HiTECH Technologies, Inc.

INSTALLATION

AND

PROGRAMMING MANUAL

EchoTREK

S-300 series compact ultrasonic level transmitters

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1. INTRODUCTION

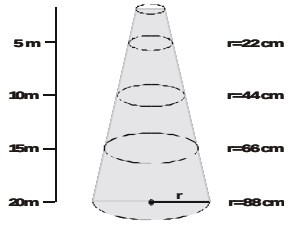
Application

The EchoTREK compact ultrasonic level transmitters from HITECH are an excellent tool for the level measurement of liquids and free flowing solids.
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.
Such reasons may include corrosive attack by the process medium against the measuring device material (acids), possible contamination (sewage) or particles of the process medium adhering to the measuring device (adhesive materials).

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

A Total beam angle of 5°-7° at –3 dB as is featured by most of HiTECH's SonicLaser transducers ensuring a reliable measurement in narrow silos with uneven side walls as well as in process tanks with various protruding objects. Furthermore, as a result of the narrow beam angle - the emitted ultrasonic signals have an outstanding focusing - deep penetration through gases, vapor and foam is ensured.



The Diameters corresponding to 5° beam angle.

Dead Band is a feature common to all ultrasonic level meters. It is specified as "Minimum measuring distance" in the Technical Data Table.

2. ORDER CODES

The order codes of the EchoTREK for liquids:

EchoTREK S □ □ – 3 □ □ – □

TYPE	CODE
Transmitter	T
Transmitter with local indicator	B

TRANSDUCER /HOUSING	CODE
PP / Aluminium	A
PVDF / Aluminium	B
PTFE / Aluminium	T
St. St. / Aluminium	S
PP / Plastic	P
PVDF / Plastic	V
PTFE / Plastic	F
St. St. / Plastic	M

RANGE*	CODE
25 m	2
15 m	4
10 m	6
8 m	7
6 m	8
4 m	9

MOUNTING	CODE
BSP thread	0
NPT thread	N
DN 80	2
DN 100	3
DN 125	4
DN 150	5
DN 200	6
200 mm bracket	K
500 mm bracket	L
700 mm bracket	M

SUPPLY / OUTPUT	CODE
85 to 265 VAC	
4...20 mA+Relay	1
4...20 mA+HART+Relay	3
RS485+Relay	5
4...20 mA+Relay (limited pr.)	A
10.5 to 40 VDC, 10.5 to 28 VAC	
4...20 mA+Relay	2
4...20 mA+HART+Relay	4
RS485+Relay	6
4...20 mA+Relay (limited pr.)	B

* For measuring ranges of PTFE (teflon) and St.St.(staninless steel) versions, see Technical Data table

Process connections: threaded with S_ _-39_ , 38_ and 37_ flange bracket or aiming kit with all other models

Order code of the EchoTREK for free flowing solids:

EchoTREK S □ □ – 3 □ □ – □

Under development

3. TECHNICAL DATA

3.1 Data of EchoTREK for liquids

General data

Product name	EchoTREK ST/SB-300 series
Product description	Compact type ultrasonic level transmitter
Transducer materials	Polypropylene (PP); Kynar (PVDF); Teflon (PTFE); Stainless Steel (DIN 1.4571, AISI SS316Ti)
Housing material	Plastic: PBT fiber-glass reinforced, flame-retardant (DuPont®) or Aluminum: Powder paint coated
Process temperature	PP, PTFE and PVDF versions: -30°C ... +90°C Stainless Steel versions : -30°... to +100°C (120° for max. 2 hours)
Ambient temperature	-30°C ... +60°C with SAP-100 -25°C ... +60°C If necessary, protect the device from over-heating by direct sunshine!
Pressure (Absolute.)	0.3 ... 3 bar (0,03 ... 0,3MPa) Stainless steel versions 0,9 ... 1,1 bar (0,09 ... 0,11 MPa)
Seals	PP transducer: EPDM; All other transducer versions: FKM (Viton)
Mechanical protection	Sensor: IP68 (submersible); Housing: IP67 (NEMA 6)
Power supply / Consumption	High voltage version: 85 ... 255 V AC / 6 VA Low voltage version: 10,5 ... 40 VDC / 3,6 W, 10,5 ... 28 V AC / 4 VA
Accuracy*	± (0.2% of the measured distance plus 0.05% of the range)
Resolution	< 2 m: 1 mm, 2…5 m: 2 mm, 5…10 m: 5 mm, > 10 m: 10 mm
Outputs	Analog: 4/20 mA, 600 Ohm, galvanically isolated, secondary lightning protection; Contact: SPDT (NO/NC); 250 V AC, 3 A;
	HART (optional); Interface: RS485 (optional)
	Display (SAP-100): 6 digits, icons and bargraph, Custom LCD
Electrical connections	2 x Pg16 and 2 x ½" NPT; Wire cross section: 0,5 ... 2,5 mm²
Electrical protection	Class I.

***** *Under optimal circumstances of reflection and stabilized transducer temperature.*

Special data of EchoTREK for liquids with PP and PVDF transducers

Type	**STÿ -39ÿ -ÿ SBÿ -39ÿ -ÿ**	**STÿ -38ÿ -ÿ SBÿ -38ÿ -ÿ**	**STÿ -37ÿ -ÿ SBÿ -37ÿ -ÿ**	**STÿ -36ÿ -ÿ SBÿ -36ÿ -ÿ**	**STÿ -34ÿ -ÿ SBÿ -34ÿ -ÿ**	**STÿ -32ÿ -ÿ SBÿ -32ÿ -ÿ**
Transducer material	PP or PVDF	PP or PVDF	PP or PVDF	PP or PVDF	PP or PVDF	PP or PVDF
Maximum measuring distance * [m / ft]	4 / 13	6 / 20	8 / 26	10 / 33	15 / 49	25 / 82
Min. measuring distance* (Dead band) [m / ft]	0,2 / 0,65	0,25 / 0,82	0,35 / 1,2	0,35 / 1,2	0,45 / 1,5	0,6 / 2
Total beam angle (-3 dB)	6°	5°	7°	5°	5°	7°
Measuring frequency	80 kHz	80 kHz	50 kHz	60 kHz	40 kHz	20 kHz
Process connection	1 ½" thread	2" thread	2" thread	Flange	Flange	Flange

* (taken from the transducer face)

Special data of EchoTREK for liquids with PTFE and Stainless Steel transducers

Type	**STT-39ÿ -ÿ SBT-39ÿ -ÿ**	**STT-38ÿ -ÿ SBT-38ÿ -ÿ**	**STT-37ÿ -ÿ SBT-37ÿ -ÿ**	**STS-36ÿ -ÿ SBS-36ÿ -ÿ**	**STS-34ÿ -ÿ SBS-34ÿ -ÿ**	**STS-32ÿ -ÿ SBS-32ÿ -ÿ**
Transducer material	PTFE	PTFE	PTFE	St. St.	St. St.	St. St.
Maximum measuring distance * [m/ft]	3 / 10	5 / 16	6 / 20	7 / 23	12 / 39	15 / 49
Min. measuring distance* (Dead band) [m/ft]	0,2 / 0,65	0,25 / 0,82	0,35 / 1,2	0,4 / 1,3	0,55 / 1,8	0,65 / 2,2
Total beam angle (-3 dB)	6°	5°	7°	5°		7°
Measuring frequency	80 kHz	80 kHz	50 kHz	60 kHz	40 kHz	20 kHz
Process connection	1 ½" thread	2" thread	2" thread	Flush flange	Flush flange	Flush flange

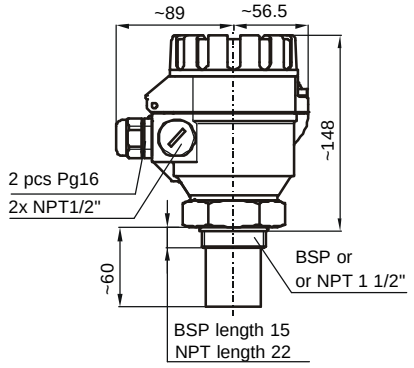
* (taken from the transducer face)

SAP-100 Programming Module

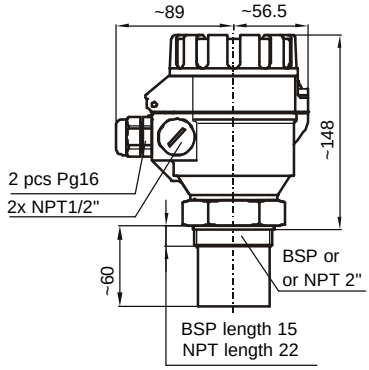
Field indication	6 digits, icons and bargraph, Custom LCD
Ambient temperature	-25°C ... +60°C
Housing material	PBT fiber-glass reinforced plastic, flame-retardant (DuPont®)

Dimensions of EchoTREK for liquids

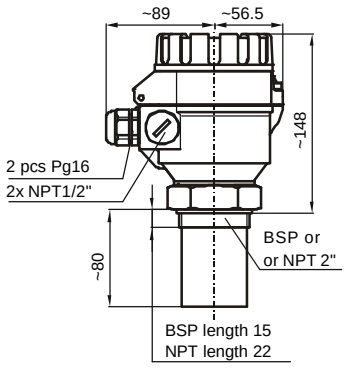
EchoTREK S□□-39□-□ / PP, PVDF, PTFE



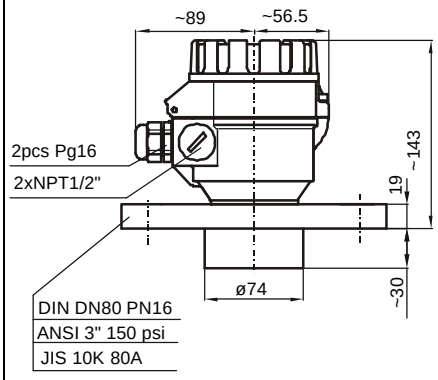
EchoTREK S□□-38□-□ / PP, PVDF, PTFE



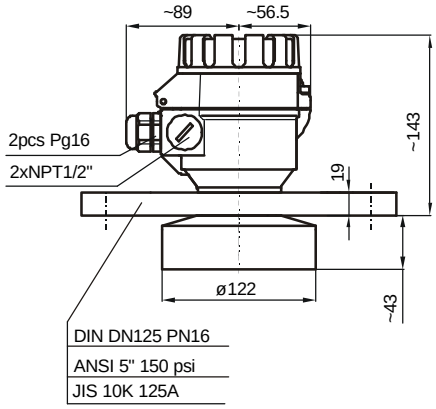
EchoTREK S□□-37□-□ / PP, PVDF, PTFE



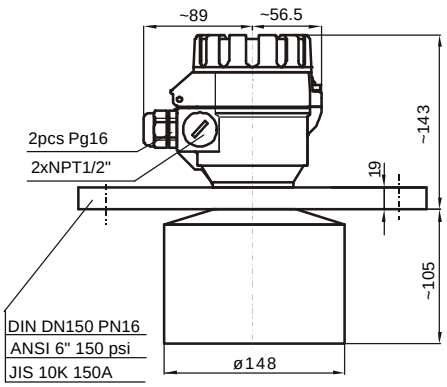
EchoTREK S□□-36□-□ / PP, PVDF



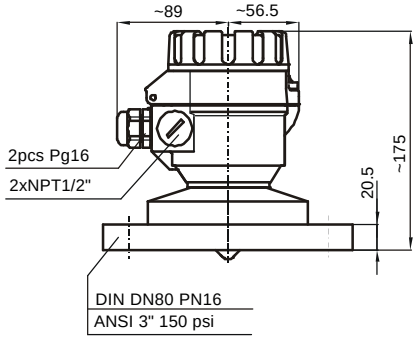
EchoTREK S□□-34□-□ / PP, PVDF



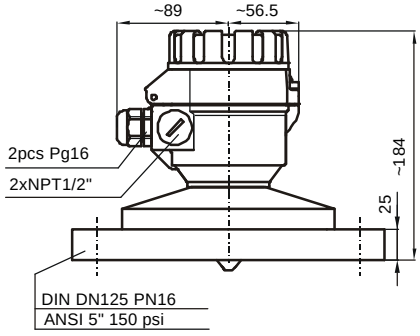
EchoTREK S□□-32□-□ / PP, PVDF



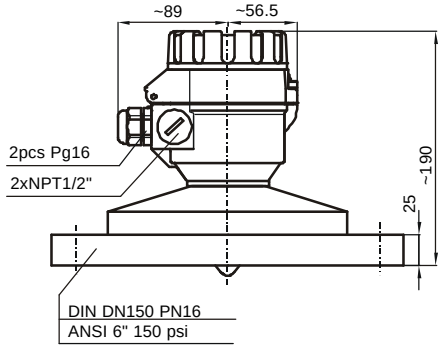
EchoTREK S□S-36□-□ / St. St.



EchoTREK S□S-34□-□ / St. St.



EchoTREK S□S-32□-□ / St. St.



3.2 Data of EchoTREK for free flowing solids

General data
Special data
Dimensions
(Under development)

3.3 Accessories

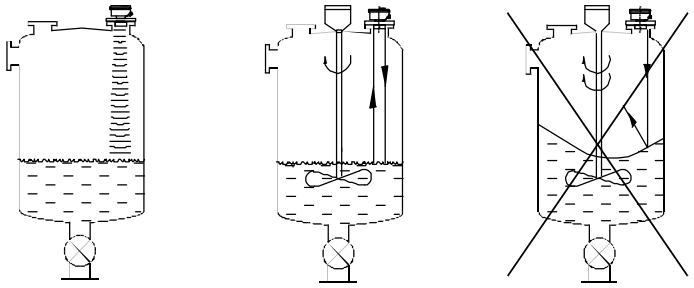
- 2 x Pg16 cable gland
- Magnetic screwdriver (for Touch-Magnet Programming)
- Installation and Programming Manual

4. INSTALLATION

4.1 Liquid Level Measurement

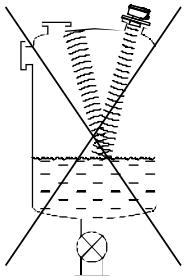
POSITION

The optimal position of the EchoTREK is between 1/2 radius and 2/3 diameter of the (cylindrical) tank / silo. (Take also sonic cone on page 1 into consideration.)



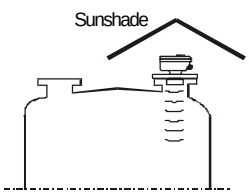
PARALLELITY

The sensor face has to be parallel to the surface of the liquid within ± 2-3°.



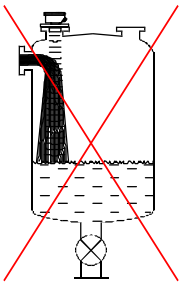
TEMPERATURE

Make sure that the transmitter will be protected against overheating by direct sunshine.



OBSTACLES

Make sure that no in-flow path or objects (e.g. cooling pipes, ladders, bracing members, thermometers, etc) or no tank wall of the ragged surface protrude into the sensing cone of the ultrasonic beam. Although up to two fix objects in the tank / silo that disturb the measurement can be blocked out by the appropriate programming of the EchoTREK



FOAM

Foaming of the liquid surface may render ultrasonic level metering impossible. If possible, a location should be found, where foaming is the smallest (the device should be located as far as possible from liquid inflow) or a stilling pipe or well should be used.

FUME/VAPOR

In case of closed tanks containing chemicals or other liquids creating fume/gases above the liquid surface especially for outdoor tanks exposed to the sun, a strong reduction of the nominal measuring range of the ultrasonic device is to be considered during device selection.
Devices with lower measuring frequency (40, 20 kHz) are recommended depending on the range.

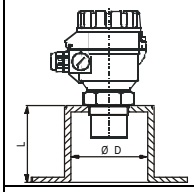
WIND

An intensive moving of the air (gas) in the vicinity of the ultrasonic cone is to be avoided. A strong draft of wind may "blow away" the ultrasound.

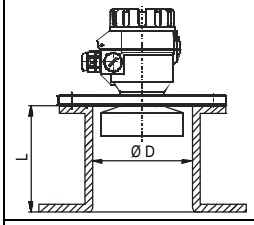
Devices with lower measuring frequency (40, 20 kHz) are recommended.

STAND-OFF PIPE

The structure of the stand off pipe should be rigid, the inner rim where the ultrasonic beam leaves the pipe should be rounded.

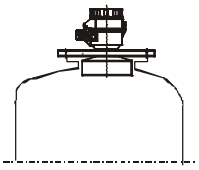


L	D_{min}		
	S_ _ -39_	S_ _ -38_	S_ _ -37_
150	50	60	60
200	50	60	75
250	65	65	90
300	80	75	105
350	95	85	120

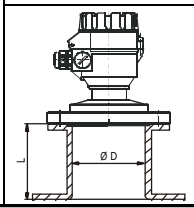


L	D_{min}	
	S_ _ -36_	S_ _ -34_
90	80	*
200	80	*
350	85	*
500	90	*

* For values consult your distributor



Models of S-32 with plastic transducer must not be installed in standoff pipes since its transducer face has to protrude into the tank.



L	D_{min}		
	S_S-36_	S_S-34_	S_S-32_
320	80	-	-
440	-	125	-
800	-	-	150

4.2 Open Channel Flow Measurement

- For ultimate accuracy, install the sensor as close as possible above the expected maximum water level (see minimum measuring range).
- Install the device upstream in a place defined by the characteristics of overflow and metering channel along the longitudinal axis of the flume or weir. In case of Parshall flumes supplied by HITECH the location of the sensor is marked.
- From the point of view of measurement accuracy the length of the channel sections preceding and following the measuring flume and their method of joining to the measuring channel section are of critical importance.
- Despite of the most careful installation, the accuracy of flow metering will be lower than that of specified for distance measurement. It will be determined by the features of the flume or weir applied.

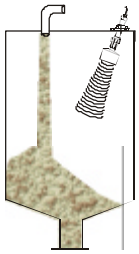
4.3 Free Flowing Solids Level Measurement

POSITION

The optimal position of the EchoTREK is between 1/2 radius and 2/3 diameter of the (cylindrical) tank / silo. (Take also sonic cone on page 1 into consideration.)

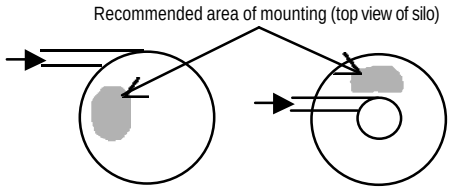
MATERIAL INFLOW

Install the device as far away from the filling point(s) as possible.



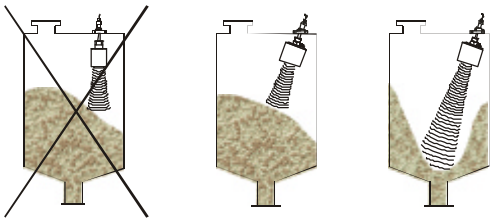
PNEUMATIC FILLING

Mount the sensor at a place where the speed of the filled-in material reaches its lowest value.



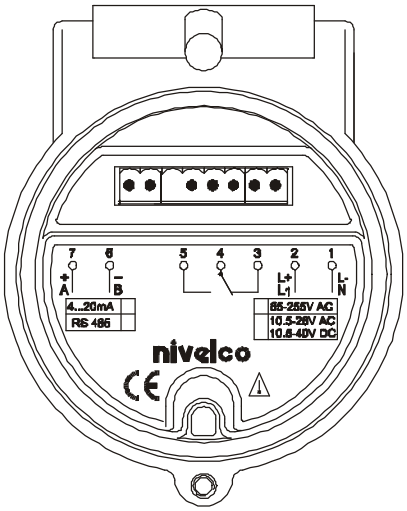
AIMING

To avoid problems caused by surface unevenness, in most cases aiming (tilting) of the device is required, which can easily be carried out with the SAA-102 Aiming Device of HITECH. Aiming is best carried out, when the tank/silo is almost empty. In most cases, the sensor should be aimed towards the silo outlet. On applications where repose is not present or typically in tall and narrow silos (diameter : height = 1 : 5 or narrower, e.g. ∅3x18 m) aiming is not critical: the sensor should face straight downwards.



4.4 Electrical Connection

- Screw out the hexagonal countersunk screw at the side of the model. Lift the tilt cover to access the screw terminal.
- There is a basic requirement for separating the 4...20 mA signal cable and 230 V AC supply (or output relay) cable by shielding.
- For grounding the unit, either use the grounding screw terminal on the outside of the housing; or use a three wire mains cable, connecting the third wire to the internal grounding screw terminal.
- Three-wire installation is also possible for the 24 V DC versions by connecting the terminals 1 and 6. In this case the galvanic isolation is not provided.
- The unit may be damaged by electrostatic discharge (EDS), via terminal, thus apply the precautions commonly used to avoid electrostatic discharge.



5. PROGRAMMING

The EchoTREK will be delivered with the following Factory Default:

⇒ Current output, display and bargraph: LEVEL
⇒ 4 mA: assigned to the minimum level 0%
⇒ 20 mA: assigned to the maximum level 100%
⇒ Error indication by the current output: hold last value
⇒ Damping: 60 sec for liquids, 300 sec for solids

The device can be programmed in two ways:

- **Touch-Magnet Programming** by the supplied magnetic screwdriver (with level transmitters for liquids only), see 5.1.
  Assignment of the levels to the 4 and 20 mA current output, relay switch differential (both with an accuracy of ± 20 mm) error indication by the analogue signal and damping can be set.
- With the **SAP-100 programming module**, see 5.2.
  All features of the device can be set, such as measurement configuration and optimization, relay programming, 32-point linearization, dimensions
  for 6 tanks with different shape and for 21 different open channels (flume or weir) etc.

Devices with the type number **EchoTREK SB...** are already equipped with the SAP-100.

The EchoTREK is fully operational without the SAP-100. The SAP-100 is only needed for programming and/or displaying measurement values.

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.

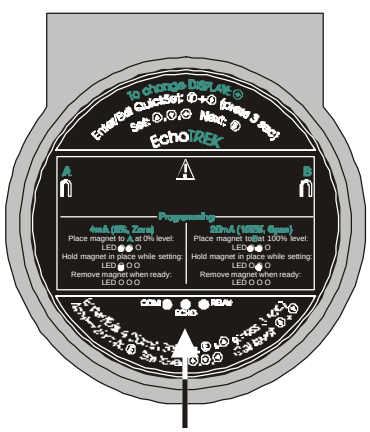
5.1 Touch-Magnet Programming (only for level transmitters for liquids)

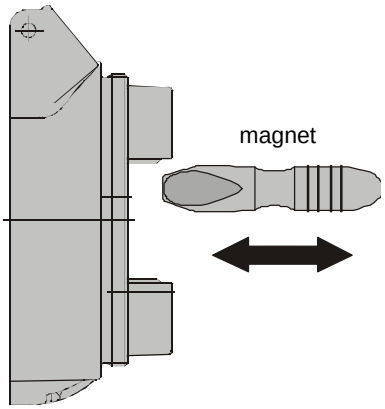
The following can be programmed: with the supplied magnetic screwdriver:

- Assignment of the 4 mA analogue output to a required e.g. min. level / max. distance
- Assignment of the 20 mA analogue output to a required e.g. max. level / min. distance
- Error indication by the current output (Hold, 3.6 mA, 22 mA) see Chapter 6.2.(P12)
- Relay switching different
- Damping (10, 30 and 60 sec)
- Reset to the factory default

Note: Current output can also be assigned in inverted mode: 4 mA= 100% (Full), 20 mA= 0% (Empty)

Programming is only possible if the EchoTREK receives valid echo i.e.***"ECHO" LED is lit !***
and transmitter is in LEV measuring mode (factory default).
The accuracy of the setting with this programming method is limited to ± 20 mm. Thus the relay switching difference between "On" and "OFF" must be greater than 20 mm.

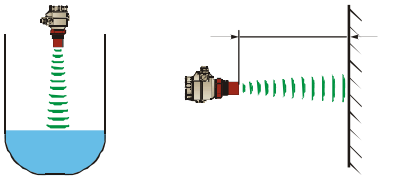




For programming: put magnetic screwdriver in accordance with the drawing to place A or B and check the LEDs for their status:
●= LED is on, ◐= LED is blinking, ○= LED is off, ◐◑ = LEDs are blinking alternatively
Make sure that after programming completed all other magnetic influences will be avoided.

Minimum level, 0%, empty tank (assignment to 4 mA,)
Place the EchoTREK at a distance to the target corresponding to the required maximum distance/minimum level.

Action	LED indication
1) Check valid echo	○●○ = Valid echo received, transmitter programmable
2) Place magnet to the symbol "**A**" and	●●○ = Transmitter in programming mode
3) Hold magnet in place	●○○ = Distance assigned to 4 mA
4) Remove magnet when all LEDs are off	○○○ = Programming completed

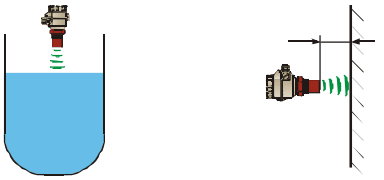


Use level in tank or a fix target e.g. the wall

Maximum level 100%, full tank (assignment to 20 mA)

Place the EchoTREK in a distance to the target corresponding to the required minimum distance/ maximum level.

Action	LED indication
1) Check valid echo	○●○ = Valid echo received, transmitter programmable
2) Place magnet to the symbol "**B**" and	●●○ = Transmitter in programming mode
3) Hold magnet in place	○●○ = Distance assigned to 20 mA
4) Remove magnet when all LEDs are off	○○○= Programming completed

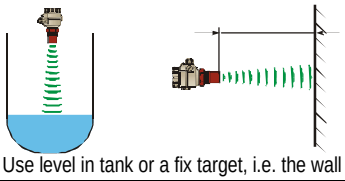


Use level in tank or a fix target e.g. the wall

Programming relay switch-on point (the level where relay becomes energized)

Place the EchoTREK at a distance to the target corresponding to the required switch-on point. (Do not forget to check valid Echo!)

Action	LED indication
1) Place magnet to symbol "**A**""	●●○ =Programming mode
2) Place magnet to symbol "**B**" and	○◐○ =Programming in progress
3) Hold magnet to symbol "**B**"	◐●○ =Programming in Progress
4) Place magnet to symbol "**A**"	●○○ =Programming in Progress
5) Remove magnet when all LEDs are off	○○○ =End of Programming

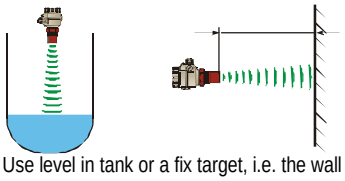


Use level in tank or a fix target, i.e. the wall

Programming relay switch-off point (the level where relay becomes de-energized)

Place the EchoTREK at a distance to the target corresponding to the required switch-off point. (Do not forget to check valid Echo!)

Action	LED indication
1) Place magnet to symbol "**A**"	●●○ =Programming mode
2) Place magnet to symbol "**B**" and	○◐○ =Programming in progress
3) Hold magnet to symbol "**B**"	◐●○ =Programming in progress
4) Keep holding magnet to symbol "**B**"	○●○ =Programming in progress
5) Remove magnet when all LEDs are off	○○○ =End of Programming



Use level in tank or a fix target, i.e. the wall

Please note that the smallest switch-differential achievable with magnet programming is 20 mm.

"Error indication" by the current output (Check valid echo as above)

Action	LED indication
1) Place magnet to the symbol "**A**"	●●○ = Transmitter in programming mode
2) Place magnet to the symbol "**B**" repeatedly to select the required error indication mode	◐○○ = Hold last value ○◐○ = 3.6 mA ◐◐○ = 22 mA
3) Place magnet to the symbol "**A**"	○○○ = Programming completed

"Damping" (Check valid echo as above)

Action	LED indication
1) Place magnet to the symbol "**B**"	●●○ = Transmitter in programming mode
2) Place magnet to the symbol "**A**" repeatedly to select the required damping	◐○○ = 10 sec ○◐○ = 30 sec ◐◐○ = 60 sec
3) Place magnet to the symbol "**B**"	○○○ = Programming completed

Reset (to factory default)

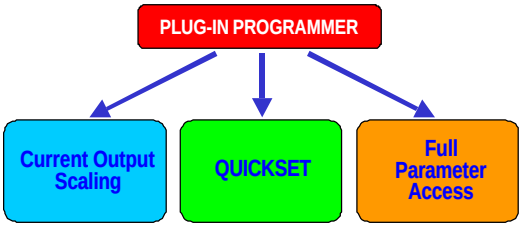
Action	LED indication
1) Place magnet to the symbol "**B**"	●●○ = Programming mode
2) Place magnet to the symbol "**A** and	◐○○ = Reset in progress
3) Hold magnet to the symbol "**A**"	◐◐○ = Reset in progress
4) Remove magnet when all LEDs are off	○○○ = End of programming

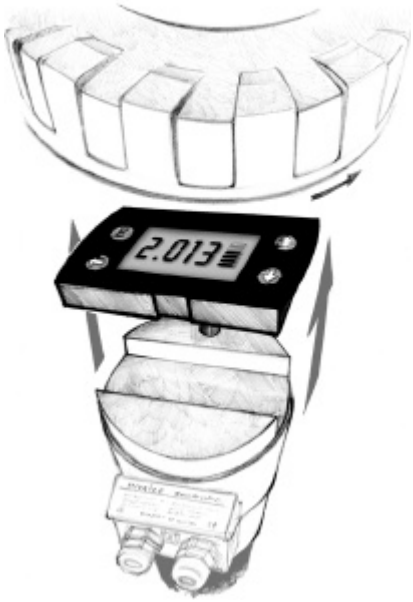
Error indications during programming (by LEDs)

Action	LED status = error indicated	Correction
1) Attempted programming	◐◐○= blinking twice = No Echo	Find valid echo
2) Attempted programming	◐◐○ = blinking three times = access denied (access code active)	With use of SAP-100 see Chapter 5.2 (P99)
3) Attempted programming	◐◐○= blinking four times = EchoTREK not in LEV meas. mode	With use of SAP-100 see Chapter 5.2 (P01)
4) Programming of the relay	◐◑○=blinking alternately = switch-differential too small	Set switch-differential greater than 20 mm

5.2 Programming of the EchoTREK by the SAP-100 Programming Module

The SAP-100 supports 3 separately accessible programming modes representing 3-layers of programming complexity, depending on user choice.





Current Output Scaling (5.2.4)

Recommended as a simple and fast way to modify the scaling of the current output.

QUICKSET (5.2.5)

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
- Assignment of min level to 4mA
- Assignment of max level to 20mA
- Error indication by the current output
- Damping time
- Assignment of level to energizing of the relay
- Assignment of level to de-energizing of the relay

Full Parameter Access (5.2.6)

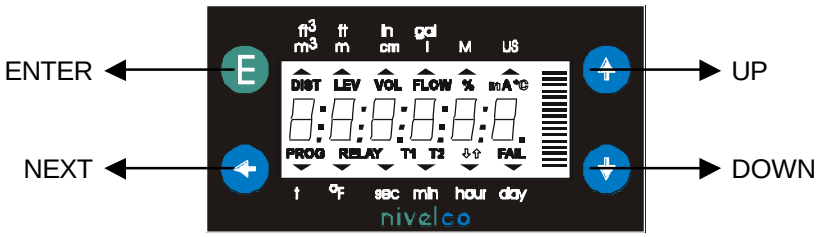
All features of the EchoTREK can be accessed by parameter addresses:
Example:

- Measurement configuration
- Outputs
- Measurement optimization
- 6 pre-programmed tank shapes for volume calculation
- 32-point linearization table
- Open channel flow metering functions

5.2.1 The SAP-100 Programming Module

The plug in programming and display module is used for programming but also for display even in case of Touch-Magnetic Programming

The Display and keys



Symbols used on the LCD:

- **DIST** – Distance (measuring) mode
- **LEV** – Level (measuring) mode
- **VOL** – Volume (measuring) mode
- **FLOW** – Open channel (flow metering) mode
- **PROG** - Programming mode (device under programming)
- **RELAY** – Relay
- **T1** - TOT1 volume flow totalizer (resetable aggregate)
- **T2** - TOT2 volume flow totalizer (aggregate)
- **FAIL** - Measurement / device error
- ⇑⇓- Level changing direction
- Bargraph assigned to the current output or echo strength

Symbols used on the frame:

- **M** – Metric system
- **US** – US calculation system

5.2.2 Programming with the SAP-100 Programming Module

Programming will be performed by pressing one or two keys (simultaneously).

Single key pressing

Ⓔ Press key ENTER - to save parameter address and go to parameter value
to return from parameter value to parameter address

◀ Press NEXT to move the blinking of the digit to the left

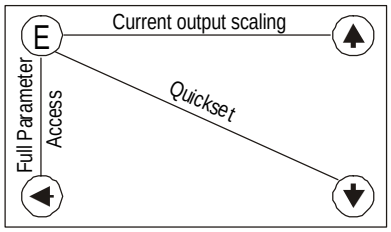
▲ Press UP to increase value of the blinking digit

▼ Press DOWN to decrease value of the blinking digit

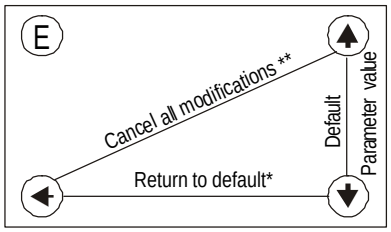
Double key pressing
(Short overview, for details see in 5.2.4, 5.2.5 and 5.2.6)

Press the two keys simultaneously for desired programming step.

Enter into or quit programming modes is blinking

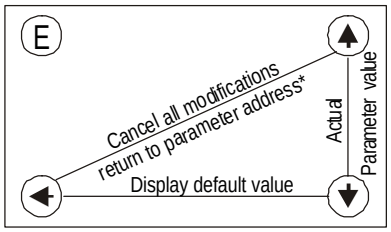


Basic steps while parameter address is blinking



* LOAD will be displayed
** CANCEL will be displayed

Basic steps while parameter value



* cancellation immediately active

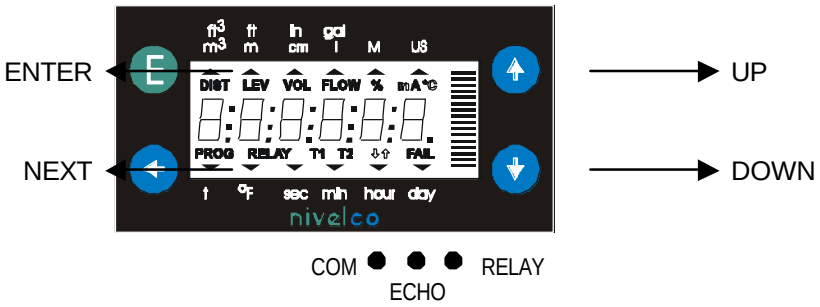
Notes:
If the parameter value is not accessible i.e. the parameter address keeps blinking after pressing ENTER Ⓔ,

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

If the modification of the parameter value is not accepted i.e. the parameter value keeps blinking after pressing ENTER Ⓔ,

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

5.2.3 Indications of the SAP-100 Programming Module and the LEDs



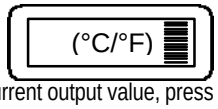
Field indication

Depending on the measuring mode (see P01 in Chapter 5.2.3) the following values can be displayed (relevant symbol is lit):

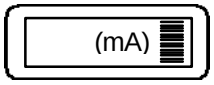
- *Distance*
- *Level*
- *Volume*
- *Flow*
- *TOT1 and TOT2*
- *Error code* (if "FAIL" is blinking)

To scroll through the displays above press NEXT ⓔ repeatedly.

To display transducer temperature, press UP ⓐ:



To display current output value, press DOWN ⓓ:



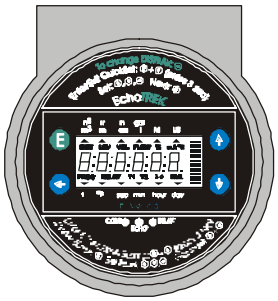
LED indication

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

RELAY - LED
LED is lit when relay is energized

COM - LED
LED is lit during communication
(Remote control)

5.2.4 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 (5.2.2). or the Full Parameter Access (5.2.3).
Current Output Scaling mode is useful for re-scaling i.e. for modifying of the minimum and maximum level assigned to the output signals 4 and 20 mA, if other than the factory default. Current Output Scaling is aided by 2 screens for setting.
The instructions for this programming can also be found below the screw cover on the front panel of the EchoTREK.
Note: For this programming the EchoTREK has to be in level measurement mode. See chapter 6.1 (P01).

Keys	Function
ENTER Ⓔ + UP ⓐ (press for 3 seconds)	Enter or exit Current Output Scaling programming mode
UP ⓐ / DOWN ⓓ	Increase/decrease blinking digit or scroll up/down
NEXT ⓔ	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 without saving the modifications
NEXT ⓔ + DOWN ⓓ	Display Factory Default of the relevant screen

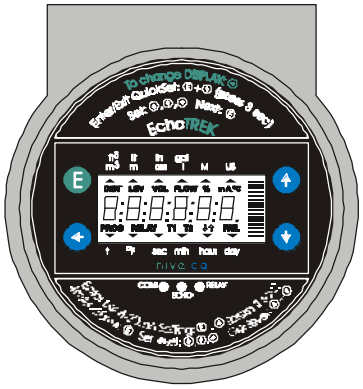
Screens	Actions
4:xxxx 4 represents the output signal x = level value to be assigned	**4** mA **xxxx**:– level value assigned to 4 mA current output Manual: set required value *(by UP ⊕ / DOWN ⊖ /* NEXT *⊲ keys)* and save it *(by the key* ENTER Ⓔ*)* Automatic: use the "GET LEVEL" function *(UP ⊕ + DOWN ⊖)* to obtain actual measured value with level in tank or a fix target, e.g. wall. ("GET LEVEL" functions only if ECHO LED is lit) and save it as above. DEFAULT: 0 m (0%, Empty tank)
20:xxxx 20 represents the output signal x = level value to be assigned	**20** mA **xxxx**: – Level value assigned to 20 mA current output Manual: set required value *(by UP ⊕ / DOWN ⊖ /* NEXT *⊲ keys)* and save it *(by the key* ENTER Ⓔ*)* Automatic: use the "GET LEVEL" function *(UP ⊕ + DOWN ⊖)* to obtain actual measured value with level in tank or a fix target, e.g. wall. ("GET LEVEL" functions only if ECHO LED is lit) and save it as above. DEFAULT: max. level = max. measuring distance - dead band (100%, Full tank) See chapter 5.1 (P04, P05)

5.2.5 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 uncomplicated level metering, recommended for liquids only.

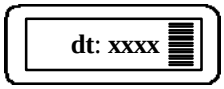
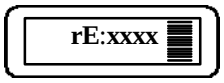
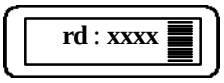
The instructions of this programming mode are also to be found, below the screw cover, on the front panel of the EchoTREK.



The DEFAULT of the Current output, Display and Bargraph is LEVEL.
This can be modified only in the Full Parameter Access mode see 5.1 (P01).

Keys	Function
ENTER Ⓔ + DOWN ⊖ (press for 3 seconds)	Enter or exit QUICKSET programming mode
UP ⊕ / DOWN ⊖	Increase/decrease blinking digit or scroll up/down
NEXT ⊲	Move left with the blinking digit
UP ⊕ + DOWN ⊖	"GET LEVEL" - display actual level measured by EchoTREK
ENTER Ⓔ	Save value on the screen and move to the next screen
NEXT ⊲ + UP ⊕	Quit QUICKSET programming mode without saving the modifications
NEXT ⊲ + DOWN ⊖	Display Factory Default of the relevant screen

Screens	Actions
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: EU
H:xxxx	**H** = **xxxx** ***maximum measuring distance*** – Distance between transducer face and tank/silo bottom Manual: set value *(Use UP ⊕ / DOWN ⊖ /* NEXT *⊲ keys)* and save it *(by* ENTER Ⓔ*)* Automatic: use the "GET LEVEL" function *(UP ⊕ + DOWN ⊖)* to obtain actual measured value with level in tank or a fix target, i.e. wall. ("GET LEVEL" functions only if ECHO LED is lit) and save it as above. DEFAULT: maximum measuring distance [m], see Technical Data Table
4:xxxx	**4** mA **xxxx** – ***level value*** assigned to 4 mA current output Manual: set level value *(by UP ⊕ / DOWN ⊖ /* NEXT *⊲ keys)* and save it *(by ENTER Ⓔ)* Automatic: use the "GET LEVEL" function *(UP ⊕ + DOWN ⊖)* to display the actual measured value with level in tank or a fix target, i.e. wall. ("GET LEVEL" functions only if ECHO LED is lit) and save it as above. DEFAULT: 0 m (0%, Empty tank)
20:xxxx	**20** mA **xxxx** – ***level value*** assigned to 20 mA current output Manual: set level value *(Use UP ⊕ / DOWN ⊖ /* NEXT *⊲ keys)* and save it (by *ENTER Ⓔ)* Automatic: use the "GET LEVEL" function *(UP ⊕ + DOWN ⊖)* to obtain actual measured value with level in tank or a fix target, i.e. wall. ("GET LEVEL" functions only if ECHO LED is lit) and save it as above. DEFAULT: max. level = max. measuring distance – dead band [m] (100%, Full tank) (See Technical Data Table)
Er:xxxx	***Error indication by the current output*** – select "Hold", "3.6" mA or "22" mA *(by UP ⊕ / DOWN ⊖ key)* and save it as above. DEFAULT: hold last value

	**d*amping time*:** select required damping time *(by UP ⊕ / DOWN ⊖ key)* and save it as above. DEFAULT: 60 sec for liquids, 300 sec for solids
	**r*elay* E*nergized* xxxx**: ***level*** of the relay energized state If the value exceeds this programmed value the relay will be energized
	**r*elay* de-*energized* xxxx**: ***level*** of the relay de-energized state If the value sinks below this programmed value the relay will be de-energized

Note: Current output can also be programmed for inverted operation: 4 mA= 100% (Full), 20 mA= 0% (Empty)

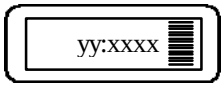
5.2.6 Full Parameter Access

To access all features provided by the EchoTREK.

Description of all parameters can be found under the chapter "Parameter" (Chapter 6.).

Keys	Function
ENTER Ⓔ + NEXT ⊖ (press for 3 seconds)	Enter or exit Full Parameter Access programming mode.

In this programming mode, the display will indicate:



by is the Parameter Address
xxxx is the Parameter Value

Note: 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.

Steps and indications of the Full Parameter Access programming mode

pressing **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 ⊕	Cancel all modifications of the actual programming phase. Pressing for 3 secs is required while 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 - Exception: clearing TOT 1 (See at P77)	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	

6. PARAMETERS – DESCRIPTIONS AND PROGRAMMING

6.1 Measurement Configuration

P00: - cba Application/Engineering Units

Programming of this parameter will result in loading the factory default with the corresponding engineering units.

a	Operating (measurement) mode	Display indication
0	Liquid level measurement	"Li"
1	Free flowing solids level measurement	"So"

b	Engineering units (according to "c")	
	Metric	ft
0	m	inch
1	cm	inch

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

c	Calculation system
0	Metric
1	US

FACTORY DEFAULT: 000

P01: - ba Measurement Mode

Display, current output and the switching points of the relays will be interpreted in the engineering units of the (measured or calculated) process value corresponding to the programmed measurement mode. On the other hand the higher the "a" of the programmed parameter value the more (measured or calculated) process values can be displayed on the screen. (e.g. if P01=b0 only the Distance, if P01=b5 the Distance the Level, the Volume and the Flow can be displayed. Exception if P01=b2 or b4.)

a	Measurement Mode	Display symbol
0	Distance	**DIST**
1	Level	**LEV**
2	Level in percentage	**LEV%**
3	Volume	**VOL**
4	Volume in percentage	**VOL%**
5	Flow	**FLOW**

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

FACTORY DEFAULT: 11

P02: - cba 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 by **P00(c)**, **P01(a)** and **P02(c)** and is irrelevant in case of percentage measurement (**P01(a)= 2** or **4**)

b	Volume		Weight (set also P32)		Volume flow	
	Metric	US	Metric	US	Metric	US
0	m^3	ft^3	-	lb (pound)	m^3/time	ft^3/time
1	liter	gallons	tons	tons	liter/time	gallons/time

c	Time
0	Sec
1	Min
2	Hour
3	Day

FACTORY DEFAULT: 000

P03: - - - a Values Displayed-Rounding

It is important to keep in mind that the instrument is measuring distance as basic quantity.

Measured distance	Resolution
X_{min} – 2m	1mm
2m – 5m	2mm
5m – 10m	5mm
over 10m	10mm

The resolution depending on the distance can be considered as a kind of rounding that will be contained in all further value (of level, volume or volume flow) calculated. Therefore if programmed for DIST or LEV measurement the setting of P03 is irrelevant.

Displayed VOL or FLOW

Displayed value	Displayed form
0.000 – 9.999	x.xxx
10.000 – 99.999	xx.xx
100.000 – 999.999	xxxx.
1000.000 – 9999.999	xxxxx.
100000.000 – 99999.999	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.

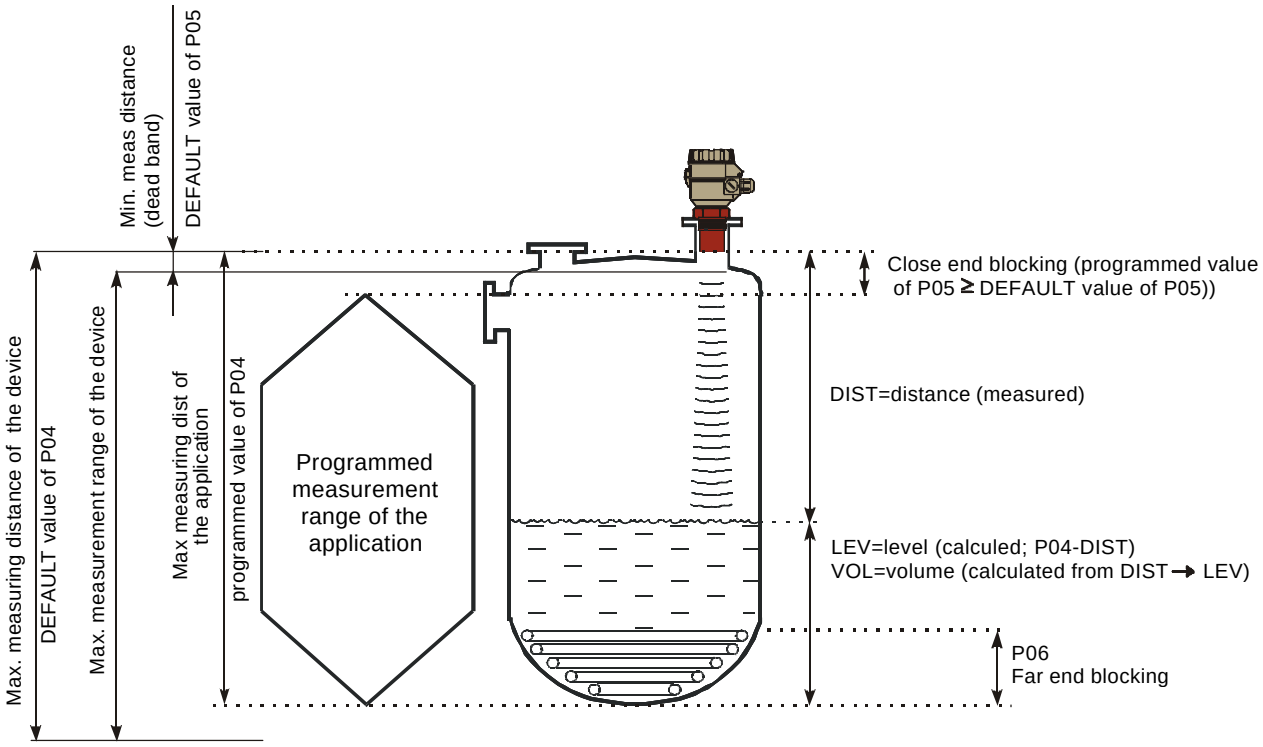
Rounding

Parameter value "a"	Steps in the displayed value
0	1 no rounding
1	2
2	5
3	10
4	20
5	50

A couple of millimeters 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).

Examples:
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: 0



Basic conception and elements of the ultrasonic measurement

P04: Maximum measuring distance

The maximum measuring distance 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 ⊛.

EchoTREK Level transmitters for liquids	Maximum measuring distance		
	PP or PVDF (m/ft)	PTFE (m/ft)	Stainless Steel (m/ft)
S-39	4 / 13	3 / 10	-
S-38	6 / 20	5 / 16	-
S-37	8 / 26	6 / 20	-
S-36	10 / 33	-	7 / 23
S-34	15 / 49	-	12 / 39
S-32	25 / 82	-	15 / 49

Keep in mind that

LEVEL (as the result of the measurement) **= P04** (programmed) **– DISTANCE** (measured by the device)

Since the accuracy of level (and all further calculated) value depends on the accuracy of the max measuring distance of the application which is the distance between the sensor face and the tank / silo bottom.
To obtain the best accuracy for a liquid level measurement, 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. Enter the actual measured value displayed as P04.

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

P05: Minimum measuring distance (Close-end blocking)

The EchoTREK will not accept any echo within the blocking distance set here.

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.

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 liquids	Factory default of the minimum measuring distance (dead band)		
	with PP or PVDF transducers (m/ft)	with PTFE transducers (m/ft)	with stainless Steel trends (m/ft)
S-39	0,2 / 0,65	0,2 / 0,65	-
S-38	0,25 / 0,82	0,25 / 0,82	-
S-37	0,35 / 1,2	0,35 / 1,2	-
S-36	0,35 / 1,2	-	0,4 / 1,3
S-34	0,45 / 1,5	-	0,55 / 1,8
S-32	0,6 / 2	-	0,65 / 2,2

FACTORY DEFAULT: automatic dead band control

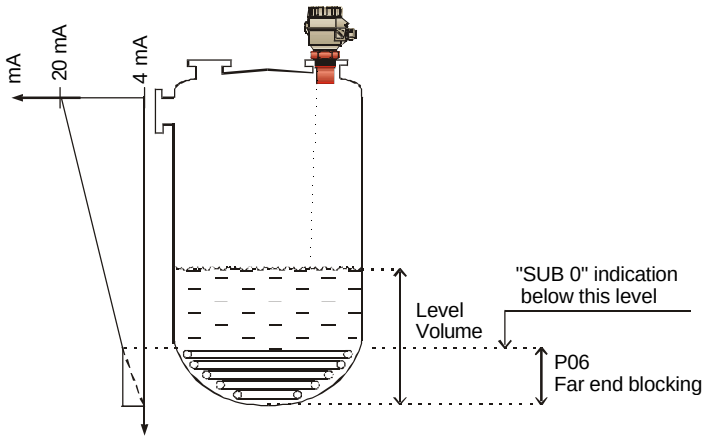
P06: Far-end blocking

A). Level measurement

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
- Distance value is not interpretable
- Current output will hold 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.

B). Open channel flow metering

Far end blocking will be used to neglect incorrect volume flow readings and output actions below a pre-set level, where accurate volume flow calculation is not possible any more.

If the liquid level in the flume/weir falls below the blocked out range:

The EchoTREK will act as follows:
- Indicate "**No Flow**" on the Display
- Hold last valid data on the current output.

If the level in the flume/weir is above the blocked out range:

The calculation of volume flow will be based on the programmed flume/weir data, therefore the measurement values will not be influenced in any way, by the far end blocking value.

FACTORY DEFAULT: 0

6.2 Current Output

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

P11: Value (of distance, level, volume or flow) 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.

FACTORY DEFAULT:
P10 0 level (max distance)
P11 max level (min distance)

P12: - - - a Error indication by the current output

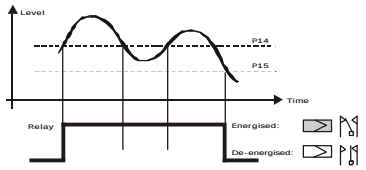
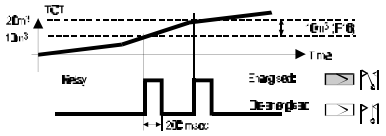
In case of error the EchoTREK will provide one of the current outputs below. (For errors and their indications see Chapter 7).

a	Error indication (according to NAMUR)
0	Hold last value
1	3.6 mA
2	22 mA

FACTORY DEFAULT: 0

6.3 Relay Output

P13: - - - a Relay function

a	Relay function		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 descends under the value set in P15		P14, P15 There is a need to set (in level min 20mm) hysteresis between P14 and P15
1	Relay is energized in case of Echo Loss		-
2	Relay is de-energized in case of Echo Loss		-
3	COUNTER Used for open channel flow metering. A 140 msec pulse is generated every 1, 10, 100, 1.000 or 10.000 m^3 according to P16.		P16= 0: 1m^3 P16= 1: 10 m^3 P16= 2: 100 m^3 P16= 3: 1.000 m^3 P16= 4: 10.000 m^3

FACTORY DEFAULT: 2

P14: ... Relay parameter – Setpoint value **FACTORY DEFAULT: 0**

P15: ... Relay parameter – Setpoint value **FACTORY DEFAULT: 0**

P16: ... Relay parameter – Pulse rate **FACTORY DEFAULT: 0**

6.4 Measurement Optimization

P20: - - - a Damping

Use this parameter to reduce unwanted fluctuation of the display and output.

a	Damping time (seconds)	LIQUIDS		FREE FLOWING SOLIDS	
		None/moderate fume or waves	Heavy/dense fume or turbulent waves	Granules >2-3 mm	Powders < 2-3 mm
0	no filter	Recommended for testing only			
1	3	applicable	not recommended	not applicable	not applicable
2	6	recommended	applicable	not applicable	not applicable
3	10	recommended	recommended	not applicable	not applicable
4	30	recommended	recommended	not applicable	not applicable
5	60	recommended	recommended	applicable	applicable
6	100	applicable	applicable	recommended	recommended
7	300	applicable	applicable	recommended	recommended
8	600	not applicable	not applicable	recommended	recommended
9	1000	not applicable	not applicable	applicable	applicable

FACTORY DEFAULT: for Liquids: 60 sec, for Solids: 300 sec

P22: - - - a Dome top tank compensation

To reduce disturbing effect of possible multiple echoes.

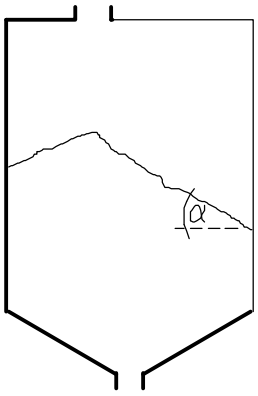
a	Compensation	Applied
0	OFF	In case the EchoTREK is mounted not in the center of the top and the top is flat.
1	ON	In case the EchoTREK is mounted in the center of a tank with dome-shaped top

FACTORY DEFAULT: 0

P23: - - - a Angle of repose (repose formation) only for free flowing solids applications

This parameter provides information for the QUEST+ software for optimizing the echo-search pattern.

a	Estimated angle of repose
0	No angle of repose (default)
1	Below 15° (α)
2	Over 15° (α)



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** for **a= 1**, confirm it with **[E]** and switch to Measurement Mode then return to Programming Mode.

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

3). Perform the above with the **P23 = 2** setting.

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

FACTORY DEFAULT: 0

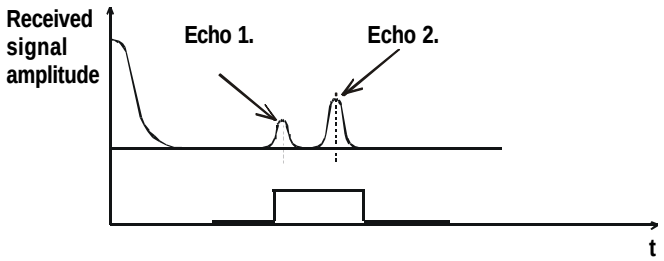
P24: - - - a Target tracking speed

a	Tracking speed	Remark
0	Standard	For most applications
1	Fast	For fast changing level
2	Special	Only for special applications (measuring range is reduced to 50% of the nominal value) The measuring window is inactive and the EchoTREK will respond practically instantly to any target. Recommended to fast target tracking, but usually not applicable for level metering.

FACTORY DEFAULT: 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	Remark
0	With the highest amplitude	For most applications (both with liquids and solids)
1	First one	For liquids applications with multiple echoes within the Measuring Window
2	Largest one	Recommended for certain free flowing solids applications

FACTORY DEFAULT: 0

P26: (m/h) Level elevation rate (filling speed) Very heavy fuming

P27: (m/h) Level descent rate (emptying speed) Very heavy fuming

Use these parameters to provide additional protection against echo loss in applications involving dust during the filling process (powders, dusting granules) or in case of very heavy fuming.

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

For all other applications, use the factory default setting.

FACTORY DEFAULT: for Liquids (**P00: Li**) P27=2000 for Solids (**P00: So**) P27=500

P28 - - - a Echo-loss handling

a	Echo-loss error indication	Remark
0	Delayed	During echo-loss, display and analogue output will hold last value. If the echo-loss prevails for 10 sec plus the time period set in **P20** (damping time), the reading on the display will change to "no Echo" and the outputs will change according to the "Error Indication Mode" preset in **P12**.
1	None	For the time of echo-loss, display and analogue output will hold last value.
2	Advance to full	During echo-loss in case of filling, the reading on the display and analogue output will shift towards the "full" tank/silo state with a level elevation rate (filling speed) preset in **P26**
3	Immediate	In case of echo-loss, the display will immediately change to "no Echo" and the outputs will change according to the "Error Indication Mode" preset 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: 0

P29 Blocking out of object #1

P30 Blocking out of object #2

Up to two fix objects in the tank/silo that disturb the measurement can be blocked out.

Enter the 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 of 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".

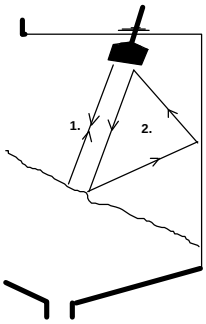
FACTORY DEFAULT: Metric (**P00: "EU"**): 343.8 m/s, US (**P00: "US"**): 1128 ft/s

P32: Specific gravity

If you enter value (other than "0") of specific gravity in this parameter, the weight will be displayed instead of VOL.
FACTORY DEFAULT: 0 [kg/dm^3] or [lb/ft^3] depending on P00(c)

P33: (m) 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.



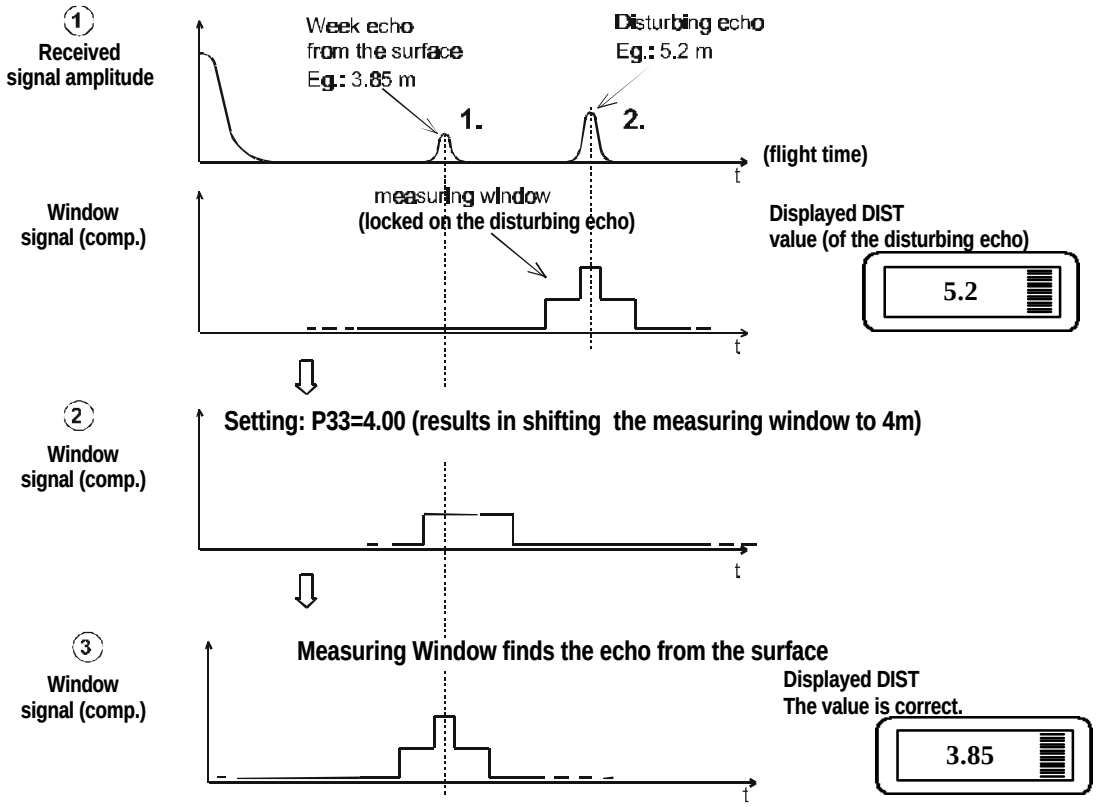
Use this parameter if the EchoTREK unambiguously selects a wrong echo; for example the echo reflected from the surface is much weaker than the interfering one(s) (*see figure beside and on next page*).

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: 0



6.5 Volume Calculation

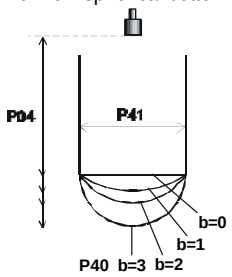
P40: - - ba Tank/silo shape

ba	Tank/silo shape	Also 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

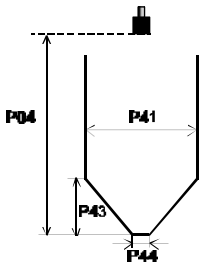
FACTORY DEFAULT: 00

P41-45: Tank/silo dimensions

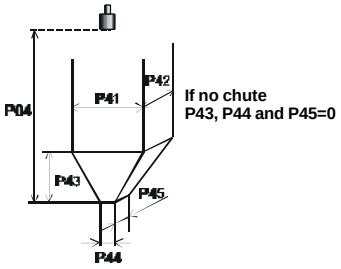
Standing cylindrical tank/silo with hemispherical bottom



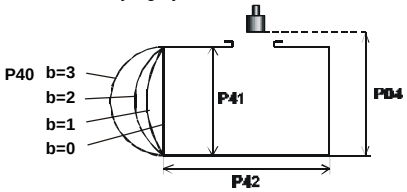
Standing cylindrical tank/silo with conical bottom



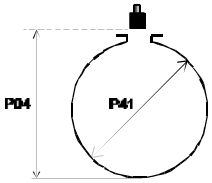
Standing rectangular tank/silo with or without chute



Lying cylindrical tank



Spherical tank



6.6 Volume Flow Measuring

P40: - - ba Appliances, formula, data

ba	Appliances, formula, data						Also to be set:
	Type		Calculation formula	Qmin [l/s]	Qmax [l/s]	"P" [cm]	
00	Parshall flume	GPA-1P1	$Q[l/s]= 60.87*h^{1.552}$	0.26	5.38	30	P46
01		GPA-1P2	$Q[l/s]= 119.7*h^{1.553}$	0.52	13.3	34	P46
02		GPA-1P3	$Q[l/s]= 178.4*h^{1.555}$	0.78	49	39	P46
03		GPA-1P4	$Q[l/s]= 353.9*h^{1.558}$	1.52	164	53	P46
04		GPA-1P5	$Q[l/s]= 521.4*h^{1.558}$	2.25	360	75	P46
05		GPA-1P6	$Q[l/s]= 674.6*h^{1.556}$	2.91	570	120	P46
06		GPA-1P7	$Q[l/s]= 1014.9*h^{1.556}$	4.4	890	130	P46
07		GPA-1P8	$Q[l/s]= 1368*h^{1.5638}$	5.8	1208	135	P46
08		GPA-1P9	$Q[l/s]= 2080.5*h^{1.5689}$	8.7	1850	150	P46
09	General PARSHALL flume						P46, P42
10	PALMER-BOWLUS (D/2)						P46, P41
11	PALMER-BOWLUS (D/3)						P46, P41
12	PALMER-BOWLUS (Rectangular)						P46, P41, P42
13	Khafagi Venturi						P46, P42
14	Bottom-step weir						P46, P42
15	Suppressed rectangular or BAZIN weir						P46, P41, P42
16	Trapezoidal weir						P46, P41, P42
17	Special trapezoidal (4:1) weir						P46, P42
18	V-notch weir						P46, P42
19	THOMSON (90°-notch) weir						P46
20	Circular weir						P46, P41
21	General flow formula: $Q[l/s]= 1000*P41*h^{P42}$, h [m]						P46, P41, P42

P41-45: Flume/weir dimensions

See next pages.

FACTORY DEFAULT: 0

P46: Distance between transducer face and level of Q=0

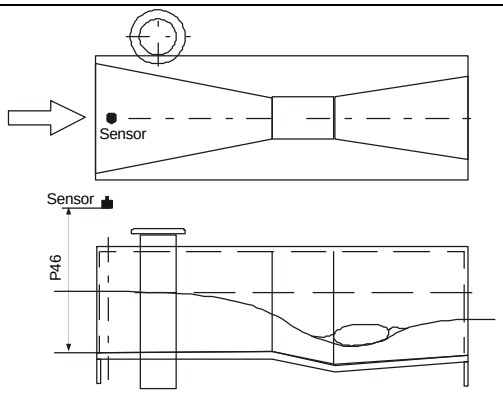
P46 is *always* the distance between the transducer face and the level, where the volume flow is 0.
FACTORY DEFAULT: 0

Flume / Weir Dimensions

P40= 00 : : 08

Parshall flumes (GPA1P1 ... GPA-1P9)

For further details see the Manual of the Parshall flume



P40= 09

General Parshall flume

0.305 < P42(width) <2.44

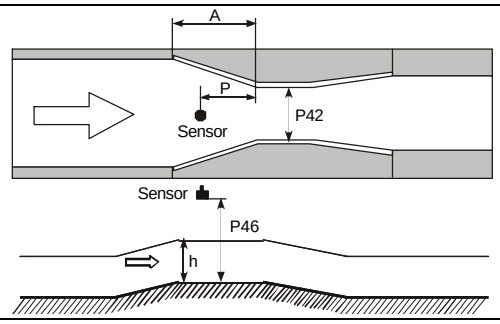
$Q[m^3/s] = 0.372*P42*(h/0.305)^{1.569*s^{0.026}}$

2.5 < P42

$Q[m^3/s] = K*P42*h^{1.6}$

P= 2/3*A

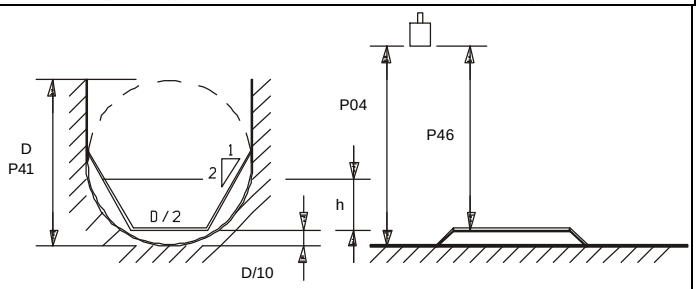
s[m]	K
3.05	2.450
4.57	2.400
6.10	2.370
7.62	2.350
9.14	2.340
15.24	2.320



P40= 10

Palmer-Bowlus (D/2) flume

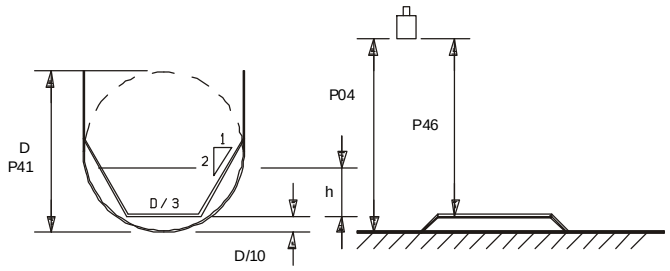
$Q[m^3/s] = f(h1/P41)*P41^{2.5}$,
where h1[m]= h+(P41/10)



P40= 11

Palmer-Bowlus (D/3) flume

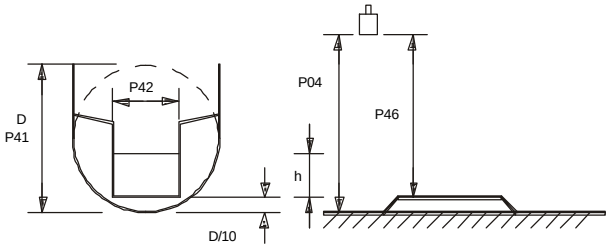
$Q[m^3/s] = f(h1/P41)*P41^{2.5}$,
where h1[m]= h+(P41/10)



P40= 12

Palmer-Bowlus (Rectangular) flume

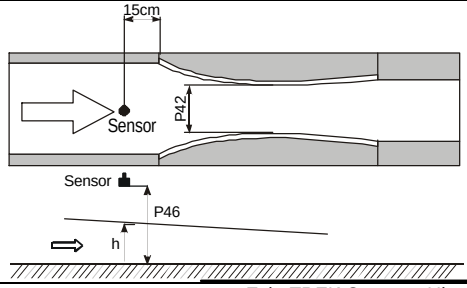
$Q[m^3/s] = C*P42*h^{1.5}$,
where C= f(P41/P42)

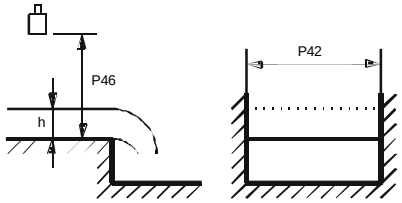
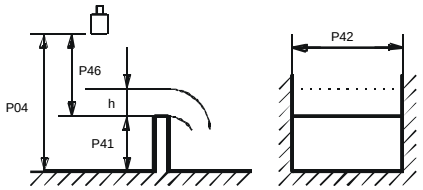
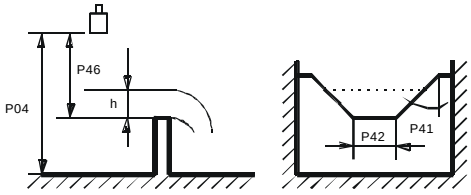
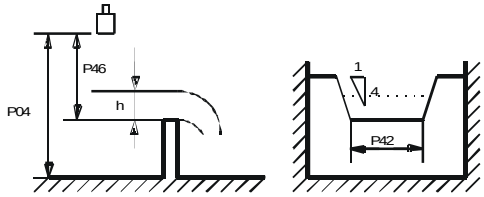
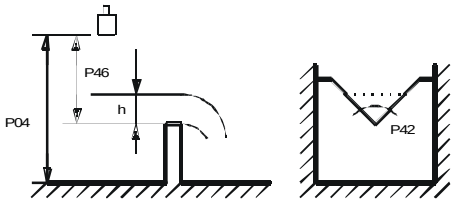
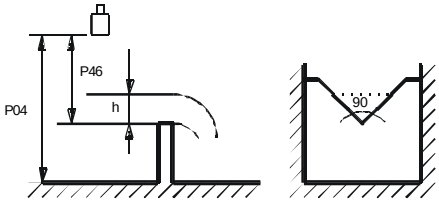
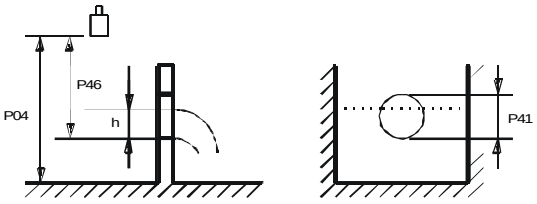


P40= 13

Khafagi Venturi flume

$Q[m^3/s] = P42*1.744*h^{1.5} + 0.091*h^{2.5}$



P40= 14	**Bottom step weir** 0.0005 < Q[m^3/s] < 1 0.3 < P42[m] < 15 0.1 < h[m] < 10 Q[m^3/s]= 5.073*P42*$h^{1.5}$ Accuracy: ±10%	
P40= 15	**Suppressed rectangular or BAZIN weir** 0.001 < Q[m^3/s] < 5 0.15 < P41[m] < 0.8 0.15 < P42[m] < 3 0.015 < h[m] < 0.8 Q[m^3/s]= 1.7599*[1+(0.1534/P41)]*P42*$(h+0.001)^{1.5}$ Accuracy: ±1%	
P40= 16	**Trapezoidal weir** 0.0032 < Q[m^3/s] < 82 20 < P41[°] < 100 0.5 < P42[m] < 15 0.1 < h[m] < 2 Q[m^3/s]= 1.772*P42*$h^{1.5}$+1.320*tg(P41/2)*$h^{2.47}$ Accuracy: ±5%	
P40= 17	**Special Trapezoidal (4:1) weir** 0.0018 < Q[m^3/s] < 50 0.3 < P42[m] < 10 0.1 < h[m] < 2 Q[m^3/s]= 1.866*P42*$h^{1.5}$ Accuracy: ±3%	
P40= 18	**V-notch weir** 0.0002 < Q[m^3/s] < 1 20 < P42[°] < 100 0.05 < h[m] < 1 Q[m^3/s]= 1.320*tg(P42/2)*$h^{2.47}$ Accuracy: ±3%	
P40= 19	**THOMSON (90°-notch) weir** 0.0002 < Q[m^3/s] < 1 0.05 < h[m] < 1 Q[m^3/s]= 1.320*$h^{2.47}$ Accuracy: ±3%	
P40= 20	**Circular weir** 0.0003 < Q[m^3/s] < 25 0.02 < h[m] < 2 Q[m^3/s]= m*b*$D^{2.5}$ m= 0.555+0.418h/P41+(P41/(0.11*h)) Accuracy: ±5%	

6.7 32-Point Linearization Curve

P47: - - - a Linearization

a	Linearization
0	OFF (FACTORY DEFAULT)
1	ON

P48: Linearization table

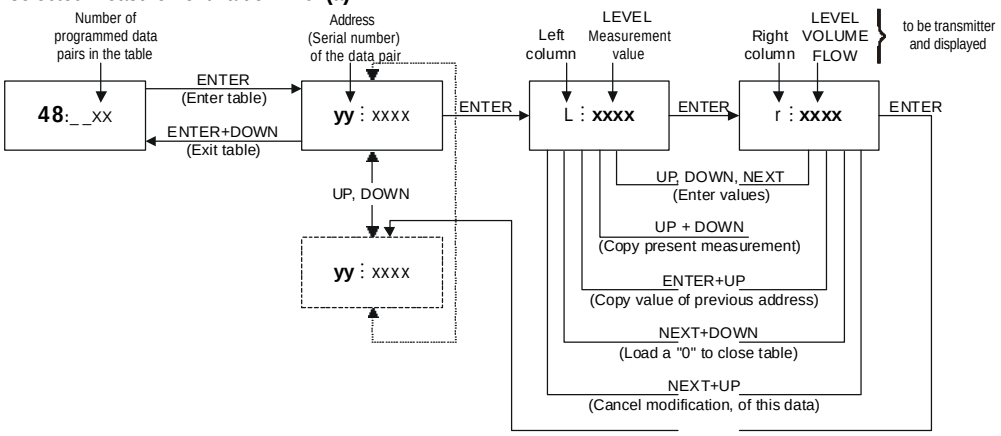
Linearization is the method of assigning requested (calibrated or calculated) level, volume or flow to values measured by the transmitter.

It can be used for instance if the sound velocity is not known (LEVEL⇒LEVEL) or in the case of vertical cylindrical tank (LEVEL ⇒ VOLUME) etc.

Data-pairs of the linearization table are handled in a 2x32 matrix, consisting of two columns.

Left column "**L**"	Right column "**r**"
LEVEL measured	LEVEL or VOLUME or FLOW to be transmitted and displayed

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



Conditions of correct programming of the data pairs

Left column "**L**"	Right column "**r**"
L(1)= 0	**r**(1)
L(i)	**r**(i)
:	:
L(j)	**r**(j)

The table must always start with: L(1)= 0 and r(1)= value (assigned to 0 level)

The table must be ended either with the 32. data pair i.e. j=32

Or 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.

The EchoTREK will ignore data after recognizing level value "0" with serial number other than "1".

If the above conditions are not met, error codes will be displayed (see chapter: Error Codes).

6.8 Informational Parameters

P60: (h) Overall operating hours of the unit

Indication varies according to the elapsed time:

Operating hours	Indication form
0 to 999.9h	xxx,x
1000 to 9999h	xxxx
Over 9999h	X,xx: e meaning x,xx 10^e

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

Indication same as in **P60**.

P64: (°C/°F) Actual temperature of the transducer
P65: (°C/°F) Maximum temperature of the transducer
P66: (°C/°F) Minimum temperature of the transducer

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

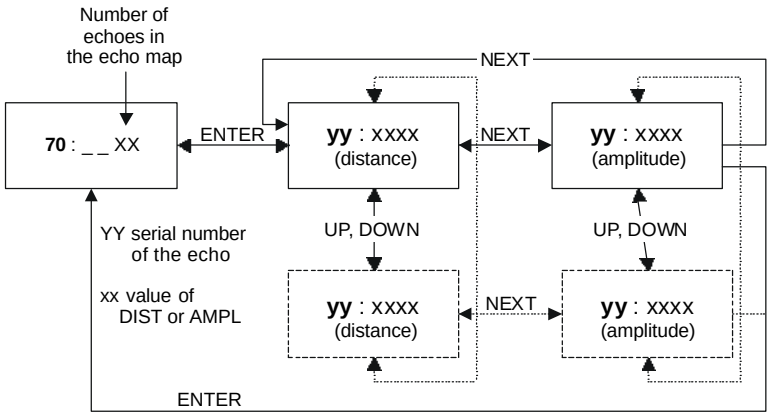
Viewing this parameter gives the number of echoes detected by the system. Entering this parameter will save the actual echo map, and the distance and amplitude of these echoes can be read-out one by one.

To move the Measuring Window 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)

P73:(msec) Echo Position (time) (read out parameter)

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**.

6.9 Additional Open Channel Flow Metering Features

P76: (LEV) Head of flow

The Headwater value can be checked here. This is the "h" value in the formula for flow calculation.

P77: TOT1 volume flow totalizer (resetable)
P78: TOT2 volume flow totalizer (non-resetable)

Resetting TOT1 totalizer:

1). Go to the parameter **P77.**
2). Press NEXT ⓒ + DOWN ⓥ simultaneously.
3). Display will indicate: "t1 Clr".
4.) Press ENTER Ⓔ for deleting.

6.10 Test Parameters

P80: (mA) Current output test

Entering this parameter will result in displaying the actual current output. Set any value between 3,8 and 20,5 and Press Ⓔ. Check current output by amp. 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-energized
1	Energized

P97: b:a.aa Software code

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

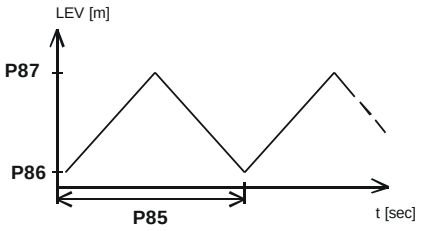
6.11 Simulation Mode

This function enables the user to test the settings of the outputs. The EchoTREK can simulate a static or continuous change of level, according to the preset simulation parameters.

Set the required simulation by programming P84, P85, P86 and P87.

P84: - - - x Simulation Mode

X	Simulation type
0	No simulation (FACTORY DEFAULT)
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**



The simulation levels must be within the programmed measuring range: **P04** and **P05**.

P85: (sec) Cycle time for simulation
P86: (m) Simulated low level value
P87: (m) Simulated high level value

To start the simulation mode, return to the measurement mode. While the EchoTREK is in simulation mode the DIST, LEV or VOL symbol will be blinking.
To quit the simulation mode, set: **P84= 0**.

6.12 Access Lock

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 the 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) **]** → **[E]** → **[E]** → **[0000]** → **[E]** ⇒ **Secret Code deleted**

7. ERROR CODES

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

SOUND VELOCITIES IN DIFFERENT GASES

The following table contains the sound velocity of various gases measured on **20°C**.

Gases		Sound Velocity (m/s)
Acetaldehyde	C_2H_4O	252.8
Acetylene	C_2H_2	340.8
Ammonia	NH_3	429.9
Argon	Ar	319.1
Bensol	C_6H_6	183.4
Carbon dioxide	CO_2	268.3
Carbon monoxide	CO	349.2
Carbon tetrachloride	CCl_4	150.2
Chlorine	Cl_2	212.7
Dimethyl ether	CH_3OCH_3	213.4
Ethane	C_2H_6	327.4
Ethanol	C_2H_3OH	267.3
Ethylene	C_2H_4	329.4
Helium	He	994.5
Hydrogen sulfide	H_2S	321.1
Methane	CH_4	445.5
Methanol	CH_3OH	347
Neon	Ne	449.6
Nitrogen	N_2	349.1
Nitrogen monoxide	NO	346
Oxygen	O_2	328.6
Propane N.A.	C_3H_8	246.5
Sulphur hexafluoride	SF_6	137.8

Par.	Page	Description		Par.	Page	Description	
P00	14	Application/Engineering Units		P25	19	Selection of Echo in the measuring window	
P01	14	Measurement Mode		P26	19	Level elevation rate (filling speed)	
P02	14	Calculation units		P27	19	Level descent rate (emptying speed)	
P03	15	Values Displayed-Rounding		P28	20	Echo-loss handling	
P04	16	Maximum measuring distance		P29	20	Blocking out of object #1	
P05	16	Minimum measuring dist. (Close-end blocking)		P30	20	Blocking out of object #2	
P06	17	Far-end blocking		P31	20	Sound velocity at 20°C	
P07		N.A.		P32	20	Specific gravity	
P08		N.A.		P33	21	Manual echo selection	
P09		N.A.		P34		N.A.	
P10	17	Value assigned to 4 mA current output		P35		N.A.	
P11	17	Value to 20 mA current output		P36		N.A.	
P12	17	Error indication by the current output		P37		N.A.	
P13	18	Relay function		P38		N.A.	
P14	18	Relay parameter – Setpoint value		P39		N.A.	
P15	18	Relay parameter – Setpoint value		P40	21/40	Tank/silo shape / Appliances, formula, data	
P16	18	Relay parameter – Pulse rate		P41	22/40	Tank/silo dimensions / Flume/weir dimensions	
P17		N.A.		P42	22/40	Tank/silo dimensions / Flume/weir dimensions	
P18		N.A.		P43	22/40	Tank/silo dimensions / Flume/weir dimensions	
P19		N.A.		P44	22/40	Tank/silo dimensions / Flume/weir dimensions	
P20		Damping		P45	22/40	Tank/silo dimensions / Flume/weir dimensions	
P21		N.A.		P46	22	Dist. btw. transducer face and level of Q=0	
P22	18	Dome top tank compensation		P47	24	Linearization	
P23	19	Angle of repose (only for free flowing solids)		P48	24	Linearization table	
P24	19	Target tracking speed		P49		N.A.	
P50		N.A.		P75	26	Blocking Distance	
P51		N.A.		P76	26	Head of flow	
P52		N.A.		P77	26	TOT1 volume flow totalizer (resetable)	
P53		N.A.		P78	26	TOT2 volume flow totalizer (non-resetable)	
P54		N.A.		P79		N.A.	
P55		N.A.		P80	26	Current output test	
P56		N.A.		P81	26	Relay test	
P57		N.A.		P82		N.A.	
P58		N.A.		P83		N.A.	
P59		N.A.		P84	27	Simulation Mode	
P60	25	Overall operating hours of the unit		P85	27	Cycle time for simulation	
P61	25	Time elapsed after last switch-on		P86	27	Simulated low level value	
P62	25	Operating hours of the relay		P87	27	Simulated high level value	
P63	25	Number of switching cycle of the relay		P88		N.A.	
P64	25	Actual temperature of the transducer		P89		N.A.	
P65	25	Maximum temperature of the transducer		P90		N.A.	
P66	25	Minimum temperature of the transducer		P91		N.A.	
P67		N.A.		P92		N.A.	
P68		N.A.		P93		N.A.	
P69		N.A.		P94		N.A.	
P70	25	Number of Echoes / Echo Map		P95		N.A.	
P71	26	Distance of Measuring Window (read-out)		P96		N.A.	
P72	26	Amplitude of Echo in Measuring (read-out)		P97	26	Software code	
P73	26	Echo Position (time) (read out parameter)		P98		N.A.	
P74	26	Signal To Noise Ratio (read out parameter)		P99	27	Access Lock by Secret Code	