



# EasyTREK

SCA-300 series compact ultrasonic  
level transmitter

## PROGRAMMING MANUAL

For SCA-3□□-4 models with HART

1<sup>st</sup> edition



Manufacturer:

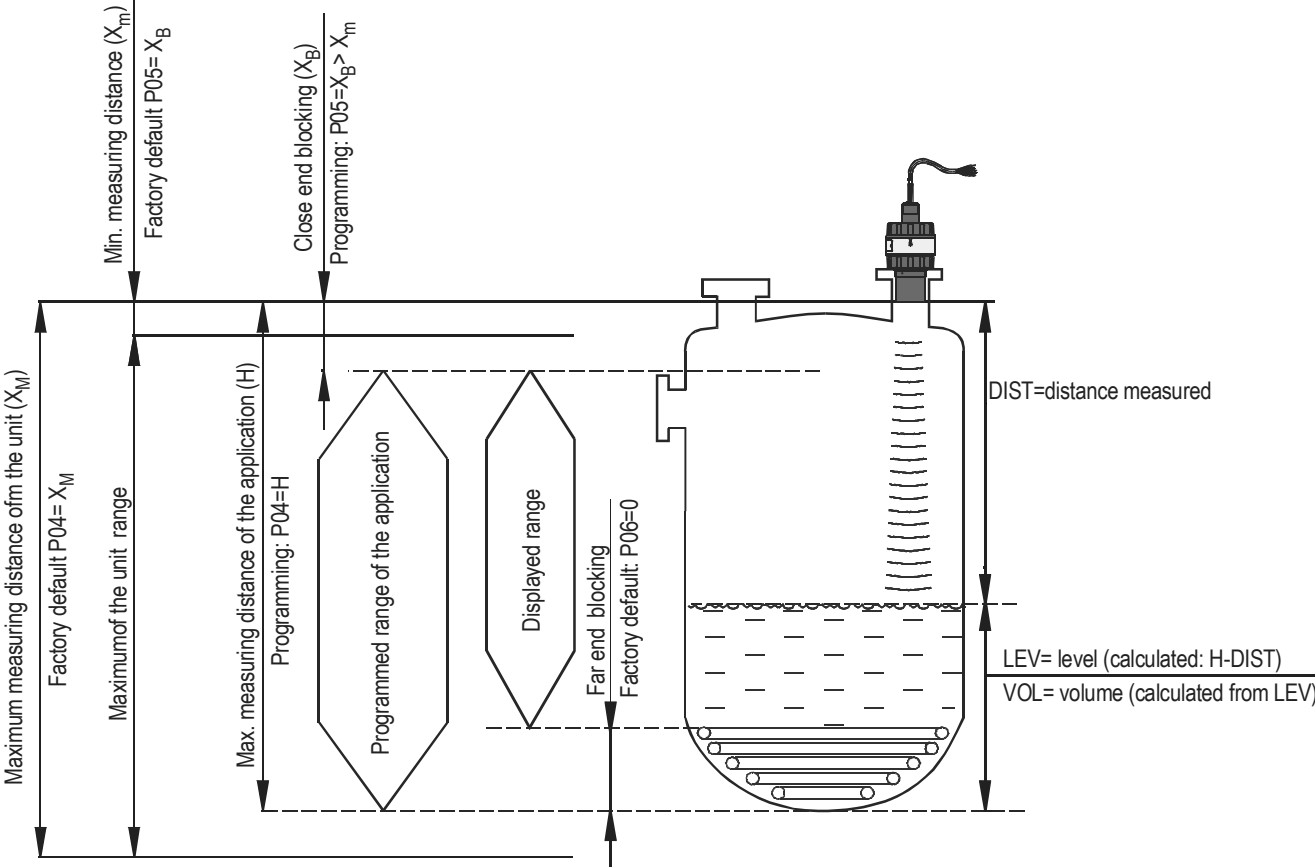
**NIVELCO Process Control Co.**

H-1043 Budapest, Dugonics u. 11.

Tel.: (36-1)-369-7575 Fax: (36-1)-369-8585

E-mail: [sales@nivelco.hu](mailto:sales@nivelco.hu) <http://www.nivelco.hu>

# Basic conception and elements of the ultrasonic measurement



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

## 1. PARAMETERS – DESCRIPTIONS AND PROGRAMMING

### 1.1 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
0	Liquid level measurement

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

c	Calculation system
0	Metric
1	US

FACTORY DEFAULT: 000

**P01: - - ba Measurement Mode**

Displayed value on the PC, 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 PC by the EVIEW software. (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

FACTORY DEFAULT: 11

**P02: - cba Calculation units**

a	Temperature
0	°C
1	°F

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

b	Volume		Weight (set also P32)		Volume flow	
	Metric	US	Metric	US	Metric	US
0	m <sup>3</sup>	ft <sup>3</sup>	-	lb (pound)	m <sup>3</sup> /time	ft <sup>3</sup> /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

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	xxx.
1000.000 – 9999.999	xxxx.
100000.000 – 99999.999	xxxxxx.
1 million – $9.99999 \times 10^9$	x.xxxx : e (exponential form)
over $1 \times 10^{10}$	(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  $1 \times 10^{10}$  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 millimetres of fluctuation of the basic DIST value (e.g. due to waves) will be enlarged by the mathematical operations. This enlarged fluctuation in displaying VOL or FLOW can (if disturbing) be avoided by rounding to be set in P03. Rounding value 2, 5, 10 etc represents the steps by which the calculated value will be changed in its (one or two) last digit(s).

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

**P04: Maximum measuring distance (H)**

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:

EasyTREK Level transmitters	Maximum measuring distance ( $X_M$ ) (m/ft)
SCA-38_	6 / 20
SCA-36_	10 / 33

Keep in mind that

**LEVEL** (as the result of the measurement) = **P04** (H value, 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 EasyTREK.

FACTORY DEFAULT: according to the table

**P05: Minimum measuring distance (Close-end blocking)**

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

***Automatic Close-end-blocking (Automatic Dead Band control) (P05= X<sub>m</sub> )***

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 (P05> X<sub>m</sub> )***

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.

<b>EasyTREK Level transmitters</b>	<b>Minimum measuring distance (dead band) (m/ft)</b>
SCA-38_	0,25 / 0,82
SCA-36_	0,35 / 1,2

FACTORY DEFAULT: automatic dead band control

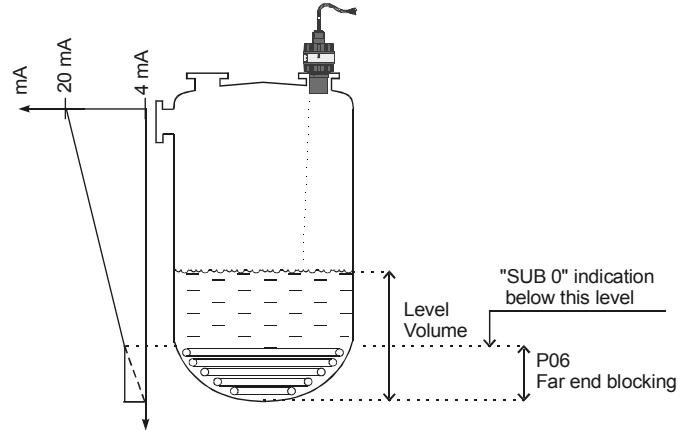
**P06: Far-end blocking**

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 below 1/8 value of P06
- 
- 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:**

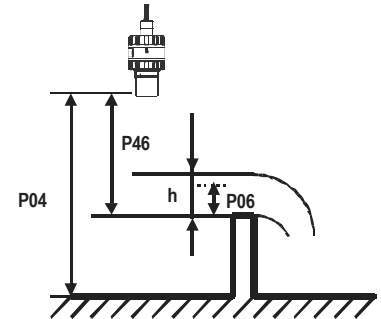
The EasyTREK will act as follows:

- Indicate "No Flow" on the Display (Q=0)
- Hold current value corresponding to Q=0

**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**



## 1.2 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<sup>3</sup>, ft<sup>3</sup>).

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 (4mA); 0

P11 (20mA)

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

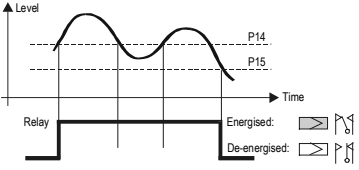
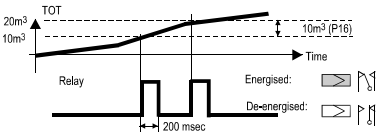
In case of error the EasyTREK will provide one of the current outputs below. (For errors and their indications see Chapter 7).

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

FACTORY DEFAULT: 0

## 1.3 Relay Output

### P13: --- a Relay function

a	Relay function	Also set:
0	<p><b>DIFFERENTIAL LEVEL CONTROL</b> (Hysteresis control)</p> <p>Relay is energised if the measured or calculated value exceeds the value set in P14</p> <p>Relay is de-energised if the measured or calculated value descends under the value set in P15</p>	 <p>P14, P15</p> <p>There is a need to set (in level min 20mm) hysteresis between P14 and P15</p>
1	Relay is energised in case of Echo Loss	-
2	Relay is de-energised in case of Echo Loss	-
3	<p><b>COUNTER</b></p> <p>Used for open channel flow metering.</p> <p>A 140 msec pulse is generated every 1, 10, 100, 1.000 or 10.000 m<sup>3</sup> according to P16.</p>	 <p>P16= 0: 1m<sup>3</sup> P16= 1: 10 m<sup>3</sup> P16= 2: 100 m<sup>3</sup> P16= 3: 1.000 m<sup>3</sup> P16= 4: 10.000 m<sup>3</sup></p>

FACTORY DEFAULT: 2

**P14: ... Relay parameter – Setpoint value**

**P15: ... Relay parameter – Setpoint value**

**P16: ... Relay parameter – Pulse rate see P13(3)**

FACTORY DEFAULT: P14=0, P15=0, P16=0

## 1.4 Measurement Optimisation

### P20: --- a Damping

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

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

FACTORY DEFAULT: 60 sec

### P22: --- a Dome top tank compensation

To reduce disturbing effect of possible multiple echos.

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

FACTORY DEFAULT: 0

**P23: --- a Angle of repose (repose formation) Will not be used**

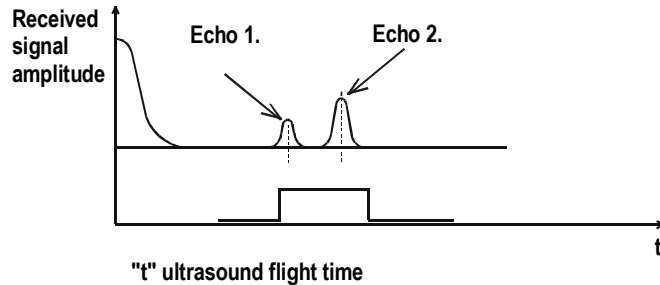
**P24: --- a Target tracking speed**

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 (P25) is inactive and the EasyTREK 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)



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)
1	First one	For liquids applications with multiple echoes within the Measuring Window
2	Largest one	Recommended if multiple echoes within the Measuring Window

FACTORY DEFAULT: 0

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

**P27: (m/h) Level descent rate (emptying speed)**

Use these parameters to provide additional protection against echo loss in applications with 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: 2000

**P28 - - - a Echo-loss handling**

<b>a</b>	<b>Echo-loss error indication</b>	<b>Remark</b>
<b>0</b>	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 <b>P20</b> (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 <b>P12</b> .
<b>1</b>	None	For the time of echo-loss, display and analogue output will hold last value.
<b>2</b>	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 <b>P26</b>
<b>3</b>	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 <b>P12</b> .
<b>4</b>	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**

One fix object 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 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 linearisation (**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<sup>3</sup>] or [lb/ft<sup>3</sup>] depending on P00(c)

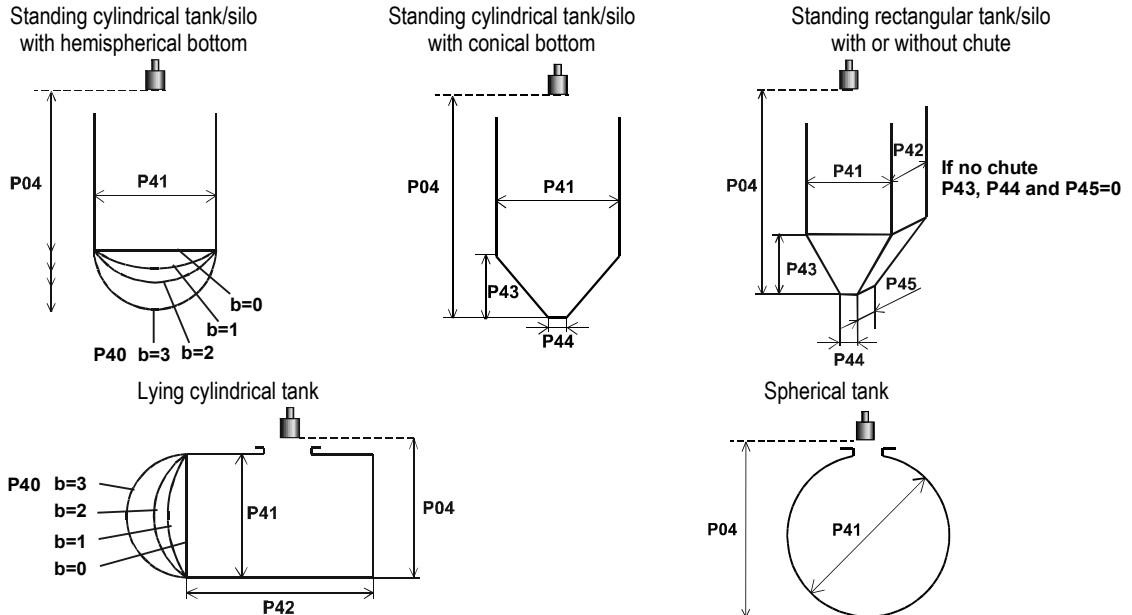
## 1.5 Volume Calculation

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 below bottom	P40(b), P41, P42
04	Spherical tank	P41

FACTORY DEFAULT: 00

P41-45: Tank/silo dimensions



## 1.6 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	Nivelco Parshall flume	GPA-1P1	$Q[l/s]= 60.87 \cdot h^{1.552}$	0.26	5.38	30	P46
01		GPA-1P2	$Q[l/s]= 119.7 \cdot h^{1.553}$	0.52	13.3	34	P46
02		GPA-1P3	$Q[l/s]= 178.4 \cdot h^{1.555}$	0.78	49	39	P46
03		GPA-1P4	$Q[l/s]= 353.9 \cdot h^{1.558}$	1.52	164	53	P46
04		GPA-1P5	$Q[l/s]= 521.4 \cdot h^{1.558}$	2.25	360	75	P46
05		GPA-1P6	$Q[l/s]= 674.6 \cdot h^{1.556}$	2.91	570	120	P46
06		GPA-1P7	$Q[l/s]= 1014.9 \cdot h^{1.556}$	4.4	890	130	P46
07		GPA-1P8	$Q[l/s]= 1368 \cdot h^{1.5638}$	5.8	1208	135	P46
08		GPA-1P9	$Q[l/s]= 2080.5 \cdot h^{1.5689}$	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: $Q[l/s]= 1000 \cdot P41 \cdot h^{P42}$ , h [m]					P46, P41, P42	

**P41-45: Flume/weir dimensions**

See next pages.

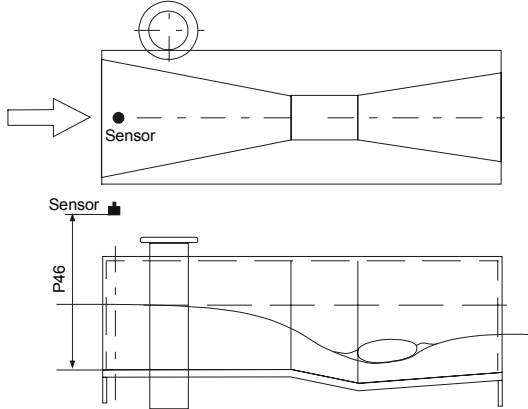
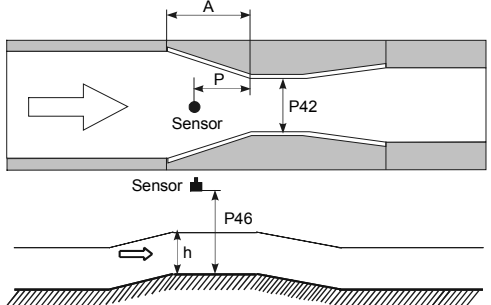
FACTORY DEFAULT: 0

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

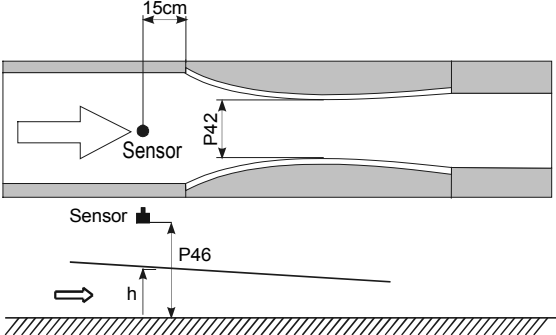
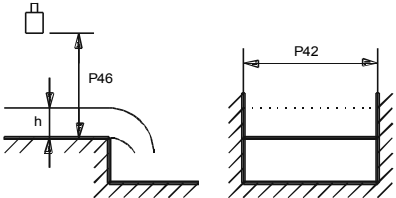
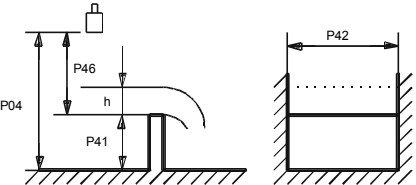
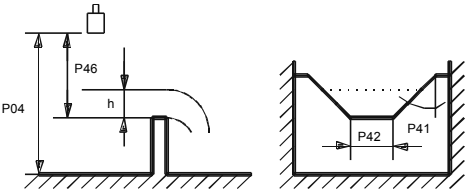
P46 is *always* the distance between the transducer face and the level, where the volume flow is 0.

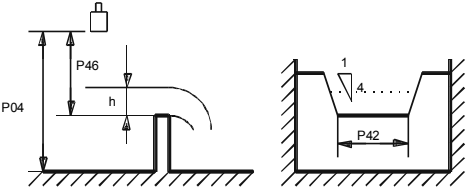
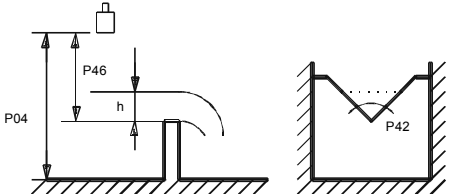
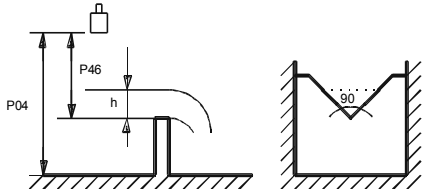
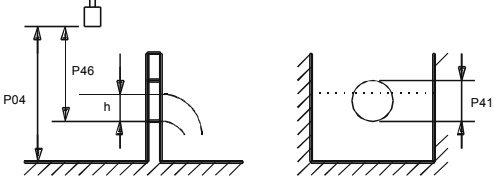
FACTORY DEFAULT: 0

**Flume / Weir Dimensions**

<p>P40= 00 . . . 08</p>	<p><b>Nivelco Parshall flumes (GPA1P1 ... GPA-1P9)</b> For further details see the Manual of the Parshall flume</p>															
<p>P40= 09</p>	<p><b>General Parshall flume</b> 0.305 &lt; P42(width) &lt; 2.44</p> $Q[m^3/s] = 0.372 * P42 * (h/0.305)^{1.569s}$ <p style="text-align: right; margin-right: 20px;"><small>0.026</small></p> <table border="1" data-bbox="446 882 703 1052"> <thead> <tr> <th>s[m]</th> <th>K</th> </tr> </thead> <tbody> <tr> <td>3.05</td> <td>2.450</td> </tr> <tr> <td>4.57</td> <td>2.400</td> </tr> <tr> <td>6.10</td> <td>2.370</td> </tr> <tr> <td>7.62</td> <td>2.350</td> </tr> <tr> <td>9.14</td> <td>2.340</td> </tr> <tr> <td>15.24</td> <td>2.320</td> </tr> </tbody> </table> <p>2.5 &lt; P42 Q[m³/s]= K*P42*h<sup>1.6</sup> P= 2/3*A</p>	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	
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															

<p><b>P40= 10</b></p>	<p><b>Palmer-Bowlus (D/2) flume</b></p> <p><math>Q[m^3/s]= f(h1/P41)*P41^{2.5}</math>,  where <math>h1[m]= h+(P41/10)</math></p>	
<p><b>P40= 11</b></p>	<p><b>Palmer-Bowlus (D/3) flume</b></p> <p><math>Q[m^3/s]= f(h1/P41)*P41^{2.5}</math>,  where <math>h1[m]= h+(P41/10)</math></p>	
<p><b>P40= 12</b></p>	<p><b>Palmer-Bowlus (Rectangular) flume</b></p> <p><math>Q[m^3/s]= C*P42*h^{1.5}</math>,  where <math>C= f(P41/P42)</math></p>	

<p><b>P40= 13</b></p>	<p><b>Khafagi Venturi flume</b></p> $Q[m^3/s]= P42*1.744*h^{1.5} + 0.091*h^{2.5}$	
<p><b>P40= 14</b></p>	<p><b>Bottom step weir</b></p> $0.0005 < Q[m^3/s] < 1$ $0.3 < P42[m] < 15$ $0.1 < h[m] < 10$ $Q[m^3/s]= 5.073*P42*h^{1.5}$ <p>Accuracy: ±10%</p>	
<p><b>P40= 15</b></p>	<p><b>Suppressed rectangular or BAZIN weir</b></p> $0.001 < Q[m^3/s] < 5$ $0.15 < P41[m] < 0.8$ $0.15 < P42[m] < 3$ $0.015 < h[m] < 0.8$ $Q[m^3/s]= 1.7599*[1+(0.1534/P41)]*P42*(h+0.001)^{1.5}$ <p>Accuracy: ±1%</p>	
<p><b>P40= 16</b></p>	<p><b>Trapezoidal weir</b></p> $0.0032 < Q[m^3/s] < 82$ $20 < P41[°] < 100$ $0.5 < P42[m] < 15$ $0.1 < h[m] < 2$ $Q[m^3/s]= 1.772*P42*h^{1.5}+1.320*tg(P41/2)*h^{2.47}$ <p>Accuracy: ±5%</p>	

<p><b>P40= 17</b></p>	<p><b>Special Trapezoidal (4:1) weir</b>  <math>0.0018 &lt; Q[m^3/s] &lt; 50</math>  <math>0.3 &lt; P42[m] &lt; 10</math>  <math>0.1 &lt; h[m] &lt; 2</math>  <math>Q[m^3/s] = 1.866 * P42 * h^{1.5}</math>  Accuracy: <math>\pm 3\%</math></p>	
<p><b>P40= 18</b></p>	<p><b>V-notch weir</b>  <math>0.0002 &lt; Q[m^3/s] &lt; 1</math>  <math>20 &lt; P42[^\circ] &lt; 100</math>  <math>0.05 &lt; h[m] &lt; 1</math>  <math>Q[m^3/s] = 1.320 * tg(P42/2) * h^{2.47}</math>  Accuracy: <math>\pm 3\%</math></p>	
<p><b>P40= 19</b></p>	<p><b>THOMSON (90°-notch) weir</b>  <math>0.0002 &lt; Q[m^3/s] &lt; 1</math>  <math>0.05 &lt; h[m] &lt; 1</math>  <math>Q[m^3/s] = 1.320 * h^{2.47}</math>  Accuracy: <math>\pm 3\%</math></p>	
<p><b>P40= 20</b></p>	<p><b>Circular weir</b>  <math>0.0003 &lt; Q[m^3/s] &lt; 25</math>  <math>0.02 &lt; h[m] &lt; 2</math>  <math>Q[m^3/s] = m * b * D^{2.5}</math>  <math>m = 0.555 + 0.418h/P41 + (P41/(0.11 * h))</math>  Accuracy: <math>\pm 5\%</math></p>	

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

**P46** is the distance between the transducer face and the liquid at which the flow starts (Q=0). (See figures)

During setting of P46 should be **P06=0**

FACTORY DEFAULT: 0

## 1.7 32-Point Linearisation Curve

### P47: --- a Linearisation

Linearisation 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.

a	Linearisation
0	OFF (FACTORY DEFAULT)
1	ON

## 1.8 Service 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 <sup>e</sup>

### 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 20°C.

**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**.

## **1.9 Additional Parameter, of Open Channel Flow Metering**

**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 totaliser (resetable)**

**P78: TOT2 volume flow totaliser (non-resetable)**

## 2. 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	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	Linearisation table error: L(1) and L(2) are both zero (no valid data-pairs)	See the Section "Linearisation"
13	Linearisation table error: there are two same L(i) data in the table	See the Section "Linearisation"
14	Linearisation table error: the r(i) values are not monotone increasing	See the Section "Linearisation"
15	Linearisation table error: measured Level is higher than the last Volume or Flow data-pair	See the Section "Linearisation"
16	The checksum of the program in the EEPROM is wrong	Contact local agent
PtErr	Break in the temperature sensor circuit	Contact local agent

### 3. TABLE OF PARAMETERS

Par.	Page	Description	Code				Par.	Page	Description	Code			
			d	c	b	a				d	c	b	a
P00	2	Application/Engineering Units					P28	13	Echo-loss handling				
P01	3	Measurement Mode					P29	13	Blocking sout of object #1				
P02	4	Calculation units					P30	-	N.A.				
P03	4	Values Displayed-Rounding					P31	14	Sound velocity at 20°C				
P04	5	Maximum measuring distance					P32	14	Specific gravity				
P05	6	Minimum measuring dist. (Close-end blocking)					P33	-	N.A.				
P06	7	Far-end blocking					P34	-	N.A.				
P07	-	N.A.					P35	-	N.A.				
P08	-	N.A.					P36	-	N.A.				
P09	-	N.A.					P37	-	N.A.				
P10	8	Value assigned to 4 mA current output					P38	-	N.A.				
P11	8	Value to 20 mA current output					P39	-	N.A.				
P12	8	Error indication by the current output					P40	15	Tank/silo shape / Appliances, formula, data				
P13	9	Relay function					P41	15	Tank/silo dimensions / Flume/weir dimensions				
P14	9	Relay parameter – Setpoint value					P42	15	Tank/silo dimensions / Flume/weir dimensions				
P15	9	Relay parameter – Setpoint value					P43	15	Tank/silo dimensions / Flume/weir dimensions				
P16	9	Relay parameter – Pulse rate					P44	15	Tank/silo dimensions / Flume/weir dimensions				
P17	-	N.A.					P45	15	Tank/silo dimensions / Flume/weir dimensions				
P18	-	N.A.					P46	17	Dist. btw. transducer face and level of Q=0				
P19	-	N.A.					P47	21	Linearisation				
P20	10	Damping					P48	-	N.A.				
P21	-	N.A.					P49	-	N.A.				
P22	10	Dome top tank compensation					P50	-	N.A.				
P23	-	N.A.					P51	-	N.A.				
P24	11	Target tracking speed					P52	-	N.A.				
P25	11	Selection of Echo in the measuring window					P53	-	N.A.				
P26	12	Level elevation rate (filling speed)					P54	-	N.A.				
P27	12	Level elevation rate (emptying speed)					P55	-	N.A.				

Par.	Page	Description	Code				Par.	Page	Description	Code			
			d	c	b	a				d	c	b	a
P56	-	N.A.					P78	22	TOT2 volume flow totaliser (non-resetable)				
P57	-	N.A.					P79	-	N.A.				
P58	-	N.A.					P80	-	N.A.				
P59	-	N.A.					P81	-	N.A.				
P60	21	Overall operating hours of the unit					P82	-	N.A.				
P61	21	Time elapsed after last switch-on					P83	-	N.A.				
P62	21	Operating hours of the relay					P84	-	N.A.				
P63	21	Number of switching cycle of the relay					P85	-	N.A.				
P64	21	Actual temperature of the transducer					P86	-	N.A.				
P65	21	Maximum temperature of the transducer					P87	-	N.A.				
P66	21	Minimum temperature of the transducer					P88	-	N.A.				
P67	-	N.A.					P89	-	N.A.				
P68	-	N.A.					P90	-	N.A.				
P69	-	N.A.					P91	-	N.A.				
P70	-	N.A.					P92	-	N.A.				
P71	22	Distance of the of Measuring Window					P93	-	N.A.				
P72	22	Amplitude of the Echo in the Measuring window					P94	-	N.A.				
P73	22	Echo Position (time) (read out parameter)					P95	-	N.A.				
P74	22	Signal To Noise Ratio (read out parameter)					P96	-	N.A.				
P75	22	Blocking Distance					P97	-	N.A.				
P76	22	Head of flow					P98	-	N.A.				
P77	22	TOT1 volume flow totaliser (resetable)					P99	-	N.A.				

## 4. 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	$C_2H_5OH$	267.3
Ethylene	$C_2H_4$	329.4
Helium	He	994.5
Hydrogen sulphide	$H_2S$	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

July, 2001  
sca3802a0600p\_01