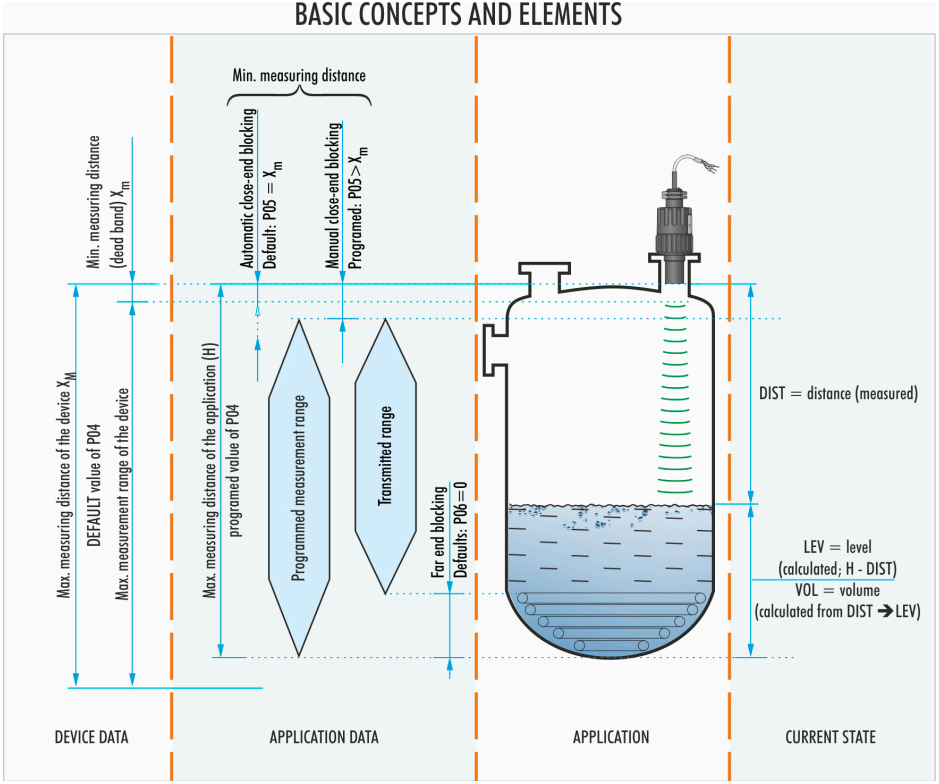
EasyTREK

SP–500 Pro

2-wire integrated ultrasonic level transmitter

Installation and Programming manual

Manufacturer:
NIVELCO Process Control Co.
H-1043 Budapest, Dugonics u. 11.
Tel.: (36-1) 889-0100
E-mail: sales@nivelco.com ■ www.nivelco.com


BASIC CONCEPTS AND ELEMENTS
Min. measuring distance
Min. measuring distance (dead band) X_m
Automatic close-end blocking Default: P05 = X_m
Manual close-end blocking Programed: P05 > X_m
Max. measuring distance of the device X_M
DEFAULT value of P04
Max. measurement range of the device
Max. measuring distance of the application (H) programed value of P04
Programmed measurement range
Transmitted range
Far end blocking Defaults: P06 = 0
DIST = distance (measured)
LEV = level (calculated; H - DIST)
VOL = volume (calculated from DIST → LEV)
DEVICE DATA
APPLICATION DATA
APPLICATION
CURRENT STATE

CONTENTS


NIVELCO Process Control Co.
EasyTREK SPA-590-4
Supply:12-36V DC
Output:4-20 mA+HART
Amb.temp.:-30..+80°C
Med.temp.:-30..+90°C
MADE IN EU

Thank you for choosing a NIVELCO instrument.

1. INTRODUCTION

Application

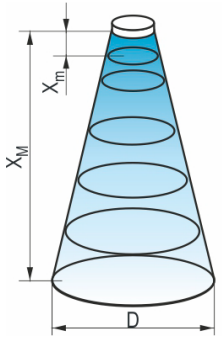
NIVELCO's **EasyTREK Pro** compact ultrasonic level transmitters are excellent for measuring the level of liquids.

The technology is based on the non-contacting ultrasonic principle, which is particularly suited for applications where the measuring device cannot touch the surface of the measured medium.

Operating principle

The ultrasonic level metering technology measures the time required for the ultrasound pulse to make a round trip from the sensor to the measured level and back. The sensor emits an ultrasonic pulse burst and receives the echoes. The electronics processes the received signal by selecting the echo reflected by the surface and calculates the distance between the sensor and the surface from the time of flight. The distance constitutes the basis of all output signals of the **EasyTREK Pro**.

The beam angle of **NIVELCO**'s SenSonic transducers is 5…7° at –3 dB, which ensures reliable measurement in narrow silos with uneven sidewalls and tanks with various interfering objects. Furthermore, the ultrasonic signals are excellently focused and penetrate through gases, vapor, and foam due to the narrow beam angle.



X	D
1 m	0.21 m
2 m	0.3 m
5 m	0.56 m
10 m	1 m
15 m	1.45 m

Diameters at 5° beam angle.

The unit's design determines the **minimum measuring distance (X_m)** within which the measurement is not possible (dead zone). *Its value is according to **P05** on page 18.* Since the measurement is impossible within this range, the material must not get into this zone.

Maximum measuring distance (X_M) is the longest distance that the device can measure under ideal conditions. *For its value, see **P04** on page 17.* The maximum measuring distance of the actual application (H) must not be greater than X_M.

2. TECHNICAL DATA

2.1 GENERAL

Transducer / enclosure materials	PP, PVDF	
Process temperature	PP, PVDF transducers –30…+90 °C [–20…+190 °F]	
Ambient temperature	–30…+80 °C [–20…+175 °F]	
Pressure[1] (absolute)	0.5…3 bar (0.05…0.3 MPa) [7.25…43.5 psi]	
Seals	PP transducer: EPDM; all other transducer versions: FPM	
Ingress protection	IP68	
Power supply / power consumption	12…36 V DC with HART® communication	40…720 mW, galvanic isolation; surge transient protection
Accuracy [2]	±(0.1% $X_{measured}$ + 0.025% X_M) or ±(0.05% X_M) whichever is greater	
Resolution	Depending on the measured distance: <2 m: 1 mm, 2…5 m: 2 mm, 5…10 m: 5 mm, >10 m: 10 mm [<6.5 ft: 40 mil, 6.5…16 ft: 78 mil, 16…32 ft: 200 mil, >32 ft: 400 mil]	
Outputs	Analog: 4…20 mA, (3.9…20.5 mA), Rtmax = (Ut – 12 V) / 0.02 A, galvanic isolation; surge transient protection	
	SPDT relay, 30 V / 1 A DC; 48 V / 0.5 A AC	
	Serial communication: HART® interface (termination resistor ≥ 250 Ω)	
	Programming / diagnostic interface: 3.3 V LVDS, 100 mA max., galvanically isolated	
Electrical connection	6 x 0.5 mm² [AWG20] shielded cable ∅6 mm x 5 m (∅0.24" x 196.9") (available max. length 30 m [98.5 ft])	
Electrical protection	Class III (SELV)	

(1) *For pressures below 1 bar (14.5 psi), contact NIVELCO.*
(2) *Under optimal reflection conditions and constant transducer temperature.*

2.2 DEVICE-SPECIFIC DATA

DEVICE-SPECIFIC DATA FOR PP AND PVDF TRANSDUCERS

	SP□–5A□–□	SP□–59□–□	SP□–58□–□	SP□–57□–□	SP□–56□–□	SP□–54□–□
Transducer material	PP, PVDF					
Max. measuring distance (X_M) [m (ft)]	3 (10)	5 (17)	8 (26)	10 (33)	12 (40)	18 (60)
Min. measuring distance* (dead zone) (X_m) [m (in)]	0.15 (6)	0.18 (7)	0.2 (8)	0.25 (10)		0.35 (14)
Beam angle (–3 dB)	5°	6°	5°	7°	5°	
Measuring frequency	120 kHz	80 kHz		50 kHz	60 kHz	40 kHz
Upper process connection	1" BSP					
Lower process connection	1" BSP / NPT	1½" BSP / NPT	2" BSP / NPT		-	

**From the transducer face.*

2.3 ACCESSORIES

- Warranty Card
- Installation and Programming Manual
- EU Declaration of Conformity

2.4 ORDER CODES (NOT ALL COMBINATIONS ARE AVAILABLE)

EasyTREK S P □ – 5 □ □ – □ Pro

Transducer material	Code
PP	A
PVDF	B

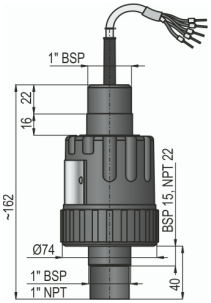
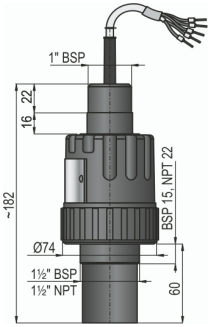
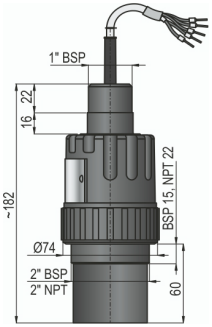
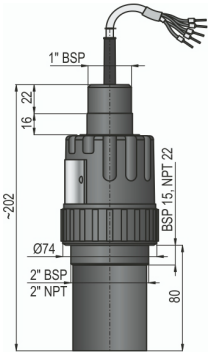
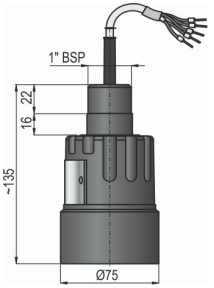
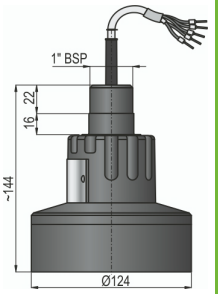
Range / Frequency	Code
0,15…3 m / 120 kHz (1)	A
0,18…5 m / 80 kHz (2)	9
0,2…8 m / 80 kHz (3)	8
0,25…10 m / 60 kHz (3)	7
0,25…12 m / 60 kHz (1)	6
0,35…18 m / 40 kHz (1)	4

Process Connection	Code
BSP thread	0
1", 1½", 2" NPT and 1" BSP (4)	N

Output	Code
4…20 mA + HART®	4
4…20 mA + Relay + HART®	N

(1) only for 1" process connection
(2) only for 1" or 1½" process connection
(3) only for 1" or 2" process connection
(4) only for SP–5A, SP–59, SP–58, SP–57

2.5 DIMENSIONS

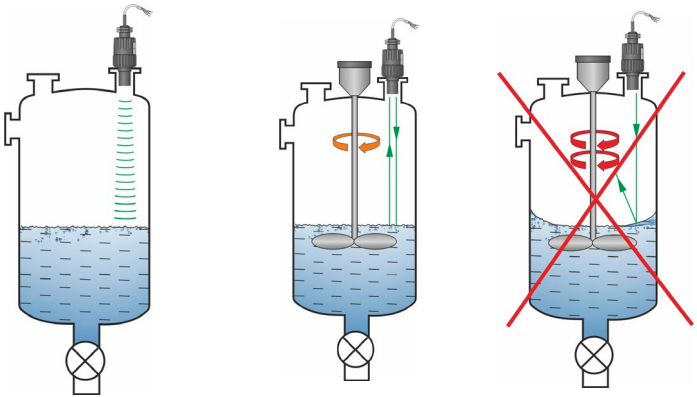
SP□–5A□–□	SP□–59□–□	SP□–58□–□	SP□–57□–□	SP□–56□–□	SP□–54□–□
					

3. INSTALLATION

3.1 LIQUID LEVEL MEASUREMENT

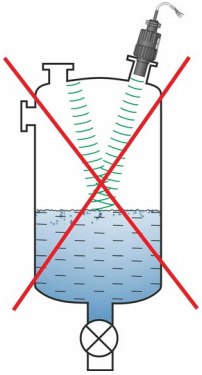
Position

The ideal position of the **EasyTREK Pro** is on the radius r = (0.3…0.5) R of the (cylindrical) tank / silo.
(Be sure to take the radiation cone (page 5) into consideration.)



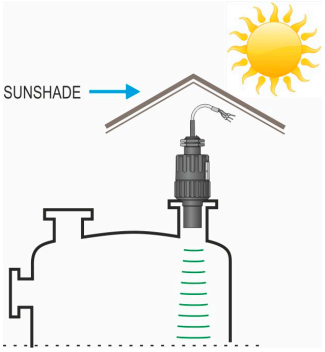
SENSOR ALIGNMENT

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



TEMPERATURE

The transmitter must be adequately protected from direct sunlight.



OBSTACLES

There must be no interfering objects (cooling pipes, bracing members, thermometers, etc.) in the sensing cone of the ultrasonic beam.

Note: The programming of the **EasyTREK** allows one static object that would otherwise disturb the measurement to be masked out *(see P29 of programming).*

FOAM

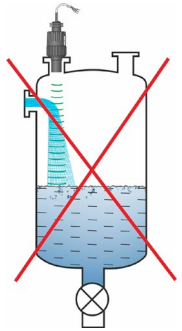
Foam on the liquid's surface may make ultrasonic level metering impossible. Find a location where the foaming is the thinnest (the device must be placed as far from liquid inflow as possible), or a stilling pipe or a well must be used.

WIND

Intensive air (gas) flow near the ultrasonic cone must be avoided. A strong gust of wind may blow the ultrasound away. Devices with lower measuring frequency (40, 20 kHz) are recommended.

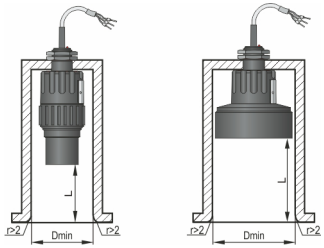
FUMES / VAPOURS

Fume or gases above the surface of the measured liquid in closed tanks, especially ones exposed to direct sunlight, may strongly reduce the nominal measuring range of the ultrasonic device. Therefore, do consider this phenomenon when selecting a device.
Devices with a lower measuring frequency (40 & 20 kHz) are recommended for such scenarios.



3.1.1 RISER

The riser must be rigid; the lower rim, where the ultrasonic beam leaves the pipe, must be rounded (r).



L	D_{min}		
	SP☐–59☐	SP☐–58☐	SP☐–57☐
150	50	60	60
200	50	60	75
250	65	65	90
300	80	75	105
350	95	80	120

L	D_{min}
	SP☐–54☐
90	**130**
200	**140**
350	**150**
500	**160**

Contact NIVELCO regarding this value.

3.2 OPEN CHANNEL FLOW MEASUREMENT

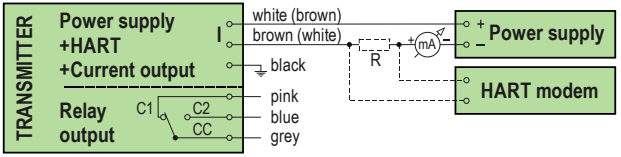
- The unit can be used for open channel flow measurement with the flumes listed in chapter 5.3.8.
- For maximum accuracy, install the sensor above the expected maximum water level as close as possible (see minimum measuring range).
- Install the unit along the longitudinal axis of the flume or weir in a place determined by the characteristics of the metering channel. O the Parshall flumes sold by NIVELCO, the sensor's location is marked.
- In some cases, foam may develop on the surface. Make sure that the surface opposite the sensor remains free of foam for proper sound reflection.
- The unit must be fixed so that its position does not change.
- Building the section preceding and following the Parshall flume is critical for accurate measurements.
- Regardless of how accurate the installation is, the accuracy of flow metering is always lower than that of distance measurement. It is determined by the properties of the flume or weir.
- The device must be protected from direct sunlight by using a sunshade.

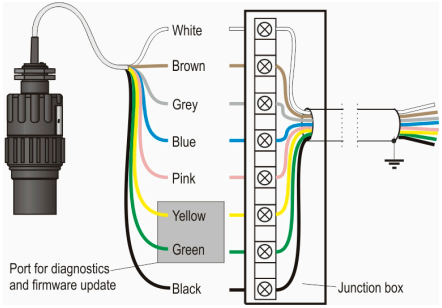
4. WIRING

- Make sure the terminals in the box are not energized (use shielded at least 7x0.5 mm^2 (AWG20) cable for a setup with a relay output and 4x0.5 mm^2 without it).
- The necessary programming can be performed after powering up.

Wire colours

Pink – relay **C1** output **white** – **I** one of the points of the current loop, power supply and HART (polarity is irrelevant)
Grey – relay **CC** output **brown** – **I** other point of the current loop, power supply and HART (polarity is irrelevant)
Blue – relay **C2** output **black** – **GND** functional earthing and shielding point





Extending the integrated cable

To extend the cable it is recommended to use a terminal block box.
The shielding of the two wires must be joined and grounded at the signal processing device.

4.1 AVAILABLE USER INTERFACES

The transmitter can be set up (programmed) using the following devices:

MultiCONT Multichannel Process Controller	Ordered separately. Functions as a display as well.
HART® USB modem **UNICOMM SAT–504–0, –1, –2**	Ordered separately. See chapter “5.3.1 Programming with the EView2 software.”
HART® USB modem **UNICOMM SAT–504–3**	Ordered separately. See chapter “5.3.1 Programming with the EView2 software.” The NiFlash software can also be used to update the device's firmware. See chapter “6.1 Firmware upgrade.”

5. COMMISSIONING, SETTING UP

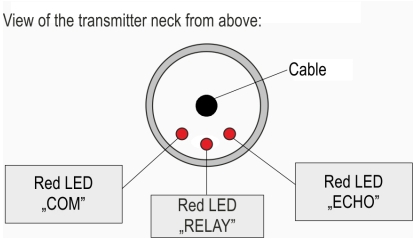
5.1 USAGE

If the device is connected correctly, it will click audibly for a short time after the power supply has been switched on. After 10…20 s, the ECHO LED will light up, and the current output will display 4…20 mA. From the moment of switching on until the start of the current transmission proportional to the measured value, during the initialization time, the value of the transmitted current will be as set in parameter **P12b "Current generator operating mode."**

In this case, the device measures with the factory default settings. The factory settings can also be used for checking the functionality and solving the simplest measurement tasks, but the possibilities of the device can only be utilized with the correct programming that fits the measured process. Therefore, to thoroughly understand the operating characteristics and acquire the operational knowledge required to solve complex measurement tasks, it is also necessary to study the programming chapters.

Single-LED status indications:

- **ECHO**-LED
  - ON if the device is receiving a proper echo.
  - Blinking, if the device is searching for an echo.
  - Blinking rapidly, when the device is in level simulation mode.
- **COM**-LED
  - Blinking on HART communication
  - ON, when remote programming is in progress
  - Blinking for 4 seconds after the device is switched on: During this time, a service communication link can be established. If it keeps blinking, it indicates a firmware error.
- **RELAY** LED (optional)
  - Lights up, if CC-C2 is ON.
  - Does not light up, if CC-C1 is ON.



Two LED status indicators

ECHO LED	**COM** LED	**Number of** blinking	**Status report**	**Source – Error bit** ***(See chapter 7.1)***
Alternately blinking		continuous	Low loop voltage	Bit15, Bit14, Bit11 co-presence.
They blink at the same time, then pause and repeat		2	OCT integrity error	Bit3 or Bit4 or Bit5
		3	Currently not used.	-
		4	Relay error	Bit13
		5	Currently not used.	-
		6	NV memory error (EEPROM)	Bit1
		continuous	• HRP detection failure • SIM detection failure	Bit12

The device can be reset to the factory settings. The default settings of the **EasyTREK SP–500 Pro** are the followings:

- measurement: level (LEV)
- zero level assigned to the maximum distance
- current loop output proportional to the level
- 4 mA and 0% assigned to zero level
- 20 mA and 100% a assigned to the maximum level (minimum distance)
- error indication via the current output: holds last value
- damping: 60 s.

5.2 CONDITIONS OF SAFE OPERATION

The cable outside the unit must be fixed and free of tension or load.
The terminal box used for connecting the device must comply with the local electrical requirements.

5.3 PROGRAMMING

The HART® interface of the **EasyTREK** provides access to the whole parameter set. The parameter set can be accessed in two different ways: by the using:

- **EView2** on a PC connected through a HART® modem to the loop.
- NIVELCO's **MultiCONT** multi-channel process control unit.

These methods require a lengthy explanation; therefore, this manual does not discuss them. This programming guide only lists the parameters of EView2. For detailed information, please refer to the descriptions or instructions for each access method.

5.3.1 PROGRAMMING WITH EVIEW2

Install the "**EView2 HART Configuration Software**" (hereafter **EView2**) according to chapter 3 of the program's manual. The software can be downloaded from nivelco.com.
Electrical connections: connect the transmitter to your PC using a HART® USB modem (sold separately).

Start the program and search for the transmitter in the program (for more details, see EView2 user manual chapter 4).
Select a device from the list of detected devices and open the “Device programming” window of the device (chapters 4.4 and 4.5 of the EView2 user manual).
EView2 lets you set all the parameters and functions. The following chapter summarizes where and how to access the parameters.

5.3.2 MEASUREMENT CONFIGURATION

P00: - c b a Engineering Units **FACTORY DEFAULT: 000**

The device loads the entire parameter set with the factory parameter values according to the new unit system if the parameter is changed. Therefore, all parameters must be set again!

a	Operation
0	Liquid level measurement

The device is only suitable for measuring liquid levels, so this parameter cannot be changed.
Eview2 setting: “Device Settings” → “Application” → “Operating mode.”

b	Engineering units (according to “c”)	
	Metric (EU)	Imperial (US)
0	m	ft
1	cm	Inch

The unit of measure of the measured value when the instrument is set to measure distance or level. It is also the unit of measure for distance or length type parameters.
EView2 setting: “Device Settings” → “Application” → “Engineering units.”

c	Unit system
0	Metric (EU)
1	Imperial (US)

The used units of measurement (length, volume, mass) are determined by the unit system set in this parameter. When changing the units of measure, the unit system must be selected first, and only then can the actual unit be set.
EView2 setting: “Device Settings” → “Application” → “Calculation system.”

P01: - - - a Measurement Mode — FACTORY DEFAULT: 11

Parameter value “a” determines the basic measurement value transmitted. Subsequently, values for the relays are also relating to these quantities.

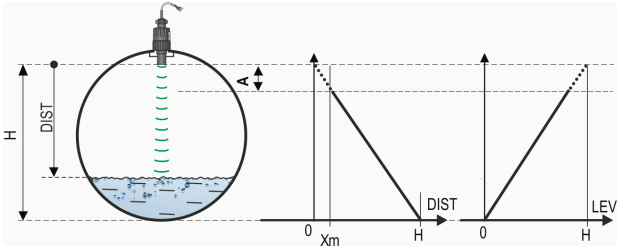
Setting the physical quantity associated with the transmitted measurement unit. The instrument measures distance. The other quantities are calculated based on the specified container parameters and material properties.

EView2 settings: “Device Settings” → “Measurement configuration” → “Measurement mode.”

a	Measurement mode	Transmitted value
0	Distance	Distance
1	Level	Level
2	Volume	Volume
3*	Mass	Mass
4	Flow	Volumetric flow

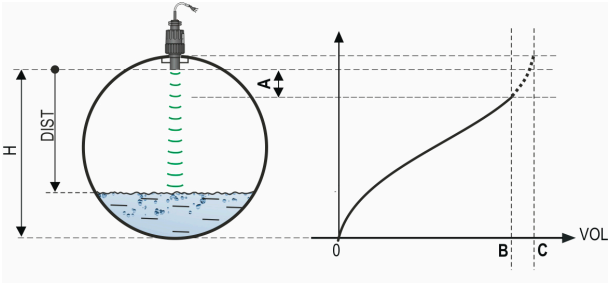
* *See:* **P32**

A: Shortest measurable distance
H: Maximum measurable distance, also the distance to the zero level



Transmitted value	**DIST**	**LEV**=H-DIST
Parameters to set	P00 P01a = 0 P05 ≥ X_m	P00 P01a = 1 P04 = H P05 ≥ X_m

A: Shortest measurable distance
H: Maximum measurable distance, also the distance to zero level
B: Volume associated with the highest measurable level
C: Total volume of the tank



Transmitted value	**VOL** $f_{P40...P45}$**(H-DIST)**
Parameters to set	P00 P01a = 3 P02b P04 = H P05 ≥ X_m P40…P45

P02: - c b a Calculation units **FACTORY DEFAULT: 000**

a	Temperature
0	°C
1	°F

The unit of temperature can be selected at this point.
EView2 setting: "Device Settings" → "Measurement configuration" → "Temperature."

b	Volume		* Weight *(set also P32)*		Volume flow	
	Metric	US	Metric	US	Metric	US
0	m^3	ft^3	tons	lb (pound)	m^3/time	ft^3/time
1	liter	gallon (BR)	tons	tons (BR)	liter/time	gallon/time
2	liter	gallon (US)	tons	tons (US)	liter/time	gallon/time

The unit of measure of the transmitted quantity for an instrument set to measure volume, mass or flow. The contents of the table is interpreted in accordance with **P00c**, **P01a** and **P02c**. The instrument converts the measured level into volume, weight, or flow by calculating using a level-dependent (non-linear) function or output correction table (OCT) according to **P40**. This parameter also gives the unit of measure of the "Output" column of the OCT table.

EView2 setting: "Device Settings" → "Measurement configuration" → "Engineering units."

c	Time
0	s
1	min
2	hour
3	day

The unit of measure of the time base for flow measurement.
EView2 setting: "Device Settings" → "Measurement configuration" → "Time."

Caution!

The EasyTREK is a level transmitter. Various factors required for weight measurement significantly affect the accuracy!

P03: - - - a Temperature compensation mode **FACTORY DEFAULT: 0**

a	Temperature compensation mode
0	Automatic
1	Manual

The operating mode of the temperature compensation for distance measurement:
Automatic: The compensation is calculated using the value measured by the temperature sensor.
Manual: The compensation is calculated a fixed setpoint temperature value in **P07** independently of the measured value.
EView2 setting: "Device Settings" → "Measurement optimalization" → "Temperature compensation."

P04: - - - - Maximum Distance to be Measured (H) **FACTORY DEFAULT: X_M as per chart.**

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

	Maximum measuring distance X_M [m (ft)] Transducer material: PP / PVDF
SP☐–5A	3 (10)
SP☐–59	5 (17)
SP☐–58	8 (26)
SP☐–57	10 (33)
SP☐–56	12 (40)
SP☐–54	18 (60)

The maximum distance to be measured is the longest distance between the surface of the transducer and the farthest level to be measured.

The factory-programmed longest distances (DEFAULT values), which **can be measured** (X_M) by the units, are listed in the table below. For the actual application, the maximum distance **to be measured** (H), i.e., the distance between the sensor and the bottom of the tank, must be entered in **P04**.
Since the level is determined by calculating the difference between the **value set in P04** and **distance (DIST) is measured** by the unit, the correct value of (H) must be set in **P04**. It is suggested that this distance is measured in the empty tank to obtain the highest accuracy.
EView2 setting:
"Device Settings" → "Measurement configuration" → "Measuring distances"

	Minimum measuring distance X_m [m (in)]
	Sensor material PP / PVDF
SP☐–5A	0.15 (6)
SP☐–59	0.18 (7)
SP☐–58	0.2 (8)
SP☐–57	0.25 (10)
SP☐–56	
SP☐–54	0.35 (12)

The range, beginning at the sensor's surface, within which (due to the physical limitations of ultrasonic measurement) measuring is impossible, is called the dead zone. The **EasyTREK** will not accept any echo within the blocking distance set here.

Close-end blocking could be considered an extension of the dead zone, within which echoes will not be used. Thus, the exclusion of interfering objects near the sensor becomes possible.

Automatic Close-end blocking = Dead Band control (P05 = X_m)

Reverting to the factory default will automatically set the shortest possible dead zone depending on the operating conditions. It will be shorter under optimal conditions and somewhat longer in unfavorable circumstances than the value given in the chart.

Manual Close-end-blocking with limitation ≥ dead zone (P05 > X_m)
By entering a value higher than the factory default, close-end blocking will be either the value programmed in P05 or the actual dead zone distance (influenced by the actual conditions of the application), whichever is greater..

EView2 setting: "Device Settings" → "Measurement configuration" → "Measuring distances"

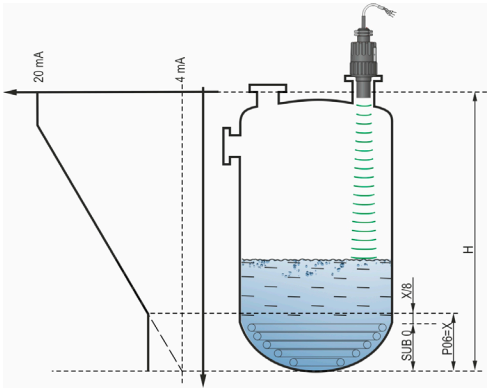
Far-end blocking is the range below the level set in parameter **P06**. It can be used to avoid interference from a stirrer or heater at the bottom of the tank.

The device uses special signals for echoes in this range.

A.) Measuring level or volume

Level sinking below

- the value of **P06** current output transmits the value of far-end blocking
- below SUB 0 (7/8 of P06) the ERROR CODE 10 is transmitted via HART



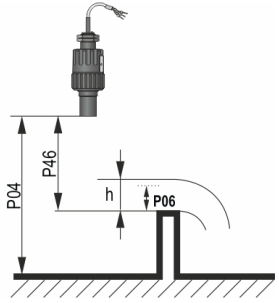
- *Level rising over value of far-end blocking:*
  The calculation of the level and volume is based on the programmed tank dimensions; therefore, the measured or calculated process values will not be influenced in any way, by the far end blocking value.

B.) Open channel flow metering

Far-end blocking is used for those small levels below which the accurate flow calculation is no longer possible.

- *Level in the flume/weir sinking below the blocked out range:*
  - Output current value will be corresponds to the value of Q = 0
  - 0 value transmitted via HART for display of „No Flow" or 0
- *Level in the flume/weir rising over the excluded range:*

The calculation of flow will be based on the programmed flume/weir data; therefore the measurement values are no affected in any way by the far end blocking value.



P06= 0 to disable remote blocking.

EView2 setting: "Device Settings" → "Measurement configuration" → "Blocking."

P07: - - - - Temperature compensation with fixed value **FACTORY DEFAULT: +20 ˚C**

Manual temperature compensation value, if **P03a** = 1 (Manual).
EView2 setting: "Device Settings" → "Measurement optimalization" → "Temperature compensation" → "Value."

5.3.3 CURRENT OUTPUT

P08: - - - - Output current fixed value **FACTORY DEFAULT: 4 mA**

Fixed current output setting parameter. See parameter **P12.**

With this parameter, the output current can be set to a fixed value between 3.8 mA and 20.5 mA.
This automatically overrides the 4 mA value set by the HART multidrop mode and the analog output current is deactivated.

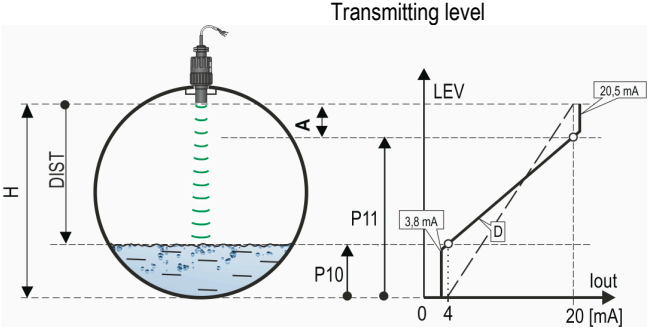
EView2 setting: "Device Settings" → "Outputs" → "Fix output current."

P10: - - - - Value (of distance, level, volume or flow) assigned to 4 mA current output **FACTORY DEFAULT: 0**

EView2 setting: "Device Settings" → "Outputs" → "Assignment of 4mA."

P11: - - - - Value (of distance, level, volume or flow) assigned to 20 mA current output **FACTORY DEFAULT: X_M – X_m** (see tables **P04** and **P05**)

Values are modified by **P01a**. The (measured or calculated) process value can be assigned to the current loop output either directly or inversely. For example, assigning 1 m to 4 mA and 10 m to 20 mA represents direct proportion and assigning 1 m to 20 mA and 10 m to 4 mA is inverse proportion.
EView2 setting**:** "Device Settings" → "Outputs" → "Assignment of 20 mA."



A: Shortest measurable distance

D: diagram valid for default values of **P10** and **P11**

P12: - - b a Current output mode **FACTORY DEFAULT: 0**

a	Error indication by output current
0	HOLD (hold last value)
1	3.8 mA
2	22 mA

Error indication by output current: Errors will be indicated by the **EasyTREK Pro** transmitter on the current output according to the set value as long as error is present.
EView2 setting: "Device Settings" → "Outputs" → "Current output" → "Error indication by the current output."

b	Current output mode
0	Automatic
1	Manual

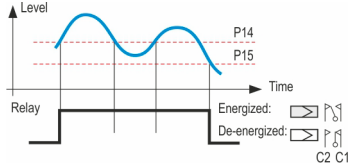
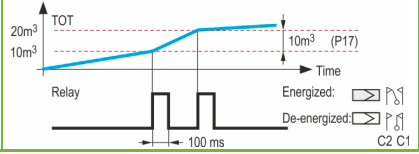
Automatic: The current loop output value is calculated from the measured value; the transmitter output is active.
Manual: The current loop output value is not calculated from the measured value, but a fixed (according to P08) current loop output value is transmitted. In this mode, the current output error setting is irrelevant.
This parameter overrides the HART multidrop communication mode 4 mA value!

c	Initial output current
0	LoSUC (3.5 mA)
1	HiSUC (23.5 mA)

LoSUC - Lo StartUp Current: The output current is calculated from the measured value; the transmitter output is active. The output current is low (3.5 mA) at start-up.
HiSUC - Hi StartUp Current: The output current value is calculated from the measured value; the transmitter output is active. The output current at start-up is high (23.5 mA).
Caution! This setting is not compatible with HART multidrop mode!

5.3.4 RELAY OUTPUT

P13: - c 0 a Relay function **FACTORY DEFAULT: 002**

a	Relay operating modes		Parameters to be programmed
0	TWO POINT SWITCH (Quantity according to **P01a**.) The relay is energized if the measured or calculated value exceeds the value set in **P14** The relay is de-energized if the measured or calculated value drops below the value set in **P15**		**P14, P15** At least 20 mm hysteresis must be set between **P14** and **P15**. **P14 > P15** – normal operation **P14 < P15** – inverted operation
1	The relay is energized in case of "noECHO."		-
2	The relay is de-energized in case of "noECHO."		-
3	COUNTER For open channel flow measurement. (Volume and dimension according to P01 and P02). It puts out a 100 ms long pulse per value defined in P17.		**P17** Pulse equivalent (according to **P13c**)

EView2 setting: "Device Settings" → "Outputs" → "Relay output" → "Relay mode."
In de-energized state of the device the „C1" circuit is closed.

c	Dimension of P17 (ha P13a = 3)	
	Metric	**US**
0	m^3	ft^3
1	liter	gallon (BR)
2	liter	gallon (US)

EView2 setting: "Device Settings" → "Outputs" → "Relay output" → "Relay parameters" → "Pulse constants unit."

P14: - - - - Relay parameter – Operating value **FACTORY DEFAULT: 0**

EView2 setting: "Device Settings" → "Outputs" → "Relay output" → "Relay parameters" → "Energized value."

P15: - - - - Relay parameter – Releasing value **FACTORY DEFAULT: 0**

EView2 setting: "Device Settings" → "Outputs" → "Relay output" → "Relay parameters" → "De-Energized value."

P17: - - - - Relay parameter – Pulse rate see P13a= 3 **FACTORY DEFAULT: 0**

EView2 setting: "Device Settings" → "Outputs" → "Relay output" → "Relay parameters" → "Pulse constant."

5.3.5 DIGITAL COMMUNICATION

P19: - - - a Short (HART) address of the unit **FACTORY DEFAULT: 0**

Addresses 0…63 are, as per the HART standard, for distinguishing units in the same loop.

- Address 0: current loop output of 4…20 mA is operational
- Address 1…15: current output is fixed 4 mA.

EView2 setting: "Device Settings" → "Device Identification" → "HART Device Short Address."

5.3.6 MEASUREMENT OPTIMIZATION

P20: - - - Damping **FACTORY DEFAULT: 60 s**

	For testing only	Applicable
No or moderate fume / waves	0 s	2 s
Dense fume or turbulent waves	>6 s	>10 s

Damping time damps unwanted output and display fluctuations. Rapidly changing measured values settle with 1% accuracy after this set time (exponential function damping).
EView2 setting: "Device Settings" → "Measurement optimalization" → "Damping time."

P22: - -- a Dome top tank compensation **FACTORY DEFAULT: 0**

a	Compensation	Note
0	OFF	If the EasyTREK is not mounted in the center of the top and the top is flat.
1	ON	If the EasyTREK is mounted in the center of a tank with a dome-shaped top.

It reduces the interference of multiple echoes.
EView2 setting: "Device Settings" → "Measurement optimalization" → "Dome Top Tank Compensation."

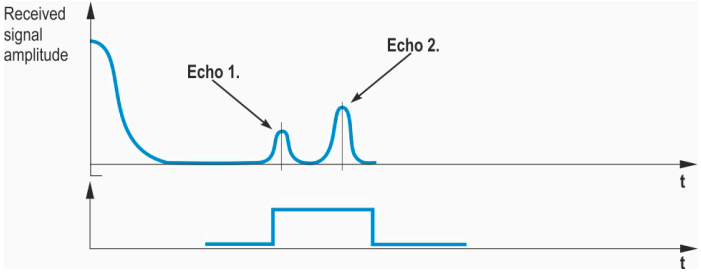
P24: - - - a Target tracking speed **FACTORY DEFAULT: 0**

a	Tracking speed	Note
0	Standard	For most applications.
1	Fast	For fast-changing levels.
2	Special	Only for special applications, measuring range is reduced to 50% of the nominal value! The measuring window is inactive (see **P25**) and the EasyTREK will respond instantly to any target.

In this parameter, evaluation can be sped up at the expense of the accuracy.
EView2 setting: "Device Settings" → "Measurement optimalization" → "Target tracking speed."

P25: - - - a **Selection of Echo within the measuring window** **FACTORY DEFAULT: 0**

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



a	Echo in the window to be selected	Note
0	With the longest amplitude	Most frequently used
1	First one	For liquids with multiple echoes within the measuring window

Some applications involve multiple (target + interfering) echoes even within the measuring window. This parameter influences selecting the echoonly within the measuring window.
EView2 setting: "Device Settings" → "Measurement optimalization" → "Selection of Echo within the measuring window."

P26: - - - - **Level elevation rate (filling speed) (m/h or ft/h))** **FACTORY DEFAULT: 2000 m/h**

EView2 setting: "Device Settings" → "Measurement optimalization" → "Level elevation rate (filling speed)."

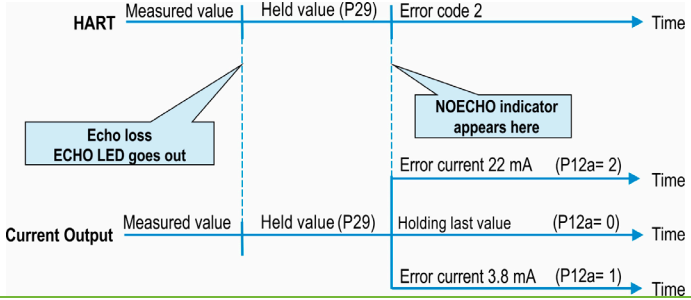
P27: - - - - **Level descent rate (emptying speed) (m/h or ft/h)** **FACTORY DEFAULT: 2000 m/h**

These parameters provide additional protection against echo loss in applications involving very heavy fuming. Setting the correct value increases the reliability of the measurement during filling and emptying.

The unit of the value is [m/h] if the metric unit system is selected and the parameters must not be slower than the fastest possible filling/emptying rate of the employed technology.
EView2 setting: "Device Settings" → "Measurement optimalization" → "Level descent rate (emptying speed)."

Caution! In tanks with conical or pyramidal bottoms, the level change rate at the bottom of the tank increases significantly!

P28 - a Echo loss indication **FACTORY DEFAULT: 0**

a	Echo loss indication:	Note
0	Delayed indication	During a short echo-loss, the last transmitted value is held for the time period of **P29**. After this period, the current value will be transmitted according to the setting in **P12a,** via HART at bit 0 of the **DSE*** of HI. 
1	No indication	For the time of the echo-loss, analog output will hold last value.
2	Filling simulation	Losing echo during the filling process, transmitted value will increase according to the filling speed set in **P26**.
3	Immediate indication	Losing echo, the current value will immediately be transmitted. – Bit 0 of **DSE*** via HART (to display noEcho) – Current value according to current output **P12a**.
4	Empty tank indication	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. In such cases, is better to indicate empty tank instead of echo loss.

EView2 setting: "Device Settings" → "Measurement optimalization" → "Echo loss handling."

*** DSE – "Device Specific Error"** signaling bits (HART). See also chapter 7. ERROR HANDLING.

P29 - - - - Blocking out of disturbing object (s) **FACTORY DEFAULT: 0**

If **P28a** is set to 0, this parameter determines the delay of the echo dropout signal in the adjustable range 0…999 s.

P31: - - - - Sound velocity at +20 °C (m/s) **FACTORY DEFAULT: 343,8 (m/s)**

This parameter is used when the speed of sound in the gases above the measured surface differs substantially from that of in the air. It is recommended for applications where the gas is more or less homogeneous.

If it is not, the accuracy of the measurement can be improved by using 32-point linearization (P48, P49).
EView2 setting: "Device Settings" → "Measurement optimalization" → "Sound velocity at +20 °C."

For sound velocities in various gases, see section "Sound Velocities."

P32: - - - - Specific gravity **FACTORY DEFAULT: 0**

If a value other than "0" is entered for specific gravity in this parameter, the weight will be displayed instead of VOL.

If the metric unit system is selected, the unit of this parameter is kg/dm^3, and lb/ft^3 if the selected unit system is the US.

EView2 setting: "Device Settings" → "Measurement optimalization" → "Density."

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

It modifies the relative acceptance threshold set for the echo diagram between −4095 and +4095. It can be used to increase (positive value) or decrease (negative value) the noise suppression capability of the device relative to the default setting. Setting the value to 0 does not affect the original setting.

EView2 setting: "Device Settings" → "Measurement optimalization" → "Threshold offset."

5.3.7 VOLUME MEASUREMENT

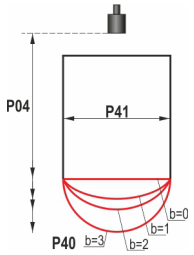
P40: d c b a Volume calculation options **FACTORY DEFAULT: 0000**

dcba	Calculation method (tank shape)	Parameters to be programmed
1000	*Output Conversion Table (OCT) table,* see chapter 5.3.9	
00b0	Standing cylindrical tank shape (value of "b" as below)	**P40b**, **P41**
0001	Standing cylindrical tank with conical bottom	**P41**, **P43**, **P44**
0002	Standing rectangular tank (with chute) (value of "b" as below)	**P41**, **P42**, **P43**, **P44**, **P45**
00b3	Horizontal cylindrical tank shape	**P40b**, **P41**, **P42**
0004	Spherical tank	**P41**

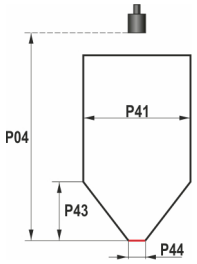
EView2 setting: "Device Settings" → "Tank/Silo parameters" → "Tank/Silo shape."

P41-45: - - - - Tank dimensions **FACTORY DEFAULT: 0**

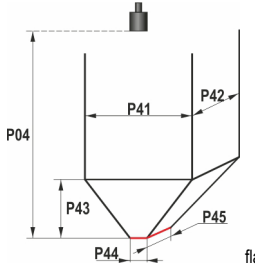
Standing cylindrical tank with hemispherical bottom P40a = P40b = 0…3



Standing cylindrical tank with conical bottom P40a = 1, P40b = 0

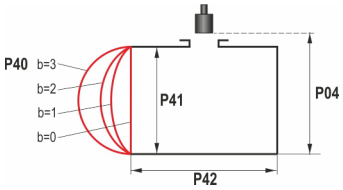


Standing rectangular tank with or without chute P40a = 2, P40b = 1

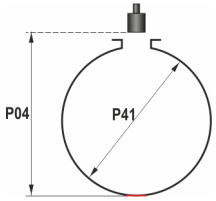


flat bottom **P43**, **P44** and **P45** = 0

Horizontal cylindrical tank P40a = 3, P40b = 0…3



Spherical tank P40a = 4, P40b = 0



EView2 setting: "Device Settings" → "Tank/Silo parameters" → "Tank / Silo dimensions."

5.3.8 OPEN CHANNEL FLOW MEASUREMENT

P40: d c b a Options for volume flow calculation **FACTORY DEFAULT: 0000**

dcba	Devices, formula, data						Parameters to be programmed
1000	*Output Conversion Table (OCT) table,* see chapter 5.3.9						P46
	NIVELCO Parshall flumes	Type	Formula	Qmin [l/s]	Qmax [l/s]	"P" [cm]	
0000		GPA–1P1	Q [l/s] = 60,87*$h^{1,552}$	0.26	5.38	30	P46
0001		GPA–1P2	Q [l/s] = 119,7*$h^{1,553}$	0.52	13.3	34	P46
0002		GPA–1P3	Q [l/s] = 178,4*$h^{1,555}$	0.78	49	39	P46
0003		GPA–1P4	Q [l/s] = 353,9*$h^{1,558}$	1.52	164	53	P46
0004		GPA–1P5	Q [l/s] = 521,4*$h^{1,558}$	2.25	360	75	P46
0005		GPA–1P6	Q [l/s] = 674,6*$h^{1,556}$	2.91	570	120	P46
0006		GPA–1P7	Q [l/s] = 1014,9*$h^{1,56}$	4.4	890	130	P46
0007		GPA–1P8	Q [l/s] = 1368*$h^{1,5638}$	5.8	1208	135	P46
0008		GPA–1P9	Q [l/s] = 2080,5*$h^{1,5689}$	8.7	1850	150	P46
0009	Generic Parshall flume						P46, P42
0010	PALMER-BOWLUS (D/2)						P46, P41
0011	PALMER-BOWLUS (D/3)						P46, P41
0012	PALMER-BOWLUS (rectangular)						P46, P41, P42
0013	Khafagi Venturi						P46, P42
0014	Step-bottomed weir						P46, P42
0015	Square section or BAZIN weir						P46, P41, P42
0016	Trapezoidal weir						P46, P41, P42
0017	Special trapezoidal (4:1) weir						P46, P42
0018	V-notch weir						P46, P42
0019	THOMSON (90° notch) weir						P46
0020	Circular weir						P46, P41
0021	General flow formula: Q [l/s] = **P41***h^{P42}, h [m]						P46, P41, P42
0121	General flow formula: Q [l/s] = **P41***h^{P42}, h **[P00c, P00b]**						P46, P41, P42

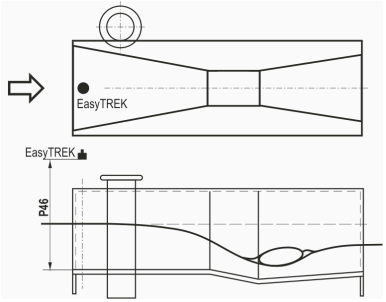
P40: d c b a Options for volume flow calculation (continued)

dcba	Devices, formula, data	Parameters to be programmed
0100	4” PALMER-BOWLUS (D/2)	**P46**
0101	6” PALMER-BOWLUS (D/2)	**P46**
0102	8” PALMER-BOWLUS (D/2)	**P46**
0103	10” PALMER-BOWLUS (D/2)	**P46**
0104	12” PALMER-BOWLUS (D/2)	**P46**
0105	15” PALMER-BOWLUS (D/2)	**P46**
0106	18” PALMER-BOWLUS (D/2)	**P46**
0107	21” PALMER-BOWLUS (D/2)	**P46**
0108	24” PALMER-BOWLUS (D/2)	**P46**

EView2 setting: “Device Settings” → “Flow measurement” → “Open channel flow measurement methods.”

P40 = 00 08

NIVELCO Parshall flumes (GPA1P1 … GPA1P9)
For further details see the manual of the Parshall flume.



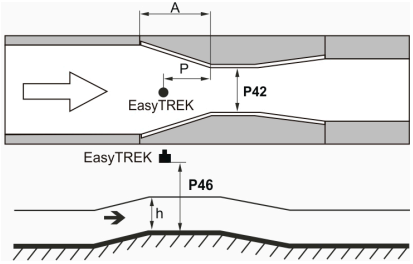
P40 = 09

Generic Parshall flume
0.305 < **P42** (width) < 2,44

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

2,5 < P42
Q [l/s] = K*P42*h^{1,6}
P = 2/3*A

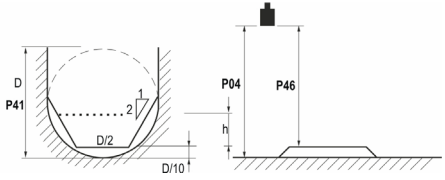
P42 [m]	K
3.05	2.450
4.57	2.400
6.10	2.370
7.62	2.350
9.14	2.340
15.24	2.320

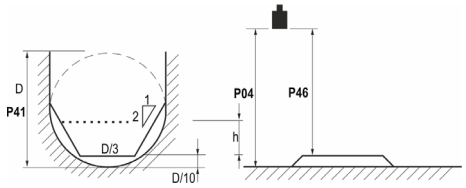
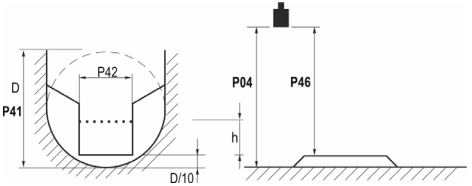
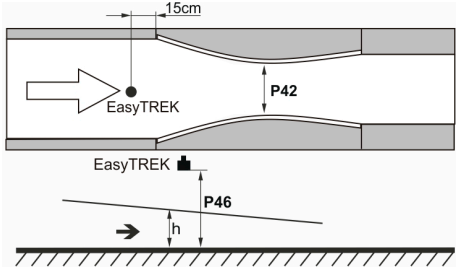
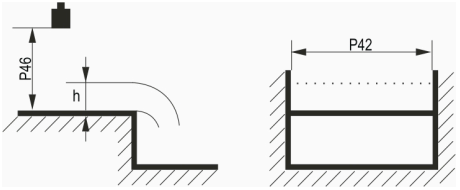


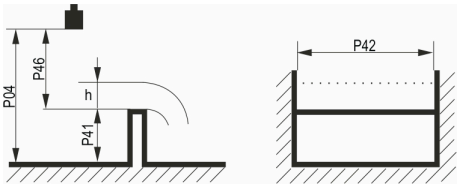
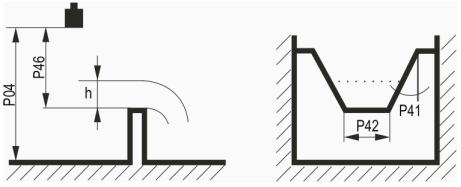
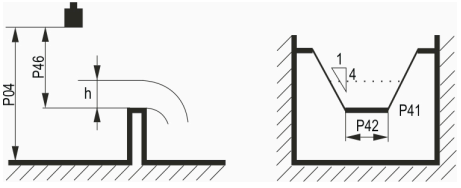
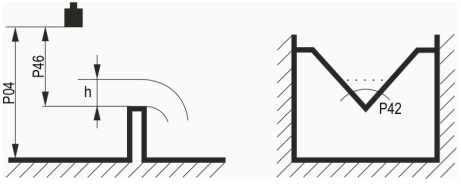
P40 = 10

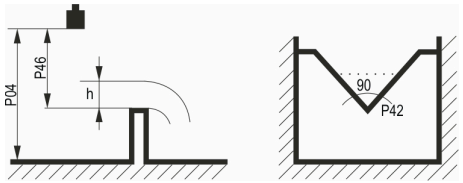
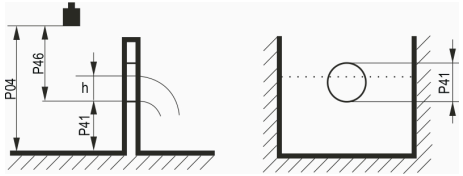
Palmer-Bowlus (D/2) flume
Q [m^3/s] = f (h1/**P41**)*$\mathbf{P41}^{2,5}$, where h1 [m] = h+(**P41**/10)

P41 [m]



P40 = 11	**Palmer-Bowlus (D/3) flume** Q [m^3/s] = f(h1/**P41**)∗**P41**^{2,5}, where h1 [m] = h+(**P41**/10) **P41** [m]	
P40 = 12	**Palmer-Bowlus (rectangular) flume** Q [m^3/s] = C∗**P42**∗h^{1,5}, where C = f(**P41**/**P42**) **P41 [m], P42 [m]**	
P40 = 13	**Khafagi Venturi flume** Q [m^3/s] = 1,744 ⋅**P42** ⋅ h^{1,5} + 0,091 ⋅ h^{2,5} **P42 [m]** **h [m]**	
P40 = 14	**Step-bottomed 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	**Square section or BAZIN weir** 0.001 < Q [m^3/s] < 5 **0.15 < P41 [m] < 0,8** **0.15 < P42 [m] < 3** 0,015 < h [m] < 0,8 **Q [m^3/s] =1,77738(1+0,1378h/P41) · P42 · (h+0,0012)^{1,5}** **Accuracy**: ±1%	
P40= 16	**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 section (4:1) roll bar** 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 · $D^{2,5}$, ahol b = f (h/D)** **m = 0,555+0,041 · h/P41+(P41/(0,11 · h))** **Accuracy: ±5%**	

P46: - - - - Distance to surface without flow **FACTORY DEFAULT: 0**

P46 is the distance between the sensor face and the surface of the liquid measured at the limit of flow initiation **(Q = 0);** see figures **(P06 = 0).**

5.3.9 Programming the Output Conversion Table – OCT

P40: d - - - *The operation of OCT* **FACTORY DEFAULT: 0**

Output signals of arbitrary characteristics can be assigned to the level values measured by the device. The characteristics can be specified with a maximum of 100 points. Using linear interpolation, the device calculates the output signal from the measured level between points. This can be used for, e.g., assigning the measured level to an arbitrary output signal or calculating the level/volume of a tank that is not in the selectable shapes (e.g., dented).

d	Calculation method
0	Formula, see chapters 5.3.7 and 5.3.8
1	OCT

EView2 setting: "Device Settings" → "OC-Table" → "Linearization."

Conditions of correct programming of the data pairs

- The table must always start with L(1)= 0 and r(1)= output value (assigned to 0 level).
- The L column may not include identical values.
- The L and R columns can only have monotonically increased values from top to bottom.
- If the table contains less than 32 data pairs, the L column must end with a level value "0" in the row following the last relevant data pair.

i	**L** (Left column) LEVEL VALUES MEASURED	**R** (Right column) OUTPUT VALUE
1	**0**	**R(1)**
2	**L(2)**	**R(2)**
	L(i)	**R(i)**
nn	**L(nn)**	**R(nn)**
nn+1	**0**	
100		

EView2 setting: "Device Settings" → "OC-Table" → "OCT list"

5.3.10 INFORMATIONAL PARAMETERS (READ ONLY PARAMETERS)

P60: - - - - Overall operating hours of the unit (h)

P61: - - - - Time elapsed after last switch-on (h)

P62: - - - - Operating hours of the relay (h)

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

P64: - - - - Actual temperature of the transducer (°C / °F)

If the temperature sensor circuit is broken, the device will give a warning via HART to display "Pt Error" and compensate to +20 ºC (+68 °F).

P65: - - - - Maximum temperature of the transducer (°C / °F)

P66: - - - - Minimum temperature of the transducer (°C / °F)

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

The amplitude and position of these echoes can also be queried.

P71: - - - - Distance of the of Measuring Window (DIST)

P72 - - - - Amplitude of the selected echo [dB] <0

P73: Position of the selected echo (time) [ms]

P74: Signal To Noise Ratio

Ratio	Measurement conditions
Over 70	Excellent
Between 70 and 30	Good
Under 30	Unreliable

P75: - - - - Blocking Distance

The current close-end blocking distance is displayed (if automatic blocking is selected in **P05)**.

5.3.11 ADDITIONAL PARAMETERS OF THE FLOW METERING

P76: - - - - Head of flow (LEV) (Read only parameter)

The measuring height required for flow measurement can be checked here. This value is the value of "h" in the flow calculation formula.

P77: - - - - TOT1 volume flow totalizer *(resettable)*

P78: - - - - TOT2 volume flow totalizer *(non-resettable)*

5.3.12 OTHER PARAMETERS

P96: - - - - Software code 1 *(Read only parameter)*

P97: - - - - Software code 2 *(Read only parameter)*

P98: - - - - Hardware code *(Read only parameter)*

P99: - - - - Access lock by secret code

Using a password protects accidental (or unauthorized) reprogramming. The password can be a number other than **0000**. After entering, disabling is activated when **EasyTREK** returns to measuring mode. To reprogram the code-protected device, the password must be entered in **P99**. Entering a new password or deleting an old one (with 0000) is only possible if you know the old password..
EView2 setting: “Device Settings” → “Advanced (button)” → “Special” → “Security” → “Change password.”

5.3.13 ECHO DIAGRAM (OSCILLOSCOPE FUNCTION)

Click the "Echo Diagram" button in EView2 to display the device's echo diagram and the "Device Echo map" window will appear. The diagram, shows the reflection curve measured by the device. In addition, this window can be used to change the threshold level. To refresh the chart or read the data, press the "Refresh" button in the bottom line of the window (or the F4 function key).
After a successful reading, an echo graph similar to the attached "Echo Diagram" will be displayed. The content of the displayed information can be selected in the legend. The "Echo list" shows the location and data of the echo peaks evaluated by the unit, of which the selected level mark is marked "Selected peak."

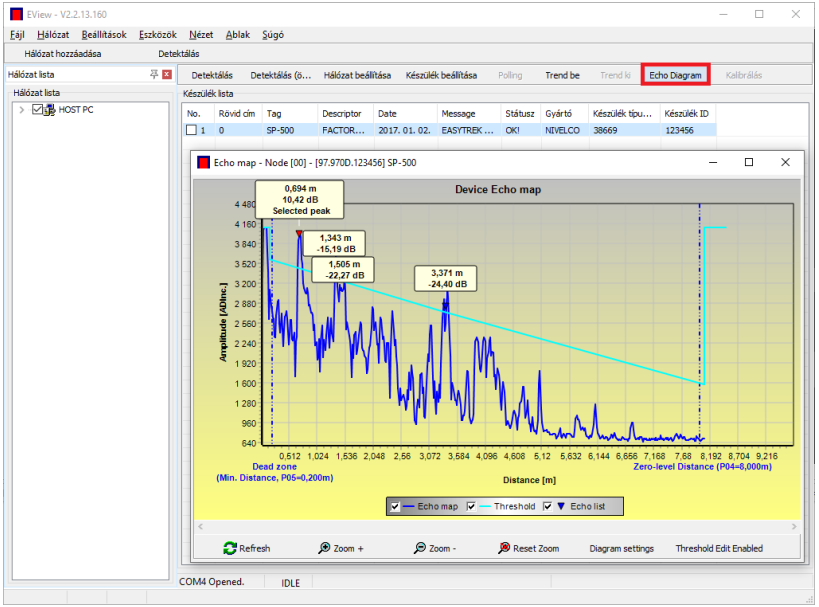


Figure 1. Echo Diagram

5.3.14 LEVEL THRESHOLD VALUE CURVE ("THRESHOLD CURVE")

This function is intended for advanced users. Incorrect settings may cause the device to malfunction!
The threshold value, or threshold line block unwanted echoes from the measurement. Echo peaks below the threshold level are not used in the evaluation. Adjusting the threshold may be necessary if the device selects an false echo, for example, if there is an interfering object in the path of the ultrasound burst. Before modifying the threshold curve, it is recommended to minimize interfering echoes by selecting the installation location of the device.

The threshold can be adjusted in the Echo Diagram window in EView2. In addition, the height of the threshold as a whole can be adjusted in a simplified manner with the "Threshold offset" parameter P34 between the measurement optimization parameters. The main threshold line is used to follow the general shape of the echo curve. Threshold highlights, also known as threshold masks, are available to mask interfering echoes protruding from the curve.

The threshold can be edited either by selecting "Threshold Edit Enable" in the bottom menu bar or "Threshold settings" → "Threshold Edit Enable" in the context menu that appears on right mouse click. The threshold editing bar appears in the upper half of the window, and the editable points are marked red on the threshold curve. If no editable point is selected, the "Threshold offset" can be set in the function bar, so the height of the three-point basic threshold curve is the same. If an editable point is selected by left-clicking, its position can also be edited separately. Threshold points can also be moved graphically with the mouse by holding down the left mouse button on the selected point.

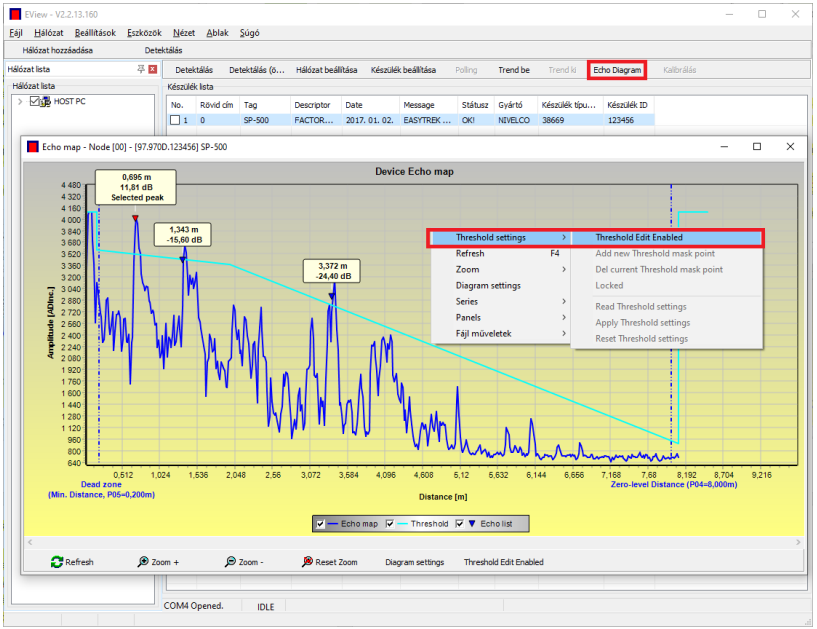


Figure 1. Main threshold curve

The changes only take effect in the device after pressing the "Apply Threshold settings" button, which can also be found in the threshold edit bar in the context menu. To display the evaluation corresponding to the new threshold, refresh the chart with the "Refresh" button in the bottom menu bar (or with the F4 key).

Use the "Threshold mask" function to mask interfering echo peaks, by pressing the "Add new Threshold mask" button in the threshold edit bar, left-click on the position in the diagram where the threshold highlight is to be placed. To use the function via the context menu, right-click on the position and select "Add new Threshold mask" function. The position and width of the threshold mask can be adjusted afterwards by selecting the center point of the highlight in the threshold edit bar as described above. Alternatively, for graphic editing, its position and height can be changed by dragging the center and adjusting the width by dragging the corner point. A total of 4 threshold highlights can be defined. If there are more interfering echoes than that, the mounting position should be changed.

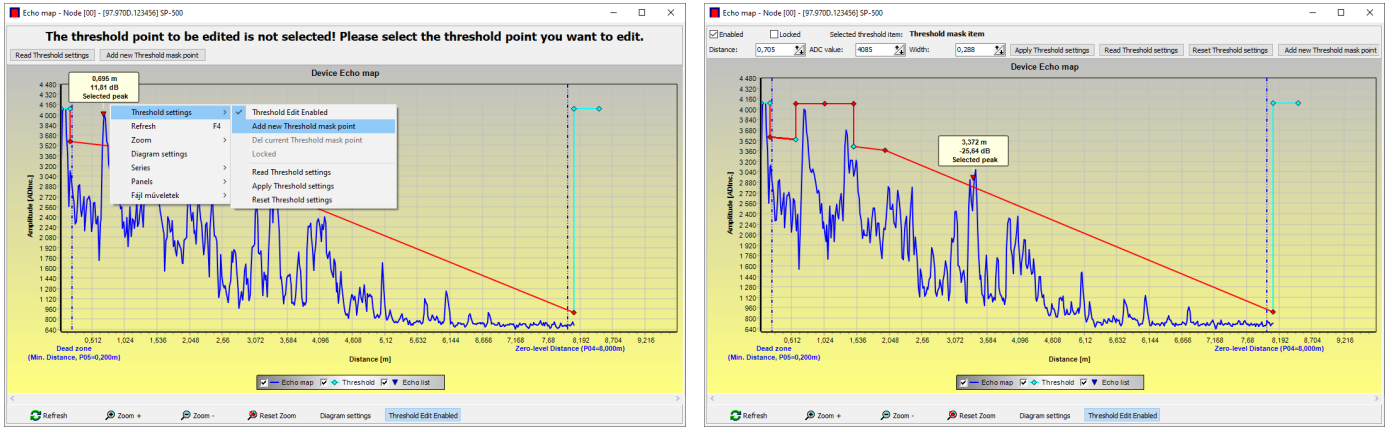


Figure 3, 4. Threshold line extension

Caution! The "Cursor On" function does not give an exact value. Instead, it only recalculates the value of the given point based on the graphical representation.

Select its center to delete a threshold highlight by turning off the "Enabled" flag in the threshold edit bar or choosing the "Del current Threshold mask" function in the context menu.

As long as the changes are not applied with the "Apply Threshold settings" function, the device will work with the previous (current) threshold settings, which can be read with the "Read Threshold settings" function. The factory default settings can be restored with the "Reset Threshold Settings" function.

6. MAINTENANCE AND REPAIR

The device does not require regular maintenance. The warranty card contains the terms and conditions. Before returning the device for repairs, it must be cleaned thoroughly. The parts in contact with the medium may contain harmful substances; therefore, they must be decontaminated. Our official form (Returned Equipment Handling Form) must be filled and enclosed in the parcel. Download it from our website www.nivelco.com. The device must be sent back with a declaration of decontamination. A statement must be provided in the declaration that the decontamination process was successfully completed and that the device is clean from any hazardous substances.

6.1 FIRMWARE UPGRADE

Based on the observations and needs of our customers, NIVELCO continuously improves and revises the firmware of the device. The software can be upgraded via the IrDA communication port of the device. Please contact NIVELCO for more information about the **"NiFlash Light"** upgrade program.

7. ERROR HANDLING

7.1 STATUS AND ERROR REPORTING IN HART COMMUNICATION

Status and error indication in HART communication: the HART standard “Response code” is two 16-bit words after the bytes, in "Error" "Status" order.

Bit №	“Device Specific Error” (DSE) flags	Meaning, possible cause, solution.
0	No echo	The device does not "see" the liquid surface to be measured, so there is no echo or too much echo due to interference. Make sure it is installed correctly. The appliance is defective, contact service.
1	EEPROM is not detected	The device parameter memory is faulty, contact service.
2	EEPROM checksum error detected	Some data stored in the device parameter memory is corrupted. The device has reset it to its default settings. If this happens frequently, the device parameter memory is faulty, contact service.
3	OCT input side integrity error	In the left (L) column of the Output Conversion Table (OCT), the data is not monotonically increasing. Please correct it!
4	OCT output side integrity error	In the right (R) column of the Output Conversion Table (OCT), the data is not monotonically increasing. Please correct it!
5	OCT item count is <2	You have entered too few points in the Output Conversion Table (OCT). A minimum of two points (elements) (i >= 2) is required. Please correct it!
6	Input level over the OCT input side (overload)	As the input value of OCT, the measured level points out from the range of the (L) column specified in OCT. Expand the range.
7	EEPROM reinitiated (EEPROM layout damaged or missing)	The data structure stored in the device parameter memory is corrupted. It has been completely rebuilt with the factory defaults. If this happens frequently, the device parameter memory is faulty, contact service.
8	„Long” ringdown	After the emitted ultrasound packet, the sensor head shows a long echo reverberation. Improper highlighting (echo in the throat) or device mounted in a steel flange that is not acoustically damped (flange ringing). Install the device as specified.
9	Echo in near blocking range	The surface to be measured is too close, within the device's minimum measuring range (Xm). Set the near block (P05) smaller, or change the technology to ensure that the surface to be measured does not get so close to the device's radiator.
10	Echo in far blocking range „SUB 0”	The surface to be measured is too far out of the device's maximum measuring range (XM). Set the remote blocking (P06) higher, or change the technology to ensure that the surface to be measured is not so far away from the device's radiator.
11	Temperature sensor failure.	The temperature sensor is defective, contact service.
12	One or more slave controller(s) failure!	One of the device's auxiliary controllers has failed. The probability of a firmware error is high. You can solve the problem by completely updating the program with "NiFlash" (including "Synchronization"). IF unsuccessful, contact service.
13	Relay failures	If the device has an optional relay, it is defective, contact service.
14	Parameter table integrity error	The value of one or more parameters is not consistent with the associated parameters. Correct the value of the parameter.
15	Sensor power failure (low sensor power)->-> bit 11, Valid=0, HOLD=1	Not enough energy to emit (shoot) the ultrasound packet. The terminal voltage of the device must be above the specified minimum in all circumstances! In general, the terminal voltage requirements of the devices inserted in the current loop (loop current display, HART Modem, PLC current input, etc…) and the voltage on the wiring may be too high, or the voltage supplying the loop may be relatively small. Check the voltage conditions of the loop by measuring and, if necessary, modify it so that the electrical conditions for the terminals of the device are met.

Bit №	“Device Specific Status” flags "(DSS)"	
0-2	Calculation mode **P01a**	The method of calculating the primary transmitted value (PV) based on **P01a**.
3	Manual programming is active	The device is in manual programming mode. (Only for device type "SE…" with user interface!)
4	Remote programming is active	The device is in remote programming mode.
5	Simulation is active	The device is in simulation mode.
6	User password is set	Password protection is set.
7	Relay energized	Relay is energized.
8	User lock is active	User lock activated.
9	Factory lock is active	Factory lock activated.
10	SAP display is connected	Display connected. (Only for device type "SE…" with user interface!)
11	Diagnostic mode is active	The device is in diagnostic mode.
12	HOLD	The transmitted value is on hold.
13	Calibration mode is active	The device is in calibration mode.
14	Valid	The transmitted value is updated and valid.
15	HS comm. mode is active	The device is in high-speed communication mode.

8. SUMMARY TABLE OF PARAMETERS

8.1 CONFIGURATION PARAMETERS (READ - WRITE)

Pr.	Page	Description	Value	Pr.	Page	Description	Value
P00	14	Engineering Units		**P26**	24	Level elevation rate (filling speed)	
P01	15	Measurement Mode		**P27**	24	Level descent rate (emptying speed) (m/h or ft/h)	
P02	15	Calculation units		**P28**	25	Echo loss indication	
P03	17	Temperature compensation mode		**P29**	26	Blocking out of disturbing object (s)	
P04	17	Maximum Distance to be Measured (H)		**P30**	-	*(Reserved for expansion)*	
P05	18	Minimum measuring distance (Dead zone…)		**P31**	26	Sound velocity at +20 °C (m/s)	
P06	19	Far-end blocking		**P32**	26	Specific gravity	
P07	20	Temperature compensation with fixed value		**P33**	-	*(Reserved for expansion)*	
P08	20	Fixed current output		**P34**	-	Threshold offset	
P09	-	*(Reserved for expansion)*		**P35**	-	*(Reserved for expansion)*	
P10	20	Value assigned to 4 mA current output		**P36**	-	*(Reserved for expansion)*	
P11	20	Value assigned to 20 mA current output		**P37**	-	*(Reserved for expansion)*	
P12	21	Current output mode		**P38**	-	*(Reserved for expansion)*	
P13	22	Relay function		**P39**	-	*(Reserved for expansion)*	
P14	22	Relay parameter – Operating value		**P40**	27	Tank shape	
P15	22	Relay parameter – Releasing value		**P41**	30	Tank dimensions / Volume calculation options	
P16	-	*(Reserved for expansion)*		**P42**	30	Tank dimensions / Flume – weir dimensions	
P17	22	Relay parameter – Pulse rate		**P43**	30	Tank dimensions / Flume – weir dimensions	
P18	-	*(Reserved for expansion)*		**P44**	30	Tank dimensions / Flume – weir dimensions	
P19	23	Short (HART) address of the unit		**P45**	30	Tank dimensions / Flume – weir dimensions	
P20	23	Damping		**P46**	33	Distance to surface without flow	
P21	-	*(Reserved for expansion)*		**P47**	-	*(Reserved for expansion)*	
P22	23	Dome top tank compensation		**P48**	-	*(Reserved for expansion)*	
P23	-	*(Reserved for expansion)*		**P49**	-	*(Reserved for expansion)*	
P24	23	Target tracking speed					
P25	24	Selection of Echo within the measuring window					

8.2 INFORMATION AND CONTROL PARAMETERS (READ ONLY)

Pr.	Page	Description	Value	Pr.	Page	Description	Value
P60	34	Overall operating hours of the unit (h)		**P80**	-	*(Reserved for service purposes)*	
P61	34	Time elapsed after last switch-on (h)		**P81**	-	*(Reserved for service purposes)*	
P62	34	Operating hours of the relay (h)		**P82**	-	*(Reserved for service purposes)*	
P63	34	Number of switching cycles of the relay		**P83**	-	*(Reserved for expansion)*	
P64	34	Actual temperature of the transducer (°C / °F)		**P84**	-	*(Reserved for service purposes)*	
P65	34	Maximum temperature of the transducer (°C / °F)		**P85**	-	*(Reserved for service purposes)*	
P66	34	Minimum temperature of the transducer (°C / °F)		**P86**	-	*(Reserved for service purposes)*	
P67	-	*(Reserved for service purposes)*		**P87**	-	*(Reserved for service purposes)*	
P68	-	*(Reserved for service purposes)*		**P88**	-	*(Reserved for service purposes)*	
P69	-	*(Reserved for service purposes)*		**P89**	-	*(Reserved for expansion)*	
P70	35	Number of Echoes / Echo Map		**P90**	-	*(Reserved for service purposes)*	
P71	34	Distance of the of Measuring Window (DIST)		**P91**	-	*(Reserved for service purposes)*	
P72	34	Amplitude of the selected echo [dB] < 0		**P92**	-	*(Reserved for service purposes)*	
P73	34	Position of the selected echo (time) [ms]		**P93**	-	*(Reserved for service purposes)*	
P74	35	Signal To Noise Ratio		**P94**	-	*(Reserved for service purposes)*	
P75	35	Blocking Distance		**P95**	-	*(Reserved for service purposes)*	
P76	35	Head of flow (LEV) (Read only parameter)		**P96**	35	Software code 1	
P77	35	TOT1 volume flow totalizer		**P97**	35	Software code 2	
P78	35	TOT2 volume flow totalizer		**P98**	35	Hardware code	
P79	-	*(Reserved for service purposes)*		**P99**	35	Access lock by secret code	

9. THE SPEED OF SOUND IN DIFFERENT GASES

The following table contains the speed of sound in various gases measured at **+20 °C** (+68 °F).

Gases	**Formula**	**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
Benzol	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
Sulphur hexafluoride	SF_6	137.8

Gases	**Formula**	**Sound Velocity** (m/s)
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	C_3H_8	246.5

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