



**AKMC-1**

**AUTOMATIC  
WATER HARDNESS  
MONITOR**

**Technical Information**

**Spectradyn Technologies LLC**

**2007**

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## **APPLICATION**

AKMC-1 automatic water hardness analyzer is designed for continuous determination of the total concentration of calcium and magnesium ions in natural, potable, and industrial water (total hardness - TH) using potentiometric technique. Fields of application include analytical monitoring of the environment and technological processes control.

The device can operate in a signaling device mode. In case of exceeding of the preset TH value, it can make an alarm signal and switch on controlling systems.

The device can be installed for simultaneous control of up to four flows, upon customer request.

## **BENEFITS**

- Continuous on-line monitoring
- High stability of the performance characteristics of solid-state electrodes, unaffected by coexisting suspended particulate matter
- Stable hydrodynamic conditions of the primary potentiometric transducer functioning
- Automatic correction for variations in the flow temperature
- Automatic calibration
- Multiple sample streams monitoring availability
- Programmable sample intake rate
- Microprocessor based control
- Digital data processing
- Nonvolatile memory
- Self-test diagnostics
- NEMA 4X wall enclosure

**OPERATIONAL CONDITIONS**

• Ambient temperature	+10 to +35°C, 41 to 122 °F
• Sample flow temperature	+5 to +40°C, 33 to 122 °F
• pH range	5-10
• Atmospheric pressure	84.0 to 106.7 kPa (0.84 to 1.07 bar)
• Air relative humidity at 25°C, %, not more	80
• Power supply, AC:	
• Voltage, V	120/220
• Frequency, Hz	50/60
• Amplitude of external vibrations with	
• 10 – 55 Hz frequency, mm, not more	0.15

**Operating place requirements**

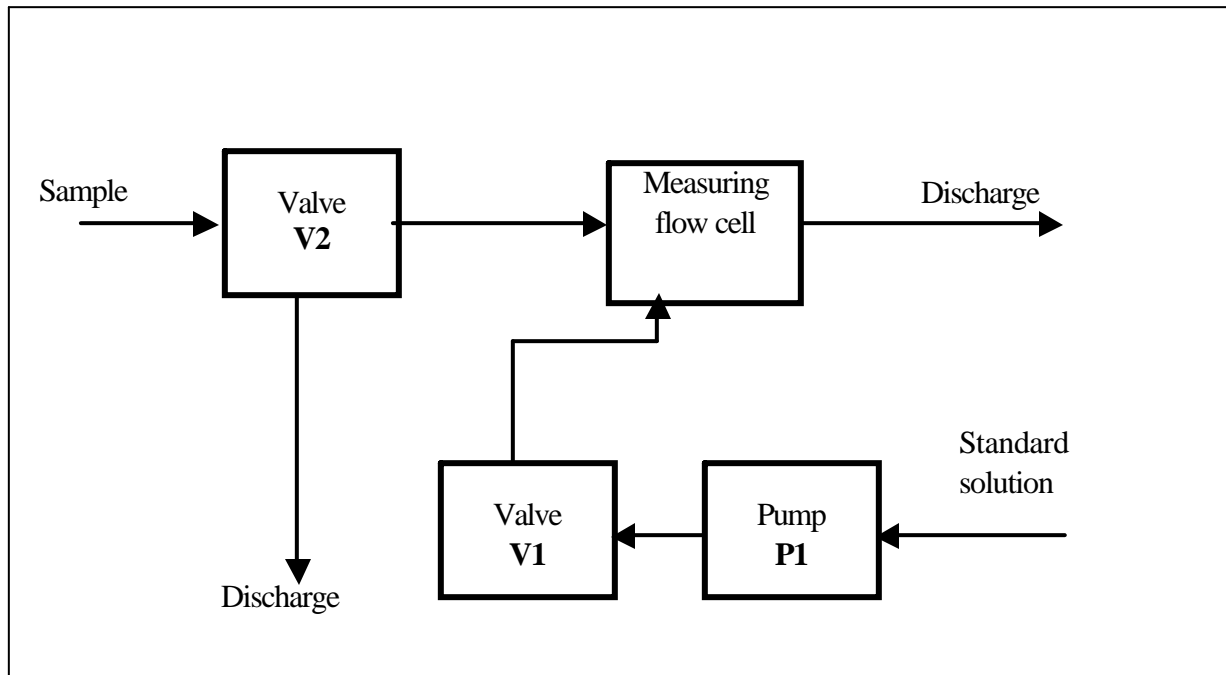
- If the device is used for determination of TH of industrial water samples, which contain suspended particles larger than 10 µm, supplying pathway should be equipped with filters.
- Temperature deviation range of the flow should not exceed 5°C per hour.
- Working place, where device is to be installed, should be free of strong electric and magnetic fields.
- It is recommended to install the instrument in a place free from dust, acidic and alkaline vapors, corrosive gases and other detrimental impurities, which may cause corrosion.
- The device should be installed at a distance not less than 0.1m from the floor and not less than 0.5m from heaters.
- Working place should be equipped with fire-fighting facilities – carbon dioxide or powder type fire extinguisher. Use of water in case of inflammation is absolutely forbidden.
- Installation can be carried on after working place is prepared, according to appended chart of connection.

**TECHNICAL SPECIFICATIONS**

- |   |  |
|---|--|
| • Concentration measuring range, ppm  | from 0.1 to 250<br>(up to 3000 by request) |
| • Limit of admitted value of the basic relative error (%),<br>for concentration ranges, ppm |  |
| from 0.1 to 10 (including)  | ± 30                                       |
| from 10 to 50 (including)   | ± 20                                       |
| from 50 to 250 (including)  | ± 15                                       |
| • Power consumption, W, not more  | 50   |
| • Mean time between failures, hours, not less   | 10000                                      |
| • Mean recovery time, hours, not more   | 8  |
| • Mean life time, years, not less   | 5  |
| • Operation mode setup time, min, not more  | 30   |
| • Dimensions, mm, not less  | 300x400x150                                |
| • Weight, lb, not more  | 44   |

## PRINCIPLE OF OPERATION

Device operates in a stand-alone mode according to algorithm specified by the control unit. Device operation principle could be explained on example of hydraulic system shown in **Figure 5**.



**Figure 5.** Diagram of hydraulic connections.

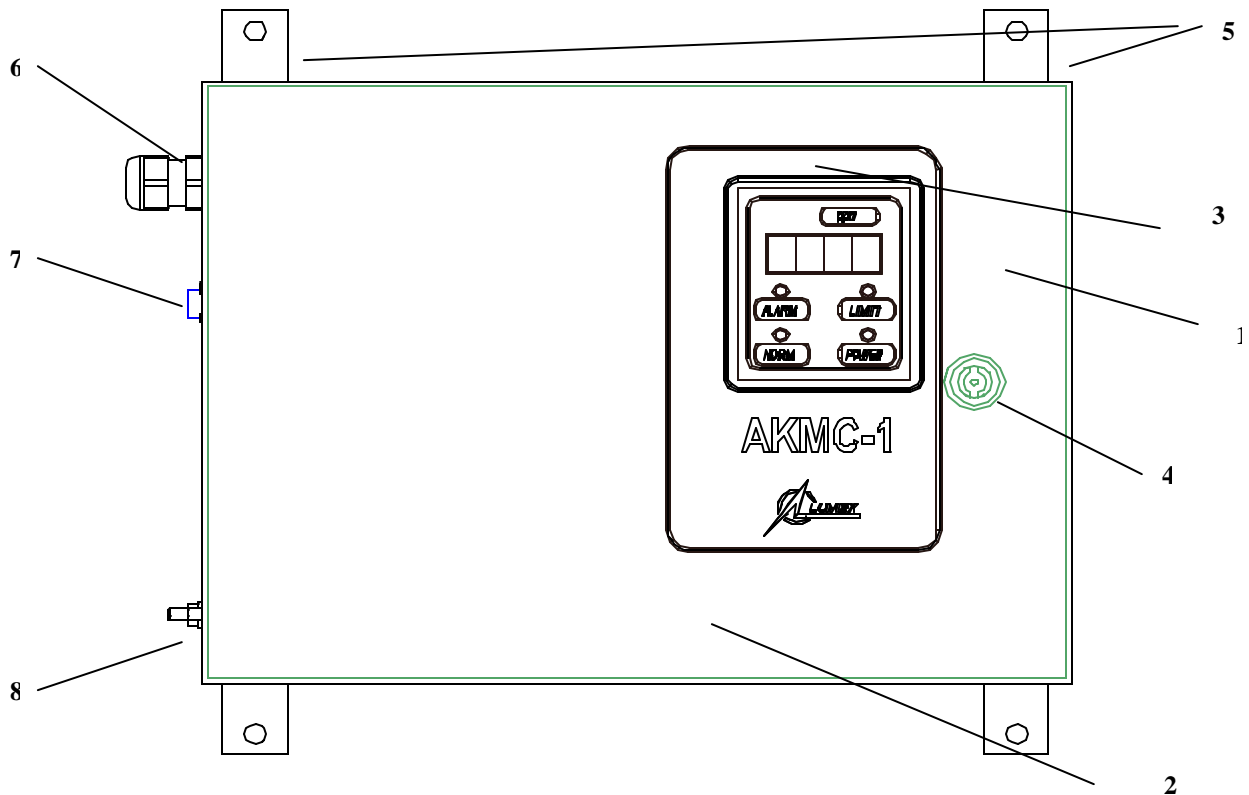
Sample flows into the measuring cell through V2 valve, and the V2 valve closes. EMF of galvanic couple, which is proportional to hardness ions concentration, is measured in the flow cell. After the measurement, the V2 valve opens and sample is discharged from the flow cell.

Correction of electrode system (i.e. calibration) is performed periodically according to the algorithm loaded in the device read-only memory. Pump P1 feeds the measuring cell through opened V1 valve with standard solution and calibration curve is automatically corrected depending on the measurement results.

Device has a capability of automatic correction of results depending on temperature changes. For this purpose, a thermo sensor is set on the bottom of measuring cell. The control unit automatically corrects EMF-hardness dependence according to the temperature difference between the sample and standard solution.

## EXTERNAL VIEW

Device external view with and without the front cover are shown in **Figures 1** and **2**, and the connection layout is shown in **Figure 3**.



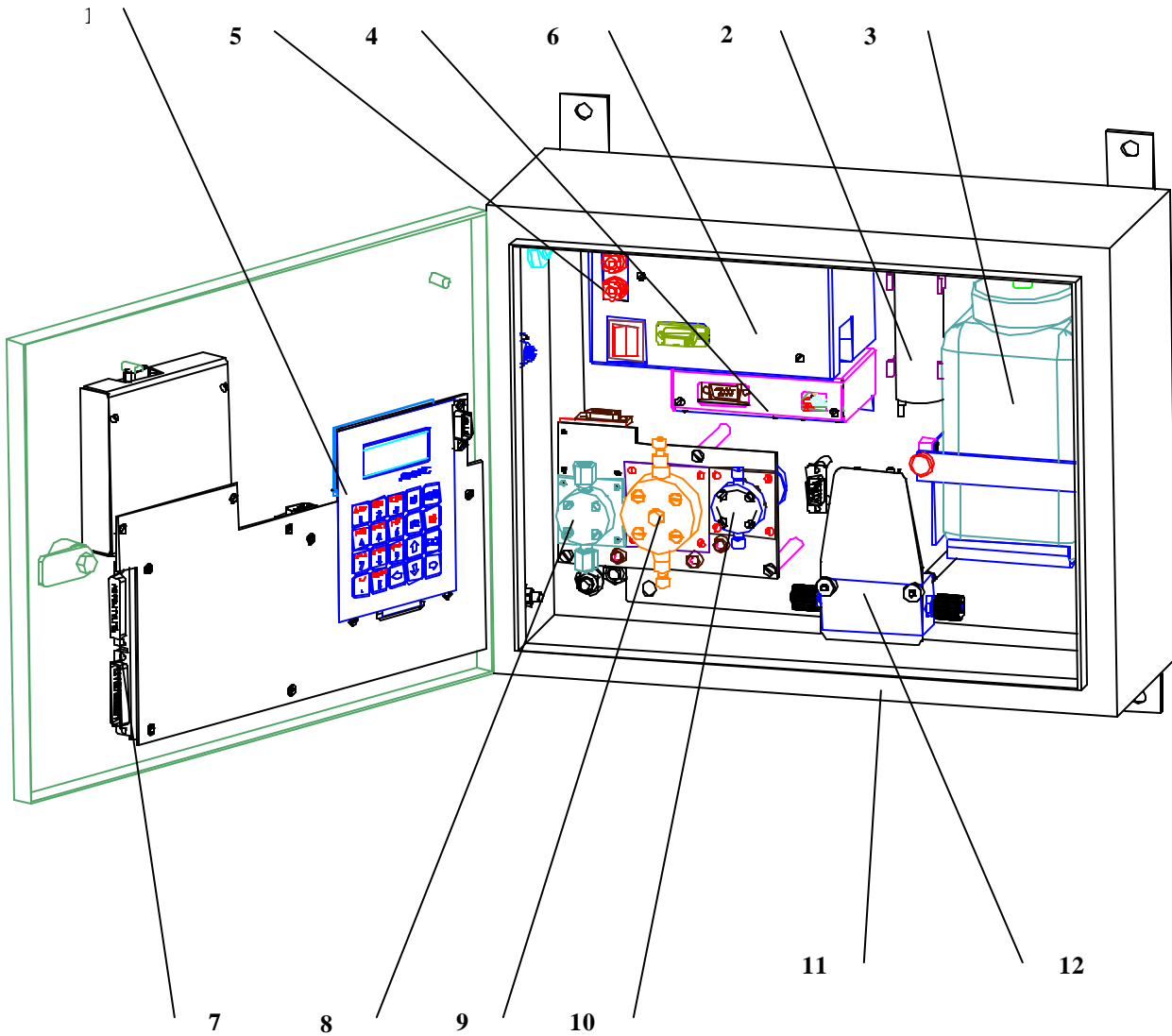
**Figure 1.** AKMC-1 external view.

- 1 - Enclosure
- 2 - Front panel
- 3 - Display with indication light diodes
- 4 - Front panel lock
- 5 - Fixing hinges
- 6 - Power Cable Clamp
- 7 - PC-10B Connector
- 8 - Grounding Stud

Device is placed into metal case (300x400x150 mm) with an opening front panel. Display and indication light diodes are located on the device front panel. Display shows results of current determination of ions concentration.

Light diodes signalize admissible concentration value (“**Norm**”), its excess value (“**Limit**”), or significant excess of concentration (“**Alarm**”). The “**Power**” light diode indicator signalizes that the device is switched on.

## INTERNAL VIEW



**Figure 2.** AKMC-1 view without front cover.

- 1 - Device control panel with display
- 2 - Reservoir for saturated solution of potassium chloride
- 3 - Bottle for standard solution of  $\text{CaCO}_3$
- 4 - Measuring unit
- 5 - Fuses board
- 6 - Device power supply
- 7 - Pump and valves control unit
- 8 - Three-way or two-way sample stream valve
- 9 - Pump
- 10 - Calibration system valve
- 11 - Inlet and outlet pipe connections on the bottom of the enclosure
- 12 - Measuring cell

Capillary tubes connect the elements of the hydraulic scheme.  
 The PC10 connector and bonding point are located on the side of the enclosure.  
 Adapting pipes for connection with the water stream under control are located on the bottom of the enclosure.

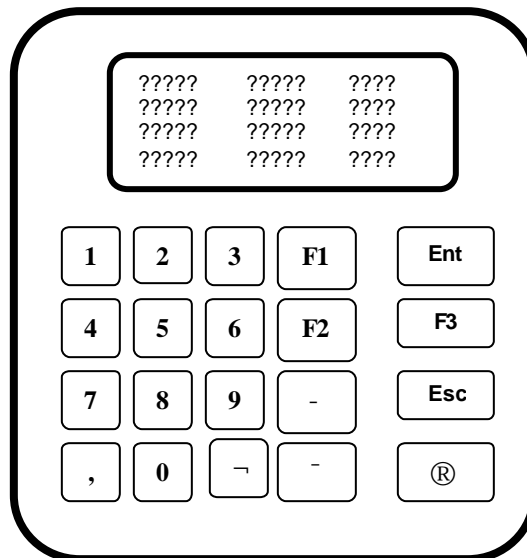
## PURPOSE OF FUNCTIONAL UNITS

### Control Unit

Control unit ensures operation of the device according to the established algorithm and performs self-control procedures.

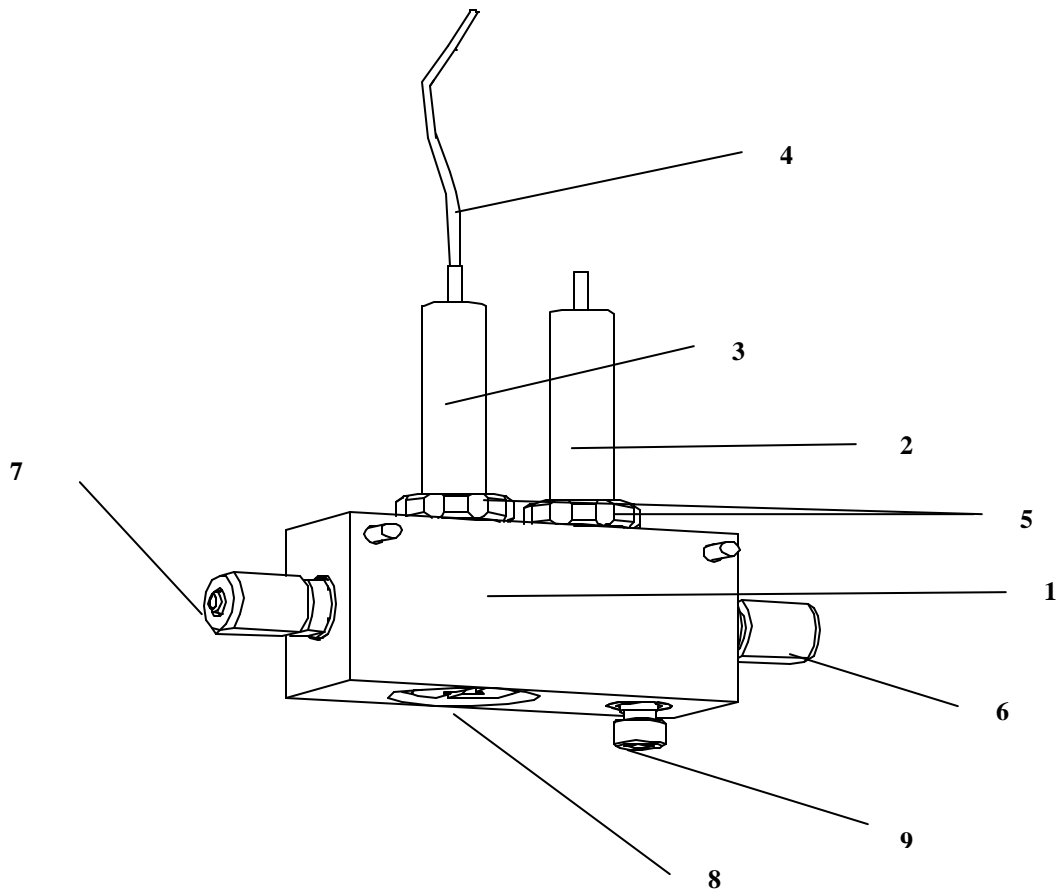
Control unit consists of control panel with a four-string display and a controller board with regulating unit and DB9 connector on it (output to computer, 20 mA, RS232). Regulating unit can be used for connection of a regulating or signaling system.

Current operation parameters and measurement results are indicated on the control unit display 1 (**Figure 2**). Display and control panel are shown in **Figure 4**:



**Figure 4.** Display and control panel

### Measuring flow cell with electrodes



**Figure 5** Measuring flow cell with electrodes

- 1 - Measuring cell;
- 2 - Measuring electrode;
- 3 - Standard electrode;
- 4 - Polymer tube for saturated potassium chloride;
- 5 - Electrodes clamp screws;
- 6 - Sample inlet;
- 7 - Sample outlet;
- 8 - Thermo sensor;
- 9 - Inlet for standard solution

In the measuring cell, total content of calcium and magnesium ions is determined in the flow coming from the controlled water stream. Method is based on the measuring of EMF (electromotive force) of the galvanic couple.

**Power supply**

Power supply unit consists of primary and secondary power supplies. Primary one produces stabilized voltage 5V, which comes to device units. Secondary one transforms 5V voltage from primary power supply to direct voltage +15V and -15V, which comes to other device units.

**Pump and valves control unit**

Control unit for pumps and valves provides switching of pump and valves according to the control unit commands.

**Pump**

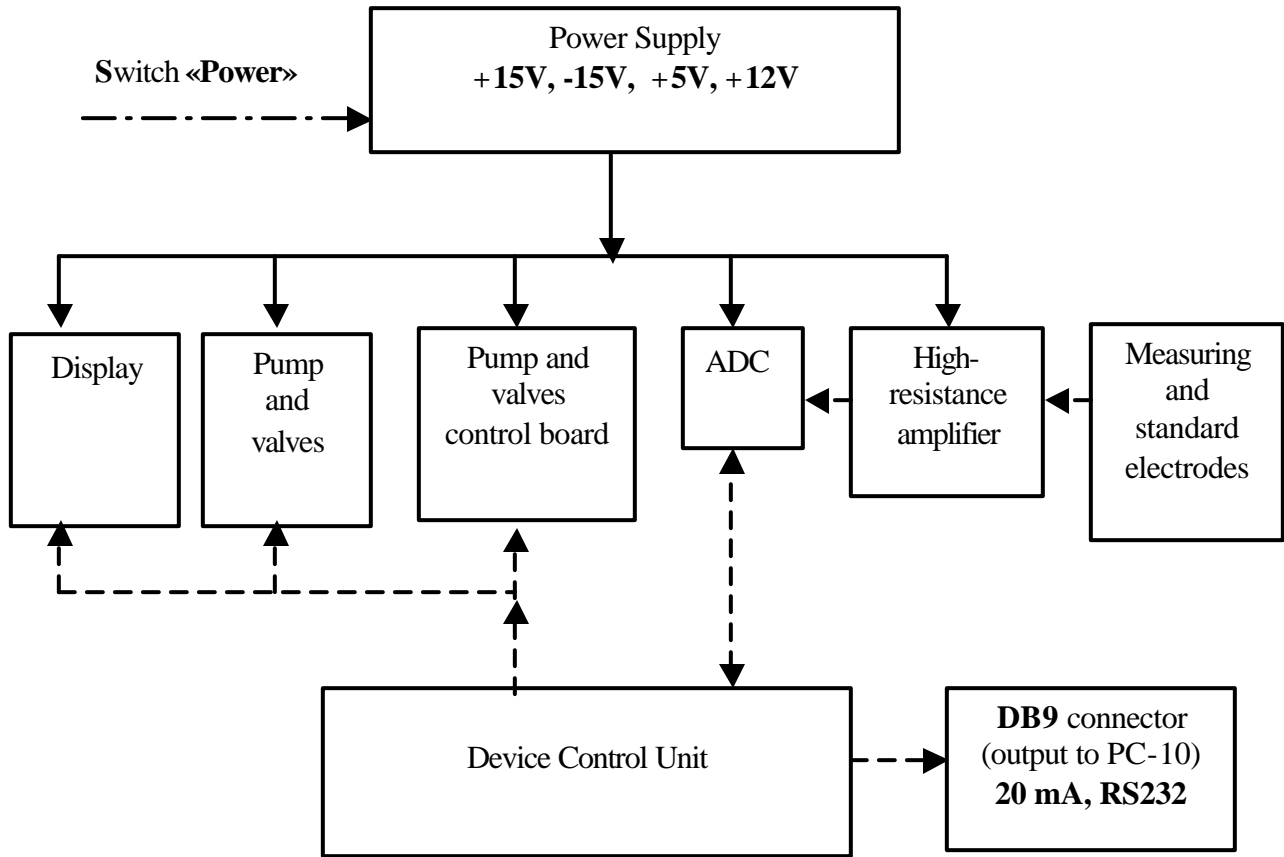
Pump together with stop valve provide the measuring cell with standard solution for correction of results of measurements.

**Reservoir for saturated solution of potassium chloride**

Reservoir **13 (Figure 2)** is filled with saturated solution of potassium chloride (KCl). It is used for refilling of reference electrode and for making conducting layer in the galvanic couple of the measuring cell.

**Other device items**

- Power (120 V, 60 Hz) is supplied by means of a cable, which passes through clamping sleeve for cable fixation.
- PC-10TB connector (RS232, analog output), located on device sidewall, is used for PC and other recording devices (self-recorder, for example, with a current loop of 4 – 20 mA) connection.
- Grounding terminal ensures security of personnel during device operation. During the installation of the device, it is necessary to connect this terminal with the earth bus by a wire with resistance not exceeding 0.2  $\Omega$ .
- Capillary tubes connect the hydraulic system elements of the device: reservoir with the calibration solution, flow measuring cell, valves and pump.



- - - - - Alternative current circuit, 120 V, 60 Hz
- \_\_\_\_\_ Power circuits
- - - - - Signal circuits

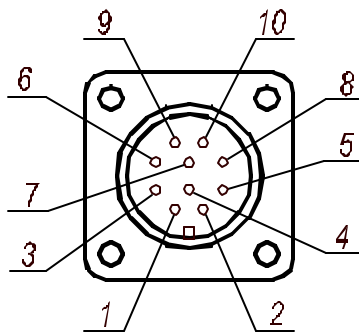
Figure 3. AKMC-1 connections diagram.

## CONNECTION OF EXTERNAL DEVICES AND CONTROLS

For real-time automatic processing and visualization of the results of measurements, the device can be connected to a PC.

PC-10TB connector is used to provide recording of the results of measurements, to connect the device to computer, self-recorder or to trigger some external devices such as water softener.

### PC-10TB CONNECTOR SOLDERING

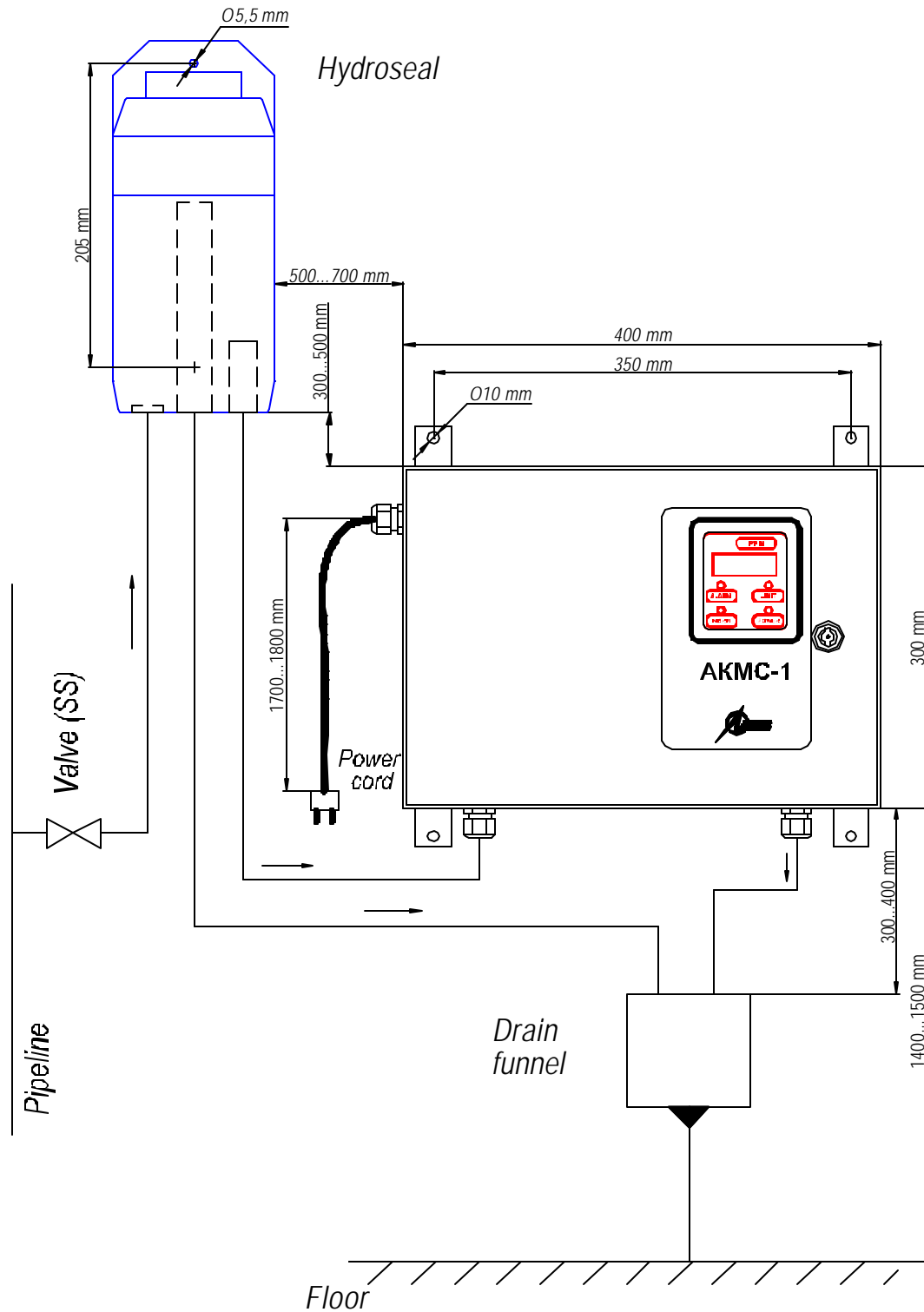


Connector soldering is given in Table A1.

Table A1

Stem No	Signal	Current
1	B (RS485)	20 mA
2	A (RS485)	20 mA
3	H3 (relay)	1 A
4	OK (relay)	1 A
5	HP (relay)	1 A
6	GND (RS232)	20 mA
7	TXD (RS232)	20 mA
8	RDX (RS232)	20 mA
9	A (current loop 4 – 20 mA)	4 - 20 mA
10	TB (current loop 4 – 20 mA)	4 - 20 mA

AKMC-1 installation scheme



## SELF-DIAGNOSTICS PROCEDURES

During operation, the device performs self-diagnostics of all components and displays reports in the error codes. If hardware failure occurs during the operation, the device stops operation, performs diagnostics and displays specific error codes. The device returns to the start of the procedure and automatically repeats the interrupted procedure.

In case of a system error, sound signal is produced and “**System error!**” report is displayed. The measurement procedure is interrupted, and device repeats measurement from the beginning.

If the system error repeats more than five times in a row, it indicates that the device is out of order. In this case, the device should be switched off, and the manufacturer representative should be notified about the failure.

## MAINTENANCE

Device performs self-diagnostics and provides its current status. Technical service includes periodical refill of bottle with standard solution of CaCO<sub>3</sub> and the reservoir with saturated solution of potassium chloride.

## STORAGE

Device should be stored in manufacturer’s packaging under ambient temperature from 5 to 40°C and absolute humidity not exceeding 80% at the temperature of 25°C, prior to its installation for operation.

Requirements for device storage without packaging should be the same as for operation.

## DELIVERY SET

1	AKMC-1 device	1
2	Spares and accessories kit	1
3	Hydroseal	1
5	Operation Manual	1
7	Spare electrodes	1
8	Potassium chloride, CPG	40 g
9	Water hardness calcium standard 1000 ppm	1 L



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