Operating Instructions

for

Non-contact Radar Level Transmitter,

80 GHz – Expert Line -

Model: NRE-4

We don’t accept warranty and liability claims neither upon this publication nor in case of improper treatment of the described products.

The document may contain technical inaccuracies and typographical errors. The content will be revised on a regular basis. These changes will be implemented in later versions. The described products can be improved and changed at any time without prior notice.
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1. Contents

Manufactured and sold by:

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2. Note

Please read these operating instructions before unpacking and putting the unit into operation. Follow the instructions precisely as described herein.
The instruction manuals on our website www.kobold.com are always for currently manufactured version of our products. Due to technical changes, the instruction manuals available online may not always correspond to the product version you have purchased. If you need an instruction manual that corresponds to the purchased product version, you can request it from us free of charge by email (info.de@kobold.com) in PDF format, specifying the relevant invoice number and serial number. If you wish, the operating instructions can also be sent to you by post in paper form against an applicable postage fee.

Operating instructions, data sheet, approvals and further information via the QR code on the device or via www.kobold.com

The devices are only to be used, maintained and serviced by persons familiar with these operating instructions and in accordance with local regulations applying to Health & Safety and prevention of accidents.

When used in machines, the measuring unit should be used only when the machines fulfil the EC machinery directive.

3. Instrument Inspection

Instruments are inspected before shipping and sent out in perfect condition.
Should damage to a device be visible, we recommend a thorough inspection of the delivery packaging. In case of damage, please inform your parcel service / forwarding agent immediately, since they are responsible for damages during transit.

Scope of delivery:
The standard delivery includes:

- Non-contact Radar Level Transmitter, 80 GHz – Expert Line-
  Model: NRE-4

4. Regulation Use

Any use of the device, which exceeds the manufacturer's specification, may invalidate its warranty. Therefore, any resulting damage is not the responsibility of the manufacturer. The user assumes all risk for such usage.

5. Operating Principle

The reflection of the millimeter-waves is highly dependent on the dielectric constant of the medium. Therefore, the measured medium's dielectric constant (εr) must be over 1.9 for millimeter-wave level measurement. The measurement principle of a level transmitter with a millimeter-waves signal is based on measuring the reflection's time of flight.
The speed of propagation of millimeter-waves signals in the air, gases, and vacuum is almost constant regardless of temperature and medium pressure, so the measured distance does not depend on the physical parameters of the intermediate medium.
The NRE-4 level transmitter is a continuous-wave frequency modulated radar (FMCW) operating at 80 GHz (W-band). The most obvious advantages of 80 GHz radars over lower frequency (5 ... 12 & 25 GHz) radars are smaller antenna size, better focus, and smaller beam angle. A portion of the millimeter-wave continuous wave energy radiated by the level transmitter antenna is reflected from the measured surface, depending on the material to be measured. The distance of the reflecting surface is calculated with high accuracy by the electronics from the frequency shift of the reflected signal and converted into a distance, level, or volume signal by the electronics.

6. Conditions for safe operation

Compliance with technological process conditions

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

- **The cable outside of the device must be secured and unencumbered!**
- **The device operated from a power supply complying with Class 1 surge protection (SELV/PELV).**

Compliance with local rules and regulations

The NRE-4 is a Local Positioning Radar (LPR) and must be mounted in a fixed, antenna-down position. In addition, the following two restrictions on antenna placement and height from the ground must be observed:

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

Compliance with Ex requirements

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

6.1 Explosion Protection, Designation, Limit Values

6.1.1 ATEX Intrinsically Safe Protection (Ex ia) – ATEX Certificate No.: XXX

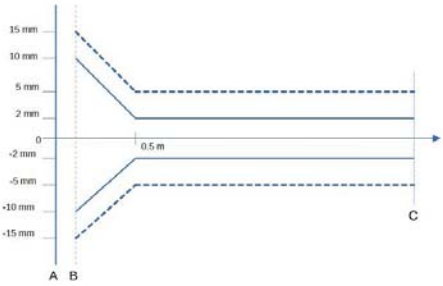
APPLICATION GROUP		IIC	IIIC
Standard version		**NRE-4xSxxxxA0I/ NRE-4xSxxxxA1I**	
Ex marking (ATEX)		**II 1G Ex ia IIC T6 Ga**	**II 1D Ex ia IIIC T85°C Da**
High-temperature version		**NRE-xxHxxxxxA0I/ NRE-xxHxxxxxA1I**	
Ex marking (ATEX)		**II 1G Ex ia IIC T6…T3 Ga**	**II 1D Ex ia IIIC T85°C…T180°C Da**
Ex power supply, intrinsically safety data (12)		Ui = 30 V, Ii = 100 mA, Pi = 0,75 W Ci ≤ 12 nF, Li ≤ 250 µH	Ui = 30 V, Ii = 140 mA, Pi = 1 W Ci ≤ 12 nF, Li ≤ 250 µH
Supply voltage		12…30 V DC	
Electrical connection	Cable entry	M20×1.5 cable gland	
	Cable outer diameter	Ø6…12 mm (Ø0.25…0.5")	
	Wire cross-section	0.5…1.5 mm² (AWG20…15)	
Temperature limit data		See tables in section 3.5.2.	

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

6.1.2 Temperature Limit Data for ATEX (Ex ia) Approved Models

Temperature data	**Hazardous gas atmospheres NRE-4xSxxxxA0I/ NRE-6xSxxxxA0I, NRE-4xSxxxxA1I/ NRE-6xSxxxxA1I**	**Explosive dust atmospheres NRE-4xHxxxxA0I/ NRE-6xHxxxxA0I, NRE-4xHxxxxA1I/ NRE-6xHxxxxA1I**		
	Ex ia IIC, Ex ia IIIC	**Ex ia IIC, Ex ia IIIC**		
Temperature class	**T6 T85°C**	**T5 T100°C**	**T4 T135°C**	**T3 T180°C**
Highest process temperature	+80 °C (+176 °F)	+100 °C (+212 °F)	+135 °C (+275 °F)	+180 °C (+356 °F)
Highest surface temperature at the process connection	+70 °C (+158 °F)	+100 °C (+212 °F)	+135 °C (+275 °F)	
Highest ambient temperature	+70 °C (+158 °F)	+70 °C (+158 °F)	+60 °C (+140 °F)	

7. Linearity error



Legend:

NRE-41

NRE-42…/NRE-43…D75…

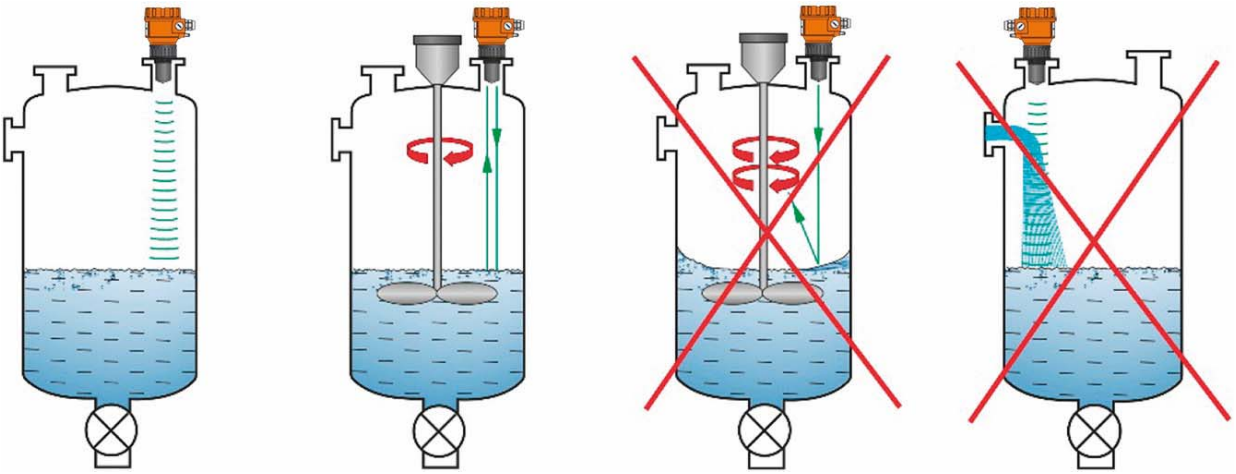
A. Process connection plane of the device
B. The minimum measurement distance below which the radar cannot measure, due to the insertion length of the antenna (X_m)
C. Maximum measurement distance (X_M)

8. Integration into the technological process

8.1 Level measurement applications

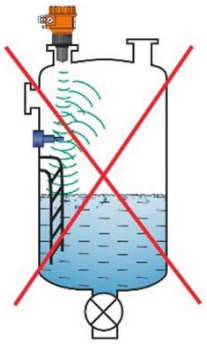
Positioning

The optimal location for NRE-4 (for a cylindrical tank) is at radius r = (0.3…0.5) R. It is always advisable to consider the radiation cone angle.
The liquid surface must be perpendicular to the axis of the device.
Under no circumstances place the device near the inlet opening! Improper placement may lead to malfunctions.
In the case of enclosed antenna designs, the possibility of antenna front surface humidity should be minimized.



OBSTACLES

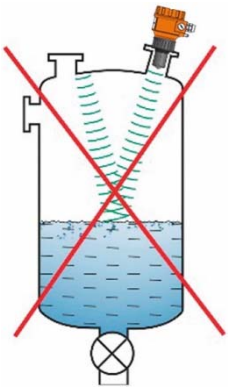
It is essential to avoid objects (pipes, ladders, structural elements, thermometers, etc.) entering the radiation cone.



CAUTION! If necessary, programming can block up to 4 interfering echoes in the NRE-4 threshold settings by programming!

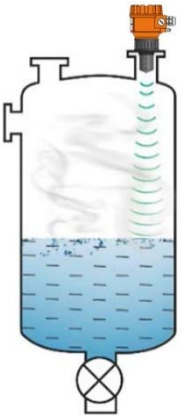
ALIGNMENT

The plane of the process connection must be parallel to the measured surface within ±2…3°.

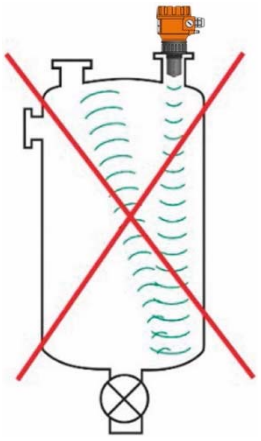


GASES / STEAM

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



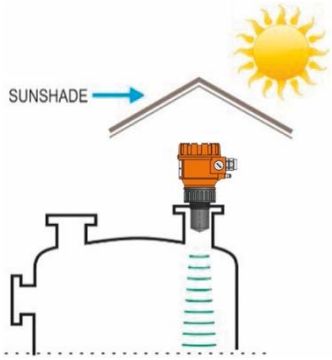
EMPTY TANK



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

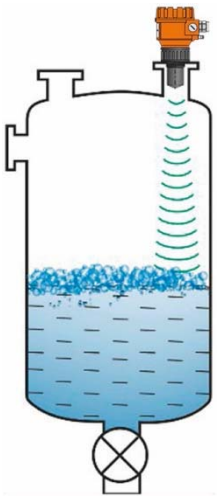
It is because the tank bottom or objects at the bottom of the tank scatter or reflect the millimeter waves emitted to a certain extent, or the lower signal level of the scattered radiation interferes with itself in the tank. At least 100 mm (3.9″) of liquid must cover these interfering devices or the convex or conical tank bottoms for a reliable measurement.

TEMPERATURE



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

FOAM



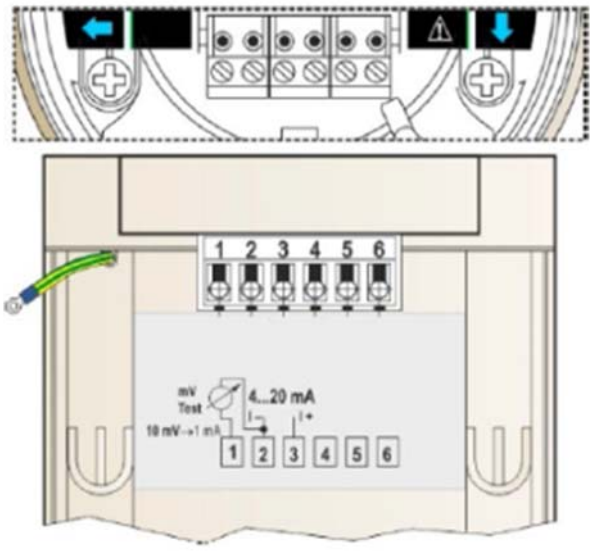
Foam on the measured surface may prevent millimeter-wave level measurement. The sensor should be mounted in a position below which the formation of foam is the smallest.

8.2 Flow measurement applications

The instrument can be used for open channel flow measurement with the flumes and weirs described in Chapter 10.7.

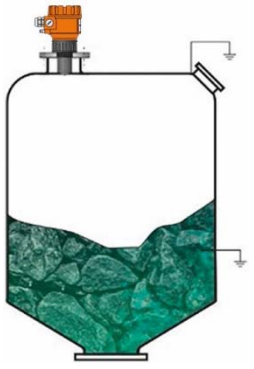
- The distance of the sensor from the surface must be adjusted, taking into account the maximum level to be measured and the proximity linearization error curve in Chapter 7.
- The sensor must be positioned on the longitudinal axis of the restricting element at a location determined by the characteristics of the restricting element. This point is marked on KOBOLD Parshall flumes.
- Foam may form on top of the flowing liquid which may affect the measurements. The liquid's surface must be exposed in front of the sensor to obtain a good echo.
- The sensor must be fixed so that it cannot move.
- The correct construction of the upstream and downstream sections of the measurement channel is of utmost importance for the accuracy of the measurement.
- The accuracy of volume flow measurement based on the level change also depends on the size and design of the restrictive element (channel or weir) used and the surface quality of the flowing liquid (ripple, foam). Therefore, flow measurement accuracy is necessarily lower than the accuracy achievable with level measurement.
- The sensor must be protected from direct sunlight by a cover to prevent the sensor from exceeding the maximum permitted temperature.

9. Wiring



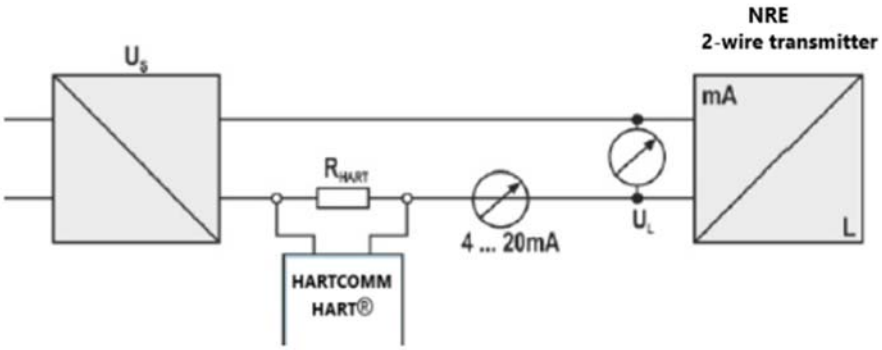
1. Remove the cover of the device housing.
2. Insert the cable through the cable gland into the terminal block.
3. Strip approximately 80 mm (3.15") of the insulation of the cable and remove approximately 4 mm of the insulation of the wires. Cut the shielding of the signal cable.
4. Connect to points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

In non-explosive atmospheres, the device must be operated only from a galvanically isolated power supply!
For devices used in hazardous areas, the requirements in section "3.7 Conditions for safe operation" must be observed when selecting the power supply.
The insulation test with a test voltage of 500 V AC is prohibited due to the internal electronic overvoltage protection!

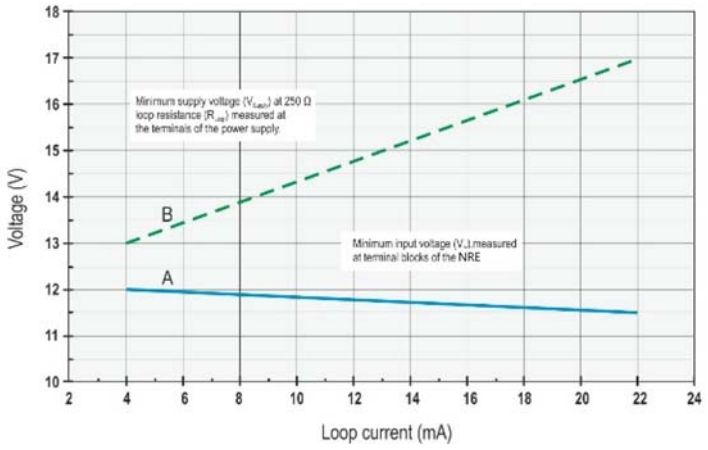
Connecting (grounding) to an equipotential network (EPH)		**Electrostatic Discharge (E.S.D.)**	
Earthing connector (EP) on the side of the device housing, maximum conductor cross-section: 4 mm² (AWG12). The instrument housing must be earthed to a R <1 Ω resistive earth. The shield of the measuring cable must be grounded in the instrument room. The measuring cable should not be routed near high- power cables, as shielding does not protect against switching harmonics.		The device is protected against 4 kV E.S.D. **Warning!** The internal protection of the instrument against ESD cannot protect the entire measuring system against electrostatic discharge. In all cases, it is the user's responsibility to ensure the grounding of the tank and the measured material.	

Designing a measuring network

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



Line "A": minimum voltage at the input terminals of the device
Line "B": minimum supply voltage (voltage across the device and the 250 Ω loop resistor)
Example for calculating the supply voltage:
The required minimum supply voltage at Imin = 4 mA:
U_{supply} min. = U_{input} min. + (I_{min} * loop resistance) = 11.5 V + (4 mA * 0.25 kΩ) = 12.5 V
the required minimum supply voltage at I_{max} = 22 mA:
U_{supply} min. = U_{input} min. + (I_{min} * loop resistance) = 11.5 V + (22 mA * 0.25 kΩ) = 18.5 V. Therefore, in the case of a loop resistance of 250 Ω, the 17 V supply voltage is just sufficient for the whole 4…20 mA in the measurement range.
In hazardous areas, the data and requirements for designing the network may be different. When designing the measurement network, take into account the data and requirements in "3.5. Explosion Protection, Designation, Limit Values" and "3.7. Conditions for safe operation".



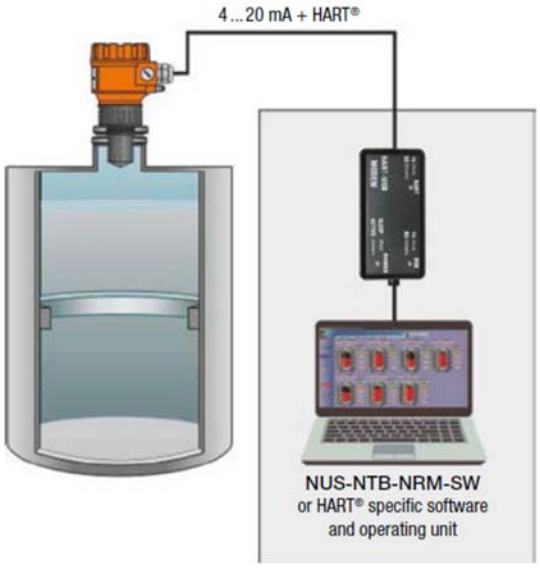
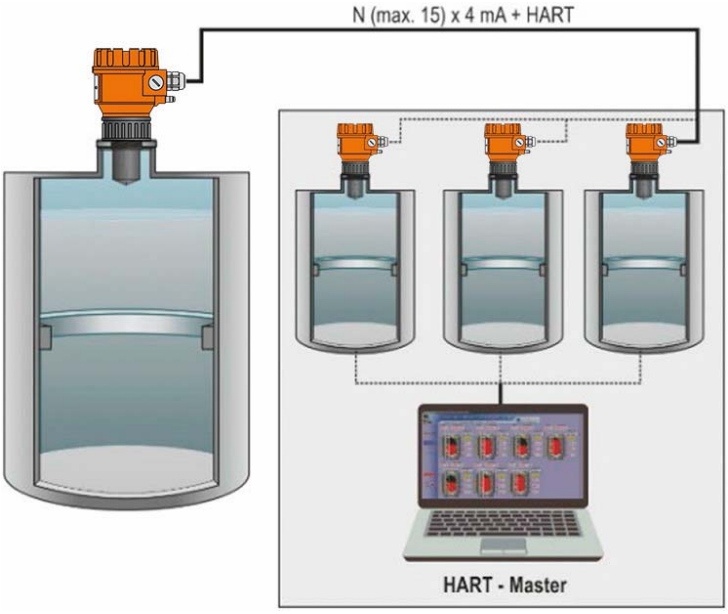
9.1 Available user interfaces

The device can be programmed using the following tools:

HART® USB modem (e.g. HARTCOMM)	Ordered separately. See “NUS-NTB_NRM-SW user manual.”
NRM-300P display unit	Ordered separately. See Chapter 13 “Programming with NRM-300P display unit”

9.2 BUS (HART®) communication

The device can be used in two modes:
– Current loop and HART®
– Multidrop, HART® protocol
The NUS-NTB_NRM-SW software supports both modes. In accordance with the Rosemount Standard, HART® communication can be used between the NRE-4 as a “slave” and the HART® master as a point-to-point connection.
Communication can be implemented in two modes.

	
If the device is set to current transmission (4…20 mA, “0” HART short address) only one device can be used in the HART communication loop.	In the case of a multidrop operation (4 mA), several devices (up to 15) can be connected in a HART communication loop. The short address of the device must be other than 0.

9.3 Commissioning and setting up

The factory default settings are suitable for checking functionality and simple measurement tasks but the device's full potential can only be used with the correct programming tailored to the requirements of the measured process. Therefore, to get to know the operational characteristics thoroughly and solve complex measuring tasks, it is necessary to read the chapters about programming.
Caution! The instrument starts with a current consumption of 3.5 mA (parameter P12c) after power-on and, after successful initialization, maintains the set error current of 3.8 mA (see parameter P12a) at the output until the first successful measurement!

10. Programming

The HART interface of the NRE-4 lets the user to access and program all device parameters. The parameter set can be accessed in three ways:
– NRM-300P plug-in display unit. See Chapter 13 for manual and menu map.
– NUS-NTB_NRM-SW software. See Chapter 12 for manual.
These methods differ in many aspects. This programming guide only discusses the method involving NUS-NTB_NRM-SW. For detailed information, refer to the descriptions of the particular access methods or the user manuals.
Some rarely used parameters cannot be set directly from the graphical interface. Instead, they can be changed referring to the parameter number at the following path.

NUS-NTB-NRM-SW
Advanced mode → Parameters

10.1 Configuring the measurement

P00: d c b a Unit system, default units, regional parameter **FACTORY DEFAULT: 0000**

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

a	Mode
0	Normal
1	High-sensitivity

NRM-300P	NUS-NTB_NRM-SW
BASIC SETUP → APPLICATION	*Application → Operating mode*

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

NRM-300P	NUS-NTB_NRM-SW
BASIC SETUP → UNITS → ENGINEERING UNITS → DISTANCE UNITS	*Application → Engineering units*

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

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

NRM-300P	NUS-NTB_NRM-SW
BASIC SETUP → UNITS → ENGINEERING SYSTEM	*Application → Calculation system*

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

NRM-300P	NUS-NTB_NRM-SW
BASIC SETUP → UNITS → ENGINEERING UNITS → DISTANCE UNITS	*Application → Engineering units*

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

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

NRM-300P	NUS-NTB_NRM-SW
BASIC SETUP → UNITS → ENGINEERING SYSTEM	*Application → Calculation system*

d	Temperature unit
0	°C
1	°F

NRM-300P	NUS-NTB_NRM-SW
BASIC SETUP → UNITS → ENGINEERING UNITS → TEMPERATURE UNITS	*Measurement configuration → Temperature*

P01: d c b a Output source **FACTORY DEFAULT: 1011**

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

a	Mode
0	Normal
1	High-sensitivity

NRM-300P	NUS-NTB_NRM-SW
BASIC SETUP → APPLICATION	*Application → Operating mode*

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

NRM-300P	NUS-NTB_NRM-SW
BASIC SETUP → UNITS → ENGINEERING UNITS → DISTANCE UNITS	*Application → Engineering units*

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

[13] *The accuracy of ±2 mm is not guaranteed for Region 3 and Region 4 settings.*

NRM-300P	NUS-NTB_NRM-SW
BASIC SETUP → UNITS → ENGINEERING SYSTEM	*Application → Calculation system*

d	Temperature unit
0	°C
1	°F

NRM-300P	NUS-NTB_NRM-SW
BASIC SETUP → UNITS → ENGINEERING UNITS → TEMPERATURE UNITS	*Measurement configuration → Temperature*

P01: d c b a Output source **FACTORY DEFAULT: 1011**

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

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

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

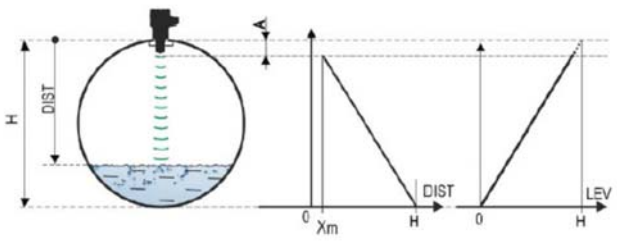
NRM-300P	NUS-NTB_NRM-SW
MEASUREMENT CONFIGURATION *→PV. Mode* *→SV. Mode*	*Measurement configuration →Measurement mode*

Distance measurement (DIST) / Level measurement (LEV)

DIST: Currently measured distance

A: Shortest measurable distance (P05)

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



Volume measurement (VOL)

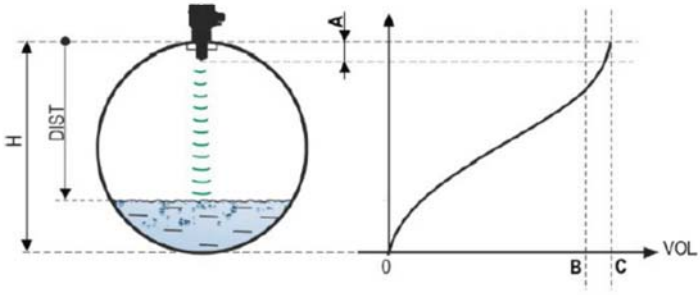
DIST: Currently measured distance

A: Shortest measurable distance

H: Zero-level distance

B: Volume associated with the highest measurable level

C: Tank's total volume



P02: d c b a Output units **FACTORY DEFAULT: 2021**

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

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

NRM-300P[15]	NUS-NTB_NRM-SW
BASIC SETUP →UNITS →ENGINEERING UNITS →MASS UNITS	*Measurement configuration →Mass Units*

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

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

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

NRM-300P[17]	NUS-NTB_NRM-SW
BASIC SETUP →UNITS →ENGINEERING UNITS →VOLUME UNITS	*Measurement configuration →Volume Units*

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

c	Time
0	Second
1	Minute
2	Hour
3	Day

NRM-300P[18]	NUS-NTB_NRM-SW
BASIC SETUP →UNITS →ENGINEERING UNITS →TIME UNITS	*Measurement configuration →Time Units*

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

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

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

NRM-300P[20]	NUS-NTB_NRM-SW
BASIC SETUP →UNITS →ENGINEERING UNITS →TOT UNITS	*Measurement configuration →TOT Units*

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

P03: Maximum sensing distance **FACTORY DEFAULT: See X_{max} + 30 cm**

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

Type-specific measuring distance	Minimum X_{min}[21]	Maximum X_{max}
NRE-41xxR25 / NRE-41xxN25[22]	0.056 m (2.2")	10 m (33 ft)
NRE-41xxR40 / NRE-41xxN40[22]	0.070 m (2.75")	10 m (33 ft)
NRE-42xxR40 / NRE-42xxN40[22]	0.070 m (2.75")	20 m (66 ft)
NRE-41xxR25 / NRE-41xxN25[23]	0.069 m (2.7")	10 m (33 ft)
NRE-41xxR40 / NRE-41xxN40[23]	0.080 m (3.15")	10 m (33 ft)
NRE-42xxR40 / NRE-42xxN40 [23]	0.080 m (3.15")	20 m (66 ft)
NRE-43xxD75... [22]	0.115 m (4.53")	30 m (98.5 ft)

[21] *From the plane of the process connection.*
[22] *NRE-4xxP, NRE-4xxV, NRE-4xxF encapsulated antenna*
[23] *NRE-4xxS, NRE-4xxM, NRE-4xxK stainless steel antenna*

NRM-300P	NUS-NTB_NRM-SW
MEASUREMENT CONFIGURATION → → SENSING DIST.	*Measurement configuration → Sensing Distance*

P04: Zero-level distance (tank height – H) **FACTORY DEFAULT: See Xmax in the table**

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

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

NRM-300P	NUS-NTB_NRM-SW
CALCULATION → ZERO-LEVEL DISTANCE	*Measurement configuration → Zero-level distance*

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

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

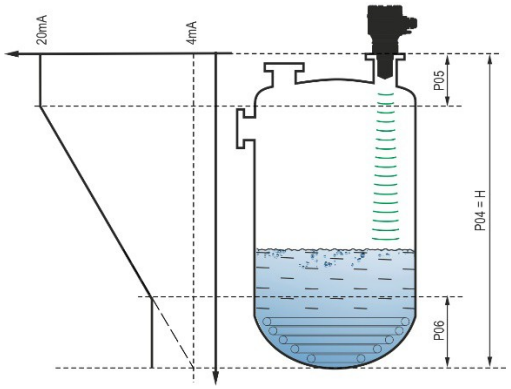
NRM-300P	NUS-NTB_NRM-SW
MEASUREMENT CONFIGURATION → →NEAR BLOCKING	*Measurement configuration →Minimum (P05)*

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

In parameter P06, we can specify a level value below which the output will no longer follow any further level decrease. Far-end blocking is used when objects at the bottom of the tank (mixer, heating coil, funnel, etc.) cause measurement uncertainty within this range, e.g., because interfering echoes cannot be safely distinguished from the echoes of the measured surface. If an echo falls within the far-end blocking range (LEV < P06), the device sends a special signal and keeps the level value defined here on the output (see figure). The “Echo in far-end blocking range” flag (see Chapter 11.1) indicates that the echo is in the far-end blocking zone. Regardless of this, the “VALID” flag is active, but the “HOLD” flag remains inactive. Far-end blocking can be deactivated with P06 = 0. Min. value: 0 / max. value: P04 – P05 – 5 cm (2")

A.) Level or volume measurement

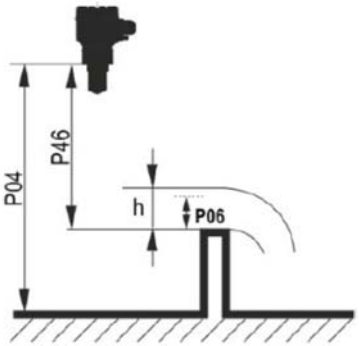
- *If the level drops below the value of P06:*
  It keeps a level value corresponding to P06 on the output and calculates the derived values from it.
- *If the level goes above the far-end blocking limit: In level or volume measurement mode, the programmed tank dimensions are valid, so far-end blocking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



B.) Open-channel flow measurement

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

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



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

NRM-300P	NUS-NTB_NRM-SW
MEASUREMENT CONFIGURATION → →FAR BLOCKING	*Measurement optimalization →Far end (P06)*

10.2 Current loop output

P08: Manual output current value **FACTORY DEFAULT: 4.0**

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

NRM-300P	NUS-NTB_NRM-SW
OUTPUT SETUP →ANALOG OUTPUT → →FIX CURRENT VALUE	*Current output →Fix output current (P08)*

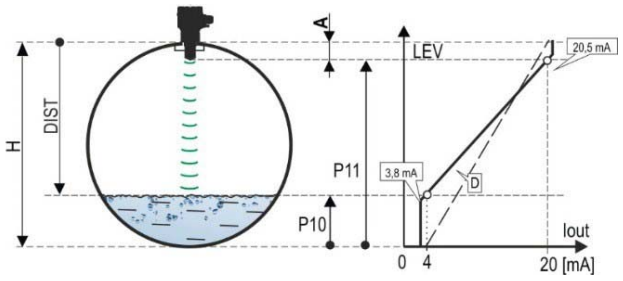
P10: The value of the transmitted quantity as signed to 4 mA output current **FACTORY DEFAULT: 0.0**

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

NRM-300P	NUS-NTB_NRM-SW
OUTPUT SETUP →ANALOG OUTPUT → →PV VALUE OF 4 mA	*Current output →Assignment of 4 mA - PV*

P11: The value of the transmitted quantity assigned to 20 mA output current **FACTORY DEFAULT: Xmax**
(See table of **P03**)

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



A: Shortest measurable distance
D: ***P10, P11*** diagram valid for factory default settings

NRM-300P	NUS-NTB_NRM-SW
OUTPUT SETUP →ANALOG OUTPUT → →PV VALUE OF 20 mA	*Outputs →Current output → →Assignment of 20 mA - PV*

P12: - c b a Analog current loop output mode **FACTORY DEFAULT: 0000**

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

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

NRM-300P	NUS-NTB_NRM-SW
OUTPUT SETUP → ANALOG OUTPUT → → ERROR MODE	*Current output → Error indication by the current output*

Analog current output mode:

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

NRM-300P	NUS-NTB_NRM-SW
OUTPUT SETUP → ANALOG OUTPUT → → CURRENT MODE	*Outputs → Current generator mode*

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

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

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

NRM-300P	NUS-NTB_NRM-SW
BASIC SETUP → STARTUP CURRENT	*Outputs → Startup current*

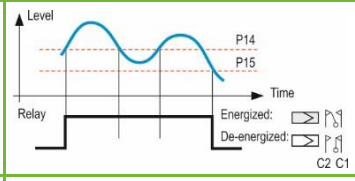
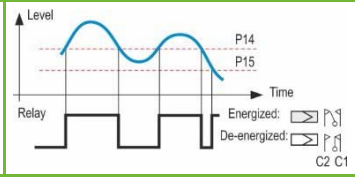
10.3 Relay output (optional)

P13: - c b a Relay function **FACTORY DEFAULT: 0001**

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

NRM-300P	NUS-NTB_NRM-SW
OUTPUT SETUP → RELAY OUTPUT → → RELAY MODE	*Outputs → Relay output → Relay mode*

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

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

NRM-300P	NUS-NTB_NRM-SW
OUTPUT SETUP → RELAY OUTPUT → RELAY FUNCTION	*Outputs → Relay Function*

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

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

NRM-300P	NUS-NTB_NRM-SW
OUTPUT SETUP → RELAY OUTPUT → → VOLUME/PULSE UNIT	*Outputs → Relay output → Relay parameters → → Pulse constant unit*

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

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

NRM-300P	NUS-NTB_NRM-SW
OUTPUT SETUP → RELAY OUTPUT → → ENERGIZED VALUE	*Outputs → Relay output → Relay parameters → Energized value*

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

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

NRM-300P	NUS-NTB_NRM-SW
OUTPUT SETUP → RELAY OUTPUT → DEENERGIZED VALUE	*Outputs → Relay output → Relay parameters → De-Energized value*

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

If the PV measurement value has reached the lower or upper switching value or an error has occurred in the case of an error signal, the actual RELAY operation is activated after this time, or after this time, a change is visible on the output. Adjustable value range: 0…999 s.

NRM-300P	NUS-NTB_NRM-SW
OUTPUT SETUP → RELAY OUTPUT → DELAY	*Outputs → Relay delay time*

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

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

NRM-300P	NUS-NTB_NRM-SW
OUTPUT SETUP → RELAY OUTPUT → VOLUME/PULSE VALUE	*Outputs → Relay output → Relay parameters → Pulse constant*

10.4 Digital communication

P19: HART short address (device address) **FACTORY DEFAULT: 1**

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

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

NRM-300P	NUS-NTB_NRM-SW
OUTPUT SETUP → DIGITAL OUTPUT → → ADDRESS	*Device Identification → HART Device Short Address*

10.5 Measurement optimization

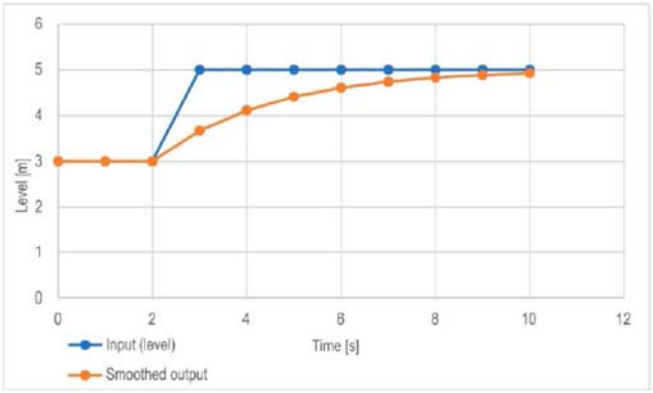
P20: Damping time **FACTORY DEFAULT: 40**

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

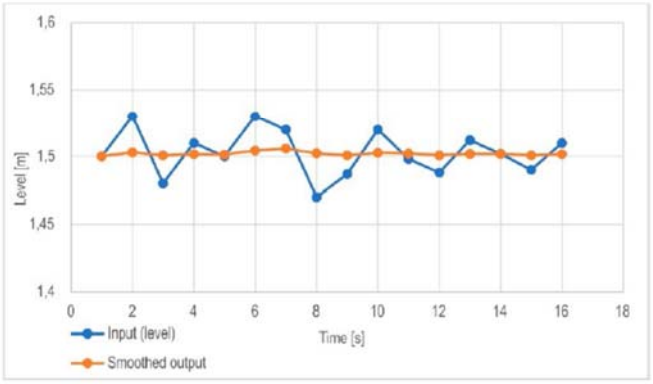
	For testing	Recommended
Barely or non-volatile/waving media	0 s	8 s
Highly volatile / strongly waving liquid	>24 s	>40 s

NRM-300P	NUS-NTB_NRM-SW
MEAS. OPTIMIZATION → DAMPING TIME	*Measurement optimalization → Damping time*

Damping example 1.
Damping time = 10 s
Level change (level) = 2 m (6.6 ft)



Damping example 2.
Damping time = 40 s
Level change = 2…3 cm
(0.39"…0.79") ripple
If a higher degree of undulation is expected in the measured liquid column, it is recommended to set a higher damping time. This way, the fluctuation of the value of the transmitted level can be reduced.



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

It corrects the transmitted quantity according to the distance. If the value measured by the device differs from the value under real conditions, this multiplier can be used to refine the result. The output value is multiplied by the number set here. By default, the multiplier (1) does not modify the output.
Value range: 0.7…10

NRM-300P	NUS-NTB_NRM-SW
CALCULATION→USER SLOPE MULTIPLIER	*Measurement optimalization → Velocity user correction factor*

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

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

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

NRM-300P	NUS-NTB_NRM-SW
MEAS. OPTIMIZATION → ECHO SELECTION	*Measurement optimalization → Echo selection → → Selection of Echo…*

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

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

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

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

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

NRM-300P	NUS-NTB_NRM-SW
MEAS. OPTIMIZATION → LEVEL TRACK SPEED → FILLING SPEED → → EMPTYING SPEED	*Measurement optimalization → Level → → Level elevation rate (filling speed) Level descent rate (emptying speed)*

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

Echo loss handling:

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

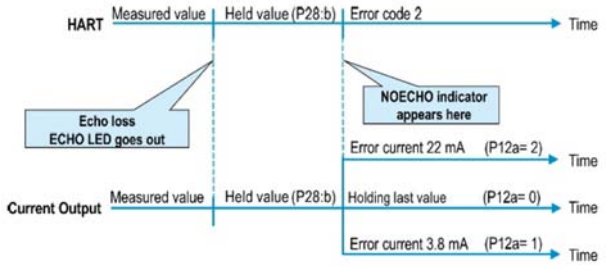
NRM-300P	NUS-NTB_NRM-SW
MEAS. OPTIMIZATION → ECHO LOSS HANDLING → OUTPUT MODE	*Measurement optimalization → Measurement loss management → Echo loss handling*

Error indication delay:

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

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

b	Error indication delay	Notes
0	No delay	During a short echo loss, the last value is held in transmission for a period set in **P28:b.** After that, it is transmitted via HART on bit **0** of **DSE**[25] according to **P12:a** on the current loop output.
1	10 s	
2	20 s	
3	30 s	
4	1 min	
5	2 min	
6	5 min	
7	15 min	



[25] *DSE – "Device Specific Error" indicator bits (HART). See Chapter 11 Troubleshooting.*

NRM-300P	NUS-NTB_NRM-SW
MEAS. OPTIMIZATION → ECHO LOSS HANDLING → OUTPUT HOLD TIME	*Measurement optimalization → Measurement loss management → Error delay*

P29: Tank full limit **FACTORY DEFAULT: 0.0**

As with P06, the echo is tracked below the specified distance, but the output is not tracked and a "Tank Full" flag is displayed. Value range: 0... (P04 – 5 cm [2"])
If P29 is less than P05, the Tank Full Limit parameter is disabled.

P32: Specific density of the measured medium **FACTORY DEFAULT: 1.0**

If the device is set to weight transmission, the specific density of the material (medium) stored in the tank must be entered here for the weight calculation. The value is a relative ratio number (without a unit) compared to the density of water, i.e., 1 g/cm3.
Value range: 0.01…10

NRM-300P	NUS-NTB_NRM-SW
CALCULATION → SPECIFIC GRAVITY	*Measurement optimalization → Specific gravity*

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

It is used for simple relative modification of the acceptance threshold value set in the Echo diagram, the value range of which is –4000…+4000. It can increase (positive value) or decrease (negative value) the device's noise suppression ability compared to the default setting. If the value is 0, there is no change compared to the set threshold value. (See Chapter 12.4 Threshold mask).

NRM-300P	NUS-NTB_NRM-SW
MEAS. OPTIMIZATION → THRESHOLD OFFSET	*Measurement optimalization → Threshold offset*

10.6 Volume measurement

P40: 0 - - b a Output value calculation method **FACTORY DEFAULT: 0000**

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

ba	Tank shape	Parameters
- -	Output Conversion Table (OCT)	See Chapter 12.5
b0	Vertical cylindrical tank with a convex bottom	**P40+(b), P41**
01	Vertical cylindrical tank with a conical bottom	**P41, P43, P44**
02	Vertical rectangular tank with a pyramidal bottom	**P41, P42, P43, P44, P45**
03	Horizontal cylindrical tank	**P40(b), P41, P42**
04	Spherical tank	**P41**

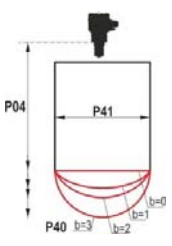
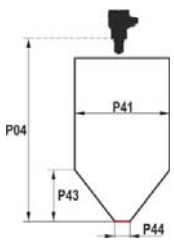
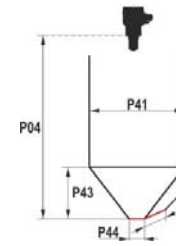
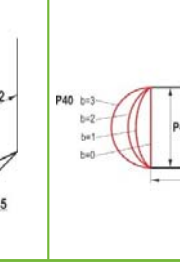
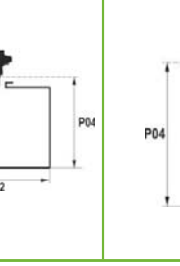
NRM-300P	NUS-NTB_NRM-SW
CALCULATION → TANK SHAPE	*Tank/Silo parameters → Tank shape*

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

NRM-300P	NUS-NTB_NRM-SW
CALCULATION → TANK SHAPE	*Tank/Silo parameters → Bottom shape*

P41-45: - - - - Tank dimensions

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

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

P47: - - - a Total tank volume **FACTORY DEFAULT: 0.0**

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

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

Value range: 0...999,999.

NRM-300P	NUS-NTB_NRM-SW
CALCULATION → TANK SHAPE	*Tank/Silo parameters → Total tank volume*

10.7 Open-channel flow measurement

P40: 0 - b a Volume flow measu rement options **FACTORY DEFAULT: 0000**

ba	Flume, formula, data						Parameters
- -	KOBOLD Parshall flumes	Output Conversion Table, See Chapter 12.5					
		Type	**Calculation formula**	**Q_{min} [l/s]**	**Q_{max} [l/s]**	**"P" [cm]**	
00		GPA-1P1	Q [l/s] = 60.87*$h^{1,552}$	0.26	5.38	30	**P46**
01		GPA-1P2	Q [l/s] = 119.7*$h^{1,553}$	0.52	13.3	34	**P46**
02		GPA-1P3	Q [l/s] = 178.4*$h^{1,555}$	0.78	49	39	**P46**
03		GPA-1P4	Q [l/s] = 353.9*$h^{1,558}$	1.52	164	53	**P46**
04		GPA-1P5	Q [l/s] = 521.4*$h^{1,558}$	2.25	360	75	**P46**
05		GPA-1P6	Q [l/s] = 674.6*$h^{1,556}$	2.91	570	120	**P46**
06		GPA-1P7	Q [l/s] = 1014.9*$h^{1,56}$	4.4	890	130	**P46**
07		GPA-1P8	Q [l/s] = 1368*$h^{1,5638}$	5.8	1208	135	**P46**
08		GPA-1P9	Q [l/s] = 2080.5*$h^{1,5689}$	8.7	1850	150	**P46**
09	Generic Parshall flume						**P46**, **P42**
10	Palmer-Bowlus (D/2)						**P46**, **P41**
11	Palmer-Bowlus (D/3)						**P46**, **P41**
12	Palmer-Bowlus (rectangular)						**P46**, **P41**, **P42**
13	Khafagi-Venturi						**P46**, **P42**
14	Weir						**P46**, **P42**
15	Rectangular or Bazin weir						**P46**, **P41**, **P42**
16	Trapezoidal weir						**P46**, **P41**, **P42**
17	Special trapezoidal (4:1) weir						**P46**, **P42**
18	V-shaped weir						**P46**, **P42**
19	Thomson (90°) weir						**P46**
20	Circular weir						**P46**, **P41**
21	Generic formula: Q[l/s] = **P41***h^{P42}, h [m]						**P46**, **P41**, **P42**
22	Generic formula: Q[l/s] = **P41***h^{P42}, h [P00:cb]						**P46**, **P41**, **P42**

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

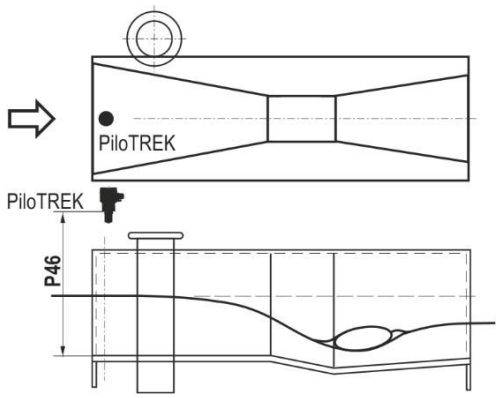
ba	Flume, formula, data	Parameters
30	4" Palmer-Bowlus (D/2)	**P46**
31	6" Palmer-Bowlus (D/2)	**P46**
32	8" Palmer-Bowlus (D/2)	**P46**
33	10" Palmer-Bowlus (D/2)	**P46**
34	12" Palmer-Bowlus (D/2)	**P46**
35	15" Palmer-Bowlus (D/2)	**P46**
36	18" Palmer-Bowlus (D/2)	**P46**
37	21" Palmer-Bowlus (D/2)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

NRM-300P	NUS-NTB_NRM-SW
CALCULATION → FLOW MEASUREMENT	*Flow measurement → Open channel flow measurement methods*

P41-45: Flume / weir dimensions **FACTORY DEFAULT: 0**

P40=00 08

KOBOLD Parshall flume (GPA1-P1 through GPA-1P9)
See details in the manual of the Parshall flume.



P40=09

Generic Parshall flume

0,305 < **P42** (throat width) < 2,44

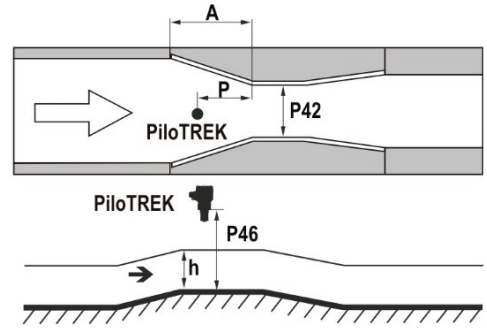
$$Q[l/s] = 372 \cdot \mathbf{P42} \cdot (h/0{,}305)^{1{,}569\,\mathbf{P42}^{0{,}026}}$$

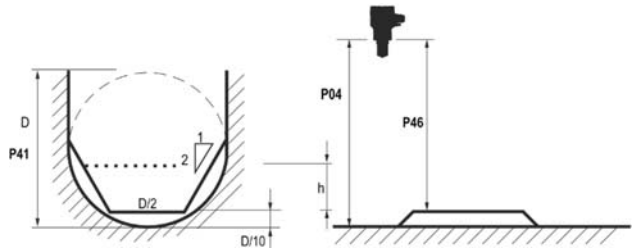
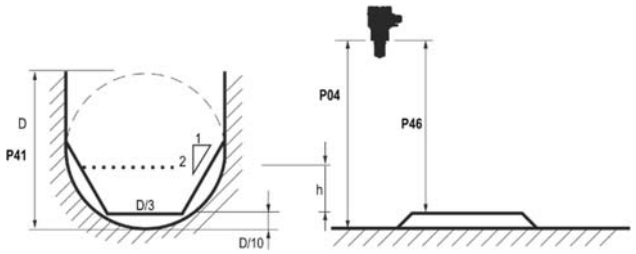
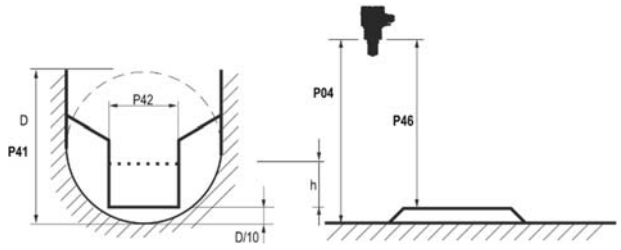
2,5 < P42

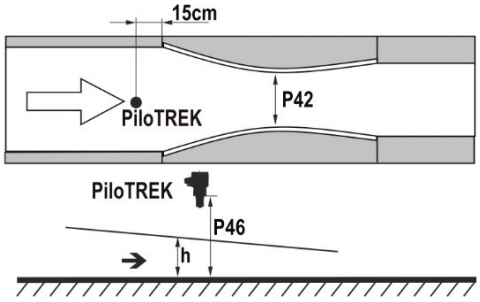
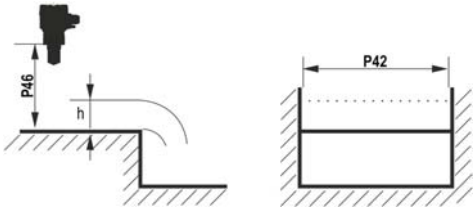
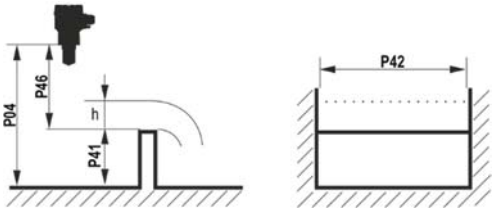
Q [l/s] = K*P42*h^{1,6}

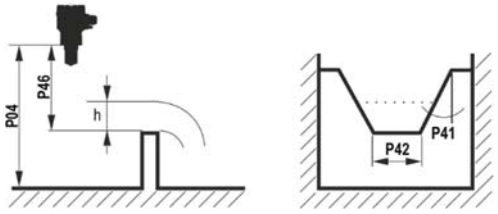
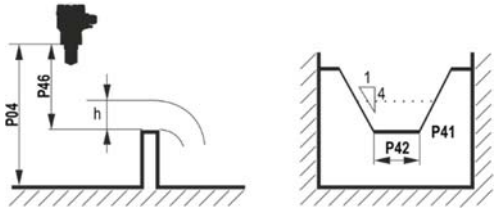
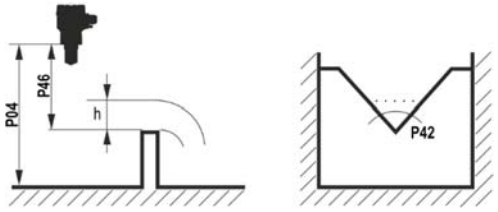
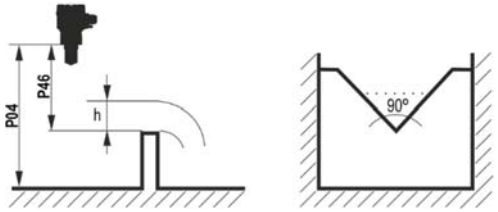
P = 2/3*A

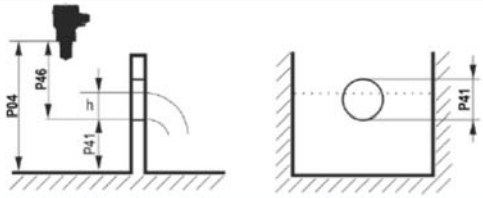
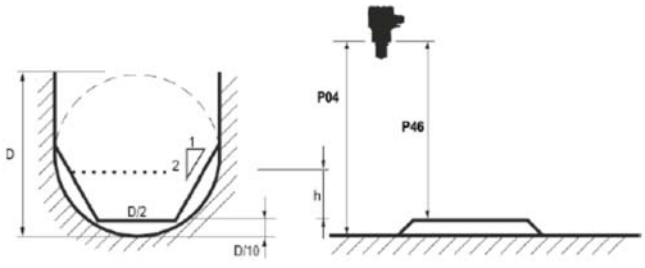
3,05	2,450
4,57	2,400
7,62	2,350
9,14	2,340
15,24	2,320



P40= 10	**Palmer-Bowlus (D/2) flume** Q [m^3/s] = f(h1/**P41**) * **P41**^{2,5}, where h1[m] = h+(**P41**/10) **P41** [m]	
P40= 11	**Palmer-Bowlus (D/3) flume** Q [m^3/s] = f(h1/**P41**) * **P41**^{2,5}, where h1[m]= h+(**P41**/10) **P41** [m]	
P40= 12	**Palmer-Bowlus (rectangular) flume** Q [m^3/s] = C*__P42__*$h^{1,5}$, where C = f(**P41**/**P42**) **P41 [m], P42 [m]**	

P40= 13	**Khafagi-Venturi flume** Q [m^3/s] = 1,744 ·**P42** · $h^{1,5}$ + 0,091 · $h^{2,5}$ **P42 [m]** h [m]	
P40= 14	**Weir** 0,0005 < Q [m^3/s] < 1 **0,3 < P42 [m] < 15** 0,1 < h [m] < 10 **Q [m^3/s] = 5,073 · P42 · $h^{1,5}$** **Accuracy: ±10%**	
P40= 15	**Rectangular or Bazin weir** 0,001 < Q [m^3/s] < 5 **0,15 < P41 [m] < 0,8** **0,15 < P42 [m] < 3** 0,015 < h [m] < 0,8 **Q [m^3/s] =1,77738(1+0,1378h/P41) · P42 · (h+0,0012)^{1,5}** **Accuracy**: ±1%	

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

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

P46: - - - a Distance associated with h=0 when measuring flow **FACTORY DEFAULT: VARIES BY TYPE**

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

10.8 Output Conversion Table – OCT programming

P40: d - [] [] OCT operation **FACTORY DEFAULT: 0**

d	Output data Measurement mode	Reference
0	Output Conversion Table OFF	See Chapter 12.5
1	Output Conversion Table ON	

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

NRM-300P	NUS-NTB_NRM-SW
CALCULATION →OCT TABLE	*OC-Table →Linearization (See Chapter12.5)*

Conditions for correct programming of data pairs

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

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

NRM-300P	NUS-NTB_NRM-SW
CALCULATION →OCT TABLE	*OC-Table →OCT list (See Chapter 7.5)*

10.9 Service diagnostic parameters (read only)

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

10.10 Flow measurement control parameters (read only)

P72	- - - -	Measuring height of the flow measurement (“h” value)

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

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

10.11 Output control parameters (read only)

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

10.12 Hardware/Software versions (read only)

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

10.13 Service functions

10.13.1 Security codes

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

NRM-300P	NUS-NTB_NRM-SW
SERVICE → SECURITY →USER LOCK	*Advanced → Special*

10.13.2 Current output test

P80: Loop current test (mA)

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

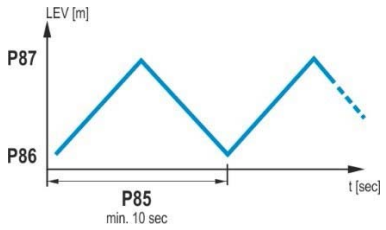
NRM-300P	NUS-NTB_NRM-SW
SERVICE → OUTPUT TEST →ANALOG OUTPUT	—

10.13.3 Simulation

This function helps the user to check the outputs and the processing device connected to it. NRE-4 can simulate a constant or a variable value of the level. The simulation level values must be within the measurement range defined by P04 and P05. To start the simulation, return to the Measurement mode. During simulation, the DIST, LEV or VOL symbols will flash. To end the simulation, set P84= 0.

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

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



NRM-300P	NUS-NTB_NRM-SW
SERVICE → DIST. SIMULATION	*Advanced → Special*

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

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

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

Unit of measurement: according to P00b.

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

Unit of measurement: according to P00b.

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

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

10.13.4 Load default setting

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

NRM-300P	NUS-NTB_NRM-SW
SERVICE → DEFAULTS → LOAD DEFAULT	*Advanced → Parameters →Load default*

10.13.5 Restart

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

NRM-300P	NUS-NTB_NRM-SW
SERVICE → RESTART	*Advanced → Special*

11. Trouble shooting

11.1 Status and error indication in HART® communication

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

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

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

Bit №	Device-Specific Status flags (DSS)	Explanation
0-2	PV value type (DIST, LEV, VOL, MASS, FLOW, LEV%, VOL%, …)	The type of the primary transmitted value (PV) by P01a.
3	Manual programming is active (Status)	The device is in manual programming mode. (Only on devices (WG☐) featuring a display.)
4	Remote programming is active (Status)	The device is in remote programming mode.
5	Simulation is active (Warning)	The device is in simulation mode. Caution! The output value is independent of the measured value.
6	User password is set (Status)	Password protection is active.
7	Relay energized (Status)	Relay is energized.
8	User lock is active (Status)	User lock is active. The parameters are protected by a password set by the user.
9	Factory lock is active (Status)	Factory lock is active. The factory default settings and calibration data are locked.
10	NRM-300P display is connected (Status)	A display is connected to the device. (Only on devices (WG☐) featuring a display.)
11	Diagnostic mode is active (Status)	The device is in diagnostic mode.
12	HOLD (Warning)	The transmitted value is on hold.
13	Calibration mode is active (Status)	The device is in calibration mode.
14	Valid (Status)	The transmitted value is refreshed and valid.
15	HS communication mode is active (Status)	The device is in high-speed communication mode.

11.2 Typical application errors

Error	Possible cause	Solution
The transmitted value takes a value from a close range (most often around 0.2 m).	Condensation or dirt on the antenna.	Clean the antenna or use a threshold mask to block the interfering echo.
The measured value does not change despite the level change.	This typically happens when echo loss occurs. In most cases, this is: – during foaming of the medium – dirt on the antenna – excessive waves – incorrect max. (P03) measurement setting – it can happen in cases of echo below the threshold curve.	Remove dirt from the antenna. Check the surface of the medium to be measured, if necessary, take measures to reduce foaming or ripples! Check threshold settings. See Chapter 12.3! Check the P03 maximum measuring distance setting.

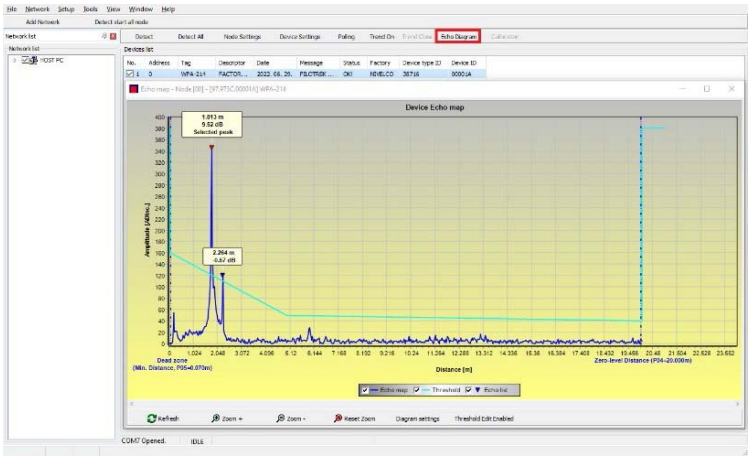
12. NUS-NTB_NRM-SW Instructions

If necessary, install the NUS-NTB_NRM-SW HART configuration software (hereafter NUS-NTB_NRM-SW) as described in the program's manual. The software can be downloaded from www.Kobold.com.
Electrical connections: Start the program and search for the transmitter with the program (for more information, see also NUS-NTB_NRM-SW user manual).
From the devices found during the detection, select the device you want to configure or program and open the "device programming" window of the device (see the NUS-NTB_NRM-SW user manual). All the necessary parameters and function settings can be changed with NUS-NTB_NRM-SW. This chapter only describes the specific functions related to NRE-4s and two programming examples.

12.1 Device Status Window

To invoke the "Device Status Window" in NUS-NTB_NRM-SW, right-click on the device line in the "Device List" in the main window and select the "Show Device Status Window" menu item in the popup window. This window shows the status and error messages of the NRE-4. (See Chapter 11.1) The "Device Status Window" can also be summoned in the "Polling" window by activating the corresponding check box.

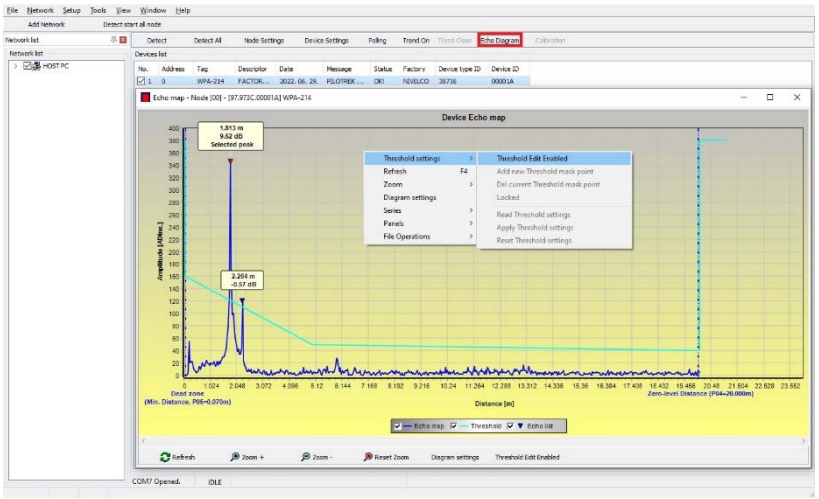
12.2 Echo Diagram (oscilloscope function)



Click the "Echo Diagram" button in NUS-NTB_NRM-SW to display the device's Echo Diagram. A window called "Echo map" will appear. This diagram shows the reflection curve measured by the device. In addition, this window can be used to adjust the threshold level. To update the chart or read the data, press the "Refresh" button on the bottom line of the window (or press the F4 key).
After a successful reading, an echo graph similar to the attached "Echo Diagram" appears. The displayed information content can be selected in the legend. The "Echo list" displays the location and data of the echo peaks evaluated by the device, of which the selected level signal is marked with the inscription "Selected peak."

12.3 Threshold settings

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

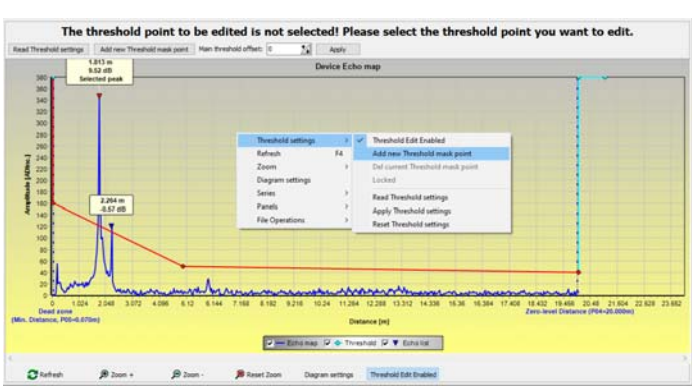


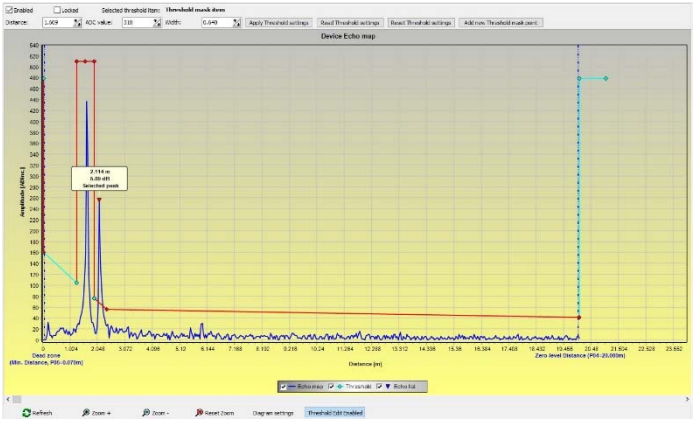
The threshold can be edited in the Echo diagram window of the NUS-NTB_NRM-SW software. In addition, the height of the entire threshold can be adjusted in a simplified way with the P34 “Threshold offset” parameter among the measurement optimization parameters. The main threshold line is used to trace the general shape of the echo curve. Threshold highlights, also known as threshold masks, are available to mask interfering echo peaks protruding from the curve.
The threshold editing mode can be activated either by selecting “Threshold Edit Enable” in the bottom menu bar or by selecting “Threshold settings” → “Threshold Edit Enable” in the context menu that appears when clicking the right mouse button. In this case, the threshold editing function bar appears in the upper half of the window, and the editable points are marked red on the threshold curve. If no editable point is selected, the “Threshold offset” can be set in the function bar, so the height of the basic threshold curve consisting of three points is the same. If an editable point is selected by clicking the left mouse button, its position can also be altered separately.

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

12.4 Threshold mask

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





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

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

12.5 The output conversion table (OCT) – (NUS-NTB_NRM-SW OC-Table)

The output conversion table (OCT) is active if table correction is selected in parameter P40. See Chapters 10.7, 10.8, and 10.9. The OCT is filled in using the NUS-NTB_NRM-SW software. The conversion table is usually used for volume measurement but can also be used for weight or flow measurement.
This table assigns different output values to the measured levels. The value on the left is always the measured level (relative to the zero-level distance (P04) setting), and the value on the right is the output value for the particular level. The unit associated with the output value is determined by the setting of the “Output source” (P01, HART - PV) and “Output units” (P02) parameters.
The output value is determined by linear interpolation between two value pairs, so the accuracy of the conversion depends on the density of the associated value pairs. After the last pair of points, the output value is calculated by linear extrapolation. The maximum number of pairs is 100.
More information:

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

A user-defined conversion table (e.g., “level - volume”) can be created using NUS-NTB_NRM-SW as follows:
To fill in or set the output conversion (OC) table of the device, go to the “Device Settings” → “OC-Table” tab in NUS-NTB_NRM-SW. Upload or modify the table according to “NUS-NTB_NRM-SW Instructions for Use.” If the appropriate changes have been made in the table and it has been filled in correctly, press the “Send” button on this page (“OC-Table” tab) on the right side under the “Get” button to download the table to the device.

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

Step	Action	Entered data / chosen value
1	In NUS-NTB_NRM-SW, open the “Device Settings” window of the given device.	
2	Go to the point called “Application” and select the unit system (“Calculation system”).	Metric (EU)
3	Select a length unit (Engineering Unit).	m
4	Go to “Measurement configuration” and select “Measurement mode (PV source): volume transmission” from the list.	Volume
5	Select a volume unit in the “Volume Units” section.	m³
6	Go to “Measuring distances” and enter the tank height in the field named “Zero-level dist.” (Click on the field and enter the value).	6.00 m
9	Press the “Send” button in the lower right corner of the window to download the new values to the device.	Wait until the download process is complete.
10	Go to the point called “OC-Table.” Fill in the table called “OCT list” with the appropriate values. A maximum of 100 points can be entered. Each level and volume point must be entered. Each subsequent point must be larger than the previous one. New lines can be created by pressing the “Ctrl + Insert” key combination or selecting “Add new item” in the popup menu of the right mouse button. A line can be deleted by pressing the “Ctrl + D” keys together.	See the following table (Example for completing OCT)
11	To download the table to the device, press the “Send” button located on this page (“OC-Table” tab) on the right side under the “Get” button.	

Example of filling out the OCT

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

Additional procedure for displaying 4…20 mA current output (using NUS-NTB_NRM-SW)

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

12.6 Programming example 1 – configuring level measurement (using NUS-NTB_NRM-SW)

Configuring level measurement in a 9 m (29.5 ft) tank (example). Level measurement is the factory default mode, it is sufficient to enter only the actual tank height (P04 = 9.0 m [29.5 ft]). The max. measuring length of the NRE-4 radar configured by the manufacturer is 10.0 m (33 ft), so it covers the required 9 m (29.5 ft).

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

12.7 Programming example 2 – configuring the current loop output (using NUS-NTB_NRM-SW)

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

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

13. Programming with NRM-300P Display Unit

The main parameters of NRE-4 can also be set using the NRM-300P display unit. By default, the display shows the primary measurement result (from which the output current is calculated). In addition to the measurement value displayed in large figures, a bar graph representing the output current value is also shown on the right. Programming is done via a text menu. Use the Ⓔ \ ⊕ \ ⊕ \ ⊖ keys to navigate through the menu.

13.1 NRM-300P display unit

Display: 64 × 128 dot matrix LCD, with symbols, units, and column diagram
Ambient temperature: –20…+65 °C (–4…+149 °F)
Housing material: PBT fiberglass-reinforced plastic (DuPont®)

The NRM-300P is a plug-in module with an LCD (universal – can be used in other KOBOLD devices, provided that the device's software supports NRM-300P).
Caution!
The NRM-300P is based on LCD technology, do not expose the NRM-300P to prolonged heat or sunlight as the display may be damaged.
If it is not possible to protect the NRE-4 from sunlight or if the NRE-4 is to be used outside the operating temperature range of the NRM-300P, do not leave the NRM-300P in the NRE-4!

13.2 The NRE-4 during programming

By default, the NRE-4 displays the main measurement data on the NRM-300P display (hereafter referred to as the display). To enter the programming menu, press the Ⓔ button. Use the buttons ⊕ / ⊖ to navigate between the menu items.
You can also enter the selected menu item by pressing the Ⓔ button. To return to the previous menu level, press the ⊖ button.

The buttons only work when the NRM-300P is present!

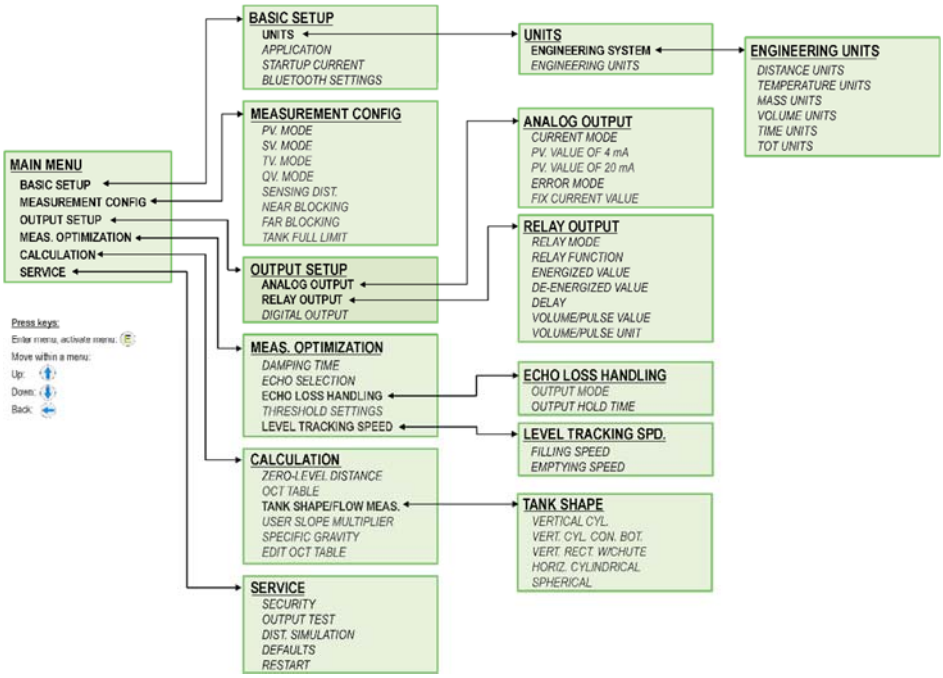
While using the menu, the instrument continues measuring without interruption. Any setting changes made in the menu will take effect when you exit the menu. If the NRE-4 menu is not exited, the NRE-4 will automatically return to the measurement display state after 30 minutes. Any changes made in the menu will then be ignored.
If the NRM-300P is unplugged from NRE-4, NRE-4 will automatically exit the menu and ignore any changes made to the menu. Since programming with the NRM-300P (manual programming) and remote programming via HART (REMOTE MODE) create a competing situation, only one mode can be used at a time.

Manual programming has priority!

During manual programming, the device sends a "device busy" signal to the HART master (HART Response code: 32 - Device is busy).
In remote programming mode, REM appears on the top right of the display. In this case, manual programming of the device is disabled, and the menu cannot be accessed.
If no NRM-300P is connected, the LEDs will become visible, the COM LED will flash to indicate HART communication, and the VALID LED will indicate if the data measured by the device is valid.

13.3 Manual programming

While on a submenu item, pressing the Ⓔ button will change the parameter or access an additional submenu. There are two modes:
Text list: It can be navigated like the menu list. Accept selection by pressing Ⓔ and discard it by pressing the ⊕ button.
Editable number field: It is used to edit numeric values. Editing is assisted by a cursor (inverse character). The number on the cursor position can be changed with the ⊕/⊕ keys (no over-, under-, or underflow between characters). The cursor can be moved to the left with the ⊕ arrow key (max. 9 characters space, including the decimal point). When you reach the end of the field, the cursor returns to the first position on the right. The modification is completed by Ⓔ pressing the button. NRE-4 will then check the value entered, and if it is not correct, the message "WRONG VALUE!" will appear on the bottom line.



14. Parameter list

Pr.	Page	Name	Value d c b a
	20	Unit system, default unit, region parameter	
	22	Output source	
	22	Output units	
	24	Maximum sensing distance	
	24	Zero-level distance (tank height – H)	
	26	Close-end blocking (dead-zone)	
	26	Far-end blocking	
		—	
	27	Manual output current value	
		—	
	27	Output value assigned to 4 mA	
	28	Output value assigned to 20 mA	
	28	Analog current loop output's mode	
	30	Relay output	
	31	Relay parameter – Trigger value	
	31	Relay parameter – Release value	
	32	Relay parameter – Delay	
	32	Relay parameter – Flow parameter value	
		—	
	32	HART address	
	32	Damping Time	
		—	

Pr.	Page	Name	Value d c b a
P22	34	User Slope Correction Factor	
P23		—	
P24		—	
P25	34	Echo selection	
P26	35	Level rise speed (filling speed)	
P27	35	Level drop speed (discharging speed)	
P28	35	Measurement loss management	
P29	36	Tank Full Limit	
P30		—	
P31		—	
P32	36	Density of the measured medium	
P34	37	Threshold offset	
P36	37	BLE settings	
P40	38	Tank shape	
P41	42	Tank dimensions / Volume flow options	
P42	42	Tank dimensions / Flume – weir dimensions	
P43	42	Tank dimensions / Flume – weir dimensions	
P44	42	Tank dimensions / Flume – weir dimensions	
P45	42	Tank dimensions / Flume – weir dimensions	
P46	46	The distance to the surface without flow	
P47	39	Total tank volume	

Pr.	Page	Name
P60	48	Number of operating hours since issuing [h]
P61	48	The number of operating hours since the last power-on [h]
P62	48	The number of operating hours of the signal detector (closed time of contact C2) [h]
P63	48	The number of switching cycles of the relay
P64	48	The current temperature of the electronics [°C / °F]
P65	48	The highest temperature of the device ever measured [°C / °F]
P66	48	The lowest temperature of the device ever measured [°C / °F]
P67		—
P68		—
P69		—
P70	48	Number of detected peaks (current)
P71	48	Magnitude of selected echo [raw value]
P72	48	Amplitude of selected echo [dB]
P73	48	Distance of selected echo [m]
P74	48	Echo lost / shot rate
P75		
P76	48	Measuring height of the flow measurement (read only) (LEV)
P77	48	TOT1 totalizer (clearable)
P78	48	TOT2 totalizer
P79	48	Current generator re-measured output current [µA]

Pr.	Page	Name
P80	48	Current generator calculated output current [mA]
P81	48	Status of relay outputs
P82		—
P83		—
P84	49	Simulation method
P85	50	DIST simulation cycle time
P86	50	Lower level of simulation
P87	50	Top level of simulation
P88	50	Total simulation time (timeout)
P89		—
P90		—
P91		—
P92		—
P93		—
P94	48	Software identifier (RADAR)
P95	48	Software identifier (COPROC)
P96	48	Software identifier (MAIN MCU)
P97	48	Special config mode (read only)
P98	48	Hardware code (read only)
P99		

15. Maintenance, repair and storage conditions

NRE-4 devices do not require regular maintenance. There may be occasions when the sensor head has to be cleaned of deposits. Cleaning must be done carefully without scratching or indenting the radiating surface.
All repairs, whether in-warranty or out-of-warranty must only be done by KOBOLD. The device must be cleaned before it is returned for repair, all chemicals must be neutralized, and the device must be disinfected! In addition, the device must be accompanied by a “Statement of Safeness”. In it, the person returning the device declares that the device is free from all contamination and hazardous substances. When not in use, the device must be stored within the ambient temperature specified in the technical data and at a maximum humidity of 98%.

16. Firmware update

The device's firmware is continuously maintained, considering user feedback and needs. If you want to update the firmware, contact your local KOBOLD partner!

17. Technical Information

Operating instructions, data sheet, approvals and further information via the QR code on the device or via www.kobold.com

18. Order Codes

Operating instructions, data sheet, approvals and further information via the QR code on the device or via www.kobold.com

19. Dimensions

Operating instructions, data sheet, approvals and further information via the QR code on the device or via www.kobold.com

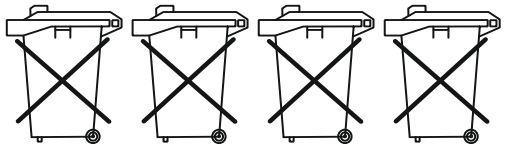
20. Disposal

Note!

- Avoid environmental damage caused by media-contaminated parts.
- Dispose of the device and packaging in an environmentally friendly manner.
- Comply with applicable national and international disposal regulations and environmental regulations.

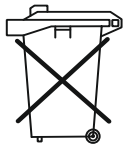
Batteries

Batteries containing pollutants are marked with a sign consisting of a crossed-out garbage can and the chemical symbol (Cd, Hg, Li or Pb) of the heavy metal that is decisive for the classification as containing pollutants:



1. „Cd" stands for cadmium
2. „Hg" stands for mercury
3. „Pb" stands for lead
4. „Li" stands for lithium

Electrical and electronic equipment



21. EU Declaration of Conformance

We, KOBOLD Messring GmbH, Nordring 22-24, 65719 Hofheim, Germany, declare under our sole responsibility that the product:

Non-contact Radar Level Transmitter, 80 GHz – Expert Line
Model: NRE-4

to which this declaration relates is in conformity with the following EU directives stated below:

2014/30/EU	**EMC Directive**
2014/35/EU	**Low Voltage Directive**
2014/53/EU	**RED**
2011/65/EU	**RoHS** (category 9)
2015/863/EU	Delegated Directive (RoHS III)

Also, the following standards are fulfilled:

EN 61010-1:2010 + A1:2019 + A1:2019/AC:2019 Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements

EN 61326-1:2013 Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements

EN 61326-2-3:2013 Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 2-3: Particular requirements - Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning

EN 302372:2017 Short Range Devices (SRD) - Tank Level Probing Radar (TLPR) operating in the frequency ranges 4,5 GHz to 7 GHz, 8,5 GHz to 10,6 GHz, 24,05 GHz to 27 GHz, 57 GHz to 64 GHz, 75 GHz to 85 GHz - Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU

EN 302 729:2017 Short Range Devices (SRD); Level Probing Radar (LPR) equipment operating in the frequency ranges 6 GHz to 8,5 GHz, 24,05 GHz to 26,5 GHz, 57 GHz to 64 GHz, 75 GHz to 85 GHz; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU

EN 301489-1:2020 ElectroMagnetic Compatibility (EMC) standard for radio equipment and services - Part 1: Common technical requirements - Harmonised Standard for ElectroMagnetic Compatibility

EN 301489-33:2020 ElectroMagnetic Compatibility (EMC) standard for radio equipment and services - Part 33: Specific conditions for Ultra-WideBand (UWB) devices - Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU

Hofheim, 16 April 2024

H. Volz
General Manager

J. Burke
Compliance Manager