EchoTREK

S-300 compact ultrasonic level
transmitter series for free flowing solids

Installation and Programming Manual
4th edition

PRINCIPLES ULTRASONIC LEVEL MEASUREMENT

Min. meas. distance (X_m)

DEFAULT value of P05=X_m

Close end blocking (X_B)

progr. value of P05=X_B>X_m

Max. measuring distance of the device (X_M)

DEFAULT value of P04=X_M

Max. measuring range of the device

Max. measuring distance of the application(H)

Programmed value of P04=H

Programmed measurement range of the application

Displayable range

Far end blocking

DEFAULT value of: P06=0

Angle of repose α

DIST=distance (measured)

LEV=(level calculated H-DIST)

VOL= volume (calculated from LEV)

C O N T E N T S

> *Thank you for choosing a NIVELCO instrument.*
> *We are sure that you will be satisfied throughout its use.*

1. INTRODUCTION

The EchoTREK SBD/STD-300 series compact ultrasonic transmitters from NIVELCO are designed to measure the level of most free flowing solids (powders and granules). Level measurement technology based on the non-contacting ultrasonic principle is especially suited for applications where, for any reason, no physical contact can be established to the surface of the material to be measured and/or moving parts are to be avoided to eliminate mechanical wear-out.

A total beam angle of 5° at –3 dB is a feature of all NIVELCO's ultrasonic sensors designed for the level measurement of free flowing solids. This uniquely narrow beam angle ensures reliable measurement in narrow silos with uneven side walls or sometimes even in the presence of dusting. Furthermore, as a result of the narrow beam angle – the emitted ultrasonic signals have an outstanding focusing – a sufficient signal penetration through dust is ensured.

PRINCIPLE OF OPERATION

The ultrasonic level metering technology is based on the principle of measuring the time required for the ultrasound pulses to make a round trip from the sensor to the level to be measured and back. The sensor emits an ultrasonic pulse train and receives the echoes reflected. The intelligent electronic device processes the received signal by selecting the echo reflected by the surface and calculates from the time of flight the distance between the sensor and the surface which constitutes the basis of all output signals of the EchoTREK.

X	D
5 m	0,7 m
10 m	1,2 m
20 m	2 m
30 m	3 m
40 m	3,8 m
50 m	4,7 m

Diameters corresponding to 5° beam angle.
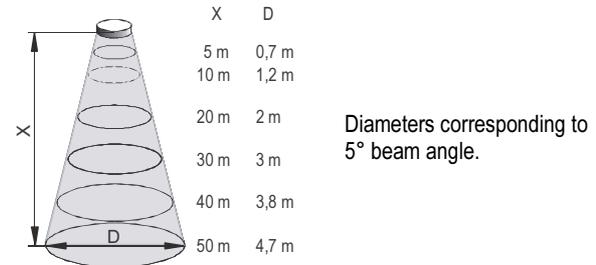
Minimum measuring distance (X_m): (also known as the "Dead Band") is a feature common to all ultrasonic level meters. This is a short range in front of the sensor within which the ultrasonic device can not measure. The immeasurable range (close-end blocking) should be increased by programming in order to avoid any measurement error caused by improper mounting or placement of the level transmitter.
Maximum measuring distance (X_M): The longest range under ideal condition within which the device can measure. No measurement is possible beyond this distance.

2. TECHNICAL DATA

2.1. GENERAL DATA

Type		EchoTREK SBD / STD–3□J–□	EchoTREK SBD / STD–3□J–□ Ex
Transducer material		Closed cell Polyurethane foam sensor face (PUR) PP and Aluminum transducer housing and fitting	Closed cell Polyurethane foam sensor face (PUR) Aluminum transducer housing and fitting
Total beam angle (-3dB)		5°	
Housing material		Paint coated aluminum	
Process temperature		–30 °C ... +75 °C	–30 °C ... +75 °C
Max. surface temperature at the transducer		130 °C	
Ambient temperature		-30 … +60 °C, with SAP-100 display: –25 … +60 °C	-30 … +60 °C, with SAP-100 display: –25 … +60 °C
Max. surface temperature at the head		130 °C	
Process pressure (absolute)		0.07 ... 0.11 MPa (0.7 … 1.1 bar) $P_{absolute}$ and ± 0.01 MPa (0.1 bar) difference between ambient and tank pressure	
Mounting		4 db M 12 screws on a $\varnothing$ 125 arc	
Ingress protection		IP65	
Power supply / consumption	Version I:	120 … 255 V DC / 5.5 W 85 … 255 V AC (50/60 Hz) / 6.8 VA	85 … 250 V AC (50/60 Hz) / 6.8 VA
	Version II:	11.4 … 40 V DC / 4.1 W, 11.4 … 28 V AC (50/60 Hz) / 4.6 VA	
Accuracy*		± (0.2 % of the measured distance + 0.1% of the measurement range)	
Resolution		10 mm	
Output		Analogue: 4 – 20 mA, R_{tmax}= 600 Ω, protection against surge transients	
		Relay: SPDT, 250V AC/ 3A, AC1, Programming and display module: SAP-100 LCD display	
		Digital communication: 4-20 mA + HART, MODBUS	
Electrical protection		Class I., protective earth (PE) conductor: 4 mm^2	
Ex marking			$\langle\!\!\!\xi\!\!\!x\rangle$ II 1/2 D Ex ma ta/tb IIIC T85°C…T130 °C Da/Db

* Under optimal circumstances of reflection and stabilised sensor temperature

2.2. SPECIAL DATA

Type	STD–34J–□, SBD–34J–□ STD–34J–□ Ex, SBD–34J–□ Ex	STD–33J–□, SBD–33J–□ STD–33J–□ Ex, SBD–33J–□ Ex	STD–31J–□ SBD–31J–□ STD–31J–□ Ex SBD–31J–□ Ex
Maximum measuring distance ** (X_M)	15 m	30 m	60 m
Minimum measuring distance ** (X_m)	0.6 m	0.6 m	1 m
Ultrasound frequency	40 kHz	30 kHz	15 kHz
Mass	7 kg		10 kg

* Under optimal circumstances of reflection and measured from the transducer face

2.3. SAP-100 PROGRAMMING AND DISPLAY MODULE

Field display	6-digit LCD display for measurement value, engineering unit and bargraph
Ambient temperature	-25 °C…+60 °C
Housing material	Fibre-glass reinforced plastic (PBT)

2.4. ACCESSORIES

- Installation and Programming Manual
- Warranty Card
- Declaration of Conformity
- EView configuration software and description on CD (only for S□D – 3□□ – 3/4 types)
- 2× M20x1.5 cable glands (in case of Ex units certified cable glands with Ex ta protection type are included)

ACCESSORIES TO BE ORDERED
- Split flange (order code: SFA – 3□5)
- SAP-100 programming and display module

2.5. ORDER CODES

EchoTREK   S ☐ D – 3 ☐ J – ☐*

TYPE	CODE
Transmitter	T
Transmitter + display	B

MEASURING RANGE	CODE
60 m	1
30 m	3
15 m	4

* The order code of an Ex version should end in "Ex"

POWER SUPPLY / OUTPUT		CODE	
Version I. 120 … 255 V DC		Standard	Dust Ex
85 … 255 V AC			
4 – 20 mA + Relay		1	5
4 – 20 mA + Relay + HART		3	7
RS485 (MODBUS protocol) + Relay		A	E
Version II. 11.4 … 40 V DC			
11.4 … 28 V AC			
4 – 20 mA + Relay		2	6
4 – 20 mA + Relay + HART		4	8
RS485 (MODBUS protocol) + Relay		B	F

2.6. DIMENSIONS

Ball-joint housing (view from above)	S☐D–33J-☐ S☐D–34J–☐	S☐D–31J–☐	S☐D–31J–☐ Ex
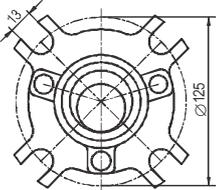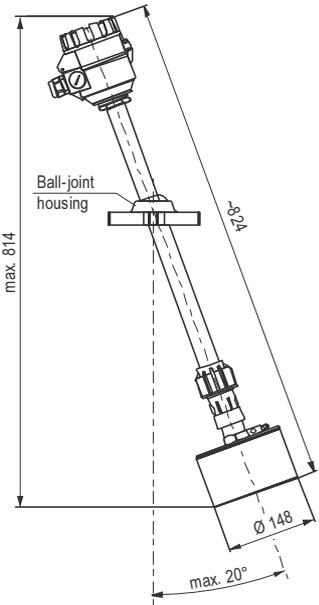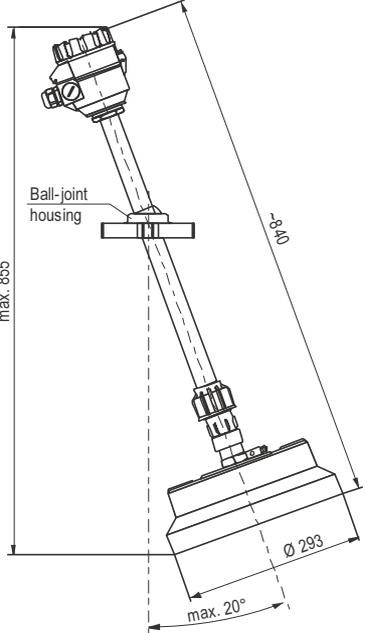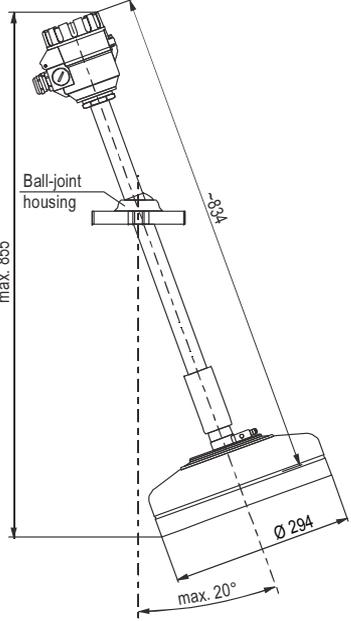
3. INSTALLATION

PLACEMENT

To find the ideal position for the location of the EchoTREK level transmitter various considerations should be made.

The transmitter should not be installed in the centre of the tank/silo when the tank roof is dome shaped or conical. The ideal position for the EchoTREK is on the r = (0.3 … 0.5) R (in case of cylindrical tank). Avoid that the 5° conical beam angle of the transmitter contact the tank/silo wall. This case the transmitter is mounted too close to the wall, therefore it should be tilted (See section "Aiming").

To avoid overheating the instrument should be protected against direct sunshine.

Sunshade

r

R
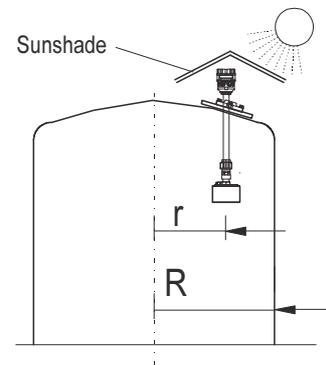
GRAVITY FILLING

The device should be mounted as far as possible from the filling stream.
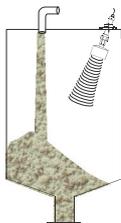
PNEUMATIC FILLING

Select a location where the speed of the in-flowing material is the smallest.

Ex type units are not allowed to be installed in the dust path of the pneumatic filling!

Suggested location (view from above)
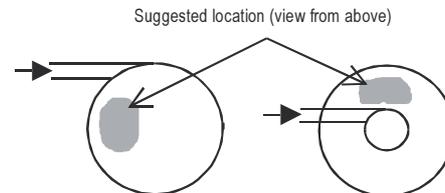
MOUNTING (see illustration of mounting options on the next page)

The EchoTREK consists of a sensor that is attached to the aiming arm (a pipe with a ball-joint housing incorporating a ball joint) that is attached to the housing of the electronics. It is recommended to mount the transmitter on the roof of the tank/silo using a flange (See drawing). The Ball-joint housing has a screw-hole diameter of 125 mm for fixing it. For easy installation we recommend to use our special flange with a split insertion, available with four sizes of DN125/150/200/300 (to be ordered separately). Removing the split insertion, the flange is to be put around the aiming arm and the ball-joint housing is to be fixed to the split flange. It is essential to use the washers and the bolts (4 pcs each) delivered with the split flange. The ball-joint will be pressed to the housing by a spring allowing adjustment/aiming. The 4 pcs of M12 bolts have to only be tightened after completing the adjustment/aiming. The maximum torque for tightening the bolts is 3.5 Nm.

Mounting EchoTREK versions S☐☐-33J-☐ and S☐☐-34J-☐

1. Check the split flange for matching the bore-holes with that of the counter-flange on the silo
2. Remove the split insertion from the flange and put the flange around the aiming arm between the sensor and the Alu-base. Slide the split insertion back to its place and screw the ball-joint housing to the flange with the 4 pcs M 12 bolts to such an extent that will allow free movement of the aiming arm through and tilting by the ball joint for the aiming process.
3. Place the sealing below the flange (if necessary)
4. Pass the sensor through the opening cut on the roof and fasten the flange to its place.
5. Fasten the EchoTREK (with the split flange) to the counter-flange or to the roof of the silo/tank. Perform the aiming (See section "Aiming" below).
6. For fixing the position of the aiming arm tighten the 4 pcs M 12 bolts of the ball-joint housing (max. 3.5 Nm).

Mounting EchoTREK S☐D-31☐-☐ versions, with silo/tank roof opening of $\varnothing$ 300 mm – 340 mm.
The procedure is the same as above but the required flange diameter is DN300.

Mounting EchoTREK S☐D-31☐-☐ version with silo/tank roof opening less than $\varnothing$ 300 mm and the silo space is accessible from inside:

1. Check the split flange for matching the bore-holes with that of the bolt places or counter-flange on the silo
2. Place the sealing below the flange (if necessary)
3. Push the unit out of the silo (upwards) (See ① on the next page)
4. When the Alu-base with the ball-joint is above the counter-flange the special flange has to be placed around the aiming arm (See ② on the next page)
5. Put the split flange on the counter-flange and lower the ball-joint housing on it
6. Slide the insertion to its place (See③ on the next page)
7. Screw in the 4 pcs of M12 bolts (See ④on the next page) to such an extent that will allow free aiming
8. Fasten the EchoTREK (with the split flange) to the counter-flange or to the roof of the silo/tank.
9. After completing aiming, tighten the 4 pcs 12M bolts (max. 3.5 Nm).

If the entire tilting range of the aiming arm is required, the thickness of the roof can not exceed as specified on the drawing next page. The EchoTREK can also be mounted on existing (manhole) covers, access lids or for instance on a steel structure lowered into a larger (for example: 0.5 x 0.5 m) opening on the roof. This solution is to be used when the roof thickness is greater than 350 … 380 mm.

The apparatus nor any part of it is not suitable as a fire resistant barrier for the Zone 20 area.

The housing cover of the Ex type units can be only removed after screw in the hex socket set screw providing protection against unauthorized (tool-free) opening of the cover. The instrument is allowed to be operated in hazardous environment only in case the cover is locked properly by the described protective screw.
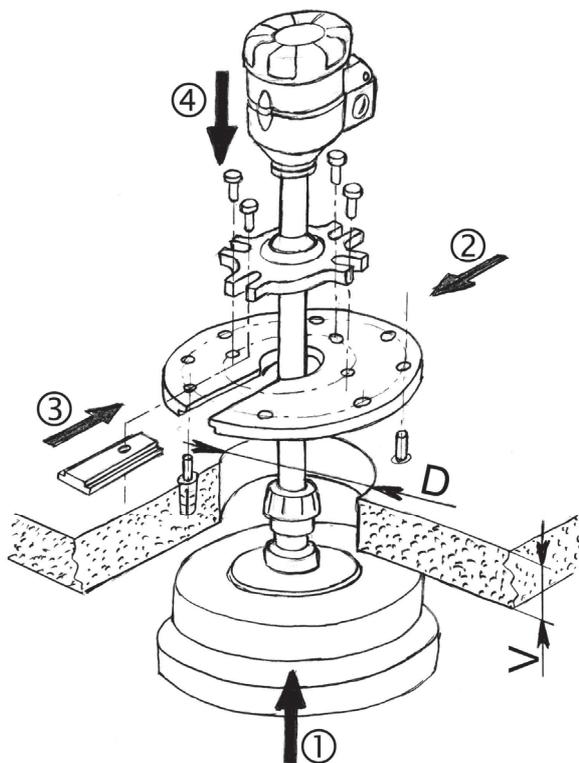
Illustration for mounting

Diameter of the opening D	Max. Thickness of the roof V
160 mm	110 mm
190 mm	150 mm
230 mm	200 mm
300 mm	280 mm
340 mm	300 mm

4. WIRING

- To access the electric connection point, unscrew the bolt on the side of the electronics housing. Use cable with a wire cross- section of 0.5 … 2.5 mm^2.
- Electric connections may be carried out by using a single or two cables. Wires in different groups (A, B, C; shown below) are not allowed to be led in the same cable.

Group A	Group B	Group C
Low voltage power supply	4 – 20 mA.	RS485 (shielded twisted pair)
	SELV voltage power supply	
Low voltage for the relay	SELV voltage power or logic signal for the relay	

- The unit should be placed and the cables should be arranged that the connecting cables outside the unit are fixed and tension-free.
- Devices should be grounded properly either at the internal or external grounding screw terminals depending on the way of cabling.
- DC powered (Version II) devices can be 3-wire connected. In this case the terminals "1" and "6" should be interconnected. In this case the galvanic isolation will not be provided!
- After performing the electric connections, check for correct sealing and close the housing!
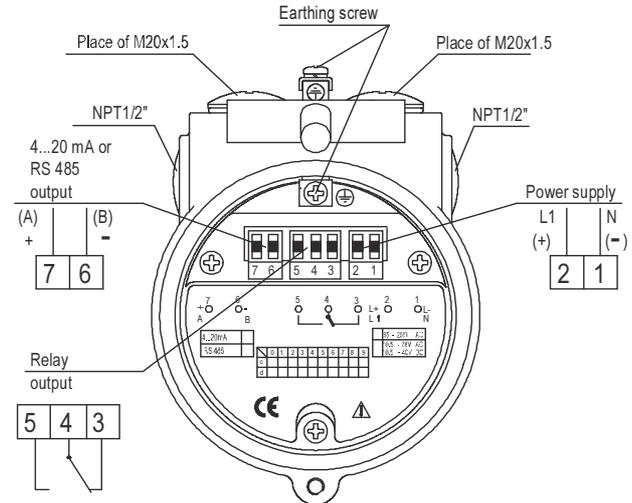
Space for the wiring, for better overview without upper part

5. PUTTING INTO OPERATION, ADJUSTING, PROGRAMMING

5.1. *PUTTING INTO OPERATION, USAGE*

After switching on the correctly wired unit the transducer begins to click audibly. In about 20 … 50 s the ECHO LED goes on and a signal between 4 – 20 mA appears on the current output. The factory default settings are suitable for checking the operation of the unit or solving most simple level metering tasks. For using the advanced features of the EchoTREK it is required to modify the programming to customize it for the required measurement task. To get familiar with the programmable features of the level transmitter and be able to solve challenging level measurement tasks it is strongly recommended reading carefully the following chapters of this user's and programming manual.

FACTORY DEFAULT PARAMETERS

All the transducers get the same factory default parameters that can also be reset later if needed. Some of the most important parameters default values of the EchoTREK S☐D-3☐☐ series can be found below:

⇒ Measurement mode: level measurement (LEV). The plug-in SAP-100 display shows level value.
⇒ Zero level is assigned to the maximum measuring distance (X_M).
⇒ The output current and the bargraph of the SAP-100 module is assigned to the measured level value.
⇒ 4 mA and 0% is assigned to zero level (maximum measuring distance).
⇒ 20 mA and 100% is assigned to maximum level (minimum measuring distance).
⇒ Current output in case of error: holding the last measurement value.
⇒ Damping time: 300 s.
⇒ Relay is de-energized in case of „NO Echo".

All the other measurement values are set to fit the values suitable for standard tasks. The functions used in special cases are switched off by default.

AIMING OF THE ECHOTREK FOR SOLIDS

To reduce week signal reflection from the material surface caused by an angle of repose building due to the filling and/or emptying process, it is recommended to tilt the sensor by the aiming arm of the transmitter. The optimal tilting position can be adjusted during operation and recommended to be checked at multiple levels during the filling / emptying process. In most cases, the sensor should be aimed towards the middle of the tank/silo bottom by aiming at the silo outlet.

In applications where repose is not present or with tall and narrow silos (diameter/height ≥ 5) aiming is not critical: the sensor should face straight downwards. Aiming should also be tested also with full silo, since due to the great angle of repose the echo might be weak despite of the fact that level is near to the sensor. In such cases a reasonable compromise of aiming should be achieved that provide acceptable echo in every state of the filling. Aiming is also aided by the informational parameters P70 – P75. Aiming procedure is recommended to perform together with the full parameter access programming.
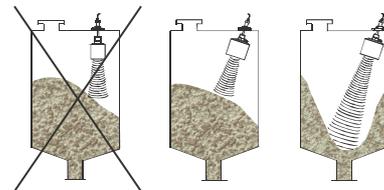
5.1.1. The SAP-100 programming and display module

The plug-in type programming and display module can be removed or plug-in during the operation of the EchoTREK level transmitter. The module has 4 push buttons and a special multifunction LCD display.

The measured values are displayed in the central line of the display. The engineering units are displayed in the bottom or top lines, or indicated by the arrow pointing the units on the frame of the display.

SYMBOLS USED ON THE LCD:

- **DIST** – distance (measuring) mode
- **LEV** – level (measuring) mode
- **VOL** – volume (measuring) mode
- **%** – measured value in percentage
- **mA** – output current
- **°C** – transducer temperature (in Celsius)
- **PROG** – programming mode (device under programming)
- **RELAY** – relay
- **↑ ↓** – level changing direction
- **FAIL** – measurement / device error

SYMBOLS USED ON THE FRAME:

Valid if pointed by the arrow

- **M** – metric (European) engineering system
- **m³ m cm l** (liter)
- **US** – imperial (US) engineering system
- **ft³ ft in gal** (gallon)
- **t** – tonne (calculated mass)
- **°F** – transducer temperature (in Fahrenheit)
- **sec** – second
- **hour** – hour
- **min day** – not used

5.1.2. Usage and the indications of the SAP-100 programming and display module in measurement mode

The device is in Measurement Mode, when **PROG** is not shown on the display. This case the display shows the measurement value which can be changed according to the following steps.

By pressing the Ⓔ (ENTER) button the display shows the primary measured value.
DEFAULT VALUE: LEV

By pressing the ◉ (NEXT) arrow button repeatedly the display shows the secondary, etc. measured values.
DEFAULT VALUE: LEV, DIST

By holding the ⊛ (UP) arrow button the display shows the transducer (also the air inside the tank) temperature.
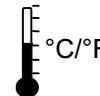
By holding the ⊛ (DOWN) arrow button the display shows the output current.

°C/°F

⌀ mA

COM ● ● ● RELAY
ECHO

Depending on the selected measuring mode (see **P01** in Chapter 5.2.1 for further details) the following primary and other values can be displayed:

- DISTANCE (DIST)
- LEVEL (LEV)
- LEVEL in percentage (LEV %)
- VOLUMA or MASS (VOL)
- VOLUMA or MASS in percentage (VOL %)

The unit of the displayed measurement value is indicated directly or by the arrow pointing the units on the frame of the display.

- When "FAIL" message is blinking on the display the error code is indicated after the measured value (see chapter 5.4.11.).

After powering up the units the measuring mode will be the same as it was at the last powering off.

LED INDICATIONS

- **COM**-LED

  LED is lit during communication (Remote programming)

- **ECHO**-LED

  LED is lit as long as the device receives a valid echo signal

- **RELAY**-LED

  LED is lit when relay is energized

5.2. SPECIAL CONDITIONS FOR SAFE USE

- The equipment is not allowed to be installed in the dust path of the pneumatic filling!
- The apparatus nor any part of it is not suitable as a fire resistant barrier for the Zone 20 area.
- The instrument should be grounded by all its grounding screws to the EP system in order to avoid electrostatic charges and due to the Class I. electronic protection classification.
- The diameter of the used cable should meet the specified dimensions of the cable gland.
- The device must be operated only with using properly sealed Ex ta certified protective cable glands.
- The current output should be connected to a galvanic isolator.
- The windows of the EchoTREK SBD-3□□-□ Ex devices are susceptible to electrostatic charges, therefore cleaning is allowed only with a wet rag.

5.3. PROGRAMMING

The factory default settings can be changed by the user. The programming can be performed with using SAP-100 type plug-in programming module which is also a field display. The **EchoTREK SB□-3□□** types include the SAP-100 programming module. After removing the windowed housing cover the programming buttons can be accessed. The SAP-100 module is able to program any EchoTREK level transmitters for solids. The EchoTREK is able to operate without the SAP-100 module and it can be removed during operation. Remote programming via HART communication protocol or RS485 interface is the same as described except the measurement simulation.

⚠ The instrument may be damaged by electrostatic discharge (ESD) via its terminal (SAP-100 and TEST), thus apply the precautions commonly used to avoid electrostatic discharge e.g. by touching a properly grounded point before removing the cover of the enclosure. A possible electrostatic discharge can cause damage for the instrument.
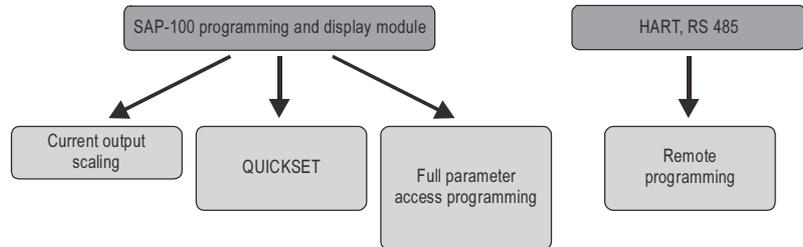
Measuring is going on during programming in accordance with the old parameter set.
New parameter set will be valid after returning to the Measurement to the Programming Mode.

If the transmitter is left in Programming Mode by mistake, it will automatically return to Measurement Mode after 30 minutes and will operate with the parameters entered during the last completed programming. In case of HART capable units or versions with RS 485 interface the automatic return from remote programming mode to measurement mode is done after 1 minute.

PROGRAMMING MODES OFFERED BY THE SAP-100 PROGRAMMING AND DISPLAY MODULE

CURRENT OUTPUT SCALING (5.3.2.)

Assign the level values to the current output (4 and 20 mA).
All the other parameters remain unchanged.

QUICKSET (5.3.3.)

Recommended as a simple and fast way to set up the EchoTREK by 8 basic parameters
This menu driven programming mode supports the following basic settings:

- Engineering unit for the display (metric or US)
- Maximum measuring distance (H)
- Minimum level assigned of to 4 mA
- Maximum level assigned to 20 mA
- Error indication by the current output
- Damping time
- Assignment of level to energising of the relay
- Assignment of level to de-energising of the relay

FULL PARAMETER ACCESS PROGRAMMING (5.3.4.)

All the programmable features of the EchoTREK can be accessed by parameter addresses:

- Measurement configuration
- Outputs
- Measurement optimization
- 13 pre-programmed tank shapes for volume calculation
- 32-point linearization table
- test parameters
- secret code

In this programming mode, the parameters are marked with numbers. The User's and Programming Manual is necessary to identify the parameters.
The unit is continuously measuring with the actual valid parameter set during the programming. When the currently measured values are used (for example GET LEVEL) the values are calculated according to the valid parameter set. New parameter set became valid only after returning into Measurement Mode.

5.3.1.   Basic steps of the programming

Local programming of the unit can be performed with the four push buttons of the SAP-100 module. The followings give an overview about handling the programming module and the detailed programming instructions are covered in the 5.3.2, 5.3.3, 5.3.4 and the 5.4 chapters.

SINGLE KEY PRESSING
The functions of the keys became active after the button is released.

- Ⓔ   ENTER – to save parameter address and go to parameter value; to return from parameter value to parameter address
- ◀   NEXT   – to move the blinking of the digit to the left
- ▲   UP   – to increase value of the blinking digit (press the key continuously to increase the value of the blinking digit faster)
- ▼   DOWN   – to decrease value of the blinking digit (press the key continuously to decrease the value of the blinking digit faster)

DOUBLE KEY PRESSING
Press the two keys simultaneously for desired programming step (0 ... 3 s)! The double key combination is marked with "+" mark in the following.

ENTER INTO OR QUIT FROM PROGRAMMING MODES
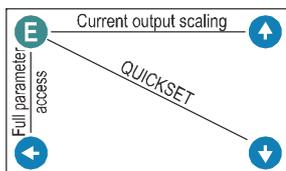
KEY COMBINATIONS FOR CHANGING PARAMETER VALUES
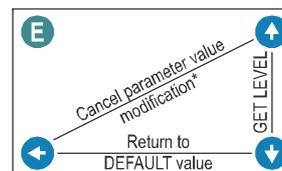
* cancellation is immediately active

GET LEVEL function can be used only in level and in distance measurement modes: reading out the actual measured value

Notes:

If the blinking cursor cannot be moved to the parameter value from the parameter address after pressing the ENTER Ⓔ button,

- *the parameter is either a read-only type, or*
- *the secret code prevents the modification (see P99).*

If the parameter value keeps blinking the modification cannot be accepted because,

- *the modified value is either out of the range, or*
- *the entered code is not valid for this parameter*

5.3.2.　Current output scaling

This programming mode is the simple and fast way to modify the scaling of the current output. For changing all parameters other than those assigned to 4 and 20 mA use either the QUICKSET (5.3.2) or the Full Parameter Access (5.3.3). Measuring is going on during programming in accordance with the old parameter set. New parameter set will be valid after returning to measurement from programming mode! The instructions for this programming can also be found below the screw cover on the front panel of the EchoTREK.

KEYS	OPERATION
ENTER Ⓔ + UP ⊕ (press for 3 seconds)	Enter into or exit from the current output scaling programming mode
UP ⊕ / DOWN ⊕ / NEXT ⊕	Set value (increase/decrease the blinking digit or scroll up/down) / Move left with the blinking digit
UP ⊕ + DOWN ⊕	"GET LEVEL" - display actual level value measured by the EchoTREK
ENTER Ⓔ	Save actual value on the screen and move to the next screen
NEXT ⊕ + UP ⊕	Quit current output scaling programming mode without saving the modifications (CANCEL)
NEXT ⊕ + DOWN ⊕	Display Factory Default of the relevant screen (DEFAULT)

In this programming mode, the display will indicate PROG and the following screens:

SCREENS	ACTIONS
4:xxxx ▦	**xxxx** – level value assigned to 4 mA current output **Manual:** set the level value manually (by using UP ⊕ / DOWN ⊕ / NEXT ⊕ keys) and save it (by ENTER Ⓔ) counted from the maximum measuring distance (H) which is to be assigned to 4 mA output current **Automatic*:** use the "GET LEVEL" function (UP ⊕ + DOWN ⊕) when the medium inside the tank is at the level what is desired to be assigned to 4 mA value ("GET LEVEL" functions only works if ECHO LED is lit) and save the displayed value as the above described **Default value:** 0 m (empty tank)
20:xxxx ▦	**xxxx** – level value assigned to 20 mA current output **Manual:** set the level value manually (by using UP ⊕ / DOWN ⊕ / NEXT ⊕ keys) and save it (by ENTER Ⓔ) counted from the maximum measuring distance (H) which is to be assigned to 20 mA output current **Automatic*:** use the "GET LEVEL" function (UP ⊕ + DOWN ⊕) when the medium inside the tank is at the level what is desired to be assigned to 20 mA value ("GET LEVEL" functions only works if ECHO LED is lit) and save the displayed value as the above described **Default value:** Measurement range = $X_M – X_m$ (max. measuring distance – max. measuring distance (dead band))

* For the **Automatic** function the EchoTREK should be set to (LEV) level measurement mode and the ECHO LED should lit.

5.3.3. QUICKSET

RECOMMENDED AS A SIMPLE AND FAST WAY TO START UP ECHOTREK

QUICKSET programming is aided by 8 screens to set the 8 basic parameters of the device if the required application is not a challenging one. The instructions of this programming mode are also to be found, below the screw cover, on the front panel of the EchoTREK.

KEYS	OPERATION
ENTER Ⓔ + UP ⊙ (press for 3 seconds)	Enter into or exit from the quickset programming mode
UP ⊙ / DOWN ⊙ / NEXT ⊙	Set value (increase/decrease the blinking digit or scroll up/down) / Move left with the blinking digit
UP ⊙ + DOWN ⊙	"GET LEVEL" - display actual level value measured by the EchoTREK
ENTER Ⓔ	Save actual value on the screen and move to the next screen
NEXT ⊙ + UP ⊙	Quit current output scaling programming mode without saving the modifications (CANCEL)
NEXT ⊙ + DOWN ⊙	Display Factory Default of the relevant screen (DEFAULT)

In this programming mode, the display will indicate PROG and the following screens:

SCREENS	SETTINGS
AP :xxyy	**APplication** xx= select "EU" (European) for metric or "US" for US engineering units (Use UP ⊙ / DOWN ⊙ keys) yy= indicating "Li" for liquids or "So" for solids level measurement (can not be changed) **Default value:** "EU" metric (European), "So" for solids level measurement
H :xxxx	**H = xxxx – maximum distance to be measured** – Distance between transducer face and tank/silo bottom **Manual:** set the tank height value manually (by using UP ⊙ / DOWN ⊙ / NEXT ⊙ keys) and save it (by ENTER Ⓔ) **Automatic*:** use the "GET LEVEL" function (UP ⊙ + DOWN ⊙) when the tank is empty to obtain the actual measured distance between the sensor face and the tank bottom ("GET LEVEL" function works only if ECHO LED is lit) and save the displayed value as the above described **Default value:** maximum measuring distance X_M, see Technical Data Table
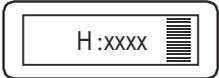
` 4:xxxx ▓`	**xxxx** – level value assigned to 4 mA current output **Manual:** set the level value manually (by using UP ⊕ / DOWN ⊛ / NEXT ⊛ keys) and save it (by ENTER Ⓔ) counted from the maximum measuring distance (H) which is to be assigned to 4 mA output current **Automatic*:** use the "GET LEVEL" function (UP ⊕ + DOWN ⊛) when the medium inside the tank is at the level what is desired to be assigned to 4 mA value ("GET LEVEL" functions only works if ECHO LED is lit) and save the displayed value as the above described **Default value:** 0 m (0%, empty tank)
` 20 :xxxx ▓`	**xxxx** – level value assigned to 20 mA current output **Manual:** set the level value manually (by using UP ⊕ / DOWN ⊛ / NEXT ⊛ keys) and save it (by ENTER Ⓔ) counted from the maximum measuring distance (H) which is to be assigned to 20 mA output current **Automatic*:** use the "GET LEVEL" function (UP ⊕ + DOWN ⊛) when the medium inside the tank is at the level what is desired to be assigned to 20 mA value ("GET LEVEL" functions only works if ECHO LED is lit) and save the displayed value as the above described **Default value:** Measurement range = X_M – X_m (max. measuring distance – max. measuring distance (dead band))
` Er :xxxx ▓`	**Error indication by the current output** by using UP ⊕ / DOWN ⊛ there are three options. According to the selected option the current output "HOLD" (holds the last value)"3.6" – gives 3.6 mA value; "22" – gives 22 mA value (for example in case of echo loss). **Default value:** HOLD
` dt: xxxx ▓`	**Damping time** – select the required damping time (by UP ⊕ / DOWN ⊛ key) and save the value as the above described **Default value:** 300 s
` rE :xxxx ▓`	**Relay energised xxxx: level** of the relay energised state If the value exceeds this programmed value the relay will be energised The step of programming are the same as the current output assignment
` rd : xxxx ▓`	**Relay de-energised xxxx: level** of the relay de-energised state If the value sinks below this programmed value the relay will be de-energised The step of programming are the same as the current output assignment
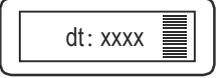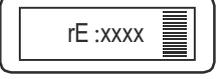
Note: – *current output can also be programmed for inverted operation: 4 mA= 100% (Full), 20 mA= 0% (Empty)*
     – *sources of possible errors are listed in the 5.4.11 - "Error Codes" chapter*

For the **Automatic** function the EchoTREK should be set to (LEV) level measurement mode and the ECHO LED should lit.

GET LEVEL will result correct value if the H = xxxx – 'maximum distance to be measured' is already set!

5.3.4. Full Parameter Access

To access all features provided by the EchoTREK

Description of all parameters can be found under the 5.4 chapter.

KEYS	OPERATION
ENTER Ⓔ + UP ⬆ (press for 3 seconds)	Enter into or exit from the Full Parameter Access programming mode

In this programming mode, the display will indicate PROG and the following screen:
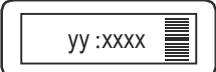
yy :xxxx ▮	yy is the Parameter Address (**Pyy** = **P01**, **P02** … **P99**) xxxx is the Parameter Value (dcba - codes or numbers)

Measuring is going on during programming in accordance with the old parameter set. New parameter set will be valid after returning to measurement from programming mode!

KEYS	WHILE PARAMETER ADDRESS IS BLINKING	WHILE PARAMETER VALUE IS BLINKING
ENTER Ⓔ	Go to the Parameter Value	Save the modification of the Parameter Value and return to the Parameter Address
NEXT ◀ + UP ⬆ (press for 3 seconds)	Cancel all modifications of the actual programming phase CANCEL will be displayed for warning	Neglect the modification of the Parameter Value and return to the Parameter Address without saving the modifications
NEXT ◀ + DOWN ⬇	Reset entire device to Factory Default. Since this action will reset all parameters, "LOAD" will appear on the display: - to confirm, press ENTER Ⓔ - to escape, press any other key	Display default of the Parameter Values (it can be saved by pressing ENTER Ⓔ)
NEXT ◀	Move blinking of the digit to the left	
UP ⬆ / DOWN ⬇	Modify the blinking digit (increase, decrease) or scroll up/down	
Summarizing the key combinations	E ↗ Cancel all modifications** ⬆ ◀ Return to factory default settings* ⬇ * LOAD will be displayed ** CANCEL will be displayed	E ↗ Cancel parameter value modification* ⬆ GET LEVEL ◀ Return to DEFAULT value ⬇ * cancellation is immediately active
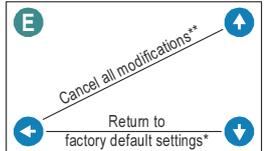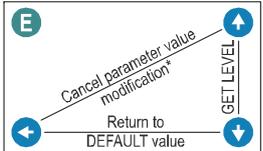
5.4. PARAMETERS – DESCRIPTIONS AND PROGRAMMING

5.4.1. Measurement Configuration

P00: - c b a   Application / Engineering Units

> *NOTE!*
> *Programming of this parameter will result in loading the factory default with the corresponding engineering units!*

a	OPERATING (MEASUREMENT) MODE
1	Free flowing solids level measurement

Attention! Mind the sequence! Coming to this parameter the right value "a" will be blinking first.

b	ENGINEERING UNITS (according to „c")	
	Metric	**US**
0	m	ft
1	cm	Inch

c	CALCULATION SYSTEM
0	Metric
1	US

FACTORY DEFAULT: 001

THE LEVEL TRANSMITTER IS ABLE TO OPERATE IN TWO DIFFERENT KINDS OF CALCULATION SYSTEMS BUT THE DESCRIPTION OF THE PROGRAMMING IS FOCUSING ONLY TO THE METRIC UNITS IN ORDER TO THE BETTER TRANSPARENCY!

P01: - - b a   Measurement Mode

This mode determines the primary value transmitted by the current output or the HART protocol communication and the displayed value. It also determines the value which will be assigned to the relay operation.

a	MEASUREMENT MODE	TRANSMITTED VALUE	DISPLAY SYMBOL	DISPLAYED VALUES
0	Distance	Distance	DIST	Distance
1	Level	Level	LEV	Level, Distance
2	Level in percentage		LEV%	Level in percentage *, Level, Distance
3	Volume	Volume	VOL	Volume, Level, Distance
4	Volume in percentage		VOL%	Volume in percentage *, Volume, Level, Distance

Attention! Mind the sequence! Coming to this parameter the right value "a" will be blinking first.

b	BARGRAPH INDICATION
0	Echo strength
1	Current output

* The displayed value is depending on the current output parameters (**P10**, **P11**)

FACTORY DEFAULT: **P01** = 11

P02: - c b a   Calculation units

a	TEMPERATURE
0	°C
1	°F

Attention! Mind the sequence! Coming to this parameter the right value "a" will be blinking first.

This table is interpreted according to **P00(c)**, **P01(a)** and **P02(c)** and is irrelevant in case of percentage measurement (**P01(a)= 2** or **4**)

b	VOLUME		MASS (see details: P32)	
	Metric	US	Metric	US
0	m^3	ft^3	tonne	lb (pound)
1	liter	gallon	tonne	tonne

c	TIME
0	Second
1	Minute
2	Hour
3	Day

FACTORY DEFAULT: **P02** = 000

P03: - - - a   Values Displayed - Rounding

DISTANCE (DIST) display

It is important to keep in mind that the instrument is measuring distance as basic quantity and all the other process values are calculated from this basic quantity.

The resolution of the measured distance is 1 cm which is reflected on the calculated (level, volume) values. The calculated volume (VOL) do not undergo further rounding as displayed value.

VOLUME (VOL) display

DISPLAYED VALUE	DISPLAY FORMAT
0.000 – 9.999	x.xxx
10.000 – 99.999	xx.xx
100.000 – 999.999	xxx.x
1000.000 – 9999.999	xxxx
10000.000 – 99999.999	xxxxx
100000.000 – 999999.999	xxxxxx
1 million – $9.99999*10^9$	x.xxxx : e (exponential form)
over $1*10^{10}$	(overflow) Err4

Obviously the decimal position will be shifted with increasing value displayed. (See table at the left).

Values over one million will be displayed in exponential format whereas the value (e) represents the exponent. Over the value of $1x10^{10}$ Err4 (overflow) will be displayed.

ROUNDING

a	STEPS OF ROUNDING IN THE DISPLAYED VALUE
0	1 (no rounding)
1	2
2	5
3	10
4	20
5	50

A couple of millimetres of fluctuation of the basic DIST value (e.g. due to waves) will be enlarged by the mathematical operations. This enlarged fluctuation in displaying VOL or FLOW can (if disturbing) be avoided by rounding to be set in **P03**. Rounding value 2, 5, 10 etc represents the steps by which the calculated value will be changed in its (one or two) last digit(s).

For example:

P03=1   steps by 2:   1,000; 1,002; 1,004
P03=5   steps by 50:   1,000; 1,050; 1,100 or
                                10,00; 10,05(0); 10,10(0); 10,15(0)
(the 0 from the steps 50, 100, 150 etc will not be displayed)

FACTORY DEFAULT: **P03** = 0

| **P04 - - - -** | **Maximum distance to be measured (H)** |

The maximum distance to be measured is the only one parameter that has to be programmed for each application other than distance measurement mode. The DEFAULT value of P04 (see table below) can also be displayed by double key pressing NEXT ⊕ + DOWN ⊕. Values of the maximum measuring distance will be in accordance with the table below.

ENGINEERING UNIT	DISPLAY FORMAT
m	x.xxx or xx.xx
cm	xxx.x
ft	xx.xx or xxx.x
inch	xxx.x

The maximum distance to be measured (H) is the maximum distance which can be measured between the transducer face and the medium surface. The factory programmed default **maximum measuring distance** values (X_M) which can be measured by the units are listed in the table below. For the actual application the **P04** parameter should be set to the **maximum distance to be measured** i.e. the distance between the transducer face and the bottom of the tank, where $H \leq X_M$

EchoTREK LEVEL TRANSMITTERS FOR SOLIDS	MAXIMUM MEASURING DISTANCE (X_M) [m]
S□D – 34□ – □	15
S□D – 33□ – □	30
S□D – 31□ – □	60

Keep in mind that

LEVEL (as the result of the measurement) is calculated according to the following formula: **P04 (programmed) – DISTANCE (measured by the device)** (LEV = H - DIST). Since the accuracy of level (and all further calculated) value depends on the accuracy of **P04** (the max. distance to be measured of the application) to obtain the best accuracy it is recommended to measure this distance in the empty tank with the EchoTREK by using the "GET LEVEL" function (press UP ⊕ and DOWN ⊕ keys simultaneously) provided the bottom is flat. Save by ENTER ⓔ the actual measured value displayed as P04.

FACTORY DEFAULT: maximum measuring distance (X_M) according to the table

P05: - - - -   Minimum measuring distance (Dead zone - Close-end blocking

As basic characteristics of the ultrasonic level metering principle the EchoTREK will not accept any echo within the close-end blocking, also called dead zone. This range is the minimum measuring distance which can be measured by the level transmitter. By increasing this parameter disturbing objects and false reflections which are close to the sensor can be eliminated.

AUTOMATIC CLOSE-END-BLOCKING (AUTOMATIC DEAD BAND CONTROL)

By using the factory default value, the unit will automatically set the smallest possible close-end-blocking distance i.e. the dead band. In case of optimal mounting this setting could be set somewhat smaller, in case of not optimal mounting this setting could be set somewhat higher value than the given minimum measuring distance values (X_m) of the below table.

MANUAL CLOSE-END-BLOCKING

Manual close-end-blocking would be used for example to block out the echo originating from the bottom rim of a stand-off pipe or from any object protruding into the ultrasonic cone near to the transmitter.

By entering a value, higher than the factory default, the minimum measuring range will be extended and fixed to the specified value.

To display factory default of the minimum measuring distance press NEXT ⊙ + DOWN ⊙

ECHOTREK LEVEL TRANSMITTERS FOR SOLIDS	MINIMUM MEASURING DISTANCE (X_m) [m]
S□D – 34□ – □	0.6
S□D – 33□ – □	0.6
S□D – 31□ – □	1

FACTORY DEFAULT: automatic dead band control (according to the minimum measuring distance (X_m) table

P06: - - - -   Far-end blocking

Far end blocking is used to neglect incorrect level/volume readings and output actions below a pre-set level. In the far-end of the measuring range, for example tanks with heaters or other interfering objects (sludge, cone of silo etc.) may cause faulty readings.

If the level of the medium sinks below the blocked out range:
– "**Sub 0**" will be indicated for the level and volume
– Current output will hold value corresponding to the far end blocking level.

LEV

LEV=level
VOL=volume

0   4mA   20mA   I$_{out}$

DIST

DIST

H

"SUB 0" display
below this level

P06
Far-end blocking
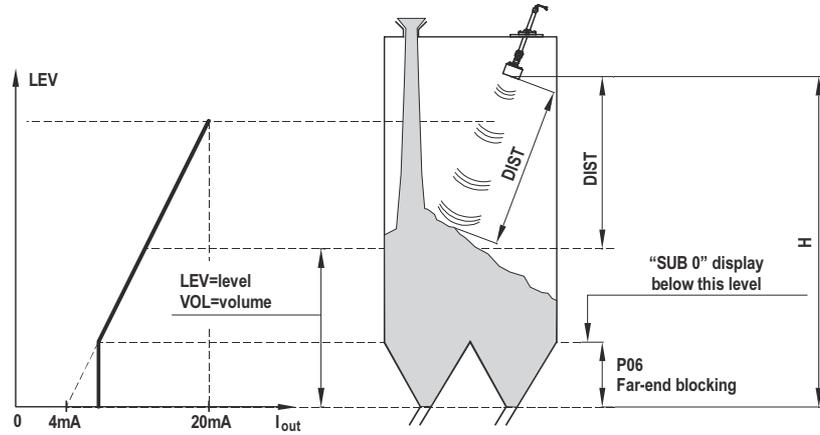
If the medium level is above the blocked out range:
The calculation of level and volume will be based on the programmed tank dimensions, therefore the measured or calculated process values will not be influenced in any way, by the far end blocking value.

FACTORY DEFAULT: **P06** = 0

P08: - - - -   Fixed Output Current

Values between 3.8 and 20.5 can be entered. The output current will be set to the entered value and analogue transmission will be suspended until **P08=0**.

FACTORY DEFAULT: **P08** = 0

5.4.2.   Analogue Output

P10: - - - -	Value (of distance, level or volume) assigned to 4 mA current output

P11: - - - -	Value (of distance, level or volume) assigned to 20 mA current output

Values are interpreted according to **P01(a)**. Please note that in case of programming for LEV % or VOL % measurement, the min. and max. value has to be entered in the relevant engineering units of LEV (m, ft) or VOL (m^3, ft^3).

Assignment can be made so that the proportion between the change of the (measured or calculated) process value and the change of the current output be either direct or inverse. E.g. lev 1m assigned to 4mA and lev 10m assigned to 20mA represents direct proportion and lev 1m assigned to 20mA and lev 10 m assigned to 4mA represents the inverse proportion. GET LEVEL function can be used for the programming.
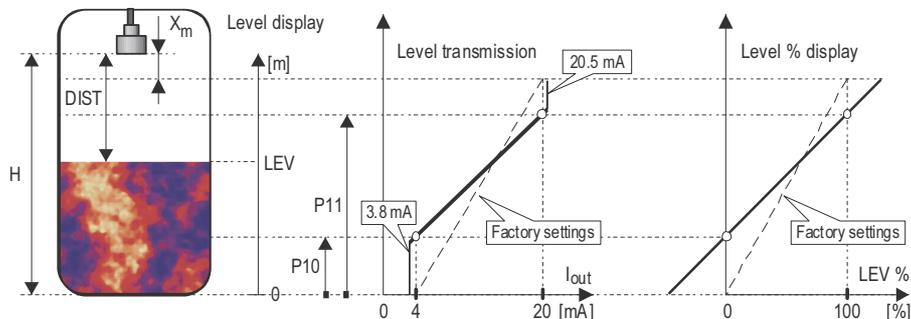
FACTORY DEFAULT: **P10**: 0,   **P11**: $X_M – X_m$ (see the tables regarding **P04** and **P05** parameters)

P12: - - - a	Output Current Error Mode

In case of error the EchoTREK will provide one of the current outputs below. This error indication is active unless the failure is fixed, or until the failure terminates.

a	ERROR INDICATION BY THE CURRENT OUTPUT
0	HOLD (error indication has no effect on the output current.)
1	3.6 mA
2	22 mA

FACTORY DEFAULT: **P12** = 0

5.4.3. Relay Output

P13: - - - a   Relay functions

a		RELAY FUNCTIONS		ALSO SET:
0	DIFFERENTIAL LEVEL CONTROL (Hysteresis control)	Relay is energised if the measured or calculated value exceeds the value set in **P14**. Relay is de-energised if the measured or calculated value descends under the value set in **P15**		**P14**, **P15** There is a need to set (in level min. 20 mm) hysteresis between **P14** and **P15**
1	ERROR INDICATION	Relay is energised in case of Echo Loss		—
2		Relay is de-energised in case of Echo Loss		—
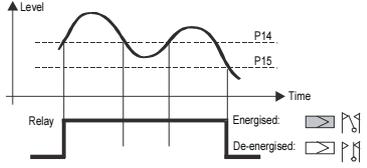
FACTORY DEFAULT: **P13** = 2

P14: - - - -   Relay parameter – Energizing value

P15: - - - -   Relay parameter – De-energizing value

P14 and P15 parameters are needed to set when differential level control is required. The values of the parameter should be set in the unit according to P01. GET LEVEL function can be used if the parameters affecting the transmitted value are valid. When using differential level control there is a need to set in level min. 20 mm hysteresis between the Relay Energizing value and the Relay De-energizing value in order to avoid too frequent relay state changes.

FACTORY DEFAULT: **P14** = 0, **P15** = 0

P19: - - - -   HART Polling Address

The polling address can be set between 0 and 15. For a single instrument the polling address is 0 and the output is 4-20 mA (analogue output). If multiple units are used in HART Multidrop mode (max. 15 pcs.) the polling addresses should differ from 0 (1-15), in this case the output current will be fixed at 4 mA.

FACTORY DEFAULT: **P19** = 00

5.4.4.   Measurement Optimisation

P20:   - - - a   Damping time

Damping time can be used to damp the unwanted fluctuations of the output and display.

a	DAMPING TIME [SECONDS]	FREE FLOWING SOLIDS	
		GRANULES > 2-3 mm	POWDERS < 1-2 mm
0	no filtering	Recommended for testing only	
1	3	not applicable	not applicable
2	6	not applicable	not applicable
3	10	not applicable	not applicable
4	30	applicable	not applicable
5	60	recommended	applicable
6	100	recommended	recommended
7	300	recommended	recommended
8	600	recommended	recommended
9	1000	applicable	applicable

FACTORY DEFAULT: **P20** = 7 (300 s)

P23: - - - a   Angle of repose (repose formation)

This parameter is important for the optimization of the of the QUEST$^+$ software echo evaluation

a	ESTIMATED ANGLE OF REPOSE
0	No angle of repose $\alpha \cong 0$
1	$\alpha < 15°$
2	$\alpha > 15°$

The optimal setting of this parameter can be done with the help of checking the echo strength in the read out parameter **P72** indicating the echo amplitude in dB. The ideal setting of **P23** is at which the parameter value in **P72** becomes the best (nearest "0").

1). Set **P23** to **a= 1**, confirm it with ENTER Ⓔ and switch to Measurement Mode then return to Programming Mode after min. 6 s.

2). Observe the change of echo amplitude in **P72** and record an average value.

3). Perform the above with the **P23: a = 2** settings.

4). Finally set **P23** with the value of (**a**) at which the amplitude value in **P72** is nearest to 0.

Note: the highest amplitude is belonging to the least negative dB value

FACTORY DEFAULT: **P23** = 0
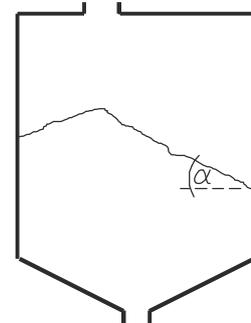
P24: - - - a   Target tracking speed

With this parameter the evaluation can be speed up at the expense of the accuracy.

a	TRACKING SPEED	REMARKS
0	Standard	For most applications
1	Fast	For fast changing level
2	Special	For very special cases only as this option reduces the maximum measuring range to 50% of the nominal value! The measuring window (P25 and P33) is inactive and the EchoTREK will respond practically instantly to any target. Recommended to fastest target tracking, but usually not applicable for level metering.

FACTORY DEFAULT: **P24** = 0

P25: - - - a   **Selection of Echo within the measuring window**

A so-called measuring window is formed around the echo signal. The position of this measuring window determines the flight time for calculation of the distance of the target. (the picture below can be seen on the test oscilloscope)

"t" ultrasound flight time
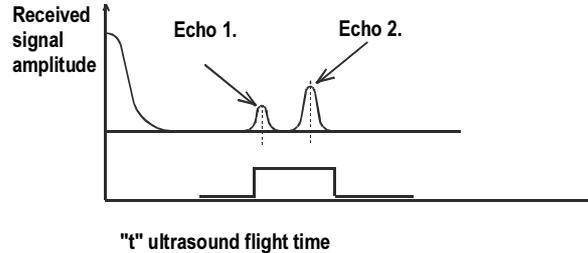
Some applications involve multiple (target + disturbing) echoes even within the measuring window. Basic echo selection will be done by the Quest + software automatically. This parameter only influences the echo selection within the measuring window.

a	ECHO IN THE WINDOW TO BE SELECTED	REMARKS
0	With the highest amplitude	For most applications
1	First one	For applications with multiple echoes within the Measuring Window
2	Largest one	Recommended for applications with floating material in the air

FACTORY DEFAULT: **P25** = 0

P26: - - - -   **Level elevation rate (filling speed) [m/h]**

P27: - - - -   **Level wane rate (emptying speed) [m/h]**

Use these parameters to provide additional protection against echo loss in applications involving dust during the filling process (powders, dusting granules). Reliability of the measurement can be enhanced by the correct setting of this parameter.

These parameters must not be smaller than the fastest possible filling/emptying rate of the actual technology.
Note: In case of tanks with cone or pyramid bottom the level changing speed can be significantly faster at the bottom.

FACTORY DEFAULT: **P26** = 500
                                      P27 = 500

P28   - - - a   Echo-loss handling

a	ECHO-LOSS ERROR INDICATION	REMARKS
0	Delayed	During short periods of echo loss both the display and the analogue output holds the last value. The display keeps displaying the last value until the time interval set in **P20** parameter then another **P20** time elapses with blinking the last value before the "No Echo" error message is indicated. The current output holds the last value for twice as long as set in **P20** before going to the "Error Indication Mode" set in **P12**.
1	None	During an echo-loss the displayed value on the display and the analogue output value will hold last value.
2	Advance to full	When echo-loss occurs during filling, the displayed value on the display and the analogue output value shifts towards the "full" tank/silo state with the level elevation rate (filling speed) set in **P26**
3	Immediate	In case of an echo-loss, 'no Echo' will appear on the display and the outputs will change according to the "Error Indication Mode" set in **P12**.
4	No echo-loss indication in case of empty tank/silo	Echo-loss may occur in completely empty tanks with a spherical bottom due to deflection of the ultrasonic beam, or in case of silos with an open outlet. If the echo is lost when the tank/silo is completely empty, the indication will correspond to empty tank, in all other cases echo-loss indication will function according to the "Delayed".

FACTORY DEFAULT: **P28** = 0

P29 - - - -	**Blocking out of object**

One object in the tank/silo disturbing measurement can be blocked out.
Enter distance of the object from the transducer. Use the Echo Map (**P70**) to read out the precise distance of disturbing objects.
FACTORY DEFAULT: 0

P31: - - - -	**Sound velocity at 20°C (m/sec or ft/sec depending on P00(c))**

Use this parameter if the sound velocity in the gases above the measured surface differs largely from that in air.
Recommended for applications where the gas is more or less homogeneous. If it is not, the accuracy of the measurement can be improved using the 32-point linearization (**P48**, **P49**).
For sound velocities in various gases see section "Sound Velocities".
FACTORY DEFAULT:Metric (**P00: "EU"**): 343.8 m/s, US (**P00: "US"**): 1128 ft/s

P32: - - - -	**Specific gravity [kg/dm³]**

If you enter value (other than "0") of specific gravity in this parameter, the weight will be displayed in EView instead of VOL.
FACTORY DEFAULT: 0 [kg/dm³] or [lb/ft³] depending on P00(c)

P33: - - - -	**Manual echo selection by moving the Measuring Window**

A so-called measuring window is formed around the echo signal (See scheme on the next page.) The distance of the target will be calculated from the flight time in accordance with the position of the measuring window.

Use this parameter if the EchoTREK unambiguously selects a wrong echo; for example the echo reflected from the surface is much weaker than the interfering one(s) (*see figure beside and on next page*).

Enter the *distance* of the correct echo and the software will move the measuring window and calibrate itself to the echo found there.

To determine the distance of the correct echo, either use the Echo Map (to load-in a value from the Echo Map, see parameter P70), or measure the distance with an appropriate device, and enter this value in **P33**.
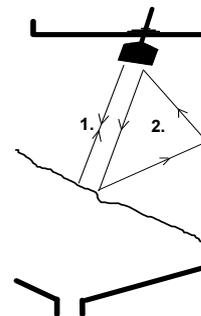
If this parameter has been used (P33 is not 0), its value will be continuously updated with the valid echo position. This means, that in case of a power loss, the EchoTREK will restart the signal processing with the measuring window at the last updated position. To switch-off this function, set P33= 0.

FACTORY DEFAULT: **P33** = 0

MANUAL ECHO SELECTION

① Received signal amplitude

Weak echo from the surface Eg.: 3.85 m

Disturbing echo Eg.: 5.2 m

1.

2.

(flight time)

t

Window signal (comp.)

measuring window (locked on the disturbing echo)

Transmitted DIST value (of the disturbing echo)

5.2 m

② **Setting: P33=4.00 (results in shifting the measuring window to 4 m)**

Window signal (comp.)

4 m

t

③ **Measuring window finds the echo from the surface**

Window signal (comp.)

Transmitted DIST value (the value is correct)

3.85 m

t

5.4.5. Volume measurement

P40: - - ba   Tank / silo shape

ba	TANK/SILO SHAPE	OTHER PARAMETERS TO BE SET
b0	Standing cylindrical tank shape: value of "b" as below bottom	**P40(b), P41**
01	Standing cylindrical tank/silo with conical bottom	**P41, P43, P44**
02	Standing rectangular tank/silo (with chute)	**P41, P42, P43, P44, P45**
b3	Lying cylindrical tank shape: value of "b" as bellow bottom	**P40(b), P41, P42**
04	Spherical tank	**P41**

Note!

Tank shape ("**a**" value) should be set first.

FACTORY DEFAULT: 00

P41-45: - - - -   Tank / silo dimensions

Standing cylindrical tank/silo with hemispherical bottom a = 0
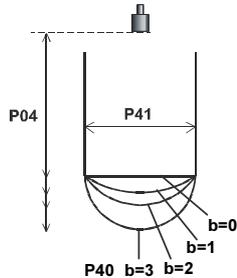
Standing cylindrical tank/silo with conical bottom a = 1, b = 0
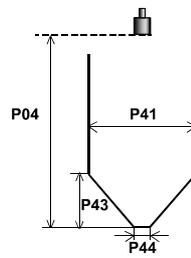
Standing rectangular tank/silo with or without chute a = 2, b = 0
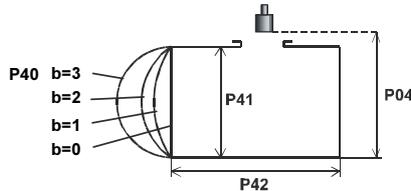
For flat bottom **P43**, **P44** and **P45** = 0

Lying cylindrical tank a = 3

Spherical tank a = 4, b = 0

FACTORY DEFAULT: **P41** ... **P45** = 0

5.4.6. Linearization

Linearization is the method of assigning requested (calibrated or calculated) level or volume to values measured by the transmitter. Data-pairs of the linearization table are handled in a 2x32 matrix, consisting of two columns. Between the entered data-pairs the unit calculates the output value from the measured level by linear interpolation. It can be used for (LEVEL $\Rightarrow$ VOLUME) instance if the tank shape is other type than the pre-programmed shapes (P41 ... P45).

a	LINEARIZATION
0	OFF
1	ON

FACTORY DEFAULT: **P47** = 0

The data-pairs determining the linearization characteristics are stored in a table with two columns. The table can be filled with pre-calculated values or measured data during filling the silo. The unit gives an address **(i)** to the data-pairs.

The left column (indicated on the display as "**L**") contains the measured LEVEL values.
The right column (indicated on the display as "**r**") contains the calibrated values interpreted according to the selected measurement value in **P01(a)**.

Number of entered data-pairs nn≤32

01, 02 ... nn address of the data-pair (i)

Entering data and modification:

entering numeric values
GET VALUE
(only for xxxx)
queries the values of the previous line of the table
CANCEL, queries the actual entry of the table
enter 0 (closing table)
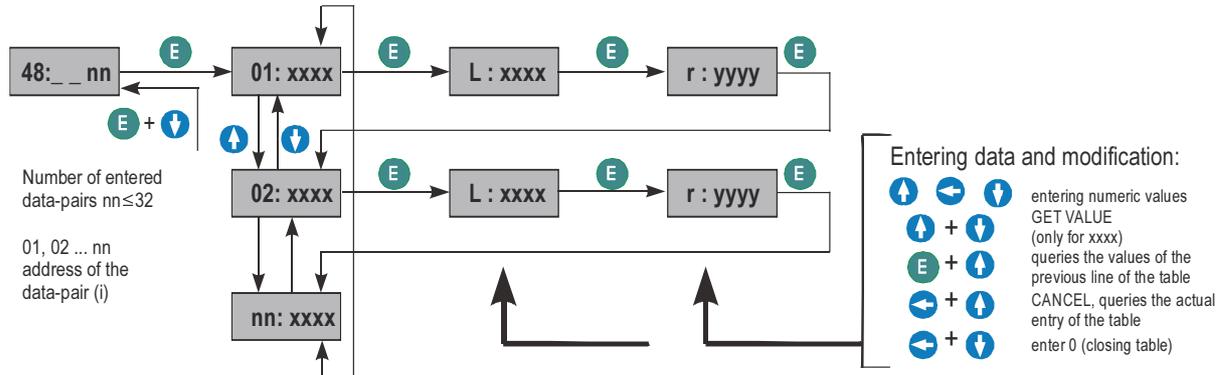
i	L (left column) LEVEL measured	r (right column) LEVEL or VOLUME to be transmitted and displayed
1	0	r(1)
2	L(2)	r(2)
	L(i)	r(i)
nn	L(nn)	r(nn)
nn+1	0	
32		

FACTORY DEFAULT: L(i) = 0
r(i) = 0

Conditions of correct programming of the data pairs
- The table should start with: L(1)= 0 and r(1)= value (assigned to 0 level)
- The L column cannot contain data entries with the same value
- If the linearization table contains less than 32 data-pairs j<32, the table must be closed by a level value "0" e.g. **L** (j<32)= 0.
- If the above conditions are not met and **P47=1** (linearization table is active) error message will be displayed (see chapter: Error Codes)

5.4.7. Informational parameters (read only)

P60: - - - -   Overall operating hours of the unit [h]

Indication varies according to the elapsed time:

OPERATING HOURS	INDICATION FORMAT
0 to 999.9h	xxx,x
1000 to 9999h	xxxx
Over 9999h	X,xx: e meaning x,xx 10^e

P61: - - - -   Time elapsed after last switch-on [h]
P62: - - - -   Operating hours of the relay [h]
P63: - - - -   Number of switching cycle of the relay

Indication same as in **P60**.

P64: - - - -   Actual temperature of the transducer [°C]
P65: - - - -   Maximum temperature of the transducer [°C]
P66: - - - -   Minimum temperature of the transducer [°C]

In case of a breaking in the temperature measuring Pt10 element „PtErr" will be displayed (See Chapter 7). The transmitter will perform temperature correction corresponding to 20ºC.

P70: - - - -   Number of Echoes / Echo Map

Viewing this parameter gives the number of echoes detected by the system. Entering this parameter will save the actual echo map, and the distance and amplitude of these echoes can be read-out one by one.

nn – Number of echoes in the Echo Map

01, 02, ... nn – serial number of the echo

xxxx – value of distance [m]

- aaa – amplitude in dB (< 0)

To move the Measuring Window (see **P33**) manually to one of the echoes displayed in the Echo Map:

1). Select an echo in the Echo map
(display should indicate the distance of the selected echo)

2). Press the UP ⊛ + DOWN ⊛ keys simultaneously (display will indicate "Set 33")

3). The selected echo is loaded into the P33 parameter (**see P33**)
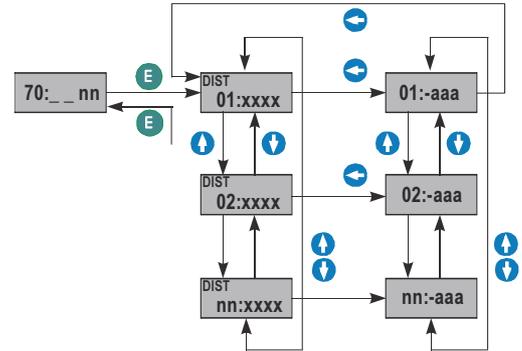
P71: - - - -   Distance of the of Measuring Window (read-out parameter)

P72: - - - -   Amplitude of the Echo in the Measuring (read-out parameter)

noEc is indicated on the display if the Echo Map is empty

P73: - - - -   Echo Position (time) (read out parameter) [ms]

P74: - - - -   Signal To Noise Ratio (read out parameter)

RATIO	MEASUREMENT CONDITIONS
Over 70	Excellent
Between 70 and 30	Good
Under 30	Unreliable

P75: - - - -   Blocking Distance

The actual close-end blocking distance is displayed. Provides useful information if automatic blocking was selected in **P05**.

5.4.8. Test parameters

Note: The outputs became activated immediately after pressing the Ⓔ ENTER button. Testing became inactive when exiting from the test parameters.

P80: - - - -   Current output test [mA]

Entering this parameter will result in displaying the actual current output. Set any value between 3.8 and 20.5 and press Ⓔ ENTER. Check current output by ampere meter. It has to show the same value set previously. Return to the parameter address by pressing Ⓔ ENTER.

P81: - - - a   Relay test

The actual state of the relay can be seen on the display (code according to the table below and symbol on the screen). Test the relay by pressing UP Ⓐ and DOWN Ⓥ white observing change of the symbol and the code or listening to the ticking of the relay or checking on-off resistance by a suitable resistance meter.

a	RELAY STATE
0	De-energised
1	Energised

P82: - - b a   Gain and short/long characteristic test

During the measurement the level transmitter changes the general gain (0, 1, 2, 3 gain stages) and the distance depending gain characteristics (short, long version) automatically in accordance to the measurement environment. In case of the short characteristics the distance depending gain reaches the full scale value at the half of the max. measuring distance ($X_M/2$) which gain is only available on the maximal measuring distance in case of long characteristics. When the maximum distance to be measured (H) of the application is smaller than the half of the max. measuring distance ($H \leq X_M/2$), then 0/ long option is chosen for strong reflection. For reducing echo strength the settings are selected by the following order: 0/ short, 1/ short, 2/ short, 3/ short. If $H > X_M/2$ always the long gain characteristics is selected. By entering this read-only parameter the display shows the selected value for **a** (0, 1) and **b** (0, 1, 2, 3). By changing **a** and **b** parameters on a test basis the operation can be tested with the help of an oscilloscope (connected to the **DEM** signal test connection).

b	GAIN CHARACTERISTICS DEPENDING ON THE DISTANCE	a	GENERAL GAIN
0	Short	**0**	Smallest gain
1	Long	**1, 2, 3**	Increasing gain stages

5.4.9.   Simulation

P84: - - - x   **Simulation Mode**

This function facilitates the user to be able to check the calculations (tank formula, table), outputs, and the additional processing instruments connected to the output. EchoTREK transmitters can perform simulation on the value of a constant or a variable. The entered values should be between the measurement range determined by **P04** and **P05** parameter values. To start simulation the instrument must return to Measurement mode. In Measurement mode if simulation is in progress, DIST, LEV or VOL symbols are blinking on the display.

To finish the simulation set **P84= 0**

X	SIMULATION TYPE
0	No simulation
1	The level changes continuously up and down between the level values set in **P86** and **P87** with a cycle time set in **P85**
2	Static level simulation: the level will be the value set in **P86**

FACTORY DEFAULT: 0
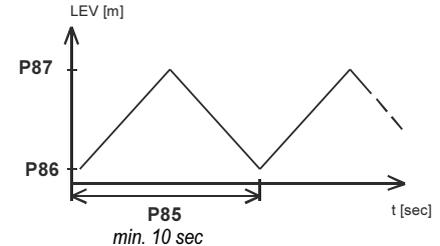
P85: - - - -	**Cycle time for simulation**	FACTORY DEFAULT: 10 s
P86: - - - -	**Simulated low level value**	FACTORY DEFAULT: 0
P87: - - - -	**Simulated high level value**	FACTORY DEFAULT: 0

5.4.10. Secret Code

P97:	b:a.aa	Software code

a.aa: Number of the software version
b: Code of the special version

P99:	dcba	Access Lock by Secret Code

The purpose of this feature is to provide protection against accidental (or intentional) re-programming of parameters.

The Secret Code can be a numeric value other than **0000**. Setting a Secret Code will automatically be activated when the EchoTREK is returned to the Measurement Mode. If the Secret Code is activated, the parameters can only be viewed, this is indicated by a flashing colon ":" between the parameter address and the parameter value.

In order to program the device locked by a secret code, first enter the Secret Code in **P99**. The Secret Code is re-activated each time the EchoTREK is returned to Measurement Mode.

To delete the Secret Code, enter the Secret Code in **P99**. After confirming it with **[E]** re-enter the parameter **P99** and enter **0000**.

[dcba (Secret Code) **]** → Ⓔ → Ⓔ → **[0000]** → Ⓔ ⇒ **Secret Code deleted**

5.4.11. Error Codes

The error codes are indicated by Err X format

ERROR CODE	ERROR DESCRIPTION	CAUSES AND ACTIONS TO BE DONE
1	Memory error	Contact local agent
No Echo or 2	Echo loss	No echo received (no reflection)
3	Hardware error	Contact local agent
4	Overflow	Check settings
5	Code referring to sensor error or improper installation/mounting, level in the dead band	Verify sensor for correct operation and check for correct mounting according to Users Manual
6	The measurement is at the reliability threshold (only for free flowing solids level measurement)	Re-aim the sensor or try to find a better location
7	No signal received within the measuring range specified in P04 and P05.	Review programming, also look for installation mistake
12	Linearization table error: L(1) and L(2) are both zero (no valid data-pairs)	See the Section "Linearization"
13	Linearization table error: there are two same L(i) data in the table	See the Section "Linearization"
14	Linearization table error: the r(i) values are not monotone increasing	See the Section "Linearization"
15	Linearization table error: measured Level is higher than the last Volume or Flow data-pair	See the Section "Linearization"
16	The checksum of the program in the EEPROM is wrong	Contact local agent
PtErr	Break in the temperature sensor circuit	Contact local agent

6. MAINTENANCE, REPAIR

The device does not require routine maintenance. In case dust adheres to the face of the sensor despite the self-cleaning of the sensor face through resonance, (ex.: static build-up) it can be cleaned by pressurised air.

Equipment sent back for repair should be cleaned or sterilised by the User. The User must declare that the above has been carried out.

Repairs during or beyond the guarantee period are carried out solely by the manufacturer.

7. STORAGE CONDITIONS

Ambient temperature: -30 ... +60°C
Relative humidity: max. 98 %

8. WARRANTY

NIVELCO provides warranty of 3 (three) years in compliance with details described in the Warranty Card.

9. PARAMETERS TABLE

Par.	Page	Description	Value d	c	b	a	Par.	Page	Description	Value d	c	b	a
P00	23	Application/Engineering Units					P28	34	Echo loss indication				
P01	24	Measurement Mode					P29	35	Blocking out of disturbing object				
P02	24	Calculation units					P30		-				
P03	25	Values displayed - Rounding					P31	35	Sound velocity in different gases				
P04	26	Maximum Measuring Distance					P32	35	Specific gravity				
P05	27	Minimum Measuring Distance					P33	35	Manual echo selection				
P06	28	Far End Blocking					P34		-				
P07		-					P35		-				
P08	28	Fixed output current					P36		-				
P09		-					P37		-				
P10	29	Transmitted value assigned to „4 mA"					P38		-				
P11	29	Transmitted value assigned to „20 mA"					P39		-				
P12	29	"Error" indication by the current output					P40	37	Selection of tank shape				
P13	30	Relay functions					P41	37	Dimensions of tank				
P14	30	Relay parameter – Energizing value					P42	37	Dimensions of tank				
P15	30	Relay parameter – De-energizing value					P43	37	Dimensions of tank				
P16		-					P44	37	Dimensions of tank				
P17		-					P45	37	Dimensions of tank				
P18		-					P46						
P19	30	HART short address					P47	38	Linearization				
P20	31	Damping time					P48	38	Linearization table				
P21		-					P49		-				
P22		-					P50		-				
P23	32	Angle of repose					P51		-				
P24	32	Target tracking speed					P52		-				
P25	33	Selection of Echo in the measuring window					P53		-				
P26	33	Level elevation rate					P54		-				
P27	33	Level descent rate					P55		-				

Par.	Page	Description	Value				Par.	Page	Description	Value			
			d	c	b	a				d	c	b	a
P56		-					P78		-				
P57		-					P79		-				
P58		-					P80	41	Current output test				
P59		-					P81	41	Relay test				
P60	39	Overall operating hours of the unit					P82	41	Gain and short/long characteristics test				
P61	39	Time elapsed after last switch-on					P83		-				
P62	39	Operating hours of the relay					P84	42	Simulation Mode				
P63	39	Number of switching cycles of the relay					P85	42	Cycle time for simulation				
P64	39	Actual temperature of the transducer					P86	42	Simulated low level value				
P65	39	Maximum temperature of the transducer					P87	42	Simulated high level value				
P66	39	Minimum temperature of the transducer					P88		-				
P67		-					P89		-				
P68		-					P90		-				
P69		-					P91		-				
P70	40	Echo Map					P92		-				
P71	40	Position of the measuring window					P93		-				
P72	40	Amplitude of the selected echo					P94		-				
P73	40	Position of the selected echo					P95		-				
P74	40	Signal / noise ratio					P96		-				
P75	40	Blocking distance value					P97	43	Software code				
P76		-					P98		-				
P77		-					P99	43	Access lock by secret code				