KLAY-INSTRUMENTS

INSTRUCTION MANUAL ("HART")

"INTELLIGENT"
PRESSURE- AND LEVEL TRANSMITTERS

SERIES 2000-SAN
SERIES 2000
SERIES CER-2000
SERIES 2000-HYDROBAR

**** WARNING ***

Read this manual before working with the product. For personal and system safety and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining the Series 2000, Series 2000-SAN, Series CER-2000 and the Series 2000-Hydrobar.
Read the precautions and warnings on page 24.







SERIES 2000 **SERIES 2000-SAN** **SERIES CER-2000**

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CONTENTS

SECTION		PAGE
1	Introduction	4
1.1	Description Series 2000–SAN	4
1.2	Description Series 2000	4
1.3	Description Peramic 'S" (Series CER-2000)	4
1.4	Description Series 2000-Hydrobar	4
1.5	Barometric reference	4
2	Dimensional drawings	5
2.1	Dimensional drawing 2000-SAN	5
2.2	Dimensional drawing 2000	5
2.3	Dimensional drawing CER-2000	5
2.4	Dimensional drawing 2000-Hydrobar	6
3	Installing transmitter	7
3.1	Installing weld-on nipple	7
3.2	Installing transmitter Series 2000-SAN	7
3.3	Installing transmitter Series 2000	7
3.4	Installing transmitter Series CER-2000	8
3.5	Mounting position	8
3.6	Mounting position effect	8
3.7	Installing transmitter Series 2000-Hydrobar	8
3.8	Calibration	8
3.9	Wiring	8
4	Remaining	9
4.1	Digital local indicator	9
4.2	CE-rules	9
4.3	External load	9
4.4	Intrinsically Safe (Ex version)	10
4.5	Tracebility year of manufacturing	11
4.6	Software Revisions	11
5	Functions of push buttons	12
6	Programming points (P101-P114)	13
7	Reading on the display	13
8	Explanation programming points P101 to P114	14
	P101 Zero adjustment (4 mA)	14
	P102 Span adjustment (20 mA) without test pressure	14
	P103 Cancel mounting position effect	15
	P104 Adjustment pressure unit on display	16
	P105 Reverse output (20-4 mA)	17
	P106 Adjustment damping (0 till 25 sec)	17
	P107 Indication of process temperature	17
	P108 Temperature in ℃ of ℉	17
	P109 Read out on display	17

	P110 Simulation of current	18
	P111 Linearisation	19/20
	P112 Specific density	21
	P113 Write protection	21
	P114 Response time from push buttons	21
	P115 Service-menu	21
	P116 Service -menu	21
9	Programming of the series 2000	22
9.1	Programming with the hand held terminal	22
9.2	Programming with DTM	22
9.3	Programming with PDA	22
10	Specifications	23
11	Precautions and warnings	24
	Attachment: EC-Declaration of conformity	

1 INTRODUCTION

The SERIES 2000 and SERIES 2000-SAN are solid-state pressure- and level transmitters based upon a piezoresistive monocrystaline silicon sensor, with a very high burst pressure. The sensor element is mounted in a stainless steel foot. A very strong stainless steel "flush" diaphragm protects the sensor from the process medium. Special oil fills the chamber surrounding the sensor and transfers pressure from the flush mounted diaphragm to the sensor.

Pressure exerted on the sensor element creates a very small deflection of the silicon substrate and bridge network. The resulting strain in the silicon resistors causes a change in the bridge resistance that is proportional to the pressure applied. The transmitter electronics detects this change in bridge resistance and converts it into 4-20 mA. The amplifier system is based on a single Integrated Circuit, which ensures a perfect linearity in the 4-20 mA output.
Together with the flush diaphragm technology the long term stability is perfect.

The Series CER-2000 are "All Stainless" pressure transmitters based on a ceramic pressure cell, with very high burst pressure. These transmitters do not have oil filling.

1.1 DESCRIPTION SERIES 2000-SAN

The SERIES 2000-SAN are specially designed to be non-clogging and capable of being cleaned inside, therefore they have a flush mounted diaphragm so they fully meet the needs of the food, chemical and pharmaceutical industries.
Standard the wetted parts are made of SS 316 (AISI), a lot of other materials are available.
Various process connections can be delivered, such as Tri-Clamp(1,5", 2" and 3"), SMS (1,5" and 2"), dairy milk couplings (NW25,40 and 50), flanges and very sanitary weld-on nipples ∅ 62 and 85 mm.

1.2 DESCRIPTION SERIES 2000

The SERIES 2000 are specially designed for the pulp- and paper industry or similar, where clogging is a problem. The very compact construction of the SERIES 2000 permits flush installation with the tank- or pipe wall. Standard the wetted parts are made of SS 316 (AISI), a lot of other materials are available.

All transmitters are fully temperature compensated, which means that various process temperatures have nearly no effect on the accuracy of the output signal. When a failure occurs, the transmitter is repairable. However, for optimum accuracy the transmitter has to be send back to the factory.

1.3 DESCRIPTION PERAMIC "S" (SERIES CER-2000)

The Series CER-2000 are pressure transmitters based on a ceramic pressure cell, which can be used for all gauge- and absolute pressure measurement on steam, liquids and gases.
These transmitters do not have oil filling.

1.4 DESCRIPTION (SERIES 2000-HYDROBAR)

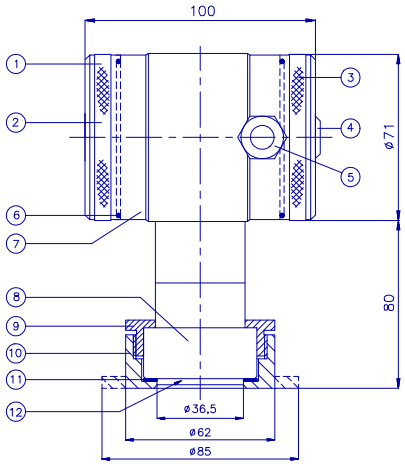
The serie 2000-Hydrobar is a complete range of submersible level transmitter for top mounting. The 2000-Hydrobar can be used in fluids like waste water, mud, pulp and chemicals. As standard the cable material is polyethylene. The connections for the wetted parts from the 2000-Hydrobar to the cable are from Viton® FKM.

1.5 BAROMETRIC REFERENCE

The SERIES 2000-SAN are in basic so-called "relative transmitter" which means that barometric changes will not affect the zero (4 mA). The venting (4) is placed at the side of the electronic housing and is the barometric reference to atmospheric. The venting must be kept clean.

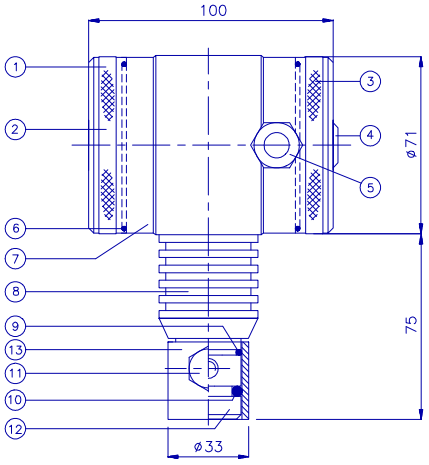
2 DIMENSIONAL DRAWINGS

2.1 DIMENSIONAL DRAWING 2000-SAN



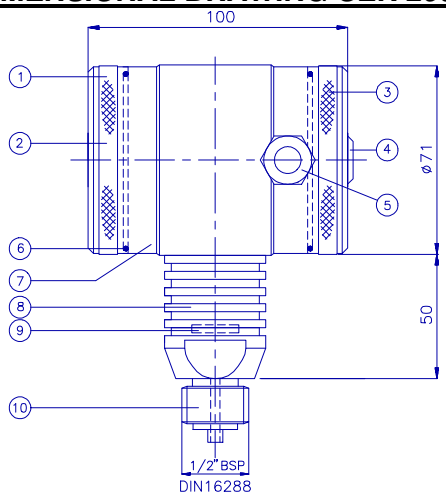
	PARTS DESCRIPTION	MATERIAL
1.	Cover	SS 304
2.	Pushbutton + Display	
3.	Cover with venting	SS 304
4.	Venting	PA
5.	PG9 Cable Gland	
6.	O-ring (2 pcs)	EPDM
7.	Electronics housing	SS 304
8.	Foot	SS 316
9.	Lock ring	SS 304
10.	Weld-on nipple	SS 316 L
11.	Packing	PTFE
12.	Diaphragm	SS 316 L

2.2 DIMENSIONAL DRAWING 2000



	PARTS DESCRIPTION	MATERIAL
1.	Cover	SS 304
2.	Pushbutton + Display	
3.	Cover with venting	SS 304
4.	Venting	PA
5.	PG9 Cable Gland	
6.	O-ring (2 pcs)	EPDM
7.	Electronics housing	SS 304
8.	Foot with cooling fins	SS 304
9.	O-ring	Viton
10.	O-ring	Viton
11.	M8 bolt	SS 316
12.	Diaphragm and ring	SS 316
13.	Weld-on nipple ∅ 33 mm	SS 316 L

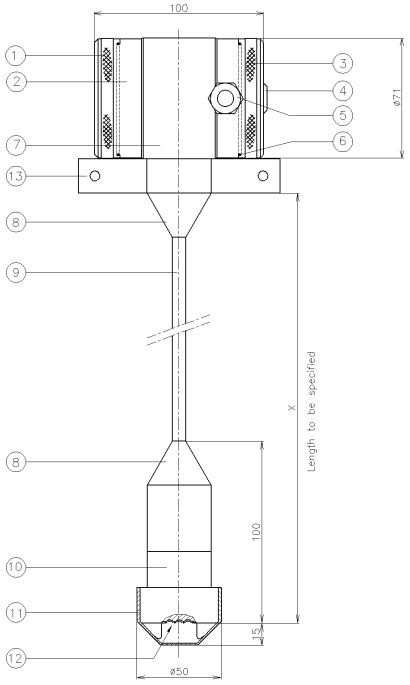
2.3 DIMENSIONAL DRAWING CER 2000



	PARTS DESCRIPTION	MATERIAL
1.	Cover	SS 304
2.	Pushbuttons + Display	
3.	Cover with venting	SS 304
4.	Venting	PA
5.	PG9 Cable Gland	
6.	O-ring (2 pcs)	EPDM
7.	Electronics housing	SS 304
8.	Foot with cooling fins	SS 316
9.	Ceramic sensor	Al2O3 (96%)
10.	Process connection ½ " BSP (M) DIN 16288	SS 316

Note: The ceramic sensor is sealed with an O-ring (VITON).
Other O-ring materials can be applied (on request).

2.4 DIMENSIONAL DRAWING 2000-HYDROBAR



PARTS DESCRIPTION		*MATERIAL*
1.	Cover	SS 304
2.	Push buttons + Display	
3.	Cover with venting	SS 304
4.	Venting	PA
5.	PG9 Cable Gland	
6.	2x O-ring	EPDM
7.	Electronics housing	SS 304
8.	2x Connection to cable	SS 316
9	Cable with venting tube	PE
10	Foot	SS 316
11.	Diaphragm protection cap	PE
12.	Diaphragm	SS 316L
13.	Mounting bracket (2 holes ø 6,5 mm	SS 304

Note: The wetted parts of the 2000-hydrobar are sealed with an O-ring (VITON). Other O-ring materials can be applied (on request).

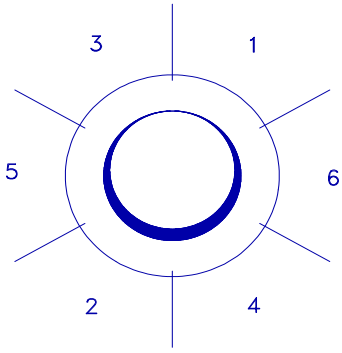
3 INSTALLING TRANSMITTER

The diaphragm of the transmitter is protected with a special protection cap. Protect the diaphragm until installation takes place. * DO NOT DAMAGE THE DIAPHRAGM. *.

3.1 INSTALLING WELD-ON NIPPLE

A skilled machinist or welder should perform installation of the weld-on nipple.
Weld Argon, MIG or TIG with the smallest welding pin.

1. Cut a hole in the process vessel/pipe to accept the weld-on nipple. The hole should produce a tight fit when coupled with the weld-on nipple.
2. Prepare the vessel hole by beveling the edge to accept filler material.
3. Remove the weld-on nipple from the transmitter.
4. Remove the PTFE packing of the SERIES 2000-SAN.



WARNING
Improper installation may result in distortion of the weld-on nipple.
Excessive heat will distort the weld-on nipple. Weld in sections as shown in the figure left. Allow adequate cooling between passes. To reduce the chances of distortion to the weld-on nipple, use a mandrell.
(SERIES 2000-SAN Part.nr. 1019)
(SERIES 2000 Part.nr. 1016)

The position of the electronic housing (SERIES 2000) is fixed by the welding position of the weld-on nipple. Before welding, locate weld-on nipple so that the cable entry and the venting are in the right direction.

5. Position the weld-on nipple in the vessel hole and tack six places.
   The weld sequence is shown in the figure above.
6. Weld the weld-on nipple in place using 0,03 to 0,045 in. (0,762 to 1,143 mm) stainless rod as filler material in the beveled area. Adjust amperage for penetration.
7. Remove mandrel after the welding operation.

3.2 INSTALLING TRANSMITTER SERIES 2000-SAN

1. Improper installation at the packing can cause a process leak.
2. Make sure to correctly locate the packing within the weld-on nipple.
3. Position the transmitter into the weld-on nipple and begin engaging threads.
   The transmitter can be rotated prior to seating enabling the user to optimize access to calibration adjustments, cable entry, and local indicator.
4. Once Lock ring (8) has been hand tightened, snug an additional turn with adjustable pliers (1/8").

3.3 INSTALLING TRANSMITTER SERIES 2000

1. After welding, clean up edges, take care of the inside nipple wall.
2. Make sure the O-rings (10) and (11) are properly located.
   Improper installation at the O-ring can cause a process leak.
3. Apply silicone grease to the O-ring(10), diaphragm ring and the hole inside wall of the weld-on nipple, this prevents galvanic cell corrosion between transmitter and nipple inside.
4. Install the transmitter and fix it with the SS M8 bolt

3.4 INSTALLING TRANSMITTER SERIES CER-2000

The position of the electronic housing is depends on the welding position of the weld-on nipple. Before welding, locate weld-on nipple so that the cable entry and the venting are in the right direction.

*** DO NOT DAMAGE THE THREAD. *.**

3.5 MOUNTING POSITION

When the transmitter is mounted horizontally, the cable gland MUST be pointed downwards.

3.6 MOUNTING POSITION EFFECT (Series 2000 and Series 2000-SAN)

All transmitters are calibrated in vertical position.
If the transmitter is mounted in a different position, there will be a little zero shift.
If the transmitter is mounted up, there is a zero shift (e.g. 4,03 mA instead of 4mA). If the transmitter is mounted down, there is a zero shift (e.g. 3.97 mA instead of 4mA). After installation of the transmitter the zero must be set to 4.00 mA with "P103" in the programming mode.
This will not affect the span.

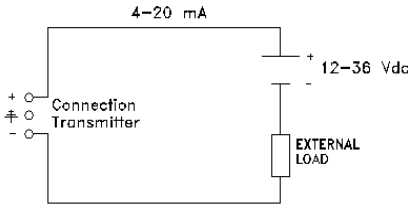
3.7 *INSTALLING TRANSMITTER SERIES 2000-Hydrobar*

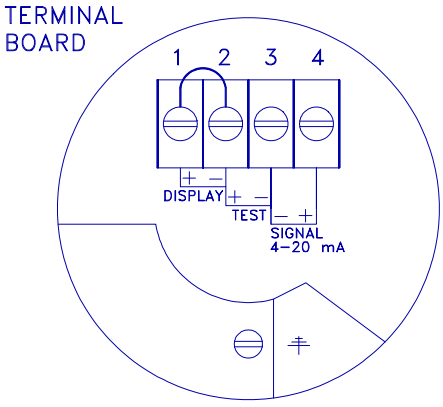
The diaphragms are protected by a special protection cap (PE). Do not remove this cap. When clogging is a problem, please contact Klay Instruments B.V. for other solutions. DO NOT DAMAGE THE DIAPHRAGM.

3.8 CALIBRATION

All transmitters are fully calibrated at the factory, to the conditions stipulated in users order. When the buyer has not requested calibration, the transmitter will be calibrated at the highest span. It is advisable to re-calibrate the transmitter after shipment.

3.9 WIRING





Under the cover (3) you will find the terminal board. The push buttons "Zero", "Span" and "Prog" are under the other cover (1).

External loads must be placed in the negative leg of the 2-wire loop.

The figure left shows the wiring connection of the transmitter. The 2-wires must be connected to 3(-) and 4 (+) of the terminal board.

The signal wiring must be shielded and twisted pairs yield best results. ***DO NOT*** run signal wiring in open trays with power wiring, or near “heavy” electrical equipment (E.g.: Frequency controller or heavy pumps). Shielding must always be connected at the side of the power supply.
The transmitter ground (internal or external) must ***NOT*** be grounded when the mounting position is already connected to earth.

This is extremely important to prevent an “earth loop”.

In applications with synthetic mounting positions the case grounding terminal (internal or external) must be connected to earth.

*Note: The Cer-2000 type with a synthetic process connection **must** be connected to earth.*
Care must be taken to assure that the polarity of the power supply is correct, a reversal of wiring polarity will not damage the transmitter, but it will not function until the wiring is connected correctly.

4. REMAINING

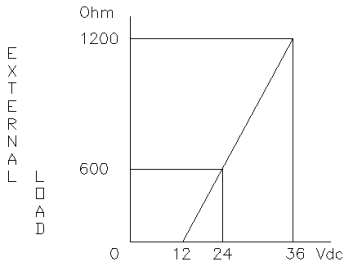
4.1 DIGITAL LOCAL INDICATOR

All transmitters from the Series 2000 are standard equipped with a digital display.
In the standard execution the covers are "closed". The three push buttons and the display are behind the cover (3).
As an option an "open" cover can be delivered to achieve the display can be used as a local display in the process. The full-scale point may be set to any value between 0000 and 9999 (4 digit). (Option: "I" extra price).

4.2 CE-rules

All our transmitters are manufactured according to the CE-rules. All transmitters are standard equipped with RFI filters. The influence on Radio Frequency Interference between 10 MHz to 10 GHz is neglectable.

4.3 EXTERNAL LOAD



The minimum power supply is based on the total circuit resistance.
The maximum permissible load(Ri max.) in case of 24 Vdc is 600 Ω (Ohm).

By increasing the power supply, the external load can be increased to 1200 Ohm / 36 Vdc. (see figure left).

$$RI\ max. = \frac{\text{Power Supply - 12 Vdc}}{20\ mA}$$

4.4 INTRINSICALLY SAFE (Ex version)

The Series 2000, Series 2000-SAN, Series CER-2000 and Series 2000-Hydrobar-cable are also available as an intrinsically safe device in category II 1G Ex ia IIC T4 Ga and/or II 1 D Ex ia IIIC T100 ºC Da IP6X (option, extra price).
Certificate Number : KEMA 03ATEX1092 X
For detailed explanation see the EC-Declaration of conformity on the last page of this manual.

Use a certified power supply in an intrinsic safe area, from 12 - 26,5 Vdc.
Installation of this device has to be carried out by a qualified mechanic / installer.

Transmitter type and options	Equipment category	Ambient temperature range
Pressure /Level Transmitter type Series 2000, 2000-SAN, CER-2000 and 2000 Hydrobar Cable, With transparant indicator cover (Option I)	II 1 G	-10ºC……70ºC
Pressure /Level Transmitter type Series 2000, 2000-SAN, CER-2000 and 2000 Hydrobar Cable, With closed cover	II 1 G	-20ºC……70ºC
Pressure /Level Transmitter type Series 2000, 2000-SAN, CER-2000 and 2000 Hydrobar Cable, With Option G100	II 1 GD	-20ºC……70ºC

The maximum surface temperature of the enclosure T 100ºC is based on a maximum ambient temperature of 70ºC.

Electrical data for Ex transmitters
Pressure Level Transmitter Type: Series 2000, Series 2000 SAN, Series CER 2000 and Series 2000-Hydrobar-cable. Supply/output circuit (terminals 3 '- ' en 4 '+'):
in type of protection intrisic safety Ex ia IIC or Ex ia IIIC only for connection to a certified intrinsically safe circuit, with the following maximum values:
U_i = 26,5 Vdc; I_i = 110mA ; P_i = 0,9W (linear source); L_i=1 mH; C_i = 32nF

Special conditions for safe use
As catogory 1G equipment may be applied directly in the process, electrostatic discharge from the cable and the protection cap of Pressure / Level Transmitter Series 2000-Hydrobar-Cable by the flow of non-conductive media (e.g. in stirring vessels or pipes) shall be avoided.

Special Instructions for Safe use
For use in a potentially explosive atmosphere caused by air/dust mixtures the following should be taken into consideration:

- the dust layer may not exceed a thickness of 5 mm
- as standard a transmitter is supplied with a certified cable gland (PG9). When using a different gland make sure it is certified.
- always use the covers supplied by Klay Instruments B.V.
-

WARNING
DO NOT REMOVE THE SCREW COVERS WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.

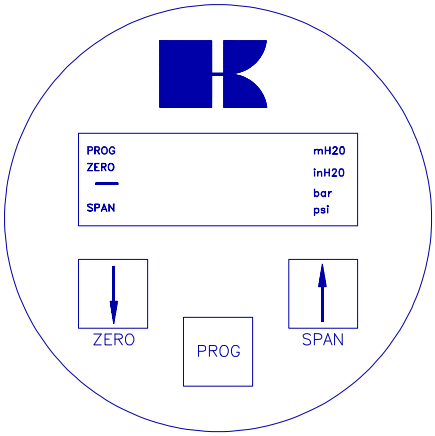
4.5 TRACEBILITY YEAR OF MANUFACTURING

The year of manufacturing of the transmitter can be traced as follows: take the first two numbers from the serial number that is engraved in the transmitter and add 1970 to it.
For example: if the serial number is 3902123. The year of manufacturing is 1970 + 39 = 2009.

4.6 SOFTWARE REVISIONS

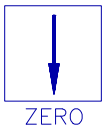
Due to the improvements on the Series 2000, there are several software versions (revisions). For this reason it is possible the transmitter you are working with does not support some options, which are discussed in this manual. This instruction is applicable from software revision 8.01. After powering up, the transmitter will show the revision number on the display.

5 FUNCTIONS OF PUSH BUTTONS



The Series 2000 can be programmed easily by use of the 3 front panel pushbuttons (See picture right).
The display can show engineering units of:
mH_2O, inH_2O, bar and PSI.

The functions of the three pushbuttons will be explained below.



This button has 2 functions:
1. It can be directly used for adjusting the zero (zero / 4mA), with or without a test pressure. When the zero (4 mA) must be adjusted at 0 (atmospheric pressure), the button must be held until the word "ZERO" appears on the display. The transmitter is now set to 4 mA.
2. Also, this button must be used for stepping down in the programming menu or to decrease a value (-).

Note: For canceling the mounting position effect you have to use P103.



This button has 2 functions:
1. It can be directly used for adjusting the span (20 mA), when using a test pressure (air). When a test pressure (e.g. 2 bar) is supplied to the transmitter, the button must be held until the word "SPAN" appears on the display. The transmitter is adjusted at 20 mA now. The span can also be adjusted without test pressure (see P102).
2. Also, this button must be used for stepping up in the programming or to increase a value (+).



This button has 2 functions:
1. It is used to adjust the 14 Programming Points (P101 to P114). Push it once and P100 is displayed, use the [↑] (SPAN) to step to P101 etc.
2. This button must also be used for confirming the adjustments (enter).

For example if you want to change the adjustment in bars (P104), the following steps must be taken:
1. Push on [PROG] till "100" appears on the display.
2. Push on [SPAN] 4 times to go to point "P104" (adjustment pressure unit).
3. Push [PROG] to confirm this.
4. Push several times on [↑] (SPAN) to reach 3 (= bar). See also the conversion table (page 11).
   1 = mWC, 3 = bar, 5 = PSI, 11 = inch WC
5. Confirm this by pushing once at [PROG].
   The transmitter is now adjusted to read in "bar".

6. PROGRAMMING POINTS (P101 – P114)

The following points can be adjusted by means of the three push buttons.
For an explanation of these points see page 11 to 18 of this manual.

To change one of these points you have to push on [PROG] until "100" appears on the display.
To go to from a lower program (P101) to a higher one (P102), push on button [↑] (SPAN).

To confirm the adjustments you always have to press on [PROG].

*) Standard adjustments ex works.

Programming points:	
P101	Zero adjustment (4 mA)
P102	Span adjustment (20 mA)
P103	Cancel mounting position effect
P104	Adjustment pressure unit (See Conversiontable)
P105	4-20 mA *) 20-4 mA (Reverse output)
P106	Adjustment damping (0 tot 25 sec)
P107	Indication of process temp. (Read out on display)
P108	0 = °C (*) 1 = °F
P109	Read out on display: Curr (0) = current (4 - 20 mA) (*) Unit (1) = pressure unit (conversiontable) PerC (2) = percentages TenP (3) = temperature Hect (4) = hectoliters CB n (5) = Cubic meters Ltr (6) = Liters
P110	Simulation of current
P111	Linearisation 0 = no linearisation (*) 1 = cylindrical tank 2 = vertical tank with cone 3 = vertical tank with spherical cone
P112	Specific density
P113	Write Protection
P114	Response time from push buttons

7. READING ON THE DISPLAY

On the standard built-in display several values can be shown.

During the programming of the transmitter the display shows all the information that is needed.
When the transmitter is in the process the display gives all the information of the process pressure or temperature.
On the display the following units can be showed: mH_2O, inH_2O, bar and PSI (see also P104 and P109).



N.B.: The standard transmitter is supplied with two "closed" covers shielding the buttons and the display. As an option an "open" cover (IP 65) can be fitted. The display can then be used as a local process display. (Option: "I" extra price). The full scale can be set between -9999 and 9999 (4 digit).

8. EXPLANATION PROGRAMMING POINTS P101 to P114

P101 ***ZERO ADJUSTMENT (4 mA)***

The transmitter as standard is adjusted to 4.00 mA at atmospheric pressure.
It is also possible to adjust a zero-suppression or elevation.

For example: zero elevation of 1 mWK.
1. Push at [PROG] until "100" is shown on the display.
2. Push once at [⇑] / SPAN till "101".
3. Confirm this by pushing [PROG].
4. Now the display will show 0.00 mH_2O. Push at [⇑] till 1.00 mH_2O is on the display.
5. Confirm with [PROG].
6. The output of the transmitter will be lower than 4 mA. The output at atmospheric pressure will be for example 3.68 mA.
   When a pressure of 1 mWC is applied on the diaphragm the output will be 4.00 mA.

The elevation can be canceled by pushing at [ZERO] till zero disappears out of the display. The transmitter is now adjusted at 4 mA at atmospheric pressure.

P102 ***SPAN ADJUSTMENT (20 mA) WITHOUT TEST PRESSURE***

Before adjusting the span take care the right pressure unit is selected.
(See also P104 and P109).

Example: Adjustment of the span at 0 - 2 bar.
First off all, the pressure unit must be adjusted at "bar". (See P104 and P109).
1. Push [PROG] till "100" is shown on the display.
2. Push twice at [⇑] / SPAN until "102" is on the display.
3. Confirm this by pushing [PROG].
4. Push [SPAN] (+) or [ZERO] (-) to select the measuring range that is required.
5. Confirm by pushing [PROG].
   The transmitter is adjusted now.

N.B.: P102 is the adjustment of the total span.
When a "compound" range must be adjusted (for example -1 till +3 bar), a span of 4 bar must be programmed. At P101 (ZERO,4 mA), -1 bar must be adjusted. Now the transmitter is adjusted at: - 1 bar = 4 mA and +3 bar = 20 mA.

N.B.:

It is not possible to show values larger than '9999' or smaller than '–9999' on the display. In this case the display will show:
- ---- For values larger than '9999'.
- ---. For values smaller than '–9999'.

As long as the display shows "- - - - ", the value will not be saved by pressing "PROG".

P103 ***CANCEL MOUNTING POSITION EFFECT***

All transmitters are calibrated vertically. When a transmitter of the Series 2000 or 2000-SAN is installed horizontally, there will be a small "mounting effect" on the zero
(4 mA). For example the transmitter shows 4.03 mA instead of 4.00 mA.
This can be easily canceled with P103. In P103 there are three options:

1. ESC:
   Nothing can be changed.
   Leave without doing anything. (confirm with PROG).

2. RESET:
   Use this option when you are not sure if P103/SET has been done in a proper way. (confirm with PROG).
   when using this option the original factory setting will be valid.

3. SET:
   Canceling mounting position effect. (confirm with PROG).
   When "SET" is selected the transmitter is automatically adjusted at 4.00 mA.
   The span will not be affected.

CAUTION: Do not apply pressure while executing "cancel mounting position effect"

N.B.:

From revision 2 the description above is valid. Transmitters working with software revision 1 will direct process cancel mounting position.

P104 ***ADJUSTMENT PRESSURE UNIT ON DISPLAY (See Conversion table)***

Several engineering units can be shown on the display by using a conversion factor. (See conversion table below). Four engineering units will light up on the display (mH_2O, inH_2O, bar and PSI).

N.B.: To show one of the engineering units, P109 must be adjusted at 1 (= pressure unit).

This will be explained with an example (e.g. bar):

1. Push at [PROG] till "100" is shown on the display.
2. Push 4 times at [↑], go to [P104].
3. Push at [PROG] to confirm this.
4. Push at [↑] / [SPAN] and adjust at 3 (= bar).
   1 = mH_2O (=mWC), 3 = bar, 5 = PSI, 11 = inch WC.
5. Confirm with [PROG].
   The transmitter will now read out in bars.

CONVERSION TABLE:

104	CONVERSION FACTOR	DISPLAY	
1	1.000	mH_2O (mWC)	*
2	1000	m H_2O (mm WC)	
3	0.09806	bar	*
4	98.0665	mbar	
5	1.4223	PSI	*
6	0.0967	Atm	
7	9.80665	KPa	
8	0.009807	MPa	
9	0.1	Kgf/cm^2	
10	73.556	mm HG	
11	39.37	inH_20 ("WC)	*
12	2.895906	"HG	

*) *Pressure units that can be shown on the display.*When the value of the highest range is larger than 9999, "NA" will appear in the display (Not Applicable). Another unit must be chosen.

P105 ***REVERSE OUTPUT (20 - 4 mA)***

The transmitter as standard is adjusted to 4-20 mA.
Push on [PROG] and go to P105.
Push once at [↑] to change the output to 20-4 mA (Reverse output).
Push at [PROG] to confirm this.
Now the transmitter will give 20 mA at atmospheric pressure.

P106 ***ADJUSTMENT DAMPING (0 till 25 sec)***

In P106 an electronic damping can be adjusted between 0 and 25 seconds.
This can be done with the push buttons [↑] (up) and [↓] (down).
Always confirm by pushing once at [PROG].

P107 ***INDICATION OF PROCESS TEMPERATURE (READ OUT ON DISPLAY)***

1. Push [PROG] until "100" is shown on the display.
2. Push 7 times at [↑], go to [P107].
3. Push [PROG] to confirm this. Now the process temperature appears on the display (Indication: +/-2°C).

This will remain on the display. To get the actual pressure back on the display you have to push again on P107 until the actual pressure appears on the display again.

P108 ***TEMPERATURE IN °C OR °F***

The temperature of the transmitter is standard adjusted at °C ("DEGR"). When pushing at [↑] in P108, this will change into °F ("FAHR").
Always confirm by pushing once at [PROG].

P109 ***READ OUT ON DISPLAY***

Curr (0) = current	(4 - 20 mA)
Unit (1) = pressure unit	(See conversion table)
PErC (2) = percentages	(0 - 100%)
TEnP (3) = temperature	(°C of °F)
HECt (4) = hectoliter	(only in combination with P111)
Cb n (5) = Cubic meter	(only in combination with P111)
Ltr (6) = Liters	(only in combination with P111)

As standard the transmitter is delivered with read out in mA (0).To change this, follow the next steps:

1. Push [PROG] until "100" is shown on the display.
2. Push 9 times at [↑] / SPAN till "109" appears on the display.
3. Confirm with [PROG].
4. Push once at [↑].
5. Push [PROG] to confirm this.
   The transmitter will now read mH_2O (mWC).

   The pressure unit can be changed with the conversion table in "P104".
   1 = mH_2O (=mWK), 3 = bar, 5 = PSI, 11 = inch WK.

Also the read out can be 0 - 100%. In this case select "P109", option 2.

P110 ***SIMULATION OF CURRENT (4-20 mA)***

The transmitter can be used as a simulator of a current between 4 - 20 mA.
This can be done in P110 with the push buttons [↑] and [↑].

The user can perform a current simulation (Curr) or a pressure simulation (Unit).

Current-simulation (Curr)
To perform a current-simulation follow the next steps:

1. Push [PROG] until "100" is shown on the display.
2. Push 10 times at [↑] / SPAN till "110" appears on the display.
3. Confirm with [PROG].
4. The display will readout 'Curr'
5. Confirm with [PROG].
6. The display shows '4.00'. Push [PROG] and the output changes to 4.00 mA.
7. By pushing [↑] / SPAN or [↓] / ZERO, you can change the value on te display. The output value will change as soon as the [↑] / SPAN OR [↓] / ZERO button is released.
8. Pressing the [PROG]-button again will exit the simulation.

Pressure-simulation (Unit)
To perform a pressure-simulation follow the next steps:

1. Push [PROG] until "100" is shown on the display.
2. Push 10 times at [↑] / SPAN till "110" appears on the display.
3. Confirm with [PROG].
4. The display will readout 'Curr'
5. Press [↑] / SPAN once
6. The display will readout 'Unit'.
7. Confirm with [PROG].
8. The display shows a pressure value. Push [PROG] and the output changes to a mA-output corresponding with the range entered in menu P101 and P102.
9. By pushing [↑] / SPAN or [↓] / ZERO, you can change the value on the display. The output value will change as soon as the [↑] / SPAN OR [↓] / ZERO button is released.
10. Pressing the [PROG]-button again will exit the simulation.

Note:

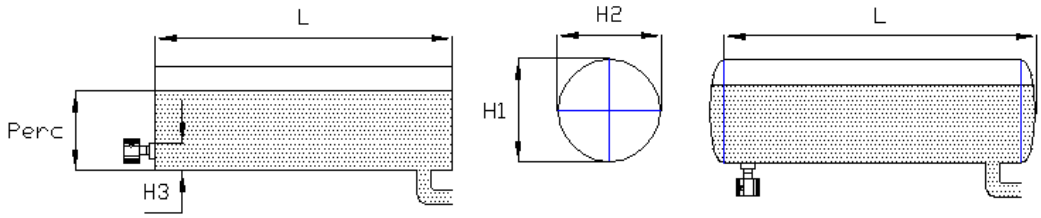
- The values that can be entered using the pressure-simulation are related to the adjustments in menu P101 and P102. These values are also the minimum and maximum values.
- For HART-transmitters: this menu will not work when the device is operating in multi-drop mode.

P111 ***LINEARISATION***

0 = no linearisation
1 = cylindrical tank (horizontal)
2 = tank with bottom cone
3 = tank with spherical bottom

As standard the transmitter is delivered without linearisation (= 0). However, for a horizontal tank or a tank with a bottom cone, a linearisation can be applied to achieve the current signal (mA) is equal to the level in the tank. All values must be programmed in meters.

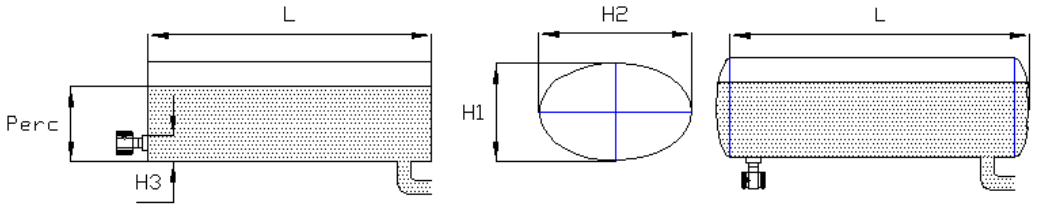
Linearisation horizontal tank (Cilindric)



Cylindrical horizontal tank *Cylindrical tank with cone-shaped ends*

1. Push [PROG] until "100" is shown on the display.
2. Push 11 x at [↑] / SPAN till "111" appears. (Confirm with [PROG])
3. Push [↑] once. (Confirm with [PROG])
4. Enter the height (H1) of the tank in meters. (Confirm with [PROG])
5. Enter the same height (H2) of the tank in meters. (Confirm with [PROG])
6. Enter the length (L) of the tank. For a "ball" or cone shaped tank, take the cylindrical length plus the length of 1 "ball" cone. (Confirm with [PROG])
7. Enter H3 in meters if the transmitter is installed like in the left picture. Enter 0m when the transmitter is installed like in the right picture.
8. Enter the percentage of the actual "full" level (for example 80%). (Confirm with [PROG]).

Linearisation horizontal tank (Elliptic)



Cylindrical horizontal tank *Cylindrical tank with cone-shaped ends*

1. Push [PROG] until "100" is shown on the display.
2. Push 11 x at [↑] / SPAN till "111" appears. (Confirm with [PROG])
3. Push [↑] once. (Confirm with [PROG])
4. Enter the height (H1) of the tank in meters. (Confirm with [PROG])
5. Enter the height (H2) of the tank in meters. (Confirm with [PROG])
6. Enter the length (L) of the tank. For a "ball" or cone shaped tank, take the

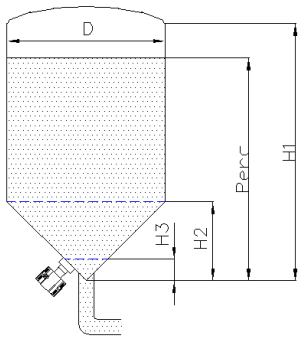
cylindrical length plus the length of 1 "ball" cone. (Confirm with [PROG])

7. Enter H3 in meters if the transmitter is installed like in the left picture. Enter 0m when the transmitter is installed like in the right picture.
8. Enter the percentage of the actual "full" level (for example 80%). (Confirm with [PROG]).

Note

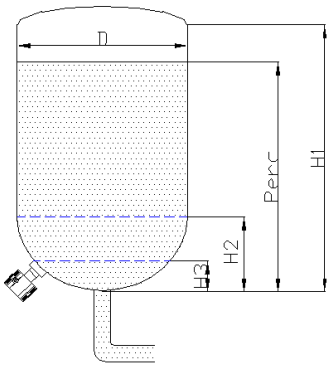
*If the height (H) of the tank is 1 meter and the maximum level in the tank is 0,8 meter the percentage (point 5) must be set at 80%.**The calibration at P102 must be adjusted at: 1 meter (if s.g. equals 1).***

Linearisation *vertical tank with cone*



1. Push [PROG] till "100" appears on the display.
2. Push 11 times at [↑] till "111" appears. (Confirm with [PROG])
3. Push twice at [↑]. (Confirm with [PROG])
4. Enter height (H1) of the tank (= actual level).(Confirm with [PROG]).
5. Enter diameter (D) of tank. (Confirm with [PROG])
6. Enter height (H2) of cone. (Confirm with [PROG])
7. Enter the height (H3) from the bottom of the tank to the topside of the diaphragm (or weld-on nipple). (Confirm with [PROG]).
8. Enter the percentage of the actual "full" level (for example 80%).(Confirm with [PROG]).

Linearisation *vertical tank with spherical cone* *(from software revision 3)*



1. Push [PROG] till "100" appears on the display.
2. Push 11 times at [↑] till "111" appears. (Confirm with [PROG])
3. Push three times at [↑]. (Confirm with [PROG])
4. Enter height (H1) of the tank (= actual level).(Confirm with [PROG]).
5. Enter diameter (D) of tank. (Confirm with [PROG])
6. Enter height (H2) of cone. (Confirm with [PROG])
7. Enter the height (H3) from the bottom of the tank to the topside of the diaphragm (or weld-on nipple). (Confirm with [PROG]).
8. Enter the percentage of the actual "full" level (for example 80%).(Confirm with [PROG]).

Note

*When the specific gravity of the fluid is unequal to 1 and you do not want to use option 4, you must take care of it by defining the **calibration** of the transmitter. Calibration (see P102) = Height of the level x Specific Gravity.*

P112 ***SPECIFIC DENSITY***

If the specific gravity of the medium differs from 1 kg/dm^3, you can enter the real density of the medium in P112. When this option is used, in menu P102, the 'true' height of the tank must be entered.

P113 ***WRITE PROTECTION***

The Series 2000 with HART-Protocol can be protected for writing (Write Protection). This is possible for two kinds of writings:

- Changes via the Display ("Lo.Pr" = Local Protection).
- Changes via external HART configuration software by the **Hand-held terminal or the P.C.** ("Co.Pr."= Communication Protection).

Standard, the transmitter is set to no-write protection.

Adjustment Local Protection

1. Push [PROG] till "100" appears on the display.
2. Push [↑] / SPAN 13 times till "113" appears on the display.
3. Push [PROG] to confirm. ("Lo.Pr." appears on the display).
4. Push [↑]/[↓] for adjusting to "ON" or "OFF".
5. Push [PROG] to confirm.

Adjustment Communication Protection

1. Push [PROG] till "100" appears on the display.
2. Push [↑] / SPAN 13 times till "113" appears on the display.
3. Push [PROG] to confirm. ("Lo.Pr." appears on the display).
4. Push once more at [PROG]. ("Co.Pr." appears on the display).
5. Push [↑]/[↓] for adjusting to "ON" or "OFF".
6. Push [PROG] to confirm.

N.B. When Lo.Pr. is set to "ON", the display shows 104, 105, 107, 108, 109 and 111 and the adjusted values of the parameters. Afterwards "PROT" (Protected) is shown.

Both protections can be adjusted at the same time, independent from each other.

P114 ***RESPONSE TIME FROM PUSH BUTTONS***

This option can only be used from software version 8.01. The response time from the push buttons can be adjusted from 0,0 till 5,0 seconds.

P115 ***SERVICE MENU***

Use only under order of manufacturer.

P116 ***SERVICE MENU***

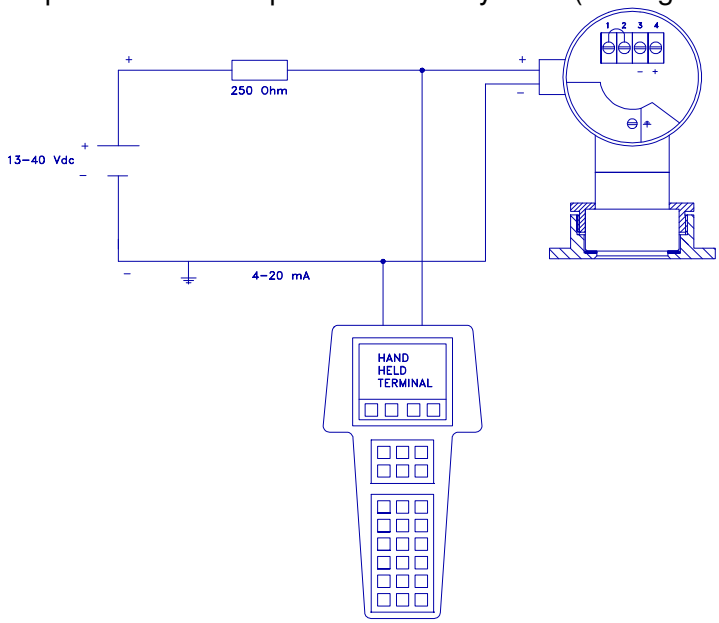
Use only under order of manufacturer.

9. PROGRAMMING THE SERIES 2000

9.1 PROGRAMMING WITH THE HAND HELD TERMINAL

The series 2000 can be programmed very easily with the Hand Held Terminal (HHT) from the "HART Foundation" or the HHT from "Rosemount" (type 275 Hart Communicator).
The HART (Highway Addressable Remote Transducer) Communicator provides a common communication link to all HART-compatible, microprocessor-based instruments.

WARNING: When using a HHT to function properly, a minimum resistance of 250 Ohms *must* be present in the loop of the 2-wire system. (See figure below).



9.2 PROGRAMMING WITH DTM

There is an instruction manual available which is a guide for installing and using the Klay Series 2000 HART DTM. This DTM is developed to make configuration changes of Klay Series 2000 HART transmitters easy.
This DTM can be used with almost every FDT-container.

To be able to install the DTM Klay Series 2000 HART on your system, you have to download the installation file. This file can be downloaded from the Klay Instruments site or via the following link: http://www.klay.nl/dtm.
The installation can be started by opening the "***DTM Klay Series 2000 HART V1-2-0-1.zip***" and continue by opening the "***DTM Klay Series 2000 HART V1-2-0-1.exe***" file.

9.3 PROGRAMMING WITH PDM

There is also a Device Description (DD) available for the Series 2000 HART. This DD can be used for configuring a Series 2000 HART transmitter using Simatic PDM. You can download this DD (in zip file) from the following link: http://www.klay.nl/pdm.
To install the DD, unzip the KLAY_PDM_HART_REV8.ZIP file and run DeviceInstall.exe.

10. SPECIFICATIONS

Manufacturer		Klay Instruments B.V.		
Instrument		Series 2000, Series 2000-SAN, Series CER-2000 and 2000-Hydrobar		
Output		4-20 mA Optional: HART Protocol		
Power Supply		12 - 36 Vdc Ex-version: 12 - 26,5 Vdc		
Accurancy		0,1% of adjusted span		
Ranges	**Code**	**Adjustable span ranges**		**Max. overpressure.**
Series 2000	1	0-0,1 bar	0-0,4 bar	6,4 bar
	2	0-0,3 bar	0-1,2 bar	10,5 bar
	3	0-1 bar	0-10 bar	30 bar
	4	0-5 bar	0-30 bar	100 bar
	5	0-20 bar	0-100 bar	200 bar
Series 2000 (SAN)/2000-Hydrobar	1	0-0,04 bar	0-0,4 bar	6,4 bar
	2	0-0,1 bar	0-1,2 bar	10,5 bar
	3	0-1 bar	0-10 bar	30 bar
	4	0-5 bar	0-30 bar	100 bar
	5	0-20 bar	0-100 bar	200 bar
Series CER 2000	1	0-0,2 bar	0-0,8 bar	5 bar
	2	0-0,8 bar	0-2 bar	10 bar
	3	0-2 bar	0-10 bar	30 bar
	4	0-10 bar	0-40 bar	120 bar
	5	0-40 bar	0-200 bar	350 bar
	6	0-150 bar	0-320 bar	600 bar
Process temperature [1]				
Series 2000		-20°C to + 80º C (-4 °F to 176 °F)		
Series 2000 (SAN)		-20°C to +100°C (-4 °F to 212 °F)		
Series CER-2000		-20°C to +100°C (-4 °F to 212 °F) (only gases)		
Series 2000-Hydrobar		-10°C to + 70°C (+10 °F to 160 °F)		
Temperature effect		0,015% / K		
Ambient Temperature		-20°C to +70C (-4 °F to 158 °F) For Ex-version see paragraph 4.4		
Damping		0,5 s to 25 sec (0,5 sec = Std. Damping)		
Protection grade		IP 66 IP 68 (for 2000-Hydrobar-cable submersed parts)		
Material *Housing*		AISI 304		
"wetted" part		AISI 316 L		

1 For higher temperatures use other kind of pressure transmitters. Contact Klay Instruments for information.

11. *PRECAUTIONS and WARNINGS*

- ✓ ***Check if the specifications of the transmitter meet the needs of the process conditions***
- ✓ ***When the Series 2000-SAN is used as a level transmitter, be aware of the place where the transmitter is mounted. Here are some suggestions:***
  1. ***DO NOT mount a level transmitter in- or near filling or discharging pipes.***
  2. ***In case of automatic cleaning systems or hand cleaning: never point the water jets on the diaphragm, take necessary steps to avoid this. Guarantee will not be granted.***
- ✓ ***When the Series 2000 is used as a pressure transmitter, be aware of the following points:***
  1. ***Rapid closing valves in combination with high flow velocity will cause water hammer(spikes) and can destroy the transmitter. DO NOT mount a transmitter near such valves, always a few pipe bends away up or down stream (avoid suction).***
  2. ***Install a pressure transmitter a few pipe bends away from pumps, as well on the suction or pressure side of the pump***
- ✓ ***WELDING INFORMATION:***
  When using the Series 2000 or 2000-SAN code "W" the welding information on page 4 must be followed exactly. This is very important to prevent distortion of the weld-on nipples. It also prevents the screw thread from the Series 2000-SAN (M56 x 1,25) from being deformed.
- ✓ ***The diaphragm of the transmitter is protected with a special protection cap. Protect the diaphragm until installation takes place, to prevent damaging of the diaphragm.***
- ✓ ***As soon as the wiring is brought inside through the PG9 cable gland and connected to the terminal board, make sure the cable gland is tightly fixed, so that moisture cannot enter into the electronic housing.***
- ✓ ***Avoid high pressure water-jets pointed at the venting.***
- ✓ ***If the ambient conditions are very wet, we advise to use a venting through the cable. A special vented cable can be delivered on request. (The normal venting will be removed)***
- ✓ ***Turn the covers (1 and 3) hand-tight, so that moisture cannot enter into the electronic housing.***
- ✓ ***WARRANTY: The warranty is 1 year from purchase date.***
  Klay Instruments B.V. does not accept liability for consequential damage of any kind due to use or misuse of the Series 2000. Warranty will be given, to be decided by the manufacturer. Transmitter must be shipped prepaid to the factory on manufacturers authorization.
- ✓ ***NOTE: Klay Instruments B.V. reserves the right to change its specifications at any time, without notice. Klay Instruments B.V. is not an expert in the customer's process (technical field) and therefore does not warrant the suitability of its product for the application selected by the customer.***

MANUFACTURER

KLAY INSTRUMENTS B.V.

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PO box 13 7990 AA Dwingeloo The Netherlands
Tel: (+31) 521-591550
Fax: (+31) 521-592046
E-mail: info@klay.nl
Web : www.klay.nl

EC-DECLARATION OF CONFORMITY

Klay Instruments B.V.

Nijverheidsweg 5, 7991 CZ Dwingeloo, The Netherlands

Certify that the equipment intended for use in potentially explosive atmospheres, only new products, indicated here after:

Electronic Pressure- and Level Transmitters
Type: Series 2000, Series 2000-SAN, Series CER-2000,
Series 2000-Hydrobar-Cable, 2000-Hydrobar-EXTD,
Level Transmitter Type: Hydrobar-I,
Temperature Transmitter Type: TT-2000

Are in accordance with:

- directive 94/9/EC of 23 march 1994 (equipment and protective systems intended for use in potentially explosive atmospheres).
- Directive 89/336/EEC of 03 may 1989
  (Electro Magnetic Compatibility).
- Harmonized standards:
  - EN 60079-0: 2009 (General rules)
  - EN 60079-11: 2007 (Intrinsic safety "i")
  - EN 60079-26: 2007 (Group II cat. 1G requirements)
  - EN 61241-11: 2006 (Group II cat 1 D requirements)
  - IEC 61000-6-2: 2001 (EMC, Immunity in industrial location)
  - IEC 61000-6-3: 2001 (EMC, Emission in industrial location)
  - IEC 61000-6-4: 2001 (EMC, Emission in industrial location)
  - NEN-EN 13980: 2007 (Potentially explosive atmospheres – Application of quality systems
- The type (protection mode "ia") which has been the subject of;
  EC-type Examination Certificate Numbers:
  KEMA 03 ATEX1092 X
  delivered by the KEMA, Utrechtseweg 310, 6812 AR Arnhem, The Netherlands, notified body Nr. 0344,
  Manufacturing plant in Dwingeloo which has been the subject of;
  Production Quality Assurance Notification Nr.:
  KEMA 06 ATEX Q1088
  delivered by the KEMA, Utrechtseweg 310, 6812 AR Arnhem, The Netherlands, notified body Nr. 0344

Date: December 1st, 2010
E. Timmer
Managing Director

Signature:

The marking of the equipment for gasgroup is as follows:	**II 1G Ex ia IIC T4 Ga**
The marking of the equipment for dustgroup is as follows:	**II 1 G Ex ia IIC T4 Ga and/or** **II 1 D Ex ia IIIC T 100 °C Da IP6X**

"II"	means that the equipment has been built for use in surface industries (and not in mines endangered by firedamp).
"1"	equipment for use in Zone 0 (if G), Zone 20 (if D)
"G"'	equipment for use with gas, vapours or mists
"D"'	equipment for use with dust
"Ex"	equipment in compliance with European standards for explosive atmospheres
"ia"	equipment in compliance with specific building rules for intrinsically save equipment
"C"	equipment for use with gas of subdivision C
"T4"	equipment whose surface temperature does not exceed 135ºC when used in an ambient temperature < 70 ºC.
100 °C	maximum surface temperature of the equipment covered with a dust layer of 5 mm
"IP6X"	equipment with Ingress Protection (IP) dust tight

Protection Grade, Series 8000-SAN, 8000, CER-8000, ***IP 66***
Protection Grade, Series 2000-SAN, 2000, CER-2000, ***IP 66***
Protection Grade, Series Hydrobar-cable, Hydrobar-EXTD, ***IP 66***
The Hydrobar-FR and all other submersible parts from the Series Hydrobar are IP 68.
Furthermore, whatever the protection mode, only use cable glands with a protection degree of at least IP 66.
Be sure the cable diameter complies with the selected cable gland. Tighten the cable gland in a proper way.
Never forget to mount the covers of the electronics housings in a proper way.
For other technical details, refer to the instruction manuals of the series transmitters.