) is at the position of the tip of the antenna.

C – Maximum measurement distance (X_M).

3.4 Temperature Limits for WH–200



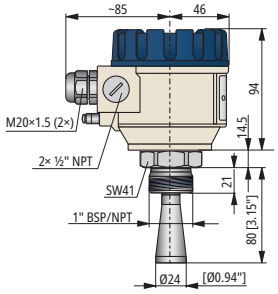
The ambient temperature around the PiloTREK electronics housing must be controlled, for example by appropriate thermal insulation of the process or other suitable methods. The "$T_{Silo\text{-}wall}$" parameter indicates the temperature of the outer surface of the thermal insulation immediately surrounding the PiloTREK. This value directly affects the maximum permissible process temperature.

3.5 Dimensions

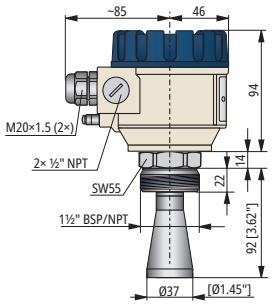
Plastic housing (W□M, W□P, W□V, W□F)

Stainless steel antenna

W□M–212–□ / –213–□

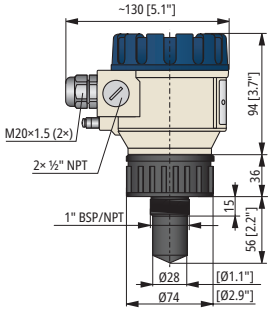


W□M–214–□ / –215–□

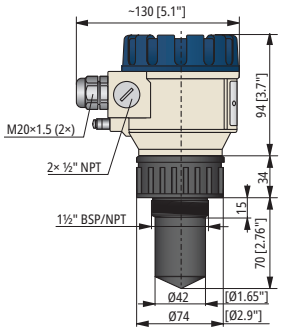


Encapsulated antenna

W□□–212–□ / –213–□



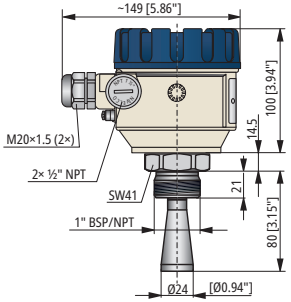
W□□–2□4–□ / –2□5–□



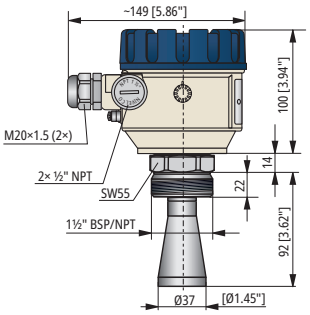
Aluminum housing (W□A, W□B, W□S, W□T)

Stainless steel antenna

W□S–212–□ / W □S –213–□

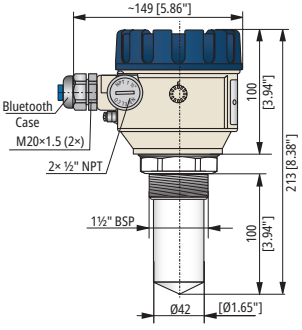


W□S–2□4–□ /W□S –2□5–□



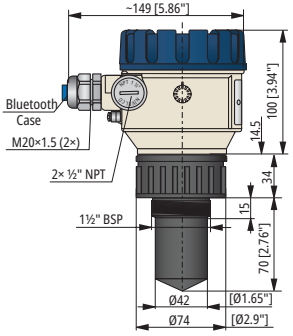
PTFE encapsulated antenna

W□T–2□4–B / W□T–2□5–B



PP/PVDF encapsulated antenna (W□B, W□A)

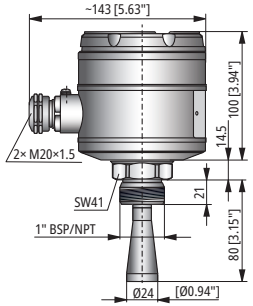
W□□–2□4–B / W□□–2□5–B



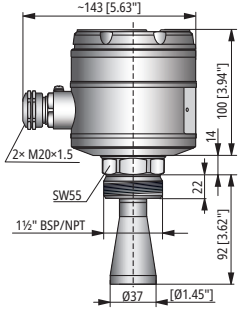
Stainless steel housing (W□K, W□D, W□L)

Stainless steel antenna

W□K–212–□ / W□K–213–□

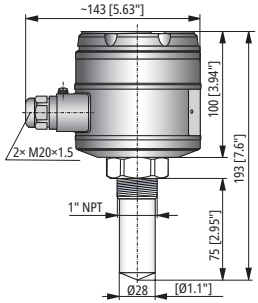


W□K–2□4–□ / W□K–2□5–□

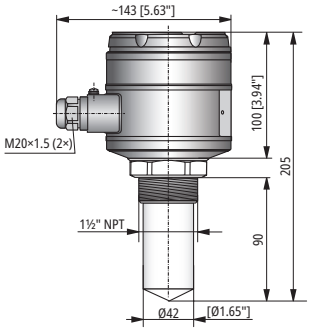


PTFE encapsulated antenna

W□L–213–□



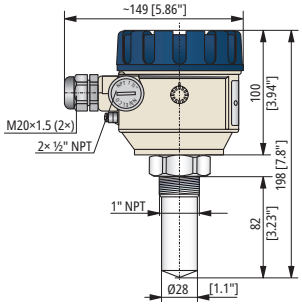
W□L–2□5–□



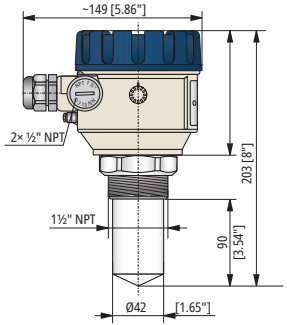
Aluminum housing

PTFE encapsulated antenna

W□T–213–□



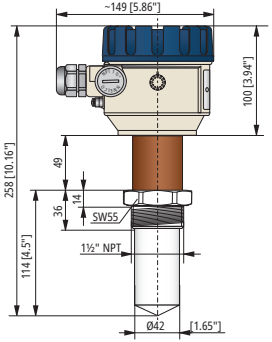
W□T–2□5–□



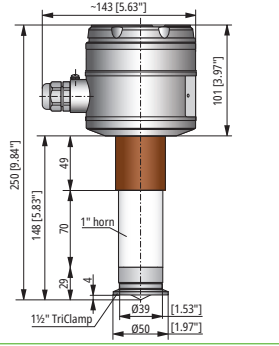
High-temperature version (WHT, WHL, WJT, WJL)

PTFE encapsulated antenna

WHT–2□5–□ / WJT–2□5–□



WHL–21C–□, WJL–21C–□



3.6 Explosion Protection, Designation, Limit Values

3.6.1 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)		**⟨Ex⟩ II 1G Ex ia IIC T6 Ga**	**⟨Ex⟩ II 1D Ex ia IIIC T85°C Da**
High-temperature version		**WH□–□□□–8 Ex / WJ□–□□□–8 Ex**	
Ex marking (ATEX)		**⟨Ex⟩ II 1G Ex ia IIC T6...T3 Ga**	**⟨Ex⟩ II 1D 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 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 3.6.2.	

[1] *In IIB applications, Ex power supply data for IIIC can be used.*

3.6.2 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			
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)	

3.6.3 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]		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 3.6.4.	

[1] *In IIB applications, Ex power supply data for IIIC can be used.*

3.6.4 Temperature limit data for IECEx (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			
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)	

3.6.5 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 3.6.6.	

[1] In IIB applications, Ex power supply data for IIIC can be used.

3.6.6 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	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			
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)	

3.7 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)

3.8 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 Level Probing 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 can only be operated from circuits that comply with the technical specifications, certified and approved as [Ex ia IIC] or [Ex ia 11B] protection.
- If the device is installed in a location exposed to overvoltage, the device must be equipped with at least Class II overvoltage protection!
- The aluminum alloy content in the device housing exceeds the limit, so in explosive (Ex) environments, the equipment must be protected against impact and friction effects (WOS, WOA, WOB, WOT).
- The housing of the device is made of a material capable of accumulating static charge! The presence of electrostatic charge poses a risk of spark generation and ignition, so electrostatic charging must be completely prevented in explosive (Ex) environments!

  The device can only be installed in an environment free from direct air streams causing charge transfer and any other charging effects. Except for Group Ill applications, where the dust conductivity is greater than $>10^{-9}$ S (at 50 ±5% relative humidity) or $>10^{-11}$ S (at 30 ±5% relative humidity). Increased caution is required during maintenance when explosive material residue may be present in the technological tank. The device in explosive (Ex) environments can only be touched with a water moistened antistatic wipe! In case of compliance with the above regulations, considering the closed technological system, there is no possibility of static charge accumulation, therefore, there is no ignition hazard.

3.9 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.

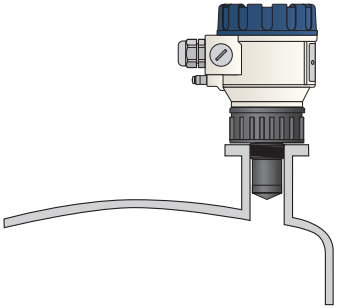
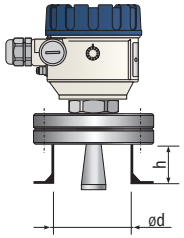
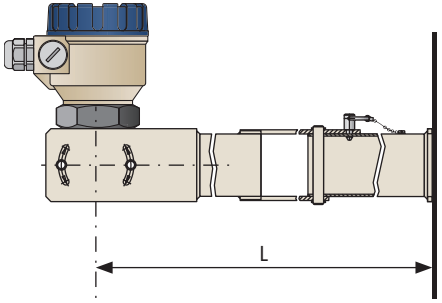
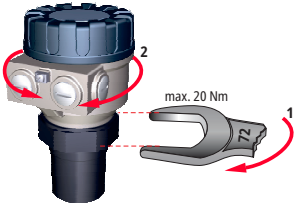
If the device is not used, store it within the ambient temperature specified in the technical data, with a maximum humidity of 98%.

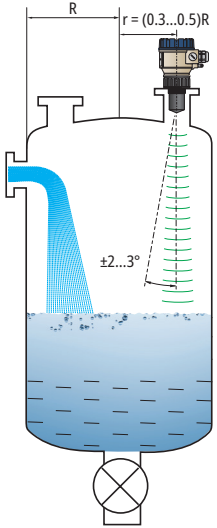
3.10 Firmware Update

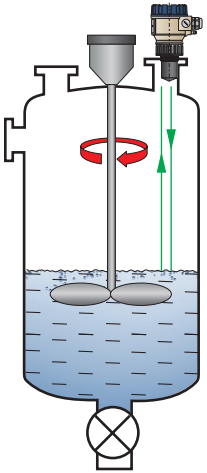
The device's firmware is continuously maintained, considering user feedback and needs. If you want to update the firmware, use the built-in update communication port to upgrade to the latest version. To update, you need the NiFlash Light program; contact your local NIVELCO partner! In addition, the SAT–506–0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

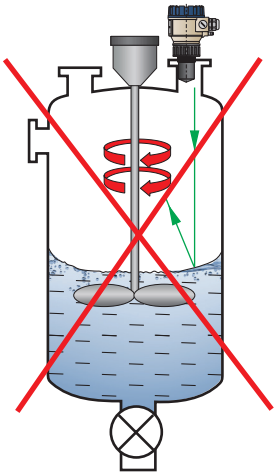
4. INTEGRATION INTO THE TECHNOLOGICAL PROCESS

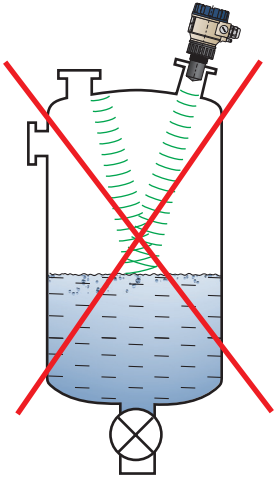
4.1 Mounting

Pipe thread	Flange	Consoles (SAA–107/8/9–☐)
	 h ≤ Ød, where h = nozzle height Ød = nozzle diameter **Consult NIVELCO if the above condition cannot be met!**	
	Rotating enclosure: After threading-in and tightening the device, the enclosure can be rotated to the desired positions by max. 350°.	









POSITION

The optimal location for PiloTREK (for a cylindrical tank) is at radius r = (0.3...0.5) R. The radiation cone angle should always be considered.

The liquid surface must be perpendicular to the axis of the device.

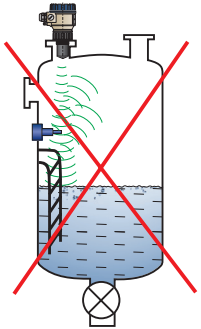
Under no circumstances place the device near the inlet opening! Improper placement may lead to malfunctions.

In the case of enclosed antenna designs, the possibility of antenna front surface humidity should be minimized.

OBSTACLES

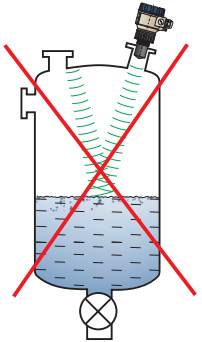
It is essential to avoid objects (pipes, ladders, structural elements, thermometers, etc.) entering the radiation cone.

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 ±2...3°.



GAS / VAPOR

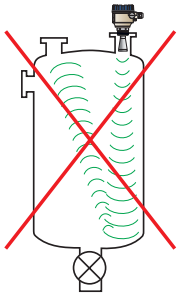
In a closed (especially outdoors, exposed to direct sunlight) tank, vapors/gases above the liquid may reduce the millimeter-wave signal transmission.

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.

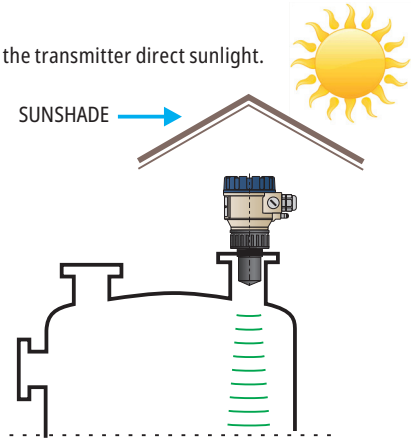
It is because the tank bottom or objects at the bottom of the tank scatter or reflect the millimeter waves emitted to a certain extent, or the lower signal level of the scattered radiation interferes with itself in the tank.

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



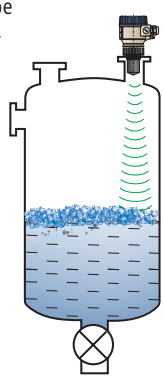
TEMPERATURE

It is recommended to shield the transmitter direct sunlight.



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 Open Channel Flow Measurement Applications

— The device can measure flow in open channels with the flumes/weirs described in Chapter 6.7. or using an output conversion table (OCT) see Chapter 8.5.

— The level transmitter must be placed as close to the surface of the maximum measured level as possible.

— The level transmitter 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 and 3rd party flumes.

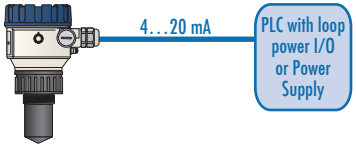
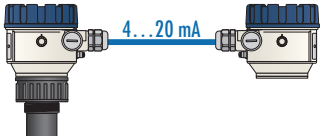
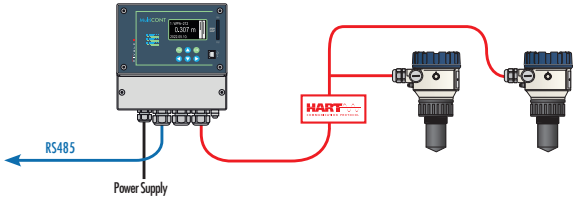
— Foam may form on the flowing liquid, compromising the measurement.

— The level transmitter must be secured in its mounting location to prevent it from moving.

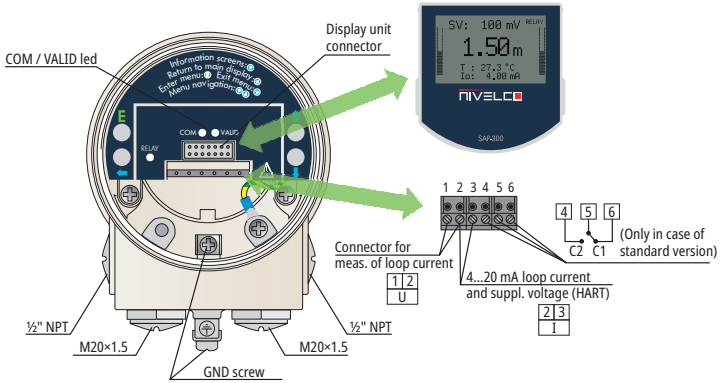
— The measurement accuracy of volume flow change depends on the size and shape of the flume-weir and the surface of the flowing liquid (rippling, foaming). Open channel flow measurement accuracy is always going to be less than level measurement accuracy.

— The level transmitter is advised to protected from direct sunlight. Use a NIVELCO **NISHADE** cover to protect the device.

4.3 Wiring

Standalone transmitter	Connected to MonoCONT	Connected to MultiCONT (HART® Multidrop)
		
See Chapter 4.3.1.	See MonoCONT User's and programming manual	See MultiCONT User's and programming manual

4.3.1 Standalone Transmitter Wiring



If the transmitter is pre-equipped with a display unit, gently unplug it by pulling it upwards using two fingers from the sides.

1. Insert the cable through the cable gland or conduit into the housing.
2. Unplug/remove black screw terminal (1-6) for easier wire connection.

LED states:

- **ECHO-LED**
  - **ON, if the device receives a suitable echo.**
  - **BLINKS when the device is searching for an echo.**
- **COM-LED**

  FLASHES UP ONCE if there has been a HART message exchange,
  - **ON, if the device is in remote programming mode.**
  - **BLINKS for 4 seconds after the device is switched on: service communication connection can be established during this time. If it continues to blink, it indicates a firmware error.**
- **RELAY LED (optional)**
  - **ON, when CC-C2 is energized.**
  - **OFF, when CC-C1 is energized.**

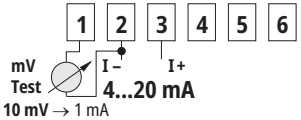
3. Check the polarity before inserting the wires into the terminal ports 2 and 3:

Minus (–) to Terminal 2
Plus (+) to Terminal 3

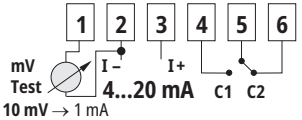
DO NOT perform an insulation test with a test voltage of 500 V AC due to the internal electronic overvoltage protection.

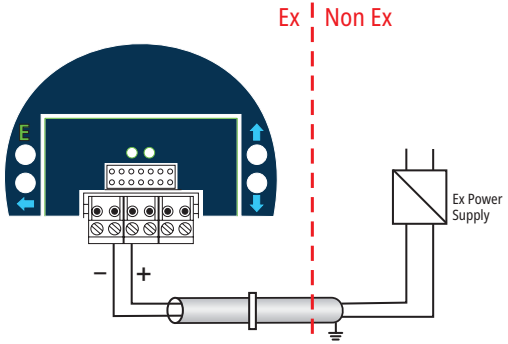
4. Don't forget to tighten the cable gland or conduit as well as the device cover to prevent humid air, water and dust penetration into the enclosure.

Model with 2-wire Loop power



Model with 2-wire Loop power and NO/NC Relay output





In non-hazardous areas, the device must be powered through a galvanically isolated power supply!

For devices used in hazardous areas, the requirements in section "3.8 Conditions for safe operation" must be observed when selecting the power supply.

The insulation test is prohibited due to the internal electronic overvoltage protection!

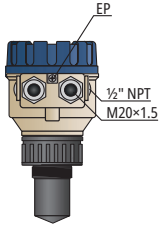
Connecting (grounding) to an equipotential network (EPH)

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.

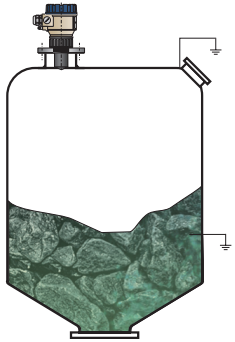


Electrostatic Discharge (E.S.D.)

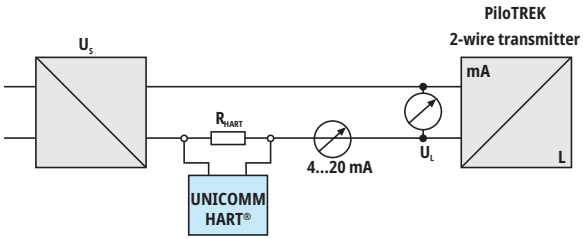
The device is protected against 4 kV E.S.D.

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:

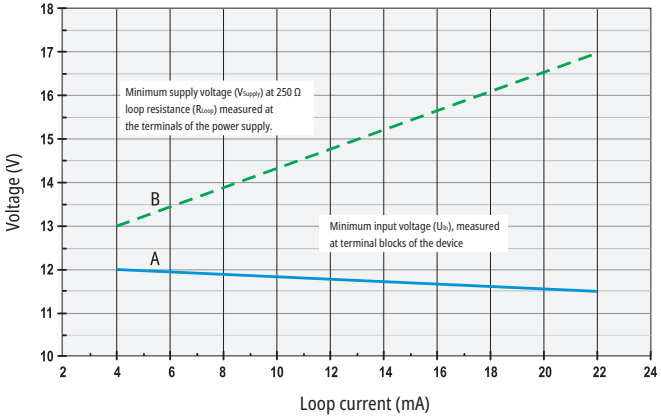
$U_{Supply\ min.} = U_{Input\ min.} + (I_{min} \times R_{Loop}) = 11.5\ V + (4\ mA \times 0.25\ k\Omega) = 12.5\ V$

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

$U_{Supply\ min.} = U_{Input\ min.} + (I_{min} \times R_{Loop}) = 11.5\ V + (22\ mA \times 0.25\ k\Omega) = 18.5\ V$

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 Device setup and service options

- UNIDISP SAP–300 Plug-in graphic display unit and 4-key menu-driven programming (if equipped)
- MobileEview App for iOS or Android device (if PiloTREK is equipped with Bluetooth® connectivity).
  Download the free MobileEView App to your iOS or Android device.
  Bluetooth® operation mode (on/off/time-out, etc.) can be selected based on security policy.
- MonoCONT and MultiCONT remote display/controllers.
- Via HART®
  EView2 free download SW for Windows devices using a HART® modem. Ex.; **UNICOMM SAT–504–☐**.
  Via PACTware™
  3rd party HART® modem

4.5 BUS (HART®) communication

The output of the device can be used as:

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

MonoCONT and MultiCONT remote display/controllers support both modes. By 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. If the device is set to current transmission (4...20 mA, "0" HART short address) only one device can be used in the HART communication loop. In a multidrop operation (4 mA), several devices (up to 15) can be connected in a HART communication loop. The device's short address must be other than 0.

4.6 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.

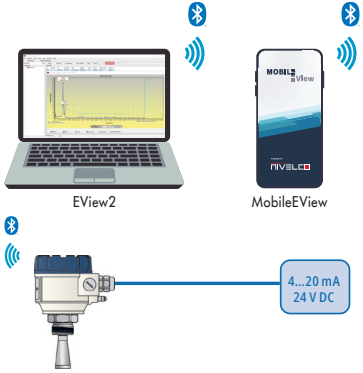
Caution! The instrument starts with a current consumption of 3.5 mA (parameter P12:c Analog current loop output mode) after power-on and, after successful initialization, maintains the set error current of 3.8 mA (see parameter P12:a) at the output until the first successful measurement!

5. USER INTERFACE OPTIONS / PROGRAMMING

Transmitters with Local display
via display and 4 push buttons

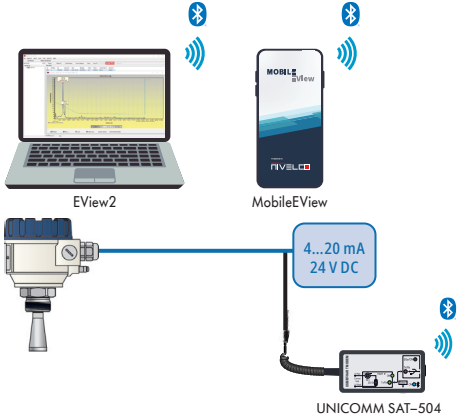
1. Insert display and power up transmitter.
2. Press 'E' button to enter menu
3. See ***5.1 Local display / menu handling*** for more information

Transmitters with Bluetooth®
via MobileEView App or EView2 (PC)



1. Install "Mobile EView" App on iOS or Android devices or download EView2 software for Windows devices
2. Power up transmitter and connect from software

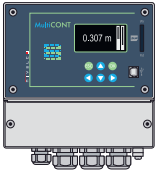
Transmitters with HART
using HART Modem (SAT–504–☐) and EView2 (PC)
or MobileEView App



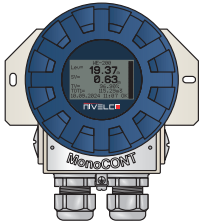
1. Connect HART modem to current loop using 250 Ω HART resistor.
2. Connect Laptop to HART modem using USB cable or via Bluetooth® if modem has Bluetooth® option
3. Download *EView2 software* for Windows devices
4. Power up transmitter and connect from software

via MultiCONT field controller

1. See MultiCONT Manual for wiring and handling
2. See section ***6. PiloTREK settings*** for configuration



via MonoCONT field display



1. See MonoCONT Manual for wiring and handling
2. See section ***6. PiloTREK settings*** for configuration

Transmitters with Modbus interface
via Modbus master

1. See Modbus Manual for supported protocol
2. See section ***6. PiloTREK settings*** for configuration

5.1 Local Display / Menu Handling

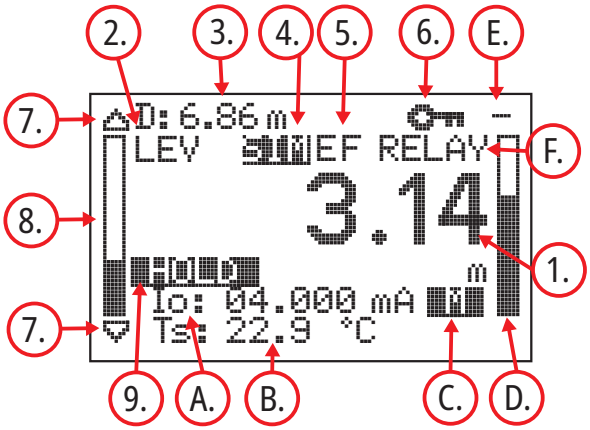
5.1.1 SAP–300 Display Unit (optional)

PiloTREK WE–200 type compact radar transmitters can be equipped with an SAP–300 display unit.
The display shows the actual measurement value and status information by default.
The display can also be used to program most of PiloTREK's parameters with the four buttons.

SAP–300 display unit – Technical data		Warning!
Display	64 × 128 dot matrix LCD	⚠ Do not expose the SAP–300 to prolonged heat or sunlight as the display may be damaged.
Operating temperature:	–20...+65 °C (–4...+149 °F)	

5.1.2 Elements of the Display

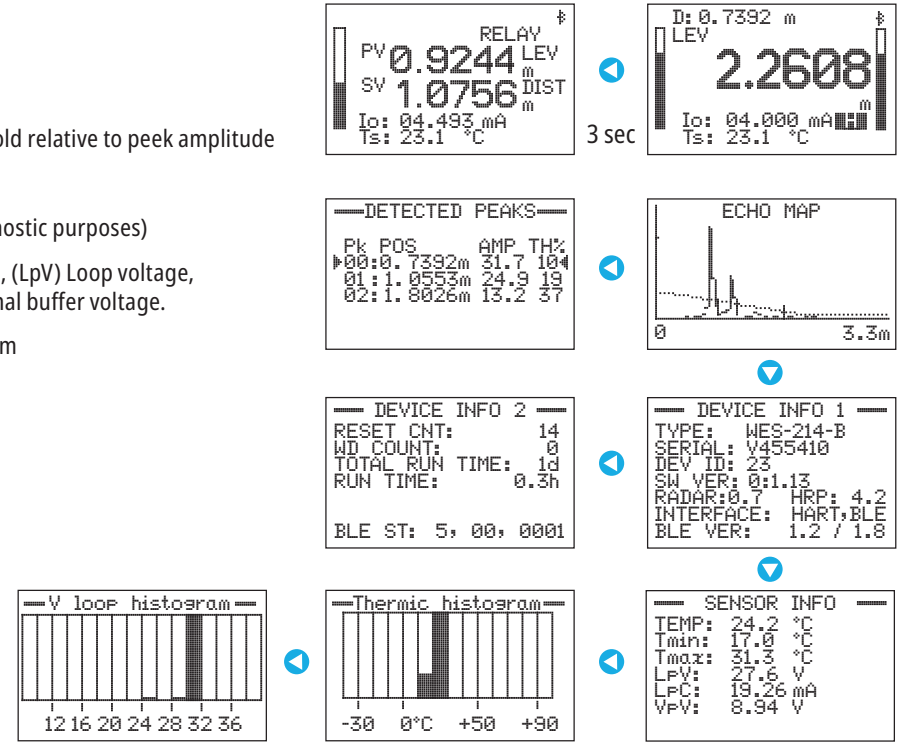
1	Measured Primary Value (PV), with unit indication below (5 digit)		
2	Measured quantity (PV mode): **LEV** – Level, **VOL** – Volume, **FLOW** – Flow, ...		
3	Raw value for PV calculation: **'D:'** – Distance, **'L:'** – Level, **'H:'** – Flow height		
4	SIM– indicator: Simulation mode active. Warning! PV is simulated, not measured!		
5	Empty/Full marker: **'E'** – Tank Empty, **'F'** – Tank Full		
6	Menu locked by: '🔑' – Security code, **'REM'** – Remote access active		
7	Trend indicator: '△' – slow increase, '▽' – slow decrease, '▲' – fast increase, '▼' – fast decrease		
8/D	Bar-graph: *left* – Level % (full range), *right* – Output % of 4–20 mA output range		
9	Output status indicator: **'OCT'** – Output Correction Table active speed Level change speed exceeds limit, output holding last valid hold Echo loss, output holding last valid value F/EE cho loss, output continuing last valid trend		
A	Output current value	B	Transmitter temperature
C	Output mode:'M' – Manual,'H' – HART multi-drop, 'E!' – Error current		
E	Bluetooth® status: '✱' – Enabled, '✱'– Connected, '–' – Disabled, 'X' – Error		
F	**'RELAY'** – Relay On (C2 state)		



5.1.3 Info Screens

You can switch between info screens using the ▼ ▲ and ◀ buttons.

- **Value display**: single display mode
- **Echo map**: dotted line indicates threshold level
- **Peek list**: Peek no., Position, Amplitude [dB], Threshold relative to peek amplitude
- **Device info 1**: Type and version info
- **Device info 2**: Run time info (only for advanced diagnostic purposes)
- **Sensor Info**: (TEMP) Electronics temperature, (LpV) Loop voltage, (LpC) Loop current, (VpV) Internal buffer voltage.
- **Histogram**: Termic histogram, Loop voltage histogram



5.1.4 Menu Handling

Navigating in the menu	Button	Value input	Checkbox setting
Entering the selected menu	E	Accepting the setting	Accepting the setting
Selecting a menu item	▲▼	Modifying digit value	Selecting an item
Going back to the previous menu	◀	Next digit	Switching checked/unchecked

Menu properties

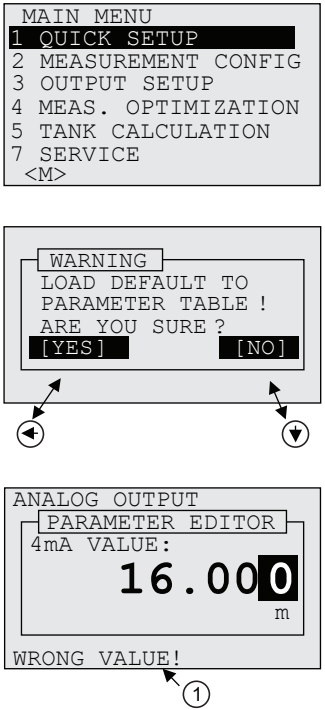
- Enter the main menu from any info screen by pressing the E button.
- Menu TOP row: left – **MENU TITLE**, right – ▲ or ▼ indicates that menu can be scrolled in given direction.
- Menu BOTTOM row: left – **<Menu ID>** (M-ID), right – **Parameter-ID** (P-ID), only if relevant
- Changes will only take effect after exiting the menu! Till then the transmitter operates with the previous settings.
- After 30 seconds of inactivity (or if SAT–300 is unplugged) PiloTREK will automatically exit menu, discarding all changes.
- Local menu access and remote programing ('REM') through Bluetooth®, HART or Modbus block each other. Whichever is first will have priority.
- Dialog BOX: ◀ or ▼ buttons perform the function displayed on the screen, e.g., [Yes], [No].

Value input – special key combinations (press simultaneously)

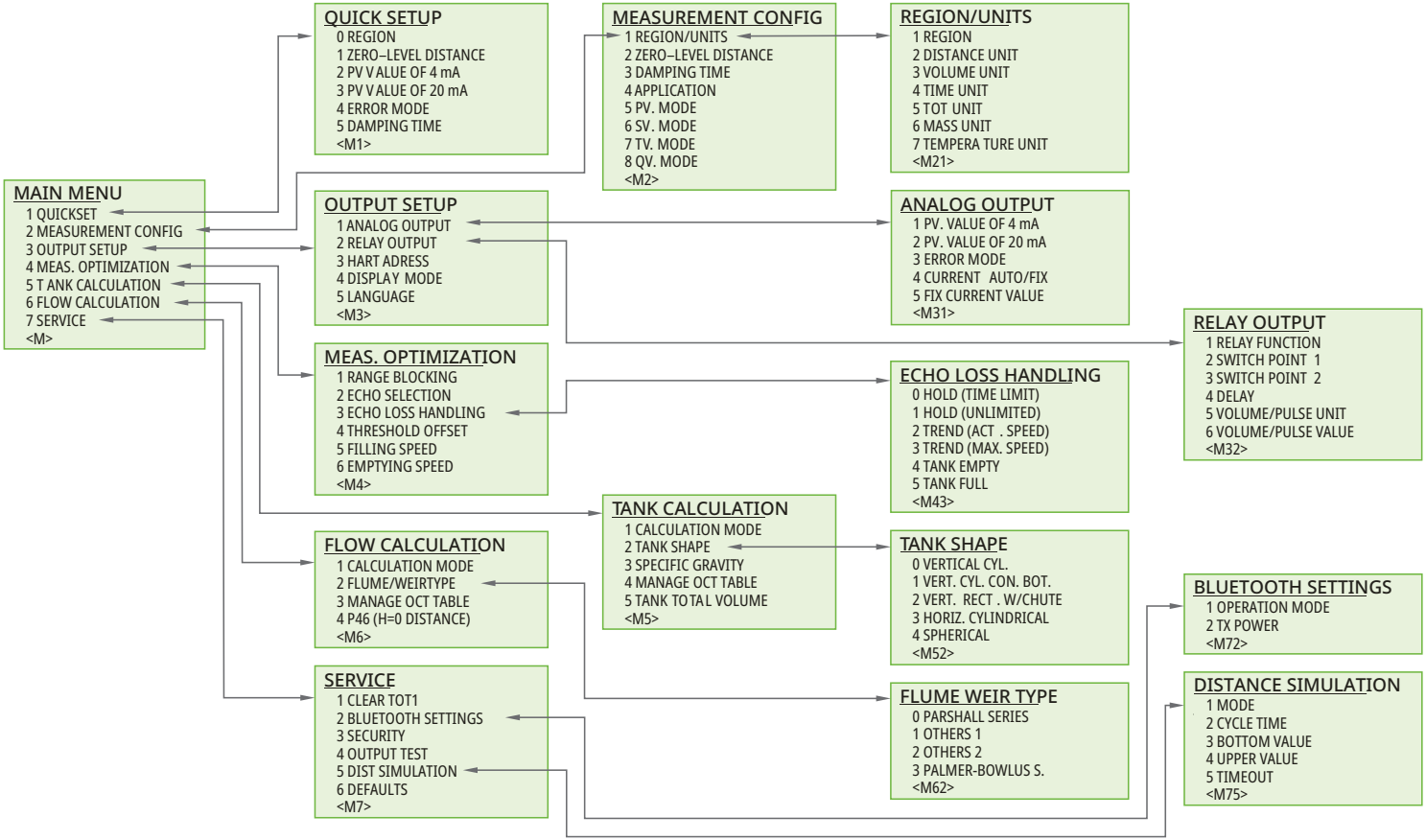
◀+▲ → Return to original value.

◀+▼ → Set to default value.

▲+▼ → Set to actually measured value. (Supported only at some parameters



5.1.5 Menu Map


MAIN MENU
1 QUICKSET
2 MEASUREMENT CONFIG
3 OUTPUT SETUP
4 MEAS. OPTIMIZATION
5 T ANK CALCULATION
6 FLOW CALCULATION
7 SERVICE
<M>
QUICK SETUP
0 REGION
1 ZERO–LEVEL DISTANCE
2 PV V ALUE OF 4 mA
3 PV V ALUE OF 20 mA
4 ERROR MODE
5 DAMPING TIME
<M1>
MEASUREMENT CONFIG
1 REGION/UNITS
2 ZERO–LEVEL DISTANCE
3 DAMPING TIME
4 APPLICATION
5 PV. MODE
6 SV. MODE
7 TV. MODE
8 QV. MODE
<M2>
REGION/UNITS
1 REGION
2 DISTANCE UNIT
3 VOLUME UNIT
4 TIME UNIT
5 TOT UNIT
6 MASS UNIT
7 TEMPERA TURE UNIT
<M21>
OUTPUT SETUP
1 ANALOG OUTPUT
2 RELAY OUTPUT
3 HART ADRESS
4 DISPLAY MODE
5 LANGUAGE
<M3>
ANALOG OUTPUT
1 PV. VALUE OF 4 mA
2 PV. VALUE OF 20 mA
3 ERROR MODE
4 CURRENT AUTO/FIX
5 FIX CURRENT VALUE
<M31>
RELAY OUTPUT
1 RELAY FUNCTION
2 SWITCH POINT 1
3 SWITCH POINT 2
4 DELAY
5 VOLUME/PULSE UNIT
6 VOLUME/PULSE VALUE
<M32>
MEAS. OPTIMIZATION
1 RANGE BLOCKING
2 ECHO SELECTION
3 ECHO LOSS HANDLING
4 THRESHOLD OFFSET
5 FILLING SPEED
6 EMPTYING SPEED
<M4>
ECHO LOSS HANDLING
0 HOLD (TIME LIMIT)
1 HOLD (UNLIMITED)
2 TREND (ACT . SPEED)
3 TREND (MAX. SPEED)
4 TANK EMPTY
5 TANK FULL
<M43>
TANK CALCULATION
1 CALCULATION MODE
2 TANK SHAPE
3 SPECIFIC GRAVITY
4 MANAGE OCT TABLE
5 TANK TOTAL VOLUME
<M5>
TANK SHAPE
0 VERTICAL CYL.
1 VERT. CYL. CON. BOT.
2 VERT. RECT . W/CHUTE
3 HORIZ. CYLINDRICAL
4 SPHERICAL
<M52>
FLOW CALCULATION
1 CALCULATION MODE
2 FLUME/WEIRTYPE
3 MANAGE OCT TABLE
4 P46 (H=0 DISTANCE)
<M6>
BLUETOOTH SETTINGS
1 OPERATION MODE
2 TX POWER
<M72>
SERVICE
1 CLEAR TOT1
2 BLUETOOTH SETTINGS
3 SECURITY
4 OUTPUT TEST
5 DIST SIMULATION
6 DEFAULTS
<M7>
FLUME WEIR TYPE
0 PARSHALL SERIES
1 OTHERS 1
2 OTHERS 2
3 PALMER-BOWLUS S.
<M62>
DISTANCE SIMULATION
1 MODE
2 CYCLE TIME
3 BOTTOM VALUE
4 UPPER VALUE
5 TIMEOUT
<M75>

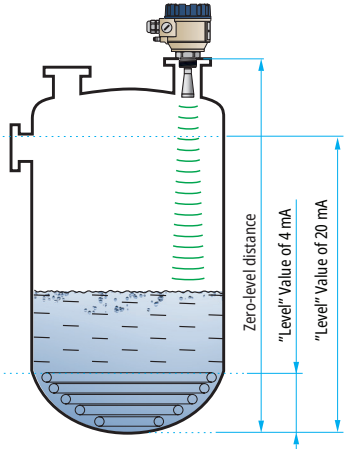
6. PiloTREK SETTINGS

6.1 Quick Setup

Local display menu	M-ID	EView2	MonoCONT	P-ID	MultiCONT	Modbus
QUICKSET	Q	—	—	—	—	—

PiloTREK W–200 models with integrated display (WG☐–2☐☐–☐) offer a built is Quick Setup feature for simple LEVEL measurement applications. Quick Setup guides you sequentially through following basic settings. Press ◀ button for 3 seconds to exit Quick Setup any time.

#		Description	
0	REGION	Defines RF compliance and the unit system (Metric/Imperial) to be used. For USA select "US / Imperial". *See chapter **6.2 Region** for more information.*	
1	ZERO-LEVEL DISTANCE	Defines the zero point for level measurement. Enter the distance between the sealing plane of the process connection and the designated zero level. *See chapter **6.3. Measurement Configuration / Zero-level distance** for more information.*	
2	PV VALUE OF 4 mA	Defines the LEVEL value assigned to 4 mA current output, by default the zero-level. *See chapter **6.4. Output setup / PV VALUE OF 4 mA** for more information.*	
3	PV VALUE OF 20 mA	Defines the LEVEL value assigned to 20 mA current output, by default the maximum measurable level. The analog output automatically scales the set level range to the 4...20 mA current output range. *See chapter **6.4. Output setup / PV VALUE OF 20 mA** for more information.*	
4	ERROR MODE	Defines the behavior of the current output in case of "No echo error", i.e. while no up-to-date LEVEL value is available. *See chapter **6.4. Output setup / ERROR MODE** for more information.* Options: – ***HOLD*** Keeps last valid value on output (default). Recommended setting. – ***3.8 mA*** Outputs "Low error current". – ***22 mA*** Outputs "High error current". "Error current" setting is recommended only if recognized distinctly from 4 mA/20 mA Zero- or Max-level.	
5	DAMPING TIME	Delay in seconds for output to reach new value. Larger values smoothen output, e.g. to hide waving, smaller values allow faster reaction to sudden changes. Default is 40 s. *See chapter **6.3. Measurement Configuration / Damping** for more information.*	



6.2 Measurement Config

6.2.1 Region / Units

a. Region M211

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → Region / Units → Region	Application → Calculation system	Transmitter → P00 Region/Mode → Engineering system	Devices → Remote Program → App. parameters → P00 Application → ☐☐■☐☐	800 → ☐■☐☐
<M211>	P00 → ☐■☐☐	<T42>	—	—

The Region setting ensures compliance with local RF regulations of PiloTREK 80 GHz radar. In addition, this setting also defines the unit system.
⚠ Changing the Region parameter will reset all parameters to factory default of selected unit system. Always set this parameter first!

#	Value	Description	Default
0	EU / Metric	EU, United Kingdom, Switzerland, Canada, Australia, Albania, Andorra, Azerbaijan, Belarus, Bosnia and Herzegovina, Liechtenstein, Moldova, Monaco, Montenegro, New Zealand, North Macedonia, Norway, San Marino, Saudi Arabia, Serbia, Turkey, Ukraine	EU / Metric
1	US / Imperial	United States	
2	Region 2 / Metric	Brazil, Japan, South Korea, Taiwan, Thailand	
3	Region 2 / Imperial		
4	Region 3 / Metric [1]	India, Malaysia, South Africa	
5	Region 4 / Metric [1]	Russia, Kazakhstan	

[1] For 'Region 3' and 'Region 4' accuracy of ±2 mm is not guaranteed.

b. DISTANCE Unit — M212

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → Region / Units → Distance Unit	Application → Engineering units	Transmitter → P00 Region/Mode → Distance units	Devices → Remote Program → App. parameters → P00 Application → □□□■□	800 → □□■□
<M212>	P00 → □□■□	<T43>	—	—

#	Metric	Imperial	Description	Default *(Metric/Imperial)*
0	m	ft	This setting defines the level or distance unit used on digital outputs, such as local display, HART, or Modbus. Additionally, the configuration parameters also require the value given in the unit set here ⚠ Changing the 'Distance Unit' parameter will reset all other parameters to the default of the selected unit system, except the 'Region' setting. All user parameters must be set again!	m / ft
1	cm	inch		
2	mm	inch		

Volume Unit — M213

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → Region / Units → Volume Unit [(1)]	Measurement config. → Volume unit	Transmitter → Transmitter setup → P02 Output unit → Volume units	Devices → Remote Program → Parameters → P02 Output unit → □□□■□	804 → □□■□
<M213>	P02 → □□■□	<T1021>	—	—

[(1)] Appears only if PV, SV, TV, or QV is set to VOLUME or FLOW!

#	Metric	Imperial	Description	Default *(Metric/Imperial)*
0	liter	gallon	Defines the unit used for digital Volume or Flow (Volume/time) value output. [(2)] In FLOW measurement mode, use only for MGD! Otherwise, in HART transmission, it can only be interpreted in conjunction with reading the application-specific code.	m^3 / barrel
1	hL	ft^3		
2	m^3	barrel		
3	million liter [(2)]	million gallon [(2)]		

d. Time Unit — M214

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → Region / Units → Time Unit [2]	Measurement config. → Time	Transmitter → Transmitter setup → P02 Output unit → Time units	Devices → Remote Program → Parameters → P02 Output unit → ☐☐■☐☐	804 → ☐■☐☐
< M214>	P02 → ☐■☐☐	<T1023>	—	—

[2] Appears only if PV, SV, TV, or QV is set to FLOW!

#	Metric	Imperial	Description	Default
0	Second		Defines the unit used for digital Volume or Flow (Volume/time) value output.	Second
1	Minute			
2	Hour			
3	Day			

e. TOT Unit — M215

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → Region / Units → TOT Unit [1]	Measurement config. → TOT unit	Transmitter → Transmitter setup → P02 Output unit → TOT units	Devices → Remote Program → Parameters → P02 Output unit → ☐■☐☐☐	804 → ■☐☐☐
<M215	P02 → ■☐☐☐	<T1024>	—	—

[1] Appears only if PV, SV, TV, or QV is set to FLOW!

#	Metric	Imperial	Description	Default *(Metric/Imperial)*
0	liter	gallon	Defines the unit used for digital TOT value output.	m^3 / barrel
1	hL	ft^3		
2	m^3	barrel		
3	million liter	million gallon		

f. Mass Unit M216

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → Region / Units → Mass Unit [2]	Measurement config. → Mass unit	Transmitter → Transmitter setup → P02 Output unit > Mass Unit	Devices → Remote Program Parameters → P02 Output unit → □□□□■	804 → □□□■
<M216>	P02 □□□■	<T1022>	—	—

[2] *Appears only if PV, SV, TV, or QV is set to MASS!*

#	Metric	Imperial	Description	Default *(Metric/Imperial)*
0	kg	lb	Defines the unit used for digital Mass value output.	ton / US ton
1	ton	US ton		
2	US ton	metric ton		

g. Temperature Unit M217

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → Region / Units → Temperature Unit	Measurement config. → Temperature	Transmitter → P00 Region/Mode → Temperature Unit	Devices → Remote Program → Parameters → P00 Application → □■□□□	800 → ■□□□
<M217>	P00 → ■□□□	<T44>	—	—

#	Metric	Imperial	Description	Default *(Metric/Imperial)*
0	°C		Defines the unit used for digital Temperature output.	°C
1	°F			

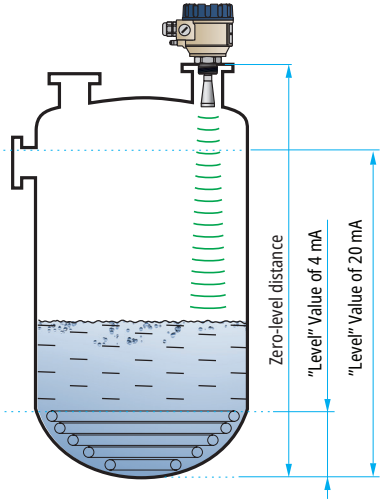
6.2.2 Zero-Level Distance M22

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config. → Zero-Level Distance	Measurement config. → Zero-Level Dist.	Transmitter → Transmitter setup → P04 Zero-level distance	Devices → Remote Program → Parameters → P04 Zero-level distance	808 → float
<M22>	P04	<T104>	—	—

The "*Zero-Level Distance*" (or "Tank Height" – 'H') is the distance between the "reference plane" of the process connection and the designated "zero level" of the application, typically the bottom of the tank.
The device calculates the level by subtracting the measured "Level Distance" ('DIST') from the "Zero-level distance". Level: 'LEV' = H – DIST

This parameter shall always be set, except for distance measurement

	Value range	Unit	Default
Zero-Level Distance	("*Near-blocking distance*" + 5 cm [2"]) ... 60 m (200 ft)	"*Distance Unit*"	See "X_{max}" in the Sensing distance table

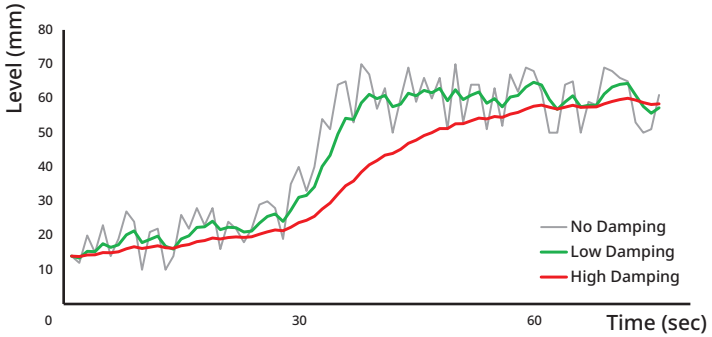


6.2.3 Damping Time M23

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config. → Damping Time	Measurement optimization → Damping time	Transmitter → Transmitter Setup → P20 Damping time	Devices → Remote Program → Parameters → P20 Damping Time	840 → float
<M23>	P20	<T120>	—	—

Damping time reduces unwanted fluctuations in displaying the measured data (e.g., ripples). It slows down the reaction of the output.
By the set time the output reaches 98% of the new value

	Value range	Unit	Default
Damping Time	0...999	s	40 s



6.2.4 Application M24

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config. → Application	Application → Operation mode	Transmitter → P00 Region/Mode → Application	Devices → Remote Program → App. parameters → P00 Application → □□□□■	800 → □□□■
<M24>	P00 → □□□■	<T41>	—	—

#	Value	Description	Default
0	Normal	At the moment this parameter defines the operating mode of the radar sensor. High-sensitivity mode is required only for special applications.	Normal
1	High-sensitivity		

6.2.5 PV Mode (Primary Output Value) M25

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config. → PV Mode	Measurement configuration → Measurement Mode (PV source)	Transmitter → Transmitter setup → P01 PVSV mode → PV. mode	Devices → Remote Program → Parameters → P01 Output function → □□□■■	802 → □□■■
<M25>	P01 → □□■■	<T1011>	—	—

Defines the Value transmitted on the Primary Output (PV), including the analogue output (4...20 mA loop current), as well as the value shown on local display.
Default: "Level"

#	Value	Description	Default
10	Distance	Distance (DIST) of the level as measured by the Transmitter.	Level
11	Level	Level (LEV) is calculated from "Distance" based on "Zero-Level Distance" (See "6.3 Zero-Level Distance").	
12	Volume	Volume (VOL) is calculated from "Level" based on tank shape settings. (See "6.6. Tank Calculation")	
15	Ullage Volume	Emty Volume (UL.VOL) is calculated from "Volume" based on "Total Volume" setting. (See "6.6. Tank Calculation")	
13	Mass	Weight (MASS) is calculated from "Volume" based on "Specific Gravity" setting. (See "6.6. Tank Calculation")	
14	Flow[(1)]	Open channel Flow (FLOW) measurement mode. (See "6.7. Flow Calculation" settings below.)	
16	Level%	Level% is the relative level in a 0% to 100% range. (100% is defined by "Near-Blocking Distance" setting.)	
17	Volume%	Volume% is the relative volume in a 0% to 100% range.	
40	Device Temperature	Temperature of transmitter. (Indicative for ambient temperature.)	
41	Flow TOT1	TOT1 is a user resetable "Flow" totalizer. (Only in combination with "Flow" mode)	
42	Flow TOT2	TOT2 is a non-resetable "Flow" totalizer. (Only in combination with "Flow" mode)	

(1) "Flow" measurement mode cannot be selected together with "Volume" and volume-based measurement modes.

6.2.6 SV Mode (Secondary Output Value) M26

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config. → SV Mode	Measurement configuration → Secondary value source (SV)	Transmitter → Transmitter setup → P01 PVSV mode → SV. mode	Devices → Remote Program → Parameters → P01 Output function → □■■□□	802 → ■■□□
<M26>	P01 → ■■□□	<T1012>	—	—

Defines the Value transmitted on the Secondary Output (SV), which is available on the digital output channels like HART® or Modbus.
See "PV Mode" concerning the selectable values. **Default: *"Distance"***

6.2.7 TV Mode (Third Output Value) M27

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config. → TV Mode	Measurement configuration 2 → Third value source (TV)	Transmitter → Transmitter setup → P30 TVQV mode → TV. mode	—	860 → □□■■
<M27>	P30 → □□■■	<T1301>	—	—

Defines the Value transmitted on the Forth Output (QV), which is available on the digital output channels like HART® or Modbus. See "PV Mode" concerning the selectable values. **Default: *"Temperature"***

6.2.8 QV Mode (Forth Output Value) M28

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → QV Mode	Measurement configuration 2 → Forth value source (QV)	Transmitter → Transmitter setup → P30 TVQV mode → QV mode	—	860 → ■■□□
<M28>	P30 → ■■□□	<T1302>	—	—

Defines the Value transmitted on the Forth Output (QV), which is available on the digital output channels like HART® or Modbus. See "PV Mode" concerning the selectable values. **Default: *"Temperature"***

6.3 Output Setup

6.3.1 Analog Output M31

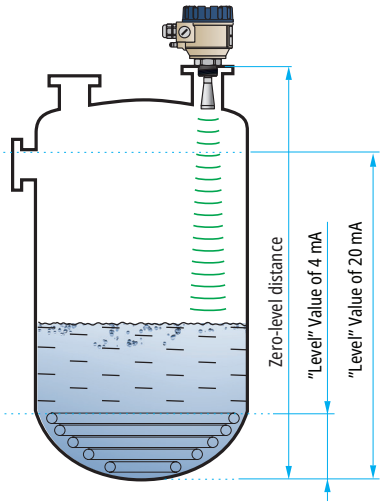
a. PV Value of 4 mA M311

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Analog Output → PV Value of 4 mA	Outputs → Current output → Assignment of 4 mA - PV	Transmitter → Transmitter setup → P10 PV Assign 4mA	Devices → Remote Program → Parameters → P10 PV assign 4 mA	820 → float
<M311>	P10	<T110>	—	—

The value of the transmitted quantity assigned to 4 mA output current. 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 PVSV mode) output value to the analog current output 4...20 mA range using the values specified in parameters P10 and P11.

	Value range	Unit	Default
PV Value of 4 mA	0...99.999	"Distance Unit"	0



b. PV Value of 20 mA — M312

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Analog Output → PV Value of 4 mA	Outputs → Current output → Assignment of 20 mA - PV	Transmitter Transmitter setup → P11 PV Assign 20mA	Devices → Remote Program → Parameters → P11 PV assign 20 mA	822 → float
<M312>	P11	<T111>	—	—

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

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 PVSV mode) output value to the analog current output 4...20 mA range using the values specified in parameters *"PV Value of 4 mA"* and *"PV Value of 20 mA"*. 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.)

	Value range	Unit	Default
PV Value of 20 mA	0...99.999	"Distance Unit"	See "X_{max}" in the Sensing distance table

c. Error Mode — M313

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Analog Output → Error Mode	Outputs → Current output → Error indication by the current output	Transmitter → Transmitter setup → P12 Error current mode → Error Mode	Devices → Remote Program → Parameters → P12 current output→ □□□□■	824 → □□□■
<M313>	P12 → □□□■	<T1121>	—	—

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.

#	Value	Default
0	HOLD (holding last valid value)	HOLD
1	3.8 mA	
2	22 mA	

d. Current Auto/Fix M314

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Analog Output → Current Auto/Fix	Outputs → Current output → Current generator mode	Transmitter → Transmitter setup → P12 Errorcurrent mode → Current Mode	Devices → Remote Program → Parameters → P12 current output→ □□□■□	824 → □□■□
<M314>	P12 → □□■□	<T1122>	—	—

Analog current output mode:

#	Value	Description	Default
0	Auto (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.	AUTO
1	Fix	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 "*HART Address*" (P19) override!	

e. Fix Current Value M315

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Analog Output → Fix current value	Outputs → Current output → Fix output current (P08)	Transmitter → Transmitter setup → P08 Fix output current	Devices → Remote Program → Parameters → P08 Fix current	816 → float
<M315>	P08	<T108>	—	—

If the "Current Auto/Fix" mode (P12:b) is set to "Fix," 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 "Fix" current output mode when a new value is set in parameter "Fix current value" (P08). When 0 is entered, the device switches to "Auto" current transmission mode ("Current Auto/Fix" P12:b = 0) and resets the value of parameter P08 to the factory setting. In HART multi-drop mode (see parameter P19 Short Address), the current loop output is fixed at 4 mA, as per standard, and the manual output current value "Fix current value" (P08) does not apply. Default: 4.0 mA

	Value range	Unit	Default
Fix current value	3.8...20.5	mA	4 mA

6.3.2 Relay Output (optional)

a Relay FUNCTION M321

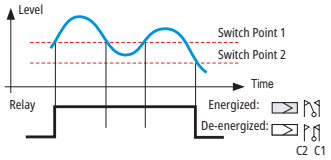
Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Relay Output → Relay Function	Outputs → Relay output → Relay mode	Transmitter → Transmitter setup → P13 Relay Function → Relay mode	Devices → Remote Program → Parameters → P13 Relay function → □□□■■	826 → □□■■
<M321>	P13 → □□■■	<T1131>	—	—

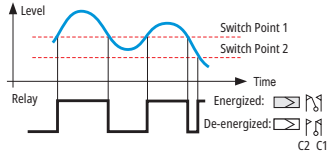
This parameter can set the operating mode of the RELAY, which is optionally built into the device. If it is set to "by PV," the RELAY operates based on the triggering *"Trigger value"* (P14) and releasing *"Release value"* (P15) values set. The "No ECHO" setting enables a switched (relay contact) error signal to the process controller.

Caution! When the device is de-energized, the relay releases, so C1 is ON.

#	Value	Default
00	PV Hysteresis (see below for function)	C1 if no Echo
10	PV Window (see below for function)	
01	C1 if no Echo	
02	C2 if no Echo	
03	Flow Pulse	
04	C1 if Error	
09	Relay OFF	

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

Function		Programmable parameters	Description
Hysteresis		**Switch Point 1 and 2** At least 20 mm (0.787") of hysteresis is required between **Switch Point 1 and 2.** **Switch Point 1 > Switch Point 2** – normal operation **Switch Point 1 < Switch Point 2** – inverted operation	The basic switching method of the RELAY set to “PV” mode can be adjusted.

Function		Programmable parameters	Description
Window comparator		**Switch Point 1 and 2** At least 20 mm (0.787") of hysteresis is required between **Switch Point 1 and 2.** **Switch Point 1 > Switch Point 2** – normal operation **Switch Point 1 < Switch Point 2** – inverted operation	The basic switching method of the RELAY set to “PV” mode can be adjusted.

Switch Point 1 M322

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Relay Output → Switch Point 1	Outputs → Relay output → Relay parameters → Energized value	Transmitter → Transmitter Setup → P14 Relay on state value	Devices → Remote Program → Parameters → P14 Relay on value	828 → float
<M322>	P14	<T114>	—	—

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.

	Value range	Unit	Default
Switch Point 1	0...99.999	“Distance Unit”	0

c. Switch Point 2 M323

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Relay Output → Switch Point 2	Outputs → Relay output → Relay parameters → De-energized value	Transmitter → Transmitter Setup → P15 Relay off state value	Devices → Remote Program → Parameters → P15 Relay off value	830 → float
<M323>	P15	<T115>	—	—

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.

	Value range	Unit	Default
Switch Point 2	0...99.999	"Distance Unit"	0

d. Delay M324

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Relay Output → Delay	Outputs → Relay output → Relay delay time	Transmitter → Transmitter Setup → P16 Relay delay	Devices → Remote Program → Parameters → P16 Relay delay	832 → float
<M324>	P16	<T116>	—	—

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.

	Value range	Unit	Default
Delay	0...999	s	0

e. Volume/Pulse Unit M325

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Relay Output → Volume/Pulse Unit	Outputs → Relay output → Relay parameters → Pulse constant unit	Transmitter Transmitter setup → P13 Relay Function → Relay mode → Flow Impulse Unit	Devices → Remote Program → Parameters → P13 Relay function ☐☐■☐☐	826 → ☐■☐☐
<M325>	P13 → ☐■☐☐	<T1133>	—	—

#	Metric (EU)	Imperial (US)	Default (Metric / Imperial)
0	m^3	$ft3^3$	m^3 / ft^3
1	liter	US gallon	
2	liter	GB gallon	

f. Volume/Pulse Value M326

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Relay Output → Volume/Pulse Value	Outputs → Relay output → Relay parameters → Pulse constant	Transmitter → Transmitter setup → P17 Flow	Devices → Remote Program → Parameters → P17 Flow pulse	834 → float
<M325>	P17	<T117>	—	—

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

	Value range	Unit	Default
Volume/Pulse Value	0...999999	"Volume/Pulse Unit"	0

6.3.3 HART Address M33

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → HART Address	Device Identification → HART Device Short Address	Transmitter → Transmitter setup → P19 Short Address	Devices → Remote Program → Parameters → P19 Polling addr.	838 → float
<M33>	P19	<T119>	—	—

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

6.3.4 Display Mode M34

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Display mode	—	—	—	1008 → □■□□
<M34>	—	—	—	—

Value	Description	Default
0	Single (PV)	Single (PV)
1	Double (PV. SV)	

6.3.5 Language M35

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Language	—	—	—	1008 → ■□□□
<M35>	—	—	—	—

Value	Description	Default
0	English	English
1	Hungarian	
2	Polish	
3	German	

6.4 Measurement Optimization

6.4.1 Range Blocking

a. Near Blocking Distance (Dead Zone) M411

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Range Blocking → Near Blocking Dist.	Measurement configuration → Minimum (P05)	Transmitter → Transmitter setup → P05 Near blocking	Devices → Remote Program → Parameters → P05 Near Blocking	810 → float
<M411>	P05	<T105>	—	—

"Near Blocking Distance" (or 'A') defines the minimum measuring distance and as such the maximum measurable level. This parameter creates dead-zone within the set distance from the transmitter. Any signal within this range will be ignored. Thus, it can be used to block disturbing Echo signals in the near zone.

	Value range	Unit	Default
Near Blocking Distance	Cannot be less than $X_{min.}$	*"Distance Unit"*	See "X_{min}" in the Sensing distance table

b. a. Far Blocking Level M412

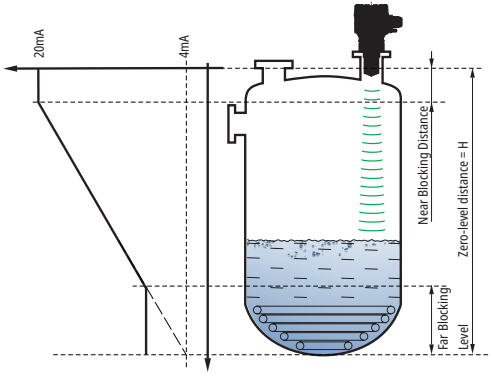
Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Range Blocking → Far Blocking Lev.	Measurement configuration → Far end (P06)	Transmitter → Transmitter setup → P06 Far blocking	Devices → Remote Program → Parameters → P06 Far Blocking	812 → float
<M412>	P06	<T106>	—	—

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 < "Far Blocking Level" 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 set to 0. Min. value: 0 / max. value: "Zero-Level Distance" – "Near Blocking Distance" – 5 cm (2")

	Value range	Unit	Default
Far-Blocking Level	0... "Zero-Level Distance" – "Near Blocking Distance" – 5 cm (2")	"Distance Unit"	0.0

A.) Level or volume measurement

- If the level drops below the value of “Far-Blocking Level” (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.



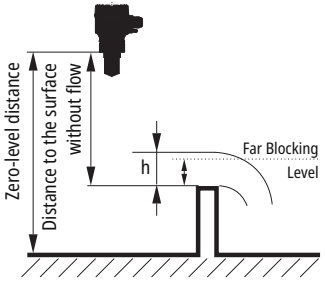
B.) Open-channel flow measurement

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.



c. Sensing Distance M413

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Range Blocking → Sensing Distance	Measurement configuration → Sensing Distance	Transmitter → Transmitter setup → P03 Sensing distance	Devices → Remote Program → Parameters → P03 Sensing distance	806 → float
<M413>	P03	<T103>	—	—

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 "Near Blocking Dist." (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 "Zero-Level Distance" (P04), within the limits of "Sensing Distance" (P03).

Type-specific measuring distance	Minimum X_{min} (1)	Maximum X_{max}	Default
W□□–212–□ / W□□–213–□ (2)	0.056 m (2.2")	10 m (33 ft)	X_{max} + 30 cm (1 ft)
W□□–214–□ / W□□–215–□ (2)	0.070 m (2.75")	10 m (33 ft)	
W□□–224–□ / W□□–225–□ (2)	0.070 m (2.75")	20 m (66 ft)	
W□□–212–□ / W□□–213–□ (3)	0.069 m (2.7")	10 m (33 ft)	
W□□–214–□ / W□□–215–□ (3)	0.080 m (3.15")	10 m (33 ft)	
W□□–224–□ / W□□–225–□ (3)	0.080 m (3.15")	20 m (66 ft)	
W□□–238–□ (2)	0.115 m (4.53")	30 m (98.5 ft)	

(1) *From the plane of the process connection.* (2) **W□P, W□V, W□F** *encapsulated antenna.* (3) **W□S, W□M, W□K** *stainless steel antenna.*

d. Tank Full Limit M414

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Range Blocking → Tank Full Limit	Advanced mode → Parameters → P29 Tank Full Limit	Transmitter → Transmitter setup → P29 Tank Full Limit	Devices → Remote Program → Parameters → P29 Tank Full Limit	858 → float
<M414>	P29	<T129>	—	—

As with Far Blocking Level, the echo is tracked below the specified distance, but the output is not tracked and a "Tank Full" flag is displayed.
Value range: 0... (“Zero-Level Distance” P04 – 5 cm [2"])
If “Tank Full” Limit is less than “Near Blocking Dist.”, the Tank Full Limit parameter is disabled.

	Value range	Unit	Default
Tank Full Limit	0... “Zero-Level Distance” P04 – 5 cm [2"]	“Distance Unit”	0

6.4.2 Echo Selection M42

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Echo Selection	Measurement optimization → Echo selection → Selection of Echo...	Transmitter → Transmitter setup → P25 Echo selection	Devices → Remote Program → Parameters → P25 Echo Selection → □□□□■	850 → □□□■
<M42>	P25→ □□□■	<T125>	—	—

The parameter *“Echo Selection”* (P25:a) 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.

#	Value	Default
0	Automatic	Automatic
1	First	
2	Second	
3	Largest	
4	Last	

6.4.3 Echo Loss Handling M43

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Echo Loss Handling	Measurement optimization → Measurement loss management → Echo loss handling	Transmitter → Transmitter setup → P28 Echo loss	Devices → Remote Program → Parameters → P28 Echo Loss → □□□□■	856 → float
<M43>	P28→ □□□■	<T128>	—	—

Echo loss handling

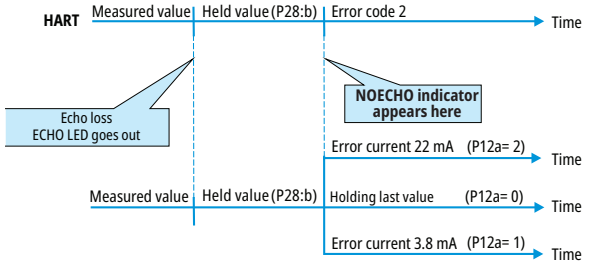
#	Echo loss ("no-Echo") handling	Default
0	Hold (time limit)	Hold (10 s)
1	Hold (unlimited)	
2	Trend (actual speed)	

#	Echo loss ("no-Echo") handling	Default
3	Trend (at maximum speed)	Hold (10 s)
4	Tank empty (DIST = maximum / LEV = 0)	
5	Tank full (DIST minimum / LEV = maximum)	

a. Hold (Time Limit) M431

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Echo Loss Handling → Hold (time limit	Measurement optimization → Measurement loss management → Error delay	Transmitter → Transmitter setup → P28 Echo loss	Devices → Remote Program → Parameters → P28 Echo Loss → □□□■□	856 → □□■□
<M431>	P28 → □□■□	<T128>	—	—

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.

#	Hold (time limit)	Default	Notes
0	No delay	10 s	
1	10 s		
2	20 s		
3	30 s		
4	1 min		
5	2 min		
6	5 min		
7	15 min		

During a short echo loss, the last value is held in transmission for a period set in *"Hold (time limit)"* (P28:b). After that, it is transmitted via HART on bit 0 of DSE(1) according to P12:a on the current loop output.

6.4.4 Threshold Offset M44

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Threshold offset	Measurement optimization → Threshold offset	Transmitter → Transmitter setup → P34 Threshold offset	Devices → Remote Program → Parameters → P34 Thresh. offs.	868 → float
<M44>	P34	<T134>	—	—

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 8.4 Threshold mask).

	Value range	Unit	Default
Threshold offset	–4000...+4000	"Distance Unit"	0

6.4.5 Filling Speed M44

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Filling Speed	Measurement optimization → Level elevation rate (filling speed)	Transmitter → Transmitter setup → P26 Filling speed	Devices → Remote Program → Parameters → P26 Filling speed	852 → float
<M45>	P26	<T126>	—	—

The level tracking speed is the fastest level change speed 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. Suppose the rapid change in level was actually real. In that case, 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. The parameter's unit of measure: metric: [m/h]; US: [ft/h].

	Value range	Unit	Default
Filling speed	0...9999 0: Filling speed limit disabled	m/h (ft/h)	600 (1970)

6.4.6 Emptying Speed M46

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Emptying Speed	Measurement optimization → Level descent rate (Emptying speed)	Transmitter → Transmitter setup → P27 Emptying speed	Devices → Remote Program → Parameters → P27 Emptying speed	854 → float
<M46>	P27	<T127>	—	—

	Value range	Unit	Default
Emptying speed	0...99990: Emptying speed limit disabled	m/h (ft/h)	600 (1970)

6.5 Tank Calculation M44

The Tank Calculation mode is available only when one of the outputs (PV, SV, TV, or QV) is configured to Volume, Ullage Volume, or Volume %. In the case of the OCT setting, the tank shape must be specified in a table. Ensure that Volume is not selected on one output while Flow is selected on another.

6.5.1 Calculation Mode M51

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Tank Calculation → Calculation Mode	Tank/Silo parameters → Calculation Mode	Transmitter → Transmitter setup → P40 Tank / Flow Calculation	Devices → Remote Program → Parameters → P40 Tank type → □■□□□	880 → ■□□□
<M51>	P40 → ■□□□	<T140>	—	—

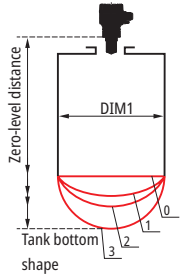
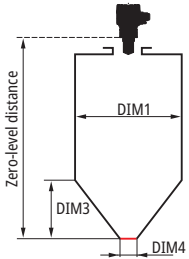
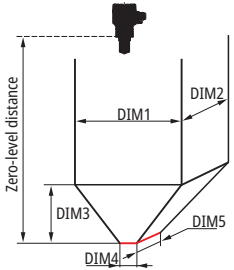
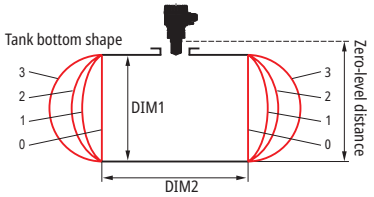
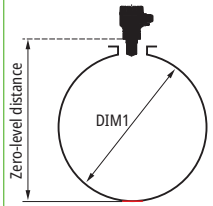
#	Value	Default
0	Formula	Formula
1	OCT Table	

6.5.2 Tank Shape M52

A selection of typical tank shapes for volume measurement. The tank dimensions can be set using parameters “Dimensions 1...5" (P41 ... P45) (see figures below). In the case of the OCT setting, the tank shape must be specified in a table. For proper operation, it is important to specify these dimensions accurately.

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Tank Calculation → Tank Shape	Tank/Silo parameters → Tank shape	Transmitter → Transmitter setup → P40 Tank / Flow Calculation → Tank Shape	Devices → Remote Program → Parameters → P40 Tank type → □□□□■	880 → □□□■
<M52>	P40 → □□□■	<T1401>	—	—

#	Value	Default
0	Vertical cylindrical tank (see tank bottom/side shape table for value)	Vertical cylindrical tank with Planar bottom
1	Vertical cylindrical tank with a conical bottom	
2	Vertical rectangular tank with or without chute	
3	Horizontal cylindrical tank (see tank bottom/side shape table for value)	
4	Spherical tank	

M521	M522	M523	M524	M525
Vertical cylindrical tank with a convex bottom	**Vertical cylindrical tank with a conical bottom**	**Vertical rectangular tank with or without chute**	**Horizontal cylindrical tank**	**Spherical tank**
				

a. Tank bottom/Side shape (in case of vertical and horizontal cylindrical tank) M521/M524

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Tank Calculation → Tank Shape → Vertical cylindrical tank	Tank/Silo parameters → Tank shape	Transmitter → Transmitter setup → P40 Tank / Flow Calculation → Tank Shape → Vertical cylindrical tank	Devices → Remote Program → Parameters → P40 Tank type → □□□□■	880 → □□■□
<M521>	P40 → □□■□	<T14011>	—	—

#	Tank bottom shape for Vertical cylindrical tank Tank side shape for Horizontal cylindrical tank	
0	Planar	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 "Dimensions 1...5" (P41...P45).
1	Slightly convex	
2	Strongly convex	
3	Hemispherical	

6.5.3 Specific Gravity M53

If the device is set to weight transmission, the specific gravity 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.

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Tank Calculation → Specific Gravity	Measurement optimization → Specific gravity	Transmitter → Transmitter setup → P32 Specific Gravity	Devices→ Remote Program → Parameters → P32 Spec. gravity.	864 → float
<M53>	P32	<T132>	—	—

	Value range	Default
Specific Gravity	0.01...10	1.0

6.5.4 Manage OCT Table M54

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Tank Calculation → Manage OCT Table	OC-Table (See Chapter 8.5)	Transmitter → OCT	Devices → Remote Program → Parameters → P40 Tank type.	880 → float
<M54>	P40	<T3>	—	—

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 "Unit system, default unit, region parameter" P00 or "Output Units" P02 of the output data type assigned to the "HART - PV" output in parameter "PVSV Mode" 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 assign the measured level to an arbitrary output signal. Its typical application is calculating level to volume for tanks not included in the tank shape list (e.g., dented) and specifying individual channel characteristics in the case of open channel flow measurement.

#	Value
1	View/Edit Table
2	Add Item
3	Delete Item

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		

6.5.5 Tank Total Volume M55

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Tank Calculation → Tank Total Volume	Tank/Silo parameters → Total tank volume	Transmitter → Transmitter Setup → P47 Total Volume	Devices → Remote Program → Parameters → P47 Total volume	894 → float
<M55>	P47	<T3>	—	—

The total tank volume is required for empty volume calculation (see “PVSV Mode” 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 “PVSV Mode” P01:b decade.

	Value range	Unit	Default
Tank Total Volume	0...999,999.999	“Volume Unit”	0.0

6.6 Flow Calculation M55

The Flow Calculation mode is available only when one of the outputs (PV, SV, TV, or QV) is configured to Flow, Flow TOT1, or Flow TOT2. In the case of the OCT setting, the Flume/Weir Type must be specified in a table. Ensure that Volume is not selected on one output while Flow is selected on another.

6.6.1 Calculation Mode M55

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Flow Calculation → Calculation Mode	Tank/Silo parameters → Calculation Mode	Transmitter → Transmitter setup → P40 Tank / Flow Calculation	Devices → Remote Program → Parameters → P40 Tank type → ■□□□□	880 → ■□□□
<M61>	P40 → ■□□□	<T140>	—	—

#	Value	Default
0	Formula	Formula
1	OCT Table	

6.6.2 Flume/Weir Type M62

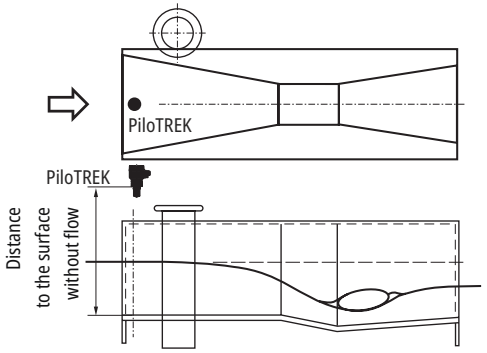
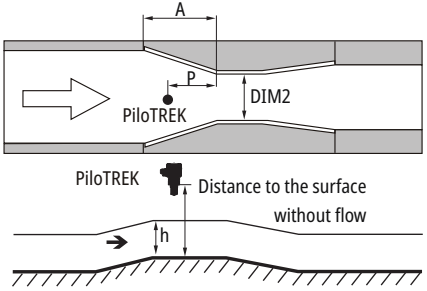
Local menu	EView2	MonoCONT	MultiCONT	Modbus
Flow Calculation → Flume/Weir Type	Flow measurement → Open channel flow measurement methods	Transmitter → Transmitter setup → P40 Tank / Flow Calculation → Flow Measurement	Devices → Remote Program → Parameters → P40 Tank type → □□□■□	880 → □□■□
<M62>	P40 →□□■□	<T1401>	—	—

#	Value	Default
0	Parshall series	Parshall series
1	Others 1	
2	Others 2	
3	Palmer-Bowlus series	

a. Parshall Series M621

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Flow Calculation → Flume/Weir Type → Parshall Series	Flow measurement → Open channel flow measurement methods	Transmitter → Transmitter setup → P40 Tank / Flow Calculation → Flow Measurement → Parshall Series	Devices → Remote Program → Parameters → P40 Tank type → □□□□■	880 → □□□■
<M621>	P40 → □□□■	<T14011>	—	—

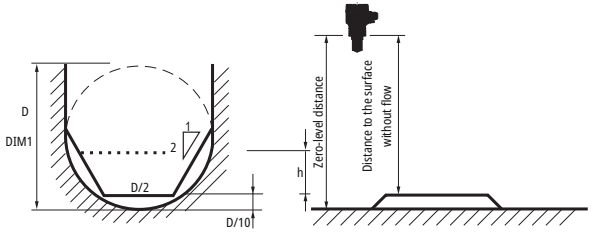
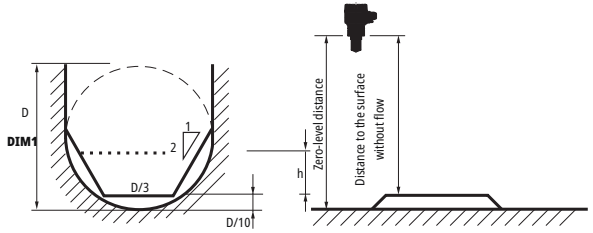
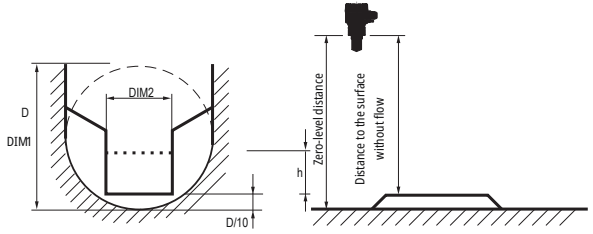
#	Value	Calculation formula	Q_{min}[l/s (GPM)]	Q_{max}[l/s (GPM)]	"P" [l/s (GPM)]	Default
0	GPA-1P1	Q [l/s (GPM)] = 60.87 * $h^{1.552}$	0.26 (4.14)	5.38 (98.18)	30 (475.51)	GPA-1P1
1	GPA-1P2	Q [l/s (GPM)] = 119.7 * $h^{1.553}$	0.52 (8.28)	13.3 (239.52)	34 (538.91)	
2	GPA-1P3	Q [l/s (GPM)] = 178.4 * $h^{1.555}$	0.78 (12.33)	49 (862.96)	39 (618.16)	
3	GPA-1P4	Q [l/s (GPM)] = 353.9 * $h^{1.558}$	1.52 (24.22)	164 (2659.33)	53 (840.06)	
4	GPA-1P5	Q [l/s (GPM)] = 521.4 * $h^{1.558}$	2.25 (35.66)	360 (5829.4)	75 (1188.77)	
5	GPA-1P6	Q [l/s (GPM)] = 674.6 * $h^{1.556}$	2.91 (46.23)	570 (9474.97)	120 (1902.04)	
6	GPA-1P7	Q [l/s (GPM)] = 1014.9 * $h^{1.56}$	4.4 (69.57)	890 (14230.07)	130 (2060.54)	
7	GPA-1P8	Q [l/s (GPM)] = 1368 * $h^{1.5638}$	5.8 (91.58)	1208 (19192.1)	135 (2139.8)	
8	GPA-1P9	Q [l/s (GPM)] = 2080.5 * $h^{1.5689}$	8.7 (137.81)	1850 (29177.8)	150 (2377.55)	
9	Generic Parshall flume					

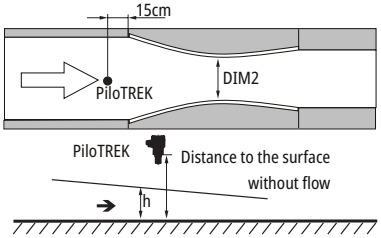
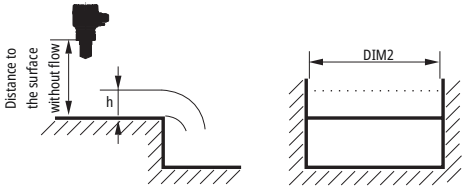
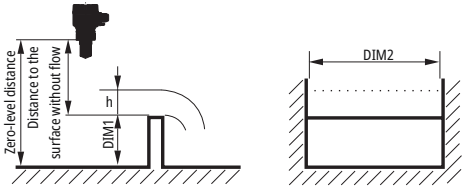
Flume / weir dimensions		
Flume/ Weir Type (P40) P40=00 08	**NIVELCO Parshall flume (GPA1-P1 through GPA-1P9)** **See details in the manual of the Parshall flume.**	
Flume/ Weir Type (P40) P40=09	Generic Parshall flume 0.305 < DIMP42 (throat width) < 2.44 m (8 ft) $Q[l/s] = 372 \cdot \mathbf{P42} \cdot (h/0,305)^{1,569 \cdot \mathbf{P42}^{0,026}}$ **2.5 < DIMP42** **Q [l/s] = K * DIMP42 * h^{1,6}** P = 2/3 * A	

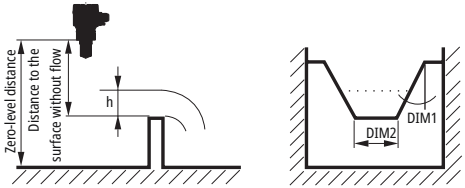
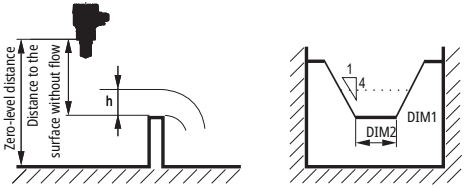
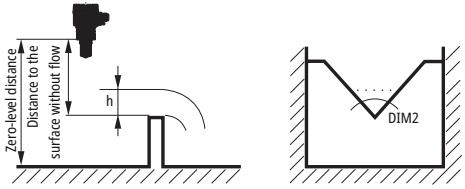
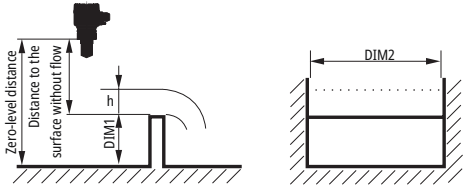
b. Others 1 M622

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Flow Calculation → Flume/Weir Type → Others 1	Flow measurement → Open channel flow measurement methods	Transmitter → Transmitter setup → P40 Tank / Flow Calculation → Flow Measurement → Others 1	Devices → Remote Program → Parameters → P40 Tank type → □□□□■	880 → □□□■
<M622>	P40 → □□□■	<T14012>	—	—

#	Value	Default
0	Palmer-Bowlus (D/2)	Palmer-Bowlus (D/2)
1	Palmer-Bowlus (D/3)	
2	Palmer-Bowlus (rectangular)	
3	Khafagi-Venturi	
4	Step Bottomed Weir	
5	Bazin weir	
6	Trapezoidal weir	
7	Special trapezoidal (4:1) weir	
8	V-notch weir	
9	Thomson (90°) weir	

Flume / Weir Dimensions		
Flume/Weir Type (P40) = 10	**Palmer-Bowlus (D/2) flume** Q [m^3/s] = f(h1/DIM1) * $DIM1^{2.5}$, where h1[m] = h+(DIM1/10) DIM1 [m]	
Flume/Weir Type (P40) = 11	**Palmer-Bowlus (D/3) flume** Q [m^3/s] = f(h1/DIM1) * $DIM1^{2.5}$, where h1[m]= h+(DIM1/10) DIM1 [m]	
Flume/Weir Type (P40) = 12	**Palmer-Bowlus (rectangular) flume** Q [m^3/s] = C * DIM2 * $h^{1.5}$, where C = f(DIM1/DIM2) DIM1 [m], DIM2 [m]	

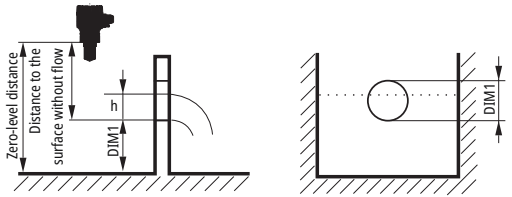
Flume / Weir Dimensions		
Flume/Weir Type (P40) = 13	**Khafagi-Venturi flume** Q [m^3/s] = 1.744 * DIM2 * $h^{1.5}$ + 0.091 * $h^{2.5}$ **DIM2 [m]** h [m]	
Flume/Weir Type (P40) = 14	**Step-bottomed weir** 0.0005 < Q [m^3/s] < 1 **0.3 < DIM2 [m] < 15** 0.1 < h [m] < 10 **Q [m^3/s] = 5.073 * DIM2 * $h^{1.5}$** **Accuracy: ±10%**	
Flume/Weir Type (P40) = 15	**Square section or BAZIN weir** 0.001 < Q [m^3/s] < 5 **0.15 < DIM1 [m] < 0.8** **0.15 < DIM2 [m] < 3** 0.015 < h [m] < 0.8 **Q [m^3/s] =1.77738(1+0.1378h/DIM1) * DIM2 * (h+0.0012)$^{1.5}$** **Accuracy: ±1%**	

Flume / Weir Dimensions		
Flume/Weir Type (P40) = 16	**Trapezoid weir** 0.0032 < Q [m^3/s] < 82 **20 < DIM1[°] < 100** **0.5 < DIM2 [m] < 15** 0.1 < h [m] < 2 **Q [m3/s] = 1.772 * DIM2 * h1.5 + 1.320 * tg(DIM1/2) * $h^{2.47}$** **Accuracy: ±5%**	
Flume/Weir Type (P40) = 17	**Special trapezoid (4:1) weir** 0.0018 < Q [m^3/s] < 50 **0.3 < DIM2 [m] < 10** 0.1 < h [m] < 2 **Q [m3/s] = 1.866 * DIM2 * $h^{1.5}$** **Accuracy: ±3%**	
Flume/Weir Type (P40) = 18	**V-notch weir** 0.0002 < Q [m^3/s] < 1 **20 < DIM2[°] < 100** 0.05 < h [m] < 1 **Q[m3/s] = 1.320 * tg(DIM2/2) * $h^{2.47}$** **Accuracy: ±3%**	
Flume/Weir Type (P40) = 19	**THOMSON (90° notch) weir** 0.0002 < Q [m^3/s] < 1 0.05 < h [m] < 1 Q [m^3/s] = 1.320 * $h^{2.47}$ **Accuracy: ±3%**	

c. Others 2 M623

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Flow Calculation → Flume/Weir Type → Others 1	Flow measurement → Open channel flow measurement methods	Transmitter → Transmitter setup → P40 Tank / Flow Calculation → Flow Measurement→ Others 2	Devices → Remote Program → Parameters → P40 Tank type → □□□□■	880 → □□□■
<M623>	P40 → □□□■	<T14013>	—	—

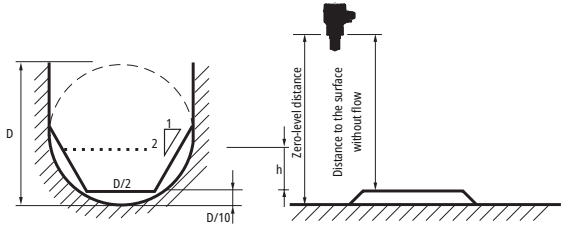
#	Value	Calculation formula	Default
0	Circular weir		Circular weir
1	Generic formula 1	Q[l/s] = **DIM1** * h^{DIM2}, h [m]	
2	Generic formula 2	Q[l/s] = **DIM1** * h^{DIM2}, h [P00:cb]	

Flume / Weir dimensions		
Flume/Weir Type (P40) = 20	Q [m^3/s] = f(h1/DIM1) * DIM12.5, where h1[m] = h+(DIM1/10) **DIM1 [m]** **Circular weir** 0.0003 < Q [m^3/s] < 25 0.02 < h [m] < 2 **Q[m^3/s] = m * b · $D^{2.5}$, where b = f (h/D)** **m = 0.555+0.041 · h/DIM1+(DIM1/(0.11 · h))** **Accuracy: ±5%**	
Flume/Weir Type (P40) =21	**Generic formula:** **Q [l/s] = DIM1 ∗ h^{DIM2}** **h [m]**	
Flume/Weir Type (P40) =22	**Generic formula:** **Q [l/s] = DIM1 ∗ h^{DIM2}** **'h' will be substituted in the unit set in P00c and P00b.**	

d. Palmer-Bowlus series M624

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Flow Calculation → Flume/Weir Type → Palmer-Bowlus series	Flow measurement → Open channel flow measurement methods	Transmitter → Transmitter setup → P40 Tank / Flow Calculation → Flow Measurement→ Palmer-Bowlus series	Devices → Remote Program → Parameters → P40 Tank type → □□□□■	880 → □□□■
<M624>	P40 → □□□■	<T14014>	—	—

#	Value	Default
0	4" Palmer-Bowlus	4" Palmer-Bowlus
1	6" Palmer-Bowlus	
2	8" Palmer-Bowlus	
3	10" Palmer-Bowlus	
4	12" Palmer-Bowlus	
5	15" Palmer-Bowlus	
6	18" Palmer-Bowlus	
7	21" Palmer-Bowlus	
8	24" Palmer-Bowlus	

Flume / Weir Dimensions		
Flume/Weir Type (P40) P40=30...38	**Palmer-Bowlus standard D/2 flume (4"...24") Refer to flume's user manual for details. The distance to the surface without flow [P00c, P00b]**	

6.6.3 Manage OCT Table M63

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Flow Calculation → Manage OCT Table	OC-Table (See Chapter 8.5)	Transmitter → OCT	Devices → Remote Program → Parameters → P40 Tank type	880 → float
<M54>	P40	<T3>	—	—

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 "Unit system, default unit, region parameter" P00 or "Output Units" P02 of the output data type assigned to the "HART - PV" output in parameter "PVSV Mode" 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 assign the measured level to an arbitrary output signal. Its typical application is calculating level to volume for tanks not included in the tank shape list (e.g., dented) and specifying individual channel characteristics in the case of open channel flow measurement.

#	Value
1	View/Edit Table
2	Add Item
3	Delete Item

6.6.4 P46 (h=0 Distance) M64

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Tank Calculation → P46 (H=0 distance)	Flow measurement → Distance between transducer face and level of Q=0	Transmitter → Transmitter setup → P40 Tank / Flow Calculation → Flow Measurement→ Flume Dimensions	Devices → Remote Program → Parameters → Distance at Q0	892 → float
<M64>	P46	<T140111>	—	—

Distance associated with h=0 when measuring flow. 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.

	Value range	Unit	Default
P46 (H=0 distance)	Near Blocking Distance" (P05) + 5 cm (2"). Maximum value: "Sensing Distance" (P03)	"Volume Unit"	0.0

6.7 Service

6.7.1 Clear TOT1 M71

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Clear TOT1	Advanced mode → Special → Clear TOT1	Transmitter → Clear TOT1	Devices → Remote Program → Clear TOT1	—
<M71>	—	<T8>	—	—

Clear TOT1 user resetable “Flow” totalizer. (Only in combination with “Flow” mode).

6.7.2 Bluetooth® settings M72

a. Bluetooth® operation mode M721

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Bluetooth settings → Operation Mode	Advanced mode → Parameters → P36 BLE settings	Transmitter → Transmitter setup → P36 BLE settings → Operation mode	Devices → Remote Program → Parameters → P36 BLE settings → □□□□■	872 → □□□■
<M721>	P36 → □□□■	<T1361>	—	—

#	Value	Default
0	Always On	Off after 15 mins
1	Off after 15 mins	
9	Always Off	

b. Bluetooth® Transmission Power M722

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Bluetooth settings → TX Power	Advanced mode → Parameters → P36 BLE settings	Transmitter → Transmitter setup → P36 BLE settings → TX Power	Devices → Remote Program → Parameters → P36 BLE settings → □□□■□	872 → □□■□
<M722>	P36 → □□■□	<T1362>	—	—

#	Value	Default
0	+0 dBm lowest signal strength	+8 dBm
1	+2 dBm signal strength	
2	+4 dBm signal strength	
3	+6 dBm signal strength	
4	+8 dBm signal strength	

6.7.3 Security M73

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Security	Advanced → Special → Security code	Security code → Transmitter	Devices → Remote Program → Secret unlock	2900 → float
<M73>	—	<S2>	—	—

Enter and unlock the user or service 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

#	Value range	Default
1	User Lock (0000...9999)	0000
2	Service Lock (0000...9999)	

6.7.4 Output Test M74

a. Analog Output Test M741

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Output Test → Analog Output	—	—	—	—
<M741>	—	—	—	—

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

b. Relay Output Test M742

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Output Test → Relay Output	—	—	—	—
<M742>	—	—	—	—

6.7.5 Distance Simulation M75

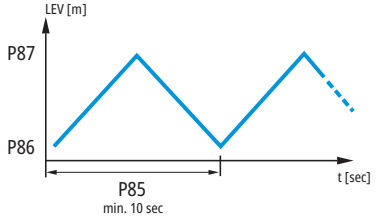
This function helps the user to check the outputs and the processing device connected to it. PiloTREK can simulate a constant or a variable value of the level. The simulation level values must be within the measurement range defined by P04 and P05. To start the simulation, return to the Measurement mode.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

a. Mode M751

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Dist. Simulation → Mode	Advanced → Special → Simulation mode	Transmitter → Simulation → Settings → Mode	Devices → Remote Program → Parameters → P84 Simulation mode → □□□■	968 → □□□■
<M751>	P84 → □□□■	<T612>	—	—

#	Simulation mode	Default
0	OFF	OFF
1	Triangular F. S.	
2	Fix value: PV = value given in *"Bottom Value"* (P86)	
3	Triangle Wave (1)	
4	Square Wave (1)	

(1) *Simulation between levels "Bottom Value" (P86), "Upper Value" P87 with "Cycle Time" (P85).*



b. Cycle Time M752

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Dist. Simulation → Cycle Time	Advanced → Special → Cycle Time (P85)	Transmitter → Simulation → Settings → Cycle time	Devices → Remote Program → Parameters → P85 Sim Cycle Time	970 → float
<M752>	P85	<T612>	—	—

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

	Value range	Unit	Default
Cycle Time	0...999	s	60 s

c. Bottom Value M753

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Dist. Simulation → Bottom Value	Advanced → Special → Sim Lower Value (P86)	Transmitter → Simulation → Settings → Bottom Value	Devices → Remote Program → Parameters → P86 Sim Lower Value	972 → float
<M753>	P86	<T613>	—	—

	Value range	Unit	Default
Bottom Value	0...99.999	"Distance unit"	20% of Zero Level Distance

d. Upper Value M754

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Dist. Simulation → Upper Value	Advanced → Special → Sim Upper Value (P87)	Transmitter → Simulation → Settings → Upper Value	Devices → Remote Program → Parameters → P87 Sim Upper Value	974 → float
<M654>	P87	<T614>	—	—

	Value range	Unit	Default
Upper Value	0...99.999	"Distance unit"	80% of Zero Level Distance

e. Timeout M755

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Dist. Simulation → Timeout	Advanced → Special → Sim Upper Value (P88)	Transmitter → Simulation → Settings → Upper Value	Devices → Remote Program → Parameters → P88 Timeout	976 → float
<M655>	P88	<T615>	—	—

The simulation mode is automatically switched off after the value set here has elapsed.

	Value range	Unit	Default
Timeout	0...9999	min	10 min

6.7.6 Defaults

a. Load Default — M761

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Defaults → Load Default	Advanced → Parameters → Load default	Transmitter → Reset → Load Defaults	Devices → Remote Program → Default	—
<M761>	—	<T93>	—	—

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!

b. Set Threshold to Default — M762

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Defaults → Set Threshold To Default	Threshold settings	Transmitter → Reset → Default Threshold	Remote Program → Default	—
<M762>	—	<T92>	—	—

c. Clear Timers — M763

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Defaults → Clear Timers	—	—	—	—
< M763>	—	—	—	—

d. Clear TOT2 M764

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Defaults → Clear TOT2	—	—	—	—
< M764>	—	—	—	—

Clear TOT2 user resetable “Flow” totalizer. (Only in combination with “Flow” mode).

e. Sensor Init M765

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Defaults → Sensor init	—	—	—	—
< M765>	—	—	—	—

f. Restart — M766

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Restart	Advanced → Special → Device Restart	Transmitter → Reset → Software Reset	—	—
<M766>	—	<T91>	—	—

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

6.8 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**

6.9 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 (H=0 distance))

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

6.10 Output Control Parameters (read only)

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

6.11 Hardware / Software Versions (read only)

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

7. TROUBLESHOOTING

7.1 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 (*Warning*)	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 (*Error*)	The parameter memory of the device is compromised. Contact dealership.
2	EEPROM checksum error detected (*Error*)	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 (*Error*)	The data in the left (L) column of the Output Conversion Table (OCT) is not incremental. Correct it.
4	OCT output side integrity error (*Error*)	The data in the right (R) column of the Output Conversion Table (OCT) is not incremental. Correct it.
5	OCT item count is <2 (*Error*)	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) (*Warning*)	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) (*Error*)	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 (Warning)	The measured surface is too close, within the device's minimum measuring range (X_{min}). Set the Near-blocking distance (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 (Warning)	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.

Bit №	Device Specific Error/Warning flags	Meaning, possible reason, solution
11	—	—
12	One or more slave controller(s) failure! (Error)	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 (Error)	If the device has an optional relay, it is faulty. Contact the dealership.
14	Parameter table integrity error (Error)	The value of one or more parameters is not consistent with the associated parameters. Correct the parameter value.
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.

7.2 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: – 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. Check the P03 maximum measuring distance setting.

8. EView2 INSTRUCTIONS

If necessary, install the EView2 HART configuration software (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.

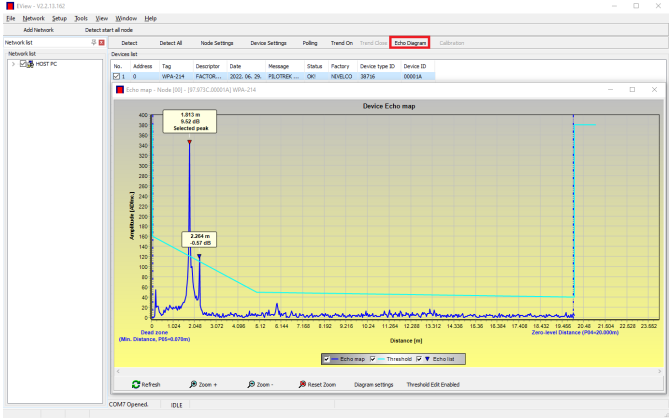
8.1 Device Status Window

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.

8.2 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.”



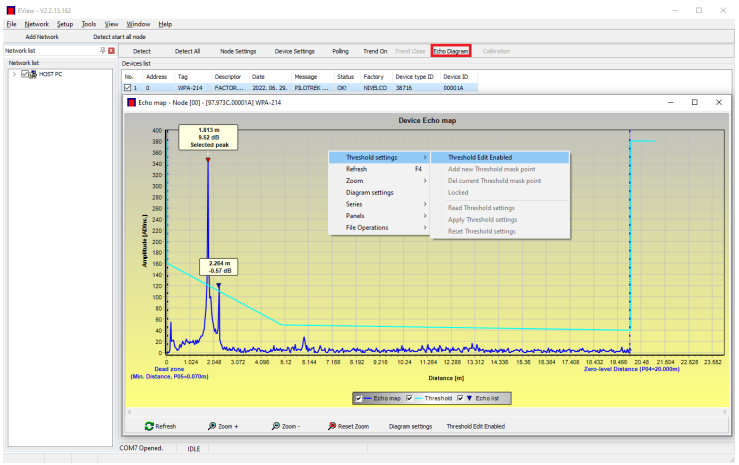
8.3 Threshold Settings

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.

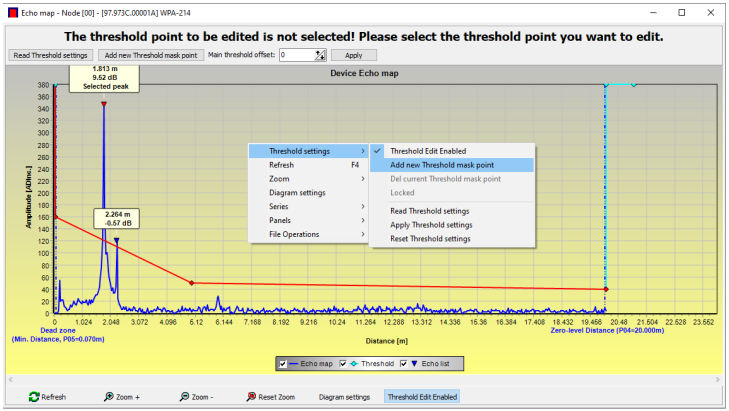
The threshold editing mode can be activated either by selecting “Threshold Edit Enable” in the bottom menu bar or by selecting “Threshold settings” → “Threshold Edit Enable” in the context menu that appears when clicking the right mouse button. In this case, the threshold editing function bar appears 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.

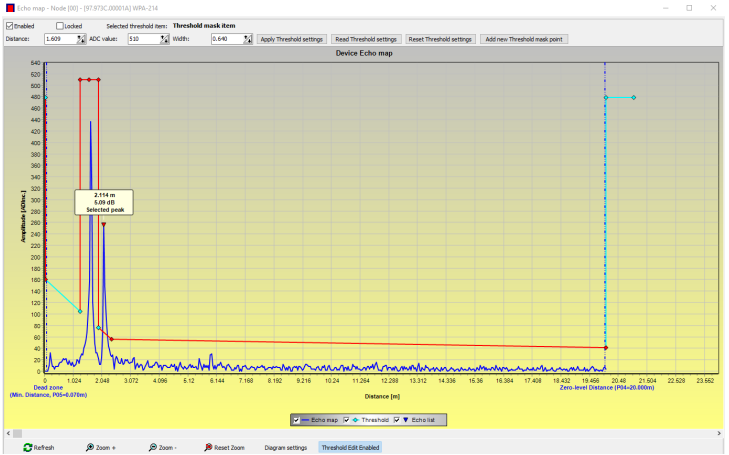


Threshold points can also be moved with the mouse by clicking and holding the left mouse button over the selected point. The changes only take effect in the device after pressing the “Apply Threshold settings” button, which can also be found in the threshold editing function bar or the context menu. 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).

8.4 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.

8.5. The Output Conversion Table (OCT) – (EView2 OC-Table)

The output conversion table (OCT) is active if table correction is selected in parameter “Tank/Flow Calculation” (P40). See Chapters 6.6 and 6.7. 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 “PVSV Mode” (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 "PV Value of 4 mA" / "PV Value of 20 mA" (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.

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 m^3 (0.0 ft^3)
2	0.20 m (0.66 ft)	0.5 m^3 (17.6 ft^3)
3	0.75 m (2.46 ft)	1.0 m^3 (35.3 ft^3)
4	1.00 m (3.30 ft)	1.5 m^3 (53 ft^3)
5	5.60 m (18.37 ft)	16.8 m^3 (593.3 ft^3)

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 m^3 (17.6 ft^3)
4	Select “Assignment of 20 mA – PV (P11)” and enter the volume value corresponding to the output current value of 20 mA.	16.80 m^3 (593.3 ft^3)
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.	

8.6 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.	

8.7 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.	

9. PARAMETER LIST

Pr.	Page	Name	Value d	c	b	a
P00	33	Unit system, default unit, region parameter				
P01	39	PVSV Mode				
P02	34	Output units				
P03	51	Sensing Distance				
P04	39	Zero-level distance (tank height – H)				
P05	49	Near Blocking Distance (dead-zone)				
P06	49	Far Blocking Level				
P07		—				
P08	43	Fix Current Value				
P09		—				
P10	41	PV Value of 4 mA				
P11	42	PV Value of 20 mA				
P12	42	Error Current Mode				
P13	44	Relay output				
P14	45	Relay parameter – Switch Point 1				
P15	46	Relay parameter – Switch Point 1				
P16	46	Relay parameter – Delay				
P17	47	Relay parameter – Volume/Pulse Value				
P18		—				
P19	47	HART address				
P20	38	Damping Time				
P21		—				
P22		—				
P23		—				
P24		—				
P25	52	Echo selection				
P26	53	Filling speed				
P27	53	Emptying Speed				
P28	53	Echo Loss Handling				
P29	57	Tank Full Limit				
P30	40	TVQV Mode				
P31		—				
P32	57	Specific Gravity				
P34	54	Threshold offset				
P36	69	Bluetooth Settings				
P40	55	Tank/Flow Calculation				
P41	56	Tank dimensions / Volume flow options				
P42	56	Tank dimensions / Flume – weir dimensions				
P43	56	Tank dimensions / Flume – weir dimensions				
P44	56	Tank dimensions / Flume – weir dimensions				
P45	56	Tank dimensions / Flume – weir dimensions				
P46	68	The distance to the surface without flow				
P47	59	Total tank volume				

Pr.	Page	Name
P60	75	Number of operating hours since issuing [h]
P61	75	The number of operating hours since the last power-on [h]
P62	75	The number of operating hours of the signal detector (closed time of contact C2) [h]
P63	75	The number of switching cycles of the relay
P64	75	The current temperature of the electronics [°C / °F]
P65	75	The highest temperature of the device ever measured [°C / °F]
P66	75	The lowest temperature of the device ever measured [°C / °F]
P67		—
P68		—
P69		—
P70	75	Number of detected peaks (current)
P71	75	Magnitude of selected echo [raw value]
P72	75	Amplitude of selected echo [dB]
P73	75	Distance of selected echo [m]
P74	75	Echo lost / shot rate
P75		
P76	75	Measuring height of the flow measurement (read only) (LEV)
P77	75	TOT1 totalizer (clearable)
P78	75	TOT2 totalizer
P79	75	Current generator re-measured output current [µA]
P80	75	Current generator calculated output current [mA]
P81	75	Status of relay outputs
P82		—
P83		—
P84	71	Distance Simulation
P85	71	Cycle time
P86	71	Bottom Value
P87	71	Upper Value
P88	72	Timeout
P89		—
P90		—
P91		—
P92		—
P93		—
P94	75	Software identifier (RADAR)
P95	75	Software identifier (COPROC)
P96	75	Software identifier (MAIN MCU)
P97	75	Special config mode (read only)
P98	75	Hardware code (read only)
P99		

wes200en25p04

August 2025

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

We reserve the right to change specifications at any time