

Confirmed
ИУСЕ.416611.005 РЭ-ЛЮ

**MULTICHANNEL DIGITAL
ENGINEERING SEISMIC SYSTEM**

LAKKOLIT X-M3

HARDWARE REFERENCE

ИУСЕ.416611.005 РЭ

Seismic manual of the MULTICHANNEL DIGITAL ENGINEERING SEISMIC SYSTEM
“Lakkolit X-M3” further names System contains description of driving handles, indication and
working routines of the System.

Maintenance

1. Purpose	
2. Composition	4
3. Technical characteristics	5
4. Hardware and software requirements	6
5. Pre-starting procedure	6
6. System operation	
6.1. Registrator routine	11
6.2. System of moment fixing operation	12
7. Application conditions	15
8. Transport and storage conditions	15
9. Battery charging	16
10. Defects correction	18
11. System cables scheme	19

1. Purpose

The System intends for seismic surveys by refracted and reflected wave methods on the basis of modern technical decisions in process of geological investigations and micro seismic research. Registration and previous data processing fulfils by built in signal processor in real time. Note Book with corresponding software guarantees additional processing of the data in field conditions. The results reflect on the color monitor of Note Book or on the System panel.

2. Composition

- 1) Seismic Registrator Lakkolit 24-M3 (further Registrator) ИУСЕ.416613.003 (without switcher of channels) or Registrator ИУСЕ.416613.003-01 (with switcher of channels);
- 2) ETHERNET-splitter (HUB not included, delivery in accordance with additional agreement);
- 3) port cable ETHERNET (cable 1 ИТЛЯ.685621.089-01);
- 4) port cable ETHERNET (cable 2 ИТЛЯ.685621.089-02 delivery with control unit);
- 5) power cable (cable 3 ИУСЕ.685621.002 delivery with control unit);
- 6) power cable (cable 4 ИУСЕ.685621.002);
- 7) synchronization cable (cable 5 ИУСЕ.685621.052);
- 8) synchronization cable (cable 6 ИУСЕ.685621.052-02 delivery with System of moment fixing operation);
- 9) lakkolit cable (cable 7 ИУСЕ.685621.051 delivery with System of moment fixing operation);
- 10) power cable (cable 8 ИУСЕ.685621.002 delivery with DC-DC adapter);
- 11) seismic cable ИУСЕ.418729.001 (seismic cables versions and its quantity adjusting additionally);
- 12) geophone GS-20DX (geophone versions and its quantity adjusting additionally);
- 13) control unit ИУСЕ.466259.003 (not included, delivery in accordance with additional agreement);
- 14) power supply BP-9/12 ИУСЕ.436704.001 (delivery with System of moment fixing operation or DC-DC adapter);
- 15) power supply BP-9/12 ИУСЕ.436704.001;
- 16) DC-DC adapter ИУСЕ.436634.003 (not included, delivery in accordance with additional agreement and Note Book type);
- 17) charger ZU-9 ИУСЕ.436241.001 (delivery with power supply BP-9/12 ИУСЕ.436704.001; quantity of rechargeable units in accordance with power supply BP-9/12 ИУСЕ.436704.001);
- 18) antenna GPS (delivery with control unit);
- 19) radio transmitter unit ИУСЕ.464216.018 (delivery with System of moment fixing operation (further SMF));
- 20) radio receiver unit ИУСЕ.464339.020 (delivery with SMF);
- 21) transmitter antenna ИУСЕ.464216.019 (delivery with SMF);
- 22) charger ZU-2 ИУСЕ.436241.002-01 (delivery with SMF);
- 23) fastening system to the person (delivery with SMF);
- 24) seismic vibration unit (not included, delivery in accordance with additional agreement);
- 25) balancing unit ИТЛЯ.489359.012 (delivery with Registrator ИУСЕ.416613.003-01 (with switcher of channels));

Note: System of moment fixing operation not included, delivery in accordance with additional agreement.

3. Technical characteristics

1) channels quantity registered by Registrator	24
2) channels quantity registered by System is formed by quantity of Registrators in System	
3) supply voltage, V	12±30%
4) Registrator power consumption, W, no more	7
5) control unit power consumption, W no more	7,8
6) total harmonics distortion ratio, %, no more	0.01
7) channels phase non identity, % from signal period, no more	2
8) a factor of gain, decibel, ± 1 %	0, 20, 40
9) a factor of transfer, V/LSB	8,77*10 ⁻⁸
10) a factor of gain non identity, no more, %	±1
11) effective voltage of noise adduced to entrance under resistor of signal no more 2 kOm in wave range 500 hertz, V, no more	0,2*10 ⁻⁶
12) dynamic range, dB, no less	103
13) cross-channel ratio, dB, no less	103
14) common-mode rejection ratio, dB, no less	90
15) attenuation on Nyquist`s frequency, dB, no less	100
16) working transition band on level 3 dB (passband ripple no more ± 1 dB) in frequency band:	
at sample frequency 500 Hz, Hz	5...125
at sample frequency 1000 Hz, Hz	5...250
at sample frequency 2000 Hz, Hz	5...500
at sample frequency 4000 Hz, Hz	5...1000
at sample frequency 8000 Hz, Hz	5...2000
at sample frequency 16000 Hz, Hz	5...4000
17) registration time, msec	16..10240
18) registration delay, samples	±512
19) temperature range	-30 ... +50°C

4. Hardware and software requirements to computer.

For system control and information analysis a computer is using. The computer has to be compatible with IBM-PC and has the following characteristics:

- 1) CPU - Pentium III;
- 2) RAM - 128 MB;
- 3) Storage disc - 2000 MB, no less
- 4) Port - ETHERNET 100BASE-T.

It is possible to use another equipment with characteristics no worse than above.

System control is realizing by «Lakkolit 1.5.x» program which are working in WINDOWS operation system in accordance to User Manual ИУСЕ.00101.01.34 01PO (further UM).

5. Pre-starting procedure.

1. Connect Registrator to units of the System in accordance with schemes on Fig. 1. or Fig. 2. for versions without channels switcher or with him accordingly.

2. Prepare seismic cable putting the geophones into soil.

3. Switch on power supply BP-9/12 (further PC) see Fig.3. LED indicator (“Contr”) begins to work at once. In order to decrease power consumption light indication works 1 sec. with interval 3-4 sec. As soon as threshold voltage of discharging of the battery takes place light indicator starts to blink often with interval 3-4 sec. Moreover short sound signal reminds each 10 min. about the fact that the power block is switched on.

Batteries have 5000 discharge/charge circles. Shelf-life -1 year.

4. During operation of batteries so-called “memory effect” can takes place, so it is necessary to make discharge/charge circles of batteries each 3 month in order to exclude the above “memory effect” and to restore batteries capacity. It can be 3-5 of such circles to restore the battery capacity completely (see p.9 “Battery charging”).

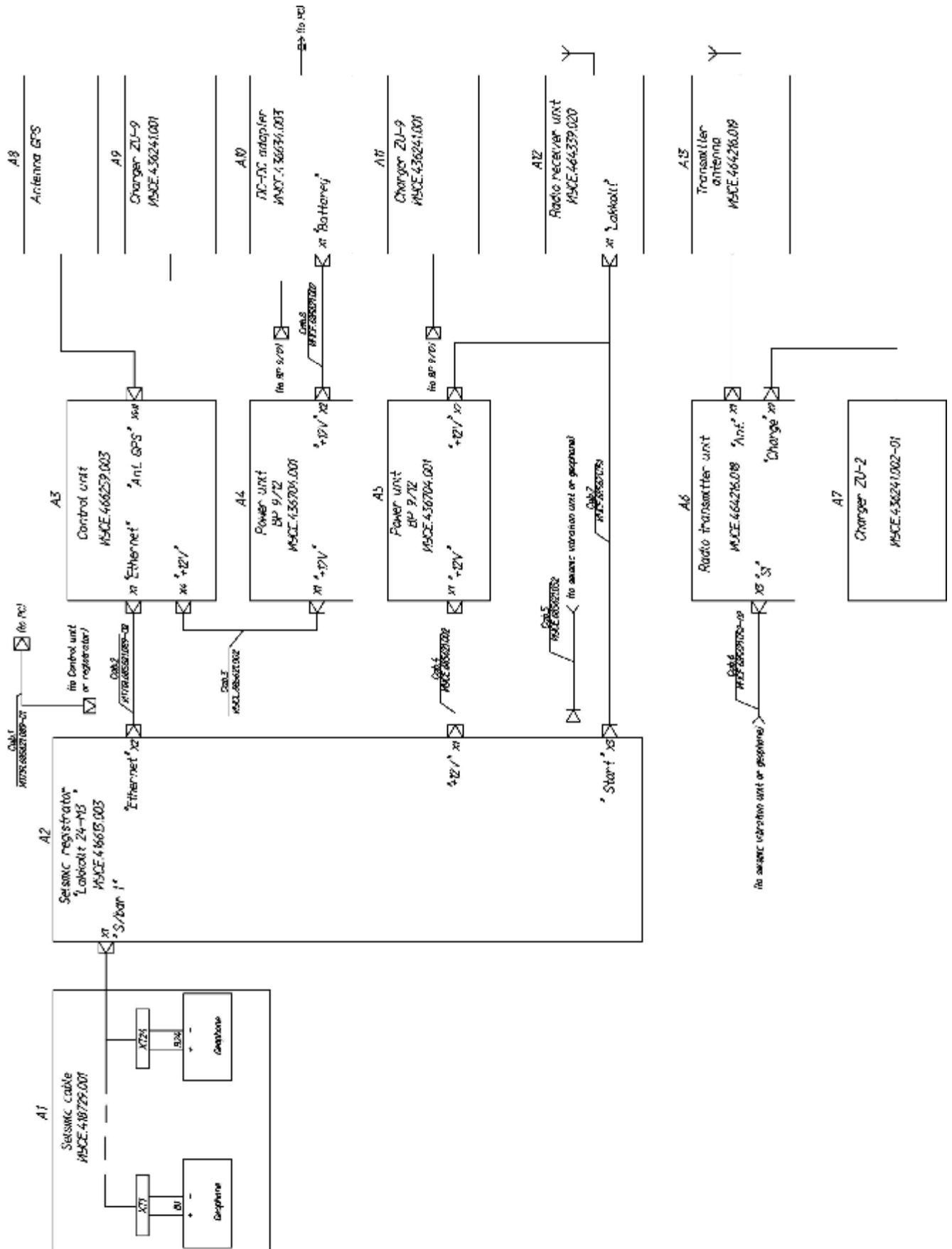


Fig. 1.

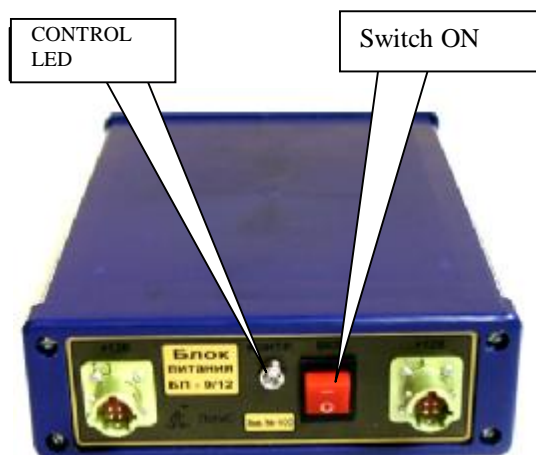


Fig. 3. Control board BP-9/12.

5. Switch on computer in accordance with service manual of the computer. In accordance with UM tune IP-address of computer (in case of using computer as a control unit).

6. Switch on the DC-DC adapter (in case of using of the DC-DC adapter for computer like Notebook), turn switch in “on” position. Make sure that LED of «Akk.» and «Notebook» are switched on the panel of DC-DC adapter.

7. In case of using CU as a control unit push «ON» CU. Wait periodical switching on of LED “Contr.”. In the case on the screen of CU the inside tests of CU will be described. In accordance with the manual of CU ИУСЕ.466259.003РЭ make sure that all inside tests are finished. During connection to CU the external antenna of built-in GPS-receiver install magnetic GPS antenna in horizontal position so that above it an open area will take place and all surroundings do not put obstacles in the way of radio-waves from communication satellite.

8. Connect the cable 5 to the port X3 «Start» of Registrator. Free tags of the cable 5 connect to clamps of the source of seismic waves (in case of using of the source of seismic waves for starting the System) or to external receiver of seismic waves. As the receiver of seism acoustic waves it is necessary to use geophones or piezoaccelerometers. Start of the System can be one of the following modes: «detecting», «locking», «unlocking».

9. If for starting of the System SMF is using the cable 7 connects to port X3 «Start» of the Registrator. To prepare for function SMF see. p 6.2.

10. Switch on the Registrator. Push the button «On» (fig. 4).



Fig. 4. Registrator front panel



Fig. 5. Registrator back panel

11. Wait for (about 5 sec.) periodic blink on of LED «Contr. » (Fig. 4).

12. Make sure that LED “Line” on the front panel of the Registrator is switched on (Fig.4). Connecting to the Registrator CU make sure that LED “Line” on the front panel is switched on. Connecting computer to the Registrator (or connecting computer to CU for transfer the data from CU) make sure that LED «link» of the power adapter computer is switched on (or in the lower right angle of the panel the sign of connection on local line is lighting: “switched on”).

13. In case of using the System in 48 channels version or more (see Fig.6) the Registrators are connecting to power HUB by cable 2. In the case computer connecting to HUB by cable 1 (or to CU by cable 2).

14. In case of using the Registrator with built in channels switcher for operating by CDP method connect to the port «S/2» the second seismic cable. Prepare the seismic cable for operation by putting the geophones into soil. If the second seismic cable is not switching on connect the matching device to the port «S/2» the balancing unit.

15. In case of using the Registrator with built in channels switcher there are two versions of numeration of the channels of seismic cable: first channel is geophone which are the nearest to the port of the seismic cable connected to the Registrator by the port «S/bar1»; first channel is geophone which are on the most distant from the port of seismic cable which are switched on to the Registrator to the port «S/bar2». In the case first or second seismic cable should be switched on with help of movable indicator of the channels switcher in «Lakkolit.exe» program in accordance with UM.

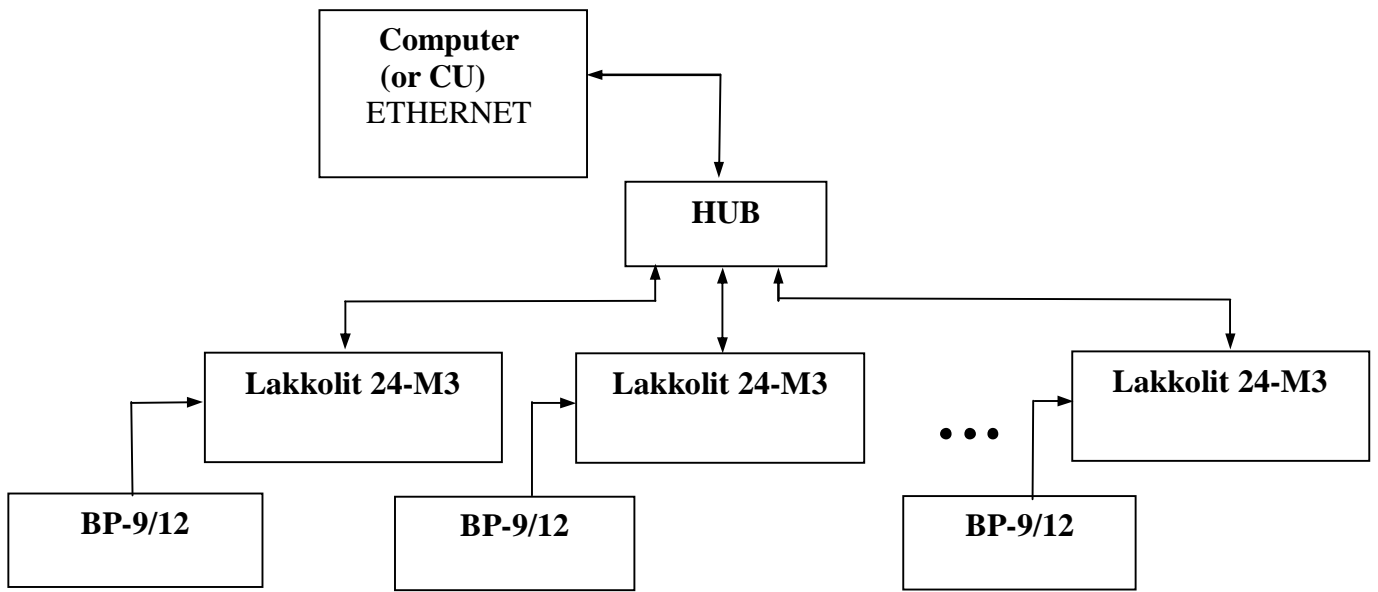


Fig. 6. Diagram of the System in 48 channels and more version.

6. Operation with the System

6.1. The Registrator`s modes

The Registrator is working in one of the following modes:

- 1) «detecting start»,
- 2) «locking start»,
- 3) «unlocking start»
- 4) «absolute start»
- 5) «test start»
- 6) «use radio channel for starting» (if there is SMF)

“Detecting start” mode ensure switching on the System in recording mode only in case of seismic event, which is entered by Registrator receiver of seismic vibrations, attached to the port “Start” of the Registrator.

«Locking start» mode ensure switching on the System in recording mode only in case of closing free tips of cable 5 (e.g. in case of using Seismic Vibration Unit (further SVU) and connecting to it cable 5 closing takes place in case of blowing active part of SVU on static part of SVU).

“Unlocking start” mode ensure switching on the System in recording mode only in case of breaking free tips of cable 5.

“Absolute start” mode ensure recording of the signal going from seismic receives directly in accordance with the command of the operator.

“Control starting” mode ensure recording of the calibrating signal going to amplifiers from built-in DAC.

«Use radio channel for starting» mode ensure switching on the System in recording mode in case of using the Registrator SMM for starting (see p. 6.2).

Putting of the parameters and modes of operation and analysis of information from the System realizes by computer in accordance with the user manual's ИУСЕ.00101.01.34 01PO or by CU in accordance with ИУСЕ.466259.003 РЭ.

6.2. Operation with the System of Moment Fixing (SMF)

1. Purpose.

System of Moment Fixing (further SMF) for operation with Lakkolit X-M3 gives the opportunity to get to know synch impulse of the source of seismic vibrations and to start of the Registrator distantly by radio channel up to 500m.

2. Basic characteristics.

1) Max. Range in case of straight line of visibility, m	500
2) Frequency, MHz	433,92
3) Transmissive Power, mW, no more	7
4) Receiver responsively, mkV	2
5) Input resistance of the channel of detection, kOm	47
6) Power consumption of transmitter in silence mode, mW, no more	21
7) Power consumption of receiver in silence regime, mW, no more	10

3. Appliance and function.

SMF has the following controls and indication.

Radio Transmitter Unit (further TU) (fig 7):

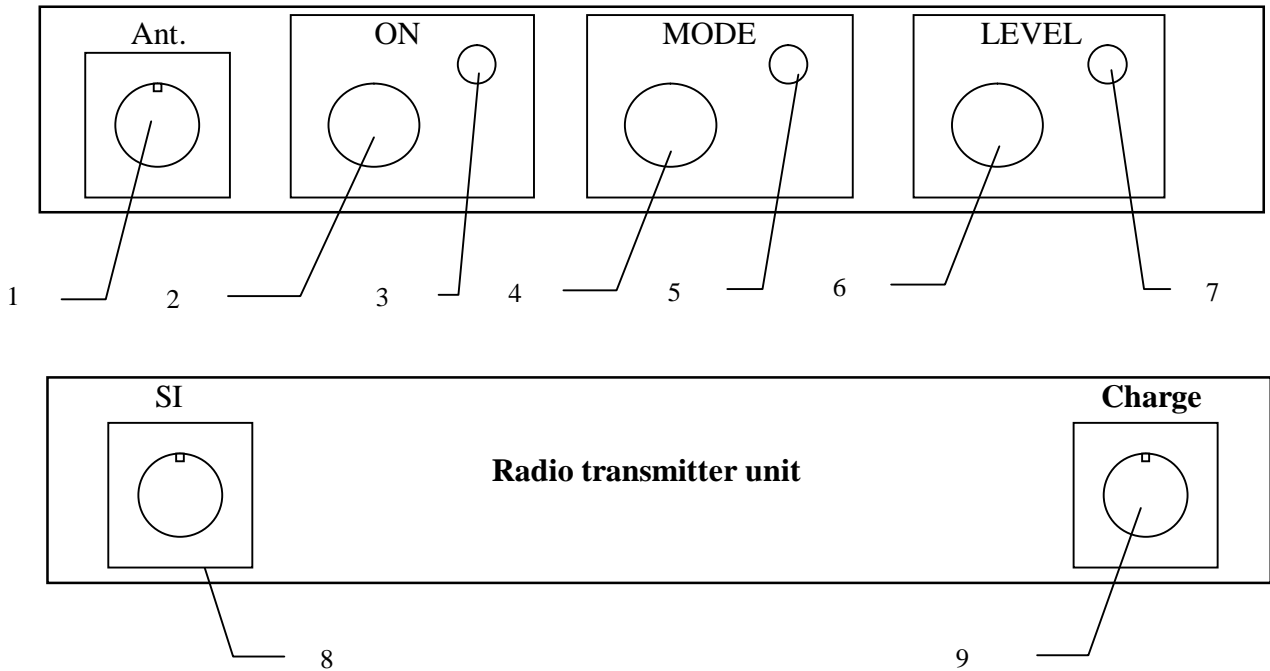


Fig.7

- 1) port for connection of the transmitting antenna (further TA);
- 2) button on/off of Radio transmitting unit;
- 3) green LED of function control of TU;
- 4) button of mode function of TU;
- 5) yellow LED of mode function of TU;
- 6) button of selection a level of detection of synchro impulse;
- 7) red LED of function control of level of detection of synchro impulse;
- 8) port for connecting of source of synchronic start "Lakkolit";
- 9) port for connecting of the charging unit.

Radio Receiver unit (further RR):

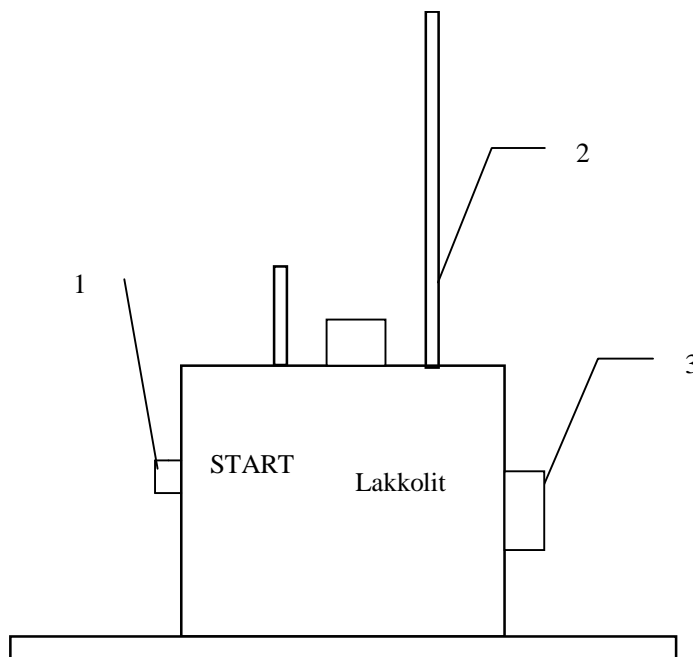


Fig. 8.

- 1) LED of control of starting of RR from TU;
- 2) receiving antenna;
- 3) port for connection of RR to issued power source of the System and to the System.

Transmitting antenna :

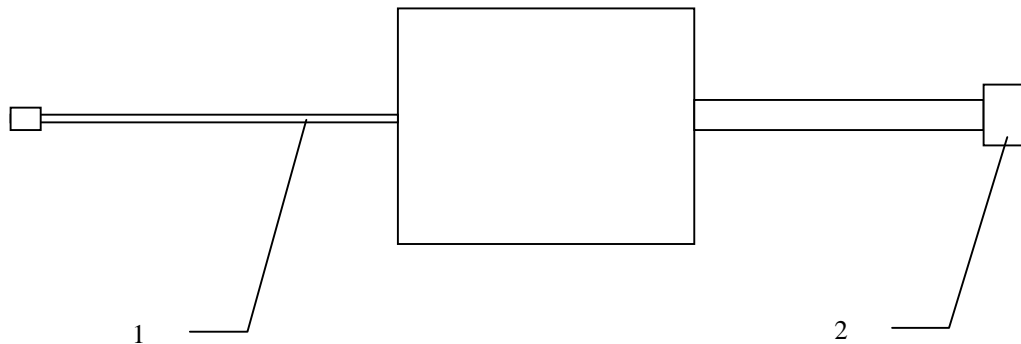


Fig. 9.

- 1) transmitting antenna;
- 2) port for connection of TA to TU.

4. Preparation to function.

- 1) put on the operator fastening system to the person on with TU,
- 2) fasten TA on the belt of the system of hang on the back side of the operator by pin of the transmitting antenna up;
- 3) connect port TA for connection to the port of “Ant” of TU;
- 4) connect to the cable of synchronization (cable 6) the source of synchronization (contacts working on locking or seismic receiver; SMF is operating together with seismic receivers type of geophone GS-20DX or any others with output resistance no more than 4 kOm and symmetric outcome);
- 5) connect the cable of synchronization to the port «SI» TU;
- 6) connect the cable “Lakkolit” (cable 7) to the port “Lakkolit” RR, counterpart of the cable connect to the port “Start” of the Registrator and to the port «+12V» BP-9/12 ИУСЭ.436704.001;
- 7) in accordance with p.5 of the Hardware Reference prepare the System to operation.
- 8) in accordance with the User Manual by the System ИУСЭ.00101.01 34 01 to install the mode «Use radio channel for starting”.

5. Operation.

- 1) switch on TU. Push the button “ON” of TU, the green light of LED will takes place and a short sound signal (0,25 sec. time length approx.);
- 2) select the mode of detecting of synch impulse. After switching on TU the mode of “detecting” of synchro impulse has been installed. In order to select starting in “locking” mode push the button “Mode” when the contacts are connected to the cable of synchronization. In the case the yellow LED “Mode” switches on, red LED “Level” switches on duration 0,2 sec. and sound signal duration 0,7 sec. In order to make the “detection” mode it is necessary to push button “Mode” or “Level”. In the case the yellow LED “Mode” switches off red LED “Level” switches on duration 0,2 sec. and sound signal duration 0,7 sec.
- 3) In case of operating in “detection” mode it is necessary to adjust the level of actuation of synchro impulse finder. For that purpose install the geophone in activation position and make acti-

vation of seismic wave. In case of synch impulse detection the signal sounds and bright LED “Level” switches on duration 0,5 sec.

4) If the detection of synch impulse failed it is necessary to adjust the level of actuation. For that purpose pushing ordinary the button “Level” making increasing/decreasing of the level of actuation up to 4 units, in the case the sound signal takes place and red bright LED “Level” switches on duration of ones is proportional to the level of actuation. The range of alteration of the level of actuation from 1 to 120 with step 4. The units are selected symbolically. In case of increasing/decreasing of the level the meaning of the level is selecting in the above pointed range and in the case as soon as the level is max./min. meaning 120 (or 1) the long sound signal takes place which points out to the fact of obtaining the limit. After that the level begins to change in reverse.

5) Repeating p. 3) – 4) tune the level of actuation so that the detection of synchro impulse was positive and at the same time false operations of the detector from random noise have not takes place.

6) In accordance with ИУСЕ.00101.01 34 01 install the “START” mode of the System.

7) Make activation of seismic wave. In the case the sound signal takes place and bright LED “Level” switches on duration 0,5 sec, TU sends coded impulse. RR takes the impulse, decodes it and activates the System.

8) Operating of TU can takes place up to discharging of the battery of TU. In the case the green LED «ON» switches on periodically with 1 sec. and short sound signal takes place.

9) To finish the work with SMF push the button “ON” on TU, in the case all LEDs will go out. Switch off BP-9/12 ИУСЕ.436704.001 power to which RR is connected.

10) Disconnect the port TA from TU.

7. Application conditions

Temperature -30°C no less, +50°C no more

Degree of humidity – 95%

8. Terms of transportation and storage

1) The System in package intends for transportation by any kind of transport.

2) Transport facilities (railway wagons, containers, car bodies) should not have traces of cement, coal, chemicals, etc.

3) Places of storage of The System have to be defended from dust, chemicals and other deleterious substances.

4) Storage temperature of the System +5°C no less.

5) Charge the battery TU no less than once in two months, but the battery BP-9/12 no less than once in four months (p.5 Hardware Reference).

6) All devices including into the System have to be switched off and disconnected with 220V.

9. Battery charging

1. Purpose.

Automatic charger ZU-9 (ZU-2) with discharging function intends for charging batteries of power adapters of BP-9/12.

2. Special characteristics.

§ The process of charging is checking by microprocessor

- § The phase of testing before the starting of the process of charging provides finding of defective batteries.
- § Defence from changing of poles connection.
- § Supervision for the battery charging
- § Switching off on ΔU and built in timer.
- § Before the charging the batteries can be discharged pressing the button PRESS (yellow button), after discharging the device flips to charging.
- § Flip to the regime of trickle charge
- § LED indicating the charging process.

3. LED indications.

Flashing red LED means:

- § The process of testing of the battery during the starting charging period of 3-4 sec.
- § Defective battery

§ The process of the battery discharging;

Acting red LED means charging process.

Acting green LED means the fact that the battery is charged and the regime of holding on charging is switched on.

4. Discharging button.

Discharging button of the battery «PRESS» (yellow). Press the button during 2 sec. to start the process of discharging of the battery. The period of discharging of the charged power supply is 6-8 hours.

5. Charging of the battery of power supply, operation procedure:

ATTENTION!!! SECUENCING OF THE BATTERIES CHARGING!!!

1. Connect the charger ZU-9 (ZU-2) to 220V, 50 Hz.
2. Switch on power supply BP-9/12.
3. Connect the charger ZU-9 (ZU-2) to PU (**БПРД**) (see Fig.10).
4. Disconnect the charging adapter after ending of charging (continuous operation without current sink lead to breakdown of the charging adapter)

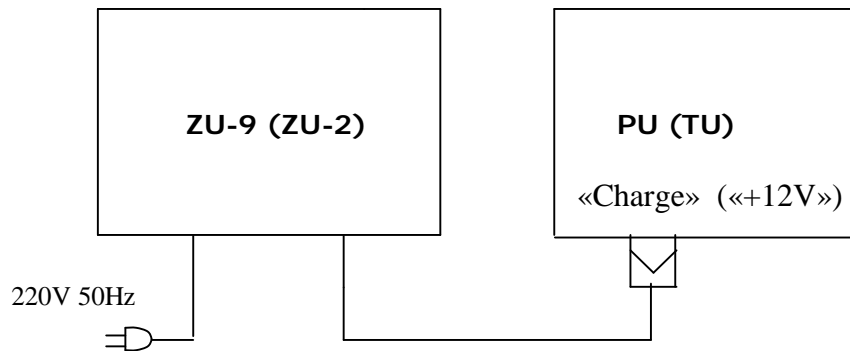


Fig. 10. Scheme of connecting the charging adapter ZU-9 (ZU-2).

During 3-5 sec. the red LED on the case of the charging adapter will blink, then will ignite constantly. After charging ending the red LED will blink off and the green LED on.

In order to discharge the batteries of power supply previously press the button «PRESS». At that during discharging of the adapter the red LED will blink and after ending of the phase of discharging the adapter starts to charge the battery automatically and the red LED will be on constantly.

Time of charging of the batteries from power 220 V 50 Hz is 10 hours no more; TU – 4 hours no more..

6.Safety engineering instruction:

§ Use the charging adapter ZU-9 only for charging of the batteries of power supply 9/12, but ZU-2 only for charging TU.

§ Use ZU-9 (ZU-2) in premise only.

§ Do not connect the device to the power in case of damaging of the case or of the plug.

§ Disconnect the device from the power in case of not using one.

§ During charging of the battery to switch on TU is **PROHIBITED!**

10. Common troubles and remedies

Tab. 1

Failure mode	Probably reasons	Elimination	Note
1. LED “Contr.” do not switch after 5 sec. of pressing the button “ON”.	Power cable is not connected The adapter BP-9/12 is discharged. The power cable is broken.	Test the connecting of the power cable. Charge the adapter BP-9/12. Test the power cable.	Voltage of the adapter must be from 10V up to 15V.
2. No connection with the Registrator through Ethernet and at that: - do not light the LED «Line» of the Registrator or LED «Link» computer; LED “Contr.” periodically quickly switches on. - The LED «Line» lights	Ethernet cable is not connected. The cable is broken. Port «Ethernet» computer is broken. Way of connection to ПЭВМ is disrupted The parameters of connection set up incorrectly Geophone is not connected to the seismic cable.	Test the connecting of the cable Ethernet (p.5). Test the Ethernet cable. Test port «Ethernet» computer, by connecting to it working LAN device Make the connection in accordance with p.«Preparation to function» Test the parameters of power connection in accordance with UM Test the connection of geophone to seismic cable	Address-IP: 10.0.0.200- for the Registrator; 10.0.0.100- for computer 10.0.0.199- for CU IP address mask - 255.255.255.0
3. There is no answer from geophone in case of seismoacoustic impact.	Geophone in inactive status. The seismic cable is broken The receiving channel of the Registrator is broken	Test geophone, change it on correct Test the seismic cable Test the receiving channels by test generator (p.6.1) built in the Registrator	
4. There is no connection with БУ through Ethernet.	See p.2	See p.2	
5. LED “ON” of TU, BP-9/12 does not switch on	The accumulator of TU, BP-9/12 discharged	Charge the accumulator TU, BP-9/12.	

If the eliminations failed to correct the fault you should apply to the manufacturing plant.

NOTE. The manufacturing plant repairs the System only in case of availability of blank form ИТЛЯ.416611.005ФО. In case of transmitting of the System to the manufacturing plant it is necessary to fill in the blank form (section “List of eliminations during using”) the columns of the “date and time of equipment failure” and “class of defect”

11. Scheme of making of solder connections of the System

Female OHLI-BC-1-7/12

Port	C.
TXD+	1
TXD	2
RXD+	3
	4
	5
RXD-	6
	7

Female OHLI-bC-1-7/12

C.	Port
3	RXD+
6	RXD
1	TXD+
4	
5	
2	TXD-
7	

Scheme port cable Ethernet ИТЛЯ.685621.089-02

Female OHLI-BC-1-7/12

Port	C.
TXD+	1
TXD-	2
RXD+	3
	4
	5
RXD-	6
	7

Male RJ-45

C.	Port
3	RXD+
6	RXD-
1	TXD+
4	
5	
2	TXD-
7	
8	
9	
10	

Scheme port cable Ethernet ИТЛЯ.685621.089-01

Female OHLI-BC-1-4/10

Port	C.
+12B	1
+12B	2
GND	3
GND	4

Female OHLI-BC-1-4/10

C.	Port
1	+12B
2	+12B
3	GND
4	GND

Female PC45TB(TB)

C.	Port
1	SI+
2	SI-
3	
4	

to seismic vibration unit or geophone

Scheme synchronization cable ИУСЕ.685621.052 (-02)

Female PC7TB

Port	C.
SI+	1
SI-	2
+12B	3
	4
GND	5
	6
	7

Female PC45TB

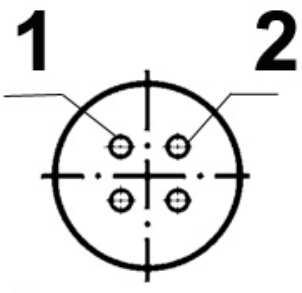
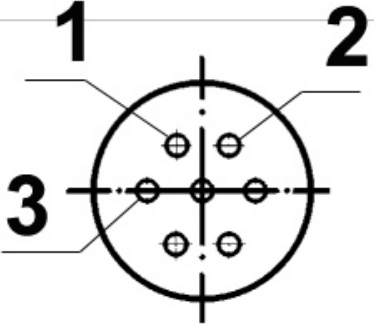
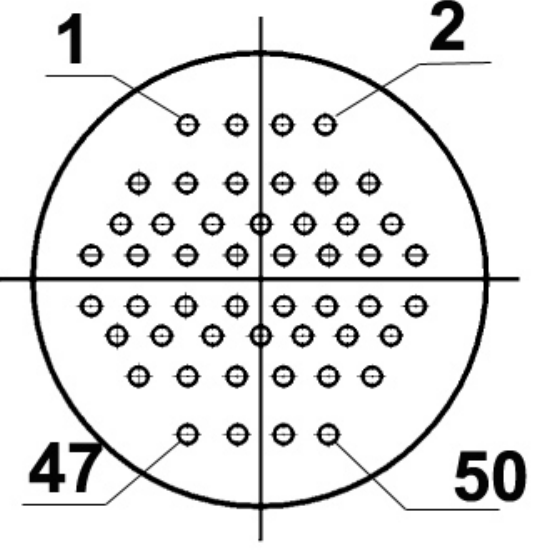
C.	Port
1	SI+
2	SI-
3	
4	

Female DILL-5C-1-4/10

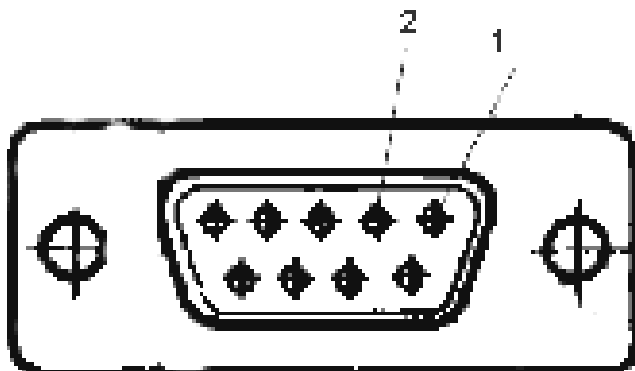
C.	Port
1	+12B
2	+12B
3	GND
4	GND

Scheme lakkolitt cable ИУСФ.685621.051

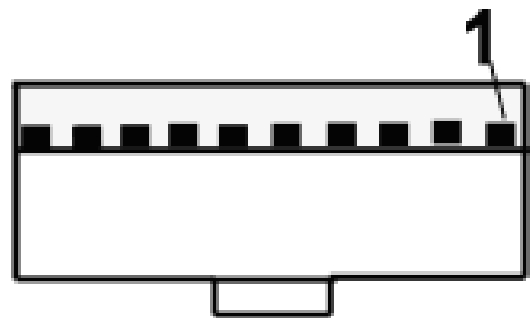
Socket female connector ОНЦ-БС, РС(Б)ТВ on the part of outside contacts Quantity of the contacts

	<p style="text-align: center; font-size: 24px;">4</p>
	<p style="text-align: center; font-size: 24px;">7</p>
	<p style="text-align: center; font-size: 24px;">50</p>

Numbers and position of the connectors contacts: **ОНЦ-БС, РС7(Б)ТВ.**



Socket unit DB-9



Plug RJ-45

ИУСЕ.416611.005 РЭ

"S/bar 1,2"	
Port	Cont.
+N1	1
-N1	2
+N2	3
-N2	4
+N3	5
-N3	6
+N4	7
-N4	8
+N5	9
-N5	10
+N6	11
-N6	12
+N7	13
-N7	14
+N8	15
-N8	16
+N9	17
-N9	18
+N10	19
-N10	20
+N11	21
-N11	22
+N12	23
-N12	24
+N13	25
-N13	26
+N14	27
-N14	28
+N15	29
-N15	30
+N16	31
-N16	32
+N17	33
-N17	34
+N18	35
-N18	36
+N19	37
-N19	38
+N20	39
-N20	40
+N21	41
-N21	42
+N22	43
-N22	44
+N23	45
-N23	46
+N24	47
-N24	48
COMPUT	49
DSND	50

"+12V"	
Cont.	Port
1	+12V
2	+12V
5	GND
4	GND

"Ethernet"	
Cont.	Port
1	TXD+
2	TXD-
3	RXD+
4	
5	
6	RXD-
7	

"Start"	
Cont.	Port
1	SI+
2	SI-
3	D/K
4	GND

Fig. 11 Outside contacts of Registrator connectors.