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SPE "Tetra" Ltd

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EFFICIENT USE

MKS-08

To the software version 0.7.84.20090807

Edition 1

PREFACE

MKS-08 – dosimeter-radiometer, recognized and used among all sorts of professional users, allows to solve the basic tasks of radiation and radiometric monitoring.

There is external digital interface, the ability to obtain the comprehensive data about control process in the on-line mode, open protocols and exchange registers, the set of free software – all of it makes MKS-08 essential and accessible tool for solving scientific-research tasks.

MKS-08 – multifunctional device, allows solving the several tasks simultaneously, particularly in the background mode, make opportunity of easy switching between the various windows of operation modes. The great deals of service and software solutions are allowed to create the comfortable facilities for using MKS-08 within the requirements of different methods for the measurement.

The using of unique set of the search modes in consoles and acceleration estimation of radiation rate make of MKS-08 essential for solving tasks of radio ecological monitoring, estimation of preserving raw material, control pollution density of material and waste metal.

MKS-08 is represented with great number of control panels and detection blocks, one of the most commonly used professional dosimeter-radiometer. This is confirmed of large quantity publications about MKS-08 and researchers performed with its participation [1, 2].

Widespread using, functional means MKS-08 are the main reasons of creation this guidelines for best practices.

This document does not replace the supplied operation manual for MKS-08 (OM) and even no contains of full information as available in MO.

The aims of creation these guidelines are:

- help professional users and brand follower more efficiently using the great number of features of this device;
- simplify beginning users of application dosimeter-radiometer and make application in pleasure process of review;
- suggest researchers and experimentalists of alternative means of solution for set problems on the base of existing our various separately decisions;
- describe the possibly field of application MKS-08 as separately measurement unit and as the part of potential measurement systems;
- persuade doubtful users in a great excellent features of consoles and separately detection blocks and dosimeter-radiometer MKS-08 in general.

And, of course, our aim – is setting the turn of experience, so-called feed-back, who express own opinion about our product, critic, suggests. We appreciate such opinions and always ready to respond the health criticism by means of new and program decisions.

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HOW READ THIS MATERIAL

This document contains the description of all application MKS-08, solved tasks with its help and fields of interest. Of course, the separate user can't be interested in the contents of all chapters, but every user MKS-08 finds for himself all necessary and useful.

The statement is not intended for serial study of all proposed material. In the preparation reader, the experience of operation with MKS-08 and reasons of this description it can begin from any part.

Even the fluent review with the sheet of opportunities MKS-08 and range of application can help to prompt the appropriate solution for occurred task.

The document is written such way that every chapter consists of maximum information according to the question and maximum necessary links as internal it, also links on the additional material published by the specialist of our company early and our co-author users.

All presented information is appropriate for control panels with software version 0.7.84.20090807 (see p. 11.1.5, Program version). The users DKS with program version at least 0.0.696.20080804 according to the agreement with supplier can upgrade the firmware of control panel and operational manual.

LIST OF ABBREVIATIONS

AT	Alarm threshold
BT	Bottom threshold
GIS	Geological information system
GPS	Global positioning system
IMS	Information monitoring system
PC	Personal computer
PMT	Photomultiplier tubes
PT	Preliminary threshold
SCD	Semiconductor detector
UM	Units of measurement

Besides, the term «threshold», or «alarm threshold» are used in text. The explanation this term is not possible to find in the dictionaries. However, it appeared in time of created the first radiation control, it is active used in the professional vocabulary of instrument-makers. This term means «threshold value». In devices and systems the measurand is constantly compared with setting threshold. In result of comparison and depending from type of threshold (alarm, preliminary) can generate the various messages, provide the certainly actions.

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BEGINNER USER MKS-08 (QUICK START)

1.1 DESIGNATION OF BUTTONS

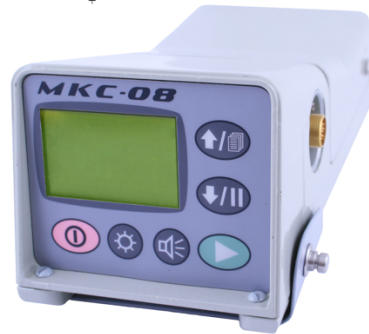


Figure 1. View of console keyboard UIK-05

Consoles of dosimeter-radiometer (Figure 1) have six multifunctional buttons as the control units. Hereinafter these buttons are identified and symbolized as follows:

- ⓪ button «On»;
- ▶️ button «Select»;
- 🔊 button «Sound»;
- ⚙️ button «Light»;
- ⏴ button «Down / Pause»;
- ⏵ button «Up / Next window».

The full designations of keyboard functions are described in p. 3.2.

1.2 SWITCH ON / OFF MKS-08

1.2.1 CONNECTION THE DETECTION BLOCK

Before the dosimeter-radiometer is switched on it should make sure that connection of detection block is right. After it has been switched on the console determines the type of detection block, reading the coefficients and user's settings from the non-volatile memory.



Detection block and console should belong to one delivery set! The console saves the coefficients "own" detection blocks.

1.2.2 SWITCH ON MKS-08

The switching on of dosimeter-radiometer is executed by action ⓪. The designation of connected detection block is indicated on the display within several seconds (Figure 2).

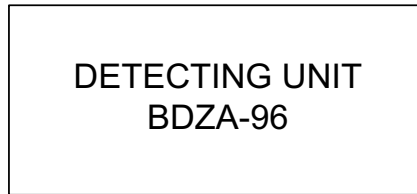


Figure 2. Indication type of detection block



While it switches on MKS-08 should control the valid designation type of connected detection block!

Further the console switches in the mode of primary measurement.

The factory setting of console is made available the minimal capabilities of MKS-08 for novice user. The learning of this document will give opportunity for user to set MKS-08 for solving certainly tasks, optimize operation, minimize chores.

1.2.3

SWITCH OFF MKS-08

The switching off the dosimeter-radiometer is executed by action $\odot\odot$ (long-term press of button \odot). Before it is powered off the message is indicated on the display «Processing unit power off» (Figure 3). After the message is indicated the action can finish $\odot\odot$.



Figure 3. Power off MKS-08

1.3 ACTIVATION OF HELP WINDOW

After the dosimeter-radiometer has been switched on in the console it begins operate all measurement algorithms and operation modes provided by company-manufacturer (or operator). It is indicated one of the mode of operation on the display. Switch to the display of next mode (window) is executed by the action \blacktriangle .

In every window, display one of operation mode for dosimeter-radiometer, having the ability for activation of help window. The prompting information about the possible operator actions is displayed in operation mode in window help. Window help is activated by action $\odot\blacktriangle$.

For the mode of primary measurement with the detection block BDMG-96 the help window is shown such way, as indicate in the Figure 4. The worth of help window consists that the contents is not permanent, and form depending of the connected detection block and the operation mode, and such way, devoid of information overload.



Figure 4. Activation of help window from the window of base measurements

Help window consists of the figures of buttons in the beginning of every line, or combination buttons, by means of it can be executed the description actions in the window.

In some cases the help text places in several sequential windows. Such windows consists the figures of cursor in right upper and right lower corners – keyboard buttons, using them, can scroll the window of help window.

Return in window of activation mode is executed by action \odot .

1.4 HELP IN MENU SETTINGS

The full description of menu Settings is described in p. 1.11.

«Setting» - full menu, giving opportunity to correct the coefficients, thresholds, setting of the operation modes, selection of measurement algorithms, motion modes, and also great quantity reference information about MKS-08.



It admits such designation in text, while reference on the point of nested menu, For example, the next line **Settings → Help → Keypad → All window** indicate about availability in the menu «Settings» nested menu «Help». As result of «Help» consists the nested menu «Keypad», and etc. In the view of operator actions such record indicates that it is possible to enter in menu «All window» by means of the menu «Setting» and select the menu «Help» by actions \uparrow or \downarrow , enter in menu «Help» by action \blacktriangleright , and till achievement of intended purpose - menu «All window». Return in the menu of upper degree is executed by action \odot .

Menu «Settings» is activated from off mode MKS-08 by action $\uparrow\odot$. The beginner user will interest the section of menu «Help» contents, in particular, description:

- using of console keypad. The designation is divided into groups by separately modes and windows. Example with general description of all modes for windows of using keypad is shown on the Figure 5;



Figure 5. One of the menu Settings → Help → Keypad → All windows

- sound messages: in this section you can learn with description full composition of sound messages for console and reproduce them for immediate review;

- special symbols – icons, displayed in the status bar of display during the operation process MKS-08 (example with figure of one window with description icons are shown on Figure 6).

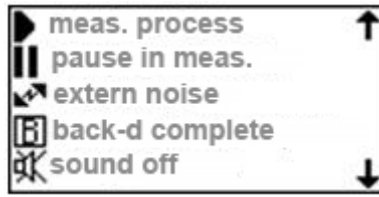


Figure 6. One of the menu window Settings → Help → Display

1.5 ROTATE DISPLAY

Rotate image on the display – option, installation for all consoles, but more frequently using with console UIK-06. It is allowed to operate with MKS-08 in more comfortable condition for user while fix of console UIK-06 on the rod of detection block, on the right, or left wrist. The rotate display is executed from menu Settings → Config → Rotate display (Figure 7).

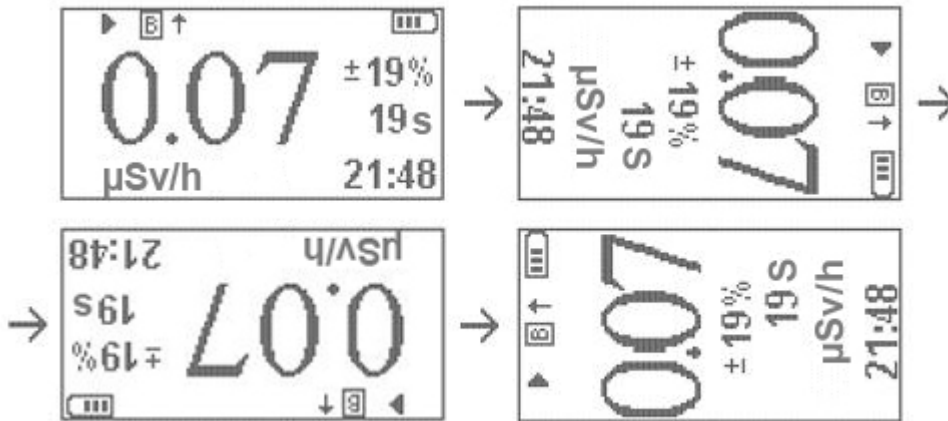


Figure 7. Execution of sequent rotate images on the display

2 GENERAL INFORMATION ABOUT MKS-08

MKS-08 – dosimeter-radiometer consists from consoles UIK-05, UIK-05-01 or UIK-06 (Figure 1) and detection block (p. 2.32.3).

MKS-08 with one console can be delivered the several various detection blocks in delivery set. In accordance with tasks and application field for MKS-08 the customer selects necessary console and set of detecting blocks.

While development of software for console MKS-08 in full measure it takes into account of international standards [3, 4] and normative documents [5 - 11].

2.1 DESIGNATION MKS-08

Dosimeter-radiometer depending from the type of detection block provides measurement:

- ambient dose equivalent $H^*(10)$ continuous and pulse for X-ray and gamma-radiation (detection blocks BMKS-08b, BMKS-08);
- ambient dose equivalent rate $\dot{H}^*(10)$ continuous and pulse for X-ray and gamma-radiation (BMKS-08b, BMKS-08);
- ambient dose equivalent rate $\dot{H}^*(10)$ for gamma-radiation (BDMG-96);
- ambient dose equivalent $H^*(10)$ for neutron-radiation (BDMN-96, BDKN-96);
- ambient dose equivalent rate $\dot{H}^*(10)$ for neutron-radiation (BDMN-96, BDKN-96);
- exposure dose rate for gamma-radiation (BDKG-96);
- alpha-flux density;
- beta-flux density;
- gamma-flux density;
- neutron-flux density;
- gamma-flux.

Dosimeter-radiometer can search and reveal the sources of ionizing radiation, conduct the assessment registered radiation accelerated according to the fixed threshold. Listed of kinds operation executes MKS-08, is completed one from the detection blocks BDVG-96, BDPG-96 or BDPG-96m in modes «Search», «Detection», «Threshold» (p. 7).

2.2 APPLICATION RANGES MKS-08

Dosimeter-radiometer is used in the radiological monitoring service of industrial establishments, control boundary and customs centres, in medical, in scientific services, sanitary and epidemiological stations, centre for storage scrap metal, building and project organizations:

- for operation and periodical control of radiological environment (window «Primary measurement», window «Dose» for primary operation mode);

- for measurement of contamination level of surface for alpha -, beta- and gamma – active substances (window «Preliminary measurement», window «Secondary measurement»);
- for search and localization of ionizing radiation (window «Search»);
- for effective detection of pointed and extended are with bizarre level of gamma-radiation (window «Detection»);
- for threshold estimate of radiation level (window «Threshold»);
- for measurement of gamma-flux and exposure dose rate for gamma-radiation in wells and liquid medium (window «Preliminary measurement»)
- for radiation mapping with reference to geographical coordinates with transducer of global positioning system (GPS) (window «Preliminary measurement»).

Consoles of dosimeter-radiometer support a great quantity of settings, allow all kinds of operation in full conformity with requirements of corresponded normative and metrological documents [5 - 11].

2.3 DETECTION BLOCK MKS-08

2.3.1 SOLVED TASKS MKS-08

MKS-08 has a great quantity various detection blocks, enabled to solve all practical tasks for dosimetry and radiometry. With occurrence new blocks, new features of detection blocks are invariable developed the composition MKS-08 and numbers of solved problems.

Analyze features of detection blocks is made possible to create new operation modes and new features MKS-08. Occurrence in the composition of blocks MKS-08 is measured several kinds of ionization radiation, allow using in the console MKS-08 the mode of parallel measurements for several kinds of radiation, conducting constant and without reference the displayed mode. Studying the requirements of methods for measurements is reason to occur new measurement modes «Threshold», «Search», «Detection», under degree of natural background.

Now delivery set MKS-08 consists of the detection blocks for alpha-, beta-, gamma-, gamma and beta-, gamma and X-ray, neutron radiation, enable operate in indicated modes.

2.3.2 DETECTION BLOCK FOR ALPHA-RADIATION

Group of blocks consists from BDZA-96, BDZA-96s, BDZA-96m, BDZA-96b, BDZA-96t, BDPS-96. It is aimed for use for alpha-flux density in the MKS-08.

BDZA-96, BDZA-96s, BDZA-96m – detection blocks, differ from one another from the active surface area and accordingly the width of measurement range and sensitivity to the registered alpha-radiation (Figure 8).



Figure 8. Detection block BDZA-96m, BDZM-96s, BDZA-96

BDZA-96b – block with great active surface area of detector. It is more fluently applied to control the degree of alpha-pollution on personals palms. It is completed guard shield (Figure 9).



Figure 9. Detection block BDZA-96b



Figure10. Detection block BDZA-96t

BDZA-96t – very small and easy block. Insensitivity to the other type of radiation, indispensable for searching operating or researching the objects with difficult configuration. It is completed with telescopic rod (Figure10).

BDPS-96 – use for simultaneously measurement alpha- and beta-flux density (Figure 11). Measurement alpha-flux density is automatically compensation for beta and gamma-radiation in the process.



Figure 11. Detection block BDPS-96

Main technical characteristic detection block are showed in Table 1.

Table 1. Main technical characteristics detection block of alpha-radiation

Parameter	BDZA-96	BDZA-96s	BDZA-96m	BDZA-96b	BDPS-96	BDZA-96t
Active surface area of detector, cm ²	70	30	10	300	28	5
Measurement range s, ppm·cm ⁻²	0.1 – 10 ⁴	0.1 – 5·10 ⁴	0.1 – 10 ⁵	0.1 – 2·10 ³	0.1 – 5·10 ⁴	0.1 – 3·10 ⁶
Type of detector	Scintillation ZnS (Ag)					SCD
Sensitivity, s ⁻¹ ·min·cm ²	0,5	0,2	0,1	1,00	0,2	0,05
Self-background, ppm·cm ⁻²	0,3	0,2	0,2	1,0	0,2	0,1
Dimensions, mm	Ø130×240	Ø90×240	Ø65×240	Ø230×290	Ø90×230	Ø50×60
Weight of detection block, kg	1,1	1,0	0,9	4,0	1,0	0,15

2.3.3

DETECTION BLOCK FOR BETA-RADIATION

Group of blocks consists BDZB-96, BMKS-08s, BDZB-96s, BDZB-96b, BDZB-99, BDPS-96. It is aimed to use for measurements beta-flux density in structure MKS-08.

BDZB-96 – detection block with more broadened measurement range. It suits for operation in laboratory conditions. (Figure 12).



Figure 12. Detection block BDZB-96



Figure 13. Detection block BDZB-96b

BDZB-96b – developed for control of the dirtiness clothes and personals palms (Figure 13).

BDZB-96s and BDZB-99 – detection blocks on the base of gas-discharge counters (Figure 14 and Figure 15). Differs from one another the active service area of detection and accordingly the width of measurements range and sensitivity to registered beta-radiation. It is easy detection blocks; it is completed with telescopic rod. The construction of blocks is made cosy of use in field conditions.



Figure 14. Detection block BDZB-99



Figure 15. Detection block BDZB-96s

BMKS-08s – block, simultaneously the flux density and dose rate for gamma-radiation (Figure 16). The main specialty and features this detection block – availability of second measurement gamma-channel, allow automatically compensate gamma-background while measurement the flux density for beta-radiation and simultaneously make measurements two types of measurements. Characteristic of block in measurements of gamma-radiation is given below in p. 2.3.4.



Figure 16. Detection block BMKS-08s

BDPS-96 – block, simultaneously the flux-density for alpha and beta radiation (Figure 11). Operation of beta-channel and its features are analogical features and operation of detection block BDZB-96. A characteristic of block in the part of measurement alpha-radiation is given upper.

Characteristic block in measurements for alpha-radiation is shown upper in p.2.3.2.

Table 2. Main technical characterises of detection block for beta-radiation

Parameter	BDZB-96	BDPS-96	BDZB-99	BDZB-96b	BDZB-96s	BMKS-08s
Measurement range, ppm·cm ⁻²	10 - 1·10 ⁵	20 - 1·10 ⁴	10 – 1.5·10 ⁴	10 - 3·10 ⁴	10 - 3·10 ⁴	10 - 3·10 ⁴
Active surface area of detector, cm ²	28	30	80	15	15	
Type of detector	Scintillation		Gas discharge-counter type			
		SI-8Б	Beta-5, 2 pcs	Beta-2	Beta-2 (beta), Beta-2M (gamma)	

Parameter	BDZB-96	BDPS-96	BDZB-99	BDZB-96b	BDZB-96s	BMKS-08s
Sensitivity, $s^{-1} \cdot \text{min} \cdot \text{cm}^2$	0,125		0,3	0,6	0,075	0,075
Dimensions, mm	$\varnothing 90 \times 230$		$\varnothing 88 \times 80$	210×150×50	$\varnothing 65 \times 65$	$\varnothing 80 \times 80$
Weight of detection block, kg	0,9	1,0	0,4	1,0	0,3	0,35

2.3.4

DETECTION BLOCK FOR GAMMA-RADIATION

Group of detection blocks consists of BDMG-96, BDKG-96, BDVG-96, BDPG-96, BDPG-96m, and also BMKS-08s, described in p. 2.3.3 and blocks BMKS-08 and BMKS-086, described in p. 2.3.5.

BDMG-96 – detection block for gamma-radiation with wide range of measurements. It has two measurements sub-ranges (Figure 17). It is supported features of automatically switch measurements sub-ranges in the process of measurements in according to the power registered radiation.

BMKS-08s – block, simultaneously the flux-density for beta-radiation and dose rate for gamma-radiation (Figure 16). Simultaneously measurements two types of radiation –gamma and beta. Automatic compensation gamma-background from measurements flux-density for beta-radiation. Characteristics of block in measurement beta-radiation are indicated in 2.3.3.

BDKG-96 – use in the process of gamma-ray logging in the well holes and shot holes in geological surveys (Figure 18). It is steady to water logging at the depth 100 meters at the time 24 hours.



Figure 17. Detection block BDMG-96



Figure 18. Detection block BDKG-96

Separately groups are «searching» blocks BDVG-96, BDPG-96 and BDPG-96m. Due to high sensitivity to registered gamma-radiation it is possible to create the effective search and detection modes (p.8.3) objects with high gamma-background.

BDVG-96 – more sensitivity detection block in group of searching blocks (Figure 19). It is used to execution the goal seeking the resources of gamma-radiation and research local plots of territory.

BDPG-96, BDPG-96m – light and commonly used detection blocks (Figure 20 and Figure 21). It is serve for execution the goal seeking the resources of gamma-radiation and research of local plots of territory.



Figure 19. Detection block BDVG-96



Figure 20. Detection block BDPG-96



Figure 21. Detection block BDPG-96m

The main technical characterises of detection block for these group are showed in Table 3 Table 4 .

Table 3. Main technical characterises of detection-block for gamma-radiation

Parameter	BDMG-96	BMKS-08s	BDKG-96
Range of measurements dose equivalent rate , Sv/h	$1 \cdot 10^{-7} - 10$	$1 \cdot 10^{-7} - 1 \cdot 10^{-3}$	$1 \cdot 10^{-7} - 1 \cdot 10^{-6}$
Range of measurement dose exposure rate, R/h			$5 \cdot 10^{-6} - 1 \cdot 10^{-2}$
Range of measurement of gamma-flux density, photon/s			$10 - 10^5$
Type of detector	Geiger-Mueller		Scintillation
	3 pcs.	2 pcs.	
Sensitivity, (cps/s)/(μSv/h)	4 (high sub-range) 0,004 (low sub-range)	5	
Sensitivity, (cps/s)/(μR/h)			2
Dimensions, mm	∅40×250	∅80×80	∅35×460
Weight of detection block, kg	0,5	0,35	3,0

Table 4. Main technical characteristics of detection block for gamma-radiation. Searching blocks

Parameter	BDVG-96	BDPG-96	BDPG-96m
Range measurements dose equivalent rate, Sv/h	$1 \cdot 10^{-7} - 1,5 \cdot 10^{-6}$	$1 \cdot 10^{-7} - 5 \cdot 10^{-5}$	$1 \cdot 10^{-7} - 1,5 \cdot 10^{-4}$
Type of detector	Scintillation		
Sensitivity, (pps/s)/(/ μ Sv/h)	3000	500	200
Dimensions, mm	$\varnothing 70 \times 350$	$50 \times 90 \times 480$	$\varnothing 35 \times 320$
Weight of detection block, kg	2,0	1,0	0,5

2.3.5

DETECTION BLOCKS OF X-RAY AND GAMMA-RADIATION

The detection blocks BMKS-08 и BMKS-08b consists in group X-ray and gamma-radiation.

BMKS-08 - detection block gamma- and X-ray radiation, fields of pulse photon radiation (among specific pulses) in the process of dosimetric control X-ray and console, acceleration of charged particles and etc. (Figure 22) Measurement range of detection block is divided into high and low sub-ranges. Switch of measurement sub-ranges is made in manual by means of mechanical plug on the detection block.



Figure 22. Detection block BMKS-08



Figure 23. Detection block BMKS-08b

BMKS-08b – improved variant BMKS-08 (Figure 23). In comparison with the precursor, BMKS-08b is more easy, in the construction missing the mechanical plug, support the automatic switch of measurement sub-ranges in the process of measurements.

Table 5. Main technical characteristics detection blocks of X-ray and gamma-radiation

Parameter	BMKS-08b	BMKS-08
Range of energy registered gamma- and X-ray radiation, MeV	0,015 – 10	
Range of measurements dose equivalent rate constant and pulses X-ray and gamma radiation, Sv/h	1·10 ⁻⁷ – 1	
Type of detector	Scintillation	
Sensitivity, (cpc/s)/(μSv/h), sensitivity sub-range	10	
Dimensions, mm	Ø62×192	Ø72×265
Weight of detection block, kg	0,9	1,8

2.3.6

DETECTION BLOCKS NEUTRON RADIATION

Group of blocks consists of detection blocks BDMN-96 and BDKN-96.



Figure 24. Detection block BDMN-96



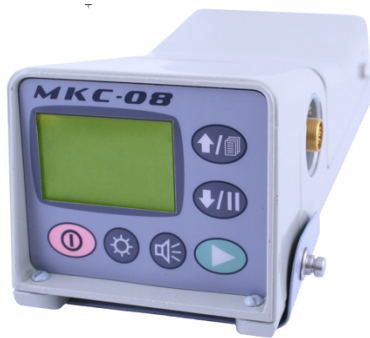
Figure 25. Detection block BDKN-96

BDMN-96 (Figure 24) and BDKN-96 (Figure 25) are used for dosimetric control of radiation environment in the condition of influence on the personal neutron radiation of broad energy spectrum source.

Table 6. Main technical characteristic of detection blocks BDMN-96 and BDKN-96

Parameter	BDMN-96	BDKN-96
Range of energy registered neutron radiation	0,025 eV – 10 MeV	0,025 э – 14 MeV
Range of measurements dose equivalent rate for neutron radiation, , Sv/h	$1 \cdot 10^{-7} - 0,1$	
Type detector	Scintillation	³ Not proportional counter
Dimensions, mm	Ø54×200 (without decelerator)	Ø100×300
Weight of detection block, kg	7,3	2,0

2.4 CONSOLES UIK-05, UIK-05-01, UIK-06



UIK-05/UIK-05-01



UIK-06

Figure 26. View of consoles UIK-05, UIK-06

Software and interface of consoles UIK-05, -05-01, -06 are not differed. There are some differences in hardware of consoles, protection levels and outlets of external alarm.

UIK-05 – a base model of console. The console is used for continuous service in the environment field. Power – from source point with four elements types C (PNN-02-02). The type of source point specifies in the order.

UIK-05-01 – is a same model UIK-05-01. But power – from source the source point with four accumulators' types AA (PNN-02-03).

UIK-06 – simplified model of console. It is convenient hold on for the arms. For convenient holding on the right or left hand in the control panel to use the function of rotate display on 90°, 180°, 270°. Power – from three elements of source point type AA. As opposed to control panel UIK-05 from UIK-06 is not supported with headphones.

MKS-08 with console UIK-05-01 can operate in the structure system «Atlant» [12] as independent monitoring point Table7 contains the characteristics the consoles UIK-05, UIK-05-01, UIK -06.



Figure 27. OSS-01

Table7. Characteristics the consoles UIK-05, -06, -07

Parameter	UIK-05	UIK-05-01	UIK-06
Power	Galvanic elements size type C, 4 pcs.	Accumulator, size type AA, 4 pcs.	Accumulator, size type AA, 3 pcs.

Parameter	UIK-05	UIK-05-01	UIK-06
Ability of connection detector GPS and operation with GIS	✓		✓
Availability signal type «Relay»			
Connect of headphones	✓		
Eternal sound and light alarm			

2.5 MODIFICATIOS OF DOSIMETER-RADIOMETER

For understanding of next text it needs to notice short about designations of variants for dosimeter-radiometer used in the operation manuals.

Dosimeter-radiometer has modifications, differs from the type of measurement console, and variants, differ the type of connection detection blocks. Designation of modifications for dosimeter-radiometer is shown in Table 8. Designation of variants for dosimeter-radiometer is shown in Table 9.

Table 8. Modifications of dosimeter-radiometer

Designation of modification	Type of consoles
MKS-08	UIK-05
MKS-08-01	UIK-05-01
MKS-08-02	UIK-06

Table 9. Modifications variants of dosimeter-radiometer MKS-08

Modification and version of dosimeter-radiometer	Designation of version of detection block	Measurand; kind of radiation and design feature
MKS-08 A	BDZA-96	FD alpha; basic modification S = 70 cm ²
MKS-08 Ab	BDZA-96b	FD alpha; «great area» S = 300 cm ²

Modification and version of dosimeter-radiometer	Designation of version of detection block	Measurand; kind of radiation and design feature
MKS-08 Am	BDZA-96m	FD alpha; «small area» S = 10 cm ²
MKS-08 As	BDZA-96s	FD alpha; «average area» S = 30 cm ²
MKS-08 At	BDZA-96t	FD alpha; «tube, SCD» S = 5 cm ²
MKS-08 B	BDZB-96	FD beta; « scintillator + PMT» S = 70 cm ²
MKS-08 Bb	BDZB-96b	FD beta; «great area» S = 100 cm ²
MKS-08 Bss	BDZB-96s	FD beta; «counter Geiger» S = 15 cm ²
MKS-08 B1	BDZB-99	FD beta; «counter Geiger » S = 30 cm ²
MKS-08 G	BMKS-08	DER, DE gamma + X-ray; shutter, pulses
MKS-08 Gm	BMKS-08b	DER, DE gamma + X-ray; without shutter, pls.
MKS-08 Gb	BMKS-08s	DER gamma, FD beta; counters S =15 cm ²
MKS-08 Nk	BDKN-96	DER, ED, FD neutron; counter «Geliu 4»
MKS-08 H	BDMN-96	DER, ED neutron; scintillator + PMT
MKS-08 M	BDMG-96	DER, ED gamma; counter Geiger
MKS-08 P	BDPG-96	DER, FD gamma; researching, NaJ(Tl) + PMT
MKS-08 Pm	BDPG-96m	DER, FD gamma; researching, NaJ(Tl) + PMT
MKS-08 K	BDKG-96	Flux, DER; gamma-ray logging
MKS-08 B	BDVG-96	DER, FD gamma; high sensitive, NaJ(Tl) +PMT
MKS-08 A, Gb, P, V	BDZA-96, BMKS-08s, BDPG-96, BDVG-96	See as above

3 USER INTERFACE CONSOLE MKS-08

3.1 WHAT COMES NEXT

General information and manual about quick start allow the user begin to operate with dosimeter-radiometer MKS-08

Information, as definite below, allows to examine complete the features of MKS-08, instruct realizing the optimal adjustment in according to proposed type and solved tasks, except from the routine operation works, and also understand its sound and graphic messages.

3.2 KEYBOARD, DESIGNATION OF BUTTONS

Console for dosimeter-radiometer has six multifunctional buttons as control elements:

- ⓘ button «On»;
- ▶ button «Select»;
- 🔊 button «Sound»;
- ⚙ button «Light»;
- ↓ / || button «Down / Pause»;
- ↑ / 🗑 button «Up / Next window».

Buttons with double designations in text can designate in any case depending on from described functions.

3.2.1 ACCEPTED SYMBOLS













Hereinafter in text it is used the next symbols of for operator actions with buttons of control panel:

- ⚙ – (single symbol of button) - press (interval ~0,5 s) indicated button;
- ⚙⚙ – (double symbol of button) – long press (~1,5 s) indicated button;
- ↑↑ – (two simplicity symbol through space) – consequent press some buttons;
- 🔊↑ – (two different symbol nearby) – simultaneously press (press and hold first, than – press second) indicated buttons;
- ▶↓↓ – (three symbols with space between second and third) – press and hold first, double step by step press second buttons.





3.2.2 VARIANTS OF USING KEYBOARD

Operation with keyboard anticipates the description below variants with using.







Variants of using keyboard regardless from current operation mode:

-  – switch on;
– exit in menu of upper level (analogue of keyboard button Esc on the keyboard of computer);
-  – switch off;
-  – activation help window;
-  – switch on (in time about 3-x seconds) / switch off lightening of display
-  – switch on the light of display (permanent);
-  – switch on / switch off of sound of registered events;
-  – increase value of sound divider;
-  – decrease value of sound divider;
-  – consequent switch of windows (operation modes);
-  – manual switch of low measurement sub-range (for dual-channels detection blocks BDMG-96 and BMKS-08b, BMKS-08);
-  – manual switch of low measurement sub-range (for dual-channels of detection blocks BDMG-96 and BMKS-08b, BMKS-08);
-  – allow of automatic switch range (for BDMG-96 and BMKS-08b).

Variants of use keyboard in mode of enter number value:

-  – increment (increase 1) number in defined sign space;
-  – decrement (decrease 1) number in defined sign space;
-  – switch to the next sign space;
-  – save, exit from the mode of number value.

Variants of use keyboard in the window of primary and secondary measurements:

-  – start new measurement;
-  – save measurement value, continue measurement;
-  – stop / continue measurement;
-  – set value of alarm threshold for the mode of primary measurement;
-  – start of measurement background;
-  – select measurement algorithm, setting algorithm parameter, additional options for setting of measurement process.

Variants of use keyboard in the window primary and secondary measurements by finished of measurement in case of setting parameter «Stop in N measurement».

Setting no zero value of parameter N «Stop after N measurement» together with the variation of state of flag «Autosave» change in the base and additional operation of console:

- set «Autosave» and N=0 process of measurement of non-stopped events and save of all results in archive;
- set «Autosave» and N=1 save the results in archive. At the display indication the result of measurement. Action **↑, ↓, ⓪, ►** start the process of measurement;
- set «Autosave» and N > 1 save in archive of every result N sequentially processing measurement. At the display indication the last saving in the archive value. Action **↑, ↓, ⓪, ►** start the process of new measurement;
- switch off «Autosave» and N=1 at the display indication the measurement value. Action **↓, ⓪, ↑** start the process of new measurement; action **►** save the measurement value in archive, start the process of new measurement.

Variants of using keyboard in the window of measurement dose:

- **⓪** – start of new measurement dose;
- **||** – start / continue of measurement dose. In time of pause the measurement process is not stopped;
- **🔊** – set the value of alarm threshold in the mode of measurement dose.

Variants of use keyboard in the window of measurement background:

- **⓪** – cancel of the value background. After that it will use the zero value of background;
- **►** – save of measurement value of background;
- **↓** – interrupt of current measurement background. In next calculation it will be used the early value of background;

Variants of use keyboard in the window Search and in window Detection:

- **►** – start of new measurement;
- **⓪** – start of new measurement.

Variants of use in window Threshold:

- **►** – start of new measurement;
- **⓪** – start of new measurement.
- **🔊** – set of value of threshold for the Threshold mode;

- ►► – start of measurement background in the Threshold mode.

Variants of use keyboard in the window Archive:

- ► – switch to the next record;
- ►► – switch to 10 records forward. Holding more time sets to switch continuous by 10 records of archive with gradual acceleration of indication;
- ↓ – switch to the previous record;
- ↓↓ – switch to 10 records back. Holding more time sets to continuous switch by 10 records of archive with gradual acceleration of indication;
- ☀↑ – switch to 100 records forward;
- ☀↓ – switch to 100 records back;
- 🔊 – switch to the service-menu of archive.

3.3 DISPLAY AND INFORMATION CONTENT

Display of console MKS-08 contents all information, which will be need to the operator in the measurement process and analyse of saving data.

In all, or almost indicated such information (Figure 28):

- dynamic logarithmic scale (1);
- data line with icons of current state for dosimeter-radiometer and providing measurement process – (2);
- current time – (7).

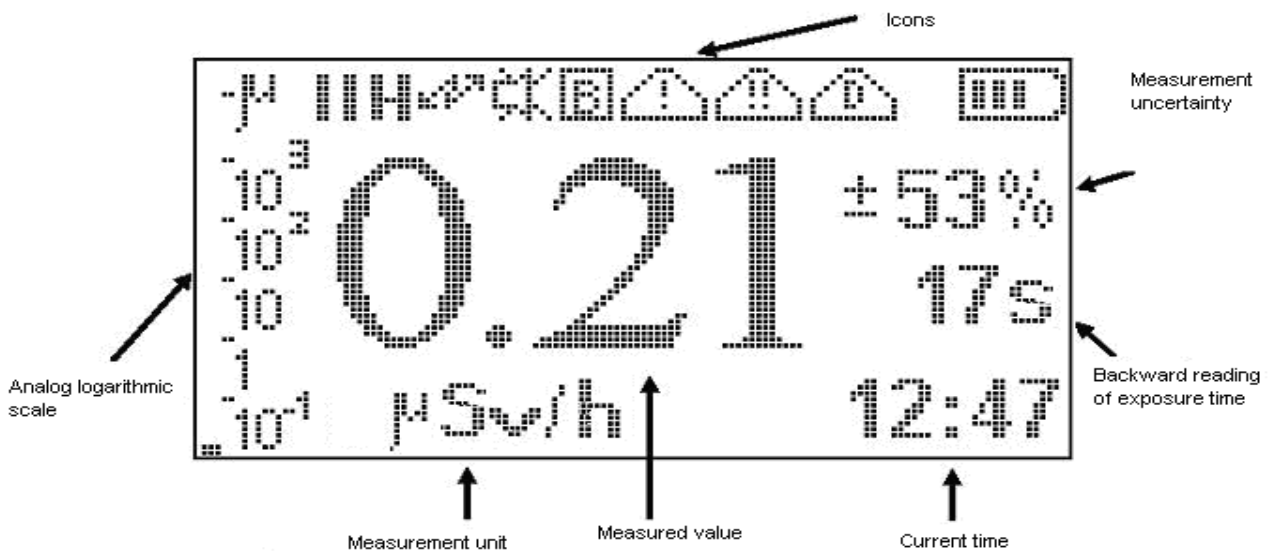


Figure 28. Window of base measurement

Window is shown the process of measurement (Figure 28), consists:

- measurement uncertainty – (3);
- measurement time – (4). Depending on type of measurement indication the time to the finished measurement time , or time, previous from the start of measurement;
- measurement unit with scale coefficients – (5);
- measurement result – (6).

3.3.1 STATUS BAR











Status bar with icons of events and state of dosimeter-radiometer is set in the upper part of display (Figure 29).








Figure 29. Icons of status bar




Status bar is displayed in all windows and mode of operation and can context of next icons:

- μ и m – icon coefficients (micro and milli) units of measurement for dynamic scale (p.3.3.2);
- α – sign of window for alpha measurement;
- β – sign of window for beta measurement;
- γ – sign of window for gamma measurement;
- \blacktriangleright – providing measurement;
- \parallel – pause in measurement (measurement continue, pause of update information on display), finished of measurement. After executed action \parallel the icon \blacktriangleright is replacement \parallel ;
- \sphericalangle – frequent external noise. Appeared icon is possible in time of operation with detection block BDZA-96t;
- \square – no providing of measurement background with the detection blocks, which such providing measurement for automatic compensation. In the process of measurement the background level icon is displayed in blink mode. After change of background the icon is not indication;

-  – switch off the audio feedback of process of registration for gamma quantum, neutron, alpha – and beta particles (hereinafter – particles). If the sound is off, so in this sign space is indicated one of the icons:  or , or , indicated on variants of regulation sound signals. More – see. p. 4.1;
-  – minimal sound divider. Sound signal is succeeded every registered particles. Regulation of sound signal can only in the direction of frequency reduction (rise of sound divider);
-  – maximal sound divider. One sound signal is corresponded of several dozen thousands particles. Regulation of sound signals is possible as in the direction of rise in frequency (lower of sound divider);
-  – regulation of frequency audible signal is possible as in the direction of lower, as rise in frequency;
-  – exceeded alarm threshold of primary measurement;
-  – exceed alarm threshold of second measurement;
-  – exceed alarm threshold dose.

Description of all icons is shown in the menu **Settings → Help → Display**.

Icons state () and regulation of sound (, , ) are displayed in every window of main mode operation. Permission or prohibition of process registration particles of sound signals is executed action .

Icons ,  or  are indicted of correspond threshold, indicated on the display constantly to the low of value of measurement parameter below set level.

Control of radiation level depends of set threshold is provided constantly and independent from displayed window now (mode of operation). Disconnect of control is provided of set null value of correspondent threshold.

Threshold of primary measurement is compared with values, estimates simultaneously by two algorism Tracking (p.8.1) and algorithm of mode for primary measurement.

Threshold of secondary measurement compares with values, estimates by choose algorithm of primary measurement.

3.3.2

DYNAMIC SCALE

Dynamic scale is disposed in the left part of display and indicated of value, estimated algorithm Tracking (p. 8.1, Figure 30).



Units of measurement for dynamic scale correspond units of measurement chosen in the mode of primary measurement. For detection block of gamma-radiation the dynamic scale is detected on the two sub-ranges of displayed information: below and upper sub-range. Below sub-range is displayed of measured values in the range $0,1 - 1 \cdot 10^5 \mu\text{Sv/h}$ (Figure 30), upper sub-range - $0,1 - 1 \cdot 10^5 \text{mSv/h}$. Switching of measurement sub-range for dynamic scale is provided automatic. Operation in below sub-range is designated icon  (micro) in status bar of display, in the upper sub-range– icon  (milli).



Figure 30. Type of dynamic scale

Sensitivity of dynamic scale is proportional of sensitivity for connected detection block and power of registered radiation.

Displayed scale can be disconnected in menu **Settings** → **Config** → **Dynamic scale**. On the Figure 31 is shown the console MKS-08, displayed the window of main measurement with unplug dynamic scale.



Figure 31. Dynamic scale unplug

4 CONTROL MEANS OF SOUND ALARM



















The several alarm modes are used in console MKS-08:

- audio feedback of process registration particles;
- sound of threshold alarm;
- sound messages of control panel.





Listening any of sounds or messages can be in the control panel **Settings → Help → Sound**.

4.1 AUDIO FEEDBACK OF PROCESS REGISTRATION PARTICLES

The frequency of signals for audio feedback of registered particles regulates with keyboard console:

-  – unplug / plug audio feedback. While prohibition of audio feedback in status bar instead one of icons ,  or  displayed icon . Repeated action , or operation with divider (  or  ) permit of audio feedback. Icon  is changed from one ,  or .
-   – decrease frequency of sound signals providing one signal on twice more the quantity of registered particles
-   – increase frequency of sound signals providing one signal on the twice less the quantity of registered particles.

The regulation is provided in the range from one registered particles to several dozen thousands on the one sound signal. While in status bar it is shown one of the icon:




-  – unplug audio feedback;
-  – audio feedback of every registered particles. It is possible to regulate only in decrease;
-  – one audio feedback on the several dozen of registered pulses. It is possible to regulate only in increase;
-  – one audio feedback on the several registered particles. It is possible to regulate frequency, as in increase so in decrease frequency.

4.2 AUDIO THRESHOLD ALARM

After switched on the console determinates the type of connected detection block and reading data from non-volatile memory which need for operation with connection block. Reading data from non-volatile memory is included the threshold, set by user for operation with this detection block.



In factory settings all value of threshold for detection block is equalled zero.

Operation MKS-08 is mean in particular providing of constant monitoring of level radiation according set threshold. The threshold control is provided constantly and even in the case, when the window of according unit of measurement is excluded from the group window of operation menu. By the means of saving facility of audio alert operator about upper of set threshold and display of according icons in the status bar of display – ,  or .

Unplug of threshold control is provided by set threshold is zero.


Available three types of thresholds are controlled by means of threshold alarm (except threshold of Threshold mode – see p.8.2):

- threshold for base units of measurement;
- alarm threshold according on the dose (available only in the detection blocks, which provide the possibility of measurement dose);
- alarm threshold according to the additional unit of measurement (available only in dual-channels detection block, measured two types of measurement (p. 7.4).





It is available three thresholds according base measurement value:

- alarm threshold;
- preliminary threshold;
- bottom threshold.

Set of value of threshold for connected detection block is allowed with keyboard of console:

- from menu **Settings** → **Thresholds** (in this mode is allowed to set of value all thresholds);
- from window of according mode of measurement (action  in window of primary measurement, additional measurement and in the window of measurement dose is provided by switch to menu Threshold. This menu is allowed to set the threshold according of measurement value).

The results of comparison units of measurement with previous and bottom threshold on the display of console is not showed. These results are accessible while reading of console register status [13] and used in operation of information system and use while operation in information system (PC with program TETRA_Checker, master of information system ...). See. p.6.10.

In case of exceeded one of alarm threshold (alarm threshold of primary measurement, secondary measurement, dose) the console is generated of alarm signal – periodic sound signal and correspondent icons in information bar of display – , , or . The alarm signals are accompanied of operation MKS-08 up to the moment of decrease of level for control radiation type below set threshold. Generated of audible alarm signal will be stopped by action . The icon of exceeded alarm is not disappeared. Generated of audible alarm signal can be resumption in case of repetitive exceeded (decrease and repeat exceeded) the level of control radiation type or initiation of alarm event by other value.









4.3 SOUND MESSAGES OF CONTROL PANEL

The console is accompanied the most important events by various sound messages:

- exceeded alarm threshold of primary measurement;
- exceeded alarm threshold of secondary measurement;
- exceeded alarm threshold of dose;
- confirm manual restart of measurement;
- confirm action of saving measurand in archive;
- autosave of measurand in archive;
- exceeded threshold in mode Search;
- exceeded threshold in mode Detection;
- automatic switch of detection block on low sub-range measurement (for detection block BDMG-96 and BMKS-08b);
- automatic switch of detection block on high sub-range measurement (for detecting block BDMG-96 and BMKS-08b).

and other messages. Having familiarity with all set of sound messages and hear it in console can make in menu **Settings → Help → Sound**.



The full deactivated of sound is executed by action  turn off the sound as accompanied registered pulses by detection block, so the generated of console sound messages. It can be saved the generated of sound messages, at the same time turn off the generation of sound accompanied registered pulses. Press and holding button  and . In this case icon in the information line  is changed  and after a time  Release button  and .

5 CONNECTION OF AUXILIARY DEVICES

Connection of auxiliary devices to MKS-08, consisting MKS-08 in various measurement systems by means of plug-and-socket RS-7 in Annex 1 Dosimeter-radiometer MKS-08. Connection layout.

5.1 GLOBAL POSITIONING SYSTEM RECEIVER



Figure 32. Receiver GPS with console MKS-08

It is more frequently used of external device, connected to the console of dosimeter-radiometer MKS-08 – global positioning system receiver (receiver GPS). MKS-08 with receiver GPS often uses for radiation monitoring and radiation search.






5.1.1 CONNECTION OF RECEIVER GPS

Receiver GPS is connected to MKS-08 simultaneously with any detection block. In time of switch on MKS-08 is determinate of availability receiver GPS. After that, all saved data of measurement in archive is automatically added the geographical coordinates.

5.1.2 USED TYPES OF RECEIVER GPS

At present time, as receivers GPS are supplied the personal receivers Garmin [14]. MKS-08 is compatible with following models: Garmin eTrex Legend, Garmin GPS 60, Garmin GPS 76, Garmin GPSMAP 76Cx, Garmin GPSMAP 76CSx.

Table 10. Comparative characteristic of navigator GPS GARMIN, compatible with MKS-08 (UIK-05, UIK-06)

Model					
	eTrex Legend	GPS 60	GPS 60CSx	GPS 76	GPS 76CSx
Guiding price, USD	210	220	480	220	480
Basic accuracy, m	<15				
Accuracy WAAS, m	<3				
Type of detector	standard	standard	high sensitivity	standard	high sensitivity
Case	waterproof by standard IEC 529 IPX7	firm, full protected, waterproof by standard IEC 60529 IPX7 (with standing submergence on the depth 1 meter during 30 minutes)		full protected, from solid plastic; waterproof by standard IEC 529 IPX7	
Operation temperature range	from minus 15 to +70°C				

5.1.3

CONNECTION AND OPERATION WITH RECEIVER GPS

For information reception from receiver GPS is used interface RS-232 and software protocol NMEA 0183, version not below 2.0. In case of combined used dosimeter-radiometer with receiver GPS the saved information about the measurement results is added about geographical coordinates of point on locality, which has been provided measurements.

«Adapter GPS-UIK» (Annex 1. Dosimeter-radiometer MKS-08.) is used for connection of receiver GPS with console MKS-08. Defined of connected receiver GPS is provided by console in the first seconds of

switching on. If the receiver GPS is connected it should be appeared the message «Connected GPS» following for the message about the type of connected detecting device during two seconds.

The availability of signal from connected receiver is controlled in the process of all following operation and in case of disconnected, the message «Processing GPS» is appeared. To resume operation MKS-08 with receiver GPS is possible after removal of reasons for disappeared signal and repeat switch on MKS-08.

6 USE FEATURES OF DATA EXCHANGE

Ability of information exchange MKS-08 with external devices (personal computers, information systems) is provided by means of using the hardware interface in the console RS-232 and software level – information exchange protocol DiBUS [15].

Volume and abilities of exchange are determinate by the set of information registers depending of variants MKS-08 [13].

«On the hardware level» exists the set of devices, providing of functions for adapting hardware in connection MKS-08 to the external devices:

- cable-adapter PI-03 (protocol converter USB-UART). It is used for connection MKS-08 to the personal computer by means of USB-port (Figure 33). Maximum length of cable-adapter (without use of additional hardware) – 2 meters;



Figure 33. Cable-adapter PI-03

- cable-adapter for connection GPS. It is provided ability of connection receiver GPS to the console MKS-08 (Figure 34);



Figure 34. Cable-adapter for connection GPS

- protocol converter PI-02 (Figure 35) in set «cable-adapter for connection GPS». It is provided of interfacing the output signal of dosimeter-radiometer with line of device data «Atlant» (RS-232 in RS-422 / RS-485). Maximum distance of data transmission– 1200 meters;



Figure 35. Protocol converter PI-02

- line adapter AMD-01 (Figure 36). It is provided of interfacing the output signal of dosimeter-radiometer with line of device data «Atlant» (RS-232 in RS-422 / RS-485). The adapter AMD-01, as opposed to other protocol converters, is provided of supply MKS-08. Maximum distance of data transmission – 1200 meters.



Figure 36. Console UIK-05 with line adapter AMD-01

6.1 OPEARATION WITH PERSONAL COMPUTER

The great quantity of abilities is given while the joint use MKS-08 with personal computers.

Figure 37 is shown the type of modification (PC + PI-03 + MKS-08 with one of detection block), often used with the aim of provided settings, calibration, reading of measurement archive, export of saved data in various GIS system.



Figure 37. MKS-08 with adapter for transfer data on PC or laptop

The steps of connection dosimeter-radiometer to PC:

- connect console and detection block to the personal computer (connector USB) by means of cable-adaptor PI-03, which is part of supply set;
- install, if it is necessary, driver USB (supply with CD, which is part of supply set for dosimeter-radiometer, or on [15]). After installed the driver, it is created virtual COM-port in the operation system by means of providing the data exchange console with PC. The number which is connected COM-port console can be known in Control board/System/Hardware/Hardware manager/Ports (COM and LPT port /Serial port (COM XX). Here XX – serial port, lines with connected to plug-and-socket by USB console.

Dosimeter-radiometer MKS-08 is supplied (in presence of order) with the set of software:

- program TETRA_Checker;
- program TETRA_Reporter;
- program TETRA_Tester;
- USB-driver.

MKS-08 operates under control software «Atlant-Monitor» and «Atlant-Protocol» in the set of information system.

6.2 OPERATION WITH PROGRAM TETRA_CHECKER

TETRA_Checker – multi-purpose program, allow of configure, adjust, correct parameters of various measuring devices (hereinafter – Device). It is including MKS-08.

Program TETRA_Checker is supplied free charge and available for downloading and updating version from [16]. The developer is supported compatibility of program versions. It is below of short description features TETRA_Checker.



The console MKS-08 can save the settings – by one on every possible modification – console and detection block. As a result, setting of particular modification DKS should be made with connected detection block!



The description is shown for program TETRA_Checker version 2.1

By means of Program TETRA_Checker is possible:

- set and correction of metrological parameters of Device;
- selection of necessary measurement algorithm;
- setting of Device;
- receive of supplemental information about Device;
- set of Device net address in information system.

Figure 38 is represented the view of main window TETRA_Checker, display of information from connected MKS-08 with detecting block BDMG-96. The main window of program contains several panels:

- information panel;
- panel «Measuring data»;
- panel «Device status»;
- panel «Device parameters».

The screenshot shows the main window of the TETRA_Checker program. At the top, the current measurement is displayed as **0.139 μ (Sv/h)**. Below this, there are three main panels:

Measuring data panel contains a table with the following data:

#	Measurand	Unit	Result	Time, s	Measurement uncert...
1	Dose rate	Sv/h	1.39e-007	200	16
2	Technology	—	1.44e+006	200	16
3	Dose	Sv	1.14e-007	2983	0
4	Average count rate H55	pps	0.687	2982	6
5	Average count rate L55	pps	0.00537	2982	50

Device status panel shows several status indicators, all of which are currently unchecked:

- Detecting block broken
- H55 failure
- L55 failure
- EEPROM error
- AT exceeded
- PT exceeded
- Below BT
- Device not ready
- Parameters changed

Device parameters panel is divided into two sections:

Static parameters:

Parameter	Parameter point
Device address	5.255.254
Device	BDMG-200
Device code	16
Firmware version	3.1.135.20080912
Configuration date	12.07.2011
Assembly date	25.06.2011
Device date/time	No information
Volume level	No information
Current device language	English
Factory number	No information

Dynamic parameters:

New value	Parameter	Parameter point
2.5e-007	Alarm threshold (AT)	2.5e-007
0	Preliminary threshold (PT)	0
0	Bottom threshold (BT)	0
0	Algorithm (0- Following, 1-Sliding)	0
1	Interval quantity (Sliding): 1-60	1
1	Interval time (Sliding), s:1-65535	1
2e-007	Sensitivity index: H55	2e-007
0	Dead time H55, μ s	0
0	K1 H55	0
0	K2 H55	0
0	K3 H55	0
0.0002	Sensitivity index: L55	0.0002
0	Dead time L55, μ s	0
0	K1 L55	0
0	K2 L55	0
0	K3 L55	0
3	Current subrange(0-A, 1-H, 2-L, 3-AH, 4-AL)	3
0	Self background, Sv/h	0
521	Running hours, h	521
6.89e-005	DB accumulated doze, Sv	6.89e-005

Figure 38. Main window of program TETRA_Checker

6.2.1

INFORMATION PANEL

Information panel is located in the upper part of the program window to the left from the button "Parameters..."

Information panel displays the following:

- in the process of preparing the Device to conduct measurements - messages about the process of preparing the Device to start operation mode;
- in the process of measurement - the result of measurement is set up by default [13];

- in the case of exchange failure between the Device and computer - information about operating errors.

In the various situations of exchange failure between the Device and computer can be display such messages on the information panel:

- **Serial port error.** It may be selected the nonexistent port, or port is busy by other program. Possible actions – select of serial port; port is free by closed using program. Possible actions - it is selected the correct port, or set free port by means of program;
- **No answer.** Message is created in case of unplug Device, or matching device (transducer RS-232 in RS-485/RS-422) is selected the incorrect mode of generation;
- **Read error.** It may be answered the several Device simultaneously by in broadcast mode. It need to switch in the reading mode of certain net address of Device, or operation in reading mode by broadcast mode, unplug all Devices from information line except of necessary.



It may be failures of program operation TETRA_Checker in case of interoperation with network clients (ICQ, Skype, GTalk, Jabber). If it is appeared the failures it is recommended to close all listed programs and restart of program.

BUTTON «PARAMETERS...»

Button «Parameters...» is situated in the upper right corner of the main window of Program. It is appeared the following window (Figure 39) after pushing the button:

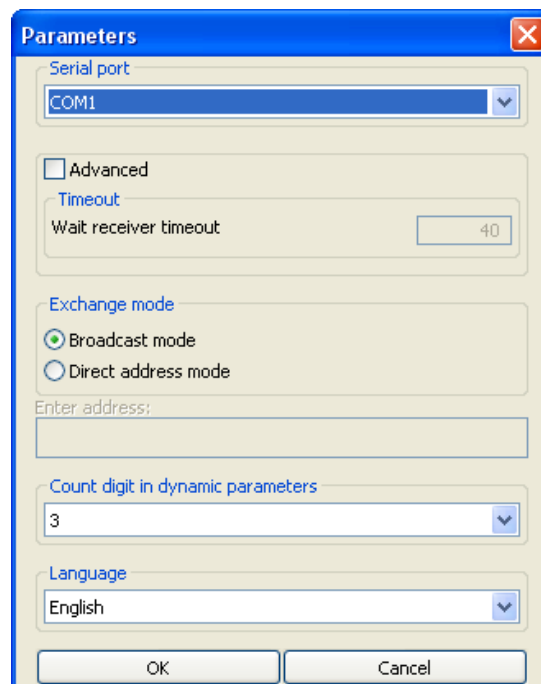


Figure 39. Menu of button «Parameters»

- window «Serial port» – availability of choosing the serial port for connection to the Device;
- by setting tab «Advanced» is available to set wait receiver timeout from Device (units of measurement – milliseconds). The increase of waiting time above specified of protocol standard

DiBUS [15] might be required in the cases of remote configuration of devices (radio modems, GSM- and GPRS – modems...). The value of timeout is set depending of particular conditions, and can be duration in 1000 ms and more;

- window «Exchange mode» is choosing the treatment to Device – broadcast mode (255.255.255), or direct address mode. Operation with Device by direct address mode need for its setting in the composition of system. In the set of request by direct address it should indicate it in window «Enter address»;
- window «Count digit in dynamic parameters» is ability to set the quantity of displayed symbols after decimal point;
- in window «Language» you can choose the interface language of Program. The current version is supported of three languages – English, Russian, Ukrainian. The language of Device interface is chosen in Device directly by means of correction of corresponding dynamical parameter.



It is simultaneously choose of interface language for program TETRA_Checker that it possible set for Device interface. The dilatation of language interfaces TETRA_Checker and Device is provided by customer order.

6.2.2

PANEL «MEASURING DATA»

Panel "Measuring data" is usually indicated several lines – measurand, each of them contains:

- measurand;
- units of measurement;
- current measurement results;
- measurement time;
- measurement uncertainty.

The quantity of measurand, displayed in window «Measuring data», depending from the type of connected Device, in case of MKS-08 – from its configuration (type of connected console to the detection block).

«Measuring data» contains the following buttons in the upper part of panel:

- **"Set current algorithm..."** – is used for choose of measurand in Device [13]. The result of chosen measurand will be indicated on the information panel. The correspond line is eliminated by colour on the panel «Measuring data»;
- **"Restart measures...F5"** – is used for start of new measurement circle for definite measurand;
- **"Restart all F4"** – is used for start of new measurement circle of all measurand.

6.2.3

PANEL «DEVICE STATUS»

Panel "Device status" is displayed information about the current state of Device and other information, determinates by type of connected Device:

- readiness of Device to conduct measurement;
- availability of various defaults in the Device operation;
- results of comparison between the value of measurand with setting threshold, etc.

6.2.4

PANEL «DEVICE PARAMETERS»

Panel "Device parameters" is displayed information about static and dynamic parameters for Device. The static parameters are not participated in the measurement process and calculation, and are basically shown the descriptive information about connected Device and firmware version. The dynamic parameters are determinate of measurement Device features, variants of functioning. It is allowed to provide setting it.

STATIC PARAMETERS

Static parameters are fixed the set of parameters, uniquely characterised the type of connected Device:

- Device address;
- Device code;
- Device;
- Firmware version;
- Configuration date;
- Assembly date;
- Volume level;
- Current device language.

Parameter "Configuration date" is an alternating quantity. The value of parameter is chosen automatically after it has been executed to correct the dynamical parameter (by pressing button "Set parameters") and is always shown the date of last changes.

Parameter "Device address" is shown the Device address. It is available of correction Device address in case of operation in broadcast mode.

DYNAMIC PARAMETERS

Every Device has proper set of dynamical parameters. The part of parameters can take value 0 or 1. The part of parameters can take value in the form of decimal fractions with multipliers, for example, 2.3e-003 (0,0023). The part of parameters is available only for reading, for example, parameter "Operating time".

Correction of parameter values is provided following:

- double click in line of parameter is activated the edit mode of value;
- new value of parameter is entered in column "New value";
- by pressed "Enter", or click in other line to finish of enter new value;
- in case of necessary, the value of other parameter is similarly corrected;
- by pressed F2, or clicked the button "Set parameters F2" the new value of dynamical parameters is saved in the memory Device;
- correction of saving parameters is controlled in column "Parameter point".



As the data separator of integer and fractional number is usually used "." (decimal point). However operating system can be set of using the symbol "," (comma).

The list of parameters and range of values are shown in operation manuals for every particular Device.

BUTTONS OF PANEL "DEVICE PARAMETERS"

In the upper part of panel is located the following buttons:

The following functional buttons are located in the upper part of panel «Device parameters»:

- **"Device date/time..."**. The button is active for Device, supported the operation of internal clock;
- **"Choose device language..."**. The button is active for Device, which used the multilingual support. It is allowed to set the current language in Device. It is changed the language in the measurand, status bits, and parameters in case of change language. The language of program interface TETRA_Checker is set separately in menu of button «Parameters...»;
- **"Set volume level..."**. The button is active for Devices, having regulated sound hardware. It is allowed to regulate the volume of alarm sound and, in case of necessary, to control it;
- **"Set device address..."**. Operation mode «Broadcast mode» is allowed to set the network address of Device. Setting address is provided by pressed the button "Set device address ..." when the window opens, input the new address – three groups of figures by three figures in every group, separated by dot (see description of DiBUS [15]). The range of values in every group is from 002 to 254. It should be clicked "Ok". The new address is saved in nonvolatile Device memory. At the same time parameter "Configuration date" is automatically assigned the value of current date;



Attention! The device address is used while Device operation in the composition of system. When you set Device address, you should keep attention on the address uniqueness for all parts of system!

- **"Get parameters F3"**. Pressing button "F3" is provided of updating the parameters on the panel "Device parameters";
- **"Set parameters F2"**. Pressing button "F2" is provided of saving new values of dynamical parameters in the Device memory. At the same time parameter "Configuration date" is automatically assigned the value of current date.

6.3 OPERATION WITH PROGRAM TETRA_REPORTER

Program TETRA Reporter is intended for reading data from archives of various devices (including archive MKS-08) and generated file-reports on its base in necessary form of data (RTF, HTML, TXT, CSV). Program TETRA_Reporter can also used for clean of non-volatile memory in Device archive.

Program TETRA_Reporter is free charge.



The description is shown for program TETRA_Reporter version 1.8

Using of Program is required for:

- install TETRA_Reporter on the PC. Launch program (Figure 40); indicate the line of serial port in line «Serial port», which Device is connected;

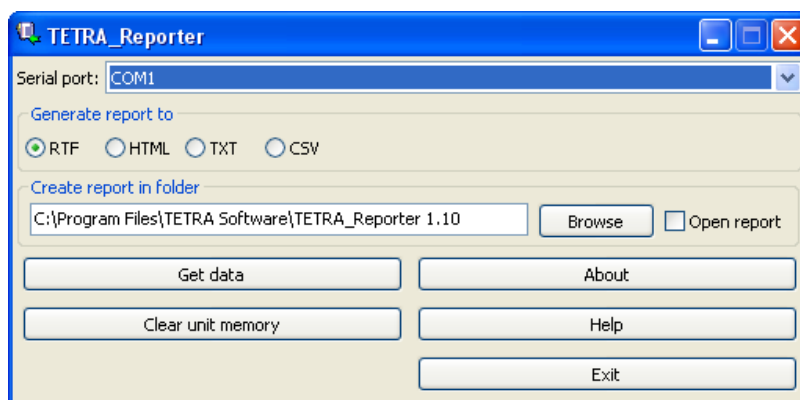


Figure 40. Main window of program TETRA_Reporter

- select necessary form of data for generation report in window «Generate report in folder»;
- click button «Browse», select folder for saving report;
- click in window «Open report», if it need view report after creation;
- click on button «Get data»;
- after finished of reading and forming report, if it is necessary, you can clear archive by click button «Clear unit memory».

The form of report in the format HTML is shown below.

Report from 23.05.2008 15:48:47 - TETRA_Reporter								
No	Type DB	Val.	Meas.unit	Mistake,%	Date	Longitude	Latitude	Height
000	MKS-08A	0.00e-00	ppm·cm ⁻²	99	11/02/08 17:26	33 30.515E	48 20.474N	60.2
000	MKS-08A	1.76e-07	Sv/h	02	11/02/08 17:36	33 30.515E	48 20.473N	60.1
000	MKS-08A	1.77e-07	Sv/h	02	11/02/08 17:38	33 30.515E	48 20.473N	60.1
...

6.4 OPERATION WITH PROGRAM TETRA_TESTER

Program TETRA_Tester is intended for:

- automation of setting, calibration, verification and checkout processes;
- providing of experimental and research operation;
- automation process of registration indications;
- statistical process of measuring data, incoming from test Device;
- automation of calculation for metrological characteristic.

Program is provided for:

- receiving, processing, indication of measurement information from Device by means of computer;
- providing of measurement set with preliminary set of value for dynamical parameters of Device;
- restoration of values for dynamical parameters of Device after providing the set of measurements;
- calculations according to set (or sets) of measurements results ;
- automation correction of values for dynamical parameters of Device according to results of providing calculations;
- creation and use of scripts for measurements;
- saving data of provided measurements in various formats.



The description is shown for program TETRA_Tester version 2.1.

Program TETRA_Tester is supplied free charge and available for download and update of version from [16].

Interaction of Program and Device is based on receiving and processing of data register 0x09 «Instantaneous value» by Program

Register «Instantaneous value» of selected measurand

Data block of burst contains from set of bytes. The structure of data block is shown on Figure 2

Idx	InsMV	InsPSS	UniqSec
-----	-------	--------	---------

Figure 2. Structure of data block for register «Instantaneous value»

Designation:

Idx – register index = 0x09, 1 byte, data type BYTE (1);

InsMV – measurement result of selected measurand, 4 bytes, data type Single (25) (see description of register «Measurand choice»), calculated by data UniqSec second;

InsPSS – pulses quantity, received for UniqSec second, 4 bytes, data type Single (25);

UniqSec – uniqueness identifier (change one per second), 4 bytes, data type DWORD (11)

Device reads of information from detecting block in every second. Received result of monitoring N without preliminary processing is packed in field register InsPSS and used by Device for calculation of measurand value as following.

Every second Device reads information from detection block. Received result of observation N without preliminary processing is packed in field InsPSS of register and used Device for calculation value of measurand as following

$$\boxed{}, \text{ where}$$

- P – measurement results of Device in correspondent units of measurement;
- K – sensitivity index of detection block;
- N – number of registered pulses;
- Θ – value «dead» time, s.

Value P is packed in field register InsMV «Instantaneous value».



Measurand in Device can be several. For example, MKS-08GB (console with detecting block BMKS-08s) has: «DER» for gamma-radiation, «Flux density» for beta-radiation, «Dose» for gamma-radiation etc. One from this measurand is selected (see description of register 0x15 «Measurand choice») as measurand by default.

Hereby, register status 0x09 «Instantaneous value» is correspondent for the any current time of measurement results of Device, received while i-th monitoring of measurement from n monitoring.

Register 0x09 «Instantaneous value» contains the result of i-th monitoring. The content of registers is updated in every second. The average value of several consequence monitoring in set interval time is formed the one measurement. Several of consequent measurements are formed the set of measurements.

Before the set of measurements in program is provided, having created record with following data name for set of measurements:

- «instantaneous value» of measurand (calculation value of measurand, accepted for «true»);
- quantity of measurements in set;
- time of one measurement (quantity of monitoring in series).

Record about set of measurements can be added the indications:

- execute the preliminary setting of values for dynamical parameters of Device (see «Dynamical parameters series»);
- restore the preliminary values of dynamical parameters for Device after finished the set of measurements;
- make calculations which is based on data of providing measurements, calculate the new values of dynamical parameters and save its in memory Device.

Creation of records about set of measurements can be saved in the form of single script.

6.4.3

MAIN WINDOW OF PROGRAM

The main window of program is shown on Figure 41 and consisted from main menu, located left upper part, and window «Set of measurements», «Point status», «Measures», «Calculate values».

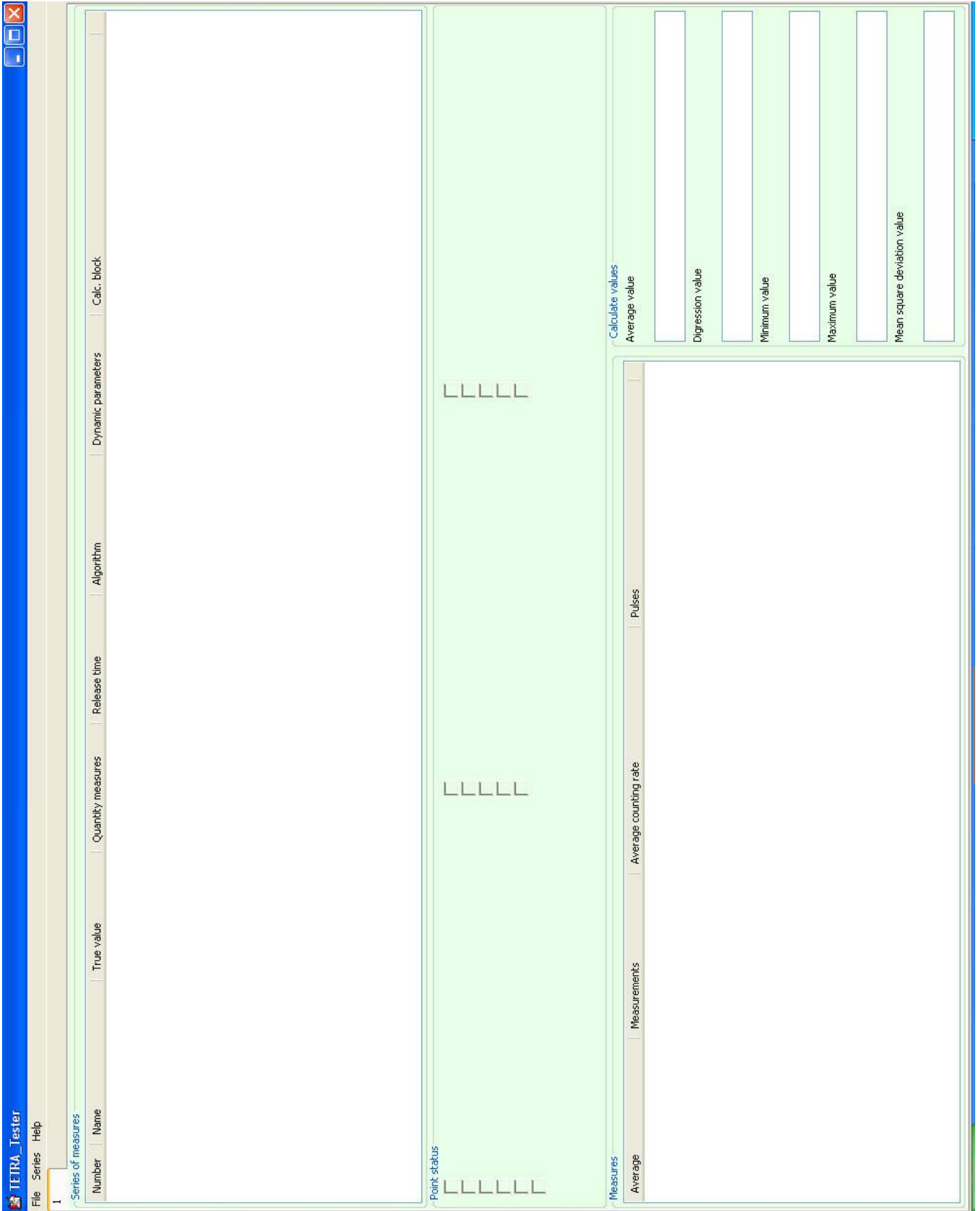


Figure 41. Main window of program TETRA_Tester

WINDOW «SERIES OF MEASURES»

Window «Series of measures» contains records about series of measures and its parameters. The records can be created manual or load with script file.

Window «Series of measures» can be presented in several tags. Every tag can be contained the records about series of measures.

WINDOW «POINT STATUS»

Window «Point status» is displayed the status messages of Device while providing of series of measures.

WINDOW «MEASURES»

Window «Measures» is displayed the results of measurement series, selected in window «Measures».

WINDOW «CALCULATE VALUES»

Window «Calculate values» is displayed for selected series of measures from n measurement in window «Calculate values»:

- minimum value;
- maximum value;
- simple average value (\bar{x});
- mean square deviation (σ);
- fractional uncertainty ($\frac{\sigma}{\bar{x}}$)

The mean square deviation value is calculated as following:

$$\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2}$$

The fractional uncertainty is calculated as following:

$$\frac{\sigma}{\bar{x}}$$

where X_0 – true value of measurand.

It is possible to providing the additional calculations and displays its results in case of connection the calculation block to the series of measure.

Main menu of program TETRA_Tester contains from points:

- File;
- Series;
- Help.

MENU «FILE»

Menu «File» contains from points and according «hot keys», displayed on Figure 42.

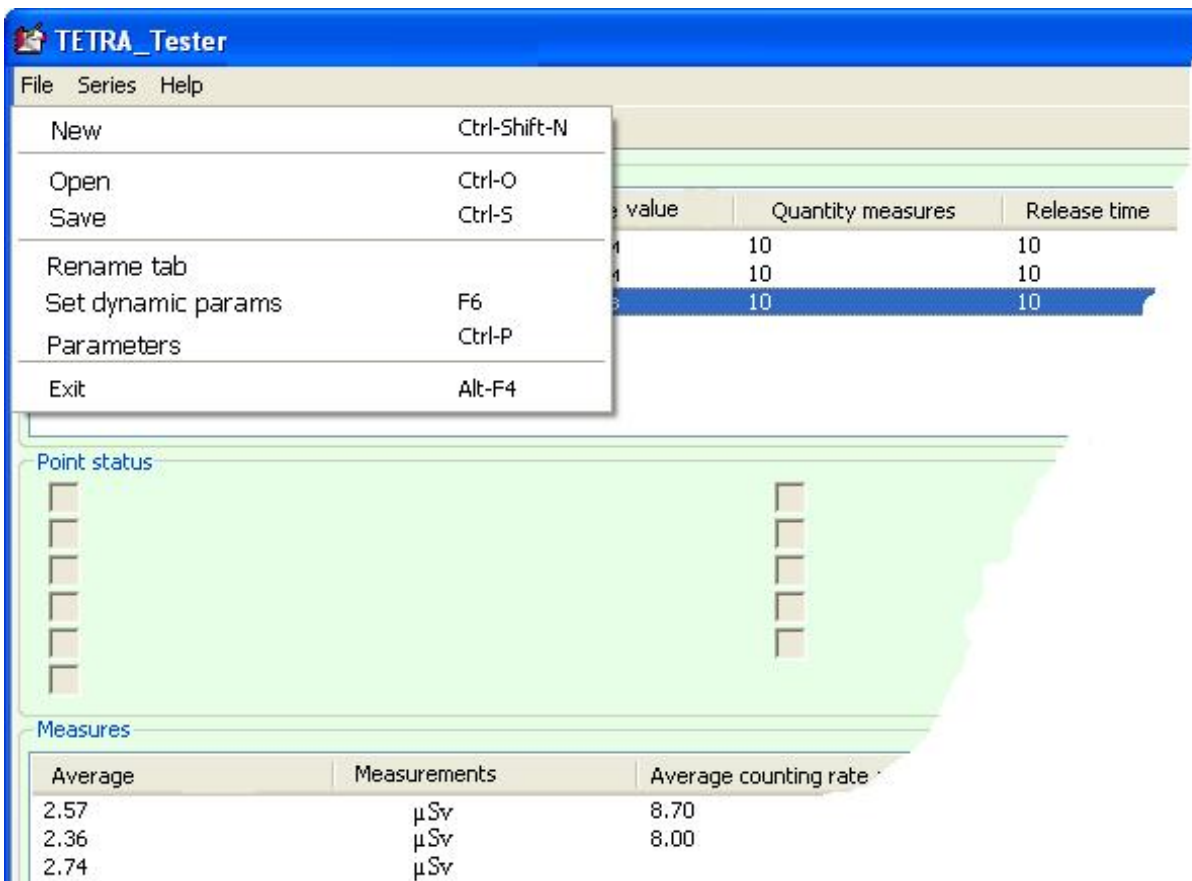


Figure 42. Menu "File"

NEW

Create new tag. It can be used, for example, serial numbers Device as the names of tabs. Window «Series of measures» (Figure 43) contains two tabs, named «#100» and «#101».



Using of several tabs can be explained in the example. While executed calibration of set it creates the appropriation quantity of tags with names, contain their serial numbers. The scripts of calibration Device is loaded in every tag.

OPEN

It is allowed to open early saved file with results of provided set of measurements, or file script.

SAVE

It is allowed to save records about measurement results, received while providing scripts, convert measurements results in various formats.

Execution of actions is determinate with select in line «File type» (Figure 43):

- **Tab**. It is allowed to save the measurement series for all tabs;
- **File**. It is allowed to save the data of measurement series in active tab;
- **Script**. It is allowed to save records about measurement series;
- **For Excel**. It is allowed to save the results of provided series of measures in format .xml;
- **For TETRA_Tuner**. It is allowed to save results in format TETRA_Tuner.

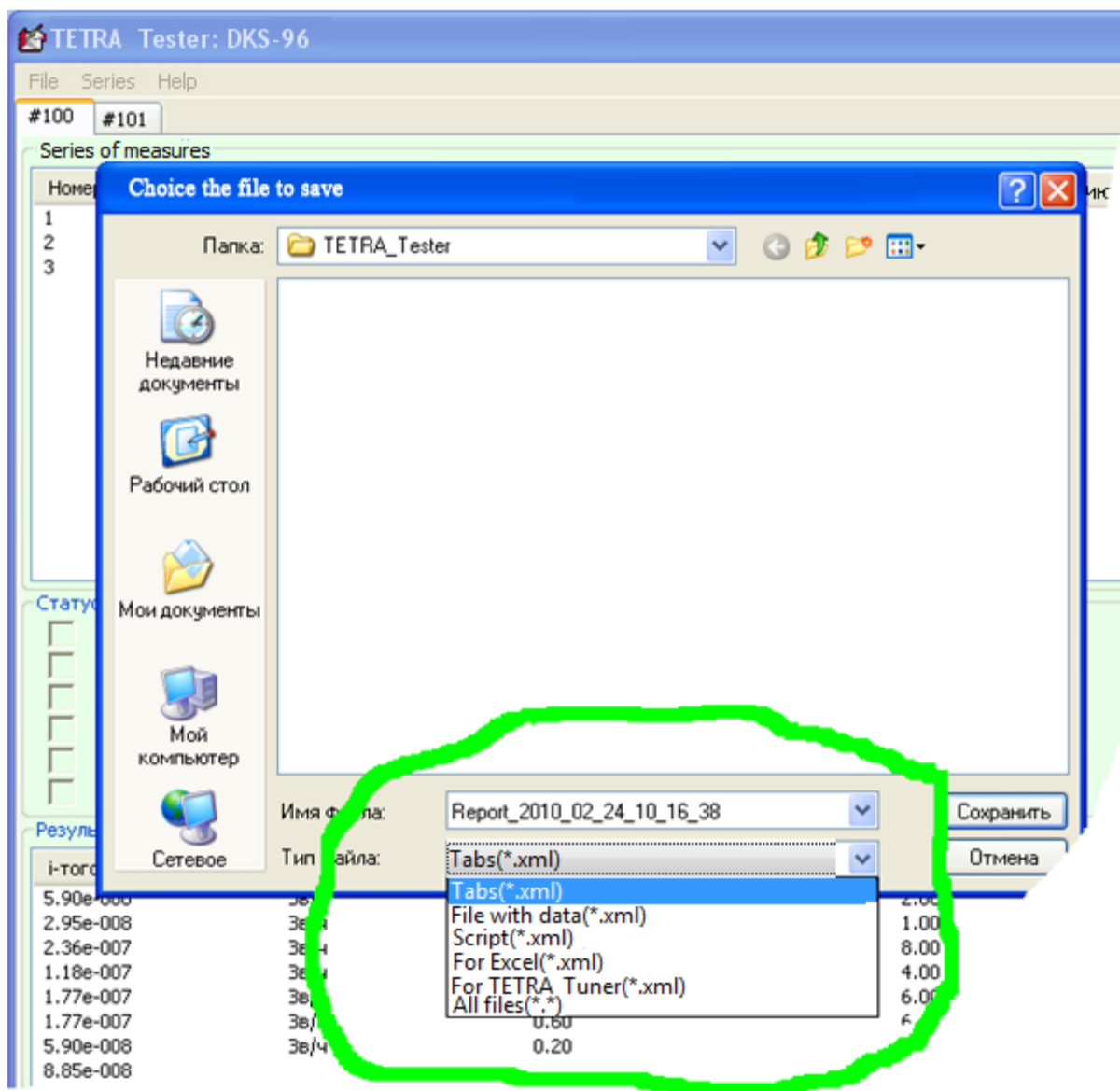


Figure 43. Types of saved files

RENAME TAB

Actions with tabs are also available from contextual menu of tabs (Figure 44, Figure 45).

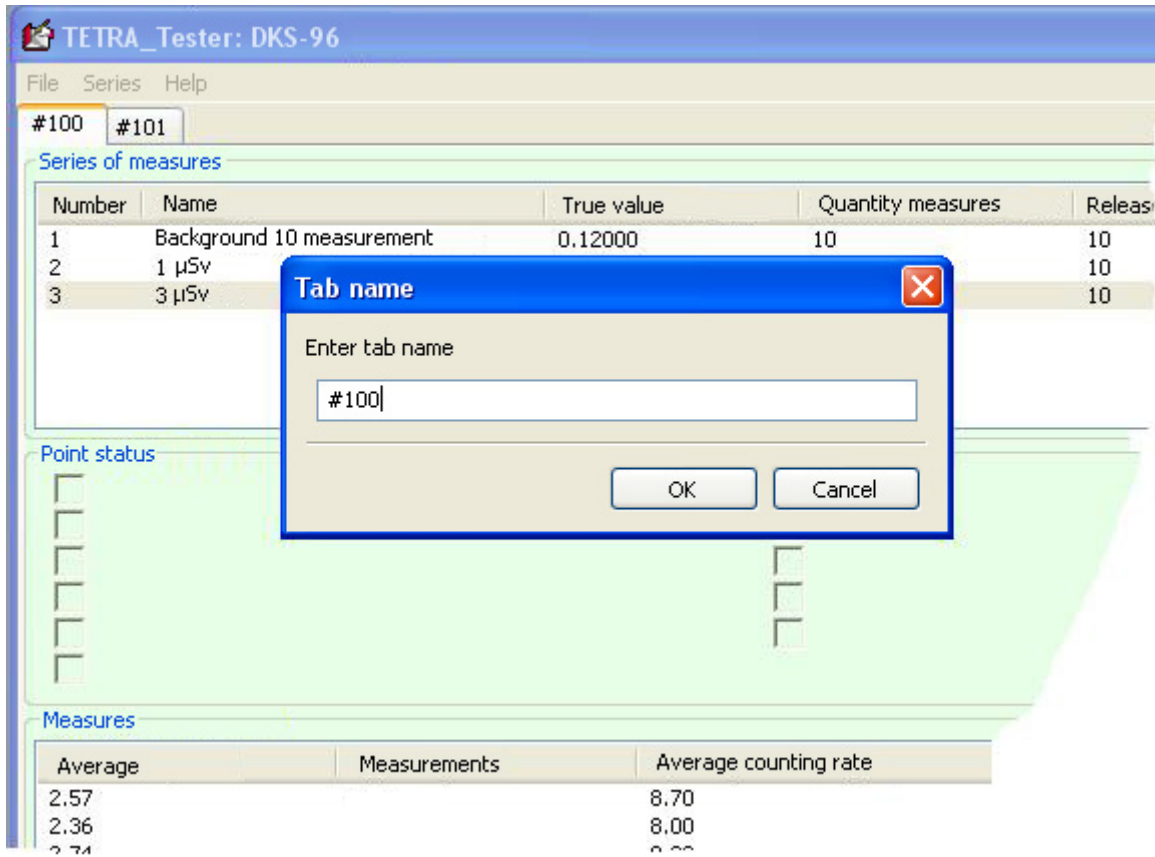


Figure 44. Rename tabs

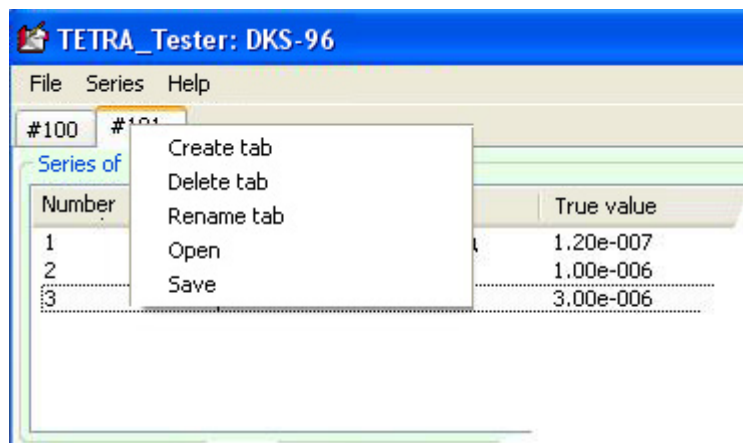


Figure 45. Contextual menu

SET DYNAMIC PARAMETERS

It is allowed to change the values of dynamical parameters in connected Device (Figure 46) and select the measurand by default. As opposed to «Series→Dynamic params series» execution of this action singular and is not connected to the series of measurements.

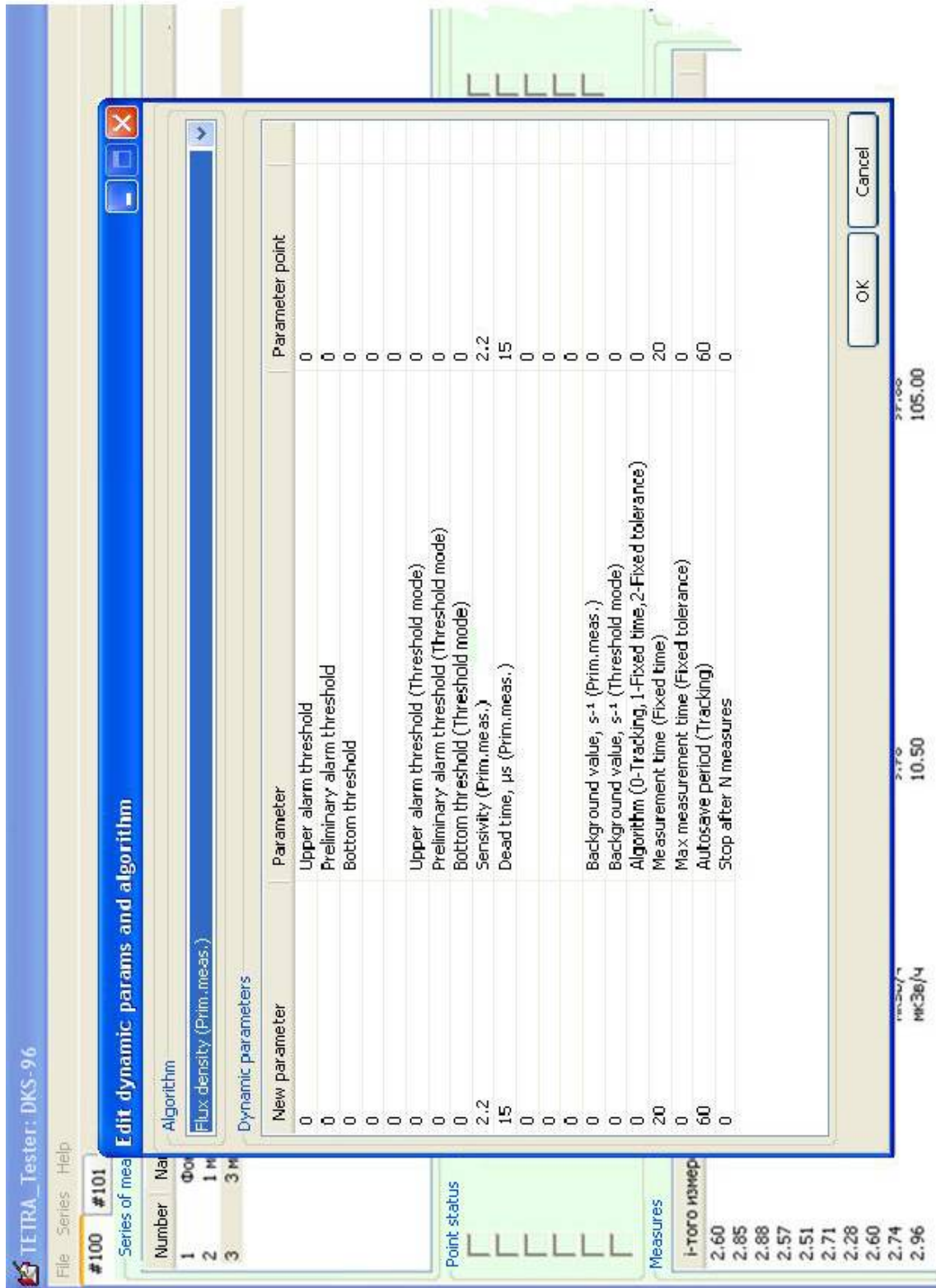


Figure 46. Set of dynamical characters

After selected the line in menu «Dynamic params series» Program is reading the names of dynamic parameters and its value, and display the reading information in window «Edit dynamic params and algorithm». New value of dynamic parameter can be edit in appropriate line of column «New column».

In window «Edit dynamic parameters and algorithm» also is possible to choice of measurand by default.

Saving new value of parameters and measurand by default in memory device is provided by pressing button «OK».

PARAMETERS

It is allowed to set the serial port number and connected Device address (Figure 47). It is set the broadcast address by default (255.255.255). It should be indicated the exact address Device in system which contains the several of connected Devices simultaneously.

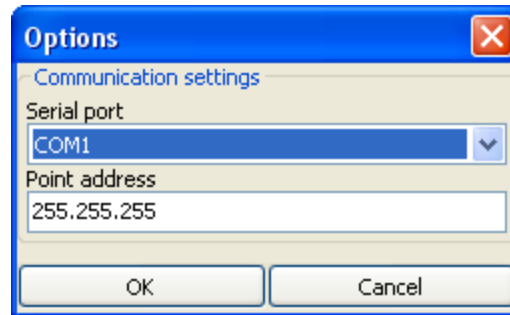


Figure 47. Window menu «Parameters»

MENU «SERIES»

Menu «Series» contains from the following points and corresponding «hot» keys (Figure 48):

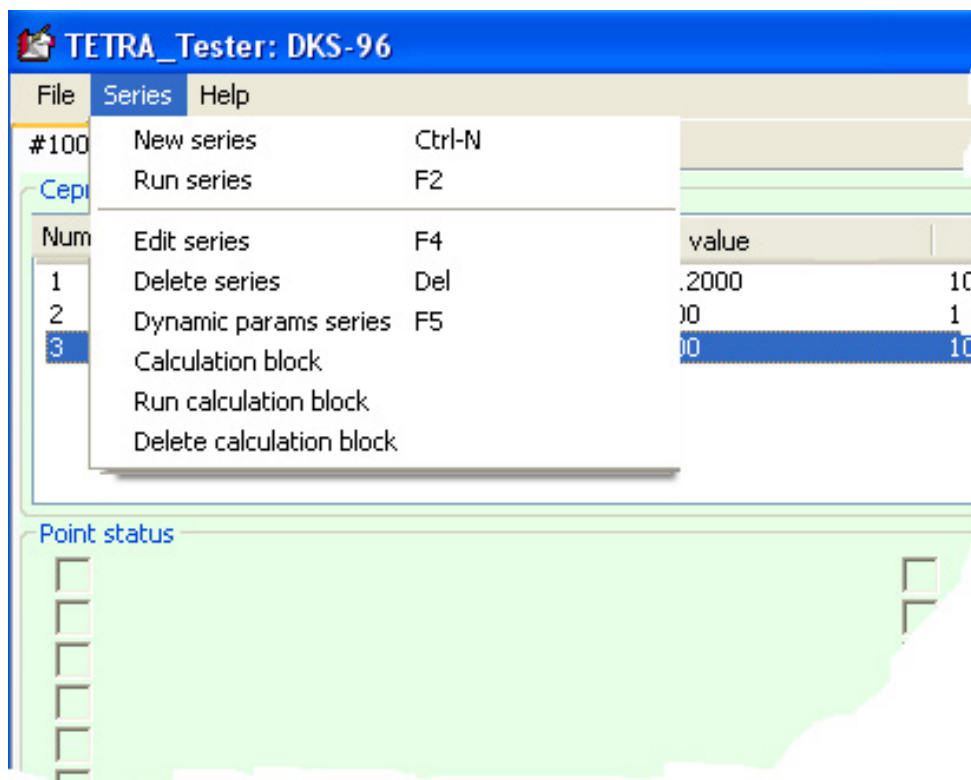


Figure 48. Menu «Series»

Menu «Series», also, can be due to click the right button «mouse» in field «Series of measures» (Figure 49).

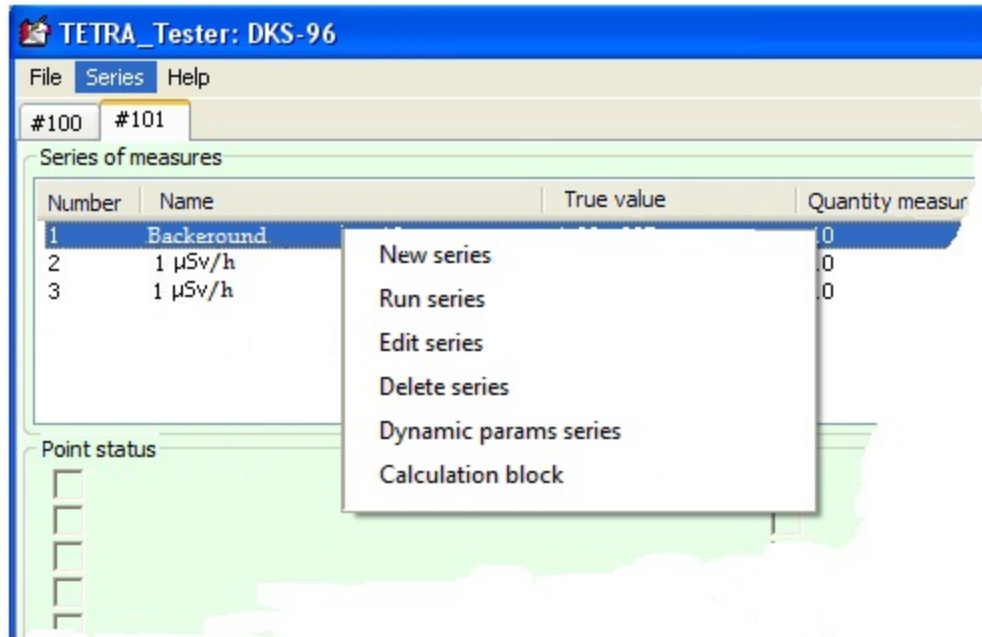


Figure 49. Contextual menu in series of measures

NEW SERIES

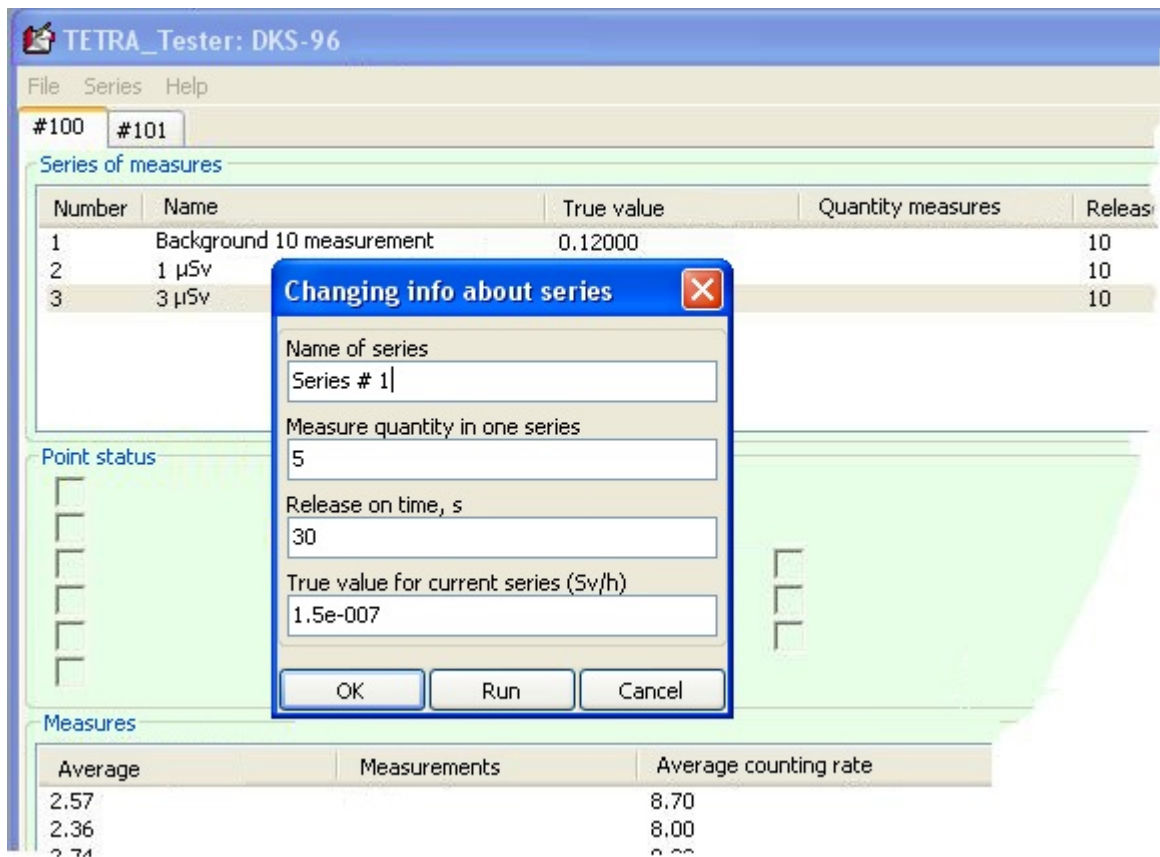


Figure 50. Window «New series»

It is allowed to create record about series of measures (Figure 50).

RUN SERIES

«Run series» is provided to execute the series of measures with specified parameters. Execution of this action is possible also by double click left button of mouse in selected series of measures.

EDIT SERIES

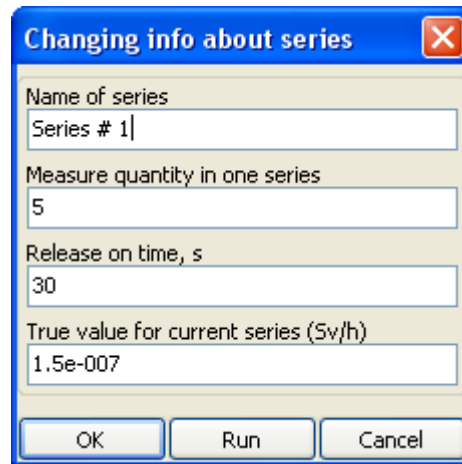


Figure 51. Window «Changing info about series »

It is allowed to edit data about the series of measures (Figure 51).

RUN SERIES

It is allowed to delete record about series of measures.

DYNAMIC PARAMS SERIES

It is allowed to set actions, which will be preceded to execution the selected series of measurement and actions which are executed after finished series.

After selected the menu point «Dynamic params series» Program provides the reading of Device register and displays the received information in window «Set dynamic params» (Figure 52).

Window «Dynamic params series» contains two option groups – «Algorithm» and «Dynamic parameters».

Option group «Algorithm»

It is allowed to select the measurand by default from which will provide the series of measures.

Set flag «Algorithm» is provided ability of selection one from measurand as «measurand by default». The selection is made directly before beginning of measuring series.

Set flag «Rollback algorithms after series ending» is pointed out of necessity of restore preliminary set algorithm by default after ending the series of measurement.

After closed the window «Dynamic params series» the state of group flag «Algorithm» is displayed in column «Algorithm» window «Series of measures» (Figure 52).

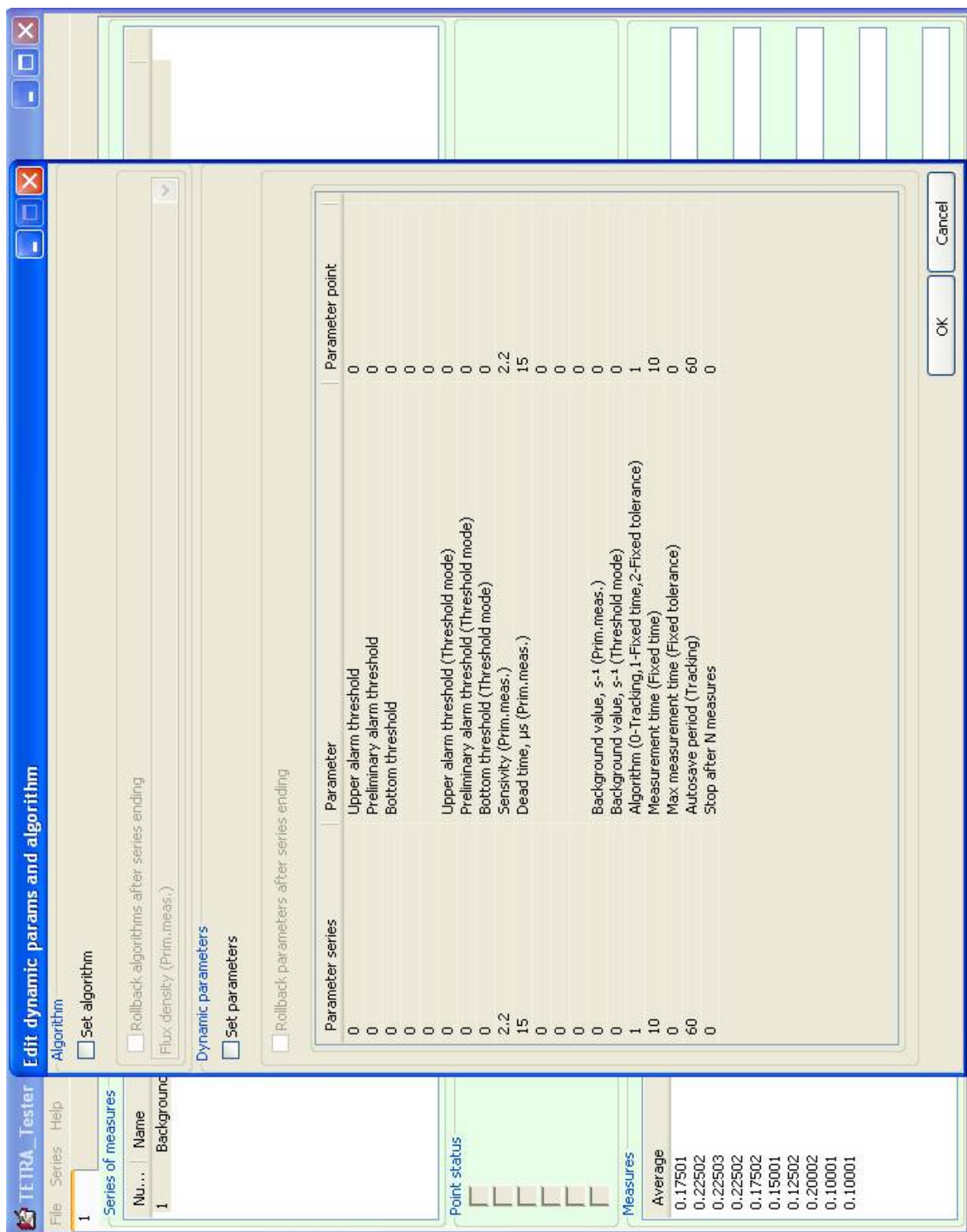


Figure 52. Set dynamic parameters

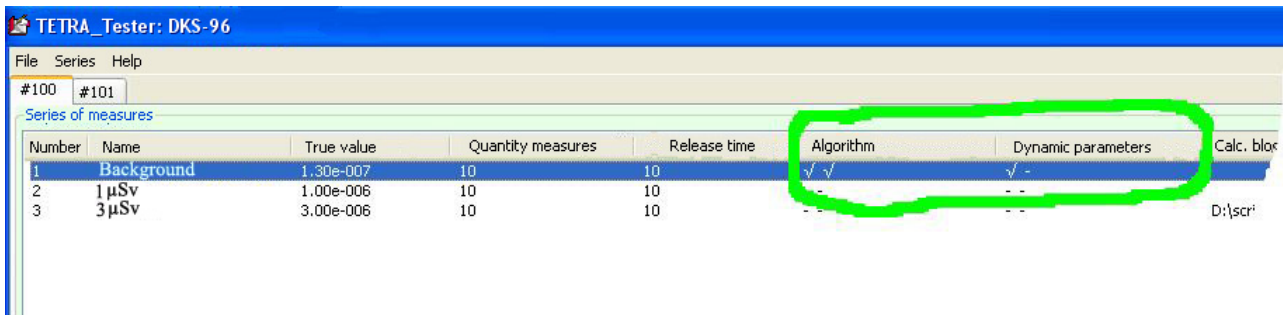
Option group «Dynamic parameters»

It is intended to set values of dynamical parameters in Device from which will be provide the series of measure.

Set flag «Rollback algorithms after series ending» is given ability to set the values for dynamical parameters, from which will be providing the chosen series of measures. Necessary values of dynamical parameters for measurement series can be set in appropriation lines of column «Parameter series».

After clicked button «OK» is set the sequence of actions saved by Program with connection to selected series of measures. In this case the selection of algorithm «by default» and set the values of dynamical parameters not providing with closed the window, but delay before start the series of measures, restore – till finished (in despite of «»).

After closed the window «Set dynamic params» the state of fields «Dynamic parameters» is displayed in column «Dynamic params» window «Series of measure» (Figure 53).



Number	Name	True value	Quantity measures	Release time	Algorithm	Dynamic parameters	Calc. blo
1	Background	1.30e-007	10	10	✓ ✓	✓ -	
2	1 μSv	1.00e-006	10	10	- -	- -	
3	3 μSv	3.00e-006	10	10	- -	- -	D:\scri

Figure 53. Icons of preset and restore parameters

CALCULATION BLOCK

It is allowed to set the calculation block after the measurement series. The calculation block is connected to the selected measurement series.

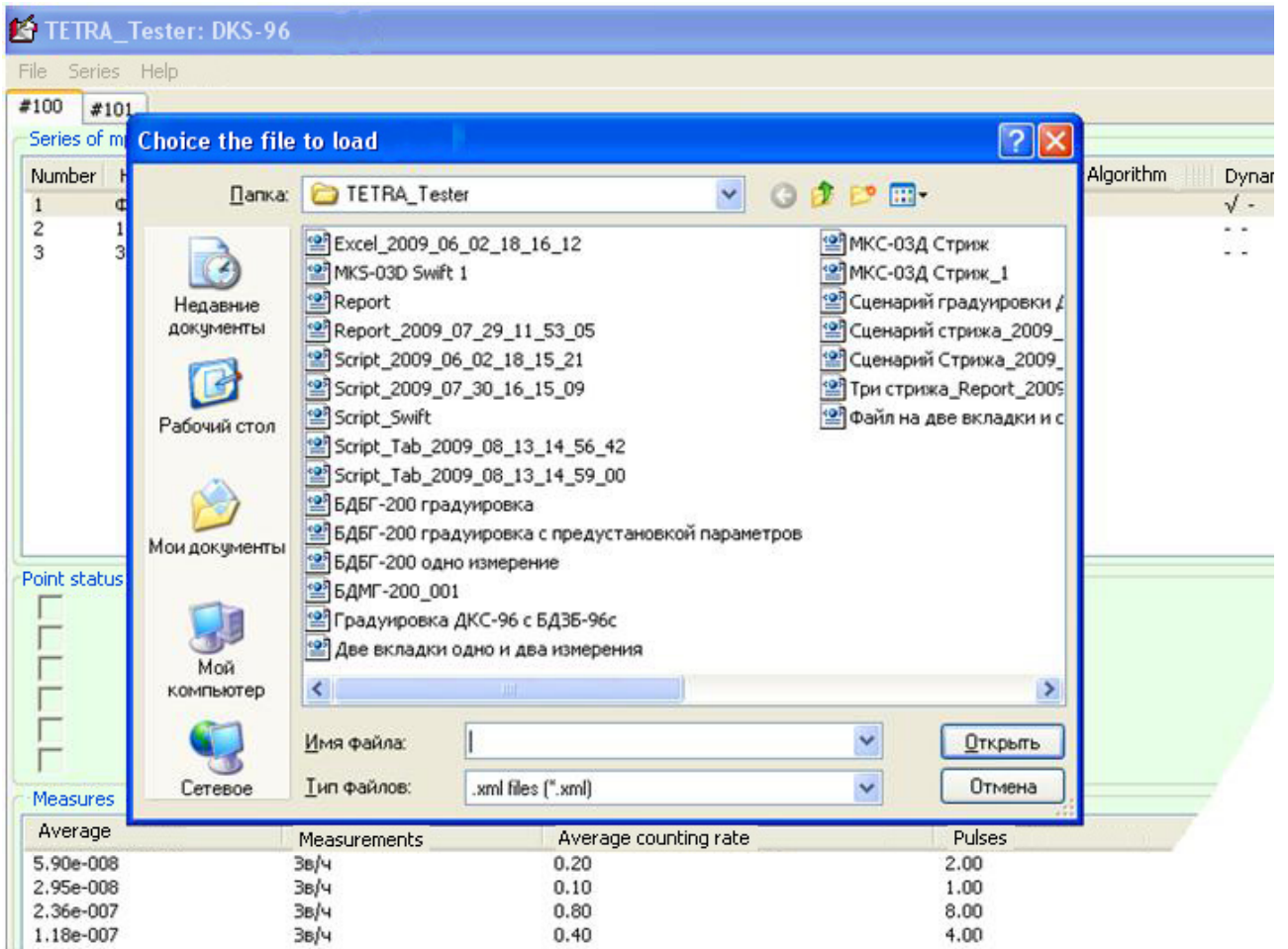


Figure 54. Creation or connection of calculation block

After entered in menu point «Calculation block» open window «Choice the file to load» (Figure 54). Using this window can be selected and connected the early formed calculation block to the measurement series, or create new, enter name in window «Name».



If it is necessary the early created file of calculation block can be open and correct via program Microsoft Excel.

Name of selected calculation block is displayed in column «Calculation block» window «Series of measures» (Figure 55).

RUN CALCULATION BLOCK

It is allowed to self-execute the calculation block, without the series of measures, which it is belonged.

DELETE CALCULATION BLOCK

It is allowed not use the calculation block for series of measures. File of calculation block is not deleted.

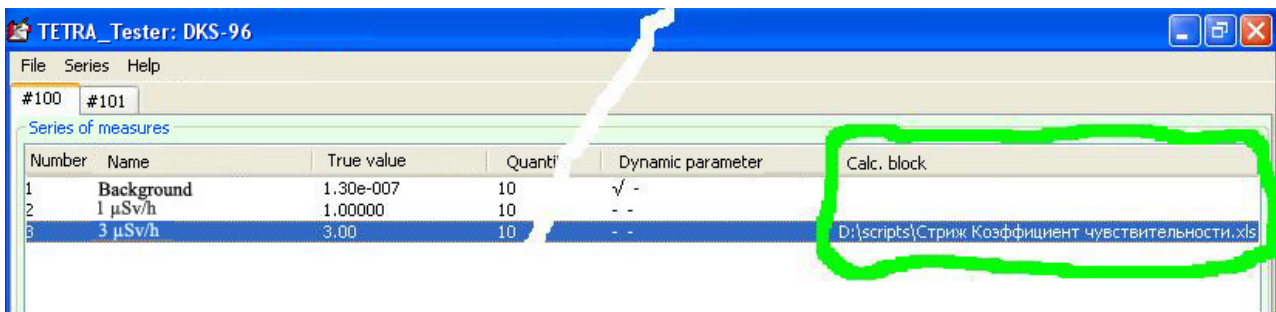


Figure 55. Calculation block in the series of measures

Fields which are aimed for record data of measurement, fill by program while creation of file and before every activation of calculation block. The user can application the free fields its own convenience for use required providing algorithm.

While creation of calculation block Program is executed the following actions:

- record values of measurement series in file of calculation block;
- record parameter values of measurement series in file of calculation block;
- record the measurement results in file of calculation block;
- reading names and values of dynamical parameters from Device memory;
- record names and values of dynamical parameters in file of calculation block;
- open file via program Microsoft Office Excel, user is given opportunity to add the necessary records in file:
 - describe the providing of necessary calculations;
 - calculate the values of Device dynamical parameters;
 - direct program to record the new values of dynamical parameters after executed calculation block;
 - direct program to display the necessary information in message window after execution the calculation block.

While execution the calculation block Program executes the following actions in sequence:

- update the fields in file of calculation block, which contains the parameters of measurement series;
- update the fields in file of calculation block, contains the measurement results;
- reading the names and values of dynamical parameters from Device memory;
- update the fields in file of calculation block, which contains the names and values of dynamical parameters;
- activation the execution of actions described in calculation file via program Microsoft Office Excel;
- record the necessary values of dynamical parameters in Device memory;
- display the necessary information in message window.

It should execute the following actions in sequence for creation of calculation block:

- connection Device to PC, power on;
- create records about necessary series of measures, or open early saved file;
- provide series of measures, preceding of execution for plan calculations;
- select series in window «Series of measures», after plan of providing calculation;
- enter in menu «Series→Calculation block»;
- select folder in window «Choice the file to load», in which the create file will be saved;
- write the name of created file in field «Name», click «Open».

In result program creates file with indication name, fills data of provided series of measures, necessary comments, supplemental information, open it via Microsoft Office Excel. The user gives abilities in calculation file:

- set for providing measurements;
- calculate new values of dynamical parameters for Device;
- describe the content of message window.

FORMAT OF CALCULATION BLOCK

File of calculation block is created in format Microsoft Office Excel. File is filled the following data while creation (Figure 56):

- column B is filled the names of measures series;
- column C, from C6 down, is filled the results of provided measurements for first series. Down, through one line is the data of second series;
- column D from D6 down is filled (analogical column C) the values of average count rate;
- column E from E6 down is filled the quantity of registered pulses;
- column F – from F6 down – «true value» of measurement series;
- column G – from G6 down – quantity of measurement in every series;
- column H – from H6 down – duration of measurement in series;
- column K – from K6 down – names of dynamical parameters for Device;
- column L – from L6 down – values of appropriate dynamical parameters;
- great quantity of inscription for recorded data, it makes easy learning features of calculation block.

The content of listed fields is updated before start of execution calculation block.

Figure 56.

	A	B	C	D	E	F	G	H	I
1	Descriptor of information lines quantity in cell N5 is								
2	indicated by the end of calculation block operation.								
3	Appropriation quantity of information lines,								
4	displayed in column M and N, starts from line 7								
5		Average	Average counting rate	Pulses	True value	Quantity measures	Release time	Evaluate value	Name dynamic parameters
6	Background	2,25E-07	0,9	9	0	10	10		Upper alarm threshold
7		1,25E-07	0,5	5					Preliminary alarm threshold
8		1,50E-07	0,6	6					Bottom threshold
9		1,25E-07	0,5	5					
10		1,00E-07	0,4	4					
11		1,00E-07	0,4	4					Upper alarm threshold (Threshold mode)
12		1,75E-07	0,7	7					Preliminary alarm threshold (Threshold mode)
13		2,25E-07	0,9	9					Bottom threshold (Threshold mode)
14		2,75E-07	1,1	11					Sensitivity (Prim.meas.)
15		1,50E-07	0,6	6					Dead time, μ s (Prim.meas.)
16									
17									
18									
19									Background value, s^{-1} (Prim.meas.)
20									Background value, s^{-1} (Threshold mode)
21									Algorithm (0-Tracking,1-Fixed time,2-Fixed tolerance)
22									Measurement time (Fixed time)
23									Max measurement time (Fixed tolerance)
24									Autosave period (Tracking)
25									Stop after N measures

Calculation block, left part μ

In column 'J' across the according parameters in column 'J' across the according parameters in column 'J' across the according parameters					
Quantity measures	Release time	Evaluate value	Name dynamic parameters	Value dynamic parameters	Count show line
10	10		Upper alarm threshold	0	User lines for show in display
			Preliminary alarm threshold	0	Show values
			Bottom threshold	0	
				0	
				0	
			Upper alarm threshold (Threshold mode)	0	
			Preliminary alarm threshold (Threshold mode)	0	
			Bottom threshold (Threshold mode)	0	
			Sensitivity (Prim.meas.)	2,2	
			Dead time, μs (Prim.meas.)	15	
				0	
				0	
				0	
			Background value, s^{-1} (Prim.meas.)	0	
			Background value, s^{-1} (Threshold mode)	0	
			Algorithm (0-Tracking,1-Fixed time,2-Fixed tolerance)	1	
			Measurement time (Fixed time)	10	
			Max measurement time (Fixed tolerance)	0	
			Autosave period (Tracking)	60	
			Stop after N measures	0	

Figure 57. Calculation, right part

Other fields are without changes and given to the disposal for user. After executed of calculation block the values of following fields are reading from:

- column J from J6 and down – by quantity of dynamical parameters in Device. The contents of all fields will be record by program in Device memory as new values of dynamical parameters;

- column M from N – from M7 and N7 down – field of form information message. Data of these fields is located in information window. (Figure 62).

The message is formed on the base of information, disposed in columns M и N, starts from 7th line. The quantity of lines, displayed in information window, is indicated in cell N5 (

Figure 57).

User can determinate the field of form resulting document about the provided series of measures and calculated values in file of calculated block. By the end of calculating block this document can be saved as separately file (Figure 58).

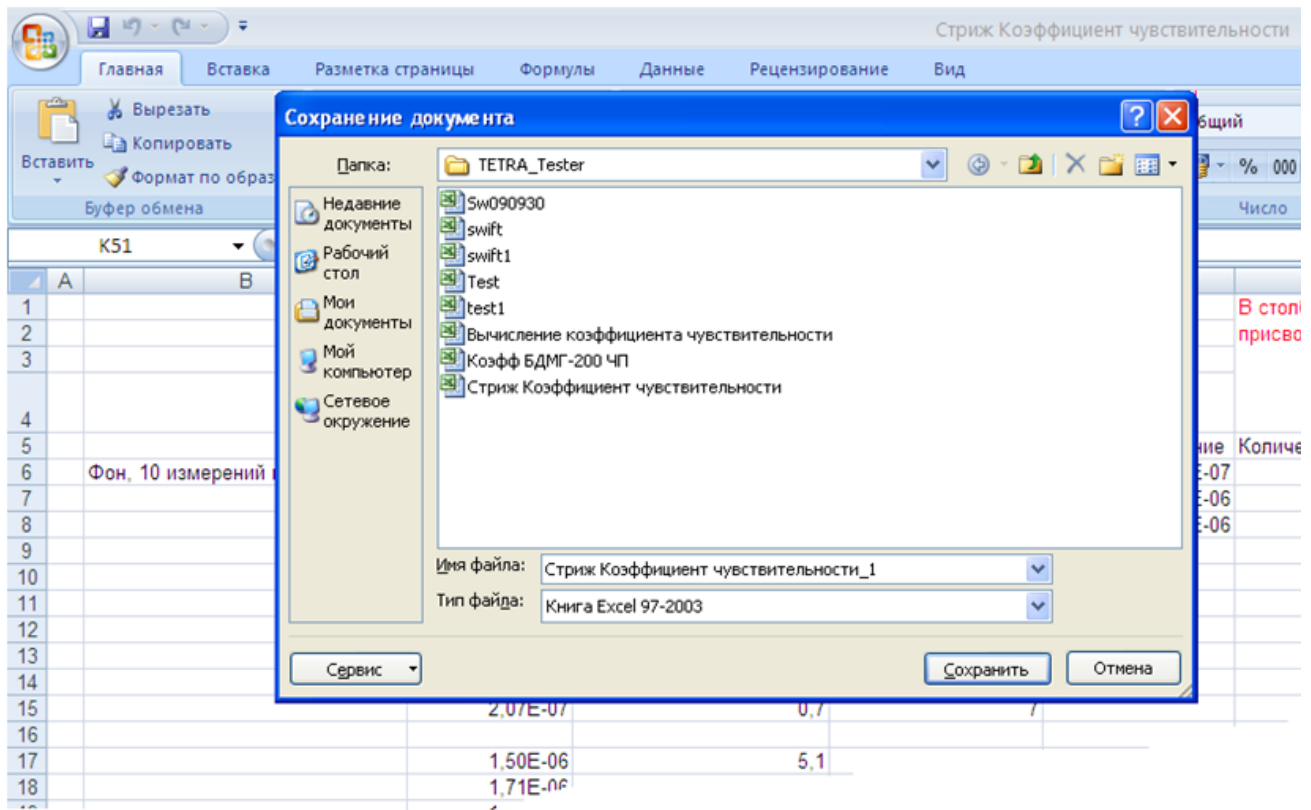


Figure 58. Saved results of execution calculation block

6.5 EXAMPLES OF USE PROGRAM TETRA_TESTER

6.5.1 EXAMPLE OF AUTOMATIZATION CALIBRATION PROCESS

The following tasks examine:

- execute the necessary quantity of measurement series for determination sensitivity coefficient and «dead» time of dosimeter-radiometer MKS-08 with detection block BDZB-96s in according of verification procedure;
- calculate the values of coefficients;
- report the calculated values in memory of dosimeter-radiometer MKS-08;
- execute the calibration protocol for dosimeter-radiometer;
- create and save the calibration script and primary verification of dosimeter-radiometer MKS-08 for gamma-channel.

Verification procedure can have the following contents:

3. VERIFICATION DETECTION BLOCK

3.1. Calculate the sensitivity coefficient.

3.1.1. Switch console in the measurement mode of average count rate of pulses.

3.1.2. Place the detecting block on the source of beta-radiation, with beta-flux density 10...30 % from upper value range of detecting block.

3.1.3. Provide 10 measurements of count rate. Measurement time - 10 s.

3.1.4. Calculate value for average count rate.

3.1.5. Calculate value of sensitivity coefficient K as following:

$$K = \Pi_p / n, \quad (3.1)$$

where n – average value of count rate, s⁻¹;

*Π_p – calculation value of flux density from standard source, ppm*cm⁻², as following*

3.1.6. Record the sensitivity coefficient in Device memory.

3.2. Calculation «dead» time for detection block.

3.2.1. Set the detecting block on the source of beta-radiation, beta-flux-density is 70-90 % from the upper value of measurement range for detecting block.

3.2.2. Provide 10 measurements of count rate in 10 s.

3.2.3. Calculate the value of average count rate n.

3.2.4. «Dead» time is calculated as following:



(3.3)

where $n - \dots$

3.2.5. Record the value of dead time in Device memory.

It should be executed the following actions in series for solved this task:

- connect MKS-08 with BDZB-96s to PC, used the standard adapter from the supplier set;
- power on PC, put on MKS-08;
- launch program TETRA_Tester. If it is necessary it should be set the program of parameter (number of serial port and net address connected Device) in menu File→Parameters;
- create new record about first measurement series with parameters, displayed on Figure 59 left (in according with requirements of calibration procedure p.p. 3.1.2, 3.1.3);

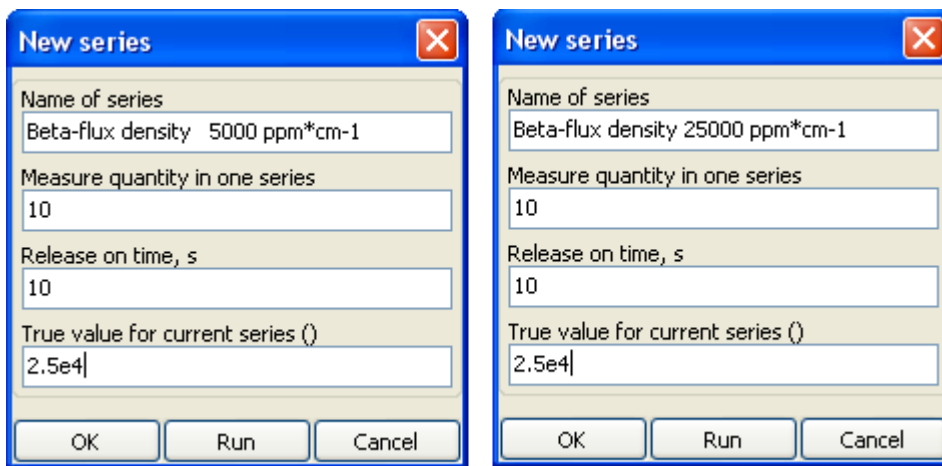


Figure 59. Parameters of first measurement series (left) and second measurement series (right)

- create record about the second measurement series with parameters, displayed on Figure 59 right (in according with requirements of verification procedure p.p. 3.2.1, 3.2.2);

	C	D	E	F	G	H	I	J	K	L
5	i-того измерения	Ср. скорость счета, имп/с	Колич.зарегистр.имп.	Истинное знач	Количество имп	Время изме	Вычисленные значен	Названия динамических параметров	Значения динамических параметр	
6	5000	384,6	384,6	5000	10	10		Верхняя АПУ	0 Г	
7	4980	383,1	383,1	25000	10	10		Верхняя ППУ	0	
8	5010	385,4	385,4					НПУ	0	
9	4997	386	386						0	
10	4997	384,4	384,4						0	
11	5025	386,5	386,5					Верхняя АПУ (Пороговый)	0	
12	4976	382,8	382,8					Верхняя ппу (Пороговый)	0	
13	5006	385,1	385,1					НПУ (Пороговый)	0	
14	4992	384	384					Кэфф.чувствительности (Осн.изм.)	13	
15	5011	385,5	385,5					Мертвое время, мкс (Осн.изм.)	50	
16									0	
17	25100	1737,7	1737,7						0	
18	24880	1722,5	1722,5						0	
19	25110	1738,4	1738,4						0	
20	24910	1724,5	1724,5					Значение фона, с ⁻¹	0	
21	24790	1716,2	1716,2					Значение фона, с ⁻¹ (Пороговый)	0	
22	25120	1739,1	1739,1					Алгоритм (0-Следящий,1-С заданным временем, 2-С зада	1	
23	24870	1721,8	1721,8					Время измерения (С заданным временем)	10	
24	25080	1736,3	1736,3					Макс. время измерения (С заданной точностью)	0	
25	24950	1727,3	1727,3					Период автосохранения (Следящий)	60	
26	25110	1738,4	1738,4					Остановка через N измерений	0	
27										
28										

Figure 60. Fragment file of data block

- set detecting block on the source with flux density in $5000 \text{ ppm} \cdot \text{cm}^{-2}$ and make the first measurement series (in according with requirements of p. 3.1.2. and 3.1.3);
- set detecting block on the source with flux density in $25000 \text{ ppm} \cdot \text{cm}^{-2}$ and make the second measurement series (in according with requirements of p. 3.2.1. and 3.2.2);
- create the calculation block (in accordance with requirements of verification procedure p. 3.1.5 and 3.2.4);
- activate the contextual menu by click of right button in line of second measurement series, choose the point «Calculation block »;
- in this window «Choose the file to load» in field «File name» enter the file name of created calculation block (for example «MKS-08 with BDZB-96s K and MV»), click by button «Open»;
- program creates and opens file with indicated name (p. 6.4.5), which is filled the data of two measurement series and registers of connected Device (Figure 60);
- record in cell J14 expression for calculation of sensitivity coefficient in according with indication of verification procedure «=F6/CP3HA4(D6:D15)»;
- record in cell J15 expression for calculation «dead» time coefficient; «=(1-J14*CP3HA4(D17:D26)/F7)/CP3HA4(D17:D26)*1000000»;
- record in cell M7 line «Calculate values:» (Figure 61);
- record in cell M8 line «Sensitivity coefficient –»;
- record in cell N8 expression «=J14»;
- record in cell M9 line «Dead time –»;
- record in cell N8 expression «=J15»;
- record in cell N5 value «3», appropriation quantity of lines in message window;
- save and close file;
- additional in file of calculation block (on the same page, or separately) can be created the pattern of verification certificate, which during calculation filling the necessary data;
- activation the calculation block. After it executed the calculation block, the calculated values of coefficients (sensitivity coefficient from cell J14 and «dead» time from cell J15) are automatically saved in connected Device memory.



Manual start of calculation block need only in the first start of creation. Then calculation block will be executed after finished of measurement series automatically.

After finished of execution calculation block program is proposed to save the received results in separately file.



For saving results of program operation it is advisable to create separately folders for various Devices, and in the name of file fixed the name of Device, serial number, date and time of execution.

Results of calculation block operation are displayed in message window (Figure 62). In according with setting of calculation block.

Executed actions need save as calibration script.

J	K	L	M	N
5	Названия динамических параметров	Значения динамических параметров	Количество индицируемых строк:	3
6	Верхняя АПУ		0 Пользовательские строки сообщений на экране	Отображаемые значения
7	Верхняя ППУ		0 Вычисленные значения:	
8	НПУ		0 Коэффициент чувствительности -	12,996
9			0 Мертвое время -	58,130
10			0	
11	Верхняя АПУ (Пороговый)		0	
12	Верхняя ППУ (Пороговый)		0	
13	НПУ (Пороговый)		0	
14	12,996 Коэф.чувствительности (Осн.изм.)		13	
15	58,130 Мертвое время, мкс (Осн.изм.)		58,1	
16			0	
17			0	
18			0	
19	Значение фона, с ⁻¹		0	
20	Значение фона, с ⁻¹ (Пороговый)		0	
21	Алгоритм (0-Следящий,1-С заданным временем,2-С задан.		1	
22	Время измерения (С заданным временем)		10	
23	Макс. время измерения (С заданной точностью)		0	
24	Период автосохранения (Следящий)		60	
25	Остановка через N измерений		0	

Figure 61. Forming of cells for information message

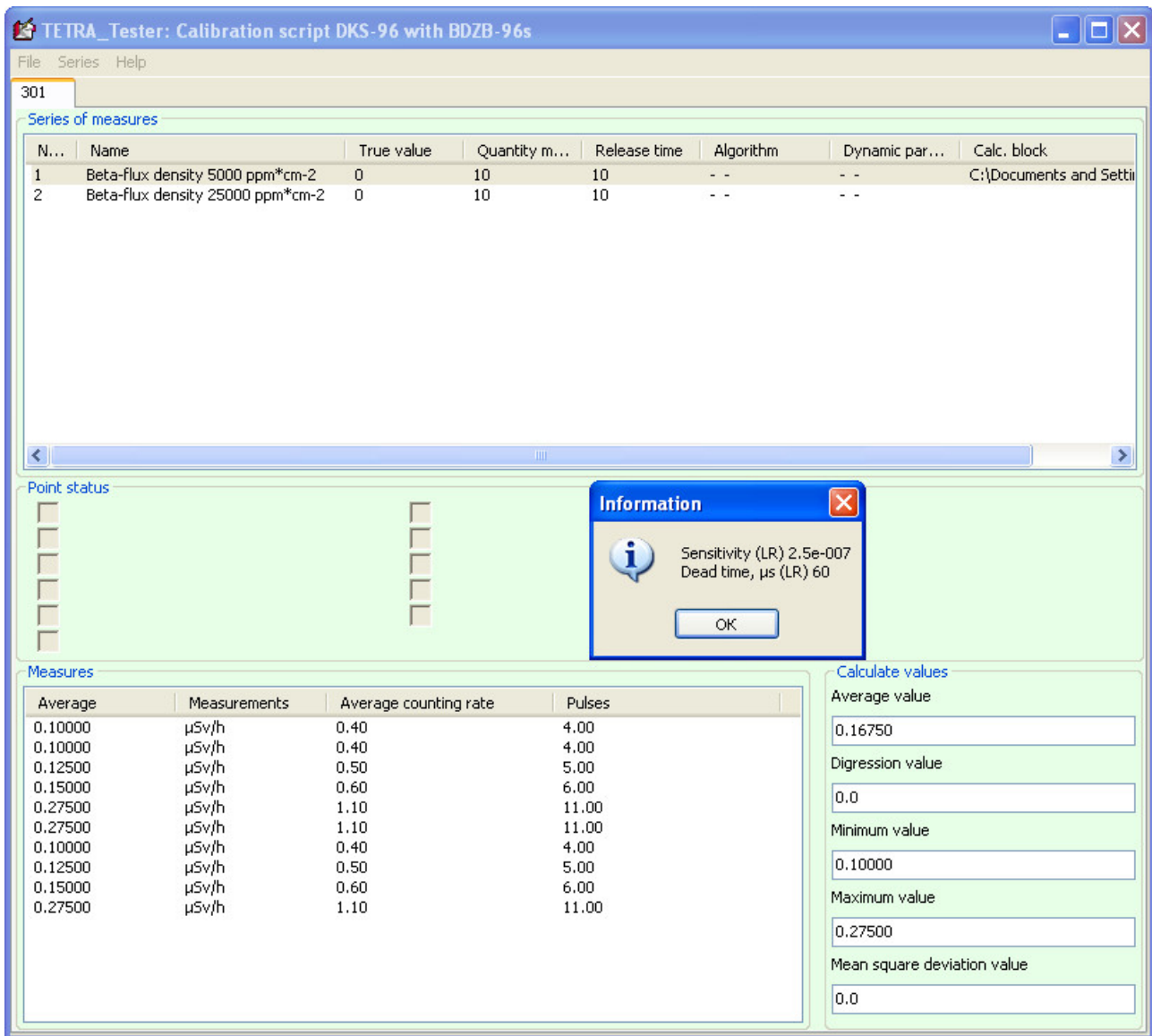


Figure 62. Message window of calculating block

6.6 EXAMPLE OF CREATION AND USE SCRIPT

It should be execute the calibration group from three with detecting block BDZB-96s with use received in example 1 script. The serial numbers of calibrated MKS-08 are 301, 302, 303.

It should be executed the following actions in series for solved this task:

- open script in Program, created in previous example;
- rename tab in «№301» in according to serial number of first Device;
- create in Program two tabs «№302» and «№303» open same script;
- create the conditions for providing of first measurement series;
- open tab «№301», connect PC to Device with serial number №301, start the first measurement series;

- open tab «№302», connect PC to Device with serial number №302, start the first measurement series;
- open tab «№303», connect PC to Device with serial number №303, start the first measurement series;
- create the conditions for providing of
- second measurement;
- open tab «№301», connect PC to Device with serial number №301, start the second measurement series;
- open tab «№302», connect PC to Device with serial number №302, start the second measurement series;
- open tab «№303», connect PC to Device with serial number №303, start the second measurement series;
- in every tab after finished second series it should be saved files with results of provided measurements and calculations.

6.6.1

MKS-08H AS NEUTRON SPECTROMETER

In Internet you can find the messages about the solved tasks of spectral neutron radiation with use MKS-08 in set with detecting block BDMN-96.

For this aim the detecting block is set of several decelerators of neutrons.

Providing of necessary quantity measurements with change decelerators and following re-calculation results in original methods is allowed this task.

Application program TETRA_Tester is appropriately lower of routine operations. For this aim it is created the script with necessary quantity of measurement series. Every measurements series begins with necessary setting of necessary value for sensitivity coefficients. After finished of last measurement series is set the execution detecting block, contains the creation user of methods for providing results.

6.7 PROGRAM DIBUS_CYCLE

Program is intended to cycle request of operation Devices by protocol DiBUS. [15]. Program DiBUS_Cycle need for software developer of system in exchange debug between separately Devices and «master» system.

6.8 DEVELOPMENT USER PROGRAMS AND SYSTEM

- build the radiation model of control object with ability time forecasting (Figure 64);

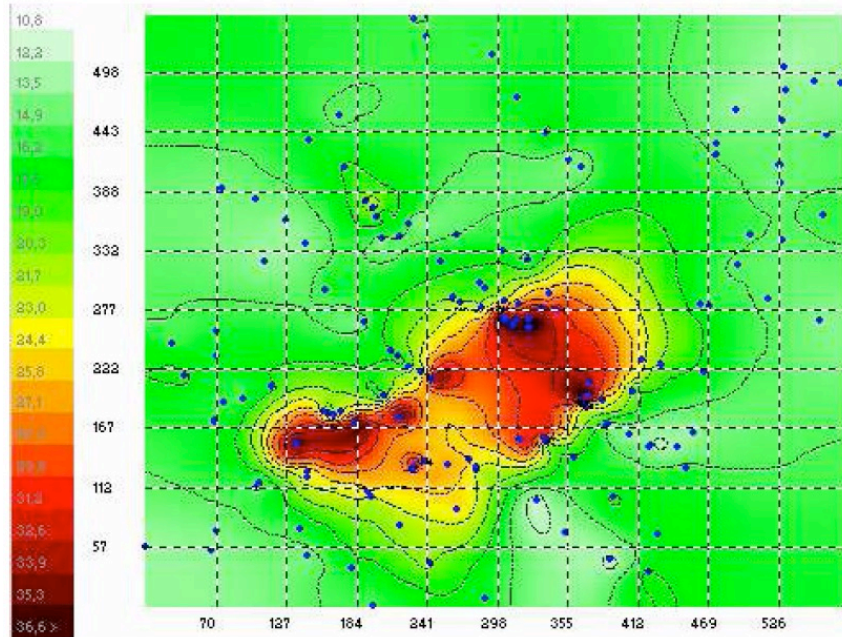


Figure 64. Model of radiation monitoring in MapInfo

- grade the values in points, where measurements has not been provided – tasks of data completion (Figure 65);



Figure 65. Forecasting in QuantumGI as example of the tailing dump

- build the surface according to received data (Figure 66).

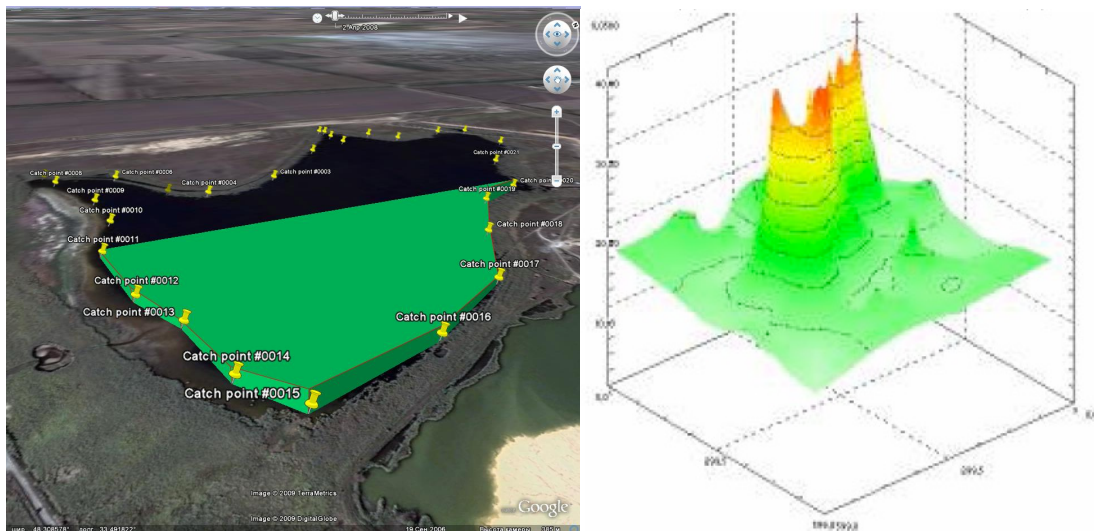


Figure 66. Build of surface on the base of data archive MKS-08

The format of measurement archive MKS-08 is universal and adapted in full measure for operation with various package GIS. Provided test of compatibility archive data MKS-08 with various software products – commercial and open (free of charge) – display the full compatibility. In [18], particularly, display the examples of analyze archive data MKS-08 with use such famous packages as «Google Earth» and «Quantum GIS». Except of these packages the successfully testing has been passed «GRASS», «SAGA GIS», «Udig». Additional testing GIS-packages and new testing are provided according to user's request, as it was in case of package «K-MINE» (<http://kai.com.ua/>).

6.10 EXAMPLE OF USE MKS-08 IN COMPOSITION OF INFORMATION SYSTEM

Dosimeter-radiometer MKS-08 (console modification UIK-05-01) can include in system of type «Atlant» [12] as monitoring point together with main adapter AMD-01. Connection console UIK-05-01 to adapter is provided via plug «mini-jack 2», is aimed for connection of charger and main phonos.

Main adapter AMD-01 – intellectual adapter, provided the coupling of output signal from dosimeter-radiometer with the line data installation «Atlant».

Below it is displayed the example of use MKS-08G with AMD-01 in one of used project.

On the upper cover of adapter case is located the two-colored light-diode, aimed for visual indication of presence reliable contact in socket. Absence of contact is tracked the interrupted fluorescence of green color. Constant of green fluorescence has the reliable contact in plug and accumulators in dosimeter-radiometer MKS-08 are full charged. The fluorescence of red diode is signaled about presence of reliable contact in the process of accumulator charge, simultaneously with data exchange between central console «Atlant» and MKS-08.

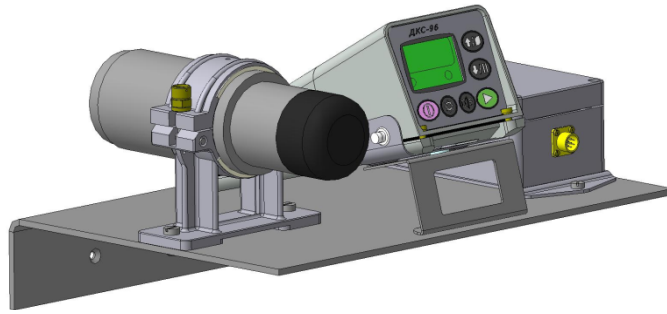


Figure 67. MKS-08GB and AMD-01 – installation component part "Atlant"

Dosimeter-radiometer MKS-08 in stationary state is located with line adapter AMD-01 on the shelf. It should disconnect socket «mini-jack 2» cable for providing of dosimeter-radiometer in portable state, connected console UIK-05-01 with adapter AMD-01, extracts detecting block BMKS-08 from holder, turn retainer screw off, and take the console from support off (Figure 67).

7 WINDOW OF MAIN OPERATION MODE

7.1 CONTAINS WINDOWS FOR MAIN OPERATION MODE

Contains windows for main operation mode is determinate of configuration MKS-08 – the type of connected the detecting block to the console. Figure 68 is shown the maximum possible set windows of main operation mode. However, for every configuration MKS-08 the set of windows for main operation mode is appeared less. It is connected; firstly, some operation modes are not available for use with certain detecting block. Possibility of display such windows are unavailable. Secondly, some windows can be unfiled by factory settings in menu «Settings», or user.

While of first starting MKS-08 is allowed the operation in windows, provided of factory settings for console (Table 11, Table 12). The factory settings are provided the minimal set of main windows (operation modes) for every configuration of dosimeter-radiometer.

For example, in according with factory settings the dosimeter-radiometer MKS-08P (console with connected the detecting block BDPG-96) is set primary for operation in two windows:

- *Primary measurement;*
- *Detection.*

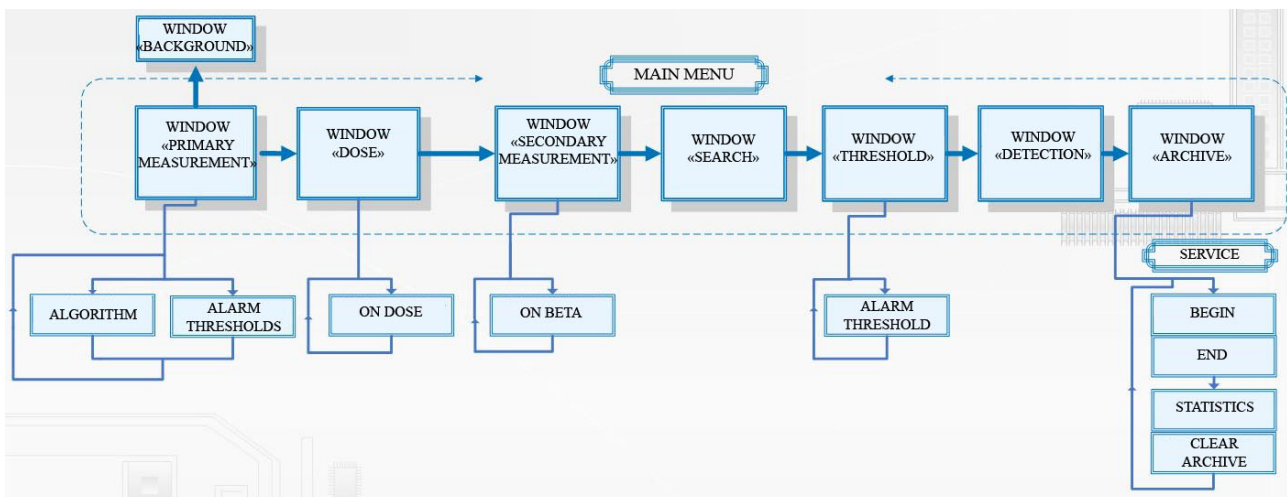


Figure 68. Window of main window operation

is primary provided the possibility of use MKS-08P in mode of measurement dose rate and detection mode of gamma-radiation. Additionally it can connect the archive window, or modes «Search», «Threshold».

Connection of additional windows is provided from menu «Settings» (p. 11.1). «»

Type of detecting block	Measurement background	Time of measurement background, s	Windows set of main operation modes, provided factory settings	Windows, included in menu «Settings»
BDZA-96	✓	60	Primary measurement	Threshold, Archive
BDZA-96b	✓	30	Primary measurement	
BDZA-96m	✓	100	Primary measurement	
BDZA-96s	✓	100	Primary measurement	
BDZA-96t	×	–	Primary measurement	
BDPS-96(alpha)	×	–	Primary measurement, secondary measurement	
BDPS-96 (beta)	✓	30		
BDZB-96	✓	30	Primary measurement	
BDZB-96s	✓	30	Primary measurement	
BDZB-99	✓	30	Primary measurement	
BDZB-96	✓	30	Primary measurement	
BDMN-96	✓	30	Primary measurement, Dose	
BDKN-96	✓	250 *	Primary measurement, Dose	
BMKS-08s	×	–	Primary measurement, Dose Additional measurement	Search, Threshold, Archive
BMKS-08	✓	30 **	Primary measurement, Dose	
BMKS-086	×	–	Primary measurement, Dose	

Type of detecting block	Measurement background	Time of measurement background, s	Windows set of main operation modes, provided factory settings	Windows, included in menu «Settings»
BDMG-96	x	–	Primary measurement, Dose	
BDPG-96	x	–	Primary measurement, Detection	
BDPG-96m	x	–	Primary measurement, Detection	
BDVG-96	x	–	Primary measurement, Detection	
BDKG-96	x	–	Primary measurement	

Note.

* For detecting block BDKN-96 the factory settings is provided the value of self-background which is equal $0,04 \text{ s}^{-1}$. If it is necessary the calculation of external background the value can be measurement and automatically recorded in memory instead of the indicated upper values is executed action ►►. Restore in memory of self-background value can execute via program TETRA_Checker

** Measurement background for BMKS-08 is provided only on high measurement sub-range.

Table 12. Algorithm, provided by factory settings, for various detecting blocks

Type of detecting block	Main unit of measurement	Additional unit of measurement	Measurement algorithm	Measurement time, s	Note
BDZA-96, BDZA-96b, BDZA-96m, BDZA-96s, BDZA-96t, RDPS-96	ppm*cm ⁻²		Fixed time	20	2
BDPS-96 (alpha)	ppm*cm ⁻²			20	2
BDPS-96 (beta)	ppm*cm ⁻²			20	2
BDZB-96, BDZB-96s, BDZB-99, BDZB-96b	ppm*cm ⁻²			10	2
BMKS-08c (beta)	ppm*cm ⁻²			20	
BMKS-08s (gamma)	Sv/h, Sv			20	
BMKS-08b, BMKS-08	Sv/h, Sv			10	
BDMG-96	Sv/h, Sv			20	
BDPG-96, BDPG-96m	Sv/h			10	
		pps*cm ⁻²		10	1
BDVG-96	Sv/h			10	
		pps*cm ⁻²		10	1
BDKG-96	R/h			10	
		s ⁻¹		10	1
BDMN-96	Sv/h, sv			20	
		pps*cm ⁻²		20	
BDKN-96	Sv/h, Sv			20	

Type of detecting block	Main unit of measurement	Additional unit of measurement	Measurement algorithm	Measurement time, s	Note
		pps*cm ⁻²		20	

Note:

1. It is available to use the additional units of measurement for detecting blocks type BDPG and BDVG after selected it in menu «Settings».

2. It is available to use the units of measurement «Bk·cm⁻²» for detecting blocks type BDZA and BDZB after selected it in menu «Settings» and calibration of the dosimeter-radiometer.

The full list of factory settings – windows and parameters – is shown in Annex 3. Factory settings

7.2 CONSOLE OPERATION

Turn on the console in main mode is start of simultaneously beginning of lot processors. In depending from the type of connected detecting block in console is executed such processes:

- start operation in all connected windows of main mode;
- start operation of algorithm Tracking, provided the functioning of dynamical scale (it is not depending to display or not);
- according to calculated values of algorithm Tracking it is controlled the exceeded threshold of main measurement;
- control of exceeded threshold on dose (for detection blocks, measurement gamma and neutron measurement).


For two-channel detecting blocks BMKS-08s (simultaneously measurement for gamma- and beta radiation) and BDPS-96 (simultaneously alpha- and beta radiation) is connected the following process:

- start of operation for additional measurement channel – measurement of beta-flux density with automatic compensation deposit of measurement main channel;
- activation of control exceeded alarm threshold for additional measurement.

The control of exceeded threshold is provided continuously; it is not depended from main menu, with generation of necessary sound messages, displayed icons of information line and form messages on information status register.

After turned on the console MKS-08 in according of the factory settings begin the operation with display of main measurement. The list of connected windows in depending of type of connected detecting block (configuration MKS-08) is displayed in Table 11)

If it is necessary, the change of window contains of main operation mode is executed in menu **Settings**→ **Config** (p. 11.1)

Switch of windows is executed the actions  (in case of more than one window).



7.3 PRIMARY MEASUREMENT WINDOW

The factory setting of console in primary measurement mode is given ability to operator to receive the qualitative assessment about monitoring type of ionization radiation with application one from the simple and intelligible for developing of measurement algorithm. As it should be from Table 12, the factory setting is chosen algorithm «Fixed time». The measurement time for every detecting block is set for received the measurement result with statistical uncertainty no worst 20%.

Hereinafter the setting of mode Primary measurement can be changed in according with user's preferences and operation specification.

Mode of primary measurement – is more powerful and flexible operation mode for the dosimeter-radiometer. The settings features are allowed to provide measurement in according with the requirements of normative documents and various methods. [5 - 11].

The following settings and service features for this mode are provided:

- selection of measurement algorithm and correction its parameters. Enter menu is provided the action  from the window mode, or in menu **Settings → Algorithm** (p. 11.1). In this menu the user is given possibility the choice of necessary algorithm (Tracking, Fixed time, Fixed tolerance – see p. 8.1), and also the options «Autosave» and «Stop after N measurement» (see below);
- «Stop after N measurement» is setting console for providing of defined quantity of measurement and after finished, switch to the mode pause. It is operation with the algorithms «Fixed time» and «Fixed tolerance» («Tracking» - algorithm of continuously measurement– is not operated with this option). The setting of parameter N is available in menu **Settings → Algorithm** (p. 11.1). The setting N in zero is allowed the measurements following one by one without stopping. Setting N is not zero value to stop after finished off indicated quantity of measurements. Stopping state in information line is correspondent the pause icon -  Allowing window «Archive» and setting flag «Autosave» every measurement result is automatically saved in Archive;
- set flag «Autosave» is:
 - saved of every measurement result (for algorithm «Fixed time», «Fixed tolerance »);
 - saved the current result of algorithm «Tracking» after finished time set by algorithm; parameters
- selection of measurement units (choice measurand). In the console for some detecting blocks it has the ability of choice additional units of measurement (Table 12). The choice of measurement units is executed in the mode **Settings → Coeff's → Units of measurement** for single-channel detecting block (or **Settings → Coeff's → Main channel → Units of measurements** for dual-channels and dual-sub-range for detecting blocks). While chose of additional units of measurements it need provide of calibration dosimeter-radiometer. The calibration coefficients for primary and additional

units of measurement is saved in non-volatile memory of console which is not depended one from other and used in according with producer choice.



While changed the units of measurement it should control the values of sensitivity (menu **Settings** → **Coeff's** → **Sensitivity**) and dead time (menu **Settings** → **Coeff's** → **Dead time**) and coincidence with indicated in passport.



The displayed values in menu of sensitivity coefficients (menu **Settings** → **Coeff's** → **Sensitivity**) and dead time (menu **Settings** → **Coeffs** → **Dead time**) of selected units of measurement.



For dosimeter-radiometer from any of connected detecting block can be chosen the units of measurements s^{-1} (average count rate). For measurement of average count rate the transformation coefficients are not used and the calibration of dosimeter-radiometer is not required. For detecting block BMKS-08s the information line in window of primary measurement is displayed the icon γ , in window of additional measurement – icon β . For detecting block BDPS-96 the information line in window of primary measurement is displayed the icon α in window of secondary measurement – icon β .

In window of primary measurement is provided the following functions of keypad:

- \odot – restart measurement. The measurement begins once. The appropriation melody is sound, on the display is indicated the message «Measurement restarted»;
- \blacktriangleright – save measurement. The current value is saved in archive. The value time and statistic uncertainty are temporarily replaced the recorded number in archive (Figure 69) and sound the appropriation melody. The saving measurement value is not influenced the measurement process;



Figure 69. Saved measurement

- \parallel – pause on/off. Stop / continue measurement. On the display the icon is \blacktriangleright changed on \parallel while activation pause in the measurement, $\parallel \blacktriangleright$ in case of continue measurement.
- speaker icon – set threshold. Set the threshold – upper alarm верхняя аварийная, предварительная и нижняя (р. 9.1);
- $\blacktriangleright \blacktriangleright$ – measure background (р. 8.6).

However, in any window, in window of primary measurement is available the all standard functions of keyboard (р. 3.2.2).

7.4 WINDOW OF SECONDARY CHANNEL. OPERATION IN MIXED FIELDS

Mode Secondary measurement (and connected window with it) is provided for dual-channel detecting block, which measures simultaneously the several parts of radiation. MKS-08 is contained such detecting blocks:

- BMKS-08s, simultaneously measured gamma (primary channel) and beta radiation (secondary channel);
- BDPS-96, simultaneously measured alpha (primary channel) and beta radiation (secondary channel).

The mode of secondary measurement has some peculiarities in compare with the mode of primary measurement:

- calculation of results for secondary measurement is provided with the use of measurement algorithm, selected in mode of primary measurement. The choice of measurement algorithm and correction of its parameters is executed by action **↓↓** from the window of primary measurement mode, or in file **Settings → Algorithm**. In this window the user is afforded the opportunity of choice one of algorithms (Tracking, Fixed time, Fixed tolerance – see p. 8.1), and also options «Autosave» and «Stop after N meas.» (see below);
- «Stop after N meas.» is setting the console for providing of set quantity measurement and after finished measurement, switch to pause mode. Operation with algorithm «Fixed time» and «Fixed tolerance» («Tracking» - algorithm of continuous measurement – is not operated with this option). Setting parameter N is available in menu **Settings → Algorithm** (p. 11.1). Setting N is zero allowing of measurements are followed one by one without break. Setting N is not zero value to stop after finished the setting quantity of measurement Stop state in information line is correspondent the pause icon - **||**
- allowed window «Archive» and set flag «Autosave» the every measurement of series is automatically saved in Archive;
- «Autosave». Setting flag is provided to:
 - save of every measurement pair (in case of availability in main mode of windows – primary and additional measurement), or every measurement (in case of availability in main mode only window of secondary measurement);
 - save of current value algorithm «Tracking» after finished time, set by algorithm parameter;
- choice of measurement units. Console for some detecting blocks has the ability of choice for additional units of measurement (Table 12). The choice of units of measurement is provided in mode **Settings → Coefficients → Secondary channel → Units of measurement**. While of first choice it necessary to calibration dosimeter-radiometer. The calibration coefficients for primary and secondary units of measurement are saved in non-volatile memory of console independently from each other and used in according of manufacture choice.



In case of change the units of measurement it should be controlled the value of sensitivity coefficient (**Settings → Coefficients → Secondary channel → Sensitivity coefficients**) and coefficient of «dead» time (**Settings → Coefficients → Sensitivity channel → Dead time**) and its coincidence with indicated in passport.



The value of sensitivity coefficients (**Settings → Coefficients → Secondary channel → Sensitivity coefficient**) and «dead time» (**Settings → Coefficients → Secondary channel → Dead time**) is depended from selected units of measurement (measurand).



Except in secondary channel can be selected the units of measurement c^{-1} (secondary count rate). For measurement of secondary average count the conversion coefficients is not used and the calibration of dosimeter-radiometer is not requirement.



To avoid of mess while operation with dual-channel of detecting block window of primary and secondary measurements is designation the necessary icons in information line. For detecting block BMKS-08s the information line in window of primary measurement is displayed the icon γ , in window of secondary measurement – icon β . For detecting block BDPS-96 the information line in window of primary measurement is displayed the icon α , in window of secondary measurement – icon β .

In window of secondary measurement is provided the following functions of keypad:

- \textcircled{R} – restart measurement. Measurement in window «Secondary measurement» starts again. On the display is indicated the message «Restart measurement»;
- \blacktriangleright – save measurement. The current value is saved in archive. Current value is saved in archive. The value time and statistic uncertainty are temporarily replaced the recorded number in archive (Figure 69) and sound appropriation melody. Saving the measurand on the measuring process is not influenced;
- || – pause on/off. Stopping of measurement window «Secondary measurement». On the display icon \blacktriangleright is changed on || while is activated pause in measurement, || on \blacktriangleright in case of continue measurement.
- 🔊 – set the threshold. Set of upper alarm threshold by secondary channel. The upper alarm threshold of secondary channel is constantly compared with measured value of current measurement algorithm.

However, as in other window, is available the functions of keypad (p. 3.2.2).

8 MEASUREMENT MODES AND APPROPRIATION CONSOLE SETTINGS

This section contains – description the possible measurement modes in the view of operator's task and requirements of used methods for providing of measurement.

8.1 MODES OF PRIMARY AND ADDITIONAL MEASUREMENTS

Operation modes in primary and secondary measurements are directly connected with measurement background (p. 8.6), abilities of algorithm choice and operation with archive.



It should notice that the operation with archive (manual and automatic saving of measurement) it is possible only in case of put on the archive window.

For providing of measurement in window primary measurement can be selected one of following algorithms:

- Tracking;
- Fixed time;
- Fixed tolerance.

Except of following algorithms, MKS-08 can be set for operation in measurement mode of average count rate (p. 8.1.4) and calculation device (p. 8.1.5).

The factory settings for every configurations MKS-08 is chosen the algorithm, indicated in Table 12. The change of algorithm is provided from menu **Settings** → **Algorithm**, or from the window of primary measurement in menu **Algorithm**, executed action **↓↓**, or with personal computer by means of correction appropriation dynamical parameters from program TETRA_Checker.

In window secondary measurement it is used the algorithm, chosen for primary measurement.

Independently from selected algorithm, MKS-08 is given ability of measurement background and automatically subtraction from results of measurement backgrounds (p. 8.6).

In according with standard documents and principles of providing measurement [7 - 11] is given ability of measurement with the deducting of the deposit for nature background.

Listed above the algorithm and additional abilities in operation with background are made MKS-08 the convenient tool for providing measurement in according with known the standard and methodic documents. [5 - 7].

8.1.1 ALGORITHM TRACKING

Algorithm «Tracking» provides obtaining the measurement result equal to the average value calculated by the sliding average method over results of N observations ($N \leq 128$) with the exposure time equal one second. In the process of measurement it is statistic analyze of registered pulses. If in the result of analyze information of observations it may draw the conclusion about changes of radiation state in the last n registered observations, the remainder information is not excluded. This provides the speed reaction of algorithm on the changes of radiation state.

The time of algorithm answer «Tracking» on the step change of registered radiation rate is corresponded the requirements of standard IEC 61526:2005 [3].

The visual difference of algorithm Tracking from algorithm «Fixed time» and «Fixed tolerance» – indicate time, which has been pasted from the start of measurement. In the moment of registration discontinuous change which the registered value of measurement time has also discontinuous changes.

The algorithm has one parameter, which setting in seconds. This parameter while set of flag «Autosave» (**Settings** → **Algorithm** → **Autosave**) and allow window «Archive» is set the period of automatically save in archive of measurement result. The null value of parameter is disable the automatic save even in the case of set flag «Autosave».

With parameter «Stop after N meas.» the algorithm Tracking is not activated.

For dual-channels detecting blocks in case of activation of primary and additional measurement of automatic save creates the two records simultaneously: by primary and secondary channels.

8.1.2 ALGORITHM FIXED TIME

Algorithm «Fixed time» provides obtaining the average value of measurement value with fixed time interval.

«Fixed time» is more easy and more frequently algorithm. The setting of value for algorithm parameter is set the duration of algorithm (exposure) in seconds. The range of available values is from 3 to 9999 seconds inclusive.

The visual difference of algorithm «Fixed time» from algorithm «Tracking» – countdown of measurement in reverse sequence, that is indication of time before finished measurement. After finished measurement the console plays melody «Restart measurement».

Further operation of console is depended from state of flag «Autosave» and parameter N «Stop after N measurement»:

- **«Autosave» off, N=0.** After finished measurement on display during three seconds:
 - indication of measurement result;
 - in information line of icon ► changes on ||;
 - not display the measurement time (Figure 70).

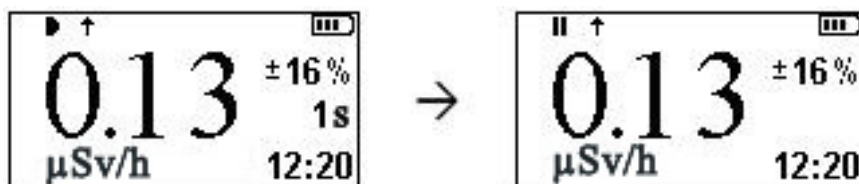


Figure 70. Final second of measurement and indication results

Start the new measurement.

While indication of indication result the action ► to save the measurement results in archive.

- **«Autosave» on, N=0.** After finished of measurement
- The melody of restart measurement sounds (hear in **Settings** → **Help** → **Sound** → **Saved measurement**).



For dual-channels of detecting blocks while activated windows of primary and additional measurement the automatic saved is provided the two records simultaneously in archive: by primary and additional channel.

It is indicated during three seconds on the display:

- indication of measurement result;
- in information line icon ► changes of ||;
- right from the measurement result of indicated the number created in archive (Figure 71).

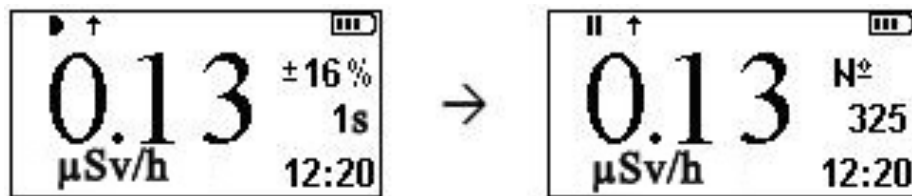


Figure 71. Final second of measurement and indication of saved value

The melody of restart measurement sounds (hear in **Settings**→ **Help** → **Sound** → **Restart measurement**), start of new measurement.

- **«Autosave» off, N=1.** After finished of measurement the melody of restart sounds. On display in three seconds:
 - indication the measurement result; μ
 - in information line the icon ► is changed on ||;
 - not display the measurement time.

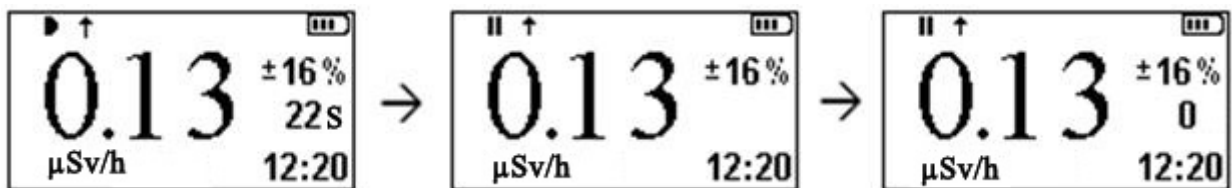


Figure 72. Final second of measurement, indication of saved value, pause

On the display is indicated the measurement time which is equaled the zero (Figure 72) – the console is switched to the mode «Pause». In this time it is possible the following actions of operator:

- ► – save the measurement result in archive and start new measurement;
- || or ⊙ – start the new measurement; μ
- **«Autosave» on, N=1.** After finished the measurement the melody or restarts sounds, saving results in archive, sounds the melody of saved measurement. On display during nearly three seconds it is shown the measurement time which is equaled the zero (Figure 72), the console is switched in mode «Pause». In this time action ►, ⊙, or || start the new measurement.
- **«Autosave» on, N>1.** The series from setting of measurement quantity, after that the console is switched in mode «Pause». The action ►, ⊙, or || start the measurement.

8.1.3

ALGORITHM WITH FIXED TOLERANCE

Algorithm «Fixed tolerance» provides obtaining the measurement result with fixed value of measurement uncertainty u which is equalled 6%. Calculation of uncertainty is performed as follows:



where N is a number of registered pulses from the start of measurement. It makes the conclusion from it said above and shown correlation that the measurement time is indefinite and finished the process of registration no less 1111 pulses.

The algorithm has one parameter, restricted the maximum duration of measurement. Upon the setting of parameter value equal to zero, limitation for measurement time interval is withdrawn. In case of non-zero value of measurement parameter is finished by the first event – or obtaining the measurement result with uncertainty equal to 6%, or finish the maximum measurement time.

Algorithm operation is connected with flag «Autosave» and parameter N «Stop after N measurement» in according to described in p. 8.1.2.

8.1.4

MEASUREMENT MODE OF AVERAGE COUNT RATE

The setting of console for operation in measurement mode of average count rate is provided from menu **Settings** → **Coefficients** → **Units of measurement** for single-channel detection block, or from menu **Settings** → **Primary channel** → **Coefficients** → **Units of measurements** for dual-channel and dual-range detection blocks. It should select the units of measurement « s^{-1} ». In this mode the input pulses from the detection block without preliminary transformation (Sensitivity s , Dead time) is transferred the processing algorithm.

In measurement mode of average count rate the console MKS-08 can use any of possible necessary calculation algorithm of primary and secondary mode of measurement.

For example. It is necessary to measure the average count rate of pulses for detecting block for 100 seconds. It should be:

- *select of measurement unit « s^{-1} »;*
- *select of measurement algorithm «Fixed time», with measurement time 100 seconds;*
- *for easy possible of set flag «Autosave» and parameter «Stop after N measurement» $N=1$.*

MKS-08 is ready to provide measurement as cytometer.

8.1.5

SCALER MODE

Providing measurement in scaler mode is realized with use of program «TETRA_Tester» by means of connection MKS-08 to PC.

8.2 RATE RADIATION LEVEL OF CONTAMINATION. THRESHOLD MODE

It is existed of tasks, requirements to provide the threshold rate of contamination level. The specific description of tasks and methods for providing measurement are shown in standard and methodical documentations [5 - 11].

Operation in Threshold mode can be useful while provide of various kind of activities in according of methods [5 – 8].

Measurement algorithm is pointed for use MKS-08 by common users for providing rapid analysis of contamination for monitoring freight, rocks and etc. in according with preliminary setting threshold. It provided for minimal possible time interval and indicated the diagnostic message, which is based on the result of comparison the measurand with setting threshold.

Threshold mode is allowed to provide the rapid rate of contamination for monitoring objects regarding to one, two or three thresholds - – «Upper», «Preliminary» и «Below». In according with quantity of used algorithm threshold the algorithm is provided the threshold of difference results.



Threshold mode used in operation only own thresholds (p. 9.4).



Comparison results of measurement for mode Threshold is not connected with generation of signals for alarm mode of primary measurement and messages in information registers DiBUS.

The console generates the message while setting only upper alarm threshold:

- «Dirty» – exceeded the upper threshold;
- «Norma» – measurement value is below of upper threshold.

The console generates the message while setting of alarm threshold and preliminary threshold:

- «Dirty» – exceeded the upper threshold;
- «Norma» – measurement value is below of upper threshold;
- «Clear» – measurement value is below of preliminary threshold.

The console generates the message while setting upper threshold, preliminary and below:

- «Dirty» – exceeded the upper threshold;
- «Norma» – measuring value is below of upper threshold;
- «Clear» – measuring value is value of preliminary threshold.
- «Clear!» – measuring value is under of below threshold.

The quantity of used thresholds in mode «Threshold» is any. It is important of setting:

- one threshold – alarm;
- two thresholds – alarm and preliminary;
- three thresholds – alarm, preliminary and below.

Necessary condition of correlation – alarm threshold is more preliminary, preliminary is more below.

Measurement result is information message on the console display (Figure 73):

- «DIRTY» – value of contamination level is upper alarm threshold;
- «NORMA» – value of contamination level is below alarm threshold, but is upper of preliminary threshold;
- «CLEAR» – value of contamination level is below the preliminary threshold, but upper threshold;
- «CLEAR!» – value of contamination level is below of below threshold.

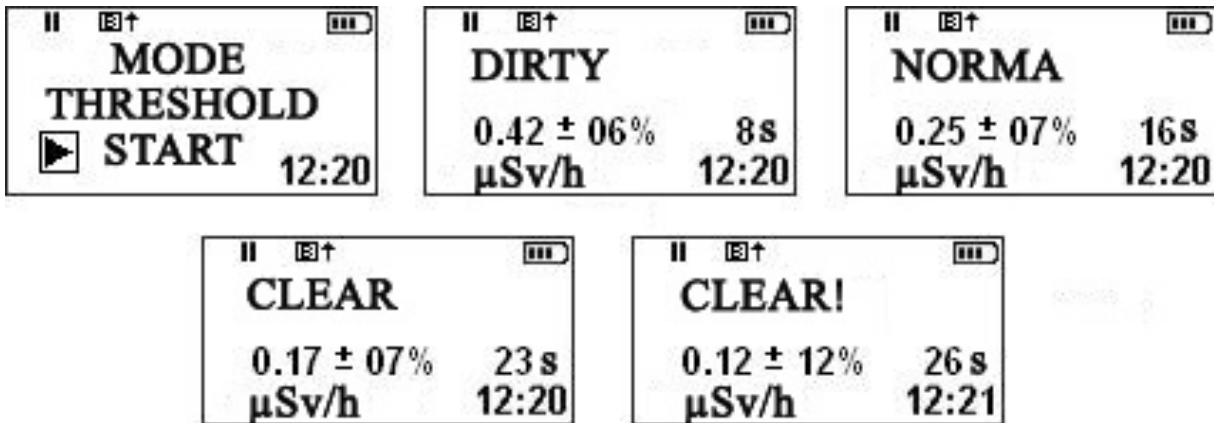




Figure 73. Display of measurement results in mode Threshold

Measurement in Threshold mode can provide also with compensation (subtraction from measurement result) preliminary measurement background. While providing measurement without compensation background in information line of display to show icon . With measurement background to display the icon  is stopped.

Below it explains to use the features of measurement background in mode Threshold on example the requirements of various methods to provide measurement.

1. To provide engineering radiation-ecological researches [5, 6] with aim of determination the radiation characteristics of soil, required the estimation of DER regarding to absolute threshold.

2. Radiation monitoring of scrap metal on the open control area is provided by means of increment DER to average value of nature gamma-background area [7, 8].

So, the measurement in mode Threshold for first case needs only the preliminary set of alarm threshold. For second – set of alarm threshold and, additionally, the measurement of average value for nature gamma-background. In second case the threshold will be compare with DER of monitoring object without accommodation of nature gamma-background.

8.3 SEARCH RESOURCES OF INOZATIION RADIATION

One of the main advantages MKS-08 can be considered the set of research features, used in the mode «Search», «Detection». The use in these modes of high sensitivity detection blocks (BDVG-96, BDPG-96, BDPG-96m) is made by MKS-08 the effective search tool, suitable for application on customs and frontier control point, in building, on the metallurgy plants and plants for stores and processed scrap. [5 – 8].

The aim of mode «Detection» - detection of increase intensity for gamma-radiation with regard to registered background while research territories and objects.

Mode «Detection» operates effective with search detection blocks – BDVG-96, BDPG-96, BDPG-96m.

Operation algorithm is based on the continuous static analyze flow of registered events. The results of algorithm operation are shown on the display of console in the view of vertical columns on the moving diagram. The volume of diagram is allowed to display the results of last 96-th of measurements (by 8 measurements, all 12 seconds). While of high processing speed of received information the moving speed of detecting block under monitoring surface can reach 0.5 m/s without damage of research quality.

Naturally, the operation results of such algorithm on account of high intensively of change values can't show in the numerical view. In this case the more suitable approach of displayed the information is used in view as the oscillograph. The information on the diagram has time of full renew for 12 seconds. The operator is given ability to concentrate on the quality «delimitation» of research object. It is enough to track for the measurement results one in the several (8-10) seconds, shown on the console display.

The displayed of count rate on the display helps the numerically appreciate the increment degree of radiation rate in separately point of monitoring point.

The result of every 1/8 seconds measurement is displayed the column on the diagram. The altitude of column is proportional the extension activity of gamma-radiation accordingly the registered background.

In the process of background measurement on the diagram is possible of occurrence the separately rare columns of various altitude (Figure 74). The sound alarm is accompanied the every of considerable column (more half of possible latitude) the typical single signal.

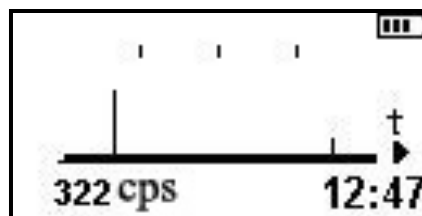


Figure 74. Mode «Detection». View of window while measurement of background value for dose rate

The occurrence of several successive columns (and, accordingly, several sound signals) is indicated about fixed exceeded of activity radiation under early registered background with probability no less 0,997.

Figure 75 can show registered of exceeded activity radiation from four to eight seconds back (as all fields of scale 12 seconds, and events are nearly the middle of scale).

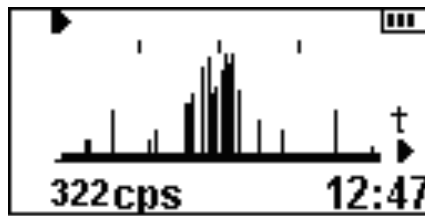



Figure 75. Mode «Detection». View of window while registration of exceeded activity radiation

Mode «Detection» is effective while research of transport, loads, luggage by frontier and customs services, research of scrap metals.

8.3.2

SEARCH MODE

The application of mode – designation of search, search and localization of radiation resources. In search mode the operator, used the evaluation of valuation criteria «larger – less», determinate the detection of search research for exceeded radiation. Because, while providing «reconnaissance on place» peculiar meaning has the value of fixed maximum value and possibility of repeated determination the place of providing measurement.

Naturally, this main information loading is given the dynamic scale. The developer's discovery of this mode, greatly easy the process of research and increase its visual, the ability of designation on the dynamic scale of last fixed maximum measurement – sign  (Figure 76). The operator of dosimeter-radiometer, moves on the research area, can easy come back to the place of fixed maximum value and continue to search in the right direction.

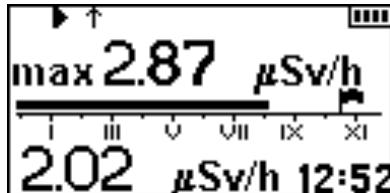




Figure 76. View of window in mode «Search»

The operation in the mode Search begins from the measurement of gamma-background from the starting point. After that the operation of search mode begins with the display of following information (top-down):

- maximum fixed dose rate of gamma-radiation in the current search series;
- dynamic scale of search mode. The scale is displayed the current dose rate of gamma-radiation, which relative to the value of fixed background, and maximum dose rate, fixed in current search series ();
- current measurement of dose rate value.

As it approached to the source of exceeded radiation of dynamic scale can be filled. In this case  is provided the measurement background, after that the search continues in the conditions of more intensive radiation.

8.4 COMBINATION OF MEASUREMENT MODE

Owing to the easy of switch windows of primary measurement and abilities of setting console by operator, MKS-08 is convenient tool for solve many tasks.

It is convenient and demand of combination the Primary measurement and Detection mode while monitoring of territory and storage of scrap metal [5 - 7]. In this time used Search mode is quickly and effective of find the sources of exceeded radiation value, switch in the mode of Primary measurement is allowed to determinate the numerical value of control value of control object.

It is convenient to compatibility the Primary measurement and Threshold. The Threshold mode is allowed to provide the express-grade the degree of radioactive pollution for research material (for example, storage raw material...), result of Primary mode, if it is necessary, can be used to conclude about the degree of clear material.

8.5 APPLICATION OF MEASUREMENT MODE WITH VARIOUS DETECTION BLOCKS

Table 13 contains general information about possible operation mode of detection blocks MKS-08. Search and Threshold modes are formally permitted for use with any detection blocks. However, practically their use is provided by group of detection blocks for gamma-radiation and by count rate in detection blocks no less 1-2 pulses.

Table 13. Possible measurement modes and search for detecting blocks

Type of detecting block	Measurement mode					
	Primary measurement	Secondary measurement	Dose	Search	Detection	Threshold
BDZA-96	✓					
BDZA-96b	✓					
BDZA-96m	✓					
BDZA-96s	✓					
BDZA -96t	✓					
BDPS-96	✓	✓				
BDZB-96	✓					
BDZB -96b	✓					

Type of detecting block	Measurement mode					
	Primary measurement	Secondary measurement	Dose	Search	Detection	Threshold
BDZB-96s	✓					
BDZB -99	✓					
BMKS-08	✓		✓			
BMKS-08b	✓		✓			
BMKS-08s	✓	✓	✓			
BDKN-96	✓		✓			
BDMN-96	✓		✓			
BDMG-96	✓		✓			
BDPG-96	✓			✓	✓	✓
BDPG-96m	✓			✓	✓	✓
BDVG-96	✓			✓	✓	✓
BDKG-96	✓					

8.6 MEASUREMENT BACKGROUND

The measurement background is provided in mode Primary, Secondary measurement and in the mode Threshold. The measurement value of background is saved in the memory of console to shut down or before change of consequently actions of operator.

In mode of primary measurement and Search in notion «background» and «measurement background» have the various meanings. In this connection of background value, measurement in one mode, is not taken into account.















How often does it make the measurement background? Except of advices from certainly methods by provided measurement and requirements OM MKS-08 the interest observation is made known in report IAEA [19]: «Rain is possible the reason of quick exceeded – on 30% or more – the level of background radiation, that causes the changes of radio concentration radon and products of nuclear decay in atmosphere»

8.6.1 MEASUREMENT BACKGROUND IN MODE OF PRIMARY MEASUREMENT

For some detection blocks in mode of primary measurement is foresighted the ability of measurement background, which stipulated the action of external gamma-radiation, contamination of detection block, or self-background of detector. The detection blocks, which allowed the measurement of background, marks in column «Measurement background»

The subtraction from the result of measurement value, caused by deposit of radiation background, provided automatically. The measurement background should provide before start of measurement and periodically in the process of measurement, from discount of measurement environment and possible external radiation contamination of detection blocks.

About possibility of provided measurement background is signaled the icon  in the information line of display. Start of measurement background is executed by action . The process of measurement background from the moment of indication information message on the display «Measurement background...». In the process of measurement the icon  is indicated in the flash mode. After finished of measurement in information line the icon  changes the icon . The result of measurement is indicated on the display before the operator decides about system of use:

-  – record the result of measurement in memory for automatic compensation, return in mode of Primary measurement. In window of primary icon  is not indicated;
-  – exit from the mode of measurement background, cancellation result – save in memory of result previous measurement background. In window of primary measurement the icon  he is not indicated, if the result of previous measurement differs from zero;
-  – exit from menu of measurement background – record of zero background value in archive. In window of primary measurement the icon  is indicated;
-  – restart of measurement background process.

Listed above the actions, if it is necessary, can be executed in the process of measuring background level.

8.6.2 MEASUREMENT BACKGROUND IN THRESHOLD MODE

The measurement of background in Threshold mode is allowed for all detection blocks. The decision about necessary of preliminary measurement background is made by operator in according with type of providing measurement and accordingly methods of providing measurements.

After background is measurement every value in mode Threshold will be automatically decreased on the value of fixed background.



See also p. 9.4: Threshold in mode Threshold.

9 THRESHOLDS


9.1 THRESHOLDS OF PRIMARY MEASUREMENT

In mode of primary measurement is possible to use the three thresholds:

- Upper alarm threshold of primary mode;
- Preliminary threshold of primary mode ;
- Below threshold of primary mode.

The measurement value is constantly compared with all thresholds. After the results of comparison MKS-08 for every threshold is made the below action.

In case of exceeded of upper alarm threshold:

- generate the sound signal;
- in information line of display is shown the icon the exceeded alarm ;
- form the message in status register [13] about the upper alarm threshold.

In case of exceeded preliminary threshold is based the message about status register about exceeded preliminary threshold.


In case of decrease measurement is lower the below of threshold to form the message in register status.

The operation results with preliminary and below threshold on the display of console MKS-08 is not displayed, the sound messages are not generated.



The threshold is considered to set if its value is different from zero. The zero value setting of any threshold is off of correspondent control.

The threshold for primary mode is used also in the operation of dynamic scale (h. 3.3).

The setting of threshold value is possible from the menu **Settings → Threshold → Window Primary measurement**, or from the menu **Thresholds**, which is activated from menu of primary measurement by action .



In case of units of measurement (menu **Settings → Coefficients → Units of measurement**, or **Settings → Coefficients → Units of measurement → Primary channel** for dual-channels of detection blocks) changes the units of measurement for thresholds, in that time of the early numerical values without changes.



In case of use in operation for several thresholds need keep correlation **Upper alarm threshold > Preliminary threshold > Below threshold**.


9.2 THRESHOLD FOR SECONDARY MEASUREMENT

In mode of secondary measurement it is possible to use one of upper alarm threshold for secondary measurement.




In mode of secondary measurement it can operate the dual-channels of detection blocks (p. 7.4).

The measurement in mode of secondary measurement the value is constantly compared with the upper alarm threshold. In case of exceeded threshold:

- generated the alarm signal;
- in information line of display is shown the icon of upper alarm threshold for secondary measurement ;
- form the message in register status [13] about alarm threshold for secondary measurement.



The threshold is considered to set, in case of the value differs from zero. The setting in zero value is out of correspondent control.

The setting of thresholds values for secondary measurement is possible from menu **Settings** → **Thresholds** → **Secondary measurement**, or from menu **Threshold**, which is activated from window of secondary measurement by action .



While of change units of measurement (menu **Settings** → **Coefficients** → **Units of measurement** → **Secondary channel**) change the units of measurement for threshold, in this time the entered numerical value without changes.


9.3 THRESHOLD OF DOSE MODE

In dose mode it is possible to use the one upper alarm threshold for dose threshold.



In dose mode can be operate the detection blocks, marked ✓ in column Dose Table 13.

The measurement dose is constantly compared with upper alarm threshold. In case of exceeded threshold:

- generate of sound alarm signal;
- in information line of display is shown the icon of upper alarm threshold on dose ;
- form the message in status register [13] about upper alarm threshold on dose.



The threshold is considered to set if its value differs from zero. The setting in zero value is out of correspondent control.

The settings values of thresholds for secondary measurement is possible to execute from menu **Settings → Thresholds → Dose**, or from menu **Thresholds**, is activated from dose window by action

9.4 THRESHOLDS VALUES OF THRESHOLD MODE

It is possible to use the three thresholds in the Threshold mode:

- upper alarm threshold in Threshold mode;
- preliminary threshold in Threshold mode;
- below threshold in Threshold mode.

The thresholds of Threshold mode is only used in time of operation for generation of information message with results.



The threshold is considered to set if its value differs from zero. The setting in zero value is out of correspondent control.

The setting values of threshold is possible from menu **Settings → Alarm thresholds → Threshold mode window**, or from menu **Thresholds**, which is activated by action



While changes the units of measurement (menu **Settings → Coefficients → Units of measurement**, or **Settings → Coefficients → Units of measurement → Primary channel** for dual channels for detection blocks) changes the units of measurement in this time the entered numerical value without changes.



While simultaneously in operation of several thresholds need keep correlation **Upper alarm > Preliminary > Bottom**.

10 ARCHIVE OF THE MEASUREMENT RESULTS

Archive of the measurement results is aimed for saved, display and process of results for primary and secondary measurements. Archive capacity – 2000 records.



The possible operator actions while operation in window Archive is described in p. 3.2. The operator actions for saved measurement results in archive are saved in p.p. 7.3, 7.4. Reading of archive records by personal computer – in p. 6.3.

10.1 DESCRIPTION OF CONTENTS IN ARCHIVE WINDOW

Every record in archive contains the following information:

- number of record;
- type of detection block, which has been provided the measurement;
- measurant;
- units of measurement;
- statistical uncertainty of measurement;
- date and time of provided measurement.

In case of use in structure MKS-08 navigator GPS every record of archive expand the following information about the place of provided measurement:

- geographical longitude;
- geographical latitude;
- altitude above the sea level.

The altitude above the sea level and type of detection block in archive window is not displayed. In full volume of archive information is available after read on the PC (p. 6.3).

Archive window of measurement contains (Figure 77):

1. indicator of records quality in archive;
2. indicator of display archive record;
3. date of creation record (YY / MM / DD);
4. value of measurement value;
5. statistic uncertainty of measurement;
6. units of measurement with scale coefficient;
7. time of creation record (HH : MM);
8. geographical longitude for measurement;
9. geographical latitude for measurement;
10. current time.

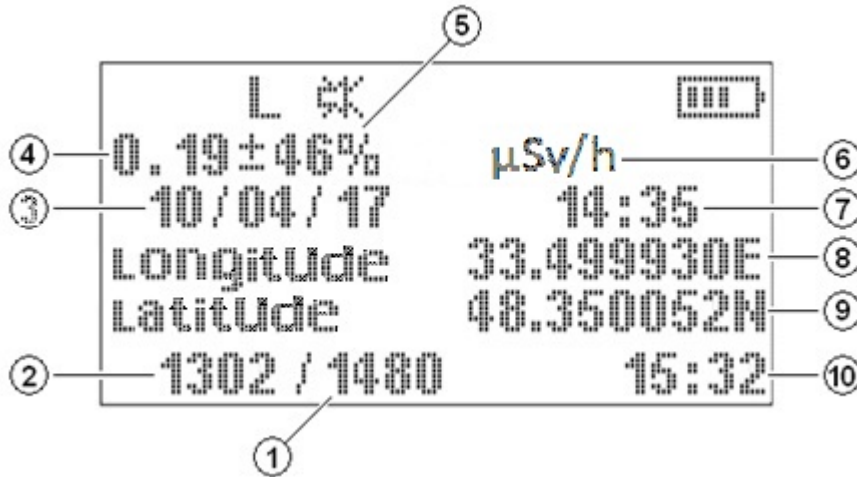


Figure 77. View of window Archive



Save results in archive is only allowed in case of permission of display the archive window in structure of windows for primary measurement.

After switch on MKS-08 the archive window is displayed the date of final saved measurement result. It is clear, while display of final archive record of indicators 1 and 2 is coincided (Figure 78).



Figure 78. Archive window. Indication of last saved record in archive

In case of while indication of Archive window is provided the automatic saved the result of current measurement, it is occurred the automatic update of displayed information (Figure 79). The update moment of displayed information is easy orally controlled – in moment of final measurement and save the melody after saved «Restart measurement».



Hearing of sound messages is available in menu **Settings** → **Help** → **Sound**

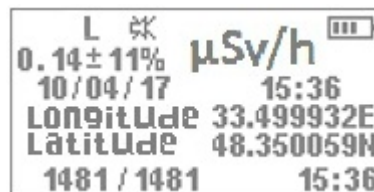


Figure 79. Archive window. View of window after saved of measurement results

If in archive window is displayed no last record, the updated of image while saved the current measurement is not provided The additional and service features are available from menu «Service», which is activated from archive window by action ㄹㄹㄹ.

Menu «Service» is given the additional while operation with archive. Menu contains the following points:

- Start (1 – xxxx);
- Finish (1 – xxxx);
- Statistic;
- Clear archive,

where xxxx – number of final record in archive.

The first three points of menu are connected between one another. The point «Start» and «Finish», as result of name, is allowed to set the scopes of interval for archive records, from which make calculation and indication values:

- minimal measurement in indicated range;
- maximum measurement in indicated range;
- average normal of measurement;
- average quadratic deviation.

The view of window «Statistic» is shown on Figure 80.

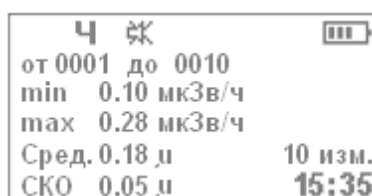


Figure 80. Window "Statistic"

The point «Clear archive» is allowed to provide the full clean of archive.

11 MENU MKS-08

In this section it is described all possible menus of console -96 in the maximum capacity, which the short description is indicated in p. 1.3 and p. 1.4.

Console MKS-08 is given ability of activity and operation in the following menu:

- menu «Settings»;
- menu «Algorithm» for primary mode;
- menu «Threshold» for primary mode;
- help window for primary mode.

11.1 MENU «SETTINGS»

Menu Settings – main and full menu MKS-08. The volume of menu is formed in depending from type of connected detection block, owing to contains from the points which need for this modification MKS-08.

In menu Settings the operation with every detection from the supply set of dosimeter-radiometer MKS-08 occurs separately.





Menu Settings for every detection blocks allows:

- set the value of calibration coefficients;
- select of necessary algorithm for primary measurement mode;
- set the value of threshold;
- form the set of windows for primary operation mode;
- receive the various type of notes about MKS-08.

Menu Settings is activated from the manual-off position MKS-08 by action  .

In full view the view of menu Settings is shown in Annex 2. Procedure of actions «Settings»



In text, in case of references on the point of menu, used such designations. For example, the following line **Settings → Help → Keypad → General** is shown about availability in menu «Help». In part «Help» contains the menu «Keypad», and etc. From the view of operator such record is shown that enter in menu «General» it is possible to enter in menu «Settings», select by actions  or  point «Help», enter in menu «Help» by action , and as it is to the gained of the aim – menu «General». Return to the menu of upper level is executed by action .

Menu Settings contains from the following menu:

- Settings;
- Threshold;
- Algorithm;
- Coefficients;

- Help.

11.1.1

MENU «CONFIG»

«Config» is allowed to determinate the set of windows for primary measurement, and also:

- allow / prohibit to display the dynamical scale;
- correction of date and time in internal clock of console;
- restore of factory setting in consol.

Menu Settings in maximum value consists the following points:

- Window of Primary measurement;
- Dose window. This point is available in menu Settings for the models MKS-08¹, marks the symbol ✓ in column «Dose» Table 13;

• Window of Secondary measurement. This point is available in menu Settings for the models MKS-08, marks the symbol ✓ in column «Secondary measurement» Table 13;

- Search window;
- Threshold window ;
- Window Detection. This point is available in menu Settings for the models MKS-08, marks the symbol ✓ in column «Detection» Table 13;

• Archive window;

• Dynamic scale. Allow / prohibit to display the dynamical scale provided for available models MKS-08;

- Date and time;
- Turn on 90. It is allowed to choice the necessary turning of image on the console display.

The option is broadly used with console UIK-06 (p.);

• Factory settings. Return to factory settings is provided simultaneously for all available models MKS-08. The list of parameters factory settings is in Annex 3. Factory settings . Restore of factory settings is not deal the calibration coefficients of detection blocks and thresholds (p. 11.1);

• Baud rate. It is allowed to set of exchange rate with PC, or external master-device by RS-232;

- Gaud GPS;
- Language. It is allowed to select the interface language of console and exchange with external devices.

¹ The model MKS-08 means the type of connected detection block to the console.



At presence the consoles support the two languages – Russian and English. If it is necessary the list of support languages can be extend.

11.1.2

MENU «THRESHOLDS»

Menu «Thresholds» is allowed to set all possible thresholds for certainly modification MKS-08. The points contain from the name of measurement modes (windows names), which this thresholds relative:

- Window for Primary measurement. In window Primary measurement it is possible to set the following thresholds:
 - «Alarm» – upper alarm threshold;
 - « Preliminary » – preliminary threshold;
 - «Below» – below threshold;
- Dose window;
- Window for Primary measurement;
- Threshold window. In menu Thresholds is possible the setting of following thresholds
 - «Alarm (Threshold)»;
 - «Preliminary (Threshold)»;
 - «Below (Threshold) ».

The setting of not zero the value of threshold the reason is automatically off the threshold control of measurement mode. The setting value in zero – off.

The units of measurement for thresholds for Primary, Secondary and Threshold mode of measurement is correspondent of measurement units, selected in **Settings → Coefficients → Units of measurement** (p. 11.1).

While change of units of measurement it should correct the values of thresholds for Primary, Secondary and Threshold modes of measurement.

11.1.3

MENU «ALGORITHM»

Menu «Algorithm» is allowed to choose one from setting algorithm of measurement in console MKS-08 for primary and secondary operation modes:

- Tracking;
- Fixed time;
- Fixed tolerance.

Description of algorithm is shown in p. 8. Except this menu «Algorithm» contains the points:

- Autosave. The mode Autosave permit / prohibit automatic saved of every finished measurement in memory of measurement archive. Operation Autosave is connected with use algorithm;

- Stop after N measurements. It is allowed to provide continues series from N measurement with stop after finished. Setting N in 0 this mode is off.

11.1.4

MENU «COEFFICIENTS»

In menu «Coefficient» open the access to the verification coefficients, which provides the metrological characteristic MKS-08. Because enter in «Coefficients» is protected by password.

Menu volume «Coefficients» is very depends from modification MKS-08 (p.), and for modification with dual-channels, or dual-range of detection blocks (Annex 4. Types of detecting blocks) is divided on two menus: «Primary channel» and «Secondary channel».

Menu «Coefficients» for various types of detection block can contains from following points:

Type of detecting block in modification MKS-08		
Single-channel	Two-channel	With two measurement channels
	Main channel:	Main channel:
<ul style="list-style-type: none"> • Sensitivity coefficient 	<ul style="list-style-type: none"> • Sensitivity coefficient 	<ul style="list-style-type: none"> • Sensitivity coefficient
<ul style="list-style-type: none"> • Dead time 	<ul style="list-style-type: none"> • Dead time 	<ul style="list-style-type: none"> • Dead time
<ul style="list-style-type: none"> • K1 	<ul style="list-style-type: none"> • K1 	<ul style="list-style-type: none"> • K1
<ul style="list-style-type: none"> • K2 	<ul style="list-style-type: none"> • K2 	<ul style="list-style-type: none"> • K2
<ul style="list-style-type: none"> • K3 	<ul style="list-style-type: none"> • K3 	<ul style="list-style-type: none"> • K3
	<ul style="list-style-type: none"> • Compensation coefficient 	
<ul style="list-style-type: none"> • Units of measurement 	<ul style="list-style-type: none"> • Units of measurement 	<ul style="list-style-type: none"> • Units of measurement
	Additional channel:	Additional channel:
	<ul style="list-style-type: none"> • Sensitivity coefficient 	<ul style="list-style-type: none"> • Sensitivity coefficient
	<ul style="list-style-type: none"> • Dead time 	<ul style="list-style-type: none"> • Dead time
	<ul style="list-style-type: none"> • K1 	<ul style="list-style-type: none"> • K1

Type of detecting block in modification MKS-08		
Single-channel	Two-channel	With two measurement channels
	<ul style="list-style-type: none"> • K2 	<ul style="list-style-type: none"> • K2
	<ul style="list-style-type: none"> • K3 	<ul style="list-style-type: none"> • K3
	<ul style="list-style-type: none"> • Units of measurement 	<ul style="list-style-type: none"> • Units of measurement

11.1.5

MENU «HELP»

Menu «Help» contains from following points:

- Keypad;
- Sound;
- Display;
- Software version;
- Producer info.

Information windows, such as **Settings → Help → Keypad → Primary measurement window**, or **Settings → Help → Display** (Figure 6), can contain in upper right and upper down the figure «↑» and «↓». These messages is aimed for inform of operator that except of display information having some parts of information, which is available by press ↑ or ↓ accordingly.

KEYPAD

It contains the full information about operation with the console keypad in all modes, notably:

- All windows;
- Set value;
- Primary measurement window;
- Dose window
- Secondary measurement window;
- Background window;
- Search window;
- Threshold mode window;
- Detection mode window;
- Archive window.

The window is activated by enter in any from this points, contains the full description of features for use the keypad in specific operation mode. The actions are executed in every window, described in information windows of point «All windows». The view of window is shown on Figure 5.

SOUND

«Sound» contains the list of all sound messages (melodies), accompanied the operation MKS-08:

- Upper alarm threshold;
- Upper alarm threshold on dose;
- Measurement restart;
- Search, Alarm mode;
- Switch to the low sub-range;
- Switch to the high sub-range;
- Low battery;
- Save measurement.

After activation of any points is displayed the melody of correspondent event.

DISPLAY

In the help window «Display» gathers the figures and description all information display lines (p. 3.3).

PROGRAM VERSION

After activation this point on the display of console is shown the information about the program version in the processor of console and version of display program (Figure 81).

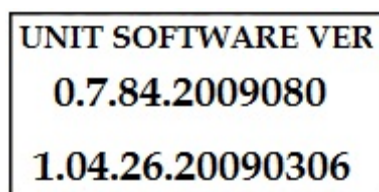


Figure 81. Information window "Program version"

This information can be useful in various situations, including, in case of determination of update software version.

PRODUCER INFORMATION

After activation this point on the display of console is shown the production logotype and contact information (Figure 82).



Figure 82. Information window "Producer info"


11.2 SUBSIDIARY MENU FOR PRIMARY OPERATION MODE

In main mode, for the convenience of operator, used the possibility of activation several auxiliary menu and separately menu parts «Settings»:

- menu «Threshold»;
- menu «Algorithm»;
- help window.


11.2.1 ACTIVATION MENU «THRESHOLD»

In mode of primary and secondary measurement, dose mode and threshold it is used the possibility of operation activation menu «Thresholds» (operation menu with thresholds) in volume, necessary for current measurement mode.

Activation menu «Thresholds» is executed by action  (Figure 83). While execution of this action from window of primary measurement is executed the activation the menu «Thresholds», contains from points:

- Alarm;
- Preliminary;
- Below.

The menu is allowed to correction the values all thresholds for primary measurement mode.

Return in activated menu is activated by action .

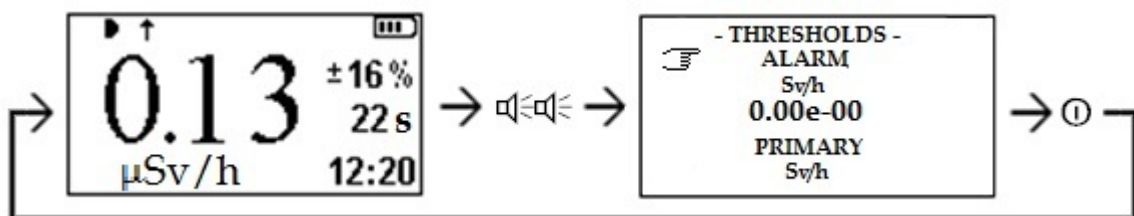



Figure 83. Activation menu "Threshold" from the window of primary measurement

While execution action  from window of secondary measurement is possible correction of alarm threshold for secondary measurement, from window dose – threshold dose, from window Threshold mode – alarm, preliminary and below thresholds.

11.2.2 ACTIVATION MENU «ALGORITHM»

In mode primary measurement is provided ability of efficient algorithm selection and correction of algorithm's parameters.

Activation menu «Algorithm» is executed the action $\Downarrow\Downarrow$ (Figure 84). By execution of this action from the window of primary measurement is executed the activation menu «Algorithm», contains from points:

- Tracking;
- Fixed time;
- Fixed tolerance;
- Autosave;
- Stop after N measurements.

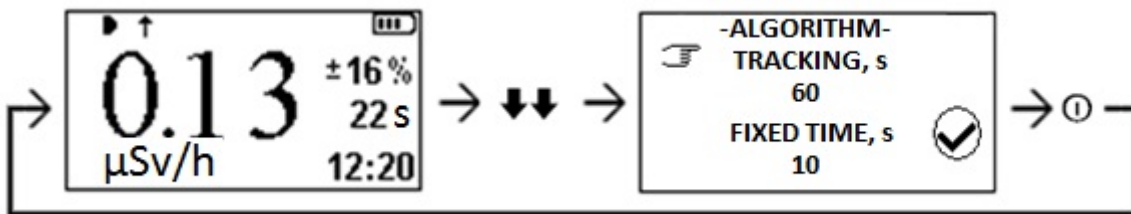


Figure 84. Activation menu "Algorithm" from window of primary measurement

The description of algorithms is shown in p. 8. Use of flag «Autosave» and parameter «Stop after N measurement» in p. 7.3. $\mu\text{Sv/h}$

Return in window of primary measurement is executed action $\textcircled{\text{O}}$.



Algorithm, selected in window of primary measurement, is automatically chosen and for operation in window of secondary measurement.

11.2.3

WINDOW HELP

The great help with operation MKS-08 is provided **Help Window**. The Help windows are activated from any window of main operation mode. Supplemental information, displayed in these windows, contains only necessary information for current of measurement mode.

For more details, the help window is described in p. 1.3.

ACCESSORIES

CHARGER

It is used with consoles UIK-05 and UIK-06 for charger of accumular elements. The process of charge is not excluded the possibility of operation with MKS-08 (Figure 85).



Figure 85. Charger

CAR CHARGER

It is used with consoles UIK-05-01 and UIK-06 for charger of accumular elements. The process of charge is not excluded the possibility of operation with MKS-08 (Figure 86).



Figure 86. Car charger

LEATHER BAG

It is used with console UIK-06. It is allowed to fix the console on belt, or the operator wrist.



Figure 87. Lather bag



Figure 88. Lather bag. Back view

SUPPORT FOOTING



Figure89. Support footing

It is used with the console UIK-05 (Figure89). Setting the support footing is provided for comfortable operation with MKS-08 in laboratory conditions (Figure 90). It is easy to plug on the console and unplug. The bonding technique is magnet.

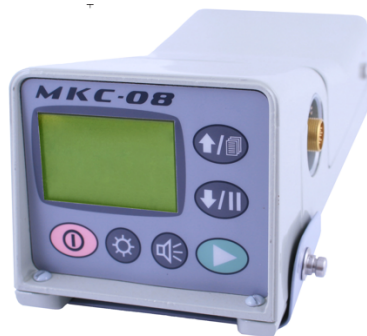


Figure 90. Desktop variant MKS-08

CABLE-ADAPTER FOR CONNECTION OF SENSOR GPS

It is used with the consoles UIK-05 and UIK-06 while providing of monitoring area with application of sensor GPS (Figure 91).



Figure 91. Cable-adapter for connection of sensor GPS

EARPHONES

It is used with consoles UIK-05 and UIK-06. It is allowed to control the activity of registered radiation orally in the conditions of high level noise (Figure 92).



Figure 92. Earphones

CABLE-ADAPTER «PI-03»

It is used with consoles UIK-05 and UIK-06. It is allowed to connect MKS-08 to PC, reading data from archive of measurement, registered process and results of measurement with use technological software [15] and user's software (Figure 93).



Figure 93. Cable-adapter PI-03

SOFTWARE CD

It is supplied with the set of cable-adapter PI-03. It contains the set of technological and specialized software (Figure 94).



Figure 94. Software CD

ACCUMULATOR POWER BOX

It is used with the console UIK-05. The accumulator power box is alternative battery power box (Figure 95).



Figure 95. Accumulator power box

SET OF ACCESSORIES FOR BEARING OF CONSOLES

It can supply the various straps with UIK-05 and UIK-06 for comfortable bearing and fixing of consoles in the operation process (Figure 96 – Figure99).



Figure 96. Neck belt for carry of console UIK-05



Figure97. Neck belt for carry of console UIK-06

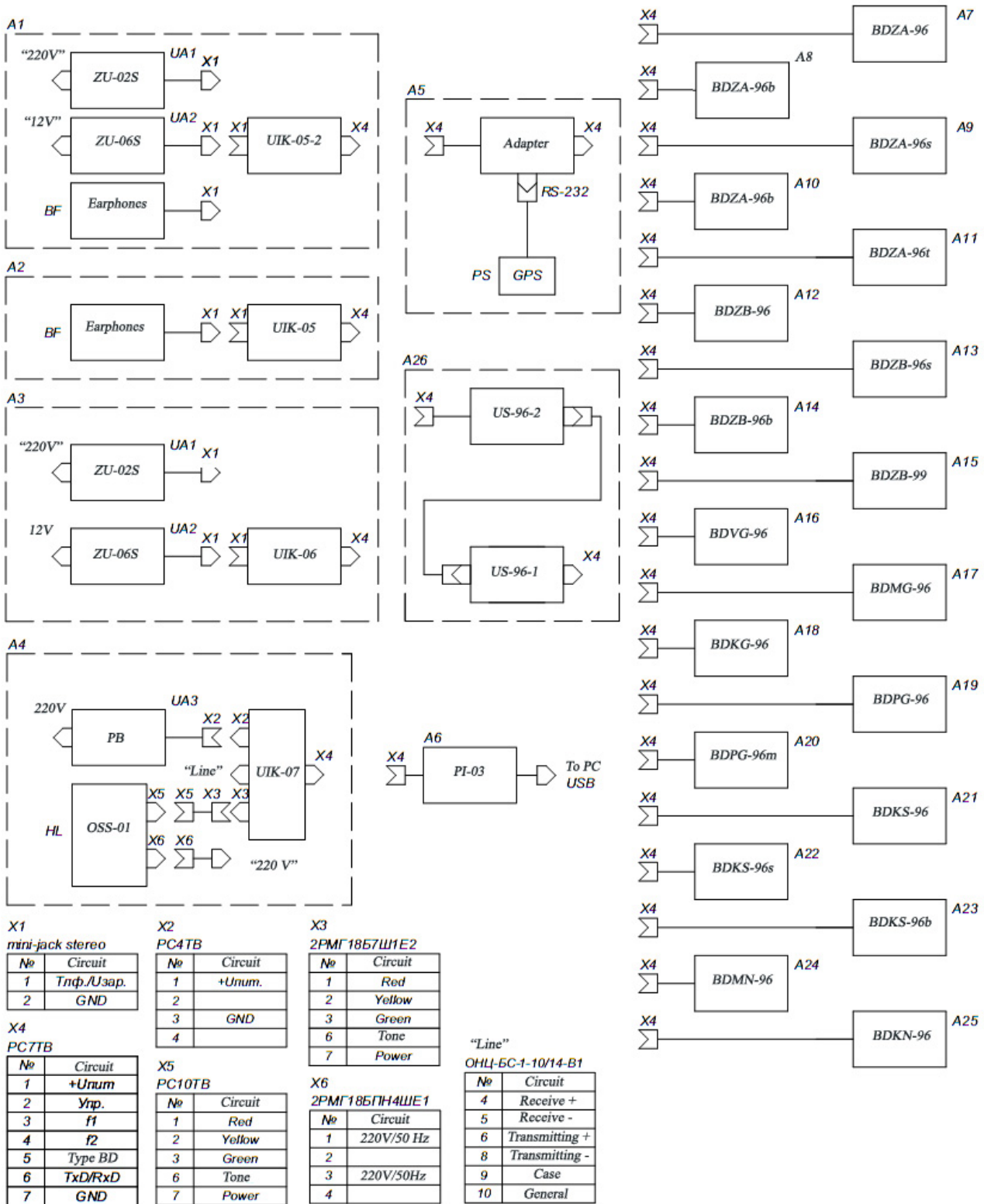


Figure 98. Small belt for carry of console UIK-06

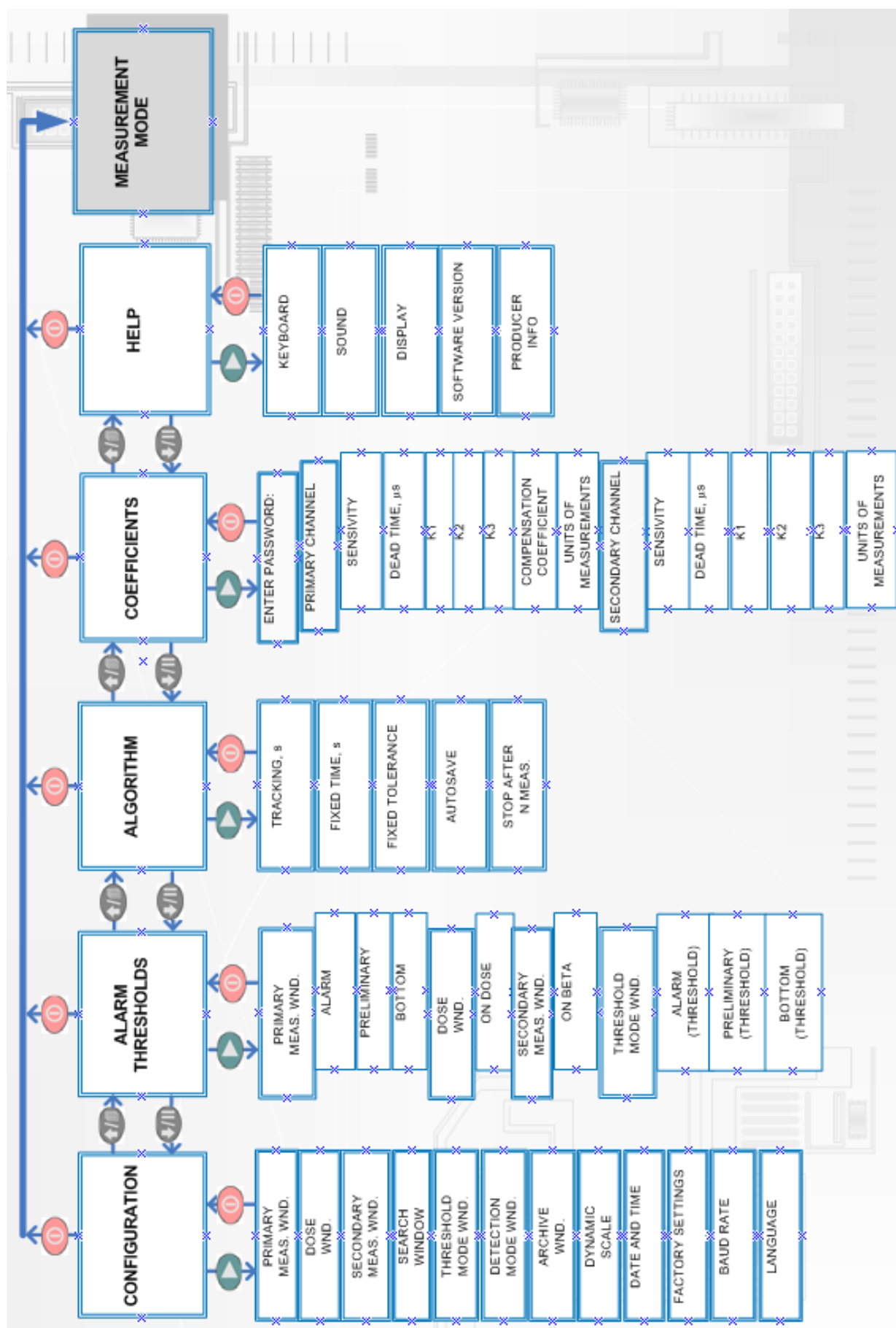


Figure99. Wrist belt with sticker for console UIK-06

ANNEX 1. DOSIMETER-RADIOMETER MKS-08. CONNECTION LAYOUT



ANNEX 2. PROCEDURE OF ACTIONS «SETTINGS»



ANNEX 3. FACTORY SETTINGS

Detection block	Indication window							Units of measurement		Dynamic scale	Algorithm	Measurement time	Autosave period. (Tracking), s	Autosave	Baud rate RS-232 (baud)	Measurement time, (Threshold), s	
	Background	Primary measurement	Dose	Secondary measurement	Search	Threshold	Detection	Archive	Primary channel								Secondary channel
BDZB-96	x	✓			x	x		x	ppm ⁻¹ cm ⁻²		Off	With fixed time	8	60	x	9600	30
BDZB-96s	x	✓			x	x		x	ppm ⁻¹ cm ⁻²				10	60	x		
BDZB-99	x	✓			x	x		x	ppm ⁻¹ cm ⁻²				8	60	x		
BDZB-96b		✓		x	x	x		x	ppm ⁻¹ cm ⁻²				10	60	x		
BDMG-96		✓	✓		x	x		x	Sv/h	Sv/h			24	60	x		
BMKS-08	x	✓	✓		x	x		x	Sv/h	Sv/h			10	60	x		
BDPG-96		✓			x	x	✓	x	Sv/h				10	60	x		
BDPG-96m		✓			x	x	✓	x	Sv/h				20	60	x		
BDVG-96		✓			x	x	✓	x	Sv/h				10	60	x		
BDMN-96		✓	x		x	x		x	Sv/h				20	60	x		
BMKS-08s		✓	✓	✓	x	x		x	Sv/h	ppm ⁻¹			24	60	x		
BDKG-96		✓			x	x		x	Sv/h				10	60	x		
BDZA-96s	x	✓			x	x		x	ppm ⁻¹ cm ⁻²				30	60	x		
BDZA-96t		✓			x	x		x	ppm ⁻¹ cm ⁻²				20	60	x		
BDZA-96m	x	✓			x	x		x	ppm ⁻¹ cm ⁻²				40	60	x		
BDZA-96	x	✓			x	x		x	ppm ⁻¹ cm ⁻²				20	60	x		
BDZA-96b	x	✓			x	x		x	ppm ⁻¹ cm ⁻²				10	60	x		
BDPS-96 (alpha)		✓			x	x		x	ppm ⁻¹ cm ⁻²				20	60	x		
BDPS-96 (beta)	✓			✓	x	x		x		ppm ⁻¹ cm ⁻²			20	60	x		

✓ - window is opened by default; x - window is closed by default.

ANNEX 4. TYPES OF DETECTING BLOCKS BY COUNTING CHANNELS

Designation	Type of first channel	Type of second channel	Switch of channels	Main unit of measurement	Quantity cable cords	Measurement time of background
BDZB-96	beta			ppm*cm ⁻²	3	30
BDZB-96s	beta			ppm*cm ⁻²	3	30
BDMN-96	neutron			Sv/h		
BDKN-96	neutron			Sv/h	3	250
BDZB-99	beta			ppm*cm ⁻²	3	30
БДЗБ-96Б	beta			ppm*cm ⁻²	3	30
BDMG-96	gamma (H)	gamma	auto	Sv/h	4	
BMKS-086	gamma (H)	gamma (L)	auto	Sv/h	4	
BMKS-08	gamma (H)	gamma (L)	manual	Sv/h	4	30
BDPG-96	gamma			Sv/h	3	
BDPG-96m	gamma			Sv/h	3	
BDVG-96	gamma			Sv/h	3	
БДМН-96	neutron			Sv/h	3	
BMKS-08c	beta+gamma	gamma		Sv/h	4	
BDKGF-96	gamma			R/h	3	
BDZA-96s	alpha			ppm*cm ⁻²	3	100
BDPS-96	alpha	beta+alpha		ppm*cm ⁻²	4	
BDZA-96t	alpha			ppm*cm ⁻²	4	
BDZA-96m	alpha			ppm*cm ⁻²	3	100

Designation	Type of first channel	Type of second channel	Switch of channels	Main unit of measurement	Quantity cable cords	Measurement time of background
BDZA-96	alpha			ppm*cm ⁻²	3	60
BDZA-96b	alpha			ppm*cm ⁻²	3	30
BDPS-96	alpha+ beta	beta		ppm*cm ⁻²	4	30

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