



*Instrumentation designed
with the user in mind*

Instruction Manual

Princo LP-D Series
Two-Wire SmartPress™
Smart Pressure and Liquid Level Transmitters

24 Aug 05



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1 Introduction

1.1 Description

The Princo SmartPress™ LPD Series is a 2-wire, microprocessor controlled pressure and level gauge. The loop-powered transmitter may also serve as an indicator by use of the model SAP-203 plug-in display and programming module. The unit measures the hydrostatic pressure. For level gauging, it calculates level based on the hydrostatic pressure and the programmed value of the density of the process material.

SmartPress™ flush diaphragm pressure and level transmitters/indicators provide simple and highly reliable solutions for the continuous monitoring of the pressure and level of liquids and masses.

The flat surface of the diaphragm avoids the risk of material build-up. The maximum medium temperature of 125°C allows proper (CIP) cleaning required by the regular cleaning processes of the food industry and similar hygienic applications.

Programming is done through the model SAP-203 plug-in module. The 4 and 20mA output points may be assigned at any two points along the measurement range. The unit may be set up to read out in either English (psi, ft) or metric (bar, mbar, meters) units of pressure or level, or in percentage of span as defined by the assigned 4 and 20mA output points. Other programmable functions include density, gravitational acceleration, zero point correction, rounding and damping time.

The SmartPress™ is available with or without HART remote programming capability.

1.2 Principles of Operation

The SmartPress™ senses pressure by means of a piezoresistive sensor that is protected by a flush diaphragm with silicon oil between the two for pressure transfer. Assuming that the density of the process material is constant, the level is directly proportional to the pressure head. Based on the equation below, the unit calculates level for level-monitoring applications.

$$P_{\text{hydr}} = 10^{-5} \rho \cdot g \cdot h$$



$$h = 10^5 \frac{P_{\text{hydr}}}{\rho \cdot g}$$



Possible maximum value of “h”: $h_{\text{max}} = 10^5 \frac{P_{\text{hydrmax}}}{\rho \cdot g}$

P_{hydr} [bar] = hydrostatic pressure

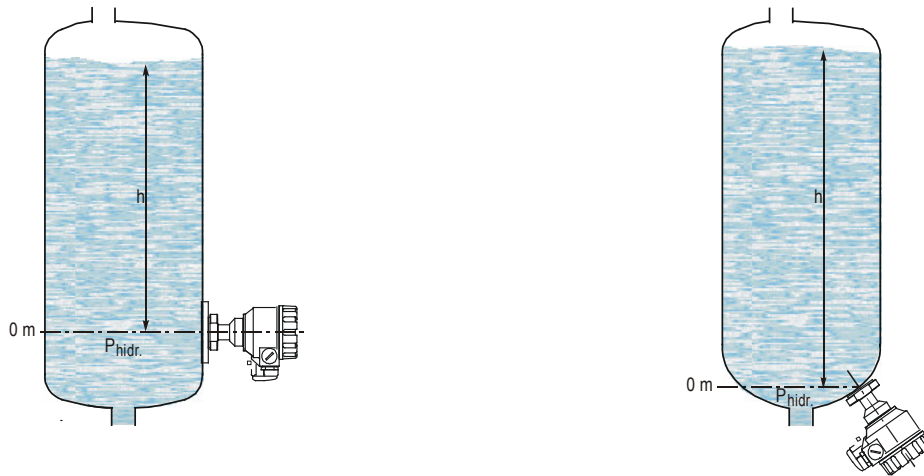
ρ [kg/m³] = density of the medium

g [m/s²] = gravitational acceleration

h [m] = distance between middle of the diaphragm and level of the medium

$P_{\text{hydr.max}}$ = highest pressure value set in the default

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2 Order Codes

SMARTPRESS LP-D - T - - - 1 - -

TYPE	CODE	PROCESS CONNECTION*	CODE	ELECTRONIC HOUSING	CODE	RANGE (PSI)	MAXIMUM PRESSURE (PSI)	CODE	OUTPUT / EX	CODE
Transmitter	T	1" Triclamp	L	Aluminium	5	-14.5 to 0	43.5	0	4 to 20 mA	2
		1½" Triclamp	M	Plastic	6	0 to 1.45	7.5	1	4 to 20 mA / HART	4
		2" Triclamp	N			0 to 3.00	14.5	2	4 to 20 mA / EEx ia	6
		1" NPT	S			0 to 5.00	14.5	3	4 to 20 mA / HART / EEx ia	8
						0 to 8.00	43.5	4		
						0 to 14.5	43.5	5		
						0 to 23.0	87.0	6		
						0 to 34.0	87.0	7		
						0 to 58.0	290	8		
						0 to 87.0	290	9		
						0 to 145	290	A		
						0 to 230	870	B		
						0 to 360	870	C		
						0 to 580	1450	D		
						0 to 870	1740	E		
						0 to 1450	3600	F		
						0 to 2300	7250	G		
						0 to 3600	7250	H		
						0 to 5800	8700	J		

*For range p > 0 to 580 psi, 1" process connection only.


- Pressure transmitting medium:
 Silicone oil, standard
 Food compatible oil (on special request)

Not all combinations possible!

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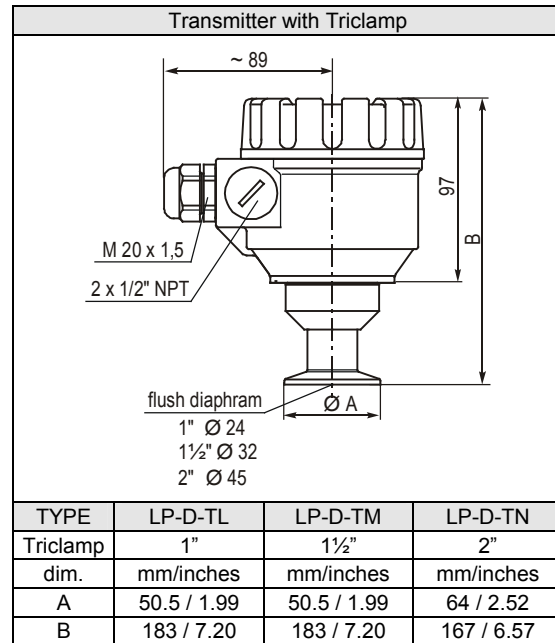
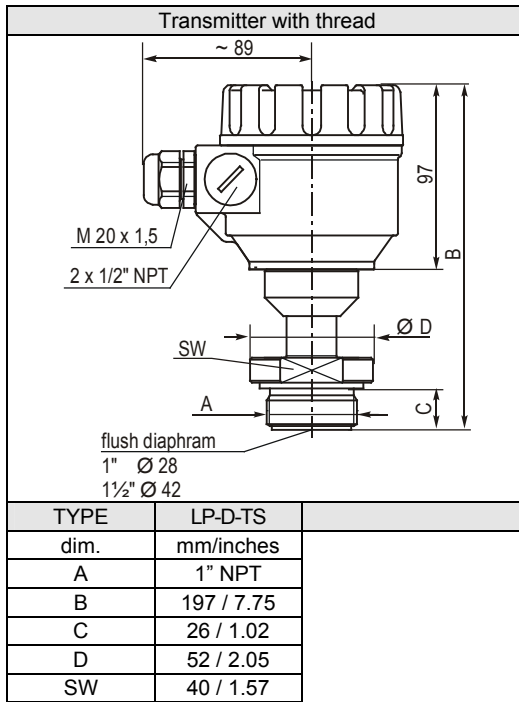
3 Technical Data

3.1 General Data

TYPE	LP-DT□-□□1-□		
Measured variables	Pressure, level		
Sensor	Piezoresistant silicon sensor, with protection front diaphragm		
Ranges	In accordance with data in the order codes		
Overload capability	In accordance with data in the order codes		
Turn down	1 : 2		
Zero offset	10% of the range for units with 1" process connection; 50% of range for other units		
Output	4 to 20 mA or HART Limits of the 4 to 20mA output signal: 3.9 to 20.5 mA Minimum loop resistance with HART: R _{tmin} = 250 ohm		
Damping time	Selectable: 3, 5, 10 or 20 seconds		
Error indication by current output	3.8 mA or 22 mA		
Power supply	10 to 36 Vdc		
Output load	R _L = (U _s - 10 V) / 0.022 A, where U _s = supply voltage		
Display	6-digit LCD, engineering units and bargraph. All variables can be displayed.		
Accuracy (linearity, hysteresis, repeatability), valid within max turn down of 1:2	± 0.25% of range for units with upper range limit p > 5 psi and for -14.5 < p ≤ 0 psi units ± 0.5% of range for 0 < p ≤ 5 psi		
Temperature coefficient in the range of the compensated temperature (relating to the higher limit value)	32°F to 158°F / 0 °C to 70 °C		32°F to 122°F / 0 °C to 50 °C
	≤ ± 0.75%	For the range of > 0 to 14.5 psi For the range of -14.5 to 0 psi	≤ ± 1% For the range of 0 to 5 psi ≤ ± 1.5% For the range of 0 to 3 psi
	≤ ± 1%	For the range of 0 to 14.5 psi For the range of 0 to 8 psi	≤ ± 2% For the range of 0 to -1.45 psi
Ambient temperature	-40°F to 158°F / -40 °C to +70 °C with display: -13°F to 158°F / -25 °C to +70 °C		
Process temperature	13°F to 257°F / -25 °C to +125 °C		
Storage temperature / humidity	-13 to +140°F / -25 to +60°C / max. 98% R.H.		
Ex marking, Ex approved power supply data	 II 1 G EEx ia IIC T6 ...T4 U _{max} ≤ 30 V I _{max} ≤ 140 mA P _{max} ≤ 1 W C _i ≤ 20 nF L _i ≤ 200 μH		
Electric protection	Class III		
Ingress protection	IP 65		
Process connection	According to the order code		
Electric connection	Shielded cable pair with diameter Ø .24 to .47 inches / 6 to 12 mm (for the cable gland M 20 x1.5) wire cross section: 15 to 23 AWG / 0.25 to 1.5 mm ²		
Electronics housing	Powder paint coated aluminium or plastic (VALOX 412)		
Wetted parts	Protection front diaphragm: stainless steel, DIN 1.4435 Process connection: stainless steel, DIN 1.4435		
Pressure transmitting medium	Silicone oil (food compatible oil on request)		
Mass	Approximately 4.4 lbs / 2 kg with aluminium housing. Approximately 3.5 lbs / 1.6 kg with plastic housing.		

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3.2 Dimensional Data



3.3 Accessories

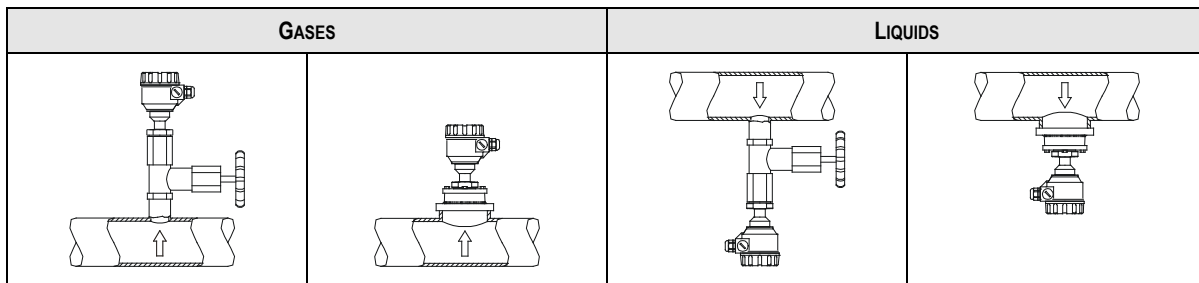
Accessories included with unit are the Instruction Manual and 2 cable glands. The Instruction Manual for this unit, as well as manuals for most other instruments made by Princo Instruments, are also available on-line at www.princoinstruments.com.

4 Installation

4.1 Mechanical Installation

Location of installation should be selected for ease of access.

Units measuring gases should be mounted at the highest point, liquids at the lowest point of the tank or pipe.



Unit should not be installed in locations with pressure waves, for instance near stirrers or pumps.

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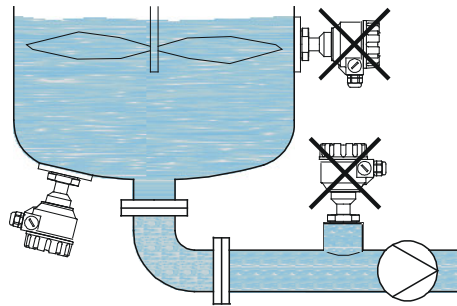
Unit should be protected from direct sunlight.

CAUTION!

Take special care to protect the front diaphragm. The front diaphragm must not be pressed by hand or any object or cleaned with a hard tool. The diaphragm protection cap should only be removed before installation!

Devices with threads should be tightened with open-end wrench to the maximum torque of 35 Nm.

After tightening the transmitter, the turnable housing may be rotated so that the cable gland will face down. This is especially suggested in open-air applications.



4.2 Electrical Installation

Transmitters are used in 2-wire systems with a power supply of 10 to 36 Vdc. Resistance of the units in the loop depends upon the voltage of the power supply. Refer to “Output Load” in Section 3.1 for limits.

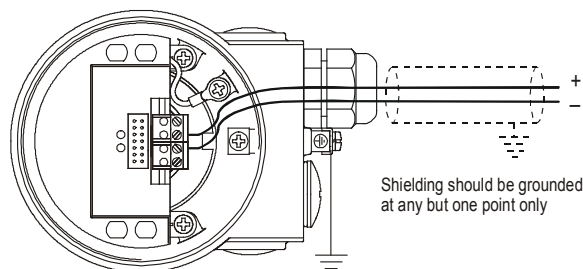
For wiring, shielded cable suggested in “Electrical Connection” Section 3.1 should be used.

After removal of the housing cover and taking out the display module (if any), the screw terminals can be accessed. The power supply should be wired to “I-“ and “I+”, the inner two of the four connections on the terminal block. The two outer terminals may be used to monitor the current with a millivoltmeter (refer to Section 5.1).

The unit should be grounded by either the inner or the outer grounding screw.

Turn on the unit and perform necessary programming.

After programming ensure proper sealing and closing of the cover.

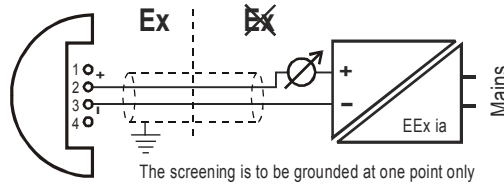


4.3 Safety Regulations for the Eex iA Approved Units

Units should be powered by duly certified intrinsically safe device with features as per technical data above.

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Device should be grounded by its grounding screw.



5 Operation

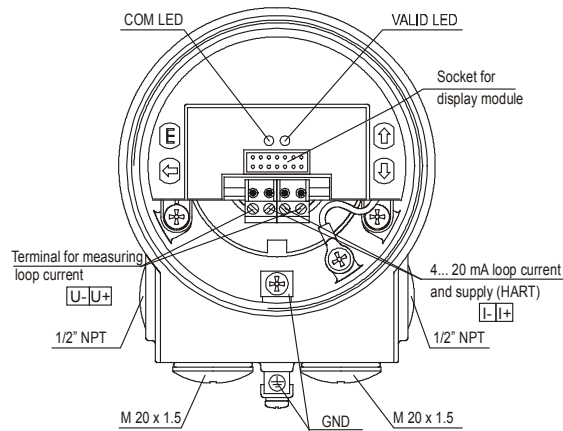
5.1 Introduction

After proper installation, wiring and power-up, the unit will operate according to the manufacturer's default settings. Operability is indicated by lighting of the **VALID LED**.

The value of the actual loop current can be monitored @ 1mV per mA with a multi-meter (set for the 20 or 200mVdc range) with an accuracy of 0.5 %. The voltmeter should be connected to "U-" and "U+", the two outer connections on the terminal block. This procedure cannot be used for calibration.

WARNING!

During installation the zero point of the transmitter can possibly shift. Therefore, the zero point has to be checked and eventually corrected as described in the Section 5.2.4, Parameter P7.



5.2 Programming

5.2.1 Overview

The SAP-203 plug-in module is used to program the unit to the specific application. Programming parameters are accessed by means of the four pushbuttons located on the face of the unit on either side of the SAP-203. The SmartPress™ is fully operational without the SAP-203 that is only needed for programming and/or displaying measurement values. Manufacturer's default settings are as below, with metric equivalents in parentheses. Note that changing the measurement mode in P10 to a metric unit (bar, mbar, m) will automatically change the default values of density and gravitational acceleration to their metric equivalents.

Measurement mode: pressure

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Engineering units: psi (bar for the range of $p > 0.6$ bar; mbar for $p \leq 0.6$ bar)

Current output: 4 to 20 mA

Damping: 3 seconds

Error indication: $I_{out} = 3.8$ mA

Noise suppression: 50 Hz

Density: 62.43 lbs/ft³ (1000 kg/m³)

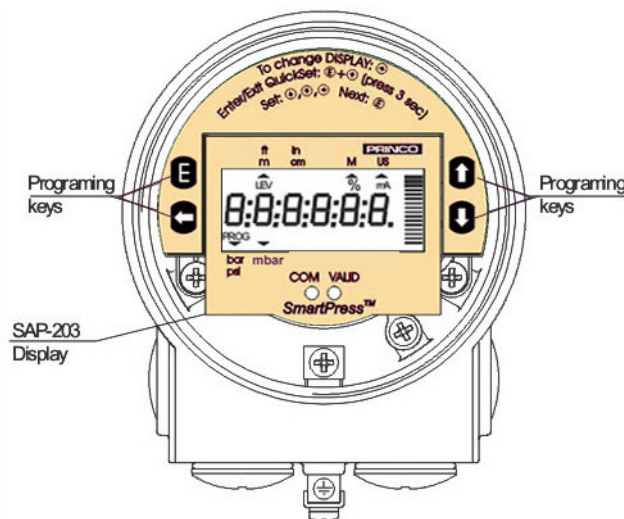
Gravitational acceleration: 32.17 ft/s² (9.806 m/s²)

If the default settings do not meet the requirements of the application, or if the unit is to be used for level measurement, the parameters must be modified. This is done using the SAP-203 display module.

During programming the unit will measure in accordance with the parameters previously set. The new, modified parameters will only be effective after returning to the Measurement Mode.

If the transmitter is left in Programming Mode by mistake, it will automatically return to the Measurement Mode after 3 minutes and will operate with the parameters entered during the last completed programming.

5.2.2 Display and Keys of SAP-203 Display Module



Symbols on the screen:

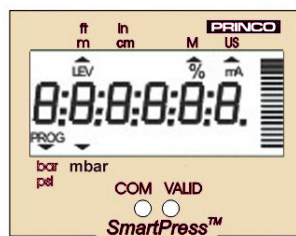
▼ – pointer (pointing to the relevant engineering unit)

LEV – on indicates level measurement mode

mA – current output displayed

% – display in percentage

PROG (blinking) – indicates programming mode



Symbols on the frame:

Pressure engineering units (**bar, mbar, psi**)

Level engineering units (**m, ft, cm, in**)

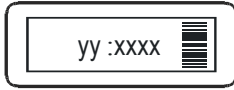
M – metric measurement system


US – US measurement system

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5.2.3 Programming Steps

Programming is performed by pressing and releasing the relevant one key or two keys simultaneously. The following description is an overview only. Detailed programming is to be found in Section 5.2.4.



- y or yy** parameter address (0, 1, ...19)
- XXXX or XXXXX** parameter value (dcba) or calibration/measurement value
-  bargraph

For entering calibration values the decimal point setting is automatic. Its position cannot be changed.

Programming keys	Operation	
Ⓔ + ⏪ (press for min. 3 sec) *	Enter or exit Programming Mode. (Return to the Measurement Mode means saving of the modifications.)	
⏩ + ⏪	GET VALUE – function for automatic setting. Actual measured value will be accepted as value to be programmed.	
Pressing keys	while Parameter address blinking	while Parameter value blinking
Ⓔ	to select parameter address and go to parameter value	to save parameter value and return to parameter address
⏪ + ⏩	Cancel all modifications of the actual programming procedure. CANCEL will be displayed for warning, pressing for 3 sec is required.	Cancel modification of the Parameter Value.
⏪ + ⏩	Reset all parameters to default. LOAD will be displayed for warning.	Display of default value.
⏪	Move blinking (changeability) of the digit to the left.	
⏩ / ⏪	Modify the blinking digit (increase or decrease, minus sign) or scroll up/down.	

* Make sure that Ⓔ is pressed first!

Double key pressing is indicated by “+”.

If, after pressing Ⓔ, blinking does not spring over from the parameter address to the parameter value:

- the parameter is either a read-out type, or
- the secret code prevents the modification (see parameter P19)

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

- the modified value is either out of the range, or
- the code entered is not a valid one.

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5.2.4 Parameters – Descriptions and Programming

WARNING!

During installation the zero point of the transmitter may shift. It is suggested to make a correction in parameter P7.

P0: _ _ _ _ Assignment of 4mA to the measured (lowest) value

P1: _ _ _ _ Assignment of 20mA to the measured (highest) value

The lowest and highest values (limits) of the measurement range (pressure or level) are assigned to the 4 and 20 mA output current levels. The points can be set in either direct or inverse proportion, i.e. the 4mA point can be set for the low point of pressure or level and 20mA the high point, or 20mA can be the low point and 4mA the high point. The span between the two points must be at least 50% of the range span of the unit in order to maintain the rated accuracy.

This can be performed by two methods:

1. Manual:

Enter the relevant values of level or pressure directly in P0 and P1. (Make sure that values to be programmed do not exceed the range of the unit. If they do, the modification of the parameter values will not be accepted, i.e. after pressing \ominus the parameter values will remain blinking.)

Example, assignment of 4 mA to 0 bar in P0: Press \ominus + \oplus to enter programming mode, go to P0 with \uparrow \oplus and press \ominus to go to parameter value. Enter 0 as lowest pressure value and press \ominus to go back to the parameter address. Finally press \ominus + \oplus to exit programming and return to the measurement mode.

2. Automatic:

Use the GET VALUE function to set P0 and P1. With this method, enter the programming mode and enter P0 or P1 (current value flashing). With the desired pressure applied to the sensor, activate GET VALUE (\oplus + \oplus). SET will appear on the display and the current pressure or level reading will be recorded as the parameter value. This method, when applied at actual levels in a tank, provides higher accuracy.

FACTORY DEFAULT: limit values of the (pressure) range of the unit in question

P5: _ _ _ _ Density [kg/m³ or lb/ft³]

This parameter is active only when P10 is set to 2 or 3 (units of level – mbar, bar or psi). It must be programmed if the density is different from the default value (the density of water).

Selectable between 37.46 and 124.9 lb/ft³ (600 and 2000 kg/m³)

FACTORY DEFAULT: 62.43 lb/ft³ (1000 kg/m³)

P6: _ _ _ _ Gravitational acceleration [m/s² or ft/s²]

This parameter is active only when P10 is set to 2 or 3 (units of level – mbar, bar or psi). For calculation of the level, the gravitational acceleration should be entered if it is substantially different as the default value.

FACTORY DEFAULT: 32.17 ft/sec² (9.806 m/s²)

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P7: _ _ _ _ Zero point correction and offset

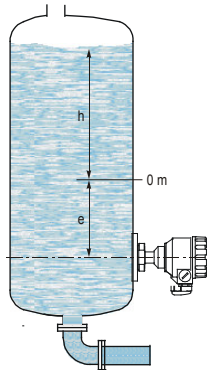
Automatic Zero Point Correction

As mentioned above, it is advisable to perform the zero point correction after the unit has been installed. With the tank pressure at the zero or reference point, this can be done using the GET VALUE function in P7. Press $\ominus + \oplus$ to enter programming mode, go to P7 with $\uparrow \oplus$, press \ominus to go to the parameter value, press $\oplus + \downarrow$ (GET VALUE) to make the unit recognize the actual 0 psi or 0 bar and record the correction in P7, press \ominus to go back to the parameter address, and finally press $\ominus + \oplus$ to exit the programming mode and return to measurement mode provided no other programming is needed. Upon returning to the measurement mode the display should give a zero reading of the appropriate engineering units.

Manual Zero Point Programming

The zero point of the transmitter can be shifted (offset) within and outside of the measurement range, which might be useful for special level gauging applications. This can also be performed in the parameter P7. Note that although the manual zero point programmed value changes the display readout according to the correction applied, the 4 and 20 mA points can only be assigned within the measurement range of the unit.

- Zero Offset within the Measurement Range:



The zero point of the transmitter can be shifted up to 10% of the range (50% of the range for units with process connections larger than 1 inch). In doing so, the active measurement range will be reduced by the distance of “e”.

Since in this case the result will be achieved by deducting “e” from the measured level “h” (provided the zero point has not been shifted during installation!) the value of the zero offset “-e” should simply be entered in P7.

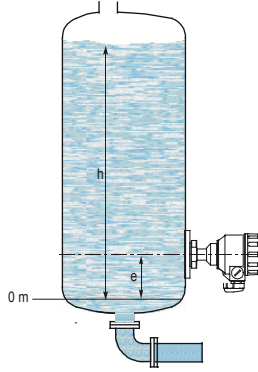
The possible zero point shift (occurred during installation) should also be taken into consideration with its mathematical sign. If, for instance, the initial zero point in P7 would show a shift of -0.027^* and the zero point has to be offset by one meter, $-1.027 [-1 + (-0.027) = -1.027]$ should be entered in P7.

For automatic programming, the required “0” level should be achieved and the GET VALUE used as described section P1.

*This value with its – or + sign can be seen during **Automatic Zero Point Correction**.

- Zero Offset outside of the Measurement Range:

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The zero point of the transmitter can also be shifted (offset) outside of the range. This is a virtual extension of the range by adding a dead zone of “e” in which no measurement will take place. Consequently, current output remains the same and the value of “e” will be displayed. The measurement will only be active in the range of “h”. However, the value of “e” will be added to the level measured.

Since the result will be achieved by adding “e” to the measured level “h”(provided the zero point has not been shifted during installation!) the value of the zero offset “+e” should simply be entered in P7.

With programming zero offset the possible zero point shift (occurred during installation) should also be taken into consideration with its mathematical sign. If, for instance, checking of zero point in P7 would show a shift of -0.027^* and the zero point has to be offset by one meter, $0.973 [+1 + (-0.027) = +0.973]$ should be entered in P7.

Obviously, in this case there is no place for automatic programming.

*This value with its – or + sign can be seen during **Automatic Zero Point Correction**.

P9: _ _ _ _ Current generator test

In this parameter the actual current output (corresponding to the measured process value) will initially be displayed. After pressing Ⓢ the blinking current value can be set for any value between 3.9 and 20.5 mA. The current output will change to the programmed value. Upon pressing Ⓢ again, the output will change back to that of the measured process value.

P10: _ _ _ a Measurement mode

The measurement mode determines the engineering units of the measurement readout on the display. The same units then are used for the P0 and P1 current output assignments. Note that when set to read directly in units of pressure (bar, mbar, psi), parameters P5 and P6 are inactive and not accessible in the programming mode. Setting P10 for units of level activates P5 and P6. These parameters would then have to be changed if different from the default values. Note also that changing the measurement mode in P10 to a metric unit (bar, mbar, m) will automatically change the default values of density and gravitational acceleration to their metric equivalents and likewise when changing from metric to English units.

a		Measurement mode
0	bar, mbar	Pressure measurement
1	psi	
2	m	(Hydrostatic pressure) Level measurement
3	ft	

FACTORY DEFAULT: 1

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P11: dcba Rounding, damping, noise suppression and displayed value

Rounding eliminates the least significant digit of the displayed value, rounding the second least significant digit accordingly.

Damping, programmed in seconds, can be used to reduce unwanted fluctuation of the value displayed.

Noise suppression is used to eliminate possible disturbance coming from the power lines.

Displayed value, i.e. the value displayed on the SAP-203 LCD readout, may be set to be either the actual value of pressure or level, or the percentage of the range based on the 4 and 20 mA values programmed into P0 and P1.

Attention: Mind the sequence! When programming, the right-hand value “a” will be blinking first.

a	Rounding of displayed value
0	No
1	Yes

b	Damping
0	3 s
1	5 s
2	10 s
3	20 s

c	Noise suppression
0	50 Hz
1	60 Hz

d	Displayed value
0	Pressure or water level
1	Percentage

FACTORY DEFAULT: 0000

P12: ___a Error indication by current output

a	Error indication
0	3.8 mA
1	22 mA

FACTORY DEFAULT: 0

P14: d c b a Software version

The number of the software version of your transmitter can be viewed in this parameter.

P19: d c b a Secret code

Settings can be protected by a 4 digit number (secret code) other than 0 entered in this parameter. If the secret code is active, the symbol **PROG** on the display is lit (while in the programming mode) and the values of the parameters can be viewed but not changed. If there is no secret code, or it is not active, the symbol **PROG** is blinking.

For opening the secret code, the old code should be entered. For modifying or deleting (modifying to 0000) the new code can only be entered after opening the old code. The procedure is as below: Go to P19, press E to go to parameter value, enter the old code; press E to go to address and E again to return to value; enter new code or 0000.

FACTORY DEFAULT: 0000

6 Error Codes

In case of error the **VALID** LED will be blinking, and Errx message will be displayed indicating the following errors:

Error Code (x)	Error description	Causes and solutions
0	Sensor error or exceeding default range by more than 10%	Contact local agent. Modify programming.
1	Memory error	Contact local agent.
3	Programming error: same value in P0 and P1	Modify programming.

7 Maintenance and Repair

The unit does not require regular maintenance. In needed, the diaphragm may be carefully cleaned.

7.1 Getting Help

If your Princo equipment is not functioning properly, and attempts to solve the problem have failed, contact the closest Princo sales representative in your area, or call the factory direct and ask for service assistance. The factory telephone number is 1-800-221-9237.

To assist us in providing an efficient solution to the particular problem, please have the following information available when you call:

1. Instrument model number
2. Date of purchase order
3. Process material being monitored
4. Detailed description of the problem

If your equipment problem cannot be resolved over the phone, then it may be necessary to return the equipment for checkout/repair. Do not return equipment without first contacting the factory for a Return Material Authorization number (RMA #). Any equipment that is returned **MUST** include the following information in addition to the list above.

5. RMA Number
6. Person to contact at your Company
7. Return (Ship to) Address

Princo level instruments are covered by a 10-year limited warranty. You will not be charged if it is determined that the problem is covered under warranty. Please return your equipment with freight charges prepaid. If repair is covered under warranty, Princo will pay return freight charges.

If telephone assistance or equipment return is not a practical solution to the problem, then it may be necessary for field assistance. Trained field servicemen are available from the factory on a time/expense basis to assist in these instances.

7.2 Warranty Statement

All Princo level control instruments are backed by a 10-year warranty. Princo will repair or replace, at its option, any instrument that fails under normal use for up to 10 years after purchase.