EchoTREK

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

User's and Programming manual

5th edition

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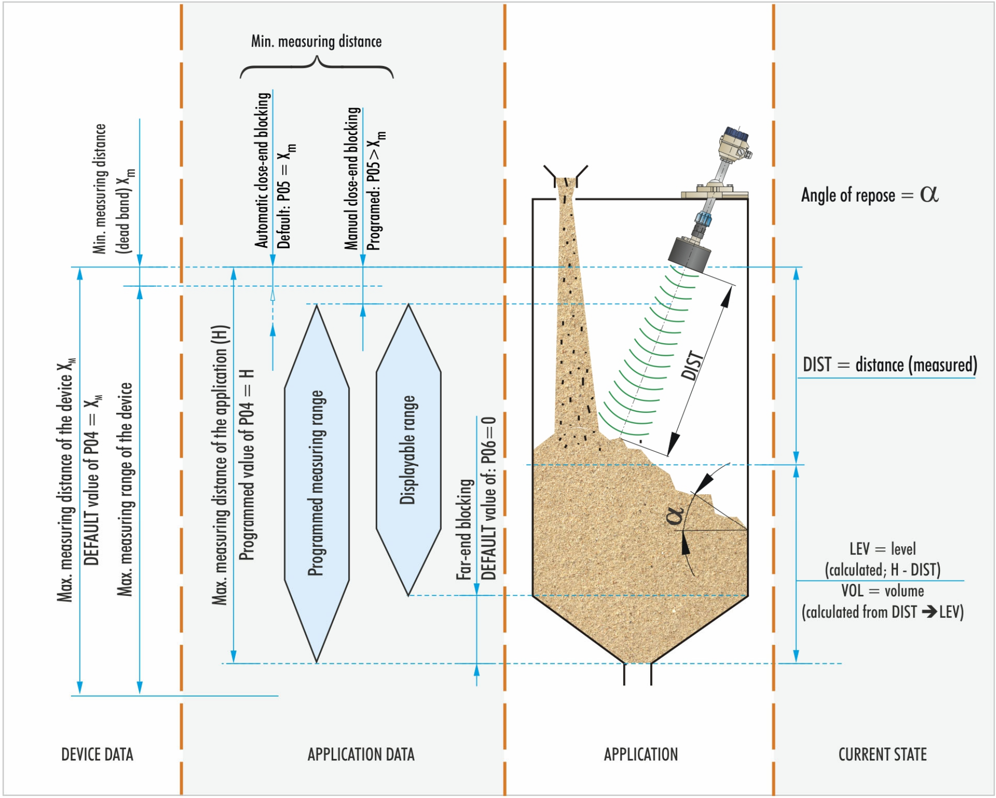
CERTIFICATES:		Reference document number
	BKI ATEX,Certificate No.: BKI16ATEX0020X/1	sbd31j0m060bp_05

BASIC CONCEPTS AND PARTS



CONTENTS

Thank you for choosing a NIVELCO instrument!

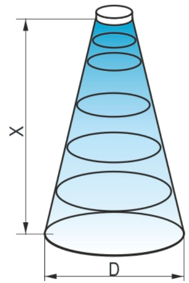
1. INTRODUCTION

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-contact ultrasonic principle is especially suited for applications where, for any reason, no physical contact can be established with the surface of the measured material, and moving parts are to be avoided to eliminate mechanical wear.

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 sidewalls or sometimes even in the presence of dusting. Furthermore, due to the narrow beam angle – the emitted ultrasonic signals have an outstanding focus – a sufficient signal penetration through dust is ensured.

OPERATING PRINCIPLE

Ultrasonic level metering technology measures the time required for the ultrasound pulses to travel from the sensor to the measured level and back. The sensor emits a series of ultrasonic pulses and receives the reflected echoes. The device processes the received signal by selecting the echo reflected by the surface and calculates the distance between the sensor and the surface from the time of flight 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 the 5° beam angle.

Minimum measuring distance (X_m): (also known as the "dead band") is a feature common to all ultrasonic level meters. It is a short distance in front of the sensor within which the ultrasonic device cannot measure. The unmeasurable range (close-end blocking) must be increased by programming to avoid any measurement error caused by incorrect mounting or placement of the level transmitter.

Maximum measuring distance (X_M): The longest distance under ideal conditions within which the device can measure. No measurement is possible beyond this distance.

2. TECHNICAL DATA

2.1. GENERAL DATA

Type		S☐D-3☐J-☐ S☐D-3☐J-☐ Ex
Transducer material		Closed cell PVC foam sensor face PP and Aluminum transducer housing and fitting
Total beam angle		~ 5°
Housing material		Powder-coated aluminum
Process temperature		−30…+75 °C (−22…+167 °F)
Ambient temperature		–30…+60 °C (−22…+140 °F), with SAP−100 display −25…+60 °C (−13…+140 °F)
Process pressure (absolute)		0.7 … 1.1 bar (10…16 psi) $P_{absolute}$ and ± 0.1 bar (±1.45 psig) difference between ambient and tank pressure
Mounting		4 × M12 screws on a Ø125 arc
Supply Voltage / consumption	Version I:	120…255 V DC / 5,5 W 85…255 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 (0.4")
Output	Analog	4…20 mA, R_{tmax} = 600 Ω, protection against surge transients If no echo: continuous 3.6 mA or 22 mA or holding value (selectable)
	Relay	SPDT, 250V AC/ 3A, AC1
	Display	SAP−100 programming and display module
	Digital communication	HART® standard on current output or RS485 MODBUS protocol
Damping time		3…1000 s (selectable) Default value: 300 s
Electrical connection		2× M20×1.5 plastic cable glands for Ø6…Ø12 mm (Ø0.24…Ø0.48") cable, 3× terminal blocks for max. 1.5 mm² (AWG16) wire cross section, 2× internally threaded ½" NPT connection for protective pipes.
Electrical protection		Class I., protective earth (PE) conductor: 4 mm² (AWG11)
Ingress protection		IP65

** Under optimal reflection circumstances and constant 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 (50 ft)	30 m (100 ft)	60 m (200 ft)
Minimum measuring distance (X_m)	0.6 m (2 ft)	0.6 m (2 ft)	1 m (3.3 ft)
Ultrasound frequency	40 kHz	30 kHz	15 kHz
Weight	~7 kg (~15.5 lbs)		~10 kg (~22 lbs)

Type	SAP–100 programming and display module
Display	6-digit LCD display for measurement value, engineering unit and bargraph
Ambient temperature	−25…+60 °C (−13…+140 °F)
Housing material	Fiberglass-reinforced plastic (PBT)

2.3. EX INFORMATION

2.3.1. ATEX CERTIFICATE No.: BKI16ATEX0020X/1

Type		S☐D–3☐J–5 Ex, S☐D–3☐J–6 Ex, S☐D–3☐J–7 Ex S☐D–3☐J–8 Ex, S☐D–3☐J–E Ex, S☐D–3☐J–F Ex
Ex marking (ATEX)		II 1/2 D Ex ma ta/tb IIIC T85°C…T130 °C Da/Db
Transducer material		Closed cell PVC foam sensor face, aluminum transducer housing and fitting
Max. surface temperature on the sensor head		+130 °C (+266 °F)
Max. surface temperature on the electronics housing		+130 °C (+266 °F)
Supply Voltage / consumption	Version I:	85… 255 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
Electrical connection		2× M20×1.5 cable glands with Ex ta IIIC protection for Ø7…Ø12 mm (Ø0.28…Ø0.48") cable, 3× terminal blocks for max. 2.5 mm² (AWG14) wire cross section, 2× internally threaded ½" NPT connection for protective pipes.

2.4. ACCESSORIES

- Installation and Programming Manual,
- Warranty Card,
- EU Declaration of Conformity
- 2× M20x1.5 cable glands (in case of Ex units certified cable glands with Ex ta IIIC protection type are included)
- 1× tripolar terminal blocks
- 2× bipolar terminal blocks

ACCESSORIES (SOLD SEPARATELY)

- Split flange (Order code: SFA–3☐5)
- SAP−100 programming and display module

2.5. ORDER CODES

EchoTREK S □ D – 3 □ J – □ *

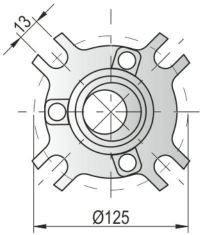
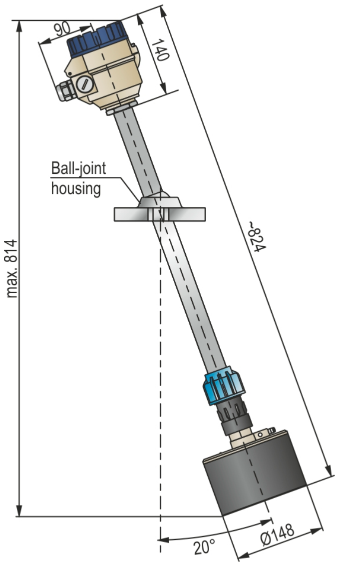
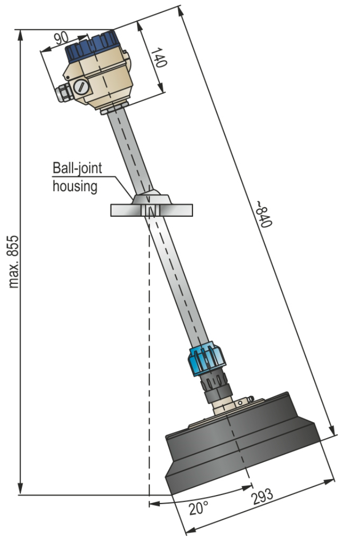
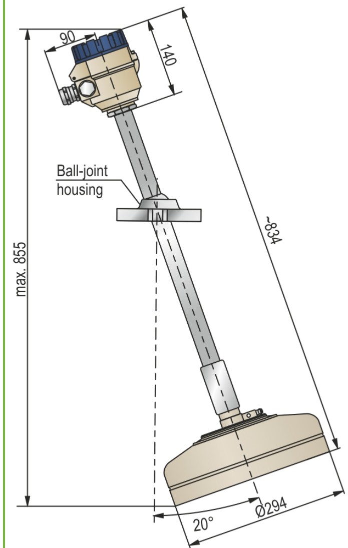
Type	Code
Transmitter	**T**
Transmitter + display	**B**

Measuring range / Frequency	Code
1…60 m (15 kHz)	**1**
0.6…30 m (30 kHz)	**3**
0.6…15 m (40 kHz)	**4**

Supply Voltage / Output	Code
Version I 85…255 V AC	
4…20 mA + Relay	**1**
4…20 mA + HART® + Relay	**3**
4…20 mA + Relay / Ex ma ta/tb D	**5**
4…20 mA + HART® + Relay / Ex ma ta/tb D	**7**
RS485 (MODBUS protocol) + Relay	**A**
RS485 (MODBUS protocol) + Relay / Ex ma ta/tb D	**E**
Version II 11,4…40 V DC and 11,4…28 V AC	
4…20 mA + Relay	**2**
4…20 mA + HART® + Relay	**4**
4…20 mA + Relay / Ex ma ta/tb D	**6**
4…20 mA + HART® + Relay / Ex ma ta/tb D	**8**
RS485 (MODBUS protocol) + Relay	**B**
RS485 (MODBUS protocol) + Relay / Ex ma ta/tb D	**F**

** Order codes of Ex versions end in 'Ex'*

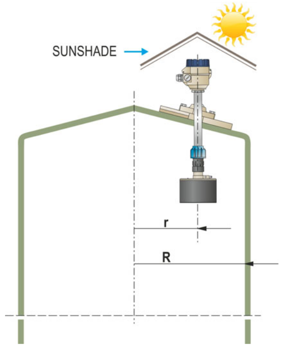
2.6. DIMENSIONS

<table>
<tr><th>Ball joint housing
(viewed from above)</th><th>S☐D–33J-☐ S☐D–34J–☐</th><th>S☐D–31J–☐</th><th>S☐D–31J–☐ Ex</th></tr>
<tr><td>
</td><td>
</td><td>
</td><td>
</td></tr>
</table>

3. INSTALLATION

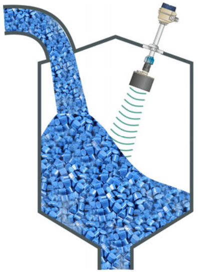
PLACEMENT

Various considerations must be taken to find the ideal position for the EchoTREK level transmitter.
The transmitter should not be installed in the center 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 the case of a cylindrical tank). Avoid the transmitter's 5° conical beam angle intersecting the tank/silo wall. In this case, the transmitter is mounted too close to the wall; therefore, it must be tilted (See "Aiming").
To avoid overheating, the instrument must be protected against direct sunlight.



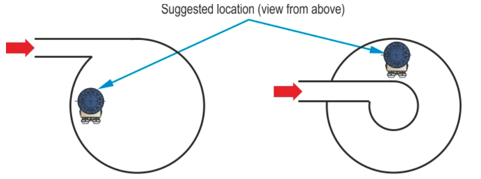
GRAVITATIONAL FILLING

The device must be mounted as far from the filling stream as possible.



PNEUMATIC FILLING

Select a location where the speed of the in-flowing material is the lowest.
Ex-type units must not be installed in the dust path of the pneumatic filling!



MOUNTING (SEE ILLUSTRATION OF MOUNTING OPTIONS ON THE NEXT PAGE)

The EchoTREK consists of a sensor attached to the aiming arm (a pipe with a ball joint housing incorporating a ball joint) 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 (5") for fixing it. For easy installation, it is recommended to use NIVELCO's special flange with a split insertion, available with four sizes of DN125/150/200/300 (to be ordered separately). Removing the split insert, the flange is must 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 × each) delivered with the split flange. The ball joint will be pressed to the housing by a spring allowing adjustment/aiming. After completing the adjustment/aiming, the 4 × of M12 bolts have only to be tightened. The maximum torque for tightening the bolts is 3.5 Nm.

Mounting EchoTREK versions S☐D–33☐–☐ and S☐D–34☐–☐:

1. Check that the split flange matches the holes of the counter-flange on the silo.
2. Remove the split insert from the flange and put the flange around the aiming arm between the sensor and the aluminum base.
   Slide the split insert back to its place and screw the ball joint housing to the flange with the four M12 bolts to such an extent that the aiming arm can move freely through and tilt by the ball joint for the aiming process.
3. Place the seal below the flange (if necessary).
4. Pass the sensor through the opening 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 process (see “Aiming” below).
6. To fix the position of the aiming arm, tighten the four M12 bolts of the ball joint housing (max. 3.5 Nm).

Mounting EchoTREK S☐D–31☐–☐ versions, with silo/tank roof opening of Ø300…Ø340 mm (Ø11.8…Ø13.4").

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 Ø300 mm (Ø11.8") and the silo space is accessible from inside:

1. Check the split flange's holes with that of the bolt places or counter-flange on the silo
2. Place the seal below the flange (if necessary)
3. Push the unit out of the silo (upwards) (See ① on the next page)
4. When the aluminum 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 insert to its place (See ③ on the next page)
7. Screw in the four of M12 bolts (See ④ on the next page) so they 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 four 12M bolts (max. 3.5 Nm).

If the entire tilting range of the aiming arm is required, the thickness of the roof cannot exceed the specified value 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 [19.7 x 19.7"]) opening on the roof. This solution is to be used when the roof thickness is greater than 350…380 mm (13.8…15").
Neither the apparatus nor any part of it is suitable as a fire resistant barrier for the Zone 20 area.

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

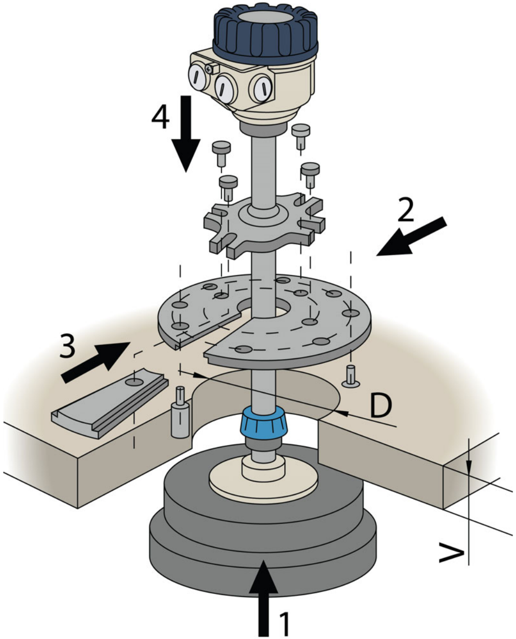


Figure 1. Mounting

DIAMETER OF THE OPENING D	MAX. ROOF THICKNESS V
160 mm (6.3")	110 mm (4.3")
190 mm (7.5")	10 mm (5.9")
230 mm (9")	200 mm (7.9")
300 mm (11.8")	280 mm (11")
340 mm (13.4")	300 mm (11.8")

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 (AWG20…AWG14).
- Electric connections can be made using one or two cables. Wires in different groups (A, B, C; shown below) cannot to be led in the same cable.

<table>
<tr><th>Group A</th><th>Group B</th><th>Group C</th></tr>
<tr><td rowspan="2">Low voltage power supply</td><td>4…20 mA.</td><td rowspan="3">RS485
(shielded twisted pair)</td></tr>
<tr><td>SELV voltage power supply</td></tr>
<tr><td>Low voltage for the relay</td><td>SELV voltage power or logic signal for the relay</td></tr>
</table>

- The unit must be put in place and the cables must be arranged so that the connecting cables outside the unit are fixed and tension-free.
- Devices must be grounded properly at the internal or external grounding screw terminals, depending on the cables.
- DC-powered (Version II) devices can be 3-wire connected. In this case, terminals 1 and 6 must be interconnected, but there will be no galvanic isolation.
- After making the electrical connections, check for correct sealing and close the housing!

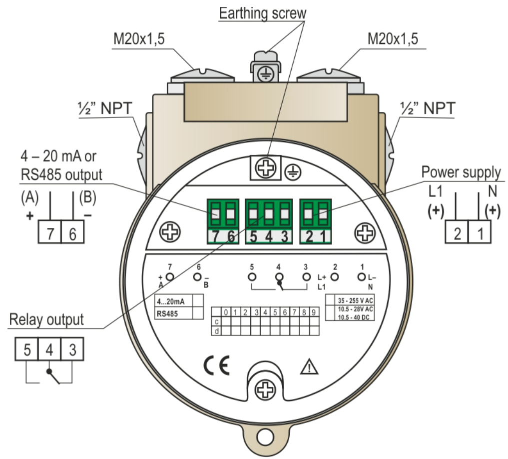


Figure 2. Wiring diagram

Space for the wiring, for better overview without the upper part.

5. COMMISSIONING, ADJUSTING, PROGRAMMING

5.1. COMMISSIONING

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 unit's operation or solving most simple level metering tasks. The programming must be modified for the required measurement task to use the advanced features of the EchoTREK. Read the following chapters of this user's and programming manual carefully to get familiar with the programmable features of the level transmitter and solve challenging level measurement tasks.

FACTORY DEFAULT PARAMETERS

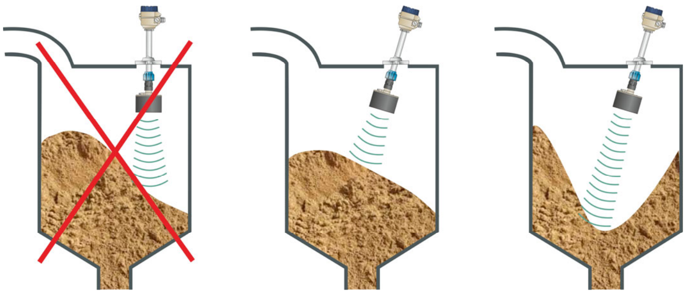
All the transducers get the same factory default parameters that can be reset later if needed. Some of the most important parameters default values of the EchoTREK S☐D–3 series can be found below:

- Measurement mode: level measurement (LEV). The plug-in SAP–100 display shows the level value.
- Zero level is assigned to the maximum measuring distance (X_M).
- The output current and the bar graph of the SAP–100 module are assigned to the measured level value.
- 4 mA and 0% are assigned to zero level (maximum measuring distance).
- 20 mA and 100% are assigned to the 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 the case of "NO Echo."

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

AIMING OF THE ECHOTREK FOR SOLIDS

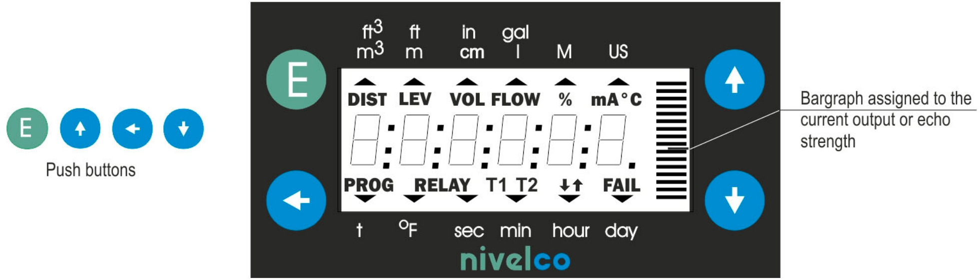
It is recommended to tilt the sensor by the aiming arm of the transmitter to reduce weak signal reflection from the material surface caused by an angle of repose building due to the filling and emptying process. The optimal tilting position can be adjusted during operation and recommended to be checked 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 absent or tall and narrow silos (diameter/height ≥ 5), aiming is not critical: the sensor must face straight downwards. Aiming must also be tested with full silo since due to the great angle of repose, the echo might be weak despite the level being near the sensor. In such cases, a reasonable compromise of aiming must be achieved that provides a good echo in every state of the filling. Aiming is also aided by the informational parameters P70 – P75. The aiming procedure is recommended to perform together with the complete parameter access programming.



5.1.1. The SAP–100 programming and display module

The plug-in programming and display module can be removed or plugged 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 units are displayed in the bottom or top lines, or indicated by the arrow pointing at the units on the display's frame.



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

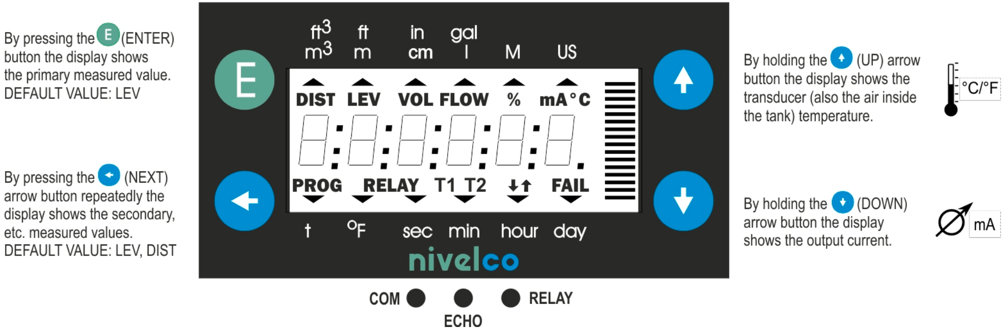
SYMBOLS USED ON THE FRAME

Valid if pointed by the arrow

- **M** – metric (European) engineering system
- **m^3 m cm l** (liter)
- **US** – imperial (US) engineering system
- **ft^3 ft in gal** (gallon)
- **t** – tonne (1000 kg) or Ton (2000 lbs) (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. In this case, the display shows the measurement value, which can be changed following the steps below.



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 %)
- VOLUME or MASS (VOL)
- VOLUME 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 the "FAIL" message is blinking on the display, the error codes can be displayed after the measured values (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 on during communication (Remote programming).
- **ECHO**-LED

  LED is on as long as the device receives a valid echo signal.
- **RELAY**-LED

  LED is on when relay is energized.

5.2. SPECIAL CONDITIONS OF EX USE

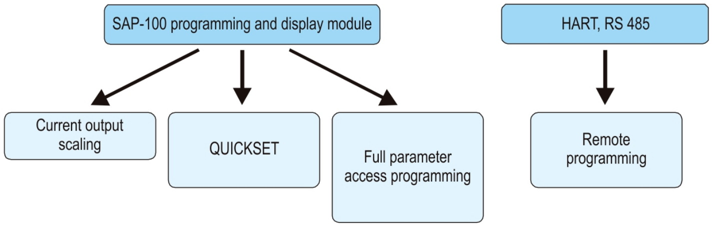
- Do not place the device in a pneumatic dust stream!
- The device or any part of it must not be used to seal the Zone 20 area in a flameproof manner.
- All earthing screws of the device must be earthed to avoid static charge in order to fulfill the safety class I.
- The diameter of the cable and the cable entry must match.
- Only Ex ta certified glands may be used to connect the device.
- The current output must be connected via galvanic isolator.

The window of equipment types EchoTREK SBD–3□–□□ Ex is susceptible to electrostatic charges; thus, its cleaning is allowed only with use of wet cloth.

5.3. PROGRAMMING

The factory default settings can be changed by the user. Programming can be performed with an SAP–100 plug-in programming module, which functions as a field display as well. The **EchoTREK SB□** types come with an SAP–100 programming module. After removing the windowed housing cover, the programming buttons can be accessed. The SAP–100 module can program any EchoTREK level transmitter for solids. The EchoTREK can 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 for 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 an adequately grounded point before removing the cover of the enclosure. A possible electrostatic discharge can cause damage to the instrument.



Measuring will continue during programming using the old parameter set.

The new settings will be in force after returning to Measurement mode from Programming mode.

If the transmitter is left in programming mode by mistake, it will automatically return to measurement mode after 30 minutes and operate with the last saved parameters. In the case of HART® capable units or versions with an 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 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)
- Level assigned to 4 mA
- Level assigned to 20 mA
- Error indication by current output
- Damping time
- Assigning level to energizing a relay
- Assigning level to release a 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 the full-access programming mode, the parameters are numbered, and they can be identified in the user manual. The unit continues measuring with the last saved settings while programming. When the currently measured values are used (for example, GET LEVEL) the values are calculated according to the last saved parameter set. The new parameter set becomes in force only after returning to measurement mode.

5.3.1. Basic steps of programming

The unit can be programmed directly with the four push buttons of the SAP–100 module. The followings are an overview of handling the programming module. Detailed programming instructions are covered in chapters 5.3.2, 5.3.3, 5.3.4, and 5.4.

SINGLE-PRESSING THE BUTTONS

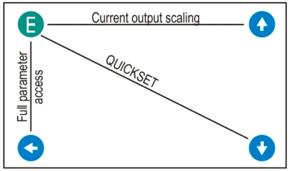
The functions of the keys become active after the button is released.

E	to save parameter address and go to parameter value; to return from parameter value to parameter address
←	to move the cursor to the left
↑	to increase the value of the digit under the cursor (press the key continuously to increase the value of the digit faster)
↓	to decrease the value of the digit under the cursor (press the key continuously to decrease the value of the digit faster)

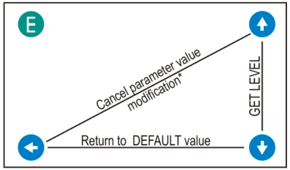
PRESSING TWO BUTTONS AT THE SAME TIME

Press the two keys simultaneously to access programming steps (0 ... 3 s). The double key combination is marked with ”+” 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 the actual measured value*

Notes:

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

- *the parameter is either read-only, or*
- *modifying the parameter is restricted by a secret code (see **P99**).*

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

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

5.3.2. Current output scaling

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

KEYS	OPERATION
E + ↑ (press for 3 s!)	Enter into or exit from the current output scaling programming mode.
↑, ↓, ←	Set value (increase/decrease the digit under the cursor or scroll up/down) / Move left with the blinking digit.
↑ + ↓	"GET LEVEL" - display the current level value measured by the EchoTREK.
E	Save the current value on the screen and move to the next screen.
← + ↑	Quit current output scaling programming mode without saving the settings (CANCEL).
← + ↓	Display the factory default of the current screen (DEFAULT).

The display will indicate PROG and the following screens:

SCREENS	SETTINGS
4:xxxx	**xxxx** – level value assigned to 4 mA current output **Manual:** set the level value manually (by using the ↑ / ↓ / ← keys) and save it (with E) counted from the maximum measuring distance (H), which is to be assigned to the 4 mA output current **Automatic*:** use the "GET LEVEL" function (↑ + ↓) when the medium inside the tank is at the level to be assigned to the 4 mA value ("GET LEVEL" functions only works if the ECHO LED is on), and save the displayed value as described above. **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 the ↑ / ↓ / ← keys) and save it (with E) counted from the maximum measuring distance (H), which is to be assigned to the 20 mA output current **Automatic*:** use the "GET LEVEL" function (↑ + ↓) when the medium in the tank is at the level to be assigned to the 20 mA value ("GET LEVEL" functions only works if the ECHO LED is on), and save the displayed value as described above. **Default value:** Measuring 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 can also be found, below the screw cover, on the front panel of the EchoTREK.

KEYS	OPERATION
Ⓔ + ⬇ (press for 3 s!)	Enter into or exit from quickset programming mode
⬆, ⬇, ⬅	Set value (increase/decrease the blinking digit or scroll up/down) / Move left with the blinking digit
⬆ + ⬇	"GET LEVEL" - display the current level value measured by the EchoTREK
Ⓔ	Save the current value on the screen and move to the next screen
⬅ + ⬆	Quit current output scaling programming mode without saving the modifications (CANCEL)
⬅ + ⬇	Display factory default of the corresponding screen (DEFAULT)

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 ⬆ / ⬇ keys) yy= indicating "Li" for liquids or "So" for solids level measurement (cannot 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 the ⬆ / ⬇ / ⬅ keys) and save it (with Ⓔ) **Automatic*:** use the "GET LEVEL" function (⬆ + ⬇) 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 described above (with Ⓔ). **Default value:** maximum measuring distance X_M, see Technical Data Table

4:xxxx	**xxxx** – level value assigned to the 4 mA current output **Manual:** set the level value manually (by using the ↑ / ↓ / ← keys) and save it (with E) counted from the maximum measuring distance (H), which is to be assigned to the 4 mA output current **Automatic*:** use the “GET LEVEL” function (↑ + ↓) when the medium in the tank is at the level to be assigned to the 4 mA value (“GET LEVEL” function only works if the ECHO LED is on) and save the displayed value as described above (with E). **Default value:** 0 m (0%, empty tank)
20:xxxx	**xxxx** – level value assigned to the 20 mA current output **Manual:** set the level value manually (by using the ↑ / ↓ / ← keys) and save it (with E) counted from the maximum measuring distance (H), which is to be assigned to the 20 mA output current **Automatic*:** use the “GET LEVEL” function (↑ + ↓) when the medium in the tank is at the level to be assigned to the 20 mA value (“GET LEVEL” function only works if the ECHO LED is on) and save the displayed value as described above (with E). **Default value:** measuring range = $X_M – X_m$ (max. measuring distance – max. measuring distance (dead band))
Er:xxxx	**Error indication by the current output** by using ↑ / ↓ 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 (with the ↑ / ↓ key) and save the value as described above. **Default value:** 300 s
rE:xxxx	**Relay energized xxxx: level** of the relay's energized state If the value exceeds this programmed value, the relay will be energized The step of programming are the same as that of the current output assignment
rd: xxxx	**Relay de-energized xxxx: level** of the relay's de-energized state If the value drops below this programmed value, the relay will be de-energized The steps of programming are the same as that of the current output assignment

Note: – *the current output can also be programmed for inverted operation: 4 mA= 100% (Full), 20 mA= 0% (Empty)*
– *sources of possible errors are listed in 5.4.11 - "Error Codes"*

For the **Automatic** function, the EchoTREK must be set to (LEV) level measurement mode and the ECHO LED must be on.

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

5.3.4. Full Parameter Access

Access to all features of the EchoTREK

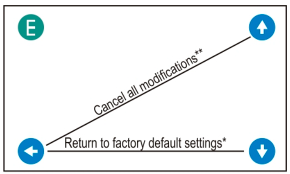
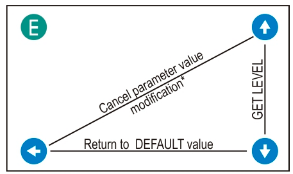
The description of all parameters can be found in chapter 5.4.

KEYS	OPERATION
E + ← (press for 3 s!)	Enter into or exit from the Full Parameter Access programming mode

The display will show 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 continues during programming in using the old settings. The new settings will be valid after returning to measurement from programming mode.

KEYS	WHILE PARAMETER ADDRESS IS BLINKING	WHILE PARAMETER VALUE IS BLINKING
E	Go to the Parameter Value	Save the modified settings and return to the Parameter Address
← + ↑ (min. 3 s)	Cancel all modifications of the current programming phase CANCEL will be displayed for warning	Discard the modified settings and return to the Parameter Address without saving the modifications
← + ↓	Reset the device to factory defaults. It will reset all parameters, “LOAD” will appear on the display: - press E to confirm - press any other key to cancel	Display the default value of the current parameter. (it can be saved by pressing E)
←	Move the cursor to the left	
↑ / ↓	Modify the cursor (increase, decrease) or scroll up/down	
Summary of key combinations	 * LOAD will be displayed ** CANCEL will be displayed	 * cancellation is immediately active

5.4. Parameters – Descriptions and Programming

5.4.1. Measurement Configuration

P00: - c b a Application / Engineering Units

NOTE!
Changing this parameter will reset all other parameters to factory default value in the selected engineering unit!

Attention! Mind the sequence!
At this parameter, the value "a" on the right will blink first.

a	Operating (measurement) mode
1	Free-flowing solids level measurement

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 CAN OPERATE IN TWO DIFFERENT CALCULATION SYSTEMS BUT THE PROGRAMMING MANUAL USES ONLY METRIC UNITS FOR 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! At this parameter, the value "a" on the right will blink first.

b	Bargraph indication
0	Echo strength
1	Current output

* The displayed value depends 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!
At this parameter, the value "a" on the right will blink first.

This table is interpreted by **P00(c)**, **P01(a)** and **P02(c)** and is irrelevant in the 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 (1000 kg)	lb (pound)
1	liter	gallon	tonne (1000 kg)	Ton (2000 pounds)

c	Time
0	s
1	min
2	hour
3	day

FACTORY DEFAULT: **P02** = 000

P03: - - - a Displayed Values – Rounding

DISTANCE (DIST) display

It is crucial to remember that the instrument is measuring distance as the base quantity, and all the other process values are calculated from this base quantity.
The resolution of the measured distance is 1 cm, which is reflected in the calculated (level, volume) values. But the displayed value of the calculated volume (VOL) can be rounded.

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

The decimal position will be shifted as the displayed value increases (see table on the left).
Values over one million will be displayed in exponential format, where the value (e) represents the exponent. If the value exceeds $1x10^{10}$, the display will show Err4 (overflow).

ROUNDING

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

The mathematical operations will enlarge a couple of centimeters of fluctuation of the base DIST value. This enlarged fluctuation in displaying VOL or FLOW can (if disturbing) be avoided by rounding set in **P03**. The rounding value 2, 5, 10, etc., represents the steps by which the (one or two) last digit(s) of the calculated value will be changed.
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 of the steps 50, 100, 150, etc., will not be displayed)

FACTORY DEFAULT: **P03** = 0

P04 - - - - Maximum measuring distance (H)

The maximum measuring distance is the only parameter that has to be programmed for each application except for distance measurement. The values of the maximum measuring distance will be displayed 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 measured distance (H) is the maximum distance, which can be measured between the transducer face and the farthest medium surface. The factory defaults of **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 must 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 <= 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 highest accuracy, it is recommended to measure this distance in the empty tank with the EchoTREK by using the "GET LEVEL" function (press and keys simultaneously) provided the bottom is flat. Save by E pressing 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)

One of the basic characteristics of ultrasonic level measurement is the denial of any echo within the close-end blocking range, also called the dead zone. This range is the minimum measuring distance, which the level transmitter can measure. By increasing this parameter, disturbing objects and false reflections 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 shortest possible close-end-blocking distance, i.e., the dead band. In the case of optimal mounting, this setting could be set somewhat lesser. In the case of non-optimal mounting, this setting could be set to a somewhat higher value than the given minimum measuring distance values (X_m) of the table below.

Manual close-end-blocking

Manual close-end-blocking would be used to block out the echo originating from the bottom rim of a stand-off pipe or any object protruding into the ultrasonic cone near the transmitter. The minimum measuring range will be extended and fixed to the specified value by entering a value higher than the factory default. To display the factory default of the minimum measuring distance, press ← + ↓.

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).

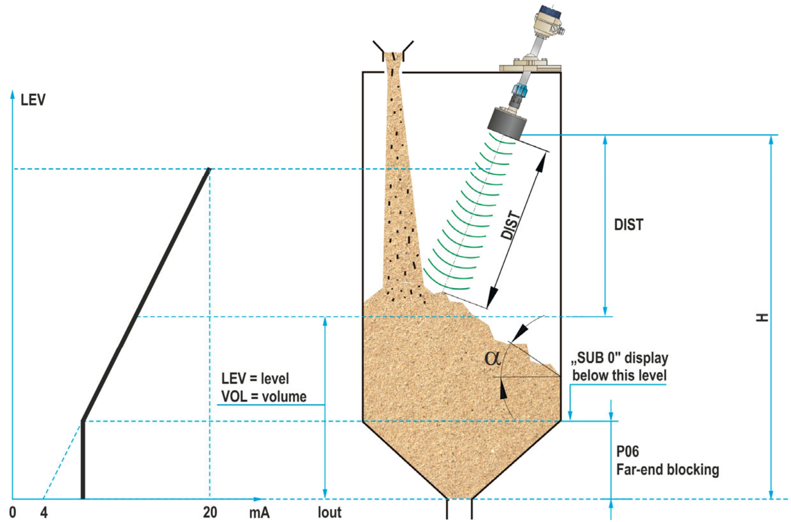
P06: - - - - Far-end blocking

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

If the level of the medium drops below the blocked-out range:

– **"Sub 0"** will be indicated for the level and volume

– Current output will hold a value corresponding to the far end blocking level.



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

Accepts values between 3.8 and 20.5. The output current will be set to the entered value and analog transmission will be suspended until **P08=0**.

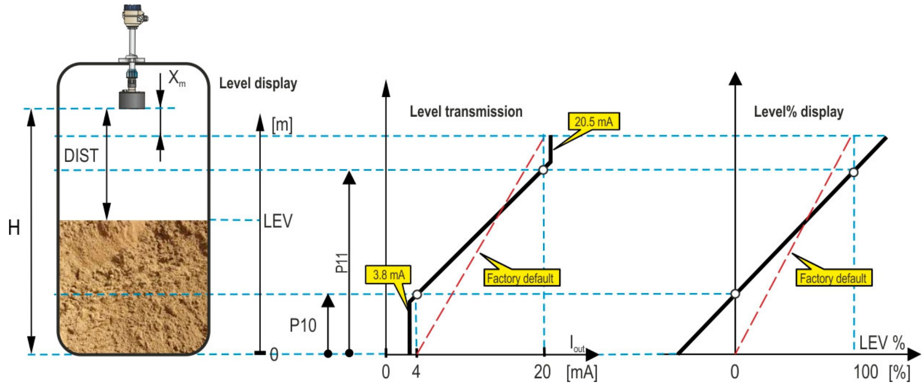
FACTORY DEFAULT: **P08** = 0

5.4.2. Analog 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)**. The process and current loop output values can be assigned to each other either directly or inversely. For example, if the 1 m (3.3 ft) level is assigned to 4 mA and 10 m (32.8 ft) is assigned to 20 mA, it represents a directly proportional relation, while assigning 1 m (3.3 ft) to 20 mA and 10 m (32.8 ft) to 4 mA represents an inversely proportional relation. Entering these parameters also determines displaying level percentage (LEV%) and volume percentage (VOL%). The value of P10 always represents 0%, and the value of P11 always represents 100%. The GET LEVEL function can be used for programming.



FACTORY DEFAULT: **P10** = 0, **P11** = $X_M - X_m$.(see the tables regarding **P04** and **P05** parameters)

P12: - - - a Output Current Error Mode

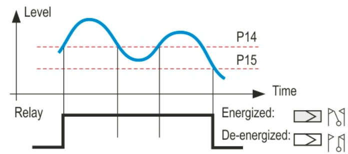
In the case of an error, the EchoTREK will provide one of the current outputs below. This error indication is active until the failure is fixed or otherwise disappears.

a	ERROR INDICATION BY THE CURRENT OUTPUT
0	HOLD (holds the last valid value)
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 energized if the measured or calculated value exceeds the value set in **P14.** Relay is de-energized if the measured or calculated value drops below 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 energized in case of "noECHO"		—
2		Relay is de-energized in case of "noECHO"		—

FACTORY DEFAULT: **P13** = 2

P14: - - - - Relay parameter – Energizing value

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

P14 and **P15** parameters must be set when differential level control is required. The parameter values must be set in the unit according to **P01**. The GET LEVEL function can be used if the parameters affecting the transmitted value are valid. When using differential level control, a minimum of 20 mm (0.8") hysteresis must be set for the level between the Relay Energizing value and the Relay De-energizing value to avoid frequent relay state changes.

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

P19: - - - - **HART® Polling Address**

The polling address can be set here between 0 and 15. For a single instrument, the polling address is 0, the output changes in the 3.8…22 mA range (analog output), and HART® is also working. If multiple units (up to 15) are used in HART® Multidrop mode, the polling addresses must be other than 0 (1…15), the output current will be a constant 4 mA, and information is only transmitted via HART®. For other aspects of setting this parameter, see the EView software manual that came with your HART® device.

FACTORY DEFAULT: **P19** = 00

5.4.4. Measurement Optimization

P20: - - - a **Damping time**

The damping time is used to dampen (filter out) unwanted fluctuations in the display and output. Increasing the value reduces the fluctuation, while the end value of a rapid change is delayed on the display and output by the damping time.

a	DAMPING TIME [s]	GRANULES particle size > 2…3 mm (> 0.08…0.12")	POWDERS particle size < 1…2 mm (< 0.04…0.08")
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** = 300 s

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

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

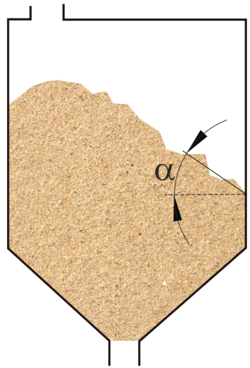
a	ESTIMATED ANGLE OF REPOSE
0	No angle of repose $\alpha \cong 0$
1	$\alpha < 15°$
2	$\alpha > 15°$

The optimal setting of this parameter can be done with the help of checking the echo strength in the readout parameter **P72** indicating the echo amplitude in dB. The ideal **P23** setting is when the parameter value in **P72** becomes the best.

1. Set **P23** to **a = 0**, confirm it with E and switch to Measurement Mode, then return to Programming Mode after min. 6 s.
2. Observe the echo amplitude in **P72** and record an average value.
3. Perform the above with the **P23: a=1** and **a = 2** settings.
4. Finally, set **P23** with the value of (a) at which the amplitude value in **P72** is highest.

Note: the highest amplitude belongs to the slightest negative dB value.

FACTORY DEFAULT: **P23** = 0



P24: - - - a Target tracking speed

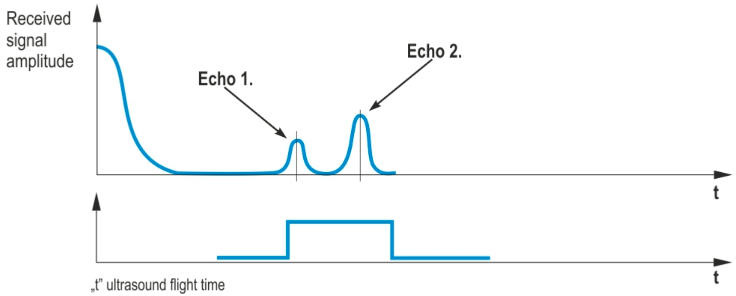
With this parameter, the evaluation can be sped up at the expense of accuracy.

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

FACTORY DEFAULT: 0

P25: - - - a **Selecting an Echo in the measuring window**

A measuring window is formed around the echo signal. The position of this measuring window determines the flight time for calculating the distance of the target (the signal forms below can be observed on an oscilloscope).



Some applications involve multiple (target + interference) echoes even within the measuring window. The Quest program will select the echoes automatically. This parameter only influences selecting the echo in 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 area	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]**

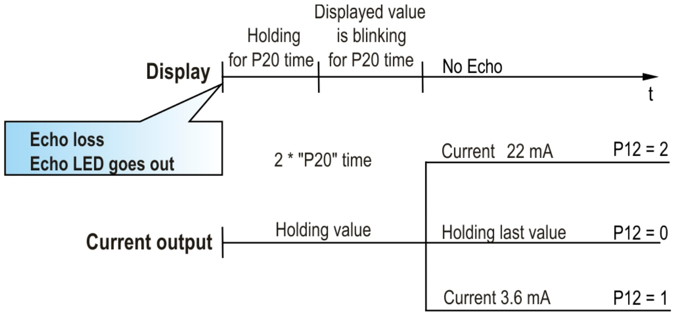
Use these parameters to provide additional protection against echo loss in applications involving dust during the filling process (powders, dusting granules). In addition, the reliability of the measurement can be enhanced by the correct setting of this parameter.

These parameters must not be smaller than the fastest possible filling/emptying rate of the used devices.

Note: In the 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 analog output hold the last value. The display keeps displaying the last value until the time interval is set in the **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 analog output value will hold the last value.
2	Advance to full	When echo loss occurs during filling, the displayed value on the display and the analog output value shifts towards the "full" tank/silo state with the level elevation rate (filling speed) set in **P26.**
3	Immediate	In the 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 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 an empty tank, in all other cases, echo loss indication will function according to "Delayed".

FACTORY DEFAULT: **P28** = 0

P29 - - - - Interfering object

The echo of a stationary object that causes an interfering echo in the tank can be ignored by masking. Use the echo map (**P70**) or manual measurement to determine the distance of the interfering object from the sensor. Enter this distance in parameter **P29**.
FACTORY DEFAULT: **P29** = 0

P31: - - - - The Speed of Sound at +20 °C (+68 °F) (m/s or ft/s depending on P00 (c))

Use this parameter if the speed of sound in the gas above the measured surface differs greatly from the speed of the sound in the air and the gas is more or less homogeneous.

If the gas is not homogeneous, 32-point linearization (**P48**, **P49**) should be used to maintain measurement accuracy.
FACTORY DEFAULT:Metric (P00: “EU”**): 343.8 m/s, US (**P00: “US”**): 1128 ft/s**

P32: - - - - Specific gravity [kg/dm^3]

If a specific gravity value (other than “0”) is entered in this parameter, weight will be displayed instead of VOL in EView.
FACTORY DEFAULT: **P32** = 0

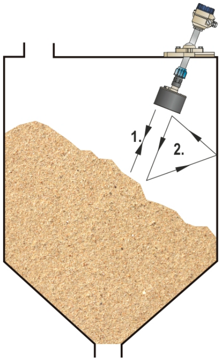
P33: - - - - Selecting echoes manually by moving the Measuring window

In order to eliminate interfering echoes, the device marks the immediate proximity of the echo arriving from the measured surface with a window, and the distance is measured within this window (see illustration on next page).

Under poor measurement conditions, the measured echo may be significantly smaller than the interfering echo, so the device will place the window on the interfering echo, thus measuring an incorrect distance.

This parameter can be used to override the device's incorrect selection and move the window to the echo at the correct distance.

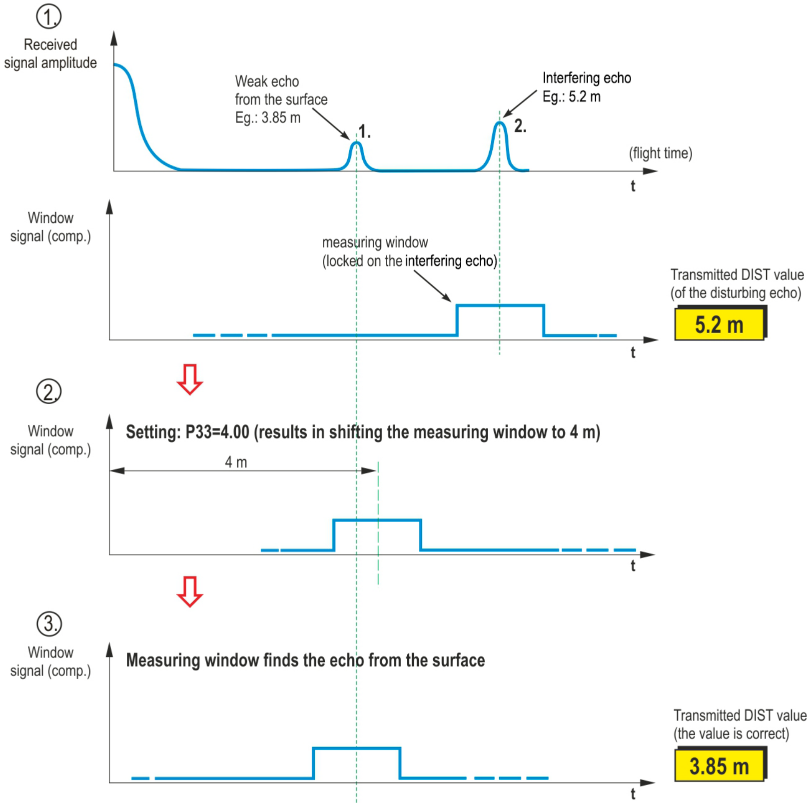
Determine the distance of the surface to be measured using the echo map (see parameter **P70**) or manual measurement and enter this approximate value in **P33**.



If this parameter has been used (**P33 ≠ 0**), its value will be continuously updated with the correct echo position. It 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



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	Horizontal cylindrical tank shape: value of “b” as bellow bottom	**P40(b)**, **P41**, **P42**
04	Spherical tank	**P41**

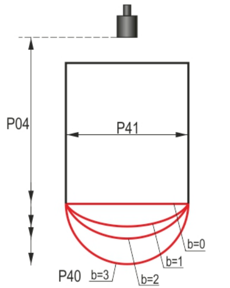
Note!

Tank shape (“**a**” value) must be set first.

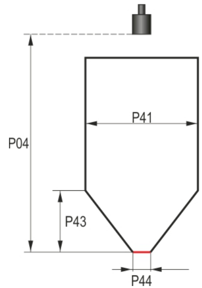
FACTORY DEFAULT: 00

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

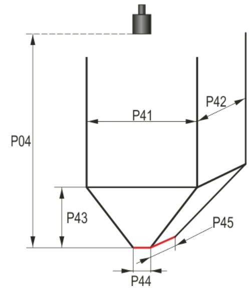
Standing cylindrical tank/silo with hemispherical bottom a = 0



Standing cylindrical tank/silo with conical bottom a = 1, b = 0

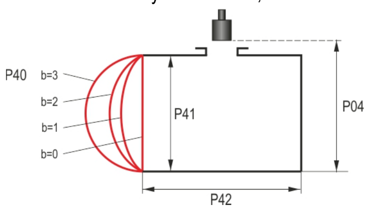


Standing rectangular tank/silo with or without chute a = 2, b = 0

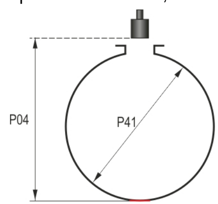


For flat bottom **P43**, **P44** and **P45** = 0

Horizontal cylindrical tank, a = 3



Spherical tank a = 4, b = 0



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

5.4.6. Linearization

P47: - - - a Linearization

Linearization is the method of assigning a (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 VOLUME) instance if the tank shape is other type than the pre-programmed shapes (P41 ... P45).

a	LINEARIZATION
0	OFF
1	ON

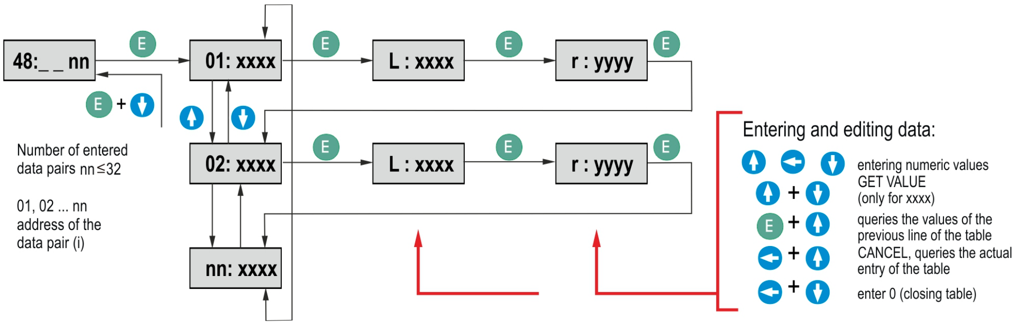
FACTORY DEFAULT: 0

P48: - - - - Linearization table

The data pairs determining the linearization characteristics are stored in a two-column table. The table can be filled with pre-calculated values or measured data while 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).**



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)
- Column L may not contain the same value in two entries.
- 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: - - - - Total 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

This display format is also used in **P61** and **P62**.

P61: - - - - Time elapsed after last switch-on [h]

P62: - - - - Operating hours of the relay [h]

P63: - - - - Number of switching cycle of the relay

P64: - - - - Actual temperature of the transducer [°C]

In case of a breaking in the temperature measuring element „Pt Er" will be displayed. The transmitter will perform temperature correction corresponding to +20 °C (+68 °F).

P65: - - - - Maximum temperature of the transducer [°C]

P66: - - - - Minimum temperature of the transducer [°C]

The maximum and minimum temperatures since commissioning are stored.

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

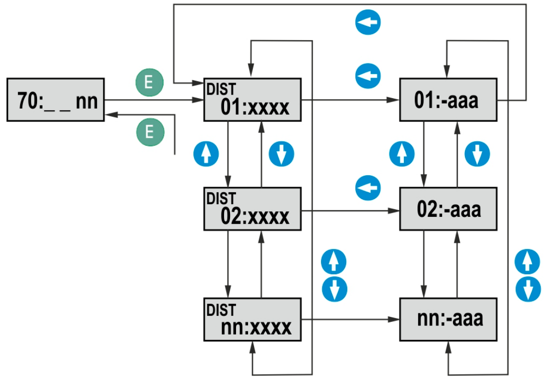
This parameter shows the number of echoes detected by the system. Entering this parameter will save the actual echo map, and the distance and amplitude of these echoes can be read-out one by one.

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 show the distance of the selected echo)

2). Press the ⬆ + ⬇ keys simultaneously (display will show “Set 33”) The selected echo is loaded into the P33 parameter (**see P33**)

P71: - - - - **Distance of the of Measuring Window (DIST) [m]**

P72 - - - - **Amplitude of the Echo in the Measuring [dB] (< 0)**

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

P73: - - - - **Echo Position (time)[ms]**

P74: - - - - **Signal To Noise Ratio**

RATIO	MEASUREMENT CONDITIONS
Over 70	Excellent
Between 70 and 50	Good
Under 50	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 become active immediately after pressing the E button. *Testing ends when exiting from the test parameters.*

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

Opening this parameter will display the actual current output. Set any value between 3.8 < x < 20.5 mA. Check current output with an ammeter. It has to show the same value set previously. Return to the parameter address by pressing E.

P81: - - - a **Relay test**

The current 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 ⬆ and ⬇ white observing change of the symbol and the code or listening to the ticking of the relay or checking on-off resistance with a multimeter.

a	RELAY STATE
0	De-energized
1	Energized

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

During the measurement, the level transmitter automatically changes the general gain (0, 1, 2, 3 gain stages) and the distance depending on gain characteristics (short, long version) according to the measurement environment. In the case of the short characteristics, the distance depending, gain reaches the full-scale value at the half of the maximum 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 half of the maximum measuring distance ($H \leq X_M/2$), then the 0/ long option is chosen for strong reflection. For reducing echo strength, the settings are selected in the following order: 0/ short, 1/ short, 2/ short, 3/ short. If $H > X_M/2$, always the long gain characteristic is selected. Opening this parameter shows the selected value for **a** (0, 1) and **b** (0, 1, 2, 3). Changing **a** and **b** parameters on a test basis can test the operation with an oscilloscope (connected to the **DEM** signal test connection).

b	GAIN CHARACTERISTICS DEPENDING ON THE DISTANCE
0	Short
1	Long

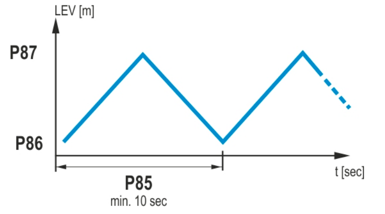
a	GENERAL GAIN
0	Smallest gain
1, 2, 3	Increasing gain stages

5.4.9. Simulation

P84: - - - x Simulation Mode

This function lets the user check the calculations (tank formula, table), outputs, and the additional processing instruments connected to the output. EchoTREK transmitters can perform simulations 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. The instrument must return to measurement mode to start the simulation. DIST, LEV, or VOL symbols are blinking on the display in measurement mode if the simulation is in progress. To finish the simulation, set **P84** = 0.

X	SIMULATION TYPE
0	No simulation
1	The level fluctuates 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: **P84** = 0

P85: - - - - Cycle time for simulation FACTORY DEFAULT: P85 = 10 s

P86: - - - - Simulated low level value FACTORY DEFAULT: P86 = 0

P87: - - - - Simulated high level value FACTORY DEFAULT: P87 = 0

5.4.10. Secret Code

P97: b:a.aa Software code

a.aa: Software version number
b: Code of the special version

P99: dcba Restricting Access with a Secret Code

This feature aims to protect accidental (or intentional) re-programming of parameters.
The secret code can only 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 become read-only; 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 Ⓔ, 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 the dealership.
noEc or **2**	No echo or echo too weak for processing.	The material is poorly reflective, the surface does not reflect the sound towards the sensor, or there is a high sound absorption due to dusting. Check the selection and application conditions of the device!
3	Hardware error.	Contact the dealership.
4	Display overflow.	Check settings.
5	Code referring to sensor error or incorrect installation/mounting, level in the dead band.	Verify that the sensor is working and mounted correctly.
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 for it.
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 ”Linearization”
13	Linearization table error: there are two identical L(i) values in the table.	See “Linearization”
14	Linearization table error: the r(i) values are not increasing linearly.	See “Linearization”
15	Linearization table error: measured level is higher than the last volume or flow data pair.	See “Linearization”
16	The checksum of the program in the EEPROM is wrong.	Contact the dealership.

6. MAINTENANCE, REPAIR

The device does not require regular maintenance. In case dust deposits are formed on the face of the sensor, despite the self-cleaning effect of resonance on the sensor face (e.g., static build-up), it can be cleaned with pressurized air.

The warranty card contains the terms and conditions. Before returning the device for repairs, it must be cleaned thoroughly.

The parts in contact with the medium may have harmful substances on their surface; therefore, they must be decontaminated. Our official form (Returned Equipment Handling Form) must be filled and enclosed in the parcel. Download it from our website www.nivelco.com. The device must be sent back with a declaration of decontamination. A statement must be provided in the declaration that the decontamination process was successfully completed and that the device is clean from any hazardous substances.

7. STORAGE

Ambient temperature: –30…+60 °C (−22…+140 °F)

Relative humidity: max. 98%

8. APPENDIX

8.1. PARAMETERS TABLE

Par.	Page	Description	Value d	c	b	a
P00	25	Application / Engineering Units				
P01	26	Measurement Mode				
P02	26	Calculation units				
P03	27	Displayed Values – Rounding				
P04	28	Maximum measuring distance (H)				
P05	29	Minimum measuring distance (Dead zone)				
P06	30	Far-end blocking				
P07		-				
P08	30	Fixed output current				
P09		-				
P10	31	Value assigned to 4 mA current output				
P11	31	Value assigned to 20 mA current output				
P12	31	Output Current Error Mode				
P13	32	Relay functions				
P14	32	Relay parameter – Energizing value				
P15	32	Relay parameter – De-energizing value				
P16		-				
P17		-				
P18		-				
P19	33	HART® Polling Address				
P20	33	Damping time				
P21		-				
P22		-				
P23	34	Angle of repose				
P24	34	Target tracking speed				
P25	35	Selecting an Echo in the measuring window				
P26	35	Level elevation rate (filling speed)				
P27	35	Level wane rate (emptying speed)				

Par.	Page	Description	Value d	c	b	a
P28	36	Echo loss handling				
P29	37	Interfering object				
P30						
P31	37	The speed of sound at +20 °C (+68 °F)				
P32	37	Specific gravity				
P33	37	Selecting echoes manually				
P34		-				
P35		-				
P36		-				
P37		-				
P38		-				
P39		-				
P40	39	Tank / silo shape				
P41	39	Tank / silo dimensions				
P42	39	Tank / silo dimensions				
P43	39	Tank / silo dimensions				
P44	39	Tank / silo dimensions				
P45	39	Tank / silo dimensions				
P46						
P47	40	Linearization				
P48	40	Linearization table				
P49		-				
P50		-				
P51		-				
P52		-				
P53		-				
P54		-				
P55		-				

Par.	Page	Description	*Value*			
			d	c	b	a
P56		-				
P57		-				
P58		-				
P59		-				
P60	41	Total operating hours of the unit				
P61	41	Time elapsed after last switch-on				
P62	41	Operating hours of the relay				
P63	41	Number of switching cycle of the relay				
P64	41	Actual temperature of the transducer				
P65	41	Maximum temperature of the transducer				
P66	41	Minimum temperature of the transducer				
P67		-				
P68		-				
P69		-				
P70	42	Number of Echoes / Echo Map				
P71	42	Distance of the of Measuring Window				
P72	42	Amplitude of the Echo in the Measuring				
P73	42	Echo Position				
P74	42	Signal To Noise Ratio				
P75	42	Blocking distance				
P76		-				
P77		-				

Par.	Page	Description	Value			
			d	c	b	a
P78		-				
P79		-				
P80	43	Current output test				
P81	43	Relay test				
P82	43	Gain and short/long characteristics test				
P83		-				
P84	44	Simulation Mode				
P85	44	Cycle time for simulation				
P86	44	Simulated low level value				
P87	44	Simulated high level value				
P88		-				
P89		-				
P90		-				
P91		-				
P92		-				
P93		-				
P94		-				
P95		-				
P96		-				
P97	45	Software code				
P98		-				
P99	45	Access lock by secret code				

sbd31jen21p05
December 2021
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