GeoRad-M
Software and Hardware System

Operating Manual

BICT.412161.027-02 HE

CONTENTS

This Operating Manual (hereinafter referred to as the OM) is intended to inform the user about the principles of operation of the software and hardware system GeoRad-M, its operation procedure, and contains all information necessary for proper use of the system and full implementation of its technical possibilities.

1 DESCRIPTION AND OPERATION

1.1 Purpose of use

The Software and Hardware System "GeoRad-M" (hereinafter – SHS) is designed to measure ambient dose equivalent rate (hereinafter – DER) of gamma radiation and accept geographical coordinates and current time from navigation satellites, display measurement results linked to a geographical map on the screen of a personal computer (hereinafter – PC), as well as archive this information.

The SHS is designed for installation on the wheeled vehicles and can be used to construct mobile radiological or radiochemical laboratories.

1.2 Composition of the SHS

The SHS consists of one BDBG-09 gamma radiation detecting BICT.418266.030-02 (or similar in agreement with the customer), BS-09 Geo unit BICT.468382.057-05, GPS antenna BULLET III TRIMBLE (or similar in agreement with the customer), a PC with installed "GRad" software, a PC power adapter (hereinafter – PA) and connecting cables. The type of PC and PA is determined separately, in accordance with the requirements for the mobile laboratory.

1.3 Specifications

1.3.1 The main technical data and specifications are given in Table 1.1.

Table 1.1 - Main technical data and specifications

Name	Unit of measure	Standardized values according to specifications
Measuring instrument for gamma radiation DER	-	BDBG-09 detecting unit of gamma radiation BICT.418266. 030-02 or similar detecting unit
Range of gamma radiation DER measurements*	μSv/h	$0.05 – 10^7$
Main relative permissible error limit during measurement of gamma radiation DER when calibrated by ^{137}Cs with a confidence probability of 0.95*	%	$15+2/\dot{H}^*(10)$, where $\dot{H}^*(10)$ – is a numerical value of gamma radiation DER, equivalent to μSv/h
Energy range of registered gamma radiation *	MeV	0.05 – 3.00
Energy dependence of measurement results during gamma radiation DER measurement in the energy range from 0.05 MeV to 1.25 MeV*	%	±25
Navigation system**	-	GNSS
Maximum root-mean-square error in location determination**	m	2.5
"Cold" start time**	s	35
"Hot" start time**	s	2.5
Power supply voltage when powered via PoE Ethernet connector**	V	from 25 to 60
Supply voltage from the on-board network through a separate connector **	V	from 12 to 32
Useful current**, no more	A	1
PC connection interface **	-	Ethernet
* Data for the BDBG-09 gamma radiation detecting unit ** Data for BS-09 Geo unit		

1.3.2 SHS records the results of gamma radiation DER measurements, as well as geographical coordinates with an interval of 1 s.

1.3.3 SHS displays the measurement results on the PC screen as a text and as route points referenced to the map. There are two modes of information display – in a specified time or display by an offset distance.

1.3.4 SHS allows establishing two threshold alarm levels – the warning threshold level and the danger threshold level.

1.3.5 SHS signals about the exceeding of the set threshold levels by the measured DER with sound signals and a change in the color of information display on the PC screen.

1.3.6 SHS signals about the failure of the detecting unit and BS-09 Geo unit with audible signals, messages on the PC screen.

1.3.7 Sound signals about exceeding the threshold levels and equipment failure are generated by the PC speaker system.

1.3.8 SHS saves measurement results, as well as geographical coordinates and measurement time on the PC's hard drive. There are two modes of information saving – in a specified time or display by an offset distance.

1.3.9 SHS allows viewing previously saved measurement results as a text (in the form of reports) and as route points on the map.

1.3.10 SHS can work with electronic maps Open Street Map, GoogleMaps.

1.4 Use Environment

The detecting unit and GNSS antenna are designed to be placed on the outer surfaces of the body (van) of the wheeled vehicle. Other equipment of the delivery kit – inside the body (van).

1.4.1 Terms of the SHS use (except for PC and PA).

1.4.1.1 Terms of the BS-09 Geo use are regulated by BICT.468382.057-05 HE.

1.4.1.2 Terms of use of the BDBG-09 gamma radiation detection unit are regulated by BICT.418266.006-03 HE.

1.4.2 Terms of use of the PC, PA are regulated by the specifications of the manufacturer and their compliance with the requirements for the mobile laboratory.

1.5 Delivery kit

1.5.1 The SHS delivery kit includes the products and operating documentation listed in Table 1.2.

Table 1.2- Delivery kit

Designation	Name	Q-ty	Note	
BICT.418266.030-02	BDBG-09 detecting unit of gamma radiation	1		
BICT.418266.006-03 ФО	BDBG-09 detecting unit of gamma radiation. Logbook	1		
BICT.418266. 006-03 НЕ	BDBG-09 detecting unit of gamma radiation. Operating Manual	1		
BICT.468382.057-05	BS-09 Geo unit	1		
BICT.468382.057-05 НЕ	BS-09 Geo unit. Operating Manual	1		
P/N 57861-00	GPS antenna BULLET III TRIMBLE[1)]	1		
BICT.685621.017	BDBG-09 cable	1	5 m	Cable lengths can be changed at the Customer's request
BICT.685621.078	Power cable	1	5 m	
BICT.685.661.050	Ethernet cable	1	2 m	
BICT.685671.001	Antenna cable	1	5 m	
	Personal computer [2)]	1		
	Power adapter [2)]	1		
	"GRad" software [3)]	1	On a USB flash drive	
BICT.412161.027-02 НЕ	GeoRad-M software and hardware system. Operating manual	1		
	GRad software. Operating manual[3)]	1	On a USB flash drive	

[1)] or similar as agreed with the customer.

[2)] supplied in a separate order.

PC and PA models are not regulated.

PC requirements:

Operating system Windows 10 and later.

Other specifications of PC and PA (resistance and strength to mechanical and climatic factors, supply voltage and power consumption, screen size, etc.) must meet the requirements set for the mobile laboratory.

1.5.2 Overall dimensions and weight of the SHS components are given in Table 1.3.

Table 1.3 - Overall dimensions and weight of the SHS components

Name	Dimensions, mm	Weight, kg
1 BDBG-09 detecting unit of gamma radiation BICT.418266.030-02, not more than	60x60x230	0.5
2 BS-09 Geo unit BICT.468382.057-05, not more than	181×230 ×81	1.2
3 BULLET III TRIMBLE GPS antenna, not more than	Ø77.5 × 66.2	0.17

1.6 Design of SHS and principle of its operation

1.6.1 General information

Block diagram of SHS shown in Fig.1.

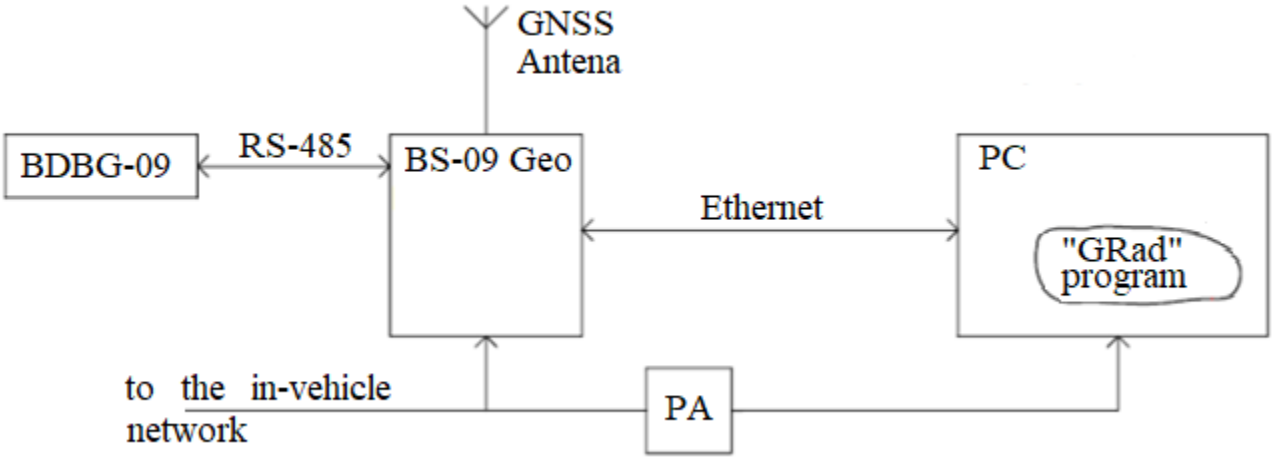

Figure 1 – Block diagram of SHS

The BDBG-09 detecting unit and GNSS antenna are connected to the BS-09 Geo unit. The BS-09 Geo is connected to a PC via an Ethernet interface. All connections are made by the corresponding cables, which are a part of the SHS or manufactured by the customer using the installation kit of the BS-09 Geo. The BS-09 Geo unit is powered from the vehicle's network, where the SHS is installed or through the PoE interface. The BS-09 Geo unit provides filtering of the voltage of the on-board network and the generation of the necessary voltages for powering the BDBG-09 detecting unit and the GNSS antenna. PC power supply is provided by the PA.

The BDBG-09 detecting unit is intended for measurement of gamma radiation DER.

The GNSS antenna is designed to receive signals from navigation satellites.

The BS-09 Geo unit is designed to accept gamma radiation DER measurement results from the BDBG-09 detecting unit, determine geographical coordinates based on signals from navigation satellites and transfer this information to a PC

The PA power adapter is designed to power the PC.

The PC is designed to receive, display, and save information results.

1.6.2 SHS design

The design of the BS-09 Geo unit complies with BICT.468382.057-05 HE.

The design of the BDBG-09 detecting unit complies with BICT.418266.006-03 HE.

Designs of the PC, PA – comply with the specifications of the manufacturing companies.

1.6.3 Operation of the SHS

Immediately after switching on, the BS-09 Geo unit starts generating queries with a period of 1 s and receive DER measurement results of gamma radiation from the BDBG-09 detecting unit, as well as determine geographic coordinates.

The PC, under the control of the GRad software, generates queries to the BS-09 Geo unit with an interval of 1 s, and in response receives the results of gamma radiation DER measurement from the BDBG-09 detecting unit and geographical coordinates. The GRad program displays this information in its main window as text and on the map.

Information on how to work with the GRad program is provided in the document "GRad Software. Operating Manual".

2 PROPER USE

2.1 Operating limitations

2.1.1 The components of the SHS shall operate under conditions that do not go beyond the conditions of use specified in section 1.4, manuals BICT.468382.057-05 HE and BICT.418266.006-03 HE.

2.2 Safety measures

2.2.1. There are no external parts in the components of the SHS, which could be exposed to life-threatening voltages.

2.2.2. In case of contamination of the SHS components (except PC), they shall be decontaminated by wiping their external surfaces with a gauze swab moistened with a standard decontamination agent.

2.3 Preparation of SHS for operation

2.3.1 Before starting work with the SHS, please read this document carefully, as well as the documents "GRad Software. Operating Manual" and BICT.468382.057-05 HE and BICT.418266.006-03 HE. You must strictly observe the requirements set forth in these documents.

2.3.2 Scope and sequence of external examination

2.3.2.1 When putting the SHS into operation, unpack it and check if the delivery kit is complete, conduct an external examination of the components of the SHS to determine if there is mechanical damage.

2.3.2.2 Install the SHS on the vehicle according to Figure 1.

2.3.2.3 Prepare the PC and PA in accordance with the requirements of its technical documentation.

2.4 SHS operation procedure

2.4.1 Turn on the PC according to its technical documentation. Wait for the operating system to boot and run the GRad software.

2.4.2 Turn on the BS-09 Geo unit and connect it to the PC according to BICT.468382.057-05 HE.

2.4.3 The operation of the SHS is managed by the GRad program in accordance with the document "GRad Software. Operating Manual".

2.5 List of possible troubles and troubleshooting

2.5.1 The list of possible troubles of the BS-09 Geo unit is provided in BICT.468382.057-05 HE.

2.5.2 The list of possible troubles of the BDBG-09 detecting unit is provided in BICT.418266.006-03 HE.

2.5.3 The list of possible troubles and troubleshooting of the SHS is provided in Table 2.1.

Table 2.1 - List of possible troubles and troubleshooting

Trouble	Probable cause	Troubleshooting
BS-09 Geo alarm unit does not accept signals from navigation satellites	1 The GPS antenna is closed from the navigation satellite signals 2 Antenna cable damage 3 GPS antenna failure 4 BS-09 Geo unit failure	1 Place the vehicle with the SHS in an open area 2 Repair the cable 3 Replace the GPS antenna 4 Replace the BS-09 Geo unit. Send the damaged BS-09 Geo unit to the manufacturer

Table 2.1 (continued)

Trouble	Probable cause	Troubleshooting
Grad SW message about connection loss with BS-09 Geo unit	1 Damage to the power cable 2 Damage to the cable 3 BS-09 Geo unit failure 4 PC COM/Ethernet port failure	1 Repair the cable 2 Repair the cable 3 Replace BS-09 Geo unit. Send the damaged BS-09 Geo alarm unit for repair to the manufacturer 4 Replace the PC. Send the damaged PC for repair to the manufacturer
Grad SW message about connection loss with the BDBG-09 detecting unit	1 Damage to the cable. 2 Detecting unit failure. 3 BS-09 Geo unit failure.	1 Repair the cable 2 Replace the detecting unit. Send the damaged detecting unit for repair to the manufacturer 3 Replace BS-09 Geo unit. Send the damaged BS-09 Geo alarm unit for repair to the manufacturer
Grad SW message about high-sensitivity or low-sensitivity detector failure of the BDBG-09 detecting unit	1 Detecting unit failure	1 Replace the detecting unit. Send the damaged detecting unit for repair to the manufacturer

2.5.4 If you fail to eliminate the troubles listed in Table 2.1, or if other complicated troubles arise, the SHS shall be sent for repair to the relevant repair services or to the manufacturer.

3 TECHNICAL MAINTENANCE

3.1 Technical maintenance of the SHS

3.1.1 General instructions

The list of operations during technical maintenance (hereinafter – TM), the order and the peculiarities of operational phases are presented in in Table 3.1.

Table 3.1 – List of operations during technical maintenance

Operation	TM type			OM item No.
	During use		During long-term storage	
	everyday	periodic (annually)		
External examination	-	+	+	3.1.2.1
Delivery kit completeness check	-	-	+	3.1.2.2
Performance check	+	+	+	3.1.2.3
Note. "+" means the operation is applicable for this type of TM; "-" means the operation is not applicable				

Maintenance of the BS-09 Geo unit is performed according to BICT.468382.057-05 HE.

Maintenance of the BDBG-09 gamma radiation detecting unit is performed in accordance with the document "BDBG-09 detecting unit of gamma radiation. Operation Manual" BICT.418266.006-03 HE".

Maintenance of PC and PA is performed in accordance with their technical documentation.

3.1.2 Maintenance procedure

3.1.2.1 External examination.

3.1.2.1.1 Examine the SHS in the following sequence:

a) check for scratches, traces of corrosion, damage to the coating on the surfaces of the SHS components;

b) check the integrity of seals of the SHS components;

c) check the condition of the connectors at the point where the cables are connected to the units.

Wipe the metal parts of the detecting unit with an oiled cloth after special treatment (decontamination).

3.1.2.1.2 Decontamination of the surface of the housing and components of the detecting units is carried out as needed in accordance with the recommendations of the document "BDBG-09 detecting unit of gamma radiation. Operation Manual" BICT.418266.006-03 HE.

3.1.2.2 Delivery kit completeness check.

Check the completeness of the SHS delivery kit in accordance with section 1.5.

3.1.2.3 Performance check of the SHS.

3.1.2.3.1 Performance of the SHS during its operation is checked automatically.

3.1.2.3.2 Performance of the SHS after its long-term storage is checked in the following sequence.

- Switch on the PC according to its technical documentation. Wait for the operating system to boot and run the GRad software.

- Connect the BS-09 Geo unit to the PC and turn on the BS-09 Geo unit according to BICT.468382.057-05 HE.

- Check the performance of the GRad SW in accordance with the document "GRad Software. Operating Manual".

4 REPAIR

4.1 Repair of the SHS is carried out by the manufacturer:

PE SPPE "Sparing-Vist Center"
79026, Ukraine, Lviv, 33 Volodymyra Velykoho St.
phone: (032) 242-15-15, fax: (032) 242-20-15.

5 PRESERVATION AND STORAGE

5.1 Components of the SHS, except for PC, should be stored before commissioning in the manufacturer's packaging in heated and ventilated warehouses, in air-conditioned storages located in any macroclimatic areas, where air temperature is from +5 to +40 ºC and relative humidity is from 60 to 80 %. Store the PC in accordance with the requirements of its technical documentation. Shelf life shall not exceed one year. Transportation time is included in the shelf life of the product.

6 TRANSPORTATION

6.1 Transportation of the SHS components, except for the PC, must be carried out under conditions not exceeding the values given in section 1.4 of this OM. Transport the PC in accordance with the requirements of its technical documentation.

6.2 The SHS can be transported by rail, road, water and air transport. Type of motor transport when transported by rail – covered car, road – closed body or van, water – a hold of the vessel, aircraft – pressurized compartments.

6.3 During transportation of the SHS, observe the requirements according to the handling signs applied on a transport container.

6.4 The total transport time of SHS in the manufacturer's packaging shall not exceed one month.

7 DISPOSAL

Disposal of the SHS should be carried out in accordance with group 4 of SanPiN 2.2.7.029-99: metals shall be recycled (remelted), plastic parts for shall be dumped.

Disposal of the SHS is not dangerous to service personnel and is environmentally friendly.

Disposal of the SHS shall be done by disassembly in accordance with the procedure adopted by the consumer company.

8 WARRANTY

8.1 The manufacturer guarantees the specifications of SHS if the consumer complies with the terms of use, transportation and storage, which are set out in the Operating Manual "GeoRad-M Software and Hardware System" BICT.412161.027-02 HE.

8.2 Warranty period of the SHS use at least 24 months from the date of commissioning or after the expiration of the warranty period of storage.

8.3 Warranty period of storage – 6 months from the date of the SHS manufacture.

8.4 Free repair or replacement during the warranty period of use is carried out by the manufacturer, if the consumer complies with the rules of operation, transportation and storage.

8.5 In the event of troubleshooting of the product (according to the claim), the warranty period is extended for the time during which the SHS was not used due to detected problems.

9 PACKING CERTIFICATE

GeoRad-M Software and Hardware System BICT.412161.027-02 with serial number _____

is packed by PE “SPE “Sparing-Vist Center” in accordance with the requirements of the valid technical documentation.

_____	_____	_____
position	signature	print full name

_____
year, month, date

10 CERTIFICATE OF ACCEPTANCE

GeoRad-M Software and Hardware System BICT.412161.027-02 with serial number _____

is manufactured and accepted in accordance with the mandatory requirements of the valid technical documentation and recognized as suitable for use.

QCD head

Seal

_____	_____
signature	print full name

_____
year, month, date