1.DESCRIPTION OF THE SOFTWARE AND HARDWARE COMPLEX

Software and hardware complex (SHC) is designed for a wide range of scientific research in various fields of chemistry and physics. In particular, for the study of electrochemical processes occurring in the electrode-electrolyte interface.

SHC is assembled on modern element base, which ensures high accuracy, reliability, performance and stability of its operation.

The work of SHC is managed by a modern, leading in research, software that enables management of SHC and performs collection and processing of data in real time.

Distinctive features of SHC are:

1. Ability to work on grounded objects (including those in industrial conditions, in environments that are directly within the operating units).
2. The possibility of simultaneous independent study of the two electrode systems on two channels in a single solution (allows simultaneous study of different materials in the same solution in exactly the same conditions).
3. The possibility of forming of the polarization signal of complex form.
4. The possibility of forming of the currents up to 5 amps.

SHC allows you to:

1. Maintain a given potential of the working electrode.
2. Change the potential of the working electrode according to the given function (linear, step, sinusoidal, etc.) with different rates.
3. Maintain a given polarization current of the working electrode.
4. Change the polarization current of the working electrode linear and stepwise with different rates.
5. Measure and record the polarization current of the working electrode.
6. Measure and record the potentials of the working and supporting electrodes with respect to the reference electrode.
7. Work in the measure mode for electrode potentials (potentiometer).
8. Perform corrosion-electrochemical measurements.
9. Measure the concentration of substances by the potentiometric method.
10. Measure the concentration of substances by the voltammetric method.
11. Generate the recorded data for further computer processing.

1.2. Technical data

For the potentiostatic mode

1. Number of channels potentiostat, pcs.	2
2. Range of output potentiostat voltages	
- for an output current 100 mA, V	±10
- for an output current 5 A,V	±5
3. Maximum output current, A	±5
4. Accuracy of the maintenance of potential, not more, %	1
5. Accuracy of the measurement of potential, not more, mV	1
6. Accuracy of the measurement of polarization current, reduced to the range of measurements, not more, %	5
7. Input resistance of the amplifiers of measure of potential of the working electrode and reference electrode, not less, Mom	1000
8. Perfomance of the potentiostat, not less, kHz	100
9. Speed of scanning, mV/sec	0,0002÷1000

For the galvanostatic mode

1. Number of galvanostat channels , pcs.	2
2. Range of output voltages (at the nominal output current, except for limit 10 A), V	±10
3. Maximum output current, A	±5
4. Accuracy of the measurement of potential, not more, mV	1
5. Accuracy of the measurement and the maintenance of polarization current reduced to the range of measurements, not more, %	5
6. Input resistance of the amplifiers of measure of potential of the working electrode and reference electrode, not less, Mom	1000
7. Speed of scanning, mA/sec (for range 100 A)	0,0000001÷1

Operating conditions

Environment temperature, °C	+10÷+35
Relative humidity at 20°C, %	30÷80
Supply voltage, V	220

1.3 Included items

1. Potentiostat ПИ-2МК-10А
2. Input- output board E14-440D
3. AC power cord
4. Set of connecting cables
5. USB cable
6. Interface cable
7. Equivalent of electrochemical cell
8. Filter
9. DVD-discs with the software
10. Jumpers
11. Set of external measuring resistors of 100 kOhm
12. Technical description and user manual
13. Packing box

2. STRUCTURE AND OPERATING PRINCIPLE OF SHC

SHC consists of:

-potentiostat ПИ-2МК-10А

- input- output board E14-440D

-software Powergraph

The main function of the potentiostat is maintaining of polarizing voltage between the reference electrode and the working electrode at the given level and measuring the polarizing current.

The software Powergraph controls the operation of potentiostat with input-output board E14-440D (of DAC-ADC block).

Potentiostat

Potentiostat has two independent channels that can operate together or separately, in different modes, in one or two electrochemical cells.

Control unit switches the operating mode (potentiostat-galvanostat) and the current limits. The control unit gives to the ADC of computer information about limit of measuring or maintaining of the current, powered at the current moment.

The control unit is controlled by switchers on the front panel (manual mode) or computer through the digital outputs if the corresponding switchers are set to "AUTO".

Operational amplifier. In the potentiostatic mode operational amplifier performs the function of voltage between the working electrode and reference electrode, according to the task.

In the galvanostatic mode operational amplifier performs the function of maintenance of current between the working electrode and auxiliary electrode, according to the task.

Task can be achieved by external voltage source, with a corresponding position of the task switcher. External voltage source should have a low output resistance. Output resistance of 1 kOhm gives the complementary maintenance error up to 1%. The input signal is inverted, so for the setting of positive values of voltage or current the polarity of the external input signal should be negative, and vice versa.

Between the output of the DAC and the input can be connected an external RC-filter for smoothing the jumps of quantization (discreteness). The resistance of the filter must be chosen as low as possible to reduce the complementary error.

Power amplifier amplifies the signal from the operational amplifier. The maximum output current-5 A. Maximum output voltage-10 V. When the output voltage of the power amplifier is above 8 V indicator "overload" on the front panel is on. This indicates that the ability to maintain a given polarization voltage or current is exhausted.

Avoid working at the limits of 1 and 10 A with a short circuit between the working and auxiliary electrodes, as in this mode high power can be dissipated on the inner elements of the SHC.

Measuring resistors are connected in the circuit between the power amplifier and the working electrode. The current of the working electrode is determined by the voltage drop on measuring resistor. On the measuring resistor takes place the voltage drop of 1 V at the nominal current.

Connecting an appropriate measuring resistor is performed by relay contacts of the control unit. If you select the measuring mode of potential of the working electrode, the measuring resistor is not connected, and through the working electrode current is not passed. In this mode, you can connect an external measuring resistor to the terminals on the front panel to set the arbitrary current limit. For example, for the limit of 10 mA the resistance of measuring resistor should be 100 kOhm. It should be remembered that the measurement of low currents requires careful screening of measuring circuits and inclusion of EMI filters.

High resistance amplifier of the working electrode has a high input resistance and allows to measure the potential of the working electrode with respect to the auxiliary electrode. Output voltage of the amplifier is equal to the input voltage.

High resistance amplifier of the reference electrode has a high input resistance and allows to measure the potential of the reference electrode with respect to the auxiliary electrode. Output voltage of the amplifier is equal to the input voltage.

Current meter measures the voltage drop on current-sense resistor. As the output voltage of the high resistance amplifier of the working electrode is equal to input, the voltage at the lower end of current-sense resistor and at the lower input of current meter are equal too. 100% of scale of the current limit corresponds to the output voltage of 1 V.

Potentiostat can produce and measure the current up to 500% of full scale (except the limit of 10A), with a maximum output voltage (between the working electrode and the auxiliary

electrode) is reduced by 1 V for every 100% overload. This allows, for example, reliably measure emissions of recharge current of capacity with a sudden change of the polarization voltage.