

PUMPING PLANT CONTROLLER MCK-107



OPERATING MANUAL

The quality management system of development and production complies with the requirements of ISO 9001:2015

Dear Customer,

NOVATEK-ELECTRO Ltd. Company thanks you for purchasing our products.
You will be able to use properly the device after carefully studying the Operating Manual.
Store the Operating Manual throughout the service life of the device

Before using the device, study the Operating Manual carefully.
Before connecting the device to electric mains, keep it for two hours at operating conditions.

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ATTENTION! ALL REQUIREMENTS OF THIS OPERATION MANUAL ARE COMPULSORY TO BE MET!



WARNING! THE DEVICE TERMINALS AND INTERNAL COMPONENTS ARE UNDER POTENTIALLY LETHAL VOLTAGE.

TO ENSURE THE DEVICE SAFE OPERATION **IT IS STRICTLY FORBIDDEN** THE FOLLOWING:

- TO CARRY OUT INSTALLATION WORKS AND MAINTENANCE WITHOUT DISCONNECTING THE DEVICE FROM THE MAINS;

- TO OPEN AND REPAIR THE DEVICE WITHOUT ANY PROFESSIONAL HELP;
- TO OPERATE THE DEVICE WITH MECHANICAL DAMAGES OF THE HOUSING.

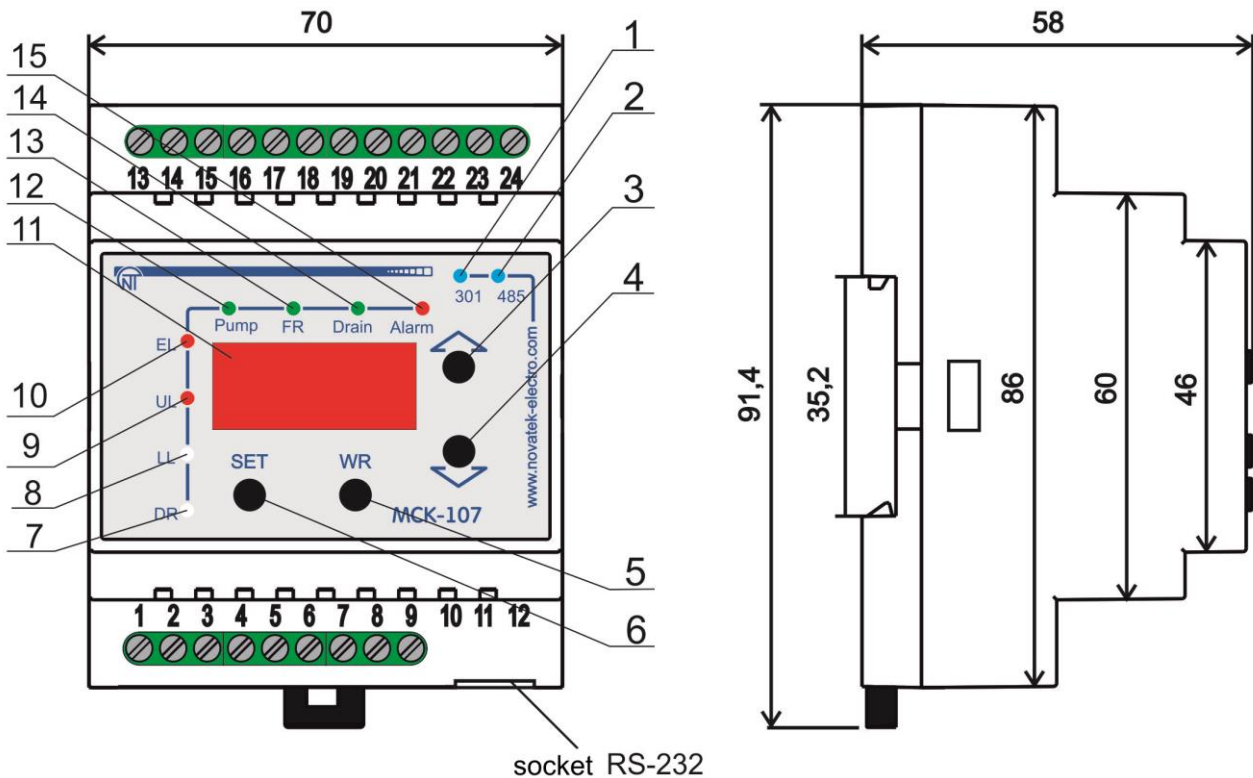
IT IS NOT ALLOWED WATER PENETRATION ON TERMINALS AND INTERNAL ELEMENTS OF THE DEVICE.

During operation and maintenance the regulatory document requirements must be met, namely:

- Regulations for Operation of Consumer Electrical Installations;
- Safety Rules for Operation of Consumer Electrical Installations;
- Occupational Safety in Operation of Electrical Installations;

Installation, adjustment and maintenance of the device must be performed by the skilled professionals having studied this Operating Manual.

The device is safe for use under keeping of the operating rules.



- 1 - blue LED "301" - glows when exchanging data with UBZ-301;
- 2 - blue LED "485" - glows when exchanging data via RS-485 interface;
- 3 - button "up arrow" (hereinafter as UP);
- 4 - button "down arrow" (hereinafter as DOWN);
- 5 - button "WR" - recording parameters in the setting mode, exit from parameter setting mode;
- 6 - button "SET" - activates the parameter setting mode;
- 7 - LED "DR" (dry run level);
- 8 - LED "LL" (lower level);

- 9 - red LED "UL" (upper level);
- 10 - red LED "EL" (emergency level)
- 11 - three-digit indicator;
- 12 - LED " Pump" - glows when the load relay is activated;
- 13 - green LED "FR" - glows when the functional relay is activated;
- 14 - green LED " Drain " - off when MCK-107 is in the filling mode; glows when MCK-107 is in the drainage mode; blinks when MCK-107 is in the manual operation mode;
- 15 - red LED "Alarm" (Failure) - glows when MCK-107 is in the failure condition.

Figure 1.1 - Controls and overall dimensions of MCK-107

1 DESCRIPTION AND OPERATION

1.1 DESIGNATION

The pumping plant controller MCK-107 (hereinafter referred to as either MCK-107 or the device) is designed to create technological processes automation systems, related to control and maintaining of a set level of liquid

substances in different kinds of tanks by controlling an electric motor (or electric motors) of one or two pumps.

Maintaining of a set level of liquid substances is performed:

- in case of single-phase motor with capacity of up to 1 kW – by controlling the integrated pump relay;
- in case of three-phase motor or single-phase motor with capacity of over 1 kW - by controlling the magnetic starter coil (contactor).

MCK-107 provides controlling of the electric motor (electric motors) of one or two pumps both in an automated mode according to one of the algorithms integrated into the device and in the manual mode - according to the user's commands, given from a faceplate or a button station.

Via RS-232 and RS-485 interfaces (MODBUS protocol) it is possible to set the main parameters of MCK-107 operation, as well as to remotely control the electric motor (electric motors).

Note – It is not possible to use RS-485 and RS-232 simultaneously.

If MCK-107 operates along with the universal electric motor protection device UBZ-301 (hereinafter referred to as UBZ-301), manufactured by Novatek-Electro, the device will provide:

- protection of the electric motors at sub-quality mains voltage (inadmissible voltage jumps, loss of phases, alternation disturbance and adhesion of phases, imbalance of phase/linear voltages) or mechanical overloads;
- indication of current consumption of the electric motor;
- transfer of data, measured and calculated by UBZ-301, UBZ-301 settings and modes via RS-232 or RS-485 interface.

For a PC to work with MCK-107, one may use the program "MCK-107 Control Panel", located on the website of NOVATEK-ELECTRO company (<http://novatek-electro.com/en/software.html>).

The program "MCK-107 Control Panel" is designed to control the state and to collect data from MCK-107 and UBZ-301 devices via RS-232 or RS-485 interface. The program allows saving (downloading) different MCK-107 settings, perform collection of data and save them for further analysis. The saved data can be viewed in the form of a diagram, enabling to compare the parameters among one another.

The graphic interface of the CP (control panel) allows real-time watching the current state of different MCK-107 parameters. The flexible interface setting enables to adjust to any user.

MCK-107 provides working with liquids of various electrical conduction - tap water and polluted water, milk and food products (low-acid, alkaline etc.).

1.2 GENERAL PROVISIONS AND TERMS

Conduction-measuring sensor of liquid level is a sensor, the operating principle whereof is based on the increase of electrical conduction between the common and the signal electrodes, if there is liquid between them.

Contact pressure gauge (CPG) measures pressure, produced by liquid. For instance, one can determine the liquid level in the tank by measuring pressure at the bottom of a tank (an outlet pipe).

The pressure gauge used in MCK-107 must correspond to type V (must have two contacts one of which must be a break contact (closed at low pressure); the second contact must be a make one (closing at high pressure); if pressure is between the high and the low levels, both contacts must be broken).

Note - As usual, CPGs with two contacts have universal (transfer) contacts and the necessary type of CPG can be set by the user.

Filling mode - In this mode, MCK-107 controls the pump, filling the outer tank by pumping water from the well.

To prevent failure of the electric motor while draining the well, one may use a dry run sensor (conduction-measuring dry run sensor is located in the well). After deactivation of the pump electric motor due to dry run failure, the pump activation delay is provided for the time of filling the well with water (the delay time is determined by the AR time (automatic reset time) parameter and can be set by the user).

Two pumps may be used in the filling mode. The second pump is used to operate simultaneously with the first pump at high flow of water, when the capacity of one pump is not enough to fill the tank within the time allotted by the user. If the capacity of both pumps is equal, the user can set the alternate operation of the pumps for balancing the tear-and-wear.

Drainage mode is used for pumping liquid out of the well, for instance - in sewerage stations. If using the two pumps in the drainage mode, the second pump is activated, if the capacity of one pump is not enough and the liquid level has exceeded the emergency level. If the capacity of both pumps is equal, the user can set the alternate operation of the pumps for balancing the tear-and-wear.

1.3 TECHNICAL CHARACTERISTICS

General data for MCK-107 are specified in Table 1.1.

The main technical characteristics of MCK-107 are specified in Table 1.2.

The characteristics of the integrated relays output contacts are specified in Table 1.3.

Table 1.1 - General Data

Name	Measuring Unit	Value
Purpose of device	-	Control and distribution equipment
Rated operating regime	-	continuous
Protection class	-	IP20
Electric shock protection class	-	II
Climatic version	-	NC3.1

Allowable pollution rating	-	II
Overtoltage category	-	II
Rated insulation overvoltage	V	450
Rated impulse withstand voltage	kV	2.5
Section of wires connected to terminals	mm ²	0.5 – 2
Maximum tightening torque of terminal screws	N*m	0.4

Table 1.2 - The main technical characteristics

Rated supply voltage: single-phase 50 Hz, V		230/240
Voltage, at which operability is maintained, V		130 – 270
Mains frequency, Hz		48 – 62
Inputs:	Number	
- analog input for connecting level sensor (of pressure)	4	
- quantized input for connecting universal electric motor protection device UBZ-301	1	
- quantized input 1 (terminal 1), pc.	1	
- quantized input 2 (terminal 2), pc.	1	
- quantized input for connecting RS-232 interface	1	
- quantized input for connecting RS-485 interface	1	
Main outputs:		
- load relay - throwable contact for controlling the electric motor starter - 16 A 250 V at cos φ=1	1	
- functional relay – transfer contact - 16 A 250 V at cos φ=1	1	
Controlled environment resistance for conduction-measuring sensor, kiloohm, not more than		450
Power consumption (under pressure), not more than, VA		5.0
Weight, not more than, kg		0.2
Overall dimensions (four S modules), mm		70*91.4*58
Installation onto standard 35 mm DIN rail		
Operating position		arbitrary
Housing material - self-extinguishing plastic		
Note - quantized inputs 1 and 2 are used for manual control of the pump electric motor		

Table 1.3 - The characteristics of the integrated relays output contacts

Operating regime	Max. current at U~250 V, A	Number of trips x1000	Max. switching power, VA	Max. continuous additional AC voltage, V	Max. current at U DC=30 V, A
cos φ = 0.4	5	50	4000	440	3
cos φ = 1.0	16	100			

1.4 COMPLIANCE WITH STANDARDS

MCK-107 complies with the requirements of:

Complete low-voltage distribution devices. Part 1. General rules (IEC 60947-1);

Low-voltage switch and controller. Part 6-2. Multifunctional equipment. Control and protection switching devices (IEC 60947-6-2);

Electromagnetic compatibility. Industrial, scientific and medical radio-frequency equipment. Characteristics of electromagnetic interference. Standards and methods of measuring (CISPR 11);

Electromagnetic compatibility. Part 4-2. Methods of testing and measuring. Electrostatic discharge non-susceptibility testing (IEC 61000-4-2).

There is no amount of harmful substances, exceeding the maximum allowable concentration.

1.5 OPERATIONAL CONDITIONS

- Operating temperature range – from -35 to +55 °C;

- Atmospheric pressure – from 84 to 106,7 kPa;

- Relative humidity 30 ... 80 % (at +25 °C temperature).

ATTENTION! The device is not intended for operation in the following conditions:

– Significant vibration and shocks;

– High humidity;

– Aggressive environment with content in the air of acids, alkalis, etc., as well as severe contaminations (grease, oil, dust, etc.).

1.6 LIST OF USED ABBREVIATIONS

EL – Emergency Level

UL – Upper Level

LL – Lower Level

AR – Automatic Reset

DR – Dry Run

CPG – Contact Pressure Gauge

MS – Magnetic Starter

1.7 CONTROLS AND OVERALL DIMENSIONS

Controls and overall dimensions of MCK-107 are specified in Figure 1.1.

1.8 MEASURED AND CALCULATED PARAMETERS

The measured and calculated parameters, which can be viewed in the MCK-107 indicator, including those transferred through RS-232/RS-485 interface, are specified in Table 1.4.

Table 1.4 - Measured and calculated parameters

Parameters	Limit	Accuracy	Code in Indicator	Address	Measuring Units at data Transfer
Resistance of sensor DR ¹ , kilohm	500	5%	dd1	100	kilohm
Resistance of sensor LL ¹ , kilohm	500	5%	dd2	101	
Resistance of sensor UL ¹ , kilohm	500	5%	dd3	102	
Resistance of sensor EL ¹ , kilohm	500	5%	dd4	103	
Condition of external control inputs ²			d11	104	
Delay time after dry run failure, minutes			tAP	105	minutes
Parameters, shown only when UBZ-301 is connected					
Current of phase L1 ³ , A			f1	106	tenths of ampere
Current of phase L2 ³ , A			f2	107	
Current of phase L3 ³ , A			f3	108	
Average phase current, A			f0	109	
Linear voltage L1 ⁴ , V	500		UL1	110	volts
Linear voltage L2 ⁴ , V	500		UL2	111	
Linear voltage L3 ⁴ , V	500		UL3	112	
Resistance of motor insulation, kilohm	500		r id	113	kilohm
Notes:					
1 - At resistance over 500 kilohm, the indicator shows "5 ";					
2 - Being displayed in the indicator, the condition of inputs is shown as "0 1", where "1" means broken input 1, "0" means closed input 2. While transferring via RS-232/RS-485 interface: bit 0 is condition of input 1, bit 1 is condition of input 2 (0 is closed, 1 is broken);					
3 - At failure "motor rated current undetermined" (Table 2.13), the indicator displays "- 1", and the number 65535 is transferred via RS-232/RS-485 interface. At single-phase operation mode, current L3 is calculated as vector sum of currents of phases L2 and L3;					
4 - At single-phase operation mode, the voltage phase value is displayed in the indicator and transferred via the interface					

The parameters, transferred via RS-232/RS-485 interface at connected UBZ-301, are specified in Table 1.5.

Table 1.5 – Parameters, intended only for transfer via RS-232/RS-485 interface at connected UBZ-301

Parameters	Limit	Accuracy	Measuring Units at data Transfer	Note
Time setting at double overload, sec	100	120	seconds	
Voltage imbalance setting, %	20.0	121	tenths of percent	percent of rated voltage
Voltage setting, %	20.0	122	tenths of percent	
Minimum current setting, %	75	123	percent	percent of rated current
Rated current setting, A	100*	124	amperes	
Percent setting to rated current	85 – 115	125	percent	
Activation time setting, sec	600	126	seconds	
Deactivation time, sec	100	127	tenths of second	
Accumulated heat, %	1999	128	percent	
* Note – parameter limiting value is specified for UBZ-301-100 (depends on type of UBZ-301)				

1.9 PROGRAMMABLE PARAMETERS

Programmable parameters and limits of their changes are specified in Table 1.6.

Table 1.6 - Programmable parameters

Parameter	Code in Indicator	Min. value	Max. value	Factory setting	Actions	Address
Operation mode	odE	0	2	0	0 – manual; 1 – drainage; 2 - filling	150
Control from faceplate	CPA	0	1	0	0-deactivated 1-activated	151

Parameter	Code in Indicator	Min. value	Max. value	Factory setting	Actions	Address
UBZ-301	<i>U30</i>	0	2	0	0 – disconnected 1 – connected, at communication loss: warning and continuing operation 2 – connected, at communication loss: warning and recording into log book	152
Functional relay	<i>FrE</i>	0	2	0	0 – alarm relay 1 – second pump electric motor control 2 - second pump electric motor control with alternate motor operation	153
AR time, minutes	<i>tAP</i>	0	300	1		154
Second pump electric motor activation time	<i>t10</i>	0	180	30	see par. 2.4.11	155
Parameters of sensors						
Emergency level sensor	<i>dAL</i>	0	1	1	0 – off 1 - on	156
Dry run sensor	<i>dSh</i>	0	1	1	0 – off; 1 – on	157
Type of level sensors	<i>tDU</i>	0	1	0	0 – conduction-measuring 1 - pressure (CPG type)	158
Sensitivity of conduction measuring sensors, kOhm	<i>SCd</i>	10	450	30		159
Sensor response delay time, sec	<i>tDr</i>	0	10	1		160
Input 1 external control	<i>d11</i>	0	2	0	0 – deactivated	161
Input 2 external control	<i>d12</i>	0	2	0	1 – allowed when contact is closed 2 – allowed when contact is broken	162
SPI interface communication parameters						
Communication address	<i>rSA</i>	1	247	1		163
Transfer rate*	<i>rSS</i>	0	1	0	0 - 9600 baud; 1 - 19200 baud	164
Converter response to communication loss	<i>rSP</i>	0	2	0	0- continuing without warning 1- warning and continuing operation 2 – warning, recording into log book and continuing operation	165
Detection of response time exceeding, sec	<i>rSD</i>	0	120	0	0-prohibited	166
Serial line communication permit	<i>rPP</i>	0	2	0	0- communication prohibited 1- communication via RS-232 2- communication via MODBUS	167
Communication protocol type* (MODBUS modes)	<i>rAS</i>	0	1	1	0 - ASCII ; 1 - RTU	168
Number of stop bits *	<i>rSb</i>	1	2	2		169
Parity checkup*	<i>rPE</i>	0	1	0	0 – deactivated; 1 – activated	170
General parameters						
Full operation time of device, days	<i>tBU</i>	0	999	0	In case of exceeding of number 999, the score will start from scratch.	171
First pump electric motor running time, days	<i>tC1</i>	0	999	0	In case of exceeding of number 999, the score will start from scratch.	172
Second pump electric motor running time, days	<i>tC2</i>	0	999	0	In case of exceeding of number 999, the score will start from scratch.	173
Reset to factory settings	<i>PPP</i>	0	1	0		174
Adjuster's access code	<i>PAS</i>	000	999	123	000 – adjuster level access allowed 000-999 – adjuster's password	175
Indicator readings at normal operation**	<i>ind</i>	0	2	0	0 – operation mode (" <i>rUC</i> " at <i>odE</i> =0; " <i>drE</i> " at <i>odE</i> =1; " <i>nAP</i> " at <i>odE</i> =2) 1 – phase average motor current 2 – L1 phase voltage	176
Device version	<i>rEL</i>			7		177

Parameter	Code in Indicator	Min. value	Max. value	Factory setting	Actions	Address
UBZ-301 rated linear voltage***	U30	0	2	0	0 – 380 V 1 – 400 V 2 – 415 V	178

Notes

* – Change of parameter will take place after power supply deactivation and reset, or after performing the " REPEATED START " command;

** – If parameter "U30" =0 (UBZ-301 disconnected), the indicator displays MCK-107 operation mode regardless of parameter " ind" value;

*** – Parameter value is set according to the rated voltage, specified on the faceplate of UBZ-301. Incorrect setting of this parameter will lead to incorrect readings, while MCK-107 is displaying voltage values, measured by UBZ-301.


1.10 POSSIBLE CONDITIONS OF LIQUID LEVEL INDICATORS

All possible conditions of liquid level indicators LEDs "DR", "LL", "UL", "EL" are specified in Table 1.7.

Table 1.7

Indicator	Condition	Cause	Register address = 240	
			bits	condition
" DR "	does not glow	DR sensor is not activated	9 – 8	00
	glows green	liquid level higher than DR sensor	9 – 8	11
	flashes out green	liquid level higher than DR sensor, but AR time after "dry run" failure has not elapsed	9 – 8	10
	glows red	liquid level lower than DR sensor (dry run failure)	9 – 8	01
" LL "	glows green	liquid level higher than LL sensor	11 – 10	11
	flashes out green	in drainage mode liquid level lower than LL sensor	11 – 10	10
	glows red	liquid level lower than LL sensor (except for drainage mode)	11 – 10	01
	flashes out red	LL sensor failure	11 – 10	00
" UL "	does not glow	liquid level lower than UL sensor	13 – 12	00
	glows red	liquid level higher than UL sensor	13 – 12	11
	flashes out red	UL sensor failure	13 – 12	01
" EL "	does not glow	EL sensor is not activated or liquid level lower than the sensor	15 – 14	00
	glows red	liquid level higher than EL sensor (emergency level failure)	15 – 14	11
	flashes out red	liquid level lower than EL sensor (dry run failure), but AR time after "by emergency level" failure has not elapsed	15 – 14	01

2 INTENDED USE**2.1 SAFETY PRECAUTIONS**

 **ALL CONNECTIONS MUST BE PERFORMED WHEN THE DEVICE IS DE-ENERGIZED.**
ATTENTION! THE DEVICE IS NOT INTENDED TO BE USED FOR LOAD COMMUTATION IN CASE OF SHORT CIRCUITS. THEREFORE THEY SHOULD BE PROTECTED BY AUTOMATIC CIRCUIT BREAKERS (FUSES).

The fuse rating is selected according to the power of connected load, but it should not exceed for contacts 15 - 18 is 15 A.

Error when performing the installation works may damage the product and connected devices.

To ensure the reliability of electrical connections you should use flexible (stranded) wires with insulation for voltage of not less than 450 V, the ends of which it is necessary to be striped of insulation for 5±0.5 mm and tightened with bootlaces. Recommended cable cross section for connection is not less than 1 mm².

Wires fastening should exclude mechanical damage, twisting and insulation abrasion of wires.

IT IS NOT ALLOWED TO LEAVE EXPOSED PORTIONS OF WIRE PROTRUDING BEYOND THE REMOVABLE TERMINAL BLOCK.

For a reliable contact, tighten the terminal screws with the force indicated in Table 1,1.

When reducing the tightening torque, the junction point is heated, the terminal block may be melted and wire can burn. If you increase the tightening torque, it is possible to have thread failure of the terminal block screws or the compression of the connected wire.

2.2 CONTROL OF MCK-107**2.2.1 Initial condition (normal operation mode)**

MCK-107 is in the initial condition after energizing and, depending on the value of parameter "odE'", can be in one of the following operation modes:

- manual mode at odE'=0;
- drainage mode at odE'=1;

- filling mode at $odE=2$.
- All the operation modes allow viewing:
- measured and calculated parameters;
 - failure conditions log book (par. 2.8).

2.2.2 Viewing measured and calculated parameters

To view the measured and calculated parameters, one should press the **UP** button. The indicator will show "dd l" code (dry run sensor resistance code). Parameter paging is performed by pressing the **UP** and **DOWN** buttons; herewith, the indicator will successively show the codes of the measured and calculated parameters (Table 1.4).

To view the numerical value of a parameter, press the **SET** button. To exit to codes display, press the **SET** button.

If either the buttons have not been pressed for 30 seconds or the **WR** button has been pressed, MCK-107 exits the measured and calculated parameters viewing mode and switches to the initial condition.

2.2.3 User's viewing and changing parameters

The user level allows:

- changing and viewing parameters of the user level;
- viewing parameters of the adjuster level.

To view and change parameters of the user level, one should press the **SET** button. Parameter paging is performed by pressing the **UP** and **DOWN** buttons; to enter the parameter changing - press the **SET** button (parameter value starts to blink), to change a parameter value - press the **UP** and **DOWN** buttons, to record a parameter - press the **WR** button, to turn back to menu without recording - press the **SET** button, to exit the menu - press the **WR** button. If no button has been pressed for 30 seconds, MCK-107 will switch to the initial condition.

If changing of a parameter is prohibited by the adjuster (while displaying the mnemonics of the changed parameter, the dot is glowing in the middle-order digit of the indicator), this means that changing of that parameter is possible only at the adjuster level after removing the prohibition.

2.2.4 Adjuster's viewing and changing parameters

To enter the adjuster level, one should press the **SET** button and hold for 5 seconds. If the level is protected by a password, "000" will be blinking in the indicator. Using the **UP** and **DOWN** buttons one should successively enter three figures of the adjuster's password - from 1 to 9, dividing each figure by pressing the **WR** button. If the password is not correct, "000" will be blinking in the indicator again, and MCK-107 will turn back to the initial condition in 15 seconds; otherwise the indicator will show the first parameter of the adjuster menu and the dot will start to glow in the low-order digit of the indicator.

Parameter paging is performed by pressing the **UP** and **DOWN** buttons; to enter the parameter changing - press the **SET** button (parameter value starts to blink), to change a parameter value - press the **UP** and **DOWN** buttons, to record a parameter - press the **WR** button, to turn back to menu without recording - press the **WR** button, to exit the menu - press the **WR** button. If no button has been pressed for 30 seconds, MCK-107 will switch to the initial condition.

At the adjuster level, the access to any parameter at the user level can be either prohibited or allowed by pressing the **SET** button and **DOWN** buttons at the same time. The access prohibition is indicated by the decimal point in the middle-order digit of the indicator, when the parameter mnemonics is displayed in it.

2.2.5 Setting of factory parameters

There are two ways of setting the factory parameters.

First way. Set the parameter $PPP=1$. After exiting the parameter setting mode, all the factory parameters will be restored (except for the adjuster's password).

Second way. While energizing MCK-107, hold the **SET** and **WR** buttons pressed for two seconds. All the factory parameters, including the adjuster's password, will be restored (adjuster's password - 123).

2.3 PREPARATION FOR USING

2.3.1 ATTENTION! To increase the running ability of MCK-107, it is recommended to install protection devices (fuse links or their equivalents) into the following circuits (enumerated in the order of necessity, hyphen is followed by the recommended protection device rating):

- 1) power supply circuits of MCK-107 (23, 24 – N, L1) - 1 A;
- 2) RS-485 (13, 14) – 1 A;
- 3) relay output contacts (protection device rating is chosen according to the connected circuits, but for contacts shall not exceed 15 - 18 – 15 A).

When using MCK-107 in three-phase mains (including using along with UBZ-301), it is recommended to connect MCK-107 to the electric mains via the electronic phase switch PEF-301, produced by Novatek-Electro or its equivalent. In this case, at sub-quality mains voltage on one or two phases (loss of phases, emergency high or low voltage) the running ability of MCK-107 will be preserved:

- displaying of MCK-107 condition in the indicator;
- transfer of parameters and MCK-107 condition via RS-232/RS-485 remote access interfaces;
- when UBZ-301 is connected: receiving data from UBZ-301 about the settings and condition of UBZ-301, receiving values of the motor currents and voltage; displaying the received data in the MCK-107 indicator and transferring them via RS-232/RS-485.

2.3.2 When using the conduction-measuring sensors of level, connect MCK-107 to electric mains according to Figure 2.1.

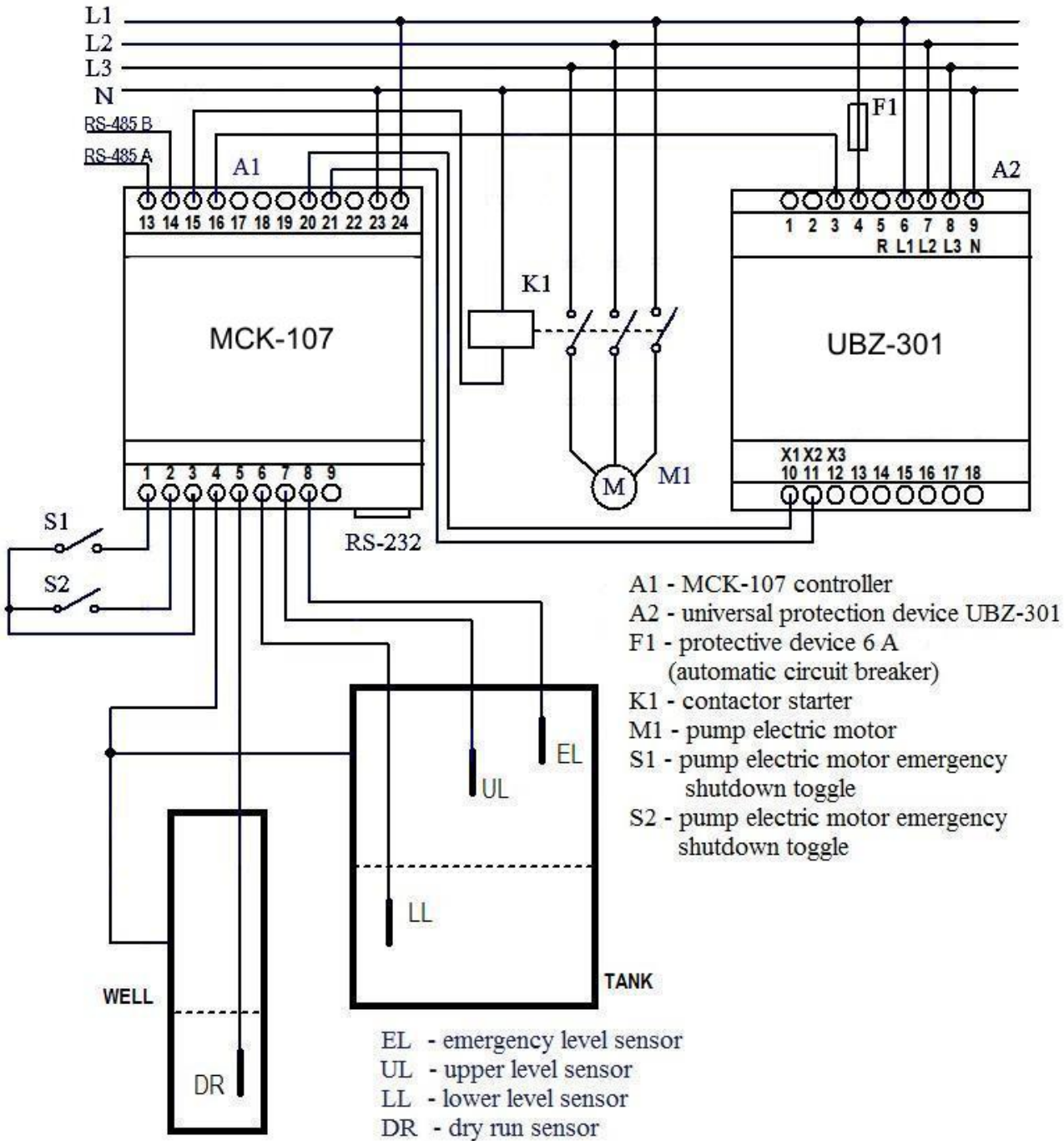
2.3.3 When using the pressure sensor, connect the sensor to MCK-107 according to Figure 2.2.

2.3.4 When using MCK-107 along with the universal protection device UBZ-301, connect the units according to Figure 2.1.

Note - Connection and setting of UBZ-301 is performed according to its operating manual.

2.3.5 For a PC as a controlling device to work with MCK-107, using the "MCK-107 Control Panel" program, one should:

- install the "MCK-107 Control Panel" program onto PC by starting the setup_KC107(x.x).exe program, where x.x. stands for version of the program;
- connect the socket "RS-232" on the MCK-107 panel to the socket RS-232 of PC with KC-01 cable;
- set the parameter "rPP=1" (setting of the parameter is allowed after energizing and performed according to par. 2.2).



ATTENTION! WHILE THE PUMP ELECTRIC MOTOR IS BEING DEACTIVATED BY MCK-107 CONTROLLER, THE STARTER COIL TERMINAL PRESERVES HIGH VOLTAGE

Figure 2.1 - MCK-107 connection diagram, when using conduction-measuring sensors

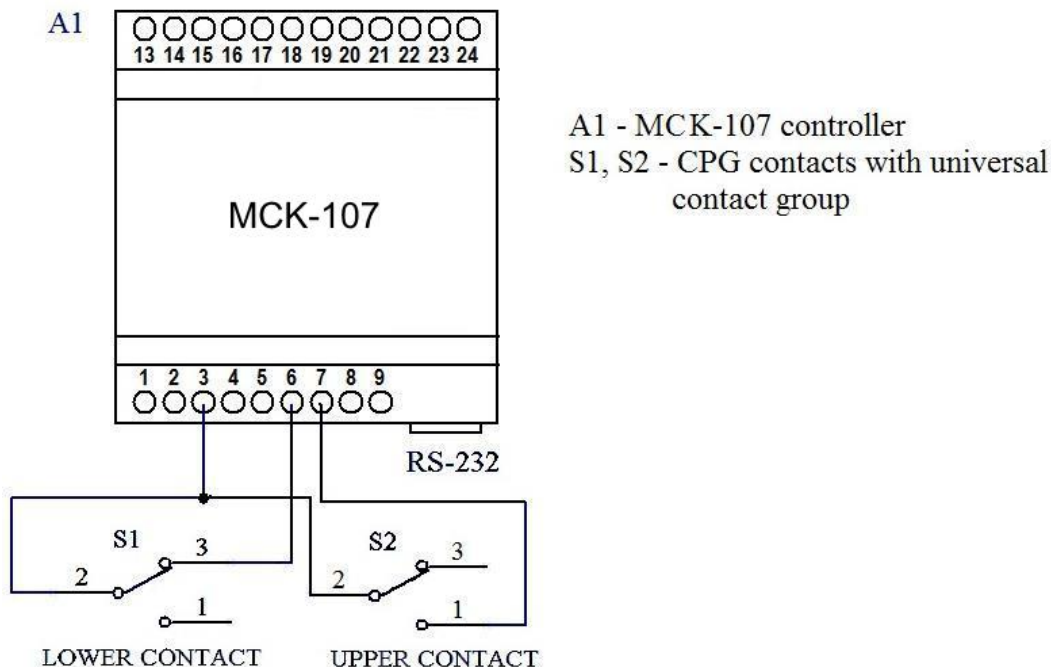


Figure 2.2 - Pressure sensor (CPG) connection diagram

Notes

1 The **Setup_cplmck107(x.x).exe** program is placed on the website of NOVATEK-ELECTRO company (<http://novatek-electro.com/en/software.html>).

2 KC-01 cable is optional. The user can make KC-01 cable on his own according to Figure 2.7.

3 It is allowable to use programs, developed by the user, for working with MCK-107.

2.3.6 When using MODBUS, connect the communication lines to terminals **13 (A RS-485 line)**, **14 (B RS-485 line)** of MCK-107 and set the parameter "rPP=2" (setting of the parameter is allowed after energizing and performed according to par. 2.2).

2.3.7 Connect the magnetic starter (hereinafter referred to as MS) of the electric motor according to Figure 2.1.

Note - The pump relay being activated, the 15 and 16 contacts shall be closed.

2.3.8 Energize MCK-107.

2.4 INTENDED USE

2.4.1 Operation of MCK-107 after energizing

After energizing, the indicator will display the "5tA" message for a short time. During this time (0.5 seconds) MCK-107 performs the internal operability test.

Then, during the sensors response delay time (parameter "5dr"), the indicator will show the "5dr" message. During this time, activation and the functional relay and the load relay is prohibited.

After that, MCK-107 will switch to the set operation mode.

Setting of the necessary parameters is performed according to paragraph 2.2.

Note - At the first activation and after reset to factory settings, MCK-107 will start operating in the manual mode.

2.4.2 Operation in the manual mode

For the device operating in the manual mode, one should set the parameter **odE=0**. Herewith, LED "Drain" will blink, and the indicator will display the "rUc" message.

If the parameter **FrE =0** (the functional relay is used as the alarm relay), then:

- at **d i l =0**, operation from the first post through the first input is prohibited;
- at **d i l =1**, the load relay is activated at closed contacts 1, 3 of MCK-107 (toggle S1 is on, Figure 2.1), and deactivated at broken contacts;
- at **d i l =2**, the load relay is activated at broken contacts 1, 3 of MCK-107 (toggle S1 is off, Figure 2.1), and deactivated at closed contacts;

At **CPA =1** and **d i l =0**, control of the pump from the faceplate is allowed.

The load relay is activated/deactivated by pressing the UP and DOWN buttons at the same time.

If the parameter **FrE =1** (the functional relay is used for controlling the second pump electric motor), then:

- at **d i 2 =0**, operation from the external post through the second input is prohibited;
- at **d i 2 =1**, the functional relay is activated at closed contacts 2, 3 of MCK-107 (toggle S2 is on, Figure 2.1), and deactivated at broken contacts;
- at **d i 2 =2**, the functional relay is activated at broken contacts 2, 3 of MCK-107 (toggle S2 is off, Figure 2.1), and deactivated at closed contacts;

At $CPR = 1$; $d1 = 0$; $d2 = 0$ control of the functional relay from the faceplate is allowed.

The functional relay and the load relay are activated/deactivated by pressing the UP and DOWN buttons at the same time.

2.4.3 Automated modes common parameters setting

While the device operating with one pump, one should set the parameter $FrE = 0$ (the functional relay is used as the alarm relay).

Depending on the type of the used sensors, the liquid electric resistance, presence of foam, the level of electrical noise and other factors, one should set the necessary sensitivity of the sensors (parameter $5Cd$).

MCK-107 provides operation in the following automated modes:

- drainage mode with level sensors (Figure 2.3);
- filling mode with a level sensor (Figure 2.4);
- filling mode with level sensors (Figure 2.5).

2.4.4 Operation in the automated drainage mode with the level sensors

For the device operating in the manual mode, one should set the parameter $odE = 1$ (drainage mode). Herewith, LED "Drain" will glow, and the indicator will display the "drE" message.

In the initial state (in case the liquid level in the tank is lower than the UL sensor), when starting the power supply, the pump electric motor will not be activated (contacts 15, 16 of MCK-107 are broken).

When the liquid level reaches the UL sensor, the automatic activation of the pump electric motor takes place (closing of contacts 15, 16 of MCK-107).

When the liquid level in the tank is lower than the LL sensor, the automatic deactivation of the pump electric motor takes place (breaking of contacts 15, 16 of MCK-107) and the cycle is repeated.

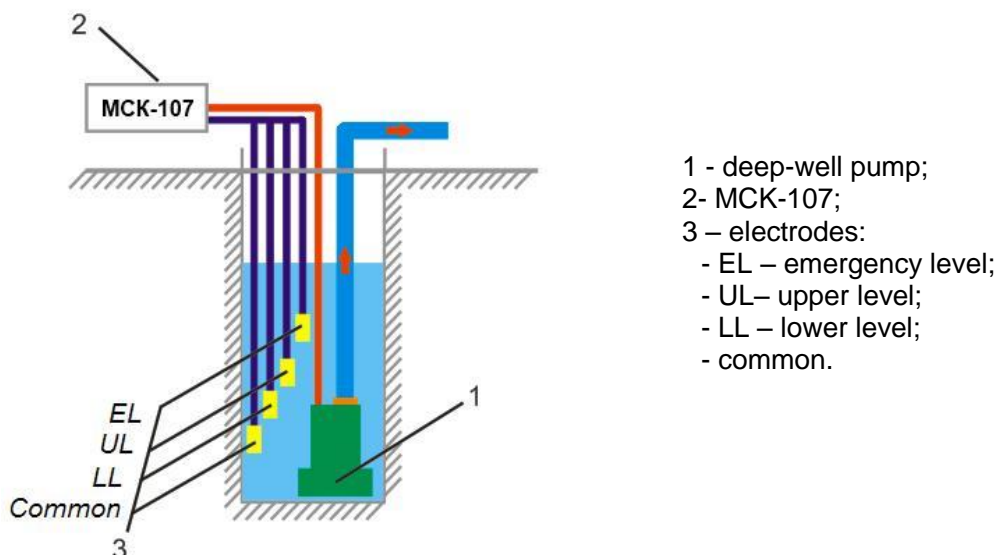


Figure 2.3 – Application of MCK-107 in the drainage mode

2.4.5 Operation in the automated filling mode with the pressure sensors

In this mode the parameter $odE = 2$ (filling mode), the parameter $tdU = 1$ (contact pressure sensor (for instance CPG)), LED "Drain" does not glow, and the indicator will display the "nAP" message.

In the initial state (no pressure on the pressure sensor), when starting the power supply, the automatic activation of the pump electric motor takes place (closing of contacts 15, 16 of MCK-107).

When closing the movable contact with the contact of the UL upper setting, the automatic deactivation of the electric motor takes place (breaking of contacts 15, 16 of MCK-107).

When closing the movable contact with the contact of the LL lower setting, the automatic activation of the electric motor takes place (closing of contacts 15, 16 of MCK-107) and the cycle is repeated.

If the movable contact in the initial state is located between the UL and LL contacts, when starting the power supply, the electric motor will not be activated. Activation of the pump electric motor will take place on closing the movable contact with the contact of the LL sensor.

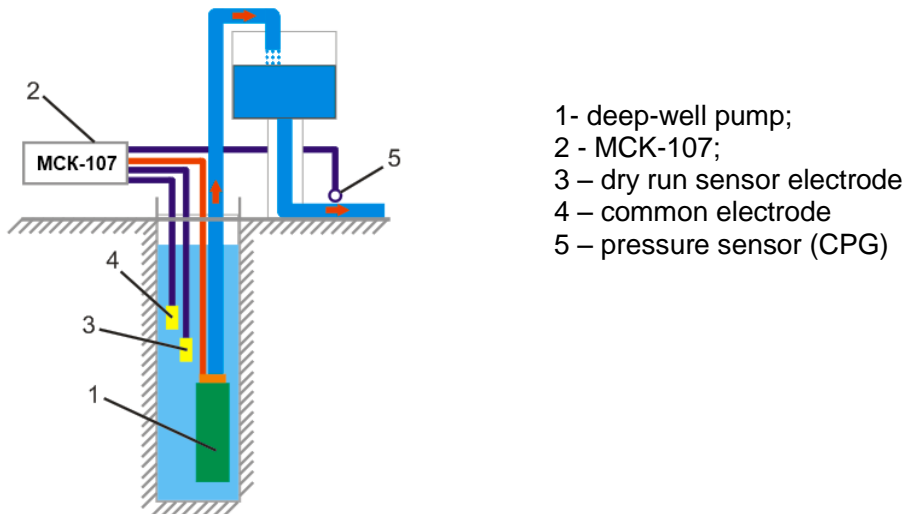


Figure 2.4 – Application of MCK-107 in the filling mode with pressure sensor

2.4.6 Operation in the automated filling mode with the level sensors

For the device operating in this mode, one should set the parameter $adE = 2$ (filling mode), the parameter $tdU = 1$ (conduction-measuring sensor), LED "Drain " does not glow, and the indicator will display the "nAP" message.

In the initial state (in case there is no water in the tank), when starting the power supply, the automatic activation of the pump electric motor takes place (closing of contacts 15, 16 of MCK-107).

When the liquid level reaches the UL sensor, the automatic deactivation of the pump electric motor takes place (breaking of contacts 15, 16 of MCK-107).

When the liquid level in the tank is lower than the LL sensor, the automatic activation of the pump electric motor takes place to pump water into the tank (closing of contacts 15, 16 of MCK-107) and the cycle is repeated.

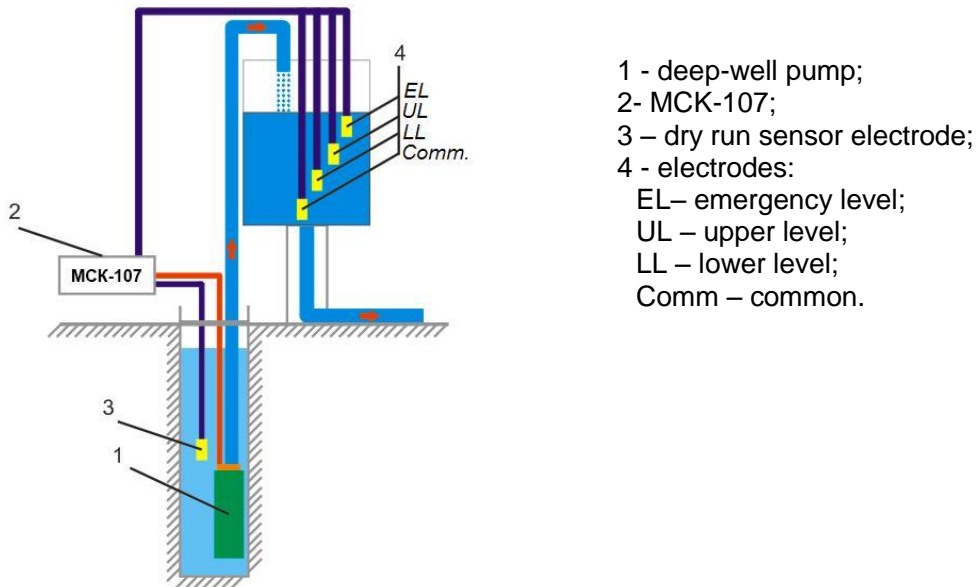


Figure 2.5 – Application of MCK-107 in the filling mode with conduction-measuring sensors (level sensors)

2.4.7 Protection of the deep-well pump electric motor from an inadmissibly low water level in the well

Protection works only in the filling mode.

To protect the deep-well pump from an inadmissibly low water level in the well, the DR sensor (dry run) is used. The parameter $d5h = 1$ (using the DR sensor is allowed).

The deep-well pump is operable, when the water level in the well is higher than the DR sensor (low resistance of the DR output if compared to the "common" output).

If the water level in the well is lower than the DR sensor (high resistance of the DR output if compared to the "common" output), MCK-107 determines the failure condition by the dry run; herewith:

- the pump electric motor is deactivated (contacts 15, 16 are broken);
- LED "Pump" goes out;
- the functional relay is activated (contacts 17, 18 are closed);
- LED "FR" starts to glow;
- LED "Alarm" blinks;

- LED "DR" blinks red;
- indicator displays the "R5h" failure code.

After the electric motor deactivation due to the dry run failure, the pump electric motor reset is possible, when the water level rises higher than the DR sensor and the AR time elapses (parameter LAP).

2.4.8 Emergency shutdown of the pump electric motor at the emergency level (EL) sensor tripping

If the parameter $dAL = 1$ (emergency sensor is on), then on the water level rising higher than the EL sensor:

- the pump electric motor is deactivated (contacts 15, 16 are broken);
- LED "Pump" goes out;
- the functional alarm relay is activated (contacts 17, 18 are closed);
- LED "FR" starts to glow;
- LED "Alarm" blinks;
- LED "EL" blinks red;
- indicator displays the "AAL" code.

If the parameter $dAL = 1$, the pump electric motor reset is possible, when the water level falls lower than the LL sensor.

2.4.9 Emergency shutdown of the pump electric motor in the drainage mode through the signals of the external control

In the drainage mode (parameter $adE = 1$), regardless of the water level, the pump electric motor can be activated through the signals of the external control with switching to emergency condition.

At $d i 2 = 1$, MCK-107 is in the normal operation condition when contacts 2, 3 are broken (toggle S2, Figure 2.1). Contacts 2, 3 being closed, MCK-107 switches to emergency condition.

At $d i 2 = 2$, MCK-107 is in the normal operation condition when contacts 2, 3 are closed. Contacts 2, 3 being broken, MCK-107 switches to emergency condition.

In the emergency condition in the drainage mode through the signals of the external control:

- the pump electric motor is activated (contacts 15, 16 are closed);
- the alarm relay is activated (contacts 17, 18 are closed);
- LED "Pump" and LED "FR" glow;
- LED "Alarm" blinks;
- indicator displays the failure code according to Table 2.12.

Note - If operation of both remote control inputs is allowed, the input $d i 1$ enjoys the priority (pump electric motor deactivation).

If the parameter $FrE = 1$ or $FrE = 2$ (the functional relay is used for controlling the second pump electric motor), the electric motors are activated at the same time.

2.4.10 Emergency shutdown of the pump electric motor in the filling mode through the signals of the external control

In the filling mode (parameter $adE = 2$), regardless of the water level, the pump electric motor can be deactivated through the signals of the external control.

At $d i 1 = 1$, MCK-107 is in the normal operation condition when contacts 1, 3 are closed (toggle S1, Figure 2.1). Contacts 1, 3 being broken, MCK-107 switches to emergency condition.

At $d i 1 = 2$, MCK-107 is in the normal operation condition when contacts 1, 3 are broken. Contacts 1, 3 being closed, MCK-107 switches to emergency condition.

In the emergency condition:

- the pump electric motor is deactivated (contacts 15, 16 are broken);
- the alarm relay is activated (contacts 17, 18 are closed);
- LED "FR" glows;
- LED "Alarm" (Failure) blinks;
- indicator displays the failure code according to Table 2.12.

2.4.11 MCK-107 operation in the automated modes with two pumps

For MCK-107 to operate with two pumps, one should:

- connect the contactor starter of the second pump electric motor according to Figure 2.6;
- set the parameter $FrE = 1$ or $FrE = 2$ (the functional relay is used for controlling the second pump electric motor).

In the automated operation modes of MCK-107 with two pumps, the operation logic of the device is preserved, but the functional relay is used to control the electric motor of the second pump and, subsequently, is not used to signal about any emergency conditions.

At $FrE = 1$ the pump electric motor, connected via the functional relay, serves as an additional one and is activated:

- in the drainage mode at the emergency level sensor tripping;
- in the filling mode after the time " $L i 2$ ", after activation of the second pump electric motor, unless during this time the liquid level in the tank reaches the higher level sensor.

At $F_rE = 2$, operates similarly, but the pump electric motors (the functional relay and the load relay) are activated in turn.

Example. Suppose that in the filling mode the M1 pump electric motor is operating. On the liquid reaching the level of the UL sensor, the M1 pump electric motor is deactivated. When the liquid level falls lower than the LL sensor, the M2 pump electric motor is activated.

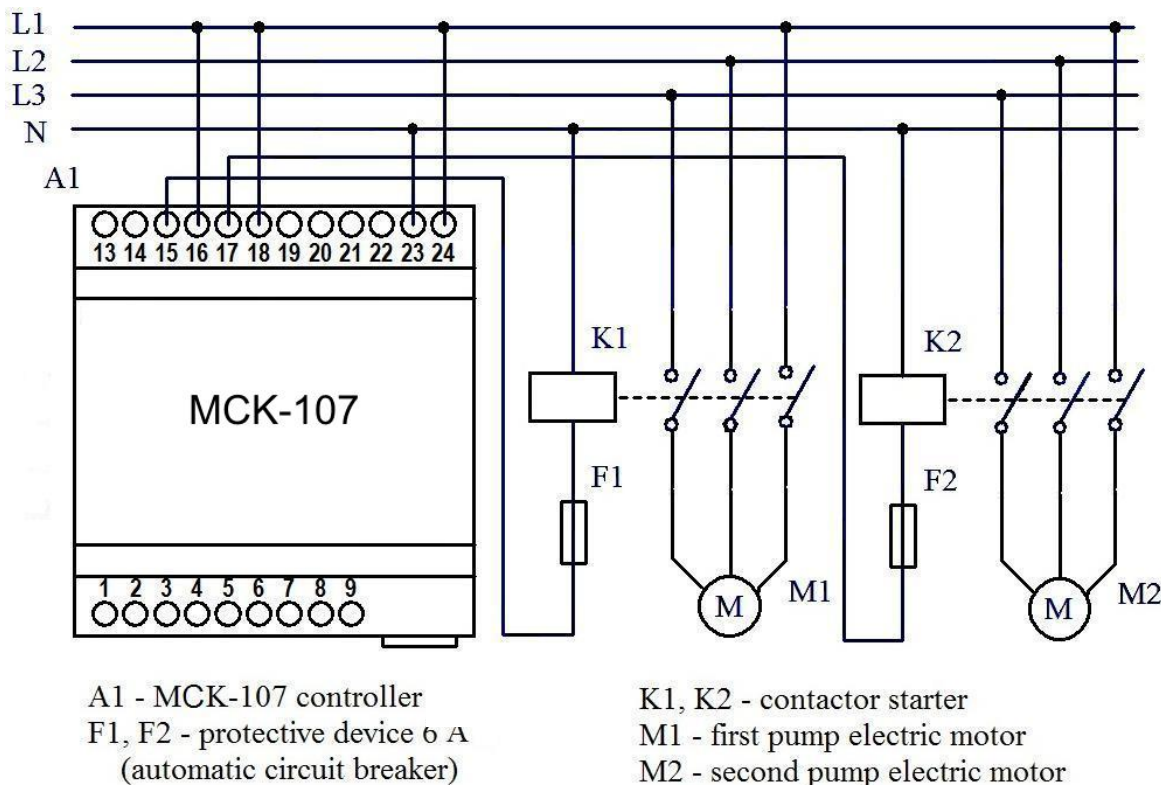


Figure 2.6 – Connection of two pumps to MCK-107

2.5 MCK-107 OPERATION ALONG WITH UBZ-301

For joint operation, UBZ-301 must be connected to MCK-107 according to Figure 2.1 and the parameter $U30 = 1$ or $U30 = 2$.

If UBZ-301 is connected and operable, the MCK-107 indicator will display the phase average current of the electric motor and LED "301" will glow.

The UP and DOWN buttons being pressed, the indicator will additionally display data, received from UBZ-301 (Table 1.5).

If no buttons have been pressed for 30 seconds, the indicator will display the phase average current.

If the parameter $U30 = 1$ and data are being received from UBZ-301, the "301" indicator will glow.

At continuous communication loss, MCK-107 indicates the UBZ-301 communication loss error, and when the value of the parameter $U30 = 2$, the UBZ-301 communication loss error is recorded into the failure log book.

If operation of the RS-232/RS-485 interface is allowed, it enables to read the additional UBZ-301 condition parameters.

The addresses of the UBZ-301 measured parameter registers, as well as their purpose, are specified in Table 1.4, 1.5. The addresses of the UBZ-301 status registers, as well as their purpose, are specified in Table 2.1.

Table 2.1 – UBZ-301 status registers to be transferred via RS-232 / RS-485 interface at connected UBZ-301

Information bit	Register Status 1 address - 129	Register Status 2 address - 130	Register Status 3 address - 131
7 (most significant)	presence of voltage imbalance	presence of current imbalance	UBZ lockup
6	voltage 1 higher than upper limit	current imbalance twice as big as voltage imbalance	UBZ-301 load relay activated
5	voltage 2 higher than upper limit	average current lower than minimum	heat overload
4	voltage 3 higher than upper limit	average current higher than maximum	incorrect phase order
3	half of voltage imbalance value	winding insulation failure	voltage is normal
2	voltage 1 lower than lower limit	current 1 lower than minimum current	leakage current higher than limit value
1	voltage 2 lower than lower limit	current 2 lower than minimum current	3-phase mode
0 (least significant)	voltage 3 lower than lower limit	current 3 lower than minimum current	single-phase mode

2.6 MCK-107 OPERATION ALONG WITH A COMPUTER

2.6.1 Connection of MCK-107 to a computer

Communication between MCK-107 and a computer is possible via RS-485 (parameter $rPP=2$) or RS-232 (parameter $rPP=1$) interface.

For operation via RS-485 interface connect MCK-107 (terminals 13, 14) to the computer via the interface converter (optional) according to Figure 2.1.

For operation via RS-232 interface connect MCK-107 (socket RS-232) to the com port of the computer via communication cable KC-01 (Figure 2.7).

Note - Communication cable KC-01 is optional, and included into the delivery set after prior reconciliation.

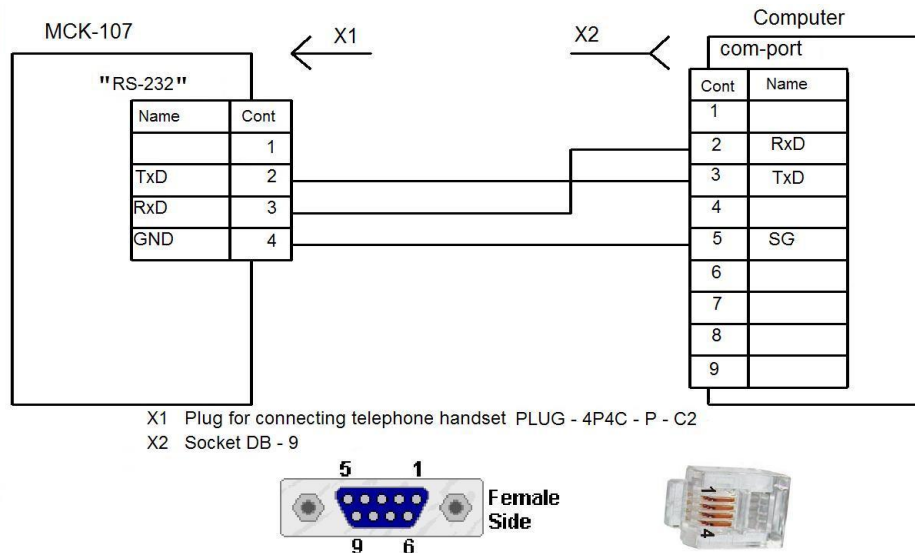


Figure 2.7 - Diagram of connecting MCK-107 to computer

2.6.2 Communication protocol and interface

For communication, one should use either MODBUS protocol in RTU mode (parameter $rR5=1$) or MODBUS protocol in ASCII mode (parameter $rR5=0$).

In ASCII mode, the 8-bit data block is a combination of two ASCII symbols (Table 2.2). For instance, 1 is a data byte: 64 Hex, in ASCII consists of two symbols '6' (36 Hex) and '4' (34 Hex).

Table 2.2

Symbol	'0'	'1'	'2'	'3'	'4'	'5'	'6'	'7'
ASCII code	30 Hex	31 Hex	32 Hex	33 Hex	34 Hex	35 Hex	36 Hex	37 Hex

Symbol	'8'	'9'	'A'	'B'	'C'	'D'	'E'	'F'
ASCII code	38 Hex	39 Hex	41 Hex	42 Hex	43 Hex	44 Hex	45 Hex	46 Hex

In RTU mode, the 8-bit data block is a combination of 4-bit hexadecimal numbers.

While performing the exchange via the RS-485 or RS-232 interface, the blue LED "485" will be glowing.

Each MCK-107 has its own individual communication address. The computer controls each MCK-107, distinguishing them by their address.

2.6.3 Communication parameters:

- device address: 1-247 (parameter $r5A$);
- data transfer rate: 9600 baud, 19200 baud (parameter $r55$);
- response to communication loss: keep operating without warning; warn and keep operating; warn, record in the failure log book and keep operating (parameter $r5P$);
- detection of response exceeding time: 1 second - 120 seconds (parameter $r5D$).

Transferred word format:

- 8 information bit in RTU mode, 7 information bit in ASCII mode;
- parity check (parameter rPE): on - 0; off - 1; (factory setting - 0);
- number of stop bits (parameter $r5b$): 1 or 2; (factory setting - 2).

ATTENTION! COMMUNICATION PARAMETER CHANGES (EXCEPT CHANGING THE DEVICE ADDRESS) WILL COME INTO FORCE ONLY AFTER DE-ENERGIZING OF MCK-107 OR AFTER PERFORMING THE "RESTART" COMMAND (TABLE 2.10).

2.6.4 Communication protocol

Exchange between the computer and MCK-107 is performed through data packets. The format of a data packet in RTU mode is specified in Table 2.3, while in ASCII mode - in Table 2.4.

Table 2.3 - Data packet in RTU mode

START	silence interval – over 4 milliseconds at transfer rate of 9600 baud, and over 2 milliseconds at transfer rate of 19200 baud
ADR	Communication address of MCK-107 (8 bit)
CMD	8 bit command code
DATA 0	Content of data: N*8 information bit (n<=24)
....	
DATA (n-1)	
CRC CHK low	CRC cycle control sum 16 bit
CRC CHK high	
END	silence interval – over 4 milliseconds at transfer rate of 9600 baud, and over 2 milliseconds at transfer rate of 19200 baud

Table 2.4 - Data packet in ASCII mode

STX	Starting symbol ':' (3A Hex)
ADR1	Communication address of MCK-107 (8 bit) consisting of two ASCII symbols
ADR0	
CMD1	8 bit command code consisting of two ASCII symbols
CMD0	
DATA 0	Content of data: N*8 information bit (n<=24) consisting of two ASCII symbols
....	
DATA (n-1)	
LRC CHK 1	LRC control sum: 8-bit control sum consisting of two ASCII symbols
LRC CHK 0	
END1	End of symbols: END1= 0D Hex – carriage return (CR), END0 = 0A Hex – line feed (LF)
END0	

2.6.5 MODBUS interface commands (CMD – command code, DATA - data symbols)

2.6.5.1 General provisions

The data symbol format depends on command codes. The examples of transfer of commands and data are given for RTU mode. For ASCII mode, the command codes remain unchanged, but the data transfer format and the data control are performed according to Table 2.4.

2.6.5.2 Register group reading command

Command code – 0x03, reading of n- words.

For example, reading of 2 uninterrupted words of the initial address 2102H in MCK-107 with communication address 01H in RTU mode (Table 2.5) and in ASCII mode (Table 2.6).

Note - While performing one command, there may be read not more than 12 registers (n=12).

Table 2.5

Command message		Response message	
ADR	0x01	ADR	0x01
CMD	0x03	CMD	0x03
Starting data address	0x21 0x02	Amount of data in bytes	0x04
Amount of data in words	0x00 0x02	Content of data according to address	0x17 0x70
CRC CHK low	0x6F	Content of data according to address	0x00 0x00
CRC CHK high	0xF7	CRC CHK low	0xFE
		CRC CHK high	0x5C

Table 2.6

Command message		Transferred code, HEX	Numbers, for LRC, HEX
STX	':'	3A	
ADR	'0'	30	01
	'1'	31	
CMD	'0'	30	03
	'3'	33	

Starting data address	'2'	32	21
	'1'	31	
	'0'	30	
	'2'	32	
Amount of data in words	'0'	30	00
	'0'	30	
	'0'	30	
	'2'	32	
LRC CHK 1	'D'	44	
LRC CHK 0	'6'	36	
END1	CR	0D	
END2	LF	0A	

2.6.5.3 Register recording command

Command code – 0x06, recording - one word.

It is not recommended to use this command, as recording of incorrect data may lead to MCK-107 failure.

Data recording is possible according to the programmable parameter addresses (Table 1.6), excluding the parameters, specified in Table 2.7.

Table 2.7

Set and read parameters	Code in indicator	Address
Operation mode Note - Switching from automated modes to manual one, as well as from manual mode to automated ones is prohibited.	odE	150
Full operation time of device, days	tbU	171
Motor 1 running time, days	tC1	172
Motor 2 running time, days	tC2	173
Reset to factory parameters	PPP	174
Adjuster's access code	PAS	175
Device version	rEL	177

Recording of parameter is performed regardless of the set adjuster's protection (recording via the communication line enjoys a higher priority).

Example - The order of recording 1000 (0x03E8) into the register with the address 0x00A0 in MCK-107 with the communication address 01H in RTU mode is shown in Table 2.8.

Table 2.8

Command message		Response message	
ADR	0x01	ADR	0x01
CMD	0x06	CMD	0x06
Starting data address	0x00 0xA0	Starting data address	0x00 0xA0
Data	0x03 0xE8	Data	0x03 0xE8
CRC CHK low	0x89	CRC CHK low	0x89
CRC CHK high	0x56	CRC CHK high	0x56

2.6.5.4 Diagnosing command

Command code 08h – diagnosing.

The 08h function provides a set of tests for checking the communication system between the computer and MCK-107, as well as for MCK-107 operability testing.

The function uses a sub-function field specification of a performed action (test).

Sub-function 00h - request data return.

The data, transferred into the request data field, have to be returned to the response data field.

The example of a request and a response for MODBUS RTU mode is given in Figure 2.8.

Request

Address	Function	Sub-function HB	Sub-function LB	Data HB	Data LB	CRC LB	CRC HB
01h	08h	00h	00h	A0h	3Ch	98h	1Ah

Response

Address	Function	Sub-function HB	Sub-function LB	Data HB	Data LB	CRC LB	CRC HB
01h	08h	00h	00h	A0h	3Ch	98h	1Ah

Figure 2.8 - Example of the request and the response of sub-function 00h - request data return.

Sub-function 01h – communication option restart.

While performing the command, only changing of the communication rate is performed in MCK-107. For complete changing of the communication parameters, one should perform the command "RESTART MCK-107" (par. 2.6.9).

The example of a request and a response for MODBUS RTU mode is given in Figure 2.9.

Request

Address	Function	Sub-function HB	Sub-function LB	Data HB	Data LB	CRC LB	CRC HB
01h	08h	00h	01h	00h	00h	B1h	CBh

Response is not returned.

Figure 2.9 - Example of the request and the response of sub-function 01h - communication option restart.

2.6.6 Check of data packet transfer correctness

2.6.6.1 Check of data packet transfer correctness in RTU mode

To check the data packet transfer correctness in RTU mode, the CRC checksum is used - the cyclic redundancy check.

The checksum (CRC16) is a cycle checking code based on A001h polynomial. The transmitting device forms the checksum for all the bytes of a transferred message. The receiving device in a similar way forms the checksum for all the bytes of a received message and compares it with the checksum, received from the transmitting device. If the formed and the received checksums do not match, an error message will be generated.

The checksum field comprises two bytes. The checksum in the message is transferred forward by the least significant byte.

The checksum is formed according to the following algorithm:

- 1) loading of CRC register (16 bit) with unities (FFFFh);
- 2) exclusive OR with the first 8 bits of the message byte and with the content of CRC register;
- 3) result shift 1 bit to the right;
- 4) is the shifted bit = 1, the exclusive OR of the register content with value A001h;
- 5) is the shifted bit = 0, repeat step 3;
- 6) repeat steps 3, 4, 5, until 8 shifts are done;
- 7) exclusive OR with the next 8 bits of the message byte and with the content of CRC register;
- 8) repeat steps 3 – 7, until all message bytes are processed;
- 9) the final register content shall contain the checksum.

The example of the CRC code generation by means of the C language. The function has two arguments:

Unsigned char* data <- a pointer to the message buffer

Unsigned char length <- the quantity of bytes in the message buffer

The function returns the CRC value as a type of unsigned integer.

Unsigned int crc_chk(unsigned char* data, unsigned char length)

```

{ int j; unsigned int reg_crc=0xFFFF;
  while(length--)
  { reg_crc ^= *data++;
    for(j=0;j<8;j++)
      {if(reg_crc & 0x01) reg_crc=(reg_crc>>1) ^ 0xA001; // LSB(b0)=1
        else reg_crc=reg_crc>>1;
      }
  }
  return reg_crc;
}

```

2.6.6.2 Check of data packet transfer correctness in ASCII mode

To check the data packet transfer correctness in ASCII mode, the LRC checksum is used - the longitudinal redundancy check. The checksum is an 8-digit number, transferred as two ASCII symbols. The checksum is formed by reverse conversion of all ASCII symbols into eight-bit binary numbers (direct conversion par. 2.6.1), summation of all these numbers regardless of transfer, and calculation of an additional code of the received number. In the receiver, LRC is calculated again and compared to the received LRC. While calculating LRC, the colon, CR and LF are omitted. The example of LRC calculation for 2 uninterrupted words reading command from the initial address 2102H in MCK-107 with communication address 01H is given in Table 2.5.

2.6.7 Processing of communication errors

In case of error at accepting a frame (parity error, frame error, checksum error) MCK-107 will not return the response.

In case of error in the format or value of the transferred data (unsupported function code etc.), MCK-107 accepts the request frame and forms the response with the identifier and the code of error. The error identifier is the most significant bit in the function field, set into a unity. In the response, a separate field is provided for the code of error. The example of the response is given in Figure 2.10.

Codes of errors are specified in Table 2.9.

Request - function 30h is not supported

Address	Function	Data	CRC LB	CRC HB
01h	30h		XXh	XXh

Response

Address	Function	Code of Error	CRC LB	CRC HB
01h	B0h	01h	94h	00h

Figure 2.10 - Example of response after occurrence of error

Table 2.9 – MODBUS codes of errors

Code of error	Name	Description
01h	ILLEGAL FUNCTION	The accepted function code cannot be processed by MCK-107
02h	ILLEGAL DATA ADDRESS	The data address, specified in request, is not available to this slave
03h	ILLEGAL DATA VALUE	The value, contained in the request data field, is an inadmissible value for MCK-107
04h	SLAVE DEVICE FAILURE	While MCK-107 was trying to perform the requested action, a non-recoverable error occurred
05h	ACKNOWLEDGE	MCK-107 has accepted the request and is processing it, but it requires a lot of time. This response prevents the master from generating the timeout error
06h	SLAVE DEVICE BUSY	MCK-107 is busy processing the command. The master must repeat the message later, when the slave becomes free
07h	NEGATIVE ACKNOWLEDGE	MCK-107 cannot perform the program function, accepted in the request

2.6.8 Remote control of the electric motor via RS-232/RS-485 interface

The remote control commands are specified in Table 2.10.

In the remote control mode, the emergency shutdown of the pump (pumps) electric motor can take place. The emergency shutdown reset (setting the command register to zero) is performed:

- while recording the 2 number in the command register via the remote control channel;
- at communication loss;
- at MCK-107 switching to the manual mode;
- at MCK-107 de-energizing.

Table 2.10

Code of command (address = 237)	Performed actions
0	normal operation mode of MCK-107
1	emergency shutdown of MCK-107 (command is not performed if MCK-107 is in the manual operation mode)
2	emergency shutdown reset
88	MCK-107 restart (RESTART command)
N o t e - After performing the command, zero is recorded in the command register.	

2.6.9 Command "RESTART MCK-107"

The MCK-107 operation at command "RESTART" being performed is similar to the device operation after energizing.

The "RESTART" command is used to implement the changed communication parameters. The "RESTART" command is performed after recording the 88 command code in the command register (Table 2.10) via RS-232/RS-485 interface. After receiving the "RESTART" command, MCK-107 does not return confirmation of the received command.

WARNING: Between the last access to the MCK-107 registers and recording the "RESTART" command, there must be a delay of not less than 100 milliseconds.

ATTENTION! IT IS PROHIBITED TO PERFORM THE "RESTART" COMMAND IF THE PUMP MOTOR IS ACTIVATED.

2.6.10 Setting the factory parameters of MCK-107 via MODBUS interface

To perform this operation, one should set the parameter *PPP*=1. At such performance of the operation, the parameters of the serial interface will remain unchanged (the interface parameter reset to factory settings is not performed). The reset-to-factory-settings operation time is up to 5 seconds. After the operation is finished, the

parameter *PPP*=0.

ATTENTION! IT IS PROHIBITED TO SET THE FACTORY PARAMETERS VIA MODBUS INTERFACE IF THE PUMP MOTOR IS ACTIVATED.

IT IS PROHIBITED TO RECORD PARAMETERS VIA MODBUS INTERFACE UNTIL THE RESET OPERATION IS FINISHED.

2.6.11 Addresses of registers

Register addresses of the MCK-107 measured and calculated parameters are specified in Table 1.4.

Register addresses of the programmable parameters are specified in Table 1.6.

Command register address and codes of commands are specified in Table 2.10.

Condition register address and data bit purpose are specified in Table 2.11.

Register addresses of the failure log book are specified in Table 2.11.

Table 2.11

Name	Address	Purpose		Note
Condition register MCK-107	240	Bit 0	0 - no failure 1 - failure (failure code in register 241)	
		Bit 1	0 - load relay is off 1 - load relay is on	
		Bit 2	0 - functional relay is off 1 - functional relay is on	
		Bit 3	0 - there will not be any reset 1 - AR is expected	
		Bit 7	0 - normal operation mode 1 - MCK-107 is in hysteresis area at operation through analog inputs	
Failure register 1	241	purpose of bits in Tables 2.12 – 2.13		0 - no failure 1 - failure
Failure register 2	242	purpose of bits in Tables 2.12 – 2.13		
Failure log book				
failure code 1	260	failure code according to Tables 2.12 – 2.13		
reserved	261	0		
failure time 1	262	two most significant bytes		
	263	two least significant bytes		
failure code N	$260+(N-1) * 4$	failure code according to Tables 2.12 – 2.13		
reserved	$260+(N-1) * 4+1$	0		
failure time N	$260+(N-1) * 4+2$	two most significant bytes		
	$260+(N-1) * 4+3$	two least significant bytes		
Notes :				
1 Failure time is the time, from the moment of MCK-107 energizing to the moment of failure occurrence. it is measured in minutes.				
2 At delivery of MCK-107 and after setting of factory parameters (par. 2.2.5), the code of error 40 and the parameter value 10000 are recorded in the failure log book.				
3 On energizing MCK-107, the number 5000000 is recorded in all the failure time registers.				

2.7 SYSTEM OF FAILURE CONDITIONS

All possible failures of level (pressure) sensors are specified in Table 2.12.

At occurrence of a MCK-107 failure condition:

- the indicator will display the code of failure according to Table 2.12;

- the red LED "Alarm" will be blinking (glowing);

- if the parameter $F_{rE} = 0$ (the functional relay is used as an alarm relay), the functional relay will be activated and LED "FR" will start to glow.

The position of the load relay and the condition of LEDs in the failure condition depend on the type of failure and the operation mode of MCK-107.

If MCK-107 determines a few different types of failures at the same time, the codes of failures and the parameter values will be displayed successively, one by one.

ATTENTION: The occurrence of "REP" failure - destruction of EEPROM - means that the programmable parameter data (Table 1.5) are damaged. To continue operation, one must turn off MCK-107 and restore the factory settings (par. 2.2.5 - second way).

Table 2.12 - Failure codes

Name of Failure	Code in Indicator	Cause and Response	Code of Failure	Register Address of N Bit
failure of LL sensor or UL sensor	<i>RdL</i>	when UL sensor has tripped, LL sensor shows absence of liquid (LL and EL LEDs glow red)	0	241:0
failure of UL sensor or EL sensor	<i>RdU</i>	when EL sensor has tripped, UL sensor shows absence of liquid (LL and EL LEDs blink red)	1	241:1
emergency level sensor	<i>RAAL</i>	LED EL glows red	2	241:2
dry run sensor	<i>RASh</i>	no liquid in well, pump electric motor deactivated (DR sensor glows red)	3	241:3
external control input di1	<i>Rd1</i>		4	241:4
external control input di2	<i>Rd2</i>		5	241:5
emergency shutdown command via RS-485 interface	<i>RAo</i>		6	241:6
emergency start command via RS-485 interface	<i>RAi</i>		7	241:7
destruction of EEPROM	<i>RAEP</i>		8	241:8
remote control channel failure	<i>RdC</i>		9	241:9

Note - LED EL glows constantly at "destruction of EEPROM" failure, while at other types of failures it blinks

When UBZ-301 is connected, the MCK-107 indicator can additionally display the codes of failures, determined by UBZ-301 (Table 2.13).

Table 2.13 - UBZ-301 codes of failures

Name of Failure	Failure Mnemonics	Code of Failure	Register Address of N Bit
reserved		16	242:0
heat overload	<i>Edt</i>	17	242:1
exceeding of current reverse sequence to voltage reverse sequence ratio	<i>EiD</i>	18	242:2
current reverse sequence	<i>Eio</i>	19	242:3
minimum current in phases	<i>Ei_</i>	20	242:4
order of phase interlacing	<i>EU4</i>	21	242:5
phase loss	<i>ECo</i>	22	242:6
minimum linear voltage	<i>EU_</i>	23	242:7
maximum linear voltage	<i>EU^</i>	24	242:8
imbalance of phases	<i>EU^n</i>	25	242:9
minimum motor winding insulation resistance	<i>Er_i</i>	26	242:10
UBZ-301 connection being allowed - there is no communication	<i>E3D</i>	27	242:11
rated current not set	<i>Eln</i>	28	242:12

2.8 FAILURE CONDITION LOG BOOK

While switching to failure condition, MCK-107 will record the code of failure, the value of parameter, according to which the failure has occurred, as well as the time of its occurrence from the moment of MCK-107 energizing, and save them in its memory. The number of failures, kept in memory at the same time, is twenty. When further failures occur, the information on the failure will be recorded, replacing the earliest failure in time.

To view the log book one should press the "**WR**" button.

The MCK-107 indicator will display the first line from Table 2.14 of the earliest failure in time (code in indicator E01). To select the further failure, press the UP and DOWN buttons. To view the failure information (2-4 lines of the failure log book), one should press the "**WR**" button and, by using the UP and DOWN buttons, select the necessary line. To exit the log book line viewing and to turn to the failure list, one should press the "**SET**" button.

Table 2.14

Mnemonics in Indicator	Note
"EYY"	YY - number of record in log book (1 - latest record in time)
"AAA"	AAA – Failure mnemonics according to Table 2.12 and Table 2.13
cFF	FF – hours passed from the moment of failure (if more than 99 hours have passed, the indicator will display cnn)
nXX	nXX - minutes passed from the moment of failure

To exit the log book viewing mode, one should press the "SET" button and the exit will be made automatically in 30 seconds after the latest pressing of any button.

While energizing MCK-107, the number 5000000 will be recorded in the failure occurrence time storage registers. In this case, instead of the failure occurrence time, the indicator will display "c--" and "n --" respectively.

3 PACKAGE CONTENTS

The delivery set is specified in Table 3.1

Table 3.1 - Delivery set

Name	Abbreviation
MCK-107 controller	MCK-107
Operating Manual	
Communication cable for PC via RS-232*	KC-01
*Delivered after prior reconciliation with the customer	

4 MAINTENANCE

4.1 SAFETY PRECAUTIONS

THE TERMINALS AND THE PRODUCT INTERNAL ELEMENTS CONTAINS POTENTIALLY LETHAL VOLTAGE.

 **DURING MAINTENANCE IT IS NECESSARY TO DISABLE THE PRODUCT AND CONNECTED DEVICES FROM THE MAINS**

4.2 Maintenance of the unit should be performed by persons admitted to the operation and have the appropriate permission.

4.3 The recommended frequency of maintenance is every six months.

4.4 MAINTENANCE PROCEDURE

- 1) check the wires connection reliability, if necessary – clamp with force as specified in Table 1.1;
- 2) check visually the housing integrity;
- 3) if necessary, wipe with cloth the front panel and the unit housing.

It is not allowed to clean the unit with abrasive materials or organic compounds (alcohol, gasoline, solvents, etc.).

5 TRANSPORTATION AND STORAGE

MCK-107 in the manufacturer's package must be stored in an indoor area at the temperature from minus 45 to +60 °C and relative humidity not exceeding 80 %, provided there are no vapours in the air, causing any damaging impact on the package and the materials of the device.

While transporting MCK-107, the user must provide protection of the device from mechanical damage.

6 SERVICE LIFE AND WARRANTIES OF THE MANUFACTURER

6.1 Service life – is 10 years. Contact manufacturer upon the expiry of the service life.

6.2 Guaranteed storage life – is 3 years.

6.3 Warranty period of the unit operation is 5 years from the date of sale.

During the warranty period the Manufacturer is responsible for free repair of the unit, if the Consumer has complied with the requirements of this Operating Manual.

ATTENTION! IF THE UNIT HAS BEEN OPERATED WITH VIOLATION OF THE REQUIREMENTS OF THIS OPERATION MANUAL, THE MANUFACTURER HAS THE RIGHT TO REFUSE WARRANTY SERVICE.

6.4 Warranty service is performed at the place of purchase or by the Manufacturer of the product.

6.5 Post-warranty service is performed by the Manufacturer at current rates.

6.6. Before sending for repair, the unit should be packed in the original or other packaging excluding mechanical damage.

Please, when returning the unit or sending it for warranty or post warranty repair, in reclamation data line in passport, explain in details the reason of returning.

7 ACCEPTANCE CERTIFICATE

The pumping plant controller MCK-107 is produced and accepted according to the requirements of the effective technical documentation and is acknowledged to be suitable for operation.

Seal Head of the Quality Department

Date of Issue

8 RECLAMATION DATA

Please contact the manufacturer should you have any questions.

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Date of Sale _____