NIVELCO

MicroTREK

H–700

2-wire guided microwave level transmitters

User's and programming manual
4th edition

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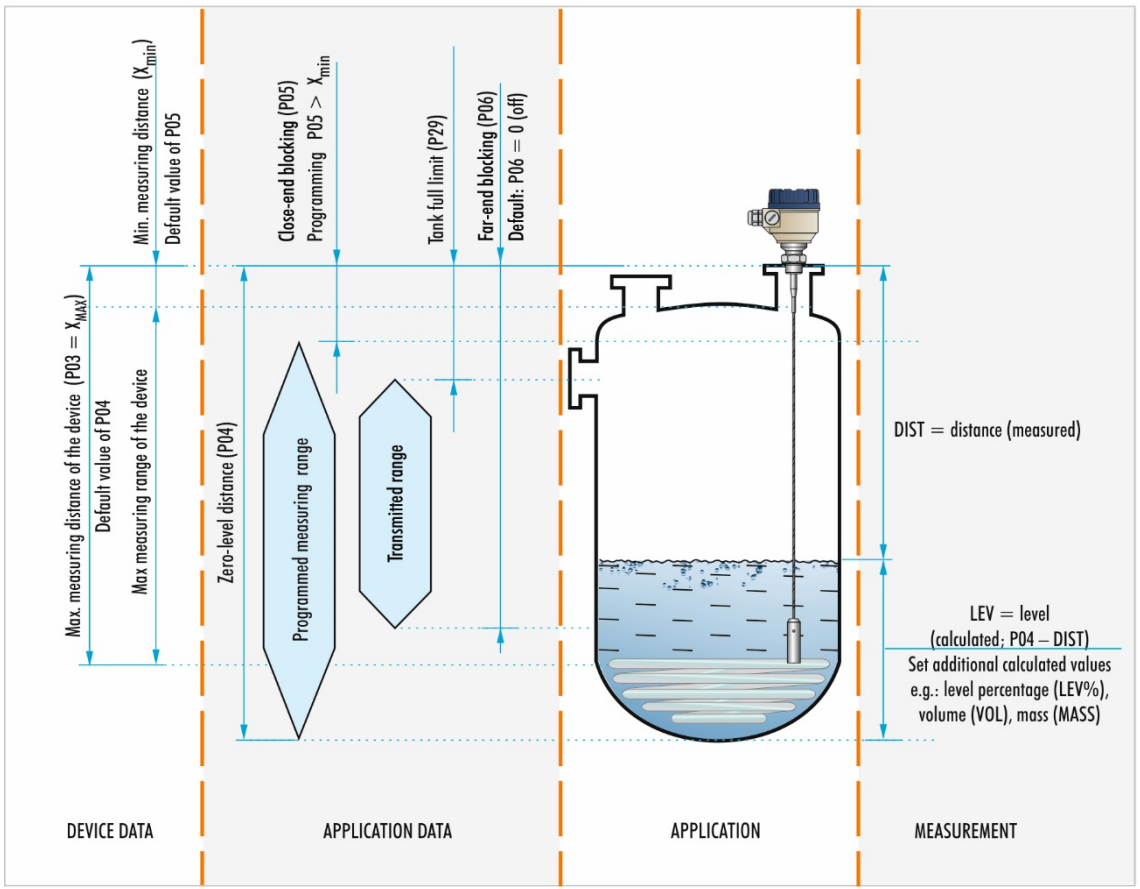
BASIC CONCEPTS AND ELEMENTS



Certificates		Reference document number
	ATEX, Certificate No.: BKI22ATEX0003 X/1	htk701hu21p03-b
	IECEx, Certificate No.: IECEx BKI 22.0003X Issue 1	htk701en21p03-b

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Thank you for purchasing a NIVELCO product.

1. INTRODUCTION

Application

The MicroTREK 2-wire guided microwave level transmitter measures the distance to the surface of liquids, solids, and granules, from which the device calculates and transmits the level, volume, or mass values as required.
The device can be used in storage and reaction tanks, bypass chambers, rigid pipelines of suitable diameter and level reference vessels. The device can also be used with HART® compliant EView2, PACT*ware* and MultiCONT universal process controller.

Operating Principle

The MicroTREK 2-wire guided-microwave level transmitter measurement method is based on TDR (Time Domain Reflectometry) analysis of the electromagnetic pulse traveling along the probe. The device sends a 0.8 nanosecond-wide, low-power pulses along an electrically conductive rod, cable, or coaxial waveguide at a known rate of light propagation speed. If the electromagnetic pulse propagating along the conductor reaches a medium boundary with a different (ε_r) dielectric constant (the surface of the measured medium or the phase boundary of two liquids), some of the energy is reflected from there. The larger and sharper the (ε_r) dielectric constant change at the boundary of the media, the better the efficiency of the reflection (e.g., 80% of the energy is reflected from a flat air-water boundary) is.

The pulse is detected and processed by the device as a voltage signal. Since the propagation speed is known, the distance of the reflecting surface can be determined by measuring the travel time of the pulse. The travel time is the time between the start of the pulse and the arrival of the reflected pulse, and the distance traveled is twice the distance to and from the target. The device calculates the distance from the measured time into an electric signal proportional to the distance, an output current of 4…20 mA, and provides a HART® output signal and displays it on the display. Other derived quantities (volume, weight, etc.) can also be obtained from the distance data using the device software. The advantage of the described measurement technology compared to other level measurement methods is that the dust, foam, steam, boiling, and surface turbulence have no disturbing effect.

2. ORDER CODES (NOT ALL COMBINATIONS ARE AVAILABLE)

2.1. MicroTREK H–700 – with cable probe

MicroTREK H ☐ ☐–☐ ☐ ☐–☐ *

Type	Code
Transmitter [1]	T
High-temperature transmitter [2]	H
Transmitter + display [1]	B
High-temperature transmitter + display [2]	P
With interface function	
Transmitter [1]	C
High-temperature transmitter [2]	E
Transmitter + display [1]	D
High-temperature transmitter + display [2]	F

Probe / Process connection		Code
Mono cable, ∅4 mm, 1.4401	1" BSP	K
	1" NPT	L
	1½" BSP	V
	1½" NPT	W
	1½" TriClamp	1
	2" TriClamp	2
Mono cable, ∅8 mm, 1.4401	1½" BSP	N
	1½" NPT	J
Twin cable, 2× ∅4 mm, 1.4401	1½" BSP	T
	1½" NPT	U
Mono cable, Ø4 mm, FEP-coated[3]	1" BSP	F
	1" NPT	G
	TriClamp 1½"	X
	Sanitary DN40	Y
Mono cable, Ø4 mm, + PFA/FEP fully coated / DN50, PN25, 1.4571 + PFA/FEP lining		M

Housing	Code
Aluminum (powder-coated)	7
Plastic, fiberglass-reinforced[4]	8
Stainless steel	9

Probe length [5]	Code
0 m	0
10 m	1
20 m	2
30 m	3

Probe length [5]	Code
0 m	0
1 m	1
2 m	2
3 m	3
4 m	4
5 m	5
6 m	6
7 m	7
8 m	8
9 m	9

Output		Code
4...20 mA	+ HART®	4
	+ HART® / Ex ta/tb IIIC (ATEX, IECEx)	5
	+ HART® / Ex ia IIIC (ATEX, IECEx)	6
	+ HART® / Ex ia IIC/IIB (ATEX, IECEx)	8
	+ HART® / Ex ta IIIC (ATEX, IECEx)	9
	+ HART® + Relay	H

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

[1] Flange temperature max. +90 °C (+194 °F).
[2] Flange temperature max. +200 °C (+392 °F) ("M" type only up to +150 °C [+302 °F]).
[3] Only the cable probe is coated.
[4] Ex version not available.
[5] Up to 30 m (100 ft) probe length.

2.2. MicroTREK H–700 – with ∅8 (∅0.3") mm rod probe

MicroTREK H ☐ ☐ – ☐ ☐ ☐ – ☐ *

Type	Code
Transmitter [1]	T
High-temperature transmitter [2]	H
Transmitter + display [1]	B
High-temperature transmitter + display [2]	P
With interface function	
Transmitter [1]	C
High-temperature transmitter [2]	E
Transmitter + display [1]	D
High-temperature transmitter + display [2]	F

Probe / Process connection		Code
Mono rod, ∅8 mm, 1.4571	1" BSP	R
	1" NPT	P
	1½" TriClamp	3
Twin rod, 1.4571	1½" BSP	D
	1½" NPT	E
Mono rod PFA-coated	1½" TriClamp PFA-coated	O
	DN50, PN25, 1.4571 flange, PFA-coated	Q
Mono rod + PP-coated / DN50, PN25, 1.4571 + PP lining [3]		I

Housing	Code
Aluminum (powder-coated)	7
Plastic, fiberglass-reinforced[4]	8
Stainless steel	9

Probe length [5]	Code
0 m	0
1 m	1
2 m	2
3 m	3

Probe length [5]	Code
0 m	0
0.1 m	1
0.2 m	2
0.3 m	3
0.4 m	4
0.5 m	5
0.6 m	6
0.7 m	7
0.8 m	8
0.9 m	9

Output		Code
4...20 mA	+ HART®	4
	+ HART® / Ex ta/tb IIIC (ATEX, IECEx)	5
	+ HART® / Ex ia IIIC (ATEX, IECEx)	6
	+ HART® / Ex ia IIC/IIB (ATEX, IECEx)	8
	+ HART® / Ex ta IIIC (ATEX, IECEx)	9
	+ HART®+ Relay	9

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

[1] Flange temperature max. +90 °C (+194 °F).
[2] Flange temperature max. +200 °C (+392 °F) (up to +150 °C [+302 °F] with plastic-coated probes).
[3] High-temperature version not available.
[4] Ex version not available.
[5] Up to 3 m (10 ft) probe length.

2.3. MicroTREK H–700 – with ∅14 mm (∅0.55") rod or coaxial probe

MicroTREK H ☐ ☐ – ☐ ☐ ☐ – ☐ *

Type	Code
Transmitter [1]	T
High-temperature transmitter [2]	H
Transmitter + display [1]	B
High-temperature transmitter + display [2]	P
With interface function	
Transmitter [1]	C
High-temperature transmitter [2]	E
Transmitter + display [1]	D
High-temperature transmitter + display [2]	F

Probe / Process connection		Code
Mono rod [3], ∅14 mm, 1.4571	1½" BSP	S
	1½" NPT	Z
	2" TriClamp	4
Coaxial [3], 1.4571	1" BSP	A
	1" NPT	B
	1½" BSP	C
	1½" NPT	H
	1½" TriClamp	5
	2" TriClamp	6

Housing	Code
Aluminum (powder-coated)	7
Plastic, fiberglass-reinforced[4]	8
Stainless steel	9

Probe length [5]	Code
0 m	0
1 m	1
2 m	2
3 m	3
4 m	4
5 m	5
6 m	6

Probe length [5]	Code
0 m	0
0.1 m	1
0.2 m	2
0.3 m	3
0.4 m	4
0.5 m	5
0.6 m	6
0.7 m	7
0.8 m	8
0.9 m	9

Output		Code
4...20 mA	+ HART®	4
	+ HART® / Ex ta/tb IIIC (ATEX, IECEx)	5
	+ HART® / Ex ia IIIC (ATEX, IECEx)	6
	+ HART® / Ex ia IIC/IIB (ATEX, IECEx)	8
	+ HART® / Ex ta IIIC (ATEX, IECEx)	9
	+ HART®+ Relay	H

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

[1] Flange temperature max. +90 °C (+194 °F).
[2] Flange temperature max. +200 °C (+392 °F).
[3] Can be ordered with segmented probe which must be specified in the text of the order. The length of the probe section is 1 m.
[4] Ex version not available.
[5] Up to 6 m (20 ft) probe length.

Accessories available	Order code
Graphic plug-in display module	**SAP–300–0**
HART®-USB modem	**SAT–304–0**
HART®-USB/Bluetooth® modem	**SAT–504–☐**
HART®-USB/RS485 modem	**SAK–305–2**
HART®-USB/RS485 modem / Ex ia G	**SAK–305–6**
Process connections [6]	
DIN and ANSI flanges	**MFT–☐☐☐–☐**
DN40 Pipe coupling (DIN 11851)	
Special seals [6]	
EPDM	
FFKM	

[6] The above process connections and special seals are ordered separately and must be specified in the text part of the order.

3. TECHNICAL DATA

3.1. GENERAL

		With plastic housing H□□–8□□–4	With aluminum housing H□□–7□□–4, 5, 6, 8	With stainless steel housing H□□–9□□–4, 5, 6, 8
Input data	Measured values	Distance between the reference point and the plane of the reflection (surface of the material); derived values: level, volume or weight		
	Measuring range	Depends on the probe and the measured medium (for technical data refer to – Probe Properties table)		
Probe types and technical data		Coaxial, dual cable, cable, dual rod, and rod probes (for technical data refer to – Probe Properties table)		
Housing		Plastic	Painted aluminum	Stainless steel 1.4571 (316Ti equivalent)
Process temperature		–30…+200 °C (–22…+392 °F) (for technical data refer to – Process Temperature table)		
Process pressure		–1…40 bar (–14…580 psig) (for technical data refer to – Process Pressure diagram)		
Ambient temperature		–30…+65 °C (–22…+149 °F), with display: –20…+65 °C (–4…+149 °F)		
Seal		FPM (Viton®), optional FFKM Perfluoroelastomer (Kalrez® 6375), EPDM		
Ingress protection		IP67 (NEMA 6 equivalent)		
Supply voltage		12[1]…36 V DC, nominal 24 V DC, Ex version: 12[1]…30 V DC, transient overvoltage protection[2]		
Output data	Output signal	Analog: 4…20 mA; (3.9…20.5 mA) passive output; error signal 3.8 or 22 mA		
		BUS: serial, HART® interface, termination resistor maximum 750 Ω		
		Display (optional): SAP–300 graphic display unit		
		Relay (optional): SPDT 30 V / 1 A DC; 48 V / 0.5 A AC		
	Accuracy [3]	Liquids: ±5 mm (±0.2"). If probe length is ≥ 10 m (L ≥ 33 ft); ±0.05% of probe length		
		Solids: ±20 mm (±0.8"). If probe length is ≥ 10 m (L ≥ 33 ft); ±0.2% of probe length		
Electrical connection		2× M20×1.5 cable glands, cable outer diameter: Ø6…Ø12 mm (Ø0.23…Ø0.47") (metal for Ex version, otherwise plastic) + 2× internally threaded ½" NPT connection for protective pipes, wire cross-section: 0.5…1.5 mm² (AWG20…AWG15) (shielded cable recommended)		
Electrical protection		Class III		
Weight (housing)		1.3 kg (2.9 lb)	2.2 kg (4.9 lb)	3.9 kg (8.6 lb)

[1] Reliable operation in industrial environments can be guaranteed for terminal voltages > 13 V.
[2] The device has been tested and complies with MSZ EN IEC 61326-1:2021 Table 2. I/O signal/control with (e) remark, Surge test.
[3] With ideal reflective surfaces and constant temperatures.

3.2. PROBE PROPERTIES

Type	H□K–□□□–□ H□L–□□□–□ H□V–□□□–□ H□W–□□□–□	H□R–□□□–□ H□P–□□□–□	H□S–□□□–□ H□Z–□□□–□	H□N–□□□–□ H□J–□□□–□	H□T–□□□–□ H□U–□□□–□	H□D–□□□–□ H□E–□□□–□	H□A–□□□–□ H□B–□□□–□ H□C–□□□–□ H□H–□□□–□
Version	4 mm cable (0.15")	Rod		8 mm cable (0.3")	4 mm dual cable (0.15")	Dual rod	Coaxial
Maximum measuring range	30 m (100 ft)	3 m (10 ft)	6 m (20 ft)	30 m (100 ft)		3 m (10 ft)	6 m (20 ft)
Minimum measuring range ε_r = 80 / 2.4	0.25 m / 0.35 m (0.82 ft / 1.15 ft)				0.15 m / 0.3 m (0.5 ft / 1 ft)		0 m (0 ft)
Sensing area around probe	∅600 mm (Ø2 ft)				∅200 mm (Ø 0.65 ft)		∅0 mm (0 ft)
Minimum ε_r of medium	2.1				1.8		1.4
Process connection	1" BSP	1" BSP	1½" BSP				1" BSP
	1" NPT						1" NPT
	1½" BSP	1" NPT	1½" NPT				1½" BSP
	1½" NPT						1½" NPT
Material of probe	1.4401 (316 equivalent)	1.4571 (316Ti equivalent)		1.4401 (316 equivalent)		1.4571 (316Ti equivalent)	
Nominal diameter of probe	4 mm (0.15")	8 mm (0.3")	14 mm (0.55")	8 mm (0.3")	4 mm (0.15")	8 mm (0.3")	28 mm (1.1")
Weight	0.12 kg/m (0.08 lb/ft)	0.4 kg/m (0.25 lb/ft)	1.2 kg/m (0.8 lb/ft)	0.4 kg/m (0.25 lb/ft)	0.24 kg/m (0.16 lb/ft)	0.8 kg/m (0.5 lb/ft)	1.3 kg/m (0.85 lb/ft)
Separator material	–				PFA, welded onto cable	PTFE-GF25 if length is >1.5 m (5 ft)	PTFE, if length is >1.5 m (5 ft)
Tensioning weight dimensions	Ø25 × 100 mm (Ø1 × 4")	–		Ø40 × 260 mm (Ø1.5 × 10")	Ø40 × 80 mm (Ø1.5 × 3")	–	
Material of tensioning weight	1.4571 (316Ti equivalent)	–		1.4571 (316Ti equivalent)		–	

3.3. COATED PROBE PROPERTIES

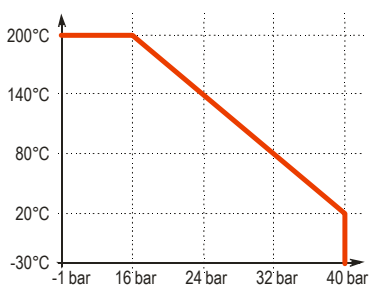
Type	H□F-□□□-□ H□G-□□□-□	H□X-□□□-□	H□Y-□□□-□	H□M-□□□-□	H□Q-□□□-□	H□O-□□□-□	H□I-□□□-□
Version	∅4 mm (0.15") FEP-coated cable			∅4 mm (0.15") fully FEP / PFA-coated cable	Fully PFA-coated rod		Fully PP-coated rod
Maximum measuring range	30 m (100 ft)				3 m (10 ft)		
Minimal measuring range ε_r = 80 / 2.4	0.25 m / 0.35 m (0.82 ft / 1.15 ft)						
Free space requirement	∅600 mm (Ø2 ft)						
Minimal ε_r of medium	2.1						
Process connection	1" BSP / 1" NPT	1½" TriClamp	DN40 Milch	DN50		1½" TriClamp	DN50
Material of probe	1.4401 (316 equivalent) / FEP			1.4401 (316 equivalent) / FEP / PFA	1.4571 (316Ti equivalent) / PFA		1.4571 (316Ti equivalent) / PP
Nominal diameter of probe	6 mm (0.23")				12 mm (0.5")		16 mm (0.62")
Mass	0.16 kg/m (0.1 lb/ft)				0.5 kg/m (0.33 lb/ft)		0.6 kg/m (0.4 lb/ft)
Probe coating	–			PFA			PP
Tensioning weight dimensions	Ø25 × 100 mm (Ø1 x 4")				–		
Material of tensioning weight	1.4571 (316Ti equivalent)				–		
Maximum process temperature	+200 °C (392 °F)			+150 °C (+302 °F)			+60 °C (+140 °F)

PROCESS TEMPERATURE

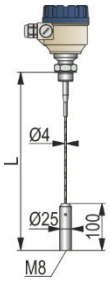
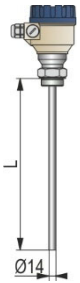
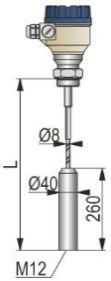
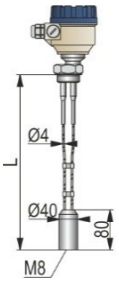
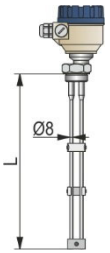
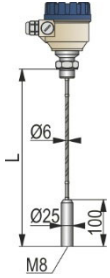
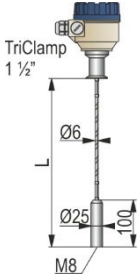
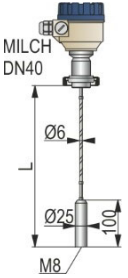
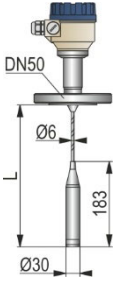
Type	Flange temperature
Standard transmitter	–30…+90 °C (–22…+194 °F)
High-temperature HH□ or HP□ transmitter	–30…+200 °C (–22…+392 °F)(1)

(1)Limited for coated probes, see "Coated probe properties" table.

PROCESS PRESSURE DIAGRAM



3.4. DIMENSIONS

HTK-□□□-□ HTL-□□□-□ HTV-□□□-□ HTW-□□□-□	HTR-□□□-□ HTP-□□□-□	HTS-□□□-□ HTZ-□□□-□	HTN-□□□-□ HTJ-□□□-□	HTT-□□□-□ HTU-□□□-□	HTD-□□□-□ HTE-□□□-□	HTA-□□□-□ HTB-□□□-□ HTC-□□□-□ HTH-□□□-□
						
HTF-□□□-□ HTG-□□□-□	**HTX-□□□-□**	**HTY-□□□-□**	**HTM-□□□-□**	**HTQ-□□□-□**	**HTI-□□□-□**	
						

3.5. EXPLOSION PROTECTION, DESIGNATION, LIMIT VALUES

3.5.1. ATEX Intrinsically safe protection (Ex ia) – ATEX Certificate No.: BKI22ATEX0003 X/1

		Metal housing with SAP-300 display	Metal housing without SAP-300 display	Metal housing
Standard version		**HB□-□□□-8 Ex**	**HT□-□□□-8 Ex**	**HB/T□-□□□-6 Ex**
Ex marking (ATEX)		⟨Ex⟩ **II 1G Ex ia IIB T6…T4 Ga**	⟨Ex⟩ **II 1G Ex ia IIC T6…T4 Ga**	⟨Ex⟩ **II 1D Ex ia IIIC T85°C…T110°C Da**
High-temperature version		**HP□-□□□-8 Ex**	**HH□-□□□-8 Ex**	**HH□-□□□-6 Ex**
Ex marking (ATEX)		⟨Ex⟩ **II 1G Ex ia IIB T6…T3 Ga**	⟨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		Ui = 30 V, Ii = 140 mA, Pi = 1 W Ci ≤ 25 nF, Li ≤ 300 µH	Ui = 30 V, Ii = 100 mA, Pi = 0,75 W Ci ≤ 25 nF, Li ≤ 300 µH	Ui = 30 V, Ii = 140 mA, Pi = 1 W Ci ≤ 25 nF, Li ≤ 300 µH
Supply voltage		12…30 V DC		
Electrical connection	Cable entry	M20×1.5 cable gland		
	Cable outer diameter	Ø6…Ø12 mm (Ø0.23…Ø0.47")		
	Wire cross-section	0.5…1.5 mm² (AWG20…AWG15)		
Temperature limit data		See tables in (the following) section 3.5.2.		

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

3.5.2.1 For standard temperature transmitters

Temperature data	Hazardous gas atmospheres HT/B□-7□□-8 Ex HT/B□-9□□-8 Ex			Explosive dust atmospheres HT/B□□-7□□-6 Ex HT/B□□-9□□-6 Ex		
	Ex ia IIC, Ex ia IIB			Ex ia IIIC		
Highest process temperature	+80 °C (+176 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+80 °C (+176 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)
Highest surface temperature at the process connection	+70 °C (+158 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+75 °C (+167 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)
Highest ambient temperature	+65 °C (149 °F)					
Temperature class	**T6**	**T5**	**T4**	**T85°C**	**T100°C**	**T110°C**

3.5.2.1 For high-temperature transmitters

Temperature data	HAZARDOUS GAS ATMOSPHERES HH/P□–7□□–8 Ex HH/P□–9□□–8 Ex				EXPLOSIVE DUST ATMOSPHERES HH/P□□–7□□–6 Ex HH/P□□–9□□–6 Ex			
	Ex ia IIC, Ex ia IIB				Ex ia IIIC			
Highest process temperature	+80 °C (+176 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+180 °C (356 °F)	+80 °C (+176 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+180 °C (356 °F)
Highest surface temperature at the process connection	+70 °C (+158 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+175 °C (347 °F)	+75 °C (+167 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+175 °C (347 °F)
Highest ambient temperature	+65 °C (149 °F)							
Temperature class	**T6**	**T5**	**T4**	**T3**	**T85°C**	**T100°C**	**T110°C**	**T180°C**

3.5.3. ATEX combustible dust protection (Ex t) – ATEX certificate No.: BKI22ATEX0003 X/1

	Metal housing		High-temperature version with metal housing
	HT/B□–7□□–9 Ex HT/B□–9□□–9 Ex	HT/B□–7□□–5 Ex HT/B□–9□□–5 Ex	HH/P□–7□□–5 Ex HH/P□–9□□–5 Ex
Ex marking (ATEX)	⟨Ex⟩ II 1 D Ex ta IIIC T105°C Da	⟨Ex⟩ II 1/2 D Ex ta/tb IIIC T85°C…T110°C Da/Db	⟨Ex⟩ II 1/2 D Ex ta/tb IIIC T85°C…T180°C Da/Db
Waiting time for opening the cover	0 min	30 min	30 min
Ex power supply[1]	Ui = 30 V DC Ii = 1 A		
Supply voltage	12…30 V DC		
Temperature limit data	See tables in Section 3.5.4.		
Cable entry	M20×1.5 cable glands with “Ex ta” protection		
Cable outer diameter	Ø6…Ø12 mm (Ø0.23…Ø0.47")		
Electrical connection	Wire cross-section: 0.5…1.5 mm² (AWG20…AWG15)		

[1] *Maximum supply voltage and current to the product while maintaining Ex protection.*

3.5.4. Temperature limit data for ATEX (Ex t) approved models

3.5.4.1 For standard temperature transmitters

Temperature data	Explosive dust atmospheres			
	HT/B□□–7□□–9 Ex HT/B□□–9□□–9 Ex	HT/B□□–7□□–5 Ex HT/B□□–9□□–5 Ex		
	Ex ta IIIC	Ex ta/tb IIIC		
Highest process temperature	+65 °C (149 °F)	+80 °C (+176 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)
Highest surface temperature at the process connection	+65 °C (149 °F)	+75 °C (+167 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)
Highest ambient temperature	+65 °C (149 °F)			
Temperature class	**T105°C**	**T85°C**	**T100°C**	**T110°C**

3.5.4.2 For high-temperature transmitters

Temperature data	Explosive dust atmospheres HH/P□□–7□□–5 Ex HH/P□□–9□□–5 Ex			
	Ex ta/tb IIIC			
Highest process temperature	+80 °C (+176 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+180 °C (356 °F)
Highest surface temperature at the process connection	+75 °C (+167 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+175 °C (347 °F)
Highest ambient temperature	+65 °C (149 °F)			
Temperature class	**T85°C**	**T100°C**	**T110°C**	**T180°C**

3.5.5. IECEx Intrinsically safe protection (Ex ia) – IECEx Certificate No.: IECEx BKI 22.0003X Issue 1

		Metal housing with SAP-300 display	Metal housing without SAP-300 display	Metal housing
Standard version		**HB□-□□□-8 Ex**	**HT□-□□□-8 Ex**	**HB/T□-□□□-6 Ex**
Ex marking (IECEx)		**Ex ia IIB T6…T4 Ga**	**Ex ia IIC T6…T4 Ga**	**Ex ia IIIC T85°C…T110°C Da**
High-temperature version		**HP□-□□□-8 Ex**	**HH□-□□□-8 Ex**	**HH□-□□□-6 Ex**
Ex marking (IECEx)		**Ex ia IIB T6…T3 Ga**	**Ex ia IIC T6…T3 Ga**	**Ex ia IIIC T85°C…T180°C Da**
Ex power supply, intrinsically safety data		Ui = 30 V, Ii = 140 mA, Pi = 1 W Ci ≤ 25 nF, Li ≤ 300 µH	Ui = 30 V, Ii = 100 mA, Pi = 0,75 W Ci ≤ 25 nF, Li ≤ 300 µH	Ui = 30 V, Ii = 140 mA, Pi = 1 W Ci ≤ 25 nF, Li ≤ 300 µH
Supply voltage		12…30 V DC		
Electrical connection	Cable entry	M20×1.5 cable gland		
	Cable outer diameter	Ø6…Ø12 mm (Ø0.23…Ø0.47")		
	Wire cross-section	0.5…1.5 mm² (AWG20…AWG15)		
Temperature limit data		See tables in (the following) section 3.5.6.		

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

3.5.6.1 For standard temperature transmitters

Temperature data	Hazardous gas atmospheres HT/B□–7□□–8 Ex HT/B□–9□□–8 Ex			Explosive dust atmospheres HT/B□□–7□□–6 Ex HT/B□□–9□□–6 Ex		
	Ex ia IIC, Ex ia IIB			Ex ia IIIC		
Highest process temperature	+80 °C (+176 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+80 °C (+176 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)
Highest surface temperature at the process connection	+70 °C (+158 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+75 °C (+167 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)
Highest ambient temperature	+65 °C (149 °F)					
Temperature class	**T6**	**T5**	**T4**	**T85°C**	**T100°C**	**T110°C**

3.5.6.1 For high-temperature transmitters

Temperature data	Hazardous gas atmospheres HH/P□–7□□–8 Ex HH/P□–9□□–8 Ex				Explosive dust atmospheres HH/P□□–7□□–6 Ex HH/P□□–9□□–6 Ex			
	Ex ia IIC, Ex ia IIB				Ex ia IIIC			
Highest process temperature	+80 °C (+176 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+180 °C (356 °F)	+80 °C (+176 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+180 °C (356 °F)
Highest surface temperature at the process connection	+70 °C (+158 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+175 °C (347 °F)	+75 °C (+167 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+175 °C (347 °F)
Highest ambient temperature	+65 °C (149 °F)							
Temperature class	**T6**	**T5**	**T4**	**T3**	**T85°C**	**T100°C**	**T110°C**	**T180°C**

3.5.7. IECEx combustible dust protection (Ex t) – IECEx certificate No.: IECEx BKI 22.0003X Issue 1

	Metal housing		High-temperature version with metal housing
	HT/B□–7□□–9 Ex HT/B□–9□□–9 Ex	HT/B□–7□□–5 Ex HT/B□–9□□–5 Ex	HH/P□–7□□–5 Ex HH/P□–9□□–5 Ex
Ex marking (IECEx)	**Ex ta IIIC T105°C Da**	**Ex ta/tb IIIC T85°C…T110°C Da/Db**	**Ex ta/tb IIIC T85°C…T180°C Da/Db**
Waiting time for opening the cover	0 min	30 min	30 min
Ex power supply[(1)]	Ui = 30 V DC Ii = 1 A		
Supply voltage	12…30 V DC		
Temperature limit data	See tables in Section 3.5.8. (next page)		
Cable entry	M20×1.5 cable glands with “Ex ta” protection		
Cable outer diameter	Ø6…Ø12 mm (Ø0.23…Ø0.47")		
Electrical connection	Wire cross-section: 0.5…1.5 mm² (AWG20…AWG15)		

[(1)] Maximum supply voltage and current to the product while maintaining Ex protection.

3.5.8. Temperature limit data for IECEx (Ex t) approved models

3.5.8.1 For standard temperature transmitters

Temperature data	Explosive dust atmospheres			
	HT/B□□–7□□–9 Ex HT/B□□–9□□–9 Ex	HT/B□□–7□□–5 Ex HT/B□□–9□□–5 Ex		
	Ex ta IIIC	Ex ta/tb IIIC		
Highest process temperature	+65 °C (149 °F)	+80 °C (+176 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)
Highest surface temperature at the process connection	+65 °C (149 °F)	+75 °C (+167 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)
Highest ambient temperature	+65 °C (149 °F)			
Temperature class	**T105°C**	**T85°C**	**T100°C**	**T110°C**

3.5.8.2 For high- temperature transmitters

Temperature data	Explosive dust atmospheres HH/P□□–7□□–5 Ex HH/P□□–9□□–5 Ex			
	Ex ta/tb IIIC			
Highest process temperature	+80 °C (+176 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+180 °C (356 °F)
Highest surface temperature at the process connection	+75 °C (+167 °F)	+90 °C (+194 °F)	+100 °C (+212 °F)	+175 °C (347 °F)
Highest ambient temperature	+65 °C (149 °F)			
Temperature class	**T85°C**	**T100°C**	**T110°C**	**T180°C**

3.6. ACCESSORIES

- Warranty card
- User and programming manual
- EU Declaration of Conformity
- 2× M20×1.5 cable gland
- SAP–300 display unit (ordered separately)
- Flat seal (if required)

3.7. CONDITIONS FOR SAFE OPERATION

- Devices with an SAP–300 display may NOT be operated in an “Ex ia IIC” environment!
- Intrinsically safe devices may only be operated from a circuit that complies with the technical data of the device and is marked [Ex ia IIC] or [Ex ia IIB].
- Devices with a plastic-coated sensor may only be installed in an “Ex ia IIB” environment free of direct airflow causing charge transfer.
- The device may contain components capable of being electrostatically charged! The presence of electrostatic charges can cause sparks and ignition, so electrostatic charges must be prevented entirely in potentially explosive (Ex) atmospheres!
  - To avoid static charge build-up on versions with a plastic-coated sensor, the following safety regulations must be observed:
  - The specific resistance of the medium to be measured shall be ≤ 10^4 Ωm.
  - The speed of the filling and emptying process must be chosen according to the medium.
  - Avoid all mechanical contact with the plastic-coated probe!
  - Extreme care must be taken during maintenance when there may be explosive residue in the process tank. The device may only be touched in an explosive (Ex) environment with a wet antistatic cloth!

If the above regulations are observed, considering the closed technological system, there is no possibility of static charge accumulation, so there is no risk of ignition.

- Devices protected against dust ignition may only be operated in a circuit with the parameters specified in the technical data.
- In the "Ex ta/tb IIIC" protection, the device cover may only be removed after a minimum waiting time of 30 minutes after de-energizing the device!
- Dust accumulation must be prevented on the housing of devices with "Ex ta/tb IIIC" protection.
- The aluminum content of the aluminum alloy housing exceeds the limit value, so the device must be protected against impact and friction in potentially explosive (Ex) environments.
- If the device is installed in a place subject to overvoltage, the device must be equipped with overvoltage protection of at least overvoltage Class II!
- The device must be earthed to the EP system at the earthing screw point of the device.

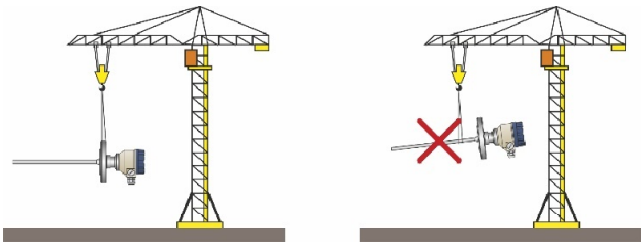
3.8. MAINTENANCE AND REPAIR

The device 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.
Refer to the warranty card for warranty information. 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, in which the sender declares that the device is free of all contamination and substances hazardous to health.

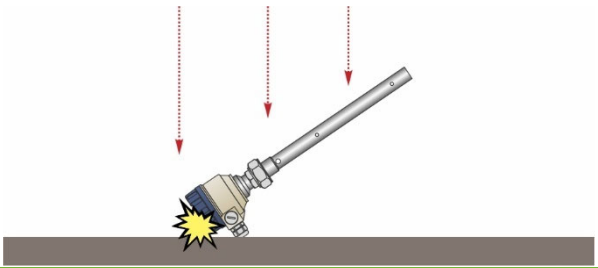
4. INSTALLING

4.1. HANDLING AND STORAGE

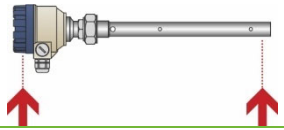
Lift the instrument using both hands, or if necessary, use a hoist. Do not lift the instrument by the probe. It is a critically sensitive part.



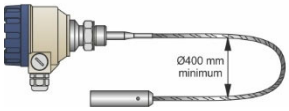
Protect the instrument from mechanical impacts and falling. The electronics is a sensitive and fragile unit.



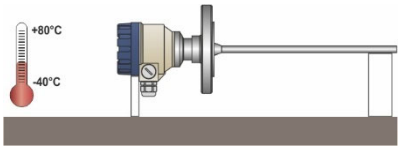
Do not bend coaxial and rod probes.
The device must be supported in the marked places.



The cable probe must not be looped, broken, or frayed.
The minimum bending diameter is 0.4 m (16").
All these may cause a measurement error.



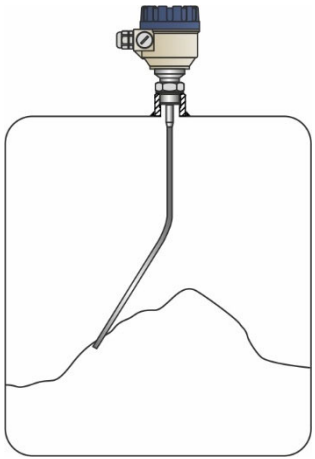
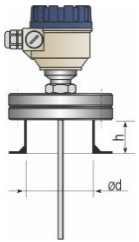
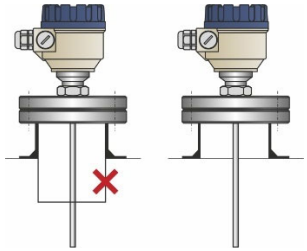
Storage temperature:

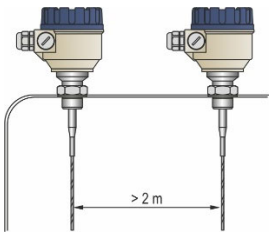
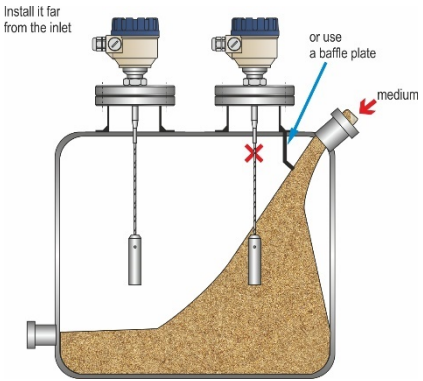
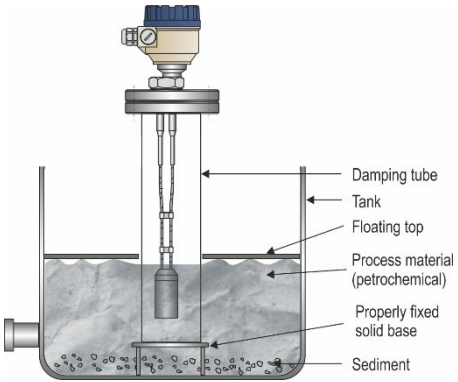


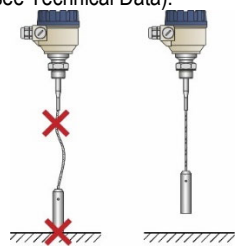
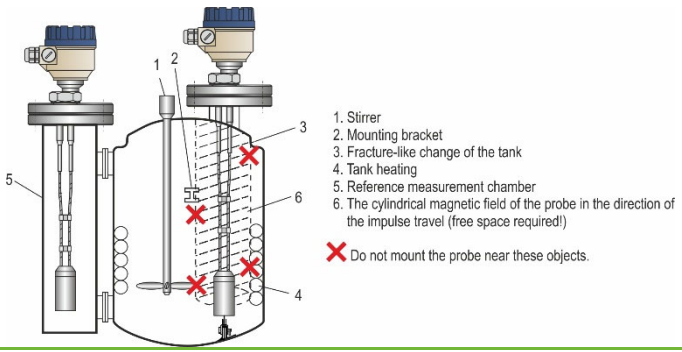
4.2. MOUNTING ON CONTAINERS

4.2.1. General mounting instructions

The size and position of the fittings on the top of the tank (and the distance from the wall), the internal anti-reflection fittings, the rough joints, the welds, and the shape and design of the top and bottom of the tank are very important for the correct operation of the device. Any factor that affects the formation of the probe's electromagnetic field also significantly impairs the measurement accuracy. The coaxial probe is an exception because it has no external electromagnetic field.

Threaded process connection	Nozzle height	Nozzles penetrating into tank
The easiest way to mount onto the tank is with a device screwed into a 1" BSP, 1" NPT, 1½" BSP or 1½" NPT threaded hole . 	Do not fit a nozzle longer than its diameter, especially for single probes and powder applications.  h ≤ Ød, where h = nozzle height Ød = nozzle diameter ***Consult NIVELCO if the above condition cannot be met!***	 ***The nozzle must not extend into the tank, as the protruding part interferes with the measurement!***

Mounting two devices	Effects of material influx	Using a protective tube
If two devices have to be mounted on one tank, they must be spaced at least 2 m (6.5 ft) apart to eliminate interference and measurement inaccuracies resulting from the interaction of the two electromagnetic fields. Devices equipped with coaxial probes are not subject to the above warning because there is no electromagnetic field outside the probe's outer sheath. 	Do not place the nozzle near the material inlet pipe connector. Material flowing onto the sensor probe causes incorrect level indication. If there is not enough space, it is recommended to install a baffle plate. 	The floating lid is a common solution for petrochemicals. In such cases, the use of a damping tube is recommended. 

Straightness and contact of measuring probes with other fittings and distance from the bottom of the tank.	Using a stirrer
After installation, the cable probes and the associated tensile weight must be straight, tensioned, and away from other fittings (e.g., mixer). They must not come into contact with the tank wall, bottom, or other objects. The installation space requirements of the different measuring probes must be taken into account according to the data of the measuring probes (see Technical Data). 	There is no radiation cone along the probe. When measuring liquids, the use of a reference chamber or damping tube is recommended, since it provides mechanical and electromagnetic protection for accurate measurement.  1. Stirrer 2. Mounting bracket 3. Fracture-like change of the tank 4. Tank heating 5. Reference measurement chamber 6. The cylindrical magnetic field of the probe in the direction of the impulse travel (free space required!) ✕ Do not mount the probe near these objects.

Protect the device from direct sunlight!

Attaching the probe to the bottom of the tank.

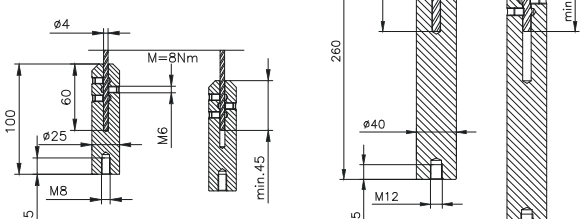
Flexible cable probes can be anchored to the bottom of the tank with a fastener or loop.

Installing and shortening the cable probes

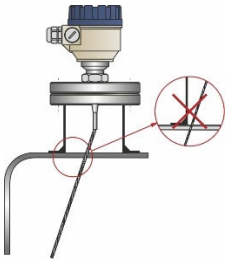
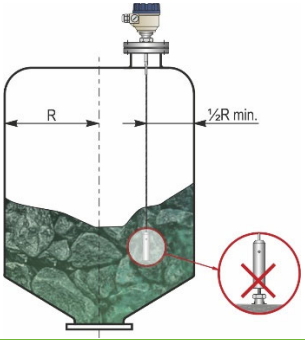
If necessary, the probe can be shortened, but only for liquid applications.

Steps:

1. Loosen the grub screws (hexagon) with an Allen key. (ISO 2936)!
2. Pull the cable out of the tension weight and cut to the desired size!
3. Insert the cable back into the weight as shown and tighten the screws!
4. Modify the configuration parameters to the new length, the reference point being the upper edge of the weight!



4.2.2. Installing the device for measuring solids

False readings	Coning and strong tensile force on the probe	
Do not let the probe touch the side of the nozzle. 		Strong tensile force. The cable rope must not be anchored when measuring solids. The device is mounted at a distance of half the radius of the tank from the top of the tank with a minimum lift nozzle height. It prevents excessive mechanical stress when emptying the tank.

The tensile force of the probe cable rope depends on the tank's height and shape, the material's fragmentation, the density, and the discharge speed. The following table gives the tensile load values for the different materials (approximate data in tons).

Probe type	Material	Probe length		
		6 m (20 ft)	12 m (40 ft)	24 m (80 ft)
Single cable, Ø8 mm (Ø0.31"), max. load: 3.0 T	Cement	0.6 T	1.2 T	2.4 T
	Ash	0.3 T	0.6 T	1.2 T

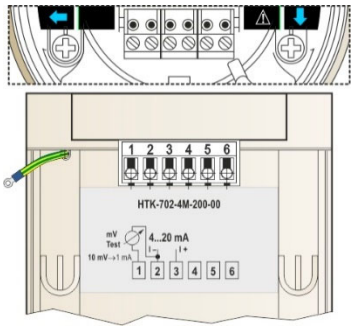
The measured process material can accumulate on the probe and nozzle, which attenuates the energy of the measuring pulse.

Avoid creating cavities that increase deposition.

Observe the load capacity of the tank top, which must ensure the maximum tensile force of the probe.

4.3. WIRING

Wiring in non-explosive environments



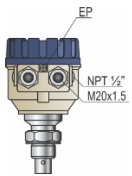
1. Take the device's lid off.
2. Put the cable through the cable gland (½" NPT) to the terminal block.
3. Remove the outer insulation for ~80 mm (~3.15") from the cable so the wires can be accessed, then strip the wires for 4 mm (0.157"). Strip the shielding from the signal cable.
4. Connect the cable to terminals 2 and 3 (polarity is irrelevant).
5. Retract the cable so the cable's outer insulation runs through the cable gland for about 10 mm (0.4"). Then tighten the cable gland's nuts with two wrenches.
6. Organize the wires in the compartment.
7. Put the lid back on.

Do not perform insulation tests with a test voltage of 500 V AC on the device due to the internal electronic surge protection!

Connecting (grounding) to equipotential network (EPH)

Threaded earth connection (EP) on the side of the housing, maximum wire cross-section: 4 mm² (AWG12). The housing of the device must be earthed to the ground with a resistance of $R < 1\ \Omega$.

The shield of the test lead must be earthed at the instrument panel. Do not run the test lead near high-current cables, as shielding does not protect against switching harmonics.



Electrostatic discharge (E.S.D.)

The device is protected against 4 kV ESD.

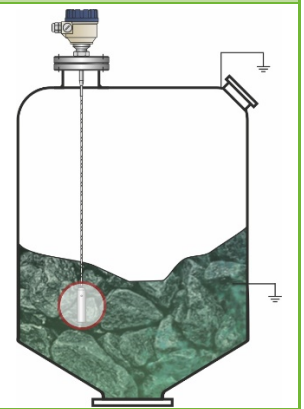
Warning: The electrostatic discharge protection of the measuring system cannot be solved by the internal ESD protection.

In all cases, it is the user's responsibility to ensure that the tank, measured material, and probe are grounded.

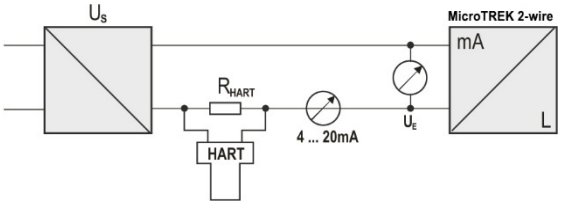
Risk of injury!

The probe may accumulate an electrostatic charge during regular operation, so discharge it to the ground by touching it (tank side) when installing!

Ground the inlet and the measured medium!



Design of the measuring network in non-explosive environments



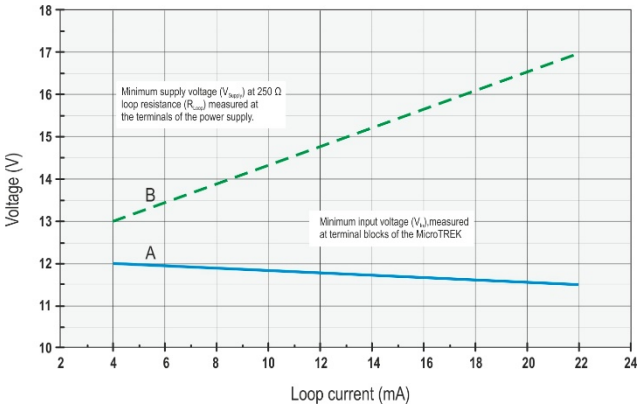
Power supply	
Nominal voltage	24 V DC
Maximum voltage (U_{in}):	36 V DC
Minimal voltage (U_{in}):	Depends on the impedance. (See diagram)
Loop resistance, R_{loop}	$R_{HART} + R_{cabel} + R_{ammeter}$
Minimum R_{HART}	0 Ω
Maximum R_{HART}	750 Ω
R_{HART} resistance for HART® communication	250 Ω (recommended)

Line A: minimum voltage on the device's input terminals
Line B: minimum supply voltage (voltage drop on the device and the 250 Ω loop resistance)

An example for calculating the supply voltage:
The minimum supply voltage at I_{min} = 4 mA current:
$U_{supply\ min.} = U_{in\ min.} + (I_{min} * \text{loop resistance}) = 12\ V + (4\ mA * 0.25\ k\Omega) = 13\ V$

The minimum supply voltage at I_{max} = 22 mA current:
$U_{supply\ min.} = U_{in\ min.} + (I_{min} * \text{loop resistance}) = 11.5\ V + (22\ mA * 0.25\ k\Omega) = 17\ V$

Therefore, if the loop resistance is 250 Ω, 17 V is just enough for the entire 4…20 mA measuring range.

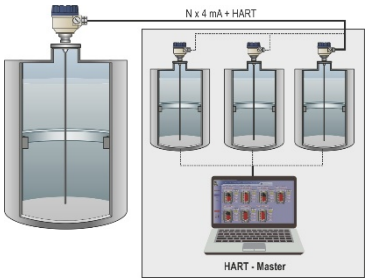


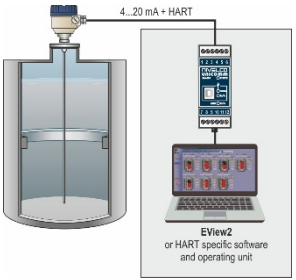
4.3.1. HART® communication

According to the Rosemount Standard, the output of the device can be used in two ways:
HART® communication between MicroTREK as a “slave” and a HART® “master” can be used as a:

- Point-to-point connection: If the HART® short address of the device is set to “0”. Then current loop transmission (4…20 mA) is set. In this case, only one device can be on the HART® communication loop as the slave device.
- For multidrop connection (4 mA), several devices (max. 15) can be connected to one HART® communication loop as slave devices. In this case, a short address other than 0 must be set for the device or devices.

- The EView2 software and the MultiCONT universal process controller support the use of both modes.





4.4. SWITCHING ON AND COMMISSIONING

NIVELCO supplies the MicroTREK 2-wire device with the technical specifications requested by the customer, so it is ready for operation immediately after installation and wiring up. Measuring starts less than 10 seconds after switching on.

Attention! The device's initial current consumption is 3.5 mA right after switching on! In this case, the device measures with factory settings. 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, it is necessary to read the programming chapters to get to know the operational characteristics thoroughly and solve complex measuring tasks.

4.5. AVAILABLE USER INTERFACES

The instrument can be programmed by using the following devices:

SAP–300 display unit	Ordered separately. See ”5.2. Programming with the SAP–300 display unit.”
MultiCONT universal process controller	Ordered separately. Display!
HART® USB modem SAT–504–3	Ordered separately. See ”5.1. Programming with EView2”

5. PROGRAMMING

There are two ways to program the MicroTREK.

- **Programming with the EView2 software**
- **Programming with the SAP–300 display unit**

5.1. PROGRAMMING WITH EVIEW2

5.1.1. Installing and Running EView2

If necessary, install the "EView2 HART® Configuration Software" (hereafter EView2) according to Chapter 3 of the programming manual.
Electrical connections: Connect the transmitter to a PC using a HART® USB modem (sold separately).
Start the program and search for the transmitter in the program (see also Chapter 4 of the EView2 User Manual).

5.1.2. Programming and Configuring the Device

Select the device from the list of found devices to configure and program, and open the device's "Device Programming" window (sections 4.4 and 4.5 of the EView2 User Manual).
All the necessary parameters and function settings can be performed with EView2. The table below summarizes the parameters and their location and path.

5.1.2.1 Parameters

Table 1.

Name (number), function	Adjustable value range Default value	Description
Zero-level distance (P04), Set container height	0...60 m (0…200 ft)	It provides the basis for level measurement calculations. The distance between the plane of the lower sealing surface of the mechanical connector (the lower plane of the flange in the case of a flanged version) and the reference point at the bottom of the tank. Its value must be set in a distance unit (Unit - P00b). Note: There is no measurement beyond the set zero distance if the output is configured for distance or level measurement. **EView2 setting:** "Device Settings" → "Measurement configuration" → "Zero-level dist." **SAP–300:** `MAIN MENU / CALCULATION / ZERO-LEVEL DISTANCE`
	As per order	

Name (number), function	Adjustable value range Default value	Description
Minimum measuring distance (P05), Dead zone **Warning!** **Critical parameter!**	Minimum measuring distance… probe length (P03) **"Minimum measuring distance" according to the Probe properties table**	The dead zone is the distance between the plane of the lower sealing surface of the mechanical connection (the lower plane of the flange in the case of the flanged version) and the highest level in the tank. Signals generated within the dead zone are not processed. The current loop output does not follow the dead zone level signal. Its value must be set in distance units (Length unit – P00b). **EView2 setting:** "Device Settings" → "Measurement configuration" → "Minimum". **SAP–300:** `MAIN MENU / MEASURETMENT CONFIG / MIN. MEAS. DIST.`
Maximum measuring range limit (P06), Far-end blocking	0 (limiter off) or the minimum measuring distance. The distance between (P05) +5 cm (1.97") and the probe length (P03) **0** **(off)**	The maximum value of the measuring range of the device can be limited with this parameter. Signals received beyond the set distance will not be processed. Its value is calculated from the plane of the lower sealing surface of the mechanical connector (in the case of a flanged version, from the lower plane of the flange). Remote blocking can be turned off by setting the parameter to 0. In this case, the device will give a valid result along the entire length of the sensor. **EView2 setting:** "Device Settings" → "Measurement optimalization" → "Far end (P06)". **SAP–300:** `MAIN MENU / MEASUREMENT CONFIG / MAX. MEAS. DIST.`
Damping time (P20) Time constant	1…999 s **20 s**	The "Damping time" is used to reduce undesired fluctuations (e.g.: rippling) in the display of the measured data. If the level changes abruptly, the new value will be set to within 1% accuracy (exponential setting). Unit of measure: seconds. **EView2 setting:** "Device Settings" → "Measurement optimalization" → "Damping time" **SAP–300:** `MAIN MENU / MEAS. OPTIMIZATION / DAMPING TIME`
Probe length (P03)	0.1…30 m (0.33…100 ft) **Default probe length as per order**	The set value is the nominal probe length. This value should only be changed if the probe length is changed or the probe is replaced. Its value must be set in distance unit (Length unit - P00b). For special applications, the length of the probe may be greater than the height of the tank but may not exceed 30 m (100 ft). **EView2 setting:** "Device Settings" → "Measurement configuration" → "Probe length settings" **SAP–300:** `MAIN MENU / MEASUREMENT CONFIG / PROBE LENGTH`
Fixed output current (P08), Setting constant output current	3.8…22 mA **4**	When the current output is set to "Fixed" mode (P12b = 1), the constant current set here is set. The PV current transmission does not work, and at the same time, it overrides any current output fault indication. **EView2 setting:** "Device Settings" → "Outputs" → "Fix output current (P8)" **SAP–300:** `MAIN MENU / OUTPUT SETUP / ANALOG OUTPUT / MANUAL VALUE`

Name (number), function	Adjustable value range Default value	Description
System of measurement units, units of measurement:		Path of parameters: “Settings” / Application” tab
Unit system (P00c), Unit system settings	Selectable values: – (0) Metric (EU), European unit system – (1) Imperial (US), US unit system **(0) Metric (EU)**	The selected unit system determines the actual units of measurement (length, volume, mass) according to this parameter. When setting or changing units, the unit system must be selected first, and only then can the actual unit to be used be set (according to the previously narrowed list). **EView2 setting:** “Device Settings” → “Application” → “Calculation system” **SAP–300:** `MAIN MENU / BASIC SETUP / UNITS / ENGINEERING SYSTEM`
Distance unit (P00b), Length unit	Selectable values: Metric (EU): – (0) m – (1) cm – (2) mm – (3) custom unit Imperial (US): – (0) inch – (1) ft **(0) m**	The unit of measurement for the transmitter when the distance and level are set. If “custom unit” is selected, the unit uses the unit of length as the distance unit based on the value specified in “User Unit.” **EView2 setting:** “Device Settings” → “Application” → “Engineering units” **SAP–300:** `MAIN MENU / BASIC SETUP / UNITS / ENGINEERING UNITS / DISTANCE UNITS`
Output unit, volume (P02b) Volume unit	Selectable values: Metric (EU): – (0) liter – (1) hl – (2) m^3 – (3) million liters Imperial (US): – (0) gallon – (1) ft^3 – (2) barrel – (3) million gallons **(0) liter**	The unit of the transmitted number when set to volume measurement. The device converts the measured level into volume by calculation. It is done by using a level-dependent (non-linear) function. It also gives the unit of measure for the “Output” column in the VM table (OC). **EView2 setting:** “Device Settings” → “Measurement configuration” → “Volume units” **SAP–300:** `MAIN MENU / BASIC SETUP / UNITS / ENGINEERING UNITS / VOLUME UNITS` **IT IS ONLY DISPLAYED IF THE PV IS VOLUME! FACTORY DEFAULT: EU: 2021, US: 1011**
Output unit, Weight (P02a) Weight unit	Selectable values: Metric (EU): – (0) kg – (1) ton – (2) US ton Imperial (US): – (0) lb – (1) US ton – (2) metric ton **(0) kg**	The unit of the transmitter number if the device is set for weight measurement. The device converts the measured level into weight. It is done by using a level-dependent (non-linear) function. It also gives the unit of measure for the “Output” column in the VM table (OC). **EView2 setting:** “Device Settings” → “Measurement configuration” → “Mass units” **SAP–300:** `MAIN MENU / BASIC SETUP / UNITS / ENGINEERING UNITS / MASS UNITS` **IT IS ONLY DISPLAYED IF THE PV IS WEIGHT! FACTORY DEFAULT: EU: 2021, US: 1011**

Name (number), function	Adjustable value range Default value	Description
Operating mode (P00a), Measured medium property	Selectable values: – (0) Liquid – (1) Granular solid – (2) Two interfacing liquids **(0) Liquid medium**	The basic characteristic of the measured medium is set here. The measuring capabilities of the device vary significantly depending on this characteristic of the medium (see specification). **EView2 setting:** "Device Settings" → "Application" → "Operating mode" **SAP–300:** `MAIN MENU / BASIC SETUP / APPLICATION`
Unit system (P00d), Temperature unit	Selectable values: – (0) °C – (1) °F **(0) °C**	The unit of temperature measurement is selected here. **EView2 setting:** "Device Settings" → "Measurement configuration" → "Temperature" **SAP–300:** `MAIN MENU / BASIC SETUP / UNITS / ENGINEERING UNITS / TEMPERATURE UNITS`

Output function:
Primary value (P01ba, PV),
Secondary value (P01dc, SV),
Tertiary value (P30ba, TV),
Quarterly value (P30dc, QV),
 	
Application mode
	Selectable values:
	– (10) Distance
	– (11) Level
	– (12) Volume
	– (15) Ullage vol.
	– (13) Mass
	– (16) Level %
	– (17) Vol. %
	– (40) Temp.
	– (20) Distance 2
	– (21) Level 2
	– (22) Volume 2
	– (23) Mass 2
	– (31) Δ Level
	– (32) Δ Volume
	– (33) Δ Mass
	**PV: (11) Level;SV: (10) Distance;
	TV: (12) Volume;QV: (15) Ullage volume**
		Setting the physical quantity corresponding to the transmitted measurement value. The device measures distance. The other quantities are calculated based on the specified tank parameters and material characteristics. For a detailed description, see **section 5.1.2.1**!
		EView2 setting: "Device Settings" → "Measurement configuration" → "Measurement mode (PV, SV, TV, QV source)"
		SAP–300:
		`MAIN MENU / MEASUREMENT CONFIG /`
		`PV. MODE or,`
		`SV. MODE or,`
		`TV. MODE or,`
		`QV. MODE`
		
		Note:
		The values between 20 and 33 can only be set for the interface measurement type!
		The Δ symbol, in the case of interface measurement, represents the deviation value between the two levels.

Dielectric constant, εr (P09)	1.0…80.0 **80.0** **For interface measurements: 2.4**	The dielectric constant of the measured substance for liquid and solid media measurements. In interface measurement, it refers to the dielectric constant of the upper measured medium. The measurement program adjusts its operation based on the set dielectric constant. In interface measurement, it affects the distance of the medium below, so its setting is crucial. **EView2 setting:** "Device settings" → "Measurement optimization" →"Dielectric constant ...". **SAP-300:** no adjustment available

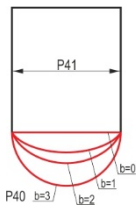
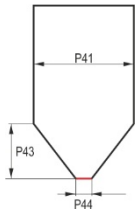
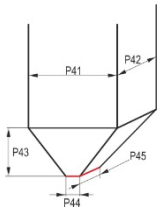
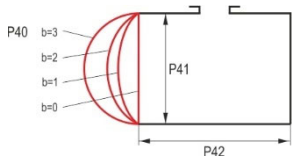
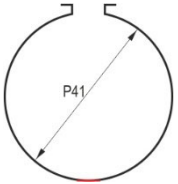
Name (number), function	Adjustable value range Default value	Description
Custom Unit multiplier (P07) User-defined unit (Length unit)	0.001…100 **1.000**	The distance in "custom unit" is the distance in meters multiplied by P07 to get. The corresponding setting field only appears or is active if "custom unit" is selected in the unit system. The reference of the multiplier is meter, the value of the conversion factor must always be given in relation to it. For example, if the conversion factor is 10, then the new unit is 10 m (33 ft) or if the conversion factor is 0.1, the new unit is 0.1 m (0.33 ft). **EView2 setting:** "Device Settings" → "Application" → "Conversion factor" **SAP–300:** no adjustment available
Select echo (P25a), for the second level (P25c)	Selectable values: – (0) Auto – (1) First – (2) Second – (3) Highest amplitude – (4) Last **(0) Auto**	In problematic cases, it is possible to choose between the echoes created during the measurement to ensure a stable measurement and transmission. **EView2 setting:** "Device Settings" → "Measurement optimalization" → "Selection of Echo…" **SAP–300:** `MAIN MENU / MEAS. OPTIMIZATION / ECHO SELECTION` *Note:* *The setting for the second level is only allowed for the interface measurement type.*
Filling speed (P26)	0.1…900 m/h (0.33…2950 ft/h) **200 m/h (656 ft / h)**	The maximum rate of rise in the tank during filling. Entering it correctly increases the reliability of the measurement during charging. **EView2 setting:** "Device Settings" → "Measurement optimalization" → "Level elevation rate …" **SAP–300:** `MAIN MENU / MEAS. OPTIMIZATION / LEVEL TRACK. SPEED / FILLING SPEED`
Emptying speed (P27)	0.1…900 m/h (0.33…2950 ft/h) **200 m/h**	The maximum rate of dropping in the tank during emptying. Entering it correctly makes the measurement more reliable during emptying. **EView2 setting:** "Device Settings" → "Measurement optimalization" → "Level descent rate …" **SAP–300:** `MAIN MENU / MEAS. OPTIMIZATION / LEVEL TRACK. SPEED / EMTYING SPEED`

Name (number), function	Adjustable value range Default value	Description
Tank Full Limit (P29)	Minimum measurement distance … probe length (P03) **"Minimum measuring distance" according to the Probe properties table**	The distance between the plane of the lower sealing surface of the process connection (or the lower plane of the flange for the flanged version) and the highest defined level in the tank. It must be set to a value equal to or greater than the value set in the "dead zone". When the measured level reaches this threshold, the instrument stops and displays the message "Tank Full" on the information output. The instrument continues to measure the level above the full tank threshold in the background, without displaying it, until the dead zone is reached. The value should be set in distance units (length unit - P00b). **EView2 setting:** "Device Settings" → "Measurement configuration" →."Minimum" **SAP–300:** `MAIN MENU / MEASURETMENT CONFIG / TANK FULL LIMIT`
Fix Gain (P24a)	Selectable values: – (0) Auto – (1) Grade 1., min. – (2) Grade 2. – (3) Grade 3. – (4) Grade 4., max. **(0) Auto**	Sets the sensitivity of the analog amplifier that processes the echo signal from the measured level. In "Auto" mode (0), the instrument searches for and sets the optimal gain level based on the measured signal levels without any user intervention. In special cases (e.g. when measuring a medium with low εr in a noisy environment), it may be necessary to turn off the "Auto" mode and set a fixed gain. **Caution! This setting requires a high level of expertise!** **EView2 setting:** "Device Settings" → "Advanced mode" → "Parameters" **SAP–300:** `MAIN MENU / MEAS. OPTIMIZATION / GAIN SETTINGS / AMPLIFIER GAIN`
Gain settings lower limit (P24b) Gain settings upper limit (P24c)	Selectable values: – (0) Auto – (1) Grade 1., min. – (2) Grade 2. – (3) Grade 3. – (4) Grade 4., max. **(0) Auto**	Here, you can set the lower and upper limits for the "Auto" adjustment of the sensitivity of the analog amplifier that processes the echo signal coming from the measured level. Important: This setting is only valid when the P24a parameter (see above) is set to "Auto" mode! **Caution! This setting requires a high level of expertise!** **EView2 setting:** "Device Settings" → "Advanced mode" → "Parameters" **SAP–300:** `MAIN MENU / MEAS. OPTIMIZATION / GAIN SETTINGS / AUTO GAIN LO. LIMT or AUTO GAIN HI LIMIT`

Name (number), function	Adjustable value range Default value	Description
Current output signal settings:		Path to parameters: “Device settings” / “Outputs” tab
Current loop output (P12b), Set mode	Selectable values: – (0) Auto – (1) Manual **(0) Auto**	Selects the current loop output mode when transmitting current. In “Auto” mode, the output current changes proportionally to the PV (4…20 mA). In the case of “Manual,” the constant current set in the parameter P08 is forced to the current output mainly for testing purposes. **EView2 setting:** “Device Settings” → “Outputs” → “Current generator mode” **SAP–300:** `MAIN MENU / OUTPUT SETUP / ANALOG OUTPUT / CURRENT MODE`
Current loop output (P12a), Value of output current if there is an error (error current)	Selectable values: – (0) Hold – (1) 3.8 mA – (2) 22 mA **(0) Hold**	This parameter determines the state that the current loop output draws in the event of a fault. For “Hold,” it keeps the last measured value (4…20 mA), for “3.8 mA” and “22 mA” it keeps the indicated value until the fault is present. **EView2 setting:** “Device Settings” → “Outputs” → “Current output -→ Error indication by the current output” **SAP–300:** `MAIN MENU / OUTPUT SETUP / ANALOG OUTPUT / ERROR MODE`
Value assigned to 4 mA (P10)	Selectable values: In accordance with the PV adjustment range, usually minimum value **0.000 m (0.000 ft)**	PV value assigned to 4 mA in current transmission mode (usually the lower limit of the measuring range for level measurement). **EView2 setting:** “Device Settings” → “Outputs” → “Assignment of 4 mA - PV” **SAP–300:** `MAIN MENU / OUTPUT SETUP / ANALOG OUTPUT / 4mA VALUE`
Value assigned to 20 mA (P11)	Selectable values: In accordance with the PV adjustment range, usually maximum value. **6.000 m (20.000 ft)**	PV value assigned to 20 mA in current transmission mode (usually the upper limit of the measuring range for level measurement). **EView2 setting:** “Device Settings” → “Outputs” → “Assignment of 22 mA - PV” **SAP–300:** `MAIN MENU / OUTPUT SETUP / ANALOG OUTPUT / 22mA VALUE`
Echo loss handling (P28b), Error signal delay	Selectable values: – (0) No delay – (1) 10 s – (2) 20 s – (3) 30 s – (4) 1 min – (5) 2 min – (6) 5 min – (7) 15 min **(1) 10 s**	This parameter determines the time elapsed between the occurrence of the fault and the error signal (e. g.: fault current). The output is held at the time of the delay, based on the last valid measured data. The function is only available for current output with an error signal set to the lower (3.8 mA) or the upper (22 mA) error current. **EView2 setting:** “Device Settings” → “Measurement optimalization” → “Error delay” **SAP–300:** `MAIN MENU / MEAS. OPTIMIZATION / OUTPUT HOLD TIME`

Name (number), function	Adjustable value range Default value	Description
Special, identifying data		Path to parameters: “Device programming window (Advanced mode) / Special” tab
HART® short address (P19), Device address	0…15 **0**	Unique device address based on which the device can be identified and managed via the HART® bus. • 0: analog output active (current loop transmission active, 4…20 mA) • 1…15: analog output inactive (no current loop transmission, constant 4 mA), Multidrop **EView2 setting:** “Device Settings” → “Device identification” → “Device short address” **SAP–300:** `MAIN MENU / OUTPUT SETUP / SERIAL OUTPUT / ADDRESS`
RELAY mode (P13a), RELAY output modes	Selectable values: – (0) OFF – (1) PV – (2) On Error **(0) OFF**	The operating mode of the RELAY with optional level switching functions can be set with this parameter. The function is Off by default. When set to “PV,” the RELAY operates based on the trigger and release values set according to the PV. The “On Error” setting allows a switched (relay contact) fault indication to the process controller. **EView2 setting:** “Device Settings” → “Outputs” → “Relay mode” **SAP–300:** `MAIN MENU / OUTPUT SETUP / RELAY OUTPUT / RELAY MODE`
RELAY mode (P13b), RELAY functions	Selectable values: – (0) Hysteresis – (1) Window comparator **(0) Hysteresis**	The basic switching methodology of the RELAY set to “PV” mode can be set. **EView2 setting:** “Device Settings” → “Outputs” → “Relay function” **SAP–300:** `MAIN MENU / OUTPUT SETUP / RELAY OUTPUT / RELAY FUNCTION`
RELAY mode (P13d), RELAY inverted mode	Selectable values: – (0) Not inverted – (1) Inverted **(0) Not inverted**	If the setting is non-inverted, the RELAY closes its contacts when the trigger value is reached, otherwise (inversion) opens these contacts. **EView2 setting:** “Device Settings” → “Outputs” → “Relay inverted” **SAP–300:** `MAIN MENU / OUTPUT SETUP / RELAY OUTPUT / INVERTING`
RELAY trigger value (P14)	Value can be adjusted in accordance with PV setting interval **1.000 m (3.300 ft) (level)**	The measured PV value at which reaching the upper limit (upper switching value) is signaled on the RELAY output. **EView2 setting:** “Device Settings” → “Outputs” → “Energized value” **SAP–300:** `MAIN MENU / OUTPUT SETUP / RELAY OUTPUT / ENERGIZED VALUE`
RELAY release value (P15)	Value can be adjusted in accordance with PV setting interval **5.000 m (16.400 ft) (level)**	The measured PV value at which reaching the lower limit (lower switching value) is signaled on the RELAY output. **EView2 setting:** “Device Settings” → “Outputs” → “De-Energized value” **SAP–300:** `MAIN MENU / OUTPUT SETUP / RELAY OUTPUT / DEENERGIZED VALUE`

Name (number), function	Adjustable value range Default value	Description
v (P16)	0…999 s **0 s**	In the event that the PV measured value has reached the lower or upper switching value or an error signal has occurred in the event of an error, the RELAY is activated and a change is visible on the relay output after this time delay. **EView2 setting:** “Device Settings” → “Outputs” → “Relay delay time” **SAP–300:** `MAIN MENU / OUTPUT SETUP / RELAY OUTPUT / DELAY`
Tank type (P40a), Tank shapes for volume measurement	Selectable values: – (0)Output Conversion table (OCT) – (1) Standing cylindrical tank with dome bottom – (2) Standing cylindrical tank with conical bottom – (3) Standing rectangular tank with or without chute – (4) Lying cylindrical tank – (5) Spherical tank **(1) Standing cylindrical tank with dome bottom**	Selecting a typical basic container shape for volume measurement. The tank dimensions can be set using parameters P41… P45 (see figures below). If OCT is set, the tank shape must be specified in tabular form. **EView2 setting: “Device settings” → “Tank/Silo parameters” → “Tank shape”** **SAP–300:** `MAIN MENU / CALCULATION / TANK SHAPE` **IT IS ONLY DISPLAYED IF THE PV IS VOLUME!**
Tank type (P40b), Tank properties for volume measurement, tank bottom shape	Selectable values: – (0) Flat – (1) Dome 1 – (2) Dome 2 – (3) Hemisphere **0 (Flat)**	Assigning typical tank bottom designs to a specific tank type for accurate volume calculation. The exact form for the setting code is shown in the figure below. **EView2 setting:** “Device settings” → “Tank/Silo parameters” → “Bottom shape” **SAP–300:** `MAIN MENU / CALCULATION / TANK SHAPE / ...`

Standig cylindrical tank with dome bottom	Standig cylindrical tank with conical bottom	Standig rectangular tank	Lying cylindrical tank	Spherical tank
				

Name (number), function	Adjustable value range Default value	Description
Tank dimensions (P41…P45), for volume measurement	0…999 999 **0**	Typical dimensions in units of length for the tank type set in parameter P40 for volume calculation. **EView2 setting:** “Device settings” → “Tank/Silo parameters” → ”Bottom shape” **SAP–300:** `MAIN MENU / CALCULATION / TANK SHAPE / ...`
Medium density (Specific gravity) (P32), for weight measurement (In case of interface measurement, it refers to the upper medium)	0.01…100 **1**	If the device is set to weight measurement, the specific gravity of the material (medium) stored in the tank must be entered here for weight calculation. The value to be set is the ratio (without unit) to the density of the water. **EView2 setting:** “Device settings” → “Measurement optimalization” → “Specific gravity” **SAP–300:** `MAIN MENU / CALCULATION / SPECIFIC GRAVITY`
Specific gravity (P33), for weight measurement (In case of interface measurement, it refers to the upper medium)	0.01…100 **1**	Parameter used in interface measurement: If the device is set to weight measurement, the specific gravity of the lower material (medium) stored in the tank must be entered here for weight calculation. The value to be set is the ratio (without unit) to the density of the water. **EView2 setting:** “Device settings” → “Measurement optimalization” → “Specific gravity” **SAP–300:** no adjustment available.

Name (number), function	Adjustable value range Default value	Description
Threshold offset (P34), interference sensitivity setting	–4095…+4095 **0**	The echo detection threshold set in point 5.3 can be adjusted by shifting upwards or downwards. In this case, the entire echo threshold line is moved up or down by the value set here. The shift value should be specified in the "AD increment" indicated on the vertical (amplitude) axis of the echo diagram (a negative value shifts the threshold downwards). **Caution! You may get a "No echo" error message if the set value is too high.** **EView2 setting:** "Device settings" → "Measurement optimalization" → "Threshold offset" **SAP–300:** `MAIN MENU / MEAS. OPTIMIZATION / THRESHOLD OFFSET`
Interface Threshold offset (P35)	–4095…+4095 **220**	Interface measurement parameter that helps to detect the second level. If an echo exceeds this increased level, it is considered a second echo. The shift value should be specified in the "AD incremens" indicated on the vertical (amplitude) axis of the echo diagram (its value depends on the gain). **Caution! This setting requires a high level of expertise!** **EView2 setting:** "Device settings" → "Measurement optimalization" → "Threshold offset" **SAP–300:** only displayed for interface measurement `MAIN MENU / MEAS. OPTIMIZATION / THRESHOLD SETTINGS / IF. THRESHOLD OFFS.`
User-defined multiplier (P22), Correction factor (measured/actual)	0.7…10 **1**	Adjusts the transmitted quantity by distance. If the value measured by the device differs from the value under real conditions, this multiplier can be used to adjust the result. The output value is multiplied by the number set here. The default multiplier is 1, which does not change the output. **EView2 setting:** "Device settings" → "Measurement optimalization" → "Velocity user correction factor" **SAP–300:** no adjustment available
Gross tank volume (P47)	0…999,999 **0**	If the output (PV source) is set to "Ullage volume" transmission, the total volume can be specified 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 volume of the medium. Its unit is PV. **EView2 setting:** "Device settings" → "Tank/Silo parameters" → "Total tank volume" **SAP–300:** `MAIN MENU / CALCULATION / TANK TOTAL VOLUME`

5.1.2.2 Additional settings required for the correct use of the application modes ("Output function"):

Code	Application mode	Programmable parameters	Note
10	Distance	–	
11	Level	P04	*It should be adjusted to the tank height, Level = P04 – Distance.*
12	Volume	P04, P40…45	In special cases, the "OC" table should be filled out.
13	Mass	P04, P32, P40…45	The medium density (specific gravity) (P32) should be given relative to water (1).
15	Ullage Volume	P04, P40…45, P47	*Providing the total volume is important, Empty volume = P47 – Volume.*
16	Level %	P04, P29	*Level relative to the full tank, Level % = 100 * Level / (P04 – P29).*
17	Volume %	P04, P40…45, P47	*Volume relative to the total volume, Volume % = 100 * Volume / P47.*
For interface measurement			
20	Distance 2	P09	Distance from the reference to the lower medium level.
21	Level 2	P04, P09	*Lower medium level, Level 2 = P04 – Distance 2.*
22	Volume 2	P04, P09, P40…45	The volume of the lower medium.
23	Mass 2	P04, P09, P33, P40…45	Mass of the lower medium, medium density: P33.
31	Δ Level	(P04), P09	Thickness of the upper medium layer, *Δ Level = Level – Level 2.*
32	Δ Volume	P04, P09, P40…45	The volume of the upper medium (layer), *Δ Volume = Volume – Volume 2.*
33	Δ Mass	P04, P09, P32, P40…45	Mass of the upper medium (layer), medium density (specific gravity): P32.**

5.1.2.3 Setting Up and Filling the OC (Output Conversion) Table

The conversion table is usually used for volume measurement but can also be used for weight measurement in cases of non-standard tank shapes. This table assigns different PV 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 output converted level. The unit associated with the output value is determined by the setting of the "Output source" (P01, PV) and "Output unit" (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 value pairs is 100.
More information:

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

The output conversion table (OCT) is active when a table correction is selected in parameter P40. A user-defined conversion table (e.g., "level - volume") can be created using EView2. 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 User's Manual – 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.

5.1.2.4 Device status window

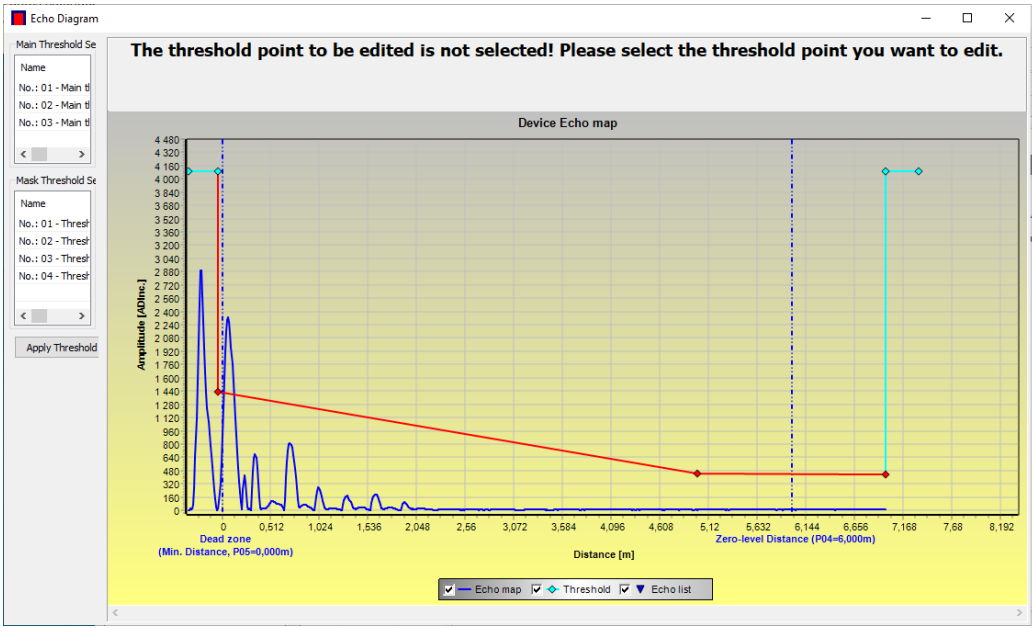
To turn on the "Device status window" in EView2, right-click on the device line in the "Device list" list in the main window and select "Show Device Status Window" in the popup window. (See also section 6.3 of the EView2 User's manual.)

5.1.2.5 Device "Echo Diagram" (Oscilloscope Function)

Open the "Echo Diagram" window to display the device echo diagram.
The "Device Echo map" window will appear. The diagram shows the reflection curve measured by the device.
Press the "Refresh" button in the bottom row of the window (or press the F4 button while in the window) to refresh the chart or read the data. After a successful reading, a curve corresponding to the image below will appear on the graph (see Figure 1).
If there is an evaluable level signal, it will also appear on the graph ("Selected peak" text bubble) along with other additional information. In addition, you can use this window to set any "Threshold" level.

5.1.2.6 Level Threshold settings

The level threshold of the device can be changed in the echo diagram window, i.e., the value of “Threshold.”
This may be necessary if the device does not find the level signal (e.g., the set level threshold is too high or too low and the gain is already at the highest level).
To change the “Threshold” value, access the “Threshold settings” → “Threshold edit enable” function from the pop-up menu triggered by a right-click. The corner points of the threshold curve on the echo diagram can then be adjusted with the mouse. Pressing the “Apply Threshold” button on the left help panel will apply the set threshold value. To refresh the chart, press the “Refresh” button (or press the F4 button in the window).



Attention! The “Cursor On” function does not give an exact value, it only recalculates the value of the given point based on the graphical representation.

5.1.3. Programming Example 1 (using EView2)

Changing the actual tank height (10.000 m [33.000 ft]). To the probe (cable) length L_2 (9.000 m [29.500 ft]) (-factory set by the manufacturer). Then, saving the newly altered parameter value.

Step	Operation	Entered data / value
1	Open the “Device Setup” window for that device in EView2	The program will read and display the device settings
2	Select “Measurement configuration.”	
3	Click on "Zero-level dist." (Zero-Level Distance)	The data in the field: 10.000 [m] ([33.000 [ft])
4	Enter the new value	9.000 [m] (29.500 [ft])
5	Press the button labeled “Send” in the lower right row of the window to download the new value to the device	
6	Press the “X” close button to exit the device settings window	

5.1.4. Programming Example 2 (using EView2)

Setting custom scale: Select the “Level” measurement mode as the current loop output parameter to set the scale from the bottom of the tank.
Set the current range from 4…20 mA with 22 mA as an error signal.
Select the appropriate minimum and maximum values for the measurement scale.

Step	Operation	Entered data / value
1	Open the “Device Setup” window in EView2 for the level transmitter to be set up.	The program will read and display the device settings
2	Select “Measurement configuration.	
3	Within the “Measurement mode PV” section, select the new setting value (Level) from the drop-down list	This field will read “Level”.
4	Select “Outputs”.	
5	Select “Error indication …” drop-down list.	The field will say “Hold”.
6	Select “New setting” from the drop-down list	The field will say “22 mA”
7	Select the data field named “Assignment of 4 mA – PV”.	The field will say “0.000 [m]” (“0.000 [ft]”)
8	Enter the new value. This gives the level corresponding to a minimum output of 4 mA.	The field will say “1.000 [m]” (“3.300 [ft]”).
9	Select the data field named “Assignment of 20 mA – PV”	The field will say “6.000 [m]” (“20 [ft]”) (default: 6.000 [m]).
10	Switch to 8.600 [m] (28.2 [ft]). This gives the level corresponding to the maximum output of 20 mA (and sets the maximum output to the upper limit of the dead zone).	The field will say “8.600 [m]” (“28.2 [ft]”)
11	Press the button labeled “Send” in the lower right row of the window to download the new values to the device.	
12	Press the “X” close button to exit the device settings window.	

5.1.5. Creating a volume table

A conversion table for volume measurement can be created using the EView2 software (EView2 OC-table (OCT)). For more information, see section 5.1.2.2.
The following example shows a five-point programming. Here's how to create a user-defined "level-to-volume" conversion table (using EView2).

Step	Operation	Entered data / selected value
1	Open the “Device Setup” window for the given level transmitter in EView2.	
2	Go to “Application” and select “Calculation system”.	Metric (EU), Imperial (US), Optional Unit
3	Select length (Engineering Unit).	m (ft)
4	Go to “Measurement configuration” and select volume from the “Measurement mode (PV source)” list.	Volume
5	Select the volume unit in “Volume Units”.	m³ (ft³)
6	Go to “Measuring distances” Enter the tank height into “Zero-level dist.” (click in the field and enter the value).	6.00 m (20 ft)
7	Go to “Probe length” and enter s value for probe length	5.80 m (19 ft)
8	Go to the “Minimum (P5)” field and enter the dead zone value (forbidden distance)	0.40 m (1.3 ft)
9	Press the button labeled “Send” in the lower right row of the window to download the new values to the device.	Please wait while the download process is complete
10	Go to “OC-Table” Fill in the table called “OCT list” with the appropriate values. A maximum of 20 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 Ctrl + Insert, or by selecting “Add new item” in the right mouse button popup menu. Lines can be deleted by pressing Ctrl + D.	See the following table (Table 2)
11	To download the spreadsheet to your device, press the “Send” button on the right side of the tab (OC-table) below the “Get” button.	

Table 2 (Input table)

Point	Level (Source column)	Volume (Source column)
1	0.0 m (0.0 ft)	0.0 m³ (0.0 ft³)
2	0.20 m (0.66 ft)	0.5 m³ (17.65 ft³)
3	0.75 m (2.5 ft)	1.0 m³ (35 ft³)
4	1.00 m (3.3 ft)	1.5 m³ (52.9 ft³)
5	5.60 m (18.5 ft)	16.8 m³ (593.3 ft³)

Note: In this example case, the level can be measured effectively between 0.20 m (0.66 ft) and 5.60 m (18.5 ft).
When the level of the measured material falls below the end of the measuring probe, the device will still indicate 0.20 m (0.66 ft), because the level meter can only display between 0.20 m (0.66 ft) and 5.60 m (18.5 ft) according to the probe length (which is now 5.8 m [19 ft]).
The dead zone's size depends on the equipment and the probe type.

Additional procedure for displaying 4…20 mA current output (using EView2)

Step	Operation	Entered data / Selected value
1	Go to “Outputs” and set “Current generator mode” to “Auto” (default)	Auto
2	Set the error status to the appropriate mode in “Error indication …” (default).	Hold
3	Select the “Assignment of 4 mA – PV (P10)” field and enter the min. volume value for the 4 mA output current.	0.5 m³ (17.65 ft³)
4	Go to the “Assignment of 20 mA – PV (P11)” field and enter the max. 20 mA output current value.	16.8 m³ (593.3 ft³)
5	Press the button labeled “Send” in the lower right row of the window to load the new values into the device.	
6	Press the “X” close button to exit the device settings window.	

5.2. PROGRAMMING WITH THE SAP–300 DISPLAY UNIT

The most important parameters of MicroTREK can also be set with the SAP–300 display unit.
By default, the display shows the primary measurement result (from which the output current is calculated).
In addition to the measured value displayed in large numbers, a bar graph representing the output current value is also shown on the right.
Programming is done using a text menu. You can use the E / ▲ / ▼ / ◀ buttons to navigate the menu.

5.2.1. SAP–300 display unit

Display: 64 × 128 dot matrix LCD, signs, units and bar graph
Ambient temperature: –20…+65 °C (–4…+149 °F)
Housing material: PBT fiberglass, plastic (DuPont®)

The plug-in module contains the SAP–300 LCD (universal – can also be used in other NIVELCO devices, provided the device software supports SAP–300).

Warning!

The SAP–300 is an LCD; do not expose the SAP–300 to prolonged exposure to strong heat or sunlight as the display may be damaged.

If the MicroTREK is not protected against strong, direct sunlight, or if it is used outside the operating temperature range of the SAP–300. Please do not leave the SAP–300 on the MicroTREK!

5.2.2. The Behavior of the MicroTREK while Programmed Manually

By default, MicroTREK displays the main measurement data on the SAP–300 display (hereafter referred to as the display).
Enter the programming menu by pressing the E button. Use the ▲ / ▼ buttons to navigate through the menu items.
Enter the selected menu item with the E button. Return to the previous menu level with the ◀ key.

The buttons only work if the SAP–300 is present!

The device continues measuring while the menu is accessed. Changes made in the menu take effect when you exit the menu. (Except for the experimental threshold auto setting functionalities, which can be instantaneous or timed.)
If you do not exit the MicroTREK menu, the device will automatically return to the measurement display state after 30 minutes. In this case, any changes made in the menu will be ignored.
If the SAP–300 is pulled out of the MicroTREK, the MicroTREK will automatically exit the menu and ignore any changes made in the menu.
Since programming with SAP–300 (manual programming) and remote programming on HART® (REMOTE MODE) creates a conflict, only one mode can be used at a time.
Manual programming has priority over programming via HART®!
During manual programming, the device sends a "device is busy" signal to the HART® master (HART® Response code: 32 – Device is busy).
In remote programming mode, **REM** is displayed on the top right of the display. In this case, manual programming of the device is disabled, the menu cannot be accessed.
If no SAP–300 is connected, the LEDs will be visible, the flashes of the COM LED will indicate HART® communication, and the VALID LED will indicate if the data measured by the device is valid.

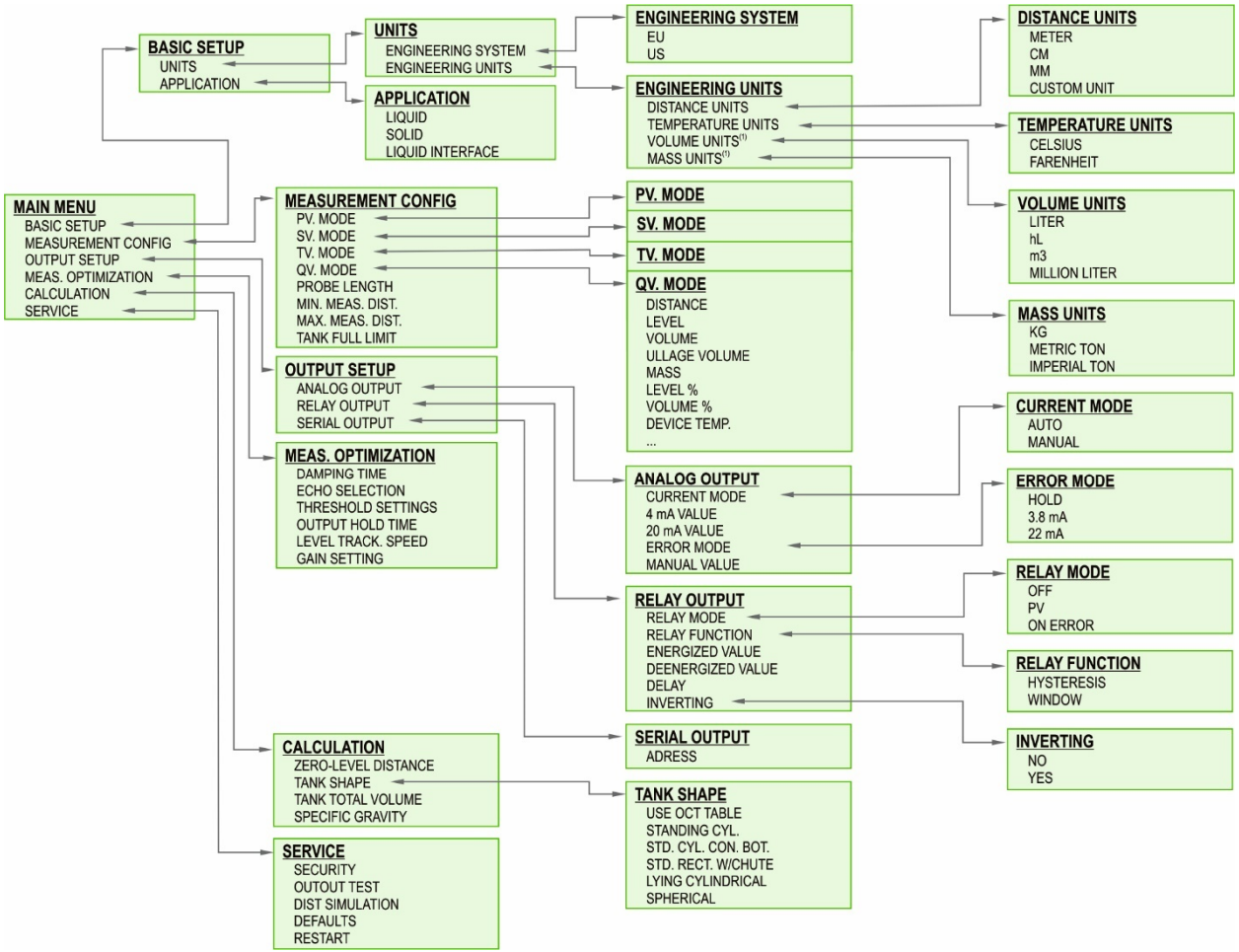
5.2.3. Manual Programming

Press the E button to modify the parameter under the cursor in the submenu.

There are two modes:

Text list:
Navigated is same as in the menu.
The E button executes the selection, and the ◀ button cancels it.

Editable number field:
Serves to edit numeric values.
Editing is aided by an (inverted) cursor.
The number under the cursor can be changed with the ▲ / ▼ buttons (no overflow).
The cursor can be moved left with the arrow (max. 9 character-positions, including the decimal point).
The number under the cursor can be changed with the ▲ / ▼ buttons (no overflow).
The cursor can be moved left with the ◀ arrow (max. 9 character-positions, including the decimal point). When the end of the field is reached, the cursor returns to the first position on the right.
Editing is concluded by pressing the E button.
In this case, MicroTREK will check the entered value and if it is not correct, "WRONG VALUE!" is displayed in the bottom row.


MAIN MENU
BASIC SETUP
MEASUREMENT CONFIG
OUTPUT SETUP
MEAS. OPTIMIZATION
CALCULATION
SERVICE
BASIC SETUP
UNITS
APPLICATION
UNITS
ENGINEERING SYSTEM
ENGINEERING UNITS
APPLICATION
LIQUID
SOLID
LIQUID INTERFACE
ENGINEERING SYSTEM
EU
US
ENGINEERING UNITS
DISTANCE UNITS
TEMPERATURE UNITS
VOLUME UNITS(1)
MASS UNITS(1)
DISTANCE UNITS
METER
CM
MM
CUSTOM UNIT
TEMPERATURE UNITS
CELSIUS
FARENHEIT
VOLUME UNITS
LITER
hL
m3
MILLION LITER
MASS UNITS
KG
METRIC TON
IMPERIAL TON
MEASUREMENT CONFIG
PV. MODE
SV. MODE
TV. MODE
QV. MODE
PROBE LENGTH
MIN. MEAS. DIST.
MAX. MEAS. DIST.
TANK FULL LIMIT
PV. MODE
SV. MODE
TV. MODE
QV. MODE
DISTANCE
LEVEL
VOLUME
ULLAGE VOLUME
MASS
LEVEL %
VOLUME %
DEVICE TEMP.
...
OUTPUT SETUP
ANALOG OUTPUT
RELAY OUTPUT
SERIAL OUTPUT
ANALOG OUTPUT
CURRENT MODE
4 mA VALUE
20 mA VALUE
ERROR MODE
MANUAL VALUE
CURRENT MODE
AUTO
MANUAL
ERROR MODE
HOLD
3.8 mA
22 mA
MEAS. OPTIMIZATION
DAMPING TIME
ECHO SELECTION
THRESHOLD SETTINGS
OUTPUT HOLD TIME
LEVEL TRACK. SPEED
GAIN SETTING
RELAY OUTPUT
RELAY MODE
RELAY FUNCTION
ENERGIZED VALUE
DEENERGIZED VALUE
DELAY
INVERTING
RELAY MODE
OFF
PV
ON ERROR
RELAY FUNCTION
HYSTERESIS
WINDOW
INVERTING
NO
YES
SERIAL OUTPUT
ADRESS
CALCULATION
ZERO-LEVEL DISTANCE
TANK SHAPE
TANK TOTAL VOLUME
SPECIFIC GRAVITY
TANK SHAPE
USE OCT TABLE
STANDING CYL.
STD. CYL. CON. BOT.
STD. RECT. W/CHUTE
LYING CYLINDRICAL
SPHERICAL
SERVICE
SECURITY
OUTOUT TEST
DIST SIMULATION
DEFAULTS
RESTART

5.3. PROPERTIES OF MICROTREK LEVEL TRANSMITTER

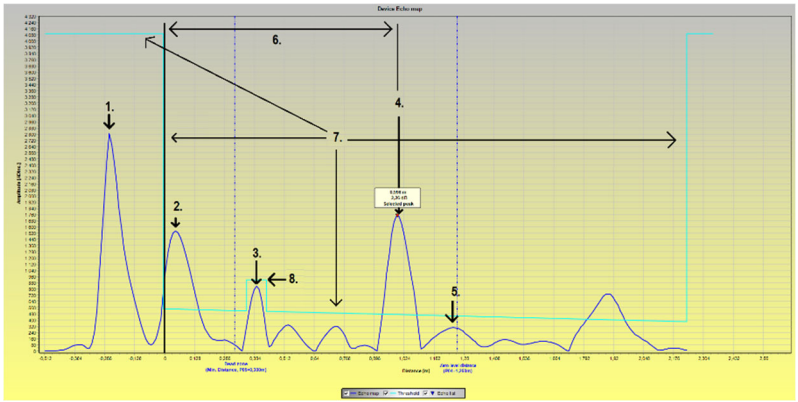
This chapter discusses the following topics:

– How does the transmitter measure the level, what factors play a role?
– Setting up and illustrating the measuring scale of the device in five possible ways.
– The role of gain adjustment in measurement.
– What is a “Threshold line” and how can it be changed?

5.3.1. Level Measurement – Level reflection, Threshold Line and Automatic Gain Adjustment

After connecting the power supply, the device will start operating:
1. It measures the reflected signals above the threshold line with the gain amplitude determined by the voltage amplitude and adjusted by cyclic repetition.
2. Determines the signal with the maximum amplitude that corresponds to the level reflection.

The following figure is a snapshot of the EView2 – “Echo Chart” function, typically for a measured material. – The ADC values of the radar digitizer are located on the vertical axis. The ADC value of 4095 corresponds to a radar signal with an amplitude of 3 V. The distance on the horizontal axis.

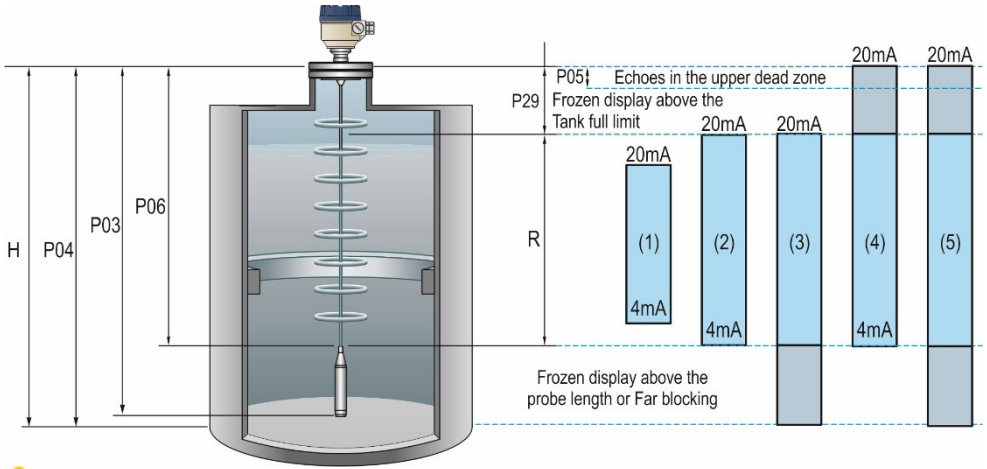


1 Radar reference pulse emitted (transmitter signal or ping)
2 Flange reflection / flange pulse (does not occur with coaxial probe)
3 Non-material level reflection (parasitic, such as stirrer)
4 Reflection of measured medium’s level
5 Zero level distance (in this case coincides with the echo of the probe end)
6 Measured distance
7 Main threshold line.
For setting up, refer to **"5.1.2.5 Setting the Threshold"**
8 Threshold mask (to mask disturbances that cross the main threshold line).
For setting up, refer to **"5.1.2.5 Setting the Threshold"**

5.3.2. The measurement scale: five possible configurations on the analog current output

– To illustrate the five possible configurations, the following fluid level measurement settings are assumed:
(EView2 →"Device Settings"→"Application"→"Operating mode: Liquid level measurement")
(EView2 →"Device Settings"→"Measurement Configuration"→"PV source: Level")

– Thus, the HART® **"PV"** of the transmitter, its primary digital output, will be a level value. The level is calculated from the parameter values below:



P03 –Probe length
P04 – "Zero level" distance
P05 – Min. distance/Near blocking
Min. Level distance now not only freezes but rather cuts from measurement. To mask flange ringdown better.
P06 – Max. distance/Far blocking
Far blocking distance now not only freezes but cuts from measurement. To increse stability of noisy measurements.
P29 – Tank full limit freezes.in exchange

Other markings in the figure::
R –Measurement range
H –Tank height

Note: The reference point for distance measurement "0" is the sealing flange of the device (bottom of hexagon), the lower surface of the flange for flanged devices. If max. distance is set to 0, the probe length is the maximum measuring distance.
The 4…20 mA current output of the level transmitter can be assigned to the measured value, HART® **"PV"** with two parameters:

P10: Lower level value: EView2 →"Device Settings"→"Outputs"→"Assignment of 4-mA")

P11: Upper level value: EView2 →"Device Settings"→"Outputs"→"Assignment of 20-mA")

The cases outlined on the right side of the figure above:

1. The “current output” range is shorter than the max. possible measuring range:
   - The 4 and 20 mA adjusters are located inside the near and far dead zone on the probe, within the limits
2. The range of the 'current output' is equal to the measuring range:
   - Assignment of 4-mA (P10): = “0 level” distance – maximum measuring distance.
   - Assignment of 20-mA (P11): = “0 level” distance – minimum measuring distance.
3. The “current output” range is longer than the measuring range:
   - Assignment of 4-mA (P10): shorter than “0 level” distance – maximum measuring distance.
   - Assignment of 20-mA (P11): = “0 level” distance – minimum measuring distance.
4. The “current output” range is longer than the measuring range:
   - Assignment of 4-mA (P10): = “0 level” distance – maximum measuring distance.
   - Assignment of 20-mA (P11): distance longer than “level 0” – minimum measuring distance.
5. The “current output” range is longer than the measuring range:
   - Assignment of 4-mA (P10): shorter than “0 level” distance – maximum measuring distance.
   - Assignment of 20-mA (P11): distance longer than “level 0” – minimum measuring distance.

5.3.3. Echo Loss Handling

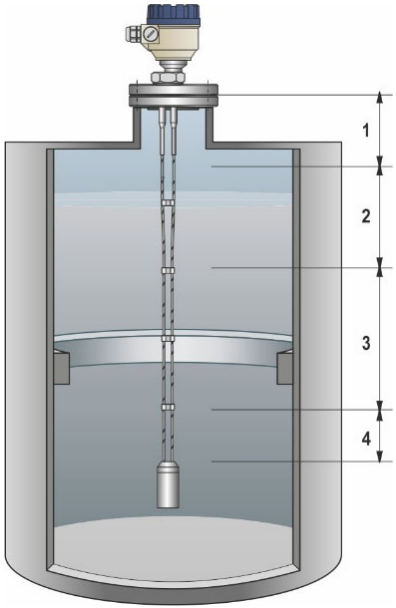
By default, the device searches for the strongest (largest amplitude) reflected signal along the probe length. The reflected signal typically disappears when the level is in the upper dead zone or near the bottom of the tank.

In the case of echo loss, the device holds the value for 10 seconds by default. After this, the output either holds the last value or, if configured differently, switches to an error current (3.8 or 22 mA) in the case of an error signal. On the display and HART remote transmission, the transmitted measured value is 'NaN', meaning 'Not a Number' (the display depends on the device). This is accompanied by the 'No echo' indication and display.

Other indications:
"E" for "Empty", "F" for "Full", "Echo in near blocking": echo in the near zone, "Echo in far blocking": echo in the far zone.

(On PC. In "EView2" while the instrument is polled. The "Device Status" window can be accessed and used to monitor the status of the instrument and the measurement. In addition, several operation parameters like the echo map can be followed on the SAP−300 display).

The echo processing zones that can be programmed are shown in the following figure.



Zone 1: Close-end blocking (P05):
It can be used to detect unwanted interference. No reflections are detected in this zone. When the level is reached, a "No echo" signal is displayed.

Caution! Multiple echoes of the level in the zone outside the zone may be picked up by the instrument.

Zone 2: Tank full limit (P29)
If the level is above the Tank full limit, measurement is still active up to the Minimum measurement distance (P05). In this case, the device returns the value of the Tank full limit or the values calculated from it, and displays "F" as "Full" and "Echo in near blocking" on the screen and in the EView2 polling window.

Zone 3: Actual measuring zone
The distance from the Tank full limit (P29) to the Zero level distance (P04) or the valid Maximum measuring distance (P06).

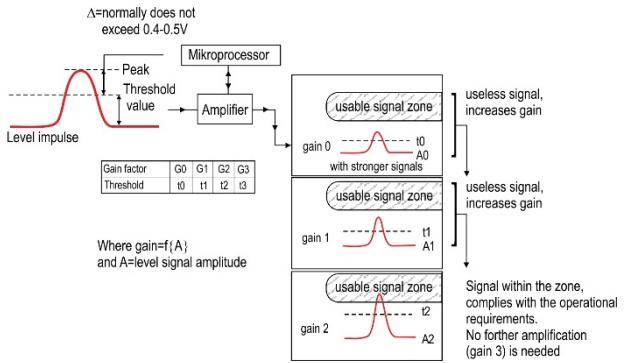
Zone 4: Far-end blocking (P06)
By default, it is set to "0" when off. When set to valid, this zone will be kept below the Maximum measuring distance (P06) until the Zero level (P04) is reached. When the level is in this zone, the output is fixed at the value corresponding to the Maximum measuring distance.
The display shows "E" for "Empty" or "Echo in far blocking". The "Echo in far blocking" signal is also detected when EView2 is consulted.

5.3.4. Gain and Voltage Amplitude

Based on the principle of measurement, the TDR guided radar emits a radar pulse and then "waits" for its reflections in time: it registers them as a time-varying voltage. The it calculates the distance from the time and the propagation speed of the radar signal. The eternal question is which reflection comes from the target we are looking for.
This is decided by a complex algorithm running on the transmitter microcontroller. It is important to configure it well.
Ideally, such a reflection with the largest voltage amplitude comes from the level of the material in the container. However, reflections from many other objects and the background noise of the electronics also interfere with the measurement. It is easy for the extent and amplitude of the reflections from the disturbances to rival its level.

- For strong, high-amplitude signals, the "Threshold" line is used to help differentiate between level echo and interference.
- In case of a weak signal, the amplification also helps, it highlights the signal from the noise, which is easier to measure. The automatic gain switching has its limits

Signal gain example (automatic by default):



Gain factor

The gain is automatically set by default to make the measured signal as ideal as possible.
In addition, a custom value or gain range can be set with parameter **P24**.
The amplitude of the signal is proportional to the dielectric factor (ε_r) of the measured substance.
For small amplitudes, gain must be used.
The applicable gain depends on the dielectric constant (ε_r) and the type of probe.

Stage	Gain factor
1	1.00
2	2.111
3	4.4
4	8.927

Threshold curve

The threshold line is used to filter out interference. The principle of operation is as follows:

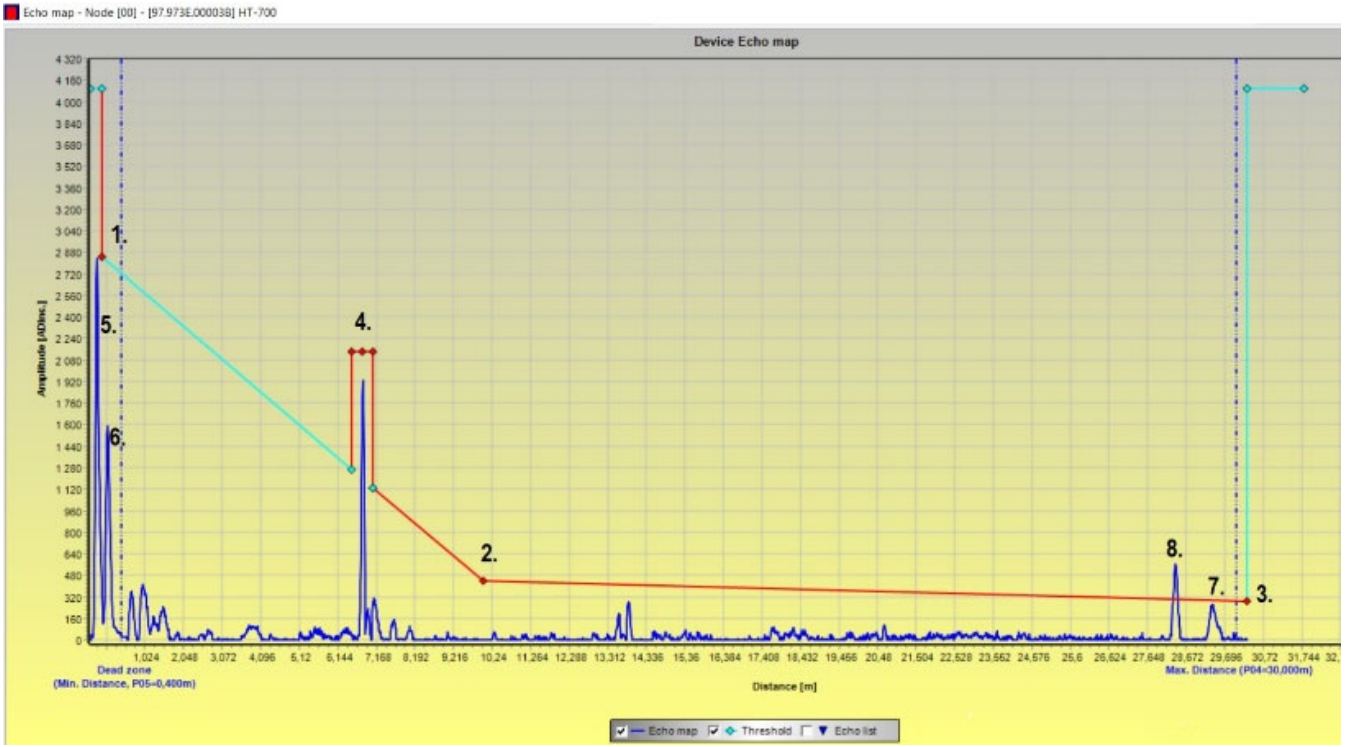
- Reflections in the area below the line: noise and disturbance signals must not be selected as the echo peak of the measured level.
- However, as soon as the level reaches the interference, the amplitude of the signal from the disturbance and the signal from the level add up.

It crosses the threshold and is selected as the level indicator.

The factory default threshold can be used for most average measurement tasks, but may need to be modified depending on the particular installation and application:

- Measuring mediums with a very low dielectric constant (ε_r), like oil.
- In case of multiple interference reflections or due to unfavorable installation conditions.
- To avoid measuring for deposits on the probe.
- For tank connection with impedance coupling other than the factory setting.

The figure below shows a radar echo diagram and a threshold line with threshold extension:



The **Main threshold is defined by** “1.”, “2.”, “3.”

- Adjustment is only permitted in justified cases: e.g.: elevated baseline, signal level, strong noise conditions close to the level transmitter!
- Signals in the area below the two extremes and below the line are not selected.
- The main threshold line can be changed in the Echo diagram by clicking Threshold settings / Threshold edit enabled in the pop-up context menu after pressing the right mouse button.
- Drag the dots on the graph with the left mouse button; the start, center, and endpoint have to be set to detect the minor noises in the waveform.
  The peak of the level echo must be above it at all distances. It must be below the baseline of the signal and the noise.

Four **Threshold masks** are intended to mask larger amplitude or infrequent protruding interferences. An example of this is the dot marked **"4."** in the figure.

- Threshold extensions can also be modified on the Echo chart by clicking Threshold settings / Threshold edit enabled in the pop-up context menu after pressing the right mouse button.
- In the right-click context menu, you can add a new threshold line addition by clicking Threshold settings / Add Threshold mask point. Where the mouse pointer is on the echo diagram.
- It can be deleted with the Threshold settings / Del current Threshold mask point in the context menu by right-clicking on any of its points.
- The middle of the three points can be moved to the desired location by grabbing them with the left mouse button. It is advisable to leave at least 25 “ADC values” at the top of the fault, but not too much. As soon as the level reaches the interference signal, the amplitude of the level and the amplitude of the interference signal add up, the threshold line addition must be lower to determine the distance.
- The width of the threshold line completion can be adjusted by similarly grasping its extreme points. -The width of the peaks usually fluctuates less than their height, however, it is recommended to leave a little on them as well.
  Deposits may form on the probe. the propagation speed of the radar signal in them slows down. Thus, over time, the distance shifts. Adding a threshold line positioned wider and wider may alleviated the problem. Although the peak of the level is selected, its distance will not be corrected.

Further points in the diagram:

"5.": radar reference signal (transmitter signal or ping).

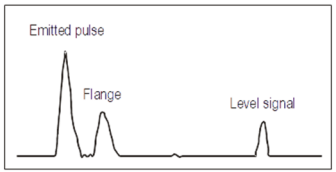
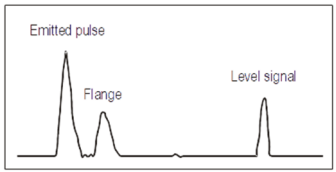
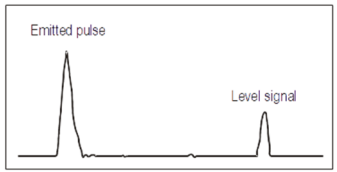
"6.": flange impulse (does not occur with a coaxial probe).

"7.": reflection from the probe’s end of weight.

"8.": the echo peak of the level.

5.3.5. Interpreting Echo Maps

The following diagrams show typical waveforms recorded in Echo diagram mode.

			
Rod or cable probe in stage 1 gain	Rod or cable probe in stage 2 gain	Coaxial probe in stage 1 gain	Coaxial probe in stage 2 gain

There is no flange reflection in the coaxial probe diagram because the mechanical design does not cause an impedance change along the probe at the flange.
The amplitude of the signal reflected from the surface of the measured substance increases as the level increases and decreases as the level decreases.
Note for the measurement of solids: for most solids measurements, the measurement is made at a gain factor of 4 (except for powders and granules with a high dielectric constant (ε_r), such as carbon dust).
If there are difficulties with the level measurement between the device's gain factor 2 and 4 at a certain point in the level measurement, there is usually some interfering object (protruding part, etc.) in the tank in the path of the electromagnetic measuring pulse. Thus, the device gives a false level value when it detects the largest signal reflected there.

5.3.6. Interface measurement

Optional advanced feature. For devices equipped with this feature. If the conditions are met, it is possible to measure the levels of two superimposed materials simultaneously.

In industry terminology, the interface between the upper gaseous layer and the material below is referred to as the **level**. This is also referred to as the first or level/product level/upper interface or distance, abbreviated as **IF1**. The measured and calculated values derived from this are: DIST1 (Distance 1), LEV1 (Level 1), MASS1 (Mass 1), VOL1 (Volume 1). By default, this is transmitted by the instrument as HART PV, analog 4…20 mA current transmission, or HART digital value.

The second contact surface between the two materials below IF1, is called the **interface**. This will be further referred to as the second or lower interface/level/distance, abbreviated as **IF2**. The measured and calculated values derived from it are: DIST2 (distance 2), LEV2 (level 2), MASS2 (mass 2), VOL2 (volume 2). By default, this value is transmitted by the device as a HART SV (Secondary Value). However, IF2 can also be set as PV (current transmission), or TV (Third Value), and QV (Fourth Value).

To enable interface measurement, the device's operating mode must be set to **"Liquid Interface Measurement"** *(Liquid interface (optional) (P00a=2))*. This can be found in the *"Device settings"* menu under *"Application"* in the EView2 configuration program.

It is essential to specify the relative dielectric constant of the upper measured medium (P09=εr) to accurately determine the "second" distance. If the dielectric constant is not precisely known, the difference in distance between the measured and actual values of the first and second interfaces can be used as an estimate. The following formula provides a reliable approximation for the εr value:

$$\varepsilon_r = \left(\frac{Measured\ layer\ thickness}{Actual\ layer\ thickness}\right)^2$$

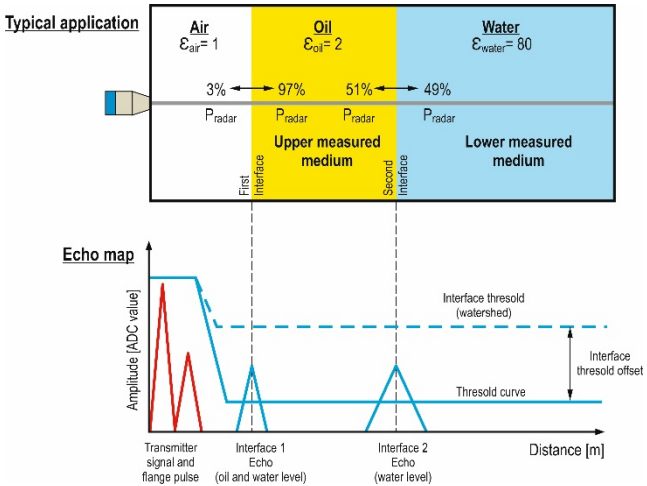
Additionally, the **threshold curve** must be adjusted to suit the specific application. The factory-default threshold curve is optimized for a dielectric constant of 80 and ideal, interference-free measurement conditions. The problem is that low-amplitude echoes are received from both interfaces, which is a characteristic feature of interface measurement requirements.

When only one of the two media is present in the tank, the **Interface Threshold Offset** (P35) is used to identify the source of the echo. The value set for this parameter, when multiplied by the current amplification gain (1x, 2.111x, 4.4x, 8.927x), generates a second, parallel threshold curve at a higher level. The original lower threshold curve remains unaffected. If the echo surpasses both the lower threshold curve and the offset-adjusted threshold curve, it originates from the interface of the lower material with the higher dielectric constant. If the signal only crosses the original lower threshold curve, it is likely the echo from the upper material with a lower dielectric constant. By default, the interface threshold offset is set to 220 [ADC value], which is ideal for oil (εr≈2) and water (εr≈80) interface measurements.

For setups designed for interface measurement, the upper material should have a low dielectric constant (ideally <3, with a maximum of 5…10, depending on the probe type), while the lower material should have a high dielectric constant (ideally >20). The difference in dielectric constants between the two measured materials must be at least 10. Under optimal conditions, the minimum measurable material layer thickness is 0.12 m (0.39 ft).

The maximum measurable layer thickness is primarily determined by the dielectric constant of the upper material. The upper material reaches its maximum measurable thickness at a dielectric constant of approximately 2.

Illustration of interface measurement



5.4. SERVICE FUNCTIONS

5.4.1. Security codes

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

SAP–300	EView2
SERVICE → SECURITY → USER LOCK	*Advanced → Special*

5.4.2. Current output test

P80: Loop current test (mA)

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

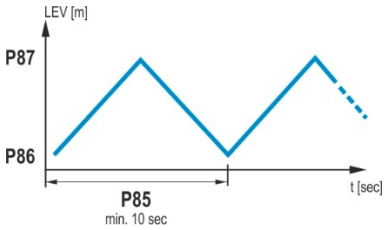
SAP–300	EView2
SERVICE → OUTPUT TEST → ANALOG OUTPUT	—

5.4.3. Simulation

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

P84: - - - a Simulation method **FACTORY DEFAULT: 0**

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



SAP–300	EView2
SERVICE → DIST. SIMULATION	*Advanced → Special*

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

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

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

Unit of measurement: according to P00b.

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

Unit of measurement: according to P00b.

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

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

5.4.4. Load default setting

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

SAP–300	EView2
SERVICE → DEFAULTS → LOAD DEFAULT	*Advanced → Parameters → Load default*

5.4.5. Restart

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

SAP–300	EView2
SERVICE → RESTART	*Advanced → Special*

5.5. TROUBLESHOOTING

Event	Fault	Solution
Error messages [1]		
"Echo in near blocking" state display freezes at maximum or minimum value	Not a fault. The level has reached (and may have exceeded) the entered max. limit value. It then prints the maximum (for level) or the minimum (for distance).	There is none. The measurement will be normal within the programmed limits.
"Echo in far blocking" state display freezes at maximum or minimum value	Not a fault. The level has dropped to the lower dead zone so no further signal detected. It then displays the maximum (for distance) or minimum (for level).	There is none. The measurement will be normal within the programmed limits.
"No echo" state display freezes at maximum or minimum value.	Not a fault. The level has risen to the upper dead zone so no further signal detected.	Empty the tank below the upper level and check its functioning!
"No echo" state display freezes.	The device has lost the signal it is looking for but has not yet found the reflected signal. This can occur if the signal has dropped below the threshold and parasitic signals from the flange or tank failure prevent the true signal from being found.	Ensure that the level in the tank drops below the maximum and check the measurement. If no signal is detected, change the threshold value manually as described in the "**Threshold line**." Use the oscilloscope chart and threshold setting functions (0).

[1] The device is connected to the EView2 software and listed in the "Device Status" window (or the "Markers" window) or the "SAP–300" screen on the lower row with active polling.

Event	Fault	Solution
General operation		
The device is inaccurate for measuring materials with high dielectric constants (ε_r). There is a constant offset when measuring.	The zero level distance (tank height) setting is incorrect	Check the tank height and the parameters. If the device has been replaced, check that the factory parameters are the same as the original! Contact NIVELCO to access the factory menu!
The device indicates an inaccurate level value.	The device does not detect the actual measurement signal.	Check for the presence of components that interfere with the interior of the tank. If the received signal is close to the tank connection, increase the ratio of the detection delay to the dead zone equally, or increase the threshold over the entire measuring range if the full measuring range is important. In all cases, visualize the phenomena using the "Echo Diagram" function of EView2. The threshold should be set to obscure interference but with sufficient margin to detect the useful signal. The reflected pulse image (same as the start signal) may be too large if the probe touches the tank wall or neck. Disconnect!

Event	Fault	Solution
The device does not measure accurately when there are two or more layers in the tank.	The device may not be properly programmed for this application and will measure the interface layer instead of the level.	Make sure that “2 liquids, 1 level” is set to “2 liquids, 1 level” in the “Application” tab of the “Device Programming” window. Also check that the top layer is at least 120 mm (0.393 ft) from the measured material. Contact NIVELCO for the correct setting.
Electrical connection and communication output		
Current output value < 3.5 mA	No power supply	Check the power supply.
	The device is not connected properly.	Check the connection between the device and the power supply.
	The output current setting is incorrect.	Perform the calibration if you have permission to do so, or contact NIVELCO.
Current output value is 22 (3.8) mA	There is an error.	This occurs when 4…20 mA / error 22 (3,8) mA are programmed. Check the status of the device during polling in the “Device status” window.
The status of the current output is not the same as the value on the display or the EView2.	The output current setting is incorrect.	Check the current loop and connections. Set the output as described in the User Manual and try to change the threshold using EView2 – Echo diagram / Threshold settings or the HHC communicator.
Data transmission via the digital interface does not work. The machine is in the process of being set up, wait 20 seconds and try again.	The communication parameters are not set correctly on the computer.	Check the computer settings (address / device number).
	Bad connection to interface.	Check the connection.
	Device current < 3.5 mA	If the problem persists, contact NIVELCO.
	Device current = 22 mA	

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