TWO-WIRE pH / ORP TRANSMITTER

MS9023

TECHNICAL DESCRIPTION AND INSTRUCTION FOR USAGE

PLOVDIV 2005

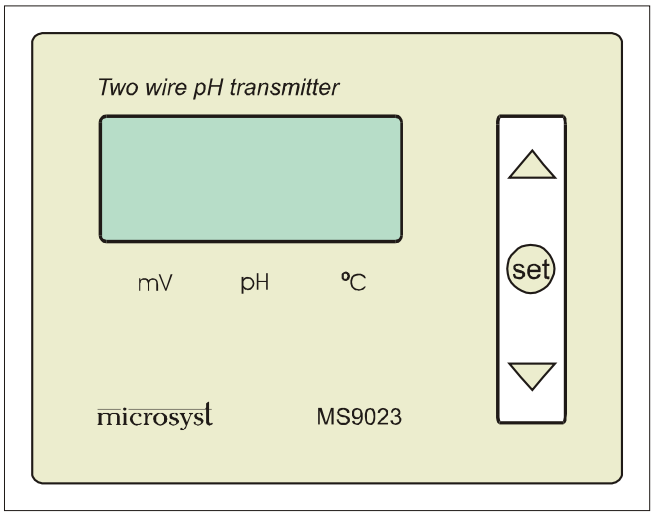
I. TECHNICAL DATA

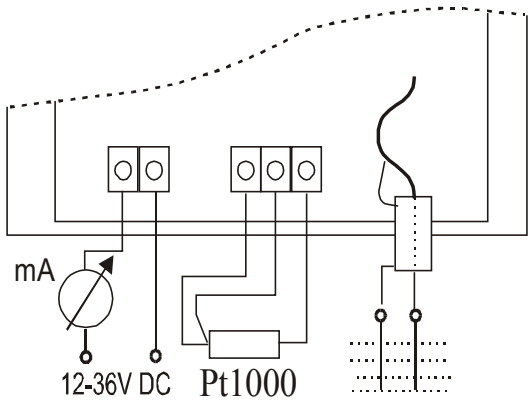
Range and accuracy of measurement	pH -2.00 … 16.00 / 0.01
	°C 0.0 … 100.0 / 0.1
	PH transmitter mV -700 … 700 / ± 0.3 ORP transmitter mV -2000 … 2000 / ± 1
Range and accuracy of conversion	I, mA PH00.00÷14.00 or ORP-2000÷2000 / 4.00÷20.00 mA ±0.005mA
Input resistance	> 10^{12} Ω
Temperature compensation	In PH mode - automatic (Pt1000) or Manual
Calibration	Automatic, with memorizing at switching off of the power supply
Buffers for calibration	pH 1.68, 3.78, 4.01, 6.86, 9.18, 12.45 NBS (DIN 19266) - automatic
	All other buffers in the range 0.00...14.00 pH or -2000 mV...+2000mV ORP
Accuracy at temperature correction of the calibration buffers for NBS standard	± 0.003
Isopotential of the electrode system	7 (±1) pH; 0 (±74.04) mV
Display	LCD 3 ½ digits
Operating temperature	-20 … 80 °C
Power supply	U power = 12÷36 V DC
Overall dimensions (WxHxL)	125x105x56
Weight	max 250 g
Degree of protection	IP65

II. DESIGNATION

The device MS9023 is designed for measurement of the activity of hydrogen ions (pH). This parameter is transmitted by current analog output 4-20 mA, and the power supply is received by the same line. On $3^{1/2}$ LCD display you can see the measured parameter of pH, the temperature °C or the voltage in mV. The device can work as ORP transmitter, if it is for range -2000 ... 2000 mV.

III. FRONT PANEL, TERMINAL PLATE





General functions of the buttons in operating mode	
set	Starting of mode CALIBRATION Passing a step forward in mode CALIBRATION Confirmation of correction (ENTER)
△	Selection of operating screen pH, mV, °C Increasing of setpointed value
▽	Selection of operating screen pH, mV, °C Decreasing of set-pointed value

IV. INSTRUCTIONS FOR USAGE

1. General instructions

For reaching of precise measurements it is necessary to keep all technological requirements for correct measurement

The storage, the preparation for operation and usage of the electrodes and the buffer solutions can be realized according to the requirements of the company producer

Before usage the device must be in nominal operating conditions according to technical data

2. Preparation for operation

The jacks of the temperature and the combinated pH electrodes must be switched to their corresponding on the device

3. The pH electrode must be prepared according to its passport

The temperature electrode does not require special preparation

4. General instructions for washing of the electrodes

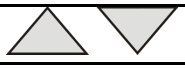
The pH electrode must be prepared according to its passport. The glass membrane and the external surface of the electrode must be washed with distilled water. The pH electrode must be dried with filter paper ONLY from its external side without rubbing its spheric membrane. Pour in a measuring vessel about 5 ml of the next solution for examination – buffer or sample. Dip the electrodes in the liquid. The solution must be stirred energetically for about 10 sec., so that the liquid souse the glass membrane. After this procedure the pH electrode is prepared for measurement and can be dipped in the solution. The electrodes must be dipped in the liquid for about 30 sec., after that pass to data reading.

*For a new measurement repeat the activities from point 3.1. to 3.7.

*The washing of the pH electrodes must be done by special sprayer, loaded with deionized water.

V. MODE “MEASUREMENT”

This is the main operating mode of the device. After power supplying **PH or ORP** appears on the display and you will pass to measuring of the respective parameter. While **PH/ORP** is on the display, you must not hold any button of the keypad, because you will activate some service menu ('parameters', 'inputs' or 'standard selection'). In mode MEASUREMENT PH the current value of pH, the measured voltage (mV) or the temperature (ºC) appear on the display. In mode ORP you can see the potential or the temperature. The current, which passes through the power supplying circuit (the output parameter) depends only on the value of pH or ORP.

	– These buttons change the parameters on the display

VI. TEMPERATURE COMPENSATION AT pH TRANSMITTER

The device recognizes if the Pt1000 sensor is switched on and determines the operating mode – automatic (with Pt1000 sensor) or manual (without Pt1000 sensor).

If at showing of the temperature the decimal point is flashing, the device is in mode of MANUAL TEMPERATURE CORRECTION. In this condition the user set-points the temperature of the measuring liquid. In mode ORP their is not manual set-pointing of the temperature, and recognition of the situation 'sensor OFF'.

set	– Press once – the decimal point stops flashing
/	– Change the the temperature value
set	– Confirm the entered temperature value. The device automatically passes to mode MEASUREMENT

VII. SELECTION OF STANDARD OF CALIBRATING SOLUTIONS

The device has automatic temperature correction of pH with standard calibrating buffers of NBS standard (1.68, 3.78, 4.01, 6.86, 9.18, 12.45 pH) and all other buffers 0.00 ... 14.00 pH - "Free" standard (but their values must be set-pointed by the user).

set +**Power ON**	Press and hold the button and supply power. Release after **nbS** or **FrE** is desplayed.
/	Select calibrating standard **- nbS** or **FrE** (at ORP transmitter - only Fre)
set	Confirm the selected standard
	The device passes to mode MEASUREMENT

VIII. SENSITIVITY, ASSYMETRY AND ERRORS

	Hold the button in mode MEASUREMENT sensitivity is read on the display – SLP
	Hold the button in mode MEASUREMENT assymetry is read on the display – AST

The range of teh accessible meanings for sensitivity and assymetry is:

pH TRANSMITTER:

30.0 < SLP < 65.0 mV/pH

5.00 < AST < 9.00 pH

Error may appear after the calculation of teh sensitivity – SLP and the assymetry - AST of the electrode system, if one of the two parameters is out of the range of the accessible meanings. In this case "---" appears on the display.

Possible reasons for errors:

- Discrepancy of the set-pointed value of the calibrating buffer and the solution in the measuring vessel.
- Defect electrode system
- Broken connection of the electrode system

ORP TRANSMITTER:

The value SLP is the ratio adjusted/measured mV, and AST is the offset at 0 mV.

The two parameters are determined automatically at calibration and can not be changed directly.

IX. MODE “CALIBRATION”

Stage	Buttons		Operation
Stage 1	set		**Press and hold. Clb appears on the display flashing. After 4 s. it becomes constant. Then release the button. If you release the button before that, the device returns to mode 'MEASUREMENT'**
Stage 2	**bF1**		Load the first calibrating buffer in the measuring vessel, keeping point IV. 3.
Stage 3		set	Press for confirmation
Stage 4	**XX.XX**	△ ▽	Set-point the value of the first calibrating buffer (In ORP mode XXXX mV)
Stage 5		set	Press to confirm the entered value
Stage 6.1*	**°C**	set	Press for confirmation.
Stage 6.2*	**XX.X**	△ ▽	Set-point the temperature value in the measuring solution
Stage 6.3*		set	Press to confirm the entered value
Stage 7			**Auto Read** – Wait! Data calculation. The device automatically passes to the next stage. In this stage if you press some of the pointers, you can see the measured voltage in mV.
Stage 8	**bF2**		Change the calibrating buffer, keeping point IV.3.
Stage 9		set	Press for confirmation (Stage 3)
Stage 10	**XX.XX**	△ ▽	Set-point the value of teh second calibrating buffer (Stage 4. In ORP mode XXXX mV)
Stage 11		set	Press to confirm the entered value (Stage 5)
Stage 12.1*	**°C**	set	Press for confirmation (Stage 6.1*)
Stage 12.2*	**XX.X**	△ ▽	Set-point the temperature value of the measured solution (Stage 6.2*)
Stage 12.3*		set	Press to confirm the entered value (Stage 6.3*)
Stage 13			**Auto Read** – Wait! Data calculation. The device automatically passes to mode MEASUREMENT

Attention! * If temperature electrode is switched on, and at ORP transmitters stages 6 and 12 are missed.

- Before stage 13 you can always return to mode MEASUREMENT by holding of **SET** till the appearing of - - - - . In this case reset is made and the old calibration is loaded, i.e. the new calibration is canceled.

X. DEFINITION OF THE PARAMETERS OF THE ELECTRODE SYSTEM (pH TRANSMITTER)

The methods aim at determination of the coordinates of the isopotential system in mV and of the real temperature coefficient. For that it is necessary to download the potentials of the electrode system, corresponding to two buffer solutions at two temperatures, supported by thermostat.

- Isopotential of teh electrode system:

$$E_0 = \frac{(E_2 - E_1)*(pH_3*E_4 + pH_4*E_3) - (E_4 - E_3)*(pH_1*E_2 + pH_2*E_1)}{(pH_4 + pH_3)*(E_2 - E_1) - (pH_2 + pH_1)*(E_4 - E_3)}$$

- Real temperature coefficient:

$$F = \frac{[(E_4 - E_3)/(pH_3 - pH_4) - (E_2 - E_3)/(pH_1 - pH_2)]}{(t_2 - t_1)},$$

where:

t_1 – value of the first temperature in °C

t_2 – value of the second temperature in °C

pH_1 – value of the first buffer solution at t_1

pH_2 – value of the second buffer solution at t_1

pH_3 – value of the first buffer solution at t_2

pH_4 – value of the second buffer solution at t_2

E_1 – potential of the electrode system in mV for pH_1 at t_1

E_2 – potential of the electrode system in mV for pH_2 at t_1

E_3 – potential of the electrode system in mV for pH_1 at t_2

E_4 – potential of the electrode system in mV for pH_2 at t_2

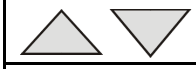
XI. MENU SYSTEM PARAMETERS

PARAMETER	DESCRIPTION	LIMITS	FACTORY VALUE
rtC	System coefficient. Do not change it !	-32000 ÷ 32000	1984
ISo	System coefficient. Do not change it !	-9999 ÷ 9999	0
AP0	Offset of the analog output	-9999 ÷ 9999	These values vary at the different devices.
AP1	Multiplying coefficient of the analog output The value, which is transmitted by DAC (11 bit) is received by: Aout = AP0 + pH . AP1 / 16 или Aout = AP0 + ORP.AP1 / 2048	-9999 ÷ 9999	
JP1	Zone of the filter of input 1 (mV)	0 ÷ 255 (mV)	50
JP2	Zone of the filter of input 2 (ºC)	0 ÷ 255 (ºC)	20
Jd1	Period before accepting of values out of the zone for input 1(mV)	0 ÷ 255 x 0,5 s	2
Jd2	Period before accepting of values out of the zone for input 2 (ºC)	0 ÷ 255 x 0,5 s	2
Fi1	Coefficient of filtering for input 1(mV). Smaller values mean "heavier" filter.	1 ÷ 127	15
Fi2	Coefficient of filtering for input 2 (ºC) Smaller values mean "heavier" filter.	1 ÷ 127	15
rEG	Configuration word. Bit 0 – shows the type of the ADC, used in the device. It is determined at the production and must not be changed ! Bit 1 – shows the operating mode of the device. 0-PH transmitter 1-ORP transmitter	0 ÷ 255	**0 - PH transmitter** **2 – ORP transmitter**

PARAMETER	DESCRIPTION	LIMITS	FACTORY VALUE
	There is a difference in the range of measurement in the two types of transmitters. For ORP -2000 .. +2000 mV, and for PH -700...700mV. So device, made for PH transmitter must not be used in ORP mode. And ORP transmitter can work in PH mode, but respectively the accuracy of measurement is smaller (1mV).		

XII. ADJUSTING OF THE ANALOG INPUTS

This menu is for adjusting of input 1 lineally in mV and in input 2 for sensor Pt1000. There must be two standard voltages for input 1 and respectively two standard voltages for input 2. The adjustments of the two inputs are independent from each other.

 +**Power ON**	Press and hold the button and supply power. Release after **Ch2** is displayed.
	Select input for adjustment – **Ch1 – mV**; **Ch2 - Ω** (Pt1000)
	Passes to adjustment of the selected channel. **tn1** can be seen on the display. Give 1-st standard value of the measured parameter. After second pressing of the button it appears on the display in ADC units.
	The rightest digit starts flashing.
	The real value must be entered in Ω for Ch2 or mV for Ch1.
	Confirm and pass to the 2-nd standard point. **tn2** can be seen on the display. Give 2-nd standard value of the measured parameter. After second pressing of the button it appears on the display in ADC units.
	The rightest digit starts flashing.
	Enter the real value in Ω for Ch2 or mV for Ch1.
	Confirm, exit to mode of measurement and **SAVING OF THE ADJUSTMENTS OF THE RESPECTIVE INPUT IN THE NON-VOLATILE MEMORY** For a short time "Clc" appears on the display. For calibration of the other channel the procedure must be repeated from the beginning, using the possibility for input selection.

All values out of the range of the display -1999... +1999 appear alternating with flashing -Lo- or -Hi- respectively under lower or over higher limit. It is about the operation of the device (not only about the adjustment of the inputs).

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