MicroTREK

HT/HH/HB/HP; HT/HH/HB/HP Ex
two-wire guided microwave level transmitter

User's and Programming manual
4th edition

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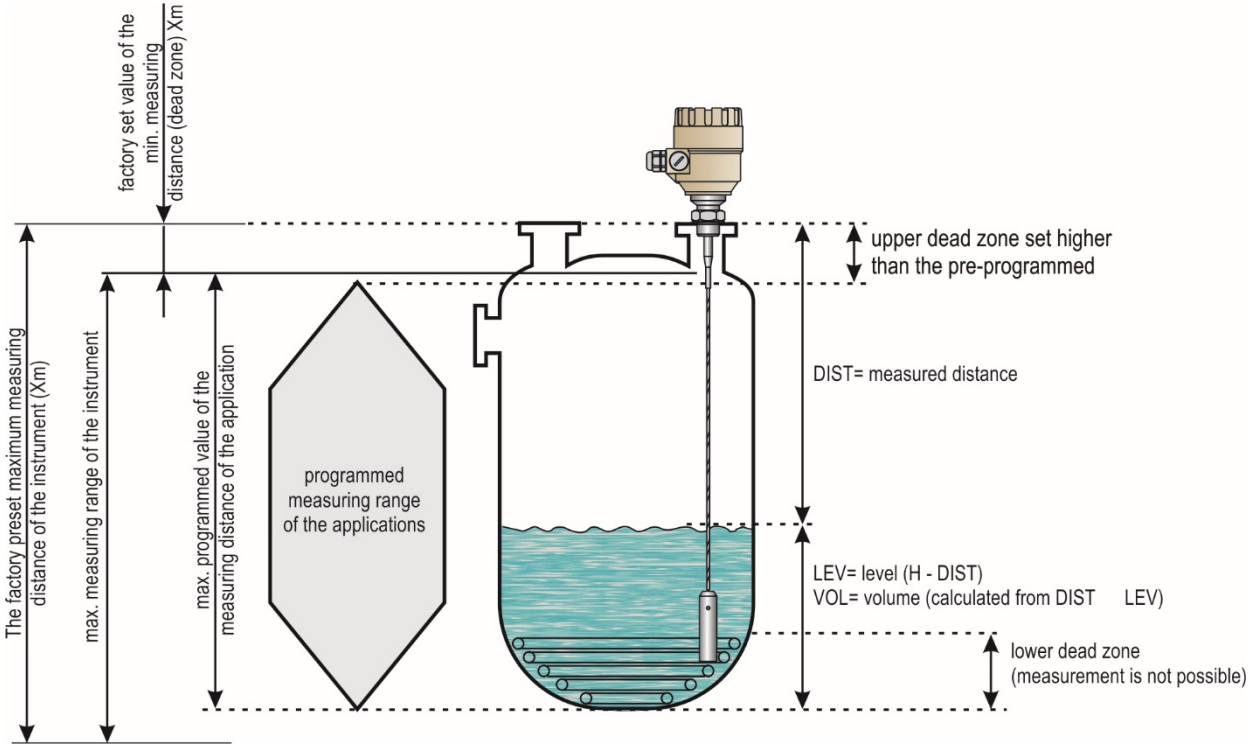
APPROVALS		Reference document number
	BKI ATEX, Certificate No.: BKI16ATEX0018X	htk4014m0600p_03
	BKI IECEx, Certificate No.: IECEx BKI 09.0001 issue No:1	htk4014a0600p_01
	INMETRO, Certificate No.: DNV 14.0169 X Rev. 01	htk4014p0600p_03
	Ex Russia, Certificate No.: RU C-HU.МЮ62.B.04400	htk4014o0600p_02

GUIDED MICROWAVE LEVEL MEASUREMENT



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Thank you for choosing a NIVELCO instrument.
We are sure that you will be satisfied with our product!

1. INTRODUCTION

Application

The MicroTREK 2-wire level gauge uses the Time Domain Reflectometry (TDR) measuring principle and two-wire technology for level measurement.
It is designed for measuring distance, level and volume of liquids, pastes, slurries and powder mediums.
The device is applicable in tank, silo, rigid pipe, reaction-vessel and level reference vessel.
The device is HART® capable, it can be programmed using a HART® Handheld Communicator (HHC), a MultiCONT universal process controller and EView2 software supplied as standard with the gauge.

Operating principle

The MicroTREK 2-wire guided microwave level transmitter uses the TDR (Time Domain Reflectometry) principle. The instrument sends low power nanosecond wide pulses along an electrically conductive rod, cable or coaxial probe with a known propagation speed (the speed of light). As the pulse reaches the surface of the medium or phase of two liquids (altered dielectric constant ε_r), a part of it is reflected back to the electronic module. The efficiency of the reflected signal depends on the dielectric constant ε_r difference of the mediums or layers. (From the plain surface of air-water phase the reflected signal's strength will be approx. 80% of the emitted signal). The reflected pulse is detected as an electrical voltage signal and processed by the electronics. Level distance is directly proportional to the flight time of the pulse. The measured level data is converted into 4 – 20 mA current and HART signals and is displayed on the LCD display. From the level data further measuring values can be calculated such as volume and mass. The TDR technology is unaffected by the other properties of the medium as well as of the space above it.

2. ORDER CODE

MicroTREK H [ ] [ ] - [ ] [ ] [ ] - [ ] **2-wire guided microwave level transmitter**

Type	Code
Transmitter	T
High temperature transmitter	H
Transmitter + display	B
High temp. transmitter + display	P

Probe / Proc. conn.	Code
Coaxial / 1" BSP	A
Coaxial / 1" NPT	B
Coaxial / 1 1/2" BSP	C
Coaxial / 1 1/2" NPT	H
Rod / 1" BSP	R
Rod / 1" NPT	P
Rod / 1 1/2" BSP	S
Rod / 1 1/2" NPT	Z
Twin rod / 1 1/2" BSP	D
Twin rod / 1 1/2" NPT	E
4 mm (0.15 inch) cable / 1" BSP	K
4 mm (0.15 inch) cable / 1" NPT	L
4 mm (0.15 inch) cable / 1 1/2" BSP	V
4 mm (0.15 inch) cable / 1 1/2" NPT	W
8 mm (0.315) cable / 1 1/2" BSP	N
8 mm (0.315) cable / 1 1/2" NPT	J
4 mm (0.15 inch) twin cable / 1 1/2" BSP	T
4 mm (0.15 inch) twin cable / 1 1/2" NPT	U
4 mm (0.15 inch) FEP coated cable 1" BSP	F
4 mm (0.15 inch) FEP coated cable 1" NPT	G
4 mm (0.15 inch) FEP coated cable / DN40 TriClamp	X
4 mm (0.15 inch) FEP coated cable / DN40 Milch	Y
PFA fully coated rod / DN50	Q
4 mm (0.15 inch) FEP fully coat. cable / DN50	M
PP fully coated rod / DN50	I
PFA fully coated rod / 1 1/2" TriClamp	O

Housing	Code
Aluminium	4
Plastic	5
Stainless steel	6

Insertion length	Code
Coaxial, Rod, Twin rod	
0 m (0 ft)	0
1 m (3.3 ft)	1
2 m (6.6 ft)	2
3 m (10 ft)	3
4 m (13.1 ft)	4
5 m (16.5 ft)	5
6 m (20 ft)	6

Cable version	
0 m (0 ft)	0
10 m (32.8 ft)	1
20 m (56.6 ft)	2

Insertion length	Code
Coaxial, Rod, Twin rod	
0 m (0 ft)	0
0.1 m (0.33 ft)	1
0.2 m (0.66 ft)	2
0.3 m (1 ft)	3
0.4 m (1.32 ft)	4
0.5 m (1.64 ft)	5
0.6 m (2 ft)	6
0.7 m (2.3 ft)	7
0.8 m (2.62 ft)	8
0.9 m (3 ft)	9

Cable version	
0 m (0 ft)	0
1 m (3.3 ft)	1
2 m (6.6 ft)	2
3 m (10 ft)	3
4 m (13.1 ft)	4
5 m (16.5 ft)	5
6 m (20 ft)	6
7 m (23 ft)	7
8 m (26.3 ft)	8
9 m (30 ft)	9

Output / Ex	Code
4 – 20 mA + HART / Normal	4
4 – 20 mA + HART / Ex tD (ATEX, EAC)	5
4 – 20 mA + HART / Ex iaD (ATEX, IECEx, EAC, INMETRO)	6
4 – 20 mA + HART / Ex ia (ATEX, IECEx, EAC, INMETRO)	8

3. TECHNICAL DATA

GENERAL DATA

Type		Plastic Housing H□□–5□□–4	Aluminium Housing H□□–4□□–4, –5, –6, –8	Stainless Steel Housing H□□–6□□–4, –5, –6, –8
Input data	Measured values	Between the reference point of the unit and reflection pane (material surface), distance, level and volume		
	Measuring range	Depends on the type of the probe and the properties of the measured medium (see: Technical data on the "probes" chart)		
Types of probes and technical data		Coaxial, twin cable, mono cable, twin rod and mono rod probes (see: Technical data of the probes table)		
Housing		Plastic PBT	Paint coated aluminium	Stainless steel (KO35)
Medium temperature		-30 °C … +200 °C (-22 °F … +392 °F) (see Technical data – MEDIUM TEMPERATURE table)		
Medium pressure		-1 – 40 bar (-0.1 – 4 MPa [-14 – 580 psig]) (see Technical data – MEDIUM PRESSURE diagram)		
Ambient temperature		-30 °C …+60 °C (-22 °F … +140 °F), with display: -20 °C … +60 °C (-4 °F … +140 °F)		
Sealing		FPM (Viton®), optional for high temperature version: FFKM Perfluoroelastomer (Kalrez® 6375), EPDM		
Ingress protection		IP67 (NEMA 4 – 4X)		
Power supply		18 – 35 V DC, nominal 24 V DC, Ex version: 18 – 28 V, protection against surge transients		
Output data	Output signals	Analogue: 4 – 20 mA, (3.9 – 20.5 mA) passive output, error signal: 22 mA		
		BUS: serial line, HART® interface, terminal resistor max. 750 Ω		
		Display: SAP-300 plug-in LCD matrix		
	Accuracy*	For liquids: ±5 mm (±0.2 inch); For probe length L ≥ 10 m (L ≥ 33 ft): ±0.05% of the range		
		For solids: ±20 mm (±0.8 inch); For probe length L ≥ 10 m (L ≥ 33 ft): ±0.2% of the range		
	Resolution	±3 μA		
Electrical connection		2x M20x1.5 metal cable glands for Ø7 – 13 mm (Ø0.3 – Ø0.5 in) cable, or 2x M20x1.5 plastic cable glands for Ø6 – 12 mm (Ø0.23 – 0.47 in) cable wire cross section: 0.5 – 1.5 mm² (AWG15) (shielded cable is recommended) + internal thread for 2x ½" NPT cable protective pipe		
Electrical protection		Class III		
Mass (housing)		1.5 kg (3.3 lb)	2.4 kg (5.3 lb)	4.1 kg (9 lb)

** Under ideal reflection and stabilised temperature conditions.*

TECHNICAL DATA OF THE PROBES

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 -□□□-□
Description	4 mm cable (0.15 inch)	Rod		8 mm cable (0.3 inch)	4 mm twin cable (0.15 inch)	Twin rod	Coaxial
Max. measuring distance	24 m (80 ft)	3 m (10 ft)	6 m (20 ft)	24 m (80 ft)		3 m (10 ft)	6 m (20 ft)
Min. measuring distance εr = 80 / εr = 2.4	0.3 m / 0.4 m (1 ft / 1.3 ft)				0.15 m / 0.3 m (0.5 ft / 1 ft)		0 m (0 ft)
Min. distance to objects	∅600 mm (Ø2 ft)				∅200 mm (Ø 0.65 ft)		∅0 mm (0 ft)
Min. medium εr	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
Probe material	1.4401	1.4571		1.4401		1.4571	
Nominal diameter of probe	4 mm (0.15 inch)	8 mm (0.3 inch)	14 mm (0.55 inch)	8 mm (0.3 inch)	4 mm (0.15 inch)	8 mm (0.3 inch)	28 mm (1.1 inch)
Mass	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 on the cable	PTFE-GF25 if length > 1.5 m (5 ft)	PTFE, If length >1.5 m (5 ft)
Weight dimensions	Ø25 x 100 mm (Ø1 x 4 inch)	–		Ø40 x 260 mm (Ø1.5 x 10 inch)	Ø40 x 80 mm (Ø1.5 x 3 inch)	–	
Weight material	1.4571 (316Ti)	–		1.4571 (316Ti)	1.4571 (316Ti)	–	

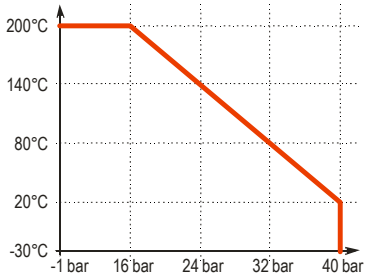
TECHNICAL DATA OF THE COATED PROBES

Type	H□F, H□G -□□□-□	HTX-□□□-□	HTY-□□□-□	HTM-□□□-□	HTQ-□□□-□	HTI-□□□-□
Description	4 mm (0.15 inch) FEP coated cable			4 mm (0.15 inch) fully FEP coated cable	Fully PFA coated rod	Fully PP coated rod
Max. measuring distance	24 m (80 ft)				3 m (10 ft)	
Min. measuring distance ε_r = 80 / ε_r = 2.4	0.3 m / 0.4 m (1 ft / 1.3 ft)					
Min. distance to objects	∅600 mm (Ø2 ft)					
Min. medium ε_r	2.1					
Process connection	1" BSP 1" NPT	DN40 TriClamp	DN40 Milch	DN50		
Probe material	1.4401 (316) / FEP				1.4571 (316) / PFA	1.4571 (316) / PP
Nominal diameter of the probe	6 mm (0.23 inch)				12 mm (0.5 inch)	16 mm (0.62 inch)
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)
Fillet coating material	–			PFA		PP
Weight dimensions	Ø25 x 100 mm (Ø1 x 4 inch)				–	
Weight material	1.4571 (316Ti)				–	
Max. medium temperature	+150 °C (+302 °F)					+60 °C (+140 °F)

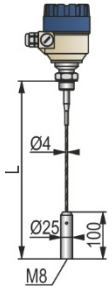
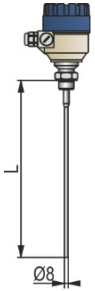
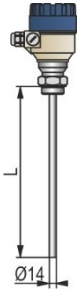
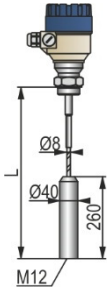
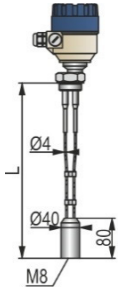
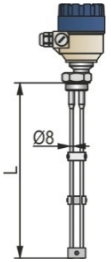
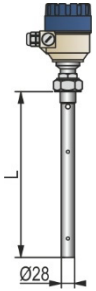
MEDIUM TEMPERATURE TABLE

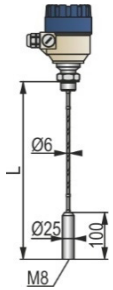
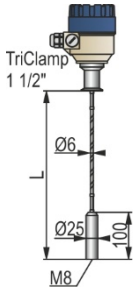
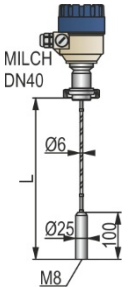
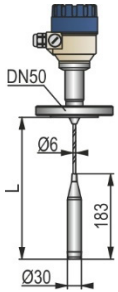
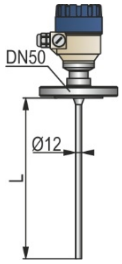
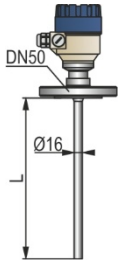
Type	Flange temperature
Transmitter	-30 °C … +90 °C (-22 °F … +194 °F)
High temp. HH□ or HP□ transmitter	-30 °C … +200 °C (-22 °F … +392 °F)

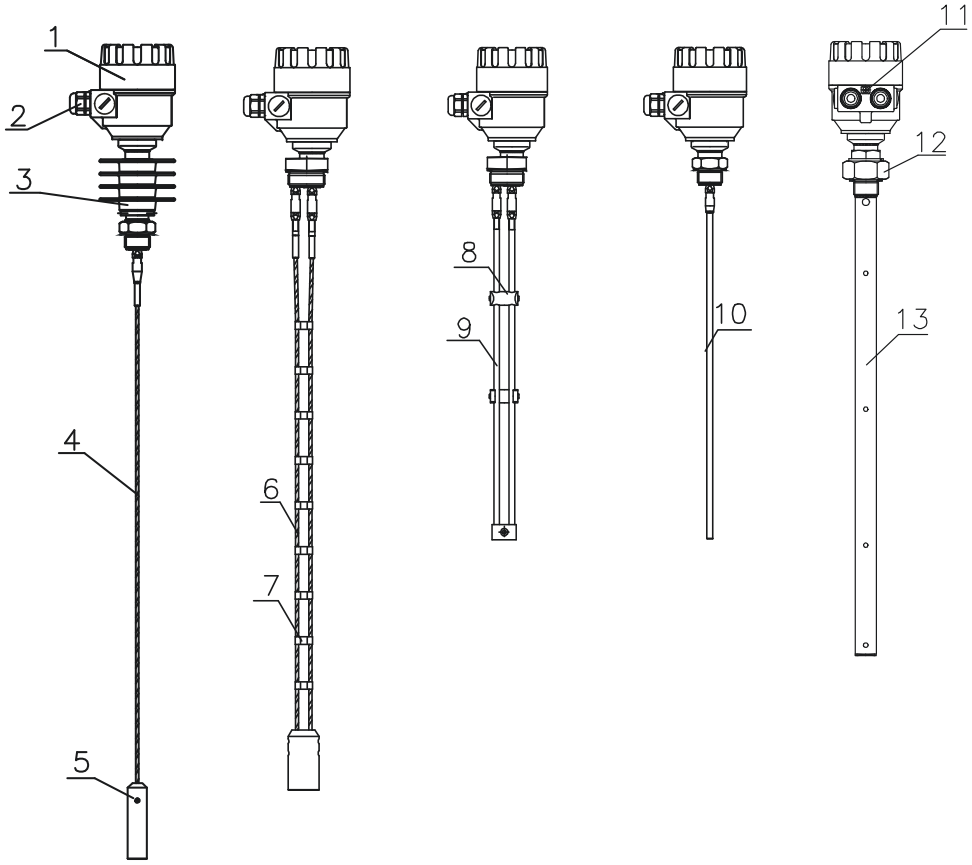
MEDIUM PRESSURE DIAGRAM



DIMENSIONS

HTK, HTL, HTV, HTW–□□□–□	HTR, HTP –□□□–□	HTS, HTZ –□□□–□	HTN, HTJ –□□□–□	HTT, HTU –□□□–□	HTD, HTE –□□□–□	H□A, H□B, H□C, H□H –□□□–□
						

HTF, HTG –□□□–□	HTX–□□□–□	HTY–□□□–□	HTM–□□□–□	HTQ–□□□–□	HTI–□□□–□	
						



1 Housing
2 Cable gland
3 High temp. connection
4 Mono cable probe
5 Weight
6 Twin cable probe
7 Twin cable separator
8 Twin rod separator
9 Twin rod probe
10 Mono rod probe
11 Grounding screw
12 Process connection
13 Coaxial probe

3.1. EXPLOSION PROTECTION, EX MARKINGS, EX LIMIT DATA

3.1.1. ATEX Approval No.: BKI16ATEX0018X

For intrinsically safe [Ex ia] protection modes

Type	Metal housing with SAP display HB□–□□□–6, –8Ex	Metal housing without SAP display HT□–□□□–6, –8Ex	High temperature version with metal housing with SAP display HP□–□□□–6, –8Ex	High temperature version with metal housing without SAP display HH□–□□□–6, –8Ex
Ex marking (ATEX)	Ⓔx II 1G Ex ia IIB T6…T3 Ga	Ⓔx II 1G Ex ia IIC T6…T3 Ga	Ⓔx II 1G Ex ia IIB T6…T3 Ga	Ⓔx II 1G Ex ia IIC T6…T3 Ga
	Ⓔx II 1D Ex ia IIIC T85°C…T110°C Da		Ⓔx II 1D Ex ia IIIC T85°C…T180°C Da	
Ex power supply, Intrinsically safety data	Ci ≤ 10 nF, Li ≤ 10 µH, Ui ≤ 30 V, Ii ≤ 140 mA, Pi ≤ 1 W	Ci ≤ 10 nF, Li ≤ 10 µH, Ui ≤ 30 V, Ii ≤ 100 mA, Pi ≤ 0,75 W	Ci ≤ 10 nF, Li ≤ 10 µH, Ui ≤ 30 V, Ii ≤ 140 mA, Pi ≤ 1 W	Ci ≤ 10 nF, Li ≤ 10 µH, Ui ≤ 30 V, Ii ≤ 100 mA, Pi ≤ 0,75 W

For dust protection by enclosure [Ex tD] protection modes

Type	Metal housing HB□–□□□–5Ex HT□–□□□–5Ex	High temperature version with metal housing HP□–□□□–5Ex HH□–□□□–5Ex
Ex marking (ATEX)	Ⓔx II 1/2 D Ex ta/tb IIIC T85°C…T110°C Da/Db	Ⓔx II 1/2 D Ex ta/tb IIIC T85°C…T180°C Da/Db
Ex power supply, Intrinsically safety data	Ui = 12.5 V DC – 30 V DC	

3.1.2. IECEx Approval No.: IECEx BKI 09.0001 Issue No: 1

For intrinsically safe [Ex ia] protection modes

Type	Metal housing with SAP display HB□–□□□–6, –8Ex	Metal housing without SAP display HT□–□□□–6, –8Ex	High temperature version with metal housing with SAP display HP□–□□□–6, –8Ex	High temperature version with metal housing without SAP display HH□–□□□–6, –8Ex
Ex marking (IECEx, INMETRO)	Ex ia IIB T6…T3 Ga	IIC T6…T3 Ga	Ex ia IIB T6…T3 Ga	Ex ia IIC T6…T3 Ga
	Ex ia IIIC T100°C Da			
Ex power supply, Intrinsically safety data	Ci ≤ 10 nF, Li ≤ 10 µH, Ui ≤ 30 V, Ii ≤ 140 mA, Pi ≤ 1 W			

3.1.3. INMETRO Approval No.: DNV 14.0169 X – Rev. 01.

For intrinsically safe [Ex ia] protection modes

Type	Metal housing with SAP display HB□–□□□–6, –8Ex	Metal housing without SAP display HT□–□□□–6, –8Ex	High temperature version with metal housing with SAP display HP□–□□□–6, –8Ex	High temperature version with metal housing without SAP display HH□–□□□–6, –8Ex
Ex marking (IECEx, INMETRO)	Ex ia IIB T6…T3 Ga	IIC T6…T3 Ga	Ex ia IIB T6…T3 Ga	Ex ia IIC T6…T3 Ga
	Ex ia IIIC T100°C Da			
Ex power supply, Intrinsically safety data	Ci ≤ 10 nF, Li ≤ 10 µH, Ui ≤ 30 V, Ii ≤ 140 mA, Pi ≤ 1 W			

3.1.4. EAC Approval No.: RU C-HU.МЮ62.B.04400

For intrinsically safe [Ex ia] protection modes:

Type	Metal housing with SAP display HB□–□□□–6, –8Ex	Metal housing without SAP display HT□–□□□–6, –8Ex	High temperature version with metal housing with SAP display HP□–□□□–6, –8Ex	High temperature version with metal housing without SAP display HH□–□□□–6, –8Ex
Ex marking (EAC)	0Ex ia IIB «T6…T3» Ga X	0Ex ia IIC «T6…T3» Ga X	0Ex ia IIB «T6…T3» Ga X	0Ex ia IIC «T6…T3» Ga X
	Ex ia IIIC «T85°C…T110°C» Da X		Ex ia IIIC «T85°C…T180°C» Da X	
Ex power supply, Intrinsically safety data	Ci ≤ 10 nF, Li ≤ 10 µH, Ui ≤ 30 V, Ii ≤ 140 mA, Pi ≤ 1 W	Ci ≤ 10 nF, Li ≤ 10 µH, Ui ≤ 30 V, Ii ≤ 100 mA, Pi ≤ 0,75 W	Ci ≤ 10 nF, Li ≤ 10 µH, Ui ≤ 30 V, Ii ≤ 140 mA, Pi ≤ 1 W	Ci ≤ 10 nF, Li ≤ 10 µH, Ui ≤ 30 V, Ii ≤ 100 mA, Pi ≤ 0,75 W

For dust protection by enclosure [Ex tD] protection modes:

Type	Metal housing HB□–□□□–5Ex HT□–□□□–5Ex	High temperature version with metal housing HP□–□□□–5Ex HH□–□□□–5Ex
Ex marking (ATEX)	Ex ta IIIC «T85°C…T110°C» Da X Ex tb IIIC «T85°C…T110°C» Db X	Ex ta IIIC «T85°C…T180°C» Da X Ex tb IIIC «T85°C…T180°C» Db X
Ex power supply, Intrinsically safety data	Ui = 12.5 – 30 V DC	

3.1.5. Temperature data for ex certified models

Temperature limit data for ATEX and IECEx approvals

Temperature data	Explosive gas atmosphere				Explosive dust atmosphere			
	Aluminium and stainless-steel housing H□□–□□□–8Ex				Aluminium and stainless-steel housing H□□–□□□–5, –6Ex			
				High temperature HH□–□□□–8Ex HP□–□□□–8Ex				High temperature HH□–□□□–6Ex HP□–□□□–6Ex
	Ex ia IIC, Ex ia IIB				Ex ia IIIC, Ex ta/tb IIIC			
Maximum permissible medium 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)
Maximum permissible 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)
Maximum permissible ambient temperature	≤ 60 °C (≤ 140 °F)							
Temperature class	**T6**	**T5**	**T4**	**T3**	**T85°C**	**T100°C**	**T110°C**	**T180°C**

Temperature limit data for IECEx and INMETRO approvals

Temperature data	Explosive gas atmosphere				Explosive dust atmosphere
	Aluminium housing H□□–4□□–8Ex				Aluminium housing
				High temperature HH□–4□□–8Ex HP□–4□□–8Ex	HT□–4□□–6Ex HB□–4□□–6Ex
	Ex ia IIC, Ex ia IIB				Ex ia IIIC
Maximum permissible medium temperature	≤ 85 °C (≤ 185 °F)	≤ 100 °C (≤ 212 °F)	≤ 135 °C (≤ 275°F)	≤ 200 °C (≤ 392 °F)	+90 °C (+194 °F)
Maximum permissible ambient temperature	≤ 60 °C (≤ 140 °F)				
Temperature class	**T6**	**T5**	**T4**	**T3**	**T100°C**

3.2. ACCESSORIES

- Warranty Card
- User's and Programming Manual
- EU declaration of Conformity
- EView2 software CD
- 2 pcs M20x1.5 cable glands
- SAP-300 display module (option)
- Flat seal (where justified)

3.3. SPECIAL CONDITIONS OF SAFE USE

The device with SAP display must not be operated in Ex ia IIC environment!

Transmitters with spark-free mode should be connected exclusively to a certified circuit with [Ex ia Ga] IIC or [Ex ia Ga] IIB safety mode, applying maximum values detailed in the 3.1 section.

The metallic housing of the device is to be connected to the network with identical potential (EP).

The aluminium content of the die-cast aluminium alloy case exceeds the limit, which requires the device is protected against any possible sources of spark or ignition resulted by impact or friction effects.

If the device is equipped with a coated sensor, then it should only be operated in a circuit with Ex ia IIB protection mode.

The size of the status window of devices with Ex ia IIC T6…T3 Ga protection level exceeds the limit; therefore, the device is to be protected against effects may cause electrostatic charging."

3.4. MAINTENANCE AND REPAIR

MicroTREK does not require maintenance on a regular basis.

In some very rare instances however, the probe may need a cleaning from deposited material.

This must be carried out gently, without damaging the probe.

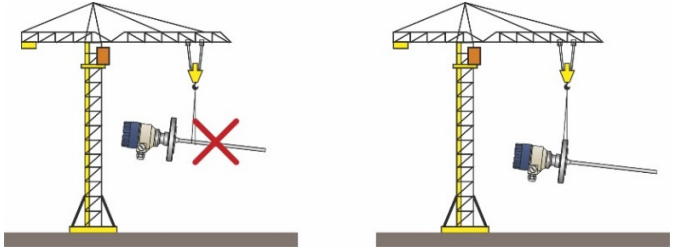
Repairs during or after the warranty period should be carried out exclusively by the Manufacturer.

The equipment sent back for repair is to be cleaned or neutralised (disinfected) by the User prior to despatch.

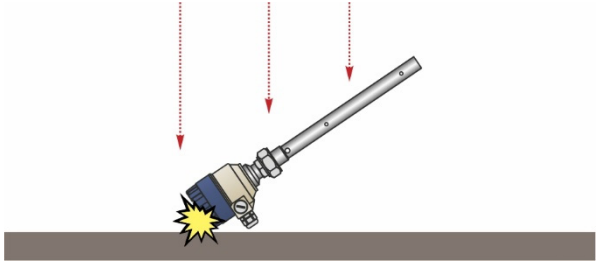
4. MECHANICAL INSTALLATION

4.1. HANDLING AND STORAGE

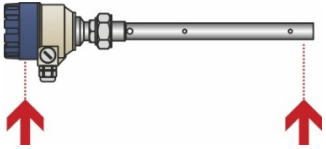
When manually carrying, hold it with both hands, or when powerlifted, pay attention to handle the device with care, lifting it by the converter housing. If necessary, use lifting gear. No attempt should be made to lift the instrument by its probe.
Caution: The probe is a critical gauge component. Do not damage – Handle with care!



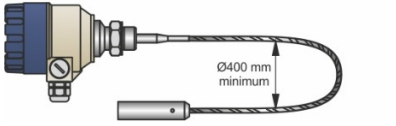
Avoiding blows – avoid hard blows, jolts, impacts, etc.
Caution: fragile electronics



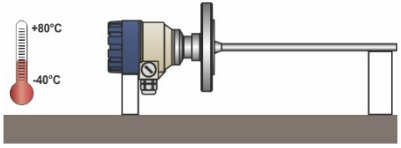
Avoid bending (single rod and coaxial probes) – Support the probe to avoid bending.



Avoid cable kinks and fraying
Do not coil the cable with less than 400 mm (16 inch) in diameter. Cable kinks or fraying will cause measurement errors.



Storage temperature

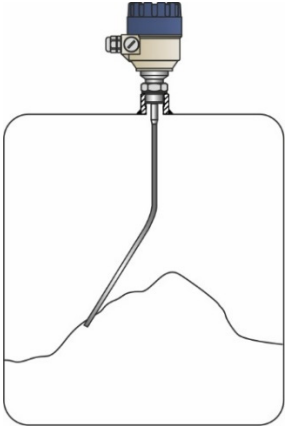
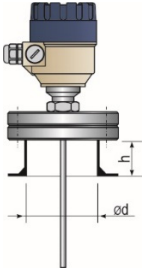
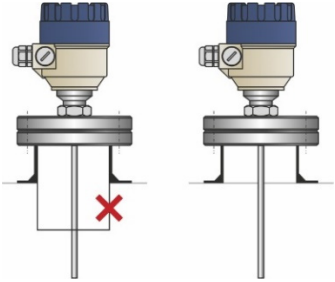


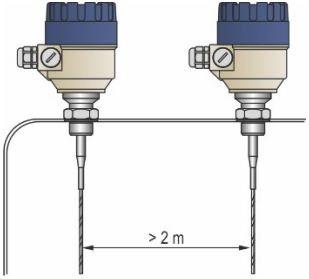
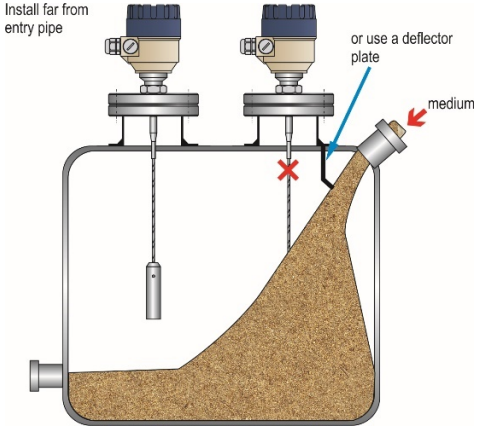
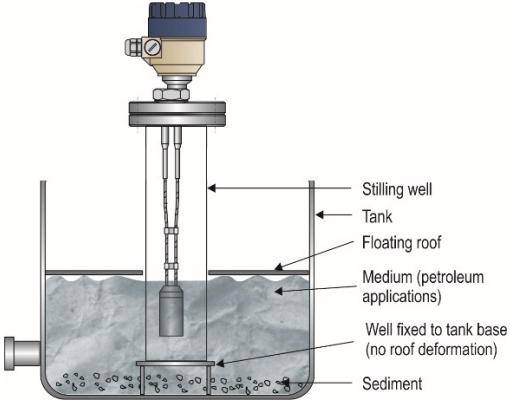
4.2. MOUNTING ON THE TANK

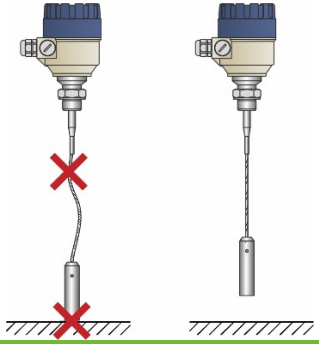
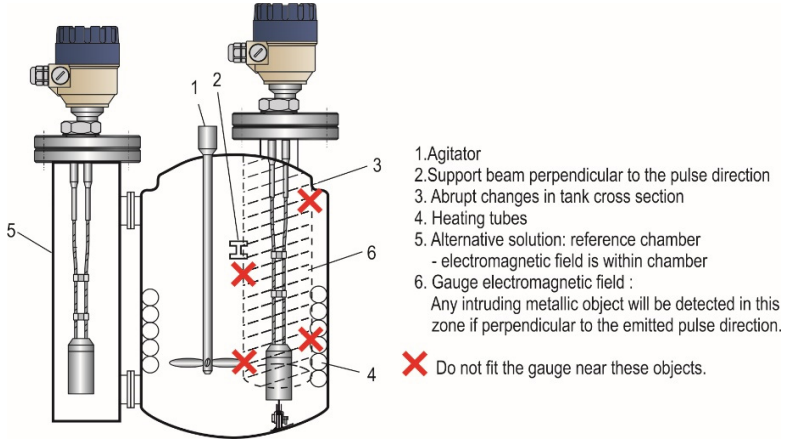
4.2.1. Installation instructions: general notes

Prior to installation the fittings and the shape of the tanks are to be taken into account. Nozzle position in relation to the tank walls and other objects inside the tanks.

(Warning: this free area will depend on the probe type selected: refer to later on in this section) design of the roof of the tank i.e. floating, concrete, integral, etc; and base, i.e. conical, etc. Before installing it, please remember to: Disconnect the power supply, the gauge may be installed when the tank contains the medium.

Threaded process connections	Nozzle height	Nozzles penetrating into tank
The simplest and most economic way is to mount the MicroTREK 2-wire directly on the tank with the 1" (1½") BSP or 1" (1½") NPT threaded connection. 	⚠ Do not fit a nozzle longer than its diameter, especially for single probes and powder applications.  h ≤ Ød, where h = nozzle height and Ød = nozzle diameter ***Contact NIVELCO if this relationship is not feasible.***	⚠  ✕ ***Caution: Do not use nozzles that penetrate into the tank. This will disturb the emitted pulse.***

Installation of two devices	Process connection and entry pipe	Stilling wells
If two devices to be used on the same tank, these should be mounted at a distance of at least 2 m (6.5 ft) from each other. If this is ignored, interferences from the electromagnetic (EM) fields generated by both instruments may cause measurement errors. Coaxial probes: the outer shell of the probe contains the EM field: no minimum distance required. 	⚠ Caution: Do not put the nozzle close to the entry pipe. Pouring the medium directly onto the probe will give false readings. Install deflector plate if impossible to distance gauge from entry pipe. 	Tanks with floating roofs for petrochemical applications: Use a stilling well. 

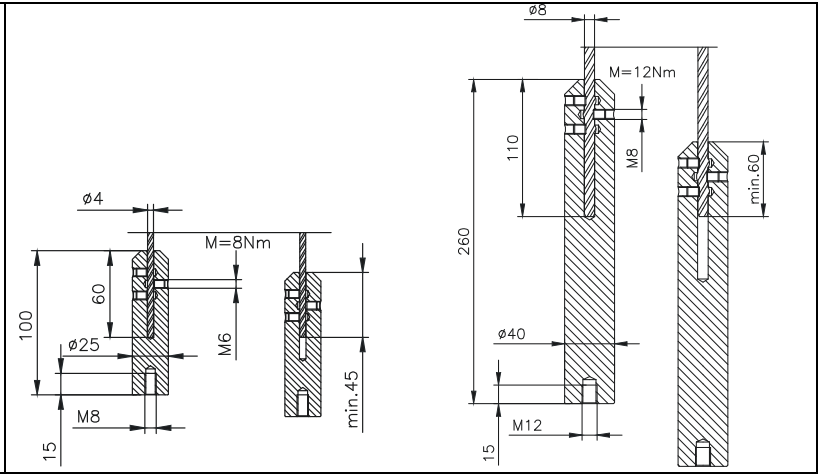
Probes: entanglement, straightness and tank bottom clearance	Agitator in the tank
Cable probes must be straight once inserted into the tank. They must also be far from other objects (e.g. mixers) to avoid entanglement. In order to maintain the gauge's operating characteristics, it is recommended to avoid touching the tank bottom with the counterweights (for cable probes) or probe end (other types). Avoid mounting near objects (discontinuities) inside the tank that influence the probe's EM (electromagnetic) field Install the gauge far from protruding objects such as: heating tubes, sudden changes in tank cross-section, tank wall reinforcements and beams, weld lines and dip-stick pipes, etc… 	No electromagnetic field outside the reference chamber. When measuring liquids, the use of a stilling well or reference chamber is favourable because it ensures electromagnetic protection to ensure the accurate measurement.  1.Agitator 2.Support beam perpendicular to the pulse direction 3. Abrupt changes in tank cross section 4. Heating tubes 5. Alternative solution: reference chamber - electromagnetic field is within chamber 6. Gauge electromagnetic field : Any intruding metallic object will be detected in this zone if perpendicular to the emitted pulse direction. ✕ Do not fit the gauge near these objects.

Use sunshade if the unit is exposed to direct sunlight.

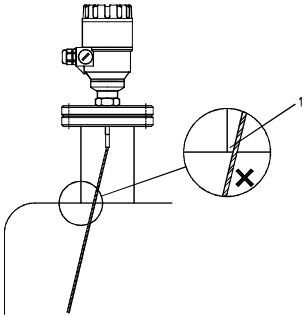
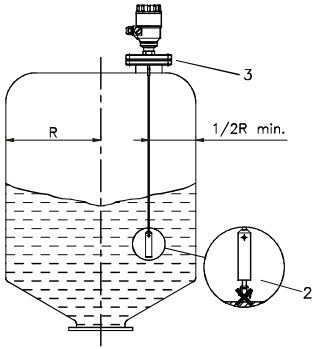
Mounting the probe to the bottom of the tank.
Flexible probes can be fastened with a chuck (ring), turnbuckle or similar fastening device to the bottom of the tank.

Shortening cable probes
If required, the cable probe can be shortened, but this applies only when used in liquids.

Process:
1. Detach socket set screw M6x10 (ISO 4026) with 5 mm (0.20 inch) Allen (hexagon) key (ISO 2936).
2. Pull cable out of counterweight and shorten to required length using cable cutters to prevent the cable wires and strands from fraying out.
3. Insert cable back into counterweight and tighten it with screws.
4. Change configuration parameters with respect to the new probe length; with the reference point is the top edge of the weight.



4.2.2. Specific installation instructions: gauge – solid applications

False readings	Conical silo nozzles, false readings and traction on the cable probes
Do not let the probe touch the side of the nozzle. 	

⚠ High traction forces: We recommend no to anchor the probe, in order to avoid excessive traction loads on the cable.

Bending and traction:
Position the connection on the roof at ½ radius of the tank and with minimum nozzle height. Thus, the damages might occur during emptying due to bending or traction can be avoided.

Traction load is depending on the height and shape of the tank, medium particle size & density, and the rate at which the tank is emptied. The following chart provides the tensile load values true for the different material.

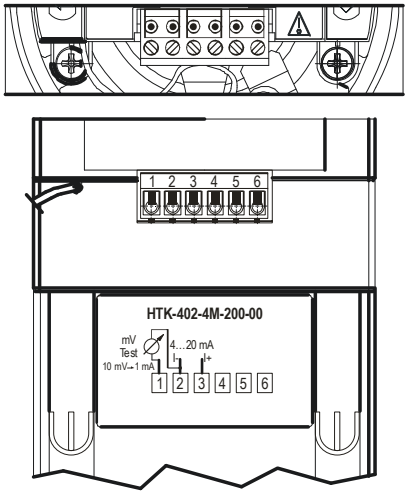
Probe type	Material	Probe Length		
		6 m (20 ft)	12 m (40 ft)	24 m (80 ft)
Mono cable Ø8 mm (Ø0.31 inch), max. load: 3.0 T	Cement	0.6 T	1.2 T	2.4 T
	Fly ash	0.3 T	0.6 T	1.2 T

Medium build-up may occur under the nozzle: this may weaken the pulse.
Avoid cavities that permit the build-up of deposits.

Tank roofs should support loads of at least 3 T for gauge installations using Ø8 mm (Ø 0.31 inch) single cable probes.

4.3. WIRING

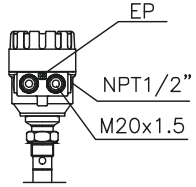
Wiring in non-Ex environment



1. Detach the cover of the unit
2. Guide the cable into the housing through the cable gland
3. Remove the insulation from the wire in 4 mm (0.16 inch) length and cut away the free part of the shielding.
4. Connect the wires of the current loop to terminals 2 and 3 (any polarity). Pull back the cable, so that 10 mm (0.4 inch) of it would remain in the cable gland. Tighten the cable gland using two wrenches.
   Check if the cable gland is adequately tightened and the connection of the wires is proper.
5. Arrange the wires in the housing and screw the cover on the housing.
   The 500 V AC insulation test should not be performed on the instrument because of the overvoltage protection of the electronics.

Connection to the EP network (grounding).

A screw-mounted grounding cable connection with max. 4 mm² (AWG 11) cross-section through EP terminals is available on the side of the housing.
The housing of the MicroTREK must be grounded.
Grounding resistance R < 1 Ω
The shielding of the signal cable should be grounded at the control room.
The shielding doesn't prevent a possible occurrence of electromagnetic noises, therefore route the signal cable away from power cables.

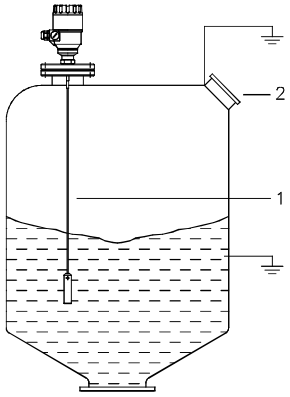


Electrostatic discharge (E.S.D.)

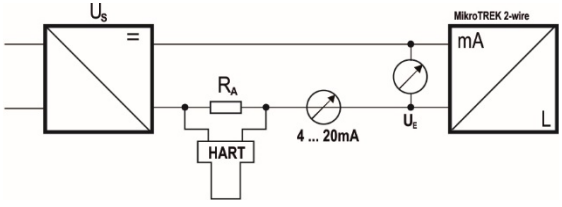
⚠ MicroTREK 2-wire non-Ex and Ex gauge electronics are shielded up to 4 kV against E.S.D.
Note: E.S.D. cannot be solved by MicroTREK 2-wire E.S.D. protection.
It is the customer's responsibility to avoid E.S.D. by grounding the tank, medium and probe installation.

⚠ **DANGER OF INJURY!**

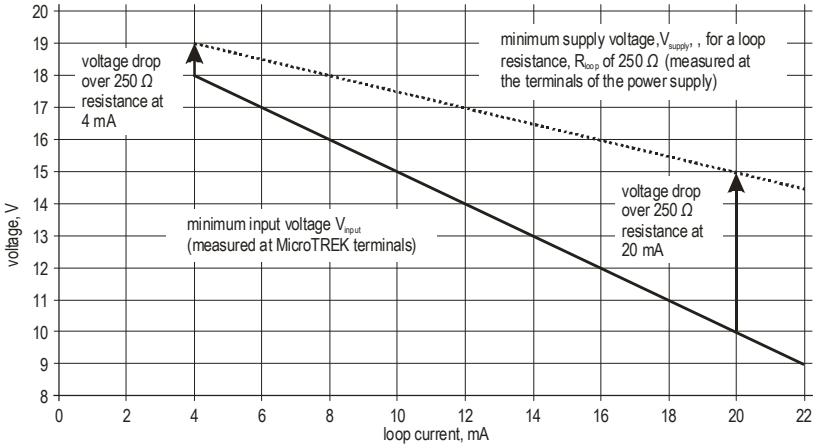
1. The probe may receive an electrostatic discharge during operation; ground the probe by pushing it against the wall of the tank with an adequately isolated tool before touching it to avoid any potential risks electric shock.
2. Ground the entry pipe and medium.



Non-hazardous-duty version



Power supply		
Nominal voltage	24 V DC	
Maximum voltage (U_{input}):	35 V DC	
Minimum voltage (U_{input}):	Depending on the load impedance, see graph below.	
Load impedance R_A		
Loop resistance, R_{loop}	$R_{HART} + R_{cable} + R_{ammeter}$	Ohm
Minimum load impedance R_A	0	Ohm
Maximum load impedance R_A	750	Ohm
R_{HART} resistance for HART® communication	250	Ohm (recommended)



Line A = minimum voltage at the MicroTREK 2-wire terminals
Line B = minimum supply voltage (for voltage drop caused by a 250 Ω loop resistance)

Example for calculating the power supply: The voltage drop is tested at 22 mA:

$U_{power\ minimum\ 22}$ = 22 mA x load impedance + $U_{input\ minimum\ 22}$

$U_{power\ minimum\ 22}$ = 22 mA x 250 Ω + 10 V = 5.5 V + 10 V = 15.5 V

In order to cover the whole current range, the voltage drop must also be tested at 4 mA:

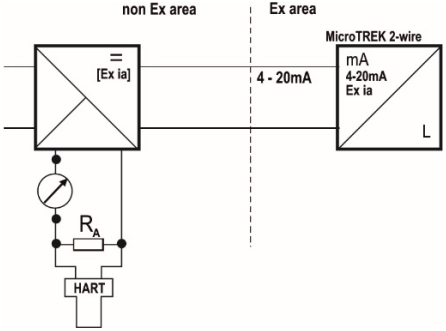
By analogy, the following applies: $U_{power\ minimum\ 4}$ = 4 mA x load impedance + $U_{input\ minimum\ 4}$

$U_{power\ minimum\ 4}$ = 4 mA x 250 Ω + 18 V = 1 V + 18 V = 19 V

At a load impedance of 250 Ω a power supply voltage of 19 V is sufficient to energize the current device range of 4 – 20 mA.

Hazardous-duty version

Connect the wires of the current loop to terminals 2 and 3 (any polarity). The device is certified to be intrinsically safe may only be used in conjunction with another intrinsically safe certified equipment. All the allowed electrical safety data indicated on the nameplate must be observed.



An 'Ex' repeater power supply unit must be used.

For calculation of the supply voltage the same applies as for the standard non-'Ex' version.

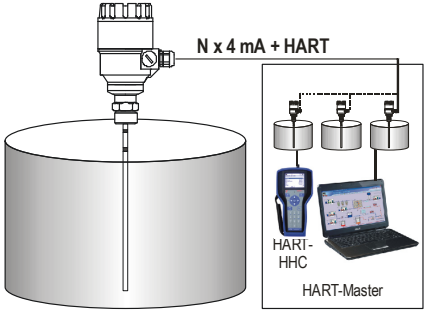
The connected Ex repeater must be HART®-compatible so that it can be operated with the EView2 communication software or the HART® communicator.

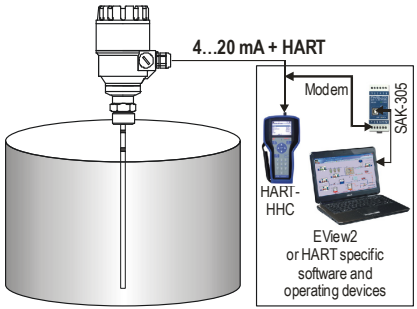
The HART® adapter should be connected to the intrinsically safe input of the Ex repeater! Units with plastic coating should only be used in IIB gas class hazardous area.

4.3.1. BUS (HART®) communication

MicroTREK has two output options:	Current out. and HART®,	Passive, HART® protocol
	'Ex ia' current out. and HART®	Intrinsically safe passive, HART® protocol

Both versions compatible with HART® protocol, and can be operated with EView2 configuration software or MultiCONT universal process controller (with display!). In accordance with the Rosemount Standard, HART® communication can be used with a MicroTREK 2-wire. It is used as a point-to-point connection between the MicroTREK 2-wire as slave and the HART® master.





4.4. POWER-ON AND START-UP

The MicroTREK 2-wire is pre-configured in accordance with the customer order specifications and ready for use immediately.
Attention! A start-up time of less than 60 seconds should be allowed once the unit is connected and the power is turned on.
If the probe length has been shortened, please refer to the following sections:
3.3.1: Summary of User Functions, user function 1.1.6: Probe length to modify configured probe length.

4.5. AVAILABLE USER INTERFACES

Programming of MicroTREK can be done using the following instruments / accessories:

SAP-300 display unit	Optional. See chapter „5.1. Programming with SAP-300 display unit".
MultiCONT universal process controller	To be ordered separately. For programming instructions see the User Manual of MultiCONT.
HART® (HHC) Handheld Communicator	Separately available. Automatic device detection upon power-on. See chapter „5.3 Programming with HART® (HHC) Communicator".

5. PROGRAMMING

MicroTREK can be programmed in three (basic) ways:

- **Programming with EView2 software**
- **Programming with SAP-300 display unit**
- **Programming with HART® Handheld (HHC) Communicator** (For operating instruction see the User manual of the HHC)

5.1. PROGRAMMING WITH EVIEW2 SOFTWARE

5.1.1. EView2 software installation and execution.

Install the "EView2 HART® configuration software" (hereinafter "EView2") as described in chapter 3 of the EView2 software user's manual.
Electrical connections: connect the transmitter to the PC using a HART® adapter (can be ordered separately).

In hazardous-duty systems a HART® communication capable Ex repeater must be inserted in the circuit before the interface! The HART adapter should be connected to the intrinsically safe input of the Ex repeater!

Run the application and detect the devices with the software (see: Chapter 4 of the EView2 User's Manual for more details).

5.1.2. Device programming, configuration with EView2

Select between the detected devices you want to configure or to program and open the "DEVICE SETTINGS" window (for further details see chapter 4.4 and 4.5 of the EView2 User's Manual).

Using EView2, all necessary device parametrization and device settings can be made. The table below summarizes the configuration parameters and their location and path (Table 1).

The **Reset Default** values can be found in the Input Range column in bold type.

5.1.2.1 Parameters

1. table

Function, Parameter name	Input Range	Description
Tank height (P05)	0 – 60 000 mm (2 362 inch)	The level measurement calculation is based on the height of the tank and the relevant current output level measurements and for the relevant current output. It is defined as the distance between the surface of the lower flange and the reference point at the bottom of the tank. The output unit is to be determined at the "Length unit – P01" menu item. The tank height, which is set here is also the upper limit of „Assignment of 4 mA – P17" Note: the device does not measure beyond the programmed probe length if the current output is configured to measure distance or level. **Set value:** "DEVICE SETTINGS" window / "Measurement configuration" tab – „Tank height" parameter.
	As per order	
Dead zone (P06)	Detection delay (P08) … probe length (P07)	

Function, Parameter name	Input Range	Description
Warning: **Critical Parameter!**	**"Minimum measuring distance"** **As probe technical data table**	The dead zone is the minimum measuring distance from the process connection (reference point) to the surface of the medium. So as not to impair measurement accuracy, the minimum values given in Section 3 should be adhered to. The current output can't go inside the dead zone. Signals generated within the dead zone does not be processed. The unit of measurement at the output is to be set by the Length one – P01. **Set value:** "DEVICE SETTINGS" window / "Measurement configuration" tab – „Dead zone" parameter.
Damping time (P18) Time constant	1 – 100 s. **5 s**	This function filters rapid signal fluctuations (eg. caused by the turbulence of the liquid). It only affects the current output. **Set value:** "DEVICE SETTINGS" window / "Measurement configuration" tab – „Damping time" parameter.
Probe length (P07)	Minimum: 100 mm (3.94 inch) Maximum: 24 000 mm (945 inch) **Ordered length** **+ 100 mm (3.94 inch)**	Set probe length + 100 mm (3.94 inch). This value should be modified when the probe replaced or shortened (cable probes). The unit of measurement at the output is to be set by the Length one – P01. In case of a special installation, the length of the Probe may be selected longer than the height of the tank, but less than 24 m (78.74 ft). **Set value:** "DEVICE SETTINGS" window / "Measurement configuration" tab – „Probe length" parameter.
Detection delay (P08)	Minimum value: 0mm (0 inch) Maximum value: Dead Zone **As per order**	This function can be used to define an area directly below the flange in which interference reflections (e.g., from the tank nozzle) are masked. This value has to be smaller or equal to the dead zone (Dead zone – P06). **Set value:** "DEVICE SETTINGS" window / "Measurement configuration" tab –„Detection delay" parameter.
Calculation system, Length unit:		Parameter path: "DEVICE SETTINGS" window / "Application" tab

Function, Parameter name	Input Range	Description
Calculation system (P00)	Select: Metric (EU), Imperial (US) and "Optional Unit"	The units of measurement (length and volume) are shorten according to the unit system set here. When setting / changing units of measurement, you must first select the Calculation system and then select the unit of measurement to use. According to the list of a previous narrow-down search. **Set value:** "DEVICE SETTINGS" window / "Application" tab – „Calculation system" parameter.
Length unit (P01)	Select: m, cm, mm, inch, ft **mm**	Displaying the unit of measure of distance and level. If "Optional Unit" is selected, the user-defined units specified in the "Optional Unit" parameter (Unit name, conversion factor) can be set, and the user-defined unit will be used as the distance unit. The unit selected here is also valid for the following functions, if "Level" or "Distance" mode is selected in the Current generator mode – P11 parameter: Tank height – P05, Dead zone – P06, Probe length – P07, Assignment of 4 mA – P16, Assignment of 20 mA – P17, Detection delay – P08. Or the unit in the „Source" column of the VM table (VMT). **Set value:** "DEVICE SETTINGS" window / "Application" tab – „Engineering units -> Length unit" parameter, or „Optional Unit" tab in „Units name" and „Conversion factor" parameter.
Volume unit (P02)	Select: m³, l, US Gal, ft³, bbl, m³/h, ft³/h, kg, metric tonnes, or tons US	Unit of displayed volume / conversion value. Conversion means converting a level value into a "conversion value" (usually volume) in order e.g. to realize a non-linear function as a factor of the level.

Function, Parameter name	Input Range	Description
	m^3	The unit selected here is also valid for the following functions, if “Volume” or "Ullage Volume" mode selected in the Current generator mode - P11, current output function parameter: Assignment of 4 mA – P16, Assignment of 20 mA – P17. Or the VM table (VMT) „ Output” column unit. **Set value:** “DEVICE SETTINGS” window / “Application” tab – „Engineering units -> Volume unit” parameter.
Optional Unit New unit (length)		Only appears with its setting field became active when “Optional unit” is selected in the Calculation system.
Unit name (P03)	4 ASCII characters **Unit**	Name of the new unit (max. 4 characters) **Set value:** “DEVICE SETTINGS” window / “Application” tab – „Optional Units -> Units name” parameter.
Unit conversion factor (P04)	Minimum: > 0.0 Maximum: 100 000 **1.0**	Reference for the conversion factor is the millimetre, always enter conversion value compared to it. At a conversion factor of 10, the new unit is equivalent to 10 mm (0.4 inch). At a conversion factor of 0.1, the new unit is equivalent to 0.1 mm (0.004 inch). **Set value:** “DEVICE SETTINGS” window / “Application” tab – „Optional Units -> Conversion factor” parameter.
Current output		Parameter path: “DEVICE SETTINGS” window / “Outputs” tab
Current generator mode (P11)	Select: Off, Level, Distance, Volume* or Ullage volume* **Level**	Selection of the required function for the current output. Specifies that what is displayed proportionally to the current signal at the 4 – 20 mA output when the analogue transmitter is used. **Set value:** “DEVICE SETTINGS” window / “Application” tab – „Current output -> Current generator mode” parameter.
Error indication (P12)	Select: Hold – last measured value, 22 mA	This parameter defines the status which the current output assumes in the event of an error

Function, Parameter name	Input Range	Description
	Hold – last measured value	Hold – last measured value: 4 – 20 mA (retains the last measured value in the event of an error) 22 mA: 4 – 20 mA (in case of error 22 mA fault current) **Set value:** "DEVICE SETTINGS" window / "Outputs" tab – „Current output -> Error indication" parameter.
Assignment of 4 mA (P16) Value corresponding to 4 mA output current	Select: Enter a value from 0 mm** to a value lower than that entered for "Assignment of 20 mA" parameter. **As per order**	This function defines the lower limit of the analogue measuring range (Assignment of 4 mA). The value of this parameter always has to be lower than the value selected for "Assignment of 20 mA" (P17) **Set value:** "DEVICE SETTINGS" window / "Outputs" tab – „Current output -> Assignment of 4 mA" parameter.
Assignment of 20 mA (P17) Value corresponding to 20 mA output current	Select: Enter value higher than the value selected for „Assignment of 4 mA" up to tank height or the maximum volume table (VMT) value*** **As per order**	This function defines the upper limit of the analogue measuring range (Assignment of 20 mA). The value of this parameter must always be: – Lower or equal to the value selected under "Tank height" (P05) or the maximum volume table (VMT) value, – Higher than the value selected under "Assignment of 4 mA" (P16), otherwise an error message will appear during parameter check. **Set value:** "DEVICE SETTINGS" window / "Outputs" tab – „Current output -> Assignment of 20 mA" parameter.
Error delay (P13)	Select: No delay, 10 sec., 20 sec., 30 sec., 1 min., 2 min., 5 min. or 15 min. **No delay**	This menu is only available when "22 mA" has been selected under "Error indication". With this parameter, a time delay can be defined for transition of the current output to 22 mA after an error has been noted. During the delay, the measuring and the analogue outputs are hold on. When the error disappears, the delay also serves to return to the measuring mode.
* complete VM table (VMT) before selecting "volume" or "ullage volume". ** or other unit selected in "Length Unit", „Volume Unit" depending in the item selected in "Current generator mode" Item. *** depends on value selected in "Current generator mode".		
Special device identification information		Parameter path: "DEVICE SETTINGS" window (Advanced mode) / "Special" tab

Function, Parameter name	Input Range	Description
(Checksum)	Read-only	This value is used for identification of the device software version. The checksum is tested when starting. This helps to detect any problems with the microcontroller.
(Serial number)	Read-only	This parameter serves to identify the respective measuring device. This number cannot be changed and sets the address for use with HART® interfaces.
(Probe type)	Select: Single rod, Twin rod, Single cable, Single cable + counterweight, Single cable without counterweight, Twin cable, Twin cable + counterweight, Coaxial, Special 1, Special 2 or Special 3 **As per order**	Information on probe type supplied with signal converter. This is a read-only parameter
		For integrating into a signal network. Standard hardware platform for HART® is the current loop with superposed FSK signals. For a multidrop application the current output is set to "OFF" and consequently to a constant 4 mA. With a multidrop bus, up to 16 pcs. of HART® devices can be operated together. Parameter path: "DEVICE SETTINGS / Identification" tab, or "DEVICE SETTINGS (Advanced mode) / Device Identification" tab
Polling Address / HART short address	Select: Addresses from 0 to 15 **0**	With this function, every device connected to a bus is assigned an address between 0 and 15 (HART® protocol). If several devices are connected to a digital bus, each device must be assigned a unique address under which it can then be identified in the bus. 0 – Analogue output active 1 to 15 – Multi-drop mode active, analogue output inactive **Set value:** "DEVICE SETTINGS" window / "Identification" tab – "Device Short HART® Address" section, or „ DEVICE SETTINGS" window (Advanced mode) / Device Identification" tab – Polling Address" section.

5.1.2.2 Setup and uploading of VMT (Linearization curve – VMT)

This function is required to prepare a conversation chart between level and volume, with max. 20 points. Each provided value must be higher than the previous one. Units of length and volume might be altered without the necessity to modify the data (Length unit, Volume unit) in the chart.

The 2 units of measurement on the left and right sides of the chart inherit the unit settings of length and volume. This rule should be kept in mind when filling the corresponding chart (Length unit and Volume Unit).

Important: The volumetric measurement is exclusively possible after the conversional chart is prepared.

To fill and set up the level/volume chart of the device, the “device programming window/Linearization curve” tab is to be selected in EView2.

Please fill or modify the chart here, similarly to what is written in chapter 6.4 of the user manual of EView2.
One difference to the process described in chapter 6.4 is that the turning on/off function cannot be selected from the „Linearization” drop-down menu for this type of device, because this function is regulated by the „Current generator mode” parameter. The VM chart is activated if this parameter (Current generator mode) is provided as „Volume” or „Ullage Volume”.
The other difference is that there is no “VMT” tab in the programming window (Advanced mode), only a „Linearization curve” tab in „Basic” mode.

In case if the required modifications completed in the chart, or if the chart is properly filled, then please select “Send” button (which is located to the right side of the window under “Get”) on the “Linearization curve” tab, to download the chart to the device.

5.1.2.3 The “Device status” window and the „Markers” diagram

To open the “device status” window in EView2, please select the desired device from the “device list” drop down menu of the main window by a right-click, and select „Show device status window” from the pop-up menu (please see: chapter 6.3 from the EView2 user manual)

The „Markers diagram” is – similarly to device status – opened by selecting “Markers” from the pop-up menu. The opening window enables monitoring the status changes of the device, visualizing it by a graph. Each status bits have its own line in the graph, with a “0” or a “1” value is presented. Status “1” stands for the status is active, with “0” indicates inactivity.

5.1.2.4 Oscilloscope device diagram (oscilloscope function)

In order for the oscilloscope diagram of the device to appear, please open the “programming window” (as described at the parameters settings in chapter 4.4 and 4.5 of the owner’s manual of EView2).
Then press the „Oscilloscope” button on the opening configuration window in the bottom row, left to the “Refresh” button.

Upon these actions, the „Oscilloscope diagram” window is opening. The diagram shows the reflection curve, measured by the device. To refurbish the graph and to read the data, please select „Refresh” button in the bottom row, or hit F4 with the cursor selects the window. Following a successful read-out, a curve, similar to the one shown below will appear (see figure #1).
In case if any level signals are detected, then this will appear in the graph as well (under the „Selected peak” floating window) alongside other auxiliary pieces of information. Further to this, „Threshold” level setup can also be performed in this window.

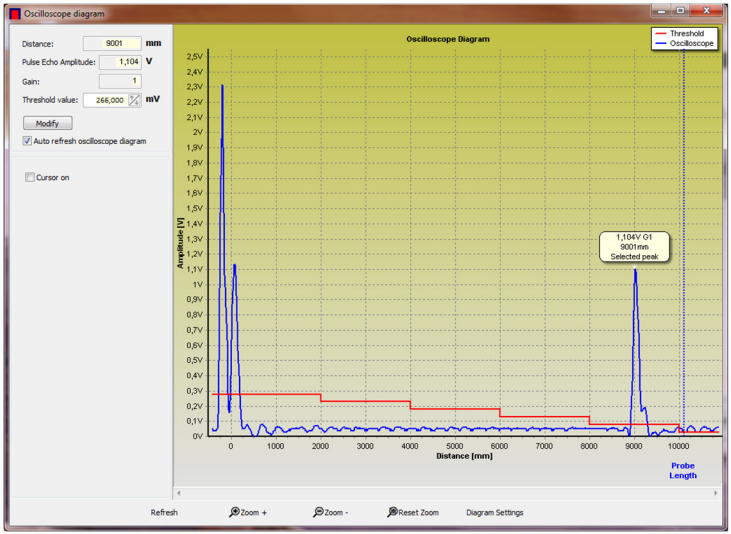


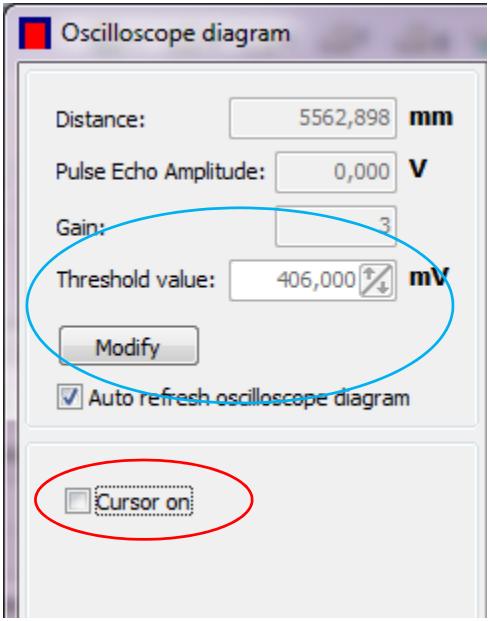
Figure 1.

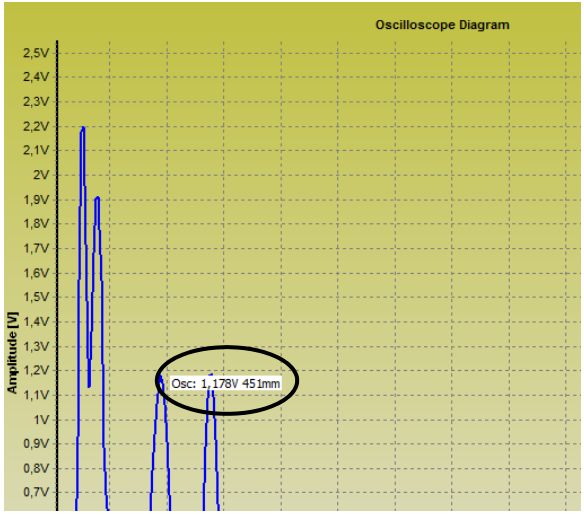
5.1.2.4.1“Cursor On” mode:

The oscilloscope diagram window gives the opportunity also to perform measures on the reflection curve made by the readouts. The cursor-driven measurement can be turned on by clicking on the „Cursor On” check-box and ticking it. (please find it on the below figure, marked in red).
Activating this function, the cursor switches to a little cross-hair.

Following this, the following measurement data of a particular position, which is specified by the cursor’s position on the curve, appears.:

- The magnitude of the amplitude
- the distance of the particular position





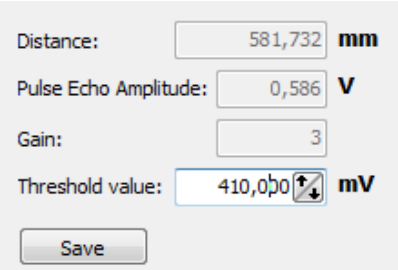
Please note, that „Cursor On” function does not provide accurate value, only calculates the value of the selected point upon the visualization of the graph.

5.1.2.4.2 Setting up level threshold („Threshold”):

The level threshold value („Threshold") can also be modified in the oscilloscope diagram window.
This is required when the device fails to detect a level signal (eg. when the value of the level threshold is set to too high or too small with the amplification is at the maximum)

To adjust „Threshold" value, hit the „Modify" button, which is located on the left side of the oscilloscope diagram (marked in blue in the previous figure to the left).

This activates the „Threshold value" setting field in which the threshold values can be provided.
To validate the new set up, select the „Save" button, or hit enter with the cursor in the setting field. Upon this, the software downloads the new threshold value to the device and triggers a new reflection curve readout if the „Auto-refresh oscilloscope diagram" checkbox is ticked on. If this checkbox is unticked, then it is also obtained by the „Refresh" button or by pressing F4 with the window is selected.



5.1.3. Quick Configuration: configuration examples

The minimum functions (fct.) to be configured for a simple measurement are listed below:

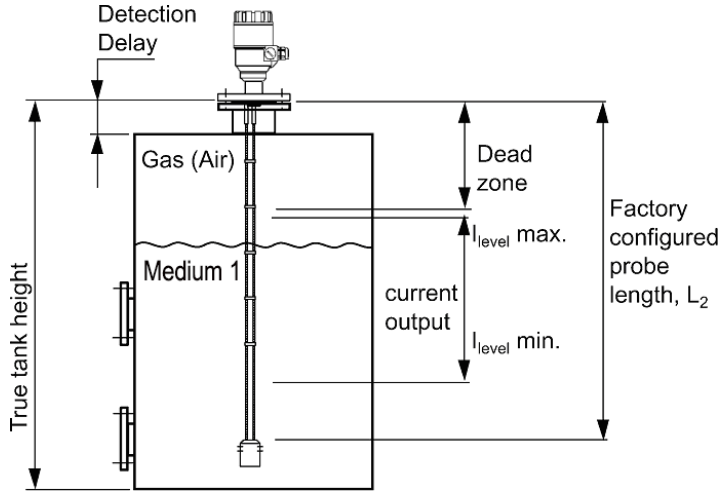
Functions		Definition
EView2	HART®	
P5 parameter set	2.1.1.1	Tank Height
P6 parameter set	2.1.1.4	Dead zone
P11, P12, P16, P17 parameters	2.1.3.1 … 4	Current Output
VMT (Linearization curve) set	2.1.7.0	Volume table*

*For volume measurements:

Example procedures for each set of functions are given on the following pages. Each procedure is described by a series of steps in tabular form and is according to the EView2-Configuration parameter list. Please refer to section “5.3 Programming with HART® handheld (HHC) communicator” for the equivalent parameters available on the HART® Communicator.

Definitions for quick configuration

in case the transmitter is programmed to mode “LEVEL”



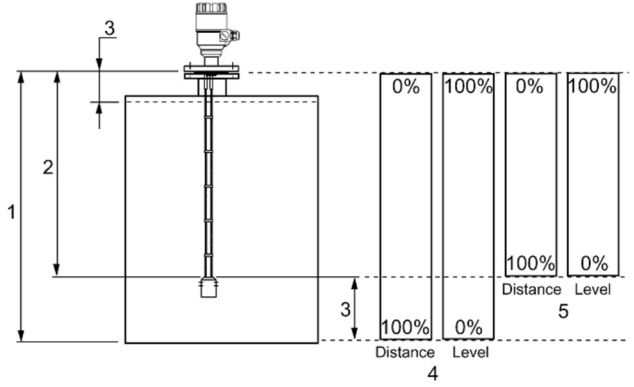
Typical gauge used for quick configuration examples:

Probe type	twin Ø4 mm or 0.15" cable probe
Measured medium	Water (dielectric constant, ε_r = 80)
Tank height	10000 mm (33 ft)
Dead zone	150 mm (0.5 ft) (see "Technical data of the probes" table in section 3. Technical data)
Probe length L_2	9000 mm (30 ft) (do not modify unless advised to do so)

Tank height: configuration of user menu EView2 (HART® Fct. 2.1.1.1).
"Tank height" function value is usually defined as true tank height.
The value of the parameter L_2 sensor's "Probe length" – unless otherwise specified by the customer – is factory configured by the manufacturer upon the order code.

Why the height of the tank is to be changed?
Setting the "Tank height" to L_2 avoids having a non-measurable zone underneath the probe where the measurement on the display freezes.
Set the "Tank height" to L_2 to avoid the device crashes in a non-measurable zone underneath the probe.
When setting up a measurement scale as explained on the following pages, this means that the level at the end of the probe will be considered as zero instead of the bottom of the tank.

How does tank height affect measurement when either Level or Distance is measured?



1 Tank height

2 Measurable height (factory configured probe length, L_2)

3 Non-measurable zone

4 With true tank height (1)

5 With factory-configured probe length (1) L_2

Figure 2.

Example procedure 1 (using EView2):

To change true tank height (10.000 mm [33 ft]) to the factory configured probe length L_2 (9000 mm [29½ ft]), and to save the new parameter (see section 5. figure Figure 2.).

Step	Action	Data entered / value set
1	Open the “DEVICE SETTINGS” window of the device in EView2	The device settings are read and displayed
2	Select the “Measurement configuration” tab	Configuration menu displayed
3	Click on the data setting field for “Tang height”	This field currently displays 10000 [mm] (33 ft)
4	Provide the new value	
5	Press the “Send” button in the bottom right corner the MicroTREK to accept the new value.	
6	Press the “X” button to quit the configuration menu.	

Dead zone: configuration of user menu EView2 – Dead zone (P06) parameter function (HART® Fct. 2.1.1.4)

The top dead zone is the minimum measuring distance between the surface of the gauge flange (the reference point) and the measured medium.

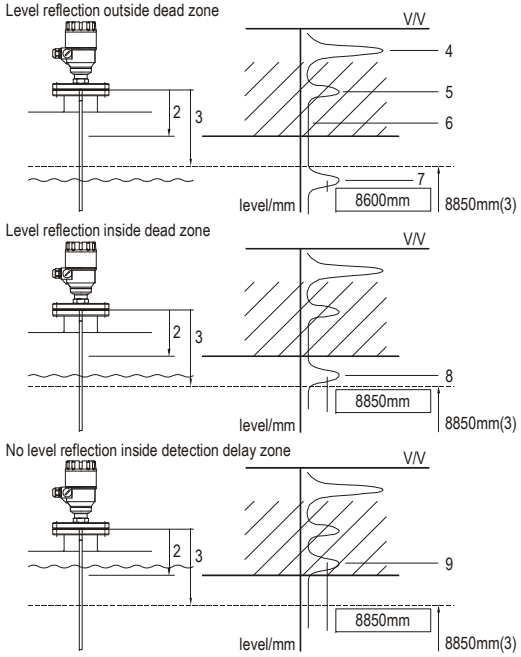
The various probes designed for MicroTREK have differing top dead zones and these length data are given in the “Technical data of the probes” chart in “3. Technical data” section

The importance of the dead zone configuration.
Limits of probe measuring ranges

The gauge will not display measurements taken in the dead zone – Entering the dead zone, the device disables the display.
This will avoid the gauge confusing the true level with a false reflection, corrupts the measurement (i.e. flange) as the medium nears the tank fitting and thereby displaying a false reading. It should be noted that although the reading is not displayed-, the gauge will continue to follow the reflection.
In EView2, the “Tank Full” status indication can be continuously monitored during polling on the device status window or on the “Markers diagram”.

What is the difference between these functions?
EView2 – Dead zone (P06) / HART® Fct. 2.1.1.4: Dead zone, EView2 – Detection delay (P08) / HART® Fct. 2.1.5.3: Detection delay
The “detection delay” function masks all signals (i.e. none are detected by the gauge) up to a defined distance from the flange facing. The “detection delay” zone size is never greater than the “dead zone” size.
The EView2 „device status” menu will display “Tank full” and “Level lost” in this zone.

This is illustrated below – the value in the box is the displayed value:



1 Height of tank fitting
2 Detection delay (Detection delay = 120 mm [4.72 inch])
3 Dead zone limit (Dead zone = 150 mm [5.9 inch])
4 Emitted signal
5 Flange reflection (masked)
6 Masked zone (all signals here are ignored)
7 Level reflection outside dead zone – true level displayed
8 Level reflection inside dead zone – level at dead zone limit displayed (frozen)
9 Level reflection inside detection delay zone – not detected by gauge and level at dead zone limit displayed (frozen)
**(3) = 985 mm (38.8 inch) Dead zone configured limit in terms of level*

Scaling the analogue current output

This set of functions allows users to set up a scale. The minimum (4 mA) and maximum (20 mA) values of an analogue current output should ideally lay within the device's active measuring zone, as the device will freeze when the signal is lost.

Refer to the measurement limits chart for each probe type in the introduction.

Example procedure 2 (using EView2):

To personalise a measurement scale: Select "Level" as the current output parameter for the scale to be set up from the tank bottom.
Select 4 – 20 mA current range with an error output at 22 mA.
Choose suitable minimum and maximum values for scaling.

Step	Action	Data entered / value set
1	Open the "DEVICE SETTINGS" window of the device in EView2	The device settings are read and displayed
2	Select the "Outputs" tab	
3	Select the "Current generator mode" from the drop-down list within the "Current output" section.	This field currently displays "Distance"
4	Use the mouse to scroll down (to) the data set field. Click on the new value.	This field now displays "Level"
5	Select the "Error indication" drop-down list.	"Hold – last measured value" message is displayed in this field
6	Use mouse to scroll down data set field. Click on the new value.	This field now displays "22 mA".
7	Select the „Assignment of 4 mA" data field.	This field currently displays "0.000 mm" (0 inch).
8	Enter the new value. This will give the level that corresponds to the minimum output of 4 mA.	This field now displays "1000.000 mm" (39.37 inch).
9	Select the „Assignment of 20 mA" data field.	This field currently displays "6000.000 mm" (236.22 inch) (std. default: 6000 mm).
10	Change to 9850 mm (387.8 inch). This will give the level that corresponds to the maximum output of 20 mA. (and sets max. output at the top dead zone limit)	This field now displays "8850.000 mm" (348.425 inch).
11	Press the "Send" button in the bottom right corner for the MicroTREK to accept the new value.	
12	Press the "X" button to quit the configuration menu.	

Setting up a volume table – (EView2 Linearization curve (VMT) – VMT (HART® Fct 2.1.7)

To be able to measure the volume, a conversion table (strapping table) will need to be created using the EView2 program or the HART® communicator.

The strapping table assigns defined volumes to the various levels. In the case of non-symmetrical tanks, e.g. tanks with dished bottom, the accuracy of volumetric measurement will depend on the number of entered "level/volume pairs". The maximum number of pairs (points) that can be set is 20. The volume is linearly determined (interpolated) between 2 points. The conversion table is generally used for volume, but can also be used for mass and flow.

Five points have been set in the following example.

Example procedure 3: creating a strap table by assigning a volume to a user-defined level (using EView2)

Step	Action	Data entered/value selected
1	Open the "DEVICE SETTINGS" window of the device in EView2	
2	Select the "Application" tab and chose the "Calculation system"	Metric (EU), Imperial (US), Optional Unit
3	Select "Length Unit" in the "Application" tab	m or ft
4	Go to „Volume Unit" to select volume units	m^3 or ft^3
5	Select „Measurement configuration" tab.	
6	Go to user function "Tank height" to enter tank height value (click on field and type in value)	6.00 m (20 ft)
7	Go to user function „Probe length" to enter probe length value	5.80 m (19 ft)
8	Go to user function „Dead zone" to enter dead zone value	0.40 m (1.3 ft)
9	Press "Send" button in the bottom right corner for the MicroTREK to accept the new value.	Wait for the download process to complete
10	Select the „Linearization curve" tab. Fill in the table "VMT list" with the appropriate values. A maximum of 20 points can be entered. For each point a level and a volume must be entered. Each point should have a value higher than the preceding one. You can create a new line by pressing the Ctrl + Insert keys, or by selecting "Add new item" from the local menu. You can delete a line by pressing Ctrl + D keys together.	See table below (table Table 2.)
11	To download the table to your device, press "Send" button under the „Get" button on this tab („Linearization curve" tab).	

Table 2. (Input table)

Point	Level (Source column)	Volume (Output column)
1	0.0 m (0.0 ft)	0.0 m³ (0.0 ft³)
2	0.20 m (0.66 ft)	0.5 m³ (17.65 ft³)
3	0.75 m (2.5 ft)	1.0 m³ (35 ft³)
4	1.00 m (3.3 ft)	1.5 m³ (52.97 ft³)
5	5.60 m (18.5 ft)	16.8 m³ (593.3 ft³)

*Max. level = tank height – dead zone = 6.00 m – 0.40 m (19.69 ft – 1.31 ft) = 5.60 m (18.37 ft), equivalent to a volume of 16.80 m³ (593.3 ft³)

Note: The level can effectively be measured between 0.20 m (8") and 5.60 m (18½ ft).
When the medium level drops below the tip of the probe, MicroTREK will indicate that 0.20 m (8") is still remained. Accordingly, MicroTREK can is capable to indicate levels only between 0.20 m (8") and 5.60 m (18½ ft), since it only measures along the probes.
The size of the dead zone depends on the installation and on the probe type.

Supplementary procedure for setting the 4 – 20 mA current to output volume readings (using EView2)

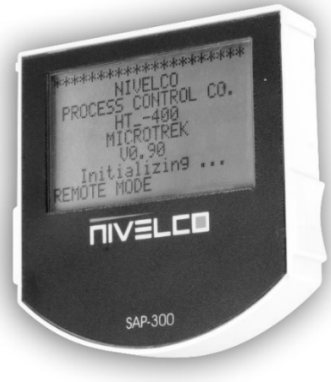
Step	Action	Data entered / value selected
1	Go to “Outputs” tab to select “Volume” measurement function in “Current generator mode”.	Volume
2	Go to user „Error indication” function to set the error status to the optimal mode.	Hold-last measured value (4 – 20 mA)
3	Select „Assignment of 4 mA” data field to enter a new value. This will give the Volume that corresponds to the minimum output of 4 mA.	0.5 m³ (17.65 ft³)
4	Select the „Assignment of 20 mA” data field to enter the new value. This will give the Volume that corresponds to the maximum output of 20 mA.	16.8 m³ (593.3 ft³)
5	Press “Send” button in the bottom right corner for the MicroTREK to accept the new value.	
6	Press “X” button to quit the configuration menu.	

5.2. PROGRAMMING WITH SAP-300 DISPLAY UNIT

The main parameters of the MicroTREK can be also set using the SAP-300 display unit.
The default display shows the primarily measured value (which the output current is calculated from).
Besides the numerical display, there is a bargraph on the right side, showing the value of the current output.
The programming is helped by a text-based menu. Navigation in the menu can be done with Ⓔ / ⊕ / ⊖ / ⊖ buttons.

5.2.1. SAP-300 display unit

Display	64 x 128 Dot-matrix LCD, glyphs, units and bargraph
Ambient temperature	-20 °C … +60 °C (-4 °F … +140 °F)
Housing material	PBT fiberglass, plastic (DuPont®)



SAP-300 is an universal plug-in LCD display and programming module, which is compatible with other NIVELCO devices, if the device software supports SAP-300 module.

Warning!

The display of the SAP-300 is based on LCD technology,
do not expose the SAP-300 continuously to direct sunlight
to avoid display damage.

If MicroTREK is not equipped with a sunshade and ambient temperature exceeds the operating temperature of SAP-300, do not risk the overheating of SAP-300, by leaving it connected to the instrument!

5.2.2. MicroTREK's behaviour in manual programming mode

After power-up MicroTREK shows the measured value on the SAP-300 display (referred as "display").

REMOTE MODE:

If the instrument senses external HART® communication it changes its display mode and shows a "REMOTE MODE" message in the bottom of the display. In this mode the measured values are refreshed according to the queries of the external HART® master.

If the HART® master does not refresh the display, the display will show the last measured values.
In the absence of SAP-300, the COM LED indicates the HART® communication.
If HART® communication stops, the COM LED is turned off after 120 sec.

Press Ⓔ button to enter the menu. Use ⊕ and ⊖ buttons to navigate in the menu.
Enter the selected menu point with Ⓔ button. Exit to the previous menu with ⊖ button.

Buttons are working only in the presence of the SAP-300 module!

When leaving the MicroTREK in (programming) menu after 30 minutes the instrument automatically returns to measuring mode.
If SAP-300 is removed the instrument instantly returns to measuring mode.

Because of manual programming (with SAP-300) and remote programming (with external HART® master, MultiCONT or EView2 software) cannot be performed at the same time (as both of them act like a HART® master) only one programming mode has priority and this is manual programming.
During manual programming the instrument sends the "BUSY" response to the external HART® master device. (HART® Response code: 32 – Device is busy)

5.2.3. Manual programming

Main menu	Sub-menu
BASIC SETUP	
	TANK HEIGHT
	DEAD ZONE
	CLOSE-END BLOCKING
	DAMPING TIME
	PROBE LENGTH
OUTPUT SETUP	
	CURRENT MODE
	FAILURE CURRENT
	CURRENT MIN
	CURRENT MAX
	ERROR DELAY
APPLICATION	
	APPLICATION TYPE

Changing parameters can be done by selecting a sub-menu and pressing Ⓔ button in two ways.

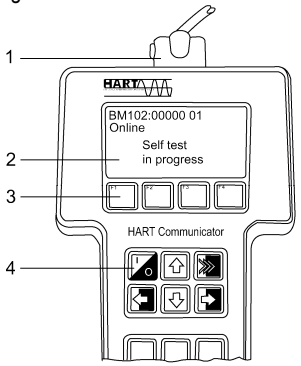
Text-based list:
Navigation is possible as described in the menu lists.
Accept changes with Ⓔ button, cancel changes (and exit) with ◄ button.

Numerical field:
Serves for editing a numeric value.
Editing is helped by a cursor (inverted character).
Change the value of the selected digit with ▲ / ▼ buttons
(there is no under-, and overflow between the characters).
Selecting a digit can be done using the ◄ button.
Accept changes with Ⓔ button.
After accepting the parameter change the MicroTREK checks the parameter and downloads it.
If parameter is incorrect the CHECK/WRITE FAILED! message appears.

5.3. PROGRAMMING WITH HART® HANDHELD (HHC) COMMUNICATOR

Displaying of the data and configuration can also be carried out with a HART® communicator.

Communicator layout

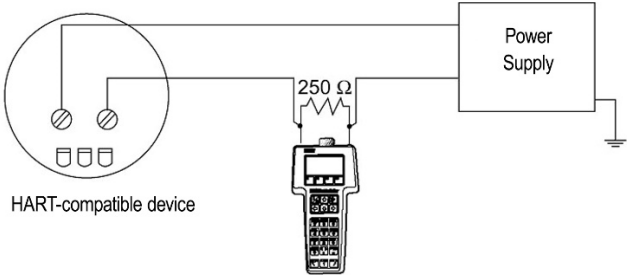


1 Two-pin jack for loop connectors
2 LCD
3 Function keys (F1 … F4)
4 Action keys

On/off	UP Arrow	n/a
LEFT Arrow	DOWN Arrow	RIGHT Arrow

Other functions: LEFT Arrow: Previous menu key
RIGHT Arrow: Select key

Wiring, standard (non-Ex)

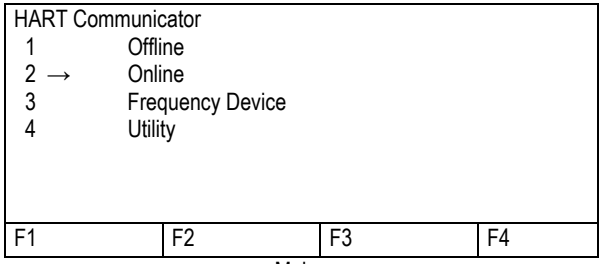


Caution: Refer to the HHC manual for wiring instructions when the operation is planned in explosive environment.

Displaying readings

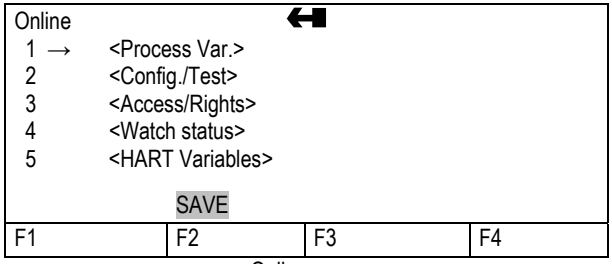
Use the UP and DOWN arrows to move to the correct line and then finish the selection with the RIGHT Arrow.

1



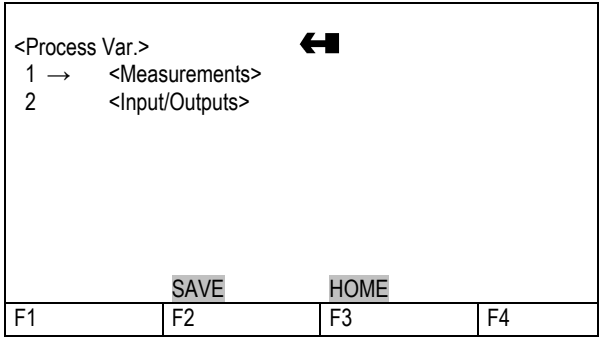
Main menu

2



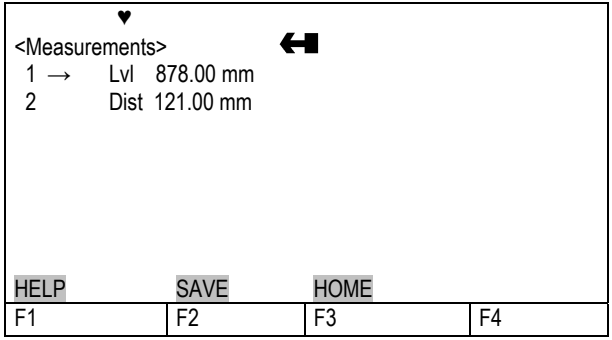
Online menu

3



Measurement & input & output functions menu

4



Measurement display function

Configuration: summary of user functions via HART® Communicator HC 275 (Version 1.00)
"Reset default" values are in bold type in the "Input Range" column.
Refer to the HART® HC275 Communicator operating instructions for further operating details.

Function (Fct.)	Input Range	Description
1.0 PROCESS VAR.		
1.1.0 MEASUREMENTS		
1.1.1 LEVEL		Level value.
1.1.2 DISTANCE		Distance value.
1.1.3 VOLUME		Volume value if a strapping table is programmed
1.1.4 ULLAGE VOLUME		Ullage Volume value if a strapping table is programmed
1.2.0 INPUTS/OUTPUTS		
1.2.1 FUNCTION I		Function associated with the current output (Primary Variable).
1.2.2 I		Current output value (mA)
1.2.3 %		Percentage of PV range
2.0 CONFIG./TEST		
2.1.0 OPERATION		
2.1.1.0 BASIS PARAMETER		
2.1.1.1 TANK HEIGHT	Enter probe length to 60.000 mm (2362") **As per order**	Tank height. The tank height is defined as the distance between the bottom of the tank and the lower flange surface.
2.1.1.2 PROBE LENGTH	Enter 0 mm to tank height but < 24.000 mm (1063") **As per order**	This value has to be equal to the exact length of the probe. The only situation when this value has to be changed is if the probe length has been changed.
2.1.1.3 TIME CONSTANT	Enter to 100 seconds **5 sec.**	The time constant allows filtering of possible signal fluctuations when the medium surface is turbulent.
2.1.1.4 DEAD ZONE	Enter a value Fct.1.5.1(Detection delay) … probe length.	Measurements near the flange may not be precise or reliable. Measurement may not be precise in an area less than this recommended value, depending on the probe type.
Warning: Critical Parameter	**See "Minimal measuring distance" Technical data of the probes**	

Function (Fct.)	Input Range	Description
2.1.1.5 SENSOR INFO		
2.1.1.5.1 Sensor upper limit	= Probe length	Read-only Menu. Upper sensor limit
2.1.1.5.2 Sensor lower limit	= 0	Read-only Menu. Lower sensor limit
2.1.1.5.3 Sensor min. span	= 1 mm (3.3 ft)	Read-only Menu. Sensor minimum span.
2.1.2.0 DISPLAY		
2.1.2.1 LENGTH		
2.1.2.1.1 LENGTH UNIT	Select: m, cm, mm, inch, Ft, optional units **mm**	Length unit of displayed value (level / distance). The optional unit allows the user to define a new unit (name and factor) see menu 1.2.1.3.
2.1.2.1.2 DISPLAY FORMAT	0, 1, 2, 3, 4, 5, exponential format, auto **2**	Number of decimal places. Defines the displayed length values format (option of the HART® communicator H275).
2.1.2.1.3.0 DEFINE NEW UNIT		
2.1.2.1.3.1 UNIT NAME	4 ASCII characters **„UNIT"**	Optional unit name. User has to enter the unit name before using it in the menu "LENGTH UNIT".
2.1.2.1.3.2 UNIT FACTOR	Enter values between 0.0 to 100.000 **1.0**	Optional unit factor. User has to enter the Unit Factor before using it in the menu "LENGTH UNIT". With a factor 1.0, the unit is equivalent to one millimetre. With a factor 1000.0, the unit is equivalent to one meter.
2.1.2.2.0 TÉRFOGAT		
2.1.2.2.1 VOLUME UNIT	Select: m^3, l, US Gal, Ft^3, bbl, M^3/h, Ft^3/h, kg, Metric Tons, US Tons **m^3**	Unit for conversion values ("volume table"). The selected unit is only used to display the conversion value from the strapping table.
2.1.2.2.2 DISPLAY FORMAT	0, 1, 2, 3, 4, 5, exponential format, auto **→2**	Number of decimal places. Defines the displayed volume value format. (Option of the HART® communicator H275).
2.1.3.0 ANALOG OUTPUT		
2.1.3.1 FUNCTION I	Select: Level, Distance, Volume, Ullage volume **Level**	Current output function (measured value to be displayed). Volume functions will appear if a volume table exists in menu 2.1.7.0.

Function (Fct.)		Input Range	Description
2.1.3.2	RANGE I	Select a 4 – 20 mA or 4 – 20 mA + 22 mA if error **4 – 20 mA**	Current output range 4 – 20 mA (1st choice). When the MicroTREK 2-wire is in error mode, the current output is frozen except if the second choice is selected and then the current output is fixed at 22 mA.
2.1.3.3	ERROR DELAY	Select: No delay, 10 s, 20 s, 30 s, 1 min, 2 min, 5 min, 15 min **No delay**	This menu is available in case if the range I menu is set to 4 – 20 mA with error 22 mA. This parameter sets the delay before the current output goes to 22 mA after the error mode occurred.
2.1.3.4	SCALE I min. 4 mA	Enter value between 0 to Scale I max **As per order**	Input the lower range value (corresponding to 4 mA) depending of the parameter 2.1.3.1 chosen.
2.1.3.5	SCALE I max. 20 mA	Enter value between Scale I min to tank height **As per order**	Input the upper range value (corresponding to 20 mA) depending of the parameter 2.1.3.1 chosen.
2.1.4.0	USER DATA		
2.1.4.1	TAG	**00000 01**	Tag number of devices.
2.1.4.2	SERIAL NUMBER		Read-only menu. Each device has its own serial number
2.1.4.3	FRENCH COMMISSION NUMBER		Read-only menu. This number is factory preset. Refer to this number in case of warranty or service claims.
2.1.4.4	GERMAN COMMISSION NUMBER		Read-only menu. This number is factory preset. Refer to this number in case of warranty or service claims.
2.1.4.5	RELEASE NUMBER		Read-only menu. Release number of the device (Software and Hardware version).

Function (Fct.)	Input Range	Description
2.1.4.5 PROBE TYPE	Rod, Twin Rod, Cable, Cable +counterweight, Cable without counterweight, Twin Cable, Twin Cable + counterweight, Coax, Special 1, Special 2, Special 3 **As per order**	Read-only menu. The type of the Probe attached to the flange.
2.1.4.5 CHECKSUM		Read-only menu. Similar to the release number. This parameter allows to identify the software version of the device.
2.1.5.0 APPLICATION		
2.1.5.1.0 THRESHOLD		
2.1.5.1.1 LEV. PULSE AMP.	Read-only value.	Dynamic value. Amplitude of the level pulse in millivolts.
2.1.5.1.2 LEV. PULSE GAIN	Read-only value.	Dynamic value. Amplification of the level pulse (gain 0, 1, 2, or 3).
2.1.5.1. THRESHOLD	Enter a value from 50 mV to 25,000 mV **500 mV G3 at 1 m (3.3 ft)**	Threshold of the level pulse (in millivolts). The threshold evolves in terms of gain amplification factor changing by the electronic converter
2.1.5.2 DISTANCE INPUT	Enter a value from Fct. 2.1.1.4: Dead zone to fct. 2.1.1.2: Probe length	This function forces MicroTREK 2-wire to search for the medium surface in a zone other than the actual measuring zone. If there is no level signal sensed, you can enter an estimated value.
2.1.5.3 DETECTION DELAY	Enter a value 0mm (0in) to Fct. 2.1.1.4: Dead zone **As per order**	This function forces the instrument not to analyse reflections in a zone directly below the flange. The entered value of the detection delay must be smaller than the “dead zone” value.
2.1.5.4 SEARCH PROBE END	Measured in the units configured in fct. 2.1.2.1.1	Measures automatically the probe length. The tank must be empty and the tank height must be configured to a value greater than estimated probe length for this to be done correctly.
2.1.5.5 RESET MicroTREK 2-wire		Restarts the MicroTREK 2-wire.
2.1.6.0 SERIAL I/O		

Function (Fct.)		Input Range	Description
2.1.6.1	ADDRESS	Enter value between 0 to 15 **0**	Sets the address of the device when this latter is connected to HART Multidrop networks. The current output drifts to 4 mA. 0 = 4 – 20 mA output current active 1 – 15 = in multidrop mode
2.1.7.0	KONVERZIÓS TÁBLÁZAT		
2.1.7.1	VOLUME UNIT	Select: m^3, l, US Gal, Ft^3, bbl, m^3/h, Ft^3/h, kg, Metric Tons, US Tons **Litre [l]**	Unit for conversion values ("volume table"). The selected unit is used to define the strapping table values.
2.1.7.2	INPUT TABLE	Between 0 to 20 points **0** (i.e. no volume table)	This function defines the strapping table. The maximum number of points is 20. Each subsequent value must be greater than the previous one. The length and volume units can be changed later without affecting the settings in the table. The units of length and volume used in Fct.s 1.2.4 and 1.2.5 shall also apply here.
2.1.7.3	DELETE TABLE		This function deletes the strapping table.
2.2.0	TESTS		
2.2.1	TEST OUTPUT	Select: 4 mA, 8 mA, 12 mA, 20 mA	This function allows the current output to be tested. The output can be set to one of the listed values. Using a reference ammeter, the calibration of the current output can be verified.
2.3.0	SERVICE		Restricted access to the factory configuration menu. These parameters may be accessed via Fct. 3.2 "Specialist PSW (password).
3.0	ACCESS RIGHTS		
3.1	MAINTENANCE PSW	Yes or No. Enter 9-character code if "YES". **No**	Disables the access lock on the configuration menu. The password must contain exactly 9 characters. E, R or U are used only. The password is displayed in a scrambled format. It allows NIVELCO to decode the password in case it was forgotten.
3.2	SPECIALIST PSW		Contact a specialist for Service Parameters.

Function (Fct.)	Input Range	Description
		Visit NIVELCO Service centre or MicroTREK 2-wire Service Manual for code.
4.0 WATCH STATUS		This function displays the status of the device.
5.0 HART® VARIABLES		
5.1 MANUFACTURER		Read-only menu
	NIVELCO	
5.2 MODEL		Read-only menu
5.3 FLD DEV REV		Field device revision.
	1.0	Read-only menu
5.4 SOFTWARE REV		Software revision.
	1.0	Read-only menu
5.5 HARDWARE REV		Hardware revision.
	1.0	Read-only menu.
5.6 DEVICE ID		Read-only menu. The device ID is also the serial number of the device.
5.7 MESSAGE		32 bytes of ASCII characters
5.8 DESCRIPTOR		16 bytes of ASCII characters
5.9 DATE		Month Day Year (xx / xx / xx).
5.10 NUM RESP PREAM		Number of preamble in the response frame of the device
5.11 TAG		Tag name of the MicroTREK 2-wire
5.12 POLL ADDRESS		Address of the device.

5.3.1. Characters available for alpha-numerical data functions in PCSTAR2 and on the HART® console

PCSTAR 2			fct. 12.6.1: Unit name, fct. 1.4.4: Device number, fct. 1.4.8: Option				
HART® console (HHC)			fct. 5.7 Message, fct. 5.8 Descriptor, fct. 5.11 Tag				
@	H	P	X	Space	(	0	8
A	I	Q	Y	!	)	1	9
B	J	R	Z	“	*	2	:
C	K	S	[	#	+	3	;
D	L	T	\	$	‘	4	<
E	M	U	]	%	-	5	=
F	N	V	^	&	.	6	>
G	O	W	_	‘	/	7	?

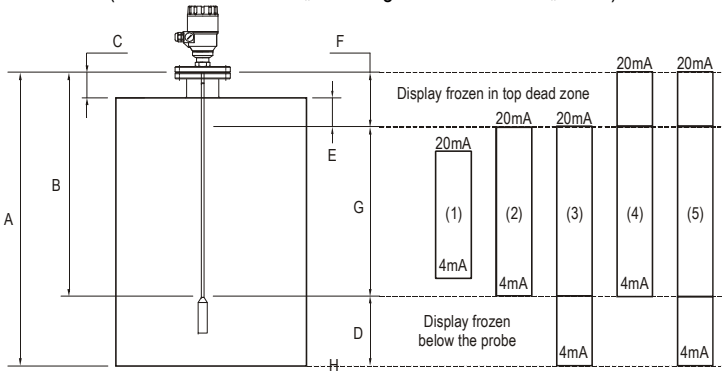
5.4. MICROTREK 2-WIRE T.D.R. METER CHARACTERISTICS

This subsection explains:

- Setting up scaling for all four fundamental measuring principle configurations, the instrument is capable of;
- What happens when the tank is full or empty;
- What is the level “Threshold” and how to modify it and;
- How to perform a measurement when multiple mediums in the tank;

The measurement scale: five possible configurations for analogue current output

with “Level” (LEVEL –> EView2 -> „Current generator mode” = „Level”)



A Tank height
B Probe length
C Detection delay
D Non-measurable zone
E Minimum distance between non-measurable zone and dead zone
F Upper dead zone
G Measuring range
H Reference point at tank bottom

The configurations described below are illustrated in the above diagram:

(1) The “current output” range is smaller than the max. possible measuring range.

(2) The “current output” range is equal to the measuring range:
Scale min.: 4 mA (P16) = tank height – probe length + H
Scale max.: 20 mA (P17) = tank height – dead zone

(3) The “current output” range is greater than the measuring range:
Scale min.: 4 mA (P16) = 0.0
Scale max.: 20 mA (P17) = tank height – dead zone

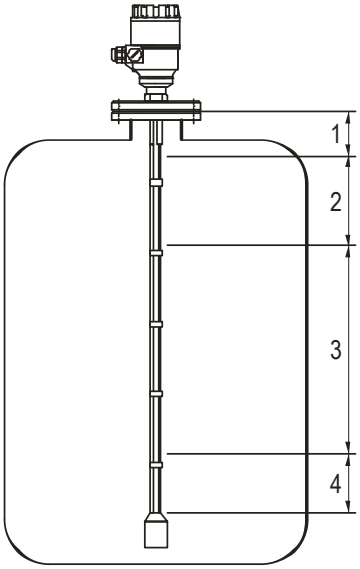
(4) The “current output” range is greater than the measuring range:
Scale min.: 4 mA (P16) = tank height – probe length + H
Scale max.: 20 mA (P17) = tank height

(5) The “current output” range is greater than the measuring range:
Scale min.: 4 mA (P16) = 0.0
Scale max.: 20 mA (P17) = tank height

NOTE: The reference point for distance measurements is the bottom of the flange face.

5.4.1. Gauge operating logic when the reflection is lost

The medium reflection pulse is usually lost when the level is at the top dead zone or near the bottom of the tank. The diagram below shows the action taken by the gauge depending on where the reflection was lost the last time.
During “EView2” polling the active “Device status” window function (or the “markers” diagram) must be used in order to follow the measurement status of the device (to activate the function, see section 5.1.2.3).



Zone 1: Dead and detection delay zones
Marker “Tank full” and “Level lost” is displayed when
the medium enters the dead zone and no reflection is found.
This will also occur when the level reflection is within the detection delay zone.
The gauge assumes the tank is full and displays the maximum level value.
The gauge searches for a reflection along the entire length of the probe.

Zone 2: Full zone (and dead zone)
Marker “Tank full” is displayed in this zone.
If the gauge loses the signal in this zone, it reacts as in zone 1:
the tank is assumed to be full.
The gauge searches for a reflection along the length of the probe.

Zone 3: Central measurement zone
The gauge searches along the length of the probe for the largest pulse reflection.
If the pulse is lost the reading freezes at the last value.
Marker “Level lost” will be displayed.

Zone 4: Empty zone
If the reflection is lost here, the gauge assumes the tank is empty and marker “tank empty” is displayed.
The gauge searches for a reflection in this zone but makes a search along the entire length of the probe every minute.
The reading will remain frozen during this time.
The short circuit reflection will become larger than the medium reflection at this time.

5.4.2. Gain and voltage amplitude

As explained amongst the measuring principles in the introduction, the level of a medium is converted from a return signal (the medium reflection) received by the gauge: this signal takes a certain amount of time to return to get to the gauge and it has a certain strength / size measured in milli-volts (dependant on the dielectric constant ε_r of the medium).

All pulse signals returning to the gauge electronics block (including flange, obstruction and the medium surface reflections) are converted to voltage amplitudes. The gauge's microprocessor looks for the largest signal that is over a set voltage amplitude, called the "threshold", and identifies this as the medium being measured. In order for the signal is applicable by the gauge, the microprocessor will amplify the signal by increasing gain. Once the signal is within a set "working" range, the gauge follows this signal. The gauge registers any changes of the signal returned to the converter and translate it into a displayed level or volume.

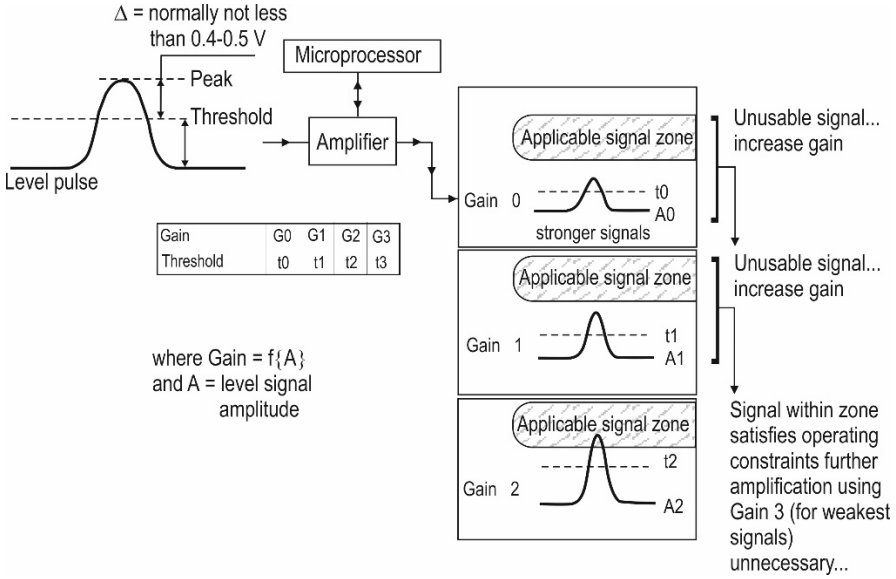
The rate of the Gain is depending on the function of voltage amplitude.

This defines the default threshold value when the gauge is searching for the medium level.

A strong return signal sets low gain rate (i.e. Gain 0 or a small amplification).

However, if the signal is very weak, then a Gain of 3 (i.e. high signal amplification) is given.

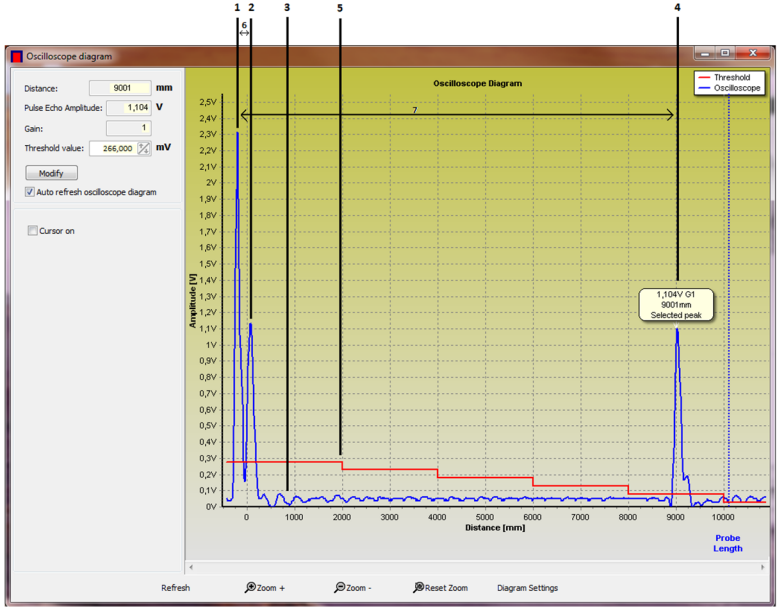
Example of signal amplification:



Level measurement – Level pulse amplitude and threshold

After connecting to a power supply, MicroTREK 2-wire will:
1. Measure reflection pulses in terms of voltage amplitude by cycling through a set of gains.
2. Identify the highest amplitude which corresponds to the level of the medium.

This screenshot taken of the EView2, oscilloscope function while measuring while a typical single-medium measurement:



The function analyses the following data:

1 Initial pulse

2 Flange reflection (except coaxial probe)

3 Non-medium reflection (e.g. parasite: agitator)

4 Medium level reflection

5 Level threshold (with two-metre steps).
Set in 5.1.2.4.2 function.

6 Offset
(the distance travelled by the signal between the processing unit and the reference point of the device)

7 Distance measured as a function of time

The level signal can be optimized upon two factors:

Amplification factor

The amplitude of the signals is proportional to the dielectric constant ε_r of the medium. At low amplitudes the signal should be amplified. The amplification factor is depend on the dielectric constant ε_r and on the probe type. The device sets gain automatically.

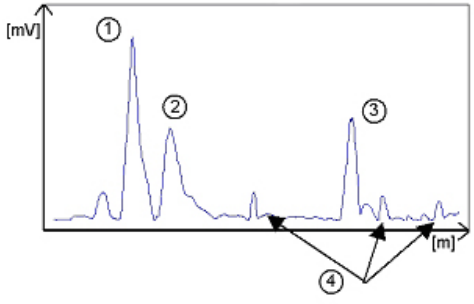
The following factors apply to the set gain:

Gain	Amplification factor
0	1.05
1	2.10
2	4.37
3	8.93

Level threshold

The level threshold suppresses interference signals so that only the reflections from the medium surface (level signal) are shown. The factory setting of the level threshold is suitable for standard applications.
The threshold has to be adjusted in case of very low dielectric constants ε_r, multiple interference reflections or unfavourable installation conditions.

The illustrations below show interference signals when the oscilloscope function is used.
These reflections can be due to various causes, e.g. tank internals or multiple reflections within the measuring range.



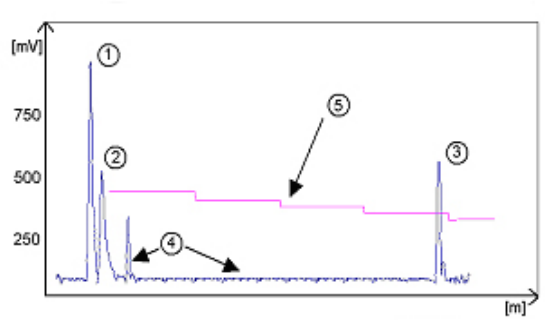
Even if interference signals very weak, threshold should never be set higher than the following signals:

1 Initial pulse

2 Flange reflection

3 Level signal

4 Interference signal



1 Initial pulse
2 Flange reflection
3 Level signal
4 Interference signal
5 Threshold

In the diagram above the inconstancy of the threshold level is visible:
400 mV at 1 m (3.3 ft), and only 250 mV at 10 m (33 ft). No attenuation is required at a probe length ≤ 3 m (10 ft).
The form of the threshold is depending on the attenuation and is automatically adjusted by the device over the measured length.

Setting the level threshold

If the level threshold is set too high, i.e. it is greater than the amplitude of the level reflection, the device will not find any levels even with maximum amplification.

If the level threshold is set too low, i.e. it is below the amplitude of some of the interference signals, the device will identify and indicate one of these interference signals as a level reflection even if the tank is empty.

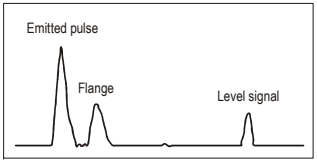
Precise setting of the level threshold is especially important when the dielectric constant ε_r is low.

In order to perform the setting level (amplitude of the reflection) must be known. A level of 500 mm (20") is ideal. The level threshold should be half-way between the invalid interference signals and the level reflection signal. The reflection from the probe tip, which is clearly identifiable at a low ε_r value, does not need to fall below the level threshold.

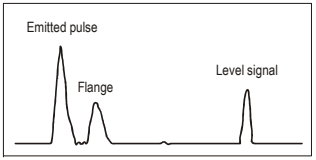
Observe at all the reflections over the entire probe length and change the level threshold and/or the amplification factor upon this observation in the “Oscilloscope diagram” tab 5.1.2.4 menu.

5.4.3. Typical signal trends

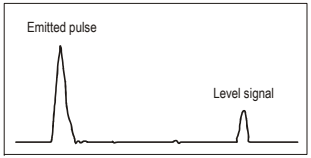
The following diagrams show typical signals that have been recorded with the oscilloscope function.



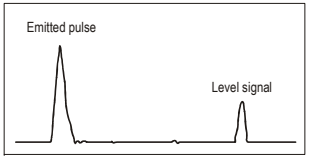
Rod or cable probe with gain 1



Rod or cable probe with gain 2



Coaxial probe with gain 1

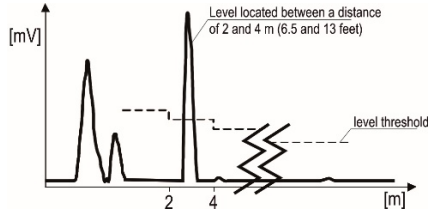


Coaxial probe with gain 2

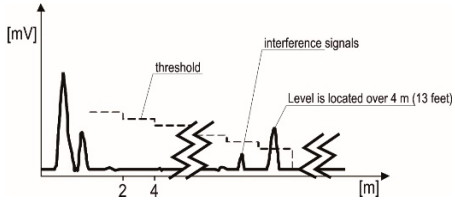
The signal from coaxial probes does not include the flange reflection, due to the mechanical setup which does not produce any changes in impedance at the flange.
The amplitude of reflection from the medium surface increases as the level rises and decreases as the level falls.

5.4.4. Automatic adjustment

To maintain a sufficiently strong reflection signal, the gain is adjusted automatically.
When the amplitude of the level reflection decreases, gain will increase to compensate for the loss in signal amplitude. Thus, the proportionality of gain and threshold levels remain unchanged. At gain 3, the level signal for both figures.



The reflected useful signal level has dropped (weakens, smaller amplitude) as the distance between the level and the flange increases.



The interference signals are now below the level threshold, of which lower limit is 50 mV.

In both cases, the automatically adjusted gain of the threshold is at the half of the level signal value. In the event of operational or installation faults, you can frequently identify the cause of the fault by means of this function and normally eliminate it yourself. Should the fault persist, please send an evidence (screen shots with F10) to your NIVELCO Service Centre.

Procedure (example where the level measured is too low compared to true level):
Read off displayed peak amplitude using the oscilloscope function – see 5.1.2.4 function.
Modify level threshold value.

Step	Action	Data entered/ value displayed
1	Execute EView2, detect device and open “DEVICE SETTINGS” window.	
2	Press the “Oscilloscope” button in the window and read the oscilloscope diagram of the device	
3	The top-left of the window displays distance, peak amplitude in volts and gain.	21.000 mm (0.83 inch) 1500 mV Gain 2
4	The configured level threshold is listed under peak amplitude in mV. Click on the “Modify” box to activate the “Threshold” field.	
5	Click on the “Threshold” field and enter a new value. Press enter and press and select “save”.	1100 mV
6	Refresh the oscilloscope diagram (F4 key)	
7	If the value is still too low, try to reduce threshold again in small steps. If this does not resolve the problem, contact the NIVELCO Service Centre.	

Note: the threshold drops every 2 m (6.5 ft).

Solid application notes:

Most solid applications except powder or flakes with high dielectric constants ε_r, such as coal powder, are measured with Gain set to 3. If it is difficult to measure level at a certain point with the gauge using Gain from 0 to 2, then an internal tank structure (protruding parts, etc.) is most likely within the electromagnetic pulse field area: the gauge will detect the largest signal and assume this is the medium level.

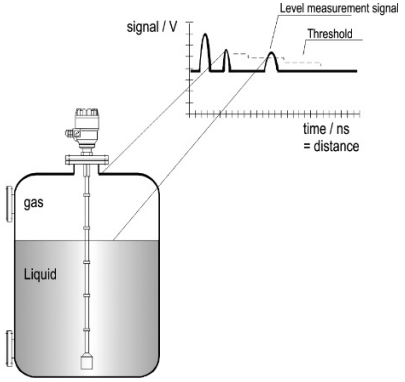
5.4.5. Level measurement where there are multiple phases or layers in the tank

Level can be measured even with more than one phase in the tank.
This requires setting the parameters in the EView2 “Device settings” window “Application” tab to the following measurement mode:
Operating mode:

2 liquids, 1 level	for measuring level with two or more phases
1 liquid, 1 level	for measuring one phase or liquid

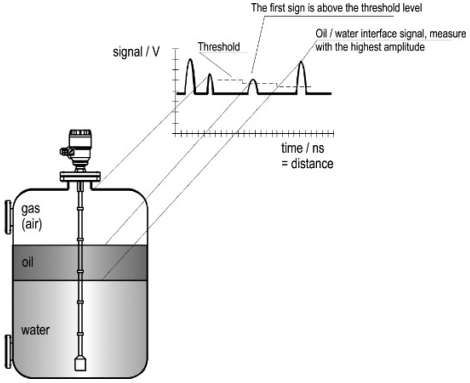
To change “Operating mode” on “Application” tab, press the “Modify” button in “Operating mode” section and enter the service code (default: 9833). If the entered code is correct, the selector list in the “Operating mode” section becomes active and the new mode can be set.
Characteristics: the top level of the medium can be detected if it has a minimum layer of approximately 100 mm (3.93 inch) – when measuring top medium with a dielectric constant of ε_r = 2.4. The mode “2 liquids, 1 level” permits level to be measured even when more than 2 type of liquids are present in the tank. The first return signal is identified as level and the second is ignored. This mode may be used with all probe types

Example application #1
level measurement of oil (1 type of liquid in the tank)



In “Application” tap in the “Operation mode” set to “1 liquid, 1 level”, the MicroTREK 2-wire will search for the return signal with the highest amplitude (i.e. higher than the threshold).
It will measure the oil level.

Example application #2
Level measurement where there are 2 types of liquids (oil/water) in the tank – using a correctly configured gauge



In “Application” tap in the “Operation mode” set to “2 liquids, 1 level”, the MicroTREK 2-wire will search for the first return signal higher than the control threshold.
It will correctly measure the oil level (i.e. “level”).

5.5. TROUBLESHOOTING

Event	Fault	Action
Error messages		
"Tank full" status marker on*, reading frozen at max. or min. value	No fault. The level has reached (and possibly risen above) the top configured measurement limit and is either displaying the maximum (when measuring level) or minimum (when measuring distance) output.	None. Measurements should be normal once the level is in the configured measurement range.
"Tank empty" status marker on*, reading frozen at max. or min. value	No fault. The level has entered the gauge's bottom dead zone and can no longer detect a return signal. Either the maximum (when measuring distance) or minimum (when measuring level) output is displayed.	None. Measurements should be normal once the level is in the configured measurement range.
"Tank full" and "Level lost" status marker on*, reading frozen at max. or min. value	No fault. The level has entered the gauge's top dead zone and can no longer detect a return signal.	Empty the tank below the top measurement range limit and check the measurement.
"Level lost" status marker on*, reading is frozen	The instrument has lost the level signal, has searched but not yet found the return pulse. This may occur if the pulse has dropped below the threshold. Parasite signals from the flange or obstructions in the tank may render the gauge unable to identify the correct signal.	Ensure that tank is emptied below maximum level and check the measurement. If the signal is not detected then modify the control threshold manually as shown in sections 5.1.2.4.2 using the oscilloscope diagram and threshold set functions (5.1.2.4).
"Reference not found" status marker on*	Occurs when there is a problem with the time base on the HF board.	Please contact NIVELCO.
"Level lost" and "Reference not found" status markers on*, reading frozen	The probe has received an electrostatic discharge.	The gauge will search for the level again and resume readings. If the reading remains frozen then the signal converter may have been damaged by ESD and may need replacing. Please contact NIVELCO.
"Flange not found" status marker on*	The signal converter has been incorrectly configured to measure with a cable or rod probe when it is equipped with a coaxial probe. This may be also due to installation on a long nozzle which has the effect of attenuating the flange pulse.	Contact NIVELCO for the corrective procedure.

Event	Fault	Action
"Delay out of limits" status marker on*, reading is frozen.	The emitted pulse has not been detected. The gauge will not work until it has been found.	The signal converter may need replacing. Please contact NIVELCO.
"Negative voltage error"*	Occurs when there is a problem with the time base on the HF circuit-board.	Please contact NIVELCO.
"VC01 voltage error" *		
"VC02 voltage error" *		
"Reprogramming FPGA" *		

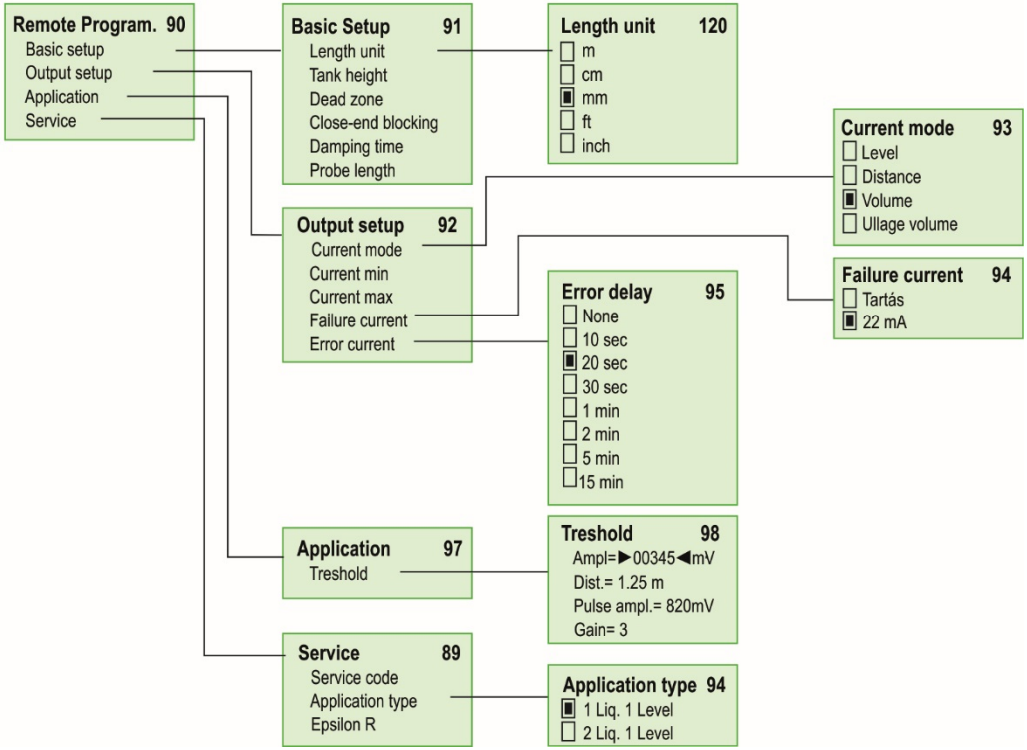
*Gauge connected to EView2 software and with polling in progress, viewed in the "Device Status" window (or in the "Markers" window), or listed on HART Handheld Controller (HHC) with Marker status window (F8).

Event	Fault	Action
General operation		
Instrument is not accurate for a product with high dielectric constant (ε_r). A constant offset is observed when taking measurements.	Tank height is not correct.	Check current output and tank height parameters. If the signal converter has been replaced, verify that factory calibration parameters are still the same. Ask NIVELCO for access to factory calibrations menu.
The MicroTREK 2-wire indicates an incorrect level value.	The MicroTREK 2-wire measures a non-valid reflection.	Check the tank for obstructions and verify that the probe is clean. In the case the indicated level is close to the nozzle, increase the detection delay and the dead zone with the same ratio or increase the threshold level if the full measurement range is essential. In any case, use the EView2 oscilloscope function to visualise and to analyse the application. The threshold level must be adjusted so that it masks the disturbances. It also gives enough margin for detection of the level pulse. Very large pulses along the measurement signal (same amplitude as the initial pulse) can be caused by a probe which is touching the nozzle or the wall of the tank (see section 1.3.5). Ensure that no contact is possible.
Instrument is not accurate when there are multiple phases in the tank.	The instrument may be incorrectly configured for this type of application i.e. it is measuring the layer interface instead of the level.	Check if "Operating mode" on the "Application" tab of the "Device Settings" window is set to the appropriate "2 liquids, 1 level". Check also if there is a layer of at least 100 mm (4 inch) on the top level of the medium. Contact NIVELCO for the corrective procedure or refer to the Service Manual.

Event	Fault	Action
Electrical Connections and Communication Output		
Current Output value < 4 mA	There is no power supply	Check the power supply!
	Connection of the device is incorrect.	Check the connection between the device and the power supply.
	The calibration of the current output is improper.	Execute the calibration if you have authorized access, otherwise contact NIVELCO Service centre.
Current output value 22 mA is displayed	An error has occurred.	This happens in case the range 4 – 20 mA / error 22 mA is selected. Check the status of the device during polling in the "Device status" window (or in the Markers diagram), or enter the status (4.0) menu of the HART® communicator.
	The device is in its start-up phase	Wait for 50 seconds. If the current value drops to a value between 4 and 20 mA, and goes immediately back to 22 mA, contact your NIVELCO Service Centre.
The value at the current output does not identical with the value at the display (EView2 or HART® communicator).	The current output settings are incorrect.	Check the current loop and the connections. Configure the output as described in User's and Programming Manual of the MicroTREK 2-wire – also try to adjust the threshold using EView2 (Oscilloscope diagram / Threshold settings) or a HHC communicator.
Data communication via the digital interface is not working. The MicroTREK 2-wire is in its start-up phase, wait for 50 seconds and try it again.	The communication parameters of the computer are set incorrectly.	Check computer setting (address/device number).
	Poor connection to the interface.	Check connection.
	Current output value is <4 mA.	If the problem persists, contact your NIVELCO Service Centre.
	Current output value is = 22 mA	

Appendix 1 – Set-up parameters of MicroTREK radar in MultiCONT controller

Parameters in the Service Menu are read-only parameters. Changing of these parameters require the service code of the instrument.



htk4014a0600p_04
February 2020
NIVELCO reserves the right to change technical data without notice!