

GAMMA Surveyor

User Guide v 1.2



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Introduction

Gamma Surveyor is a new group of multi-channel gamma-ray spectrometers designed for measurements of natural and artificial radioisotopes in ground, boreholes and laboratories. This group of instruments covers a wide range of devices from radiameters and compact handheld instruments to general purpose sets for field, borehole and carborne surveys using various probes and types of detectors.

Gamma Surveyor is a useful tool for searching for radiation sources, dose rate and gamma-ray spectra measurements, determination of concentrations of elements (especially K, eU, eTh) and for other applications in radiation monitoring, geophysical mapping, geological studies, surveys for mining, laboratory analyses of samples etc.

Gamma Surveyor offers three basic measuring modes:

- quick and selective searching for gamma-ray sources
- precise radiometric measurements
- spectral measurements with determination of K, eU, eTh concentrations

The measuring system supports point, profile and continuous measurements with the use of external GPS data.

The methodology is based on the recommendation of IAEA (International Atomic Energy Agency). The factory calibration is done on high-volume standards. (For more detailed information see IAEA: Guidelines for radioelement mapping using gamma ray spectrometry data, IAEA-1363, 2003.)

Warning:

The instrument is equipped with a scintillation detector.
Avoid strong mechanical and temperature shocks!

Control Unit



Power Supply

The instrument can be supplied from internal lithium batteries, using AC adapter or from the 12 V car socket or other external 12 V/2 A source. For external power supply the connector „External power“ is to be used.

If the instrument is supplied from the internal batteries, their condition is indicated in the upper right corner of the display.

Battery Charging

The battery charging is activated automatically when an external power source is connected to the instrument. Thus a user can charge the batteries either from a mains source or e.g. in a car.

The status of the battery charging is signalized by the control light next to the display:

- Green colour – charging
- The light is off – charging has been finished

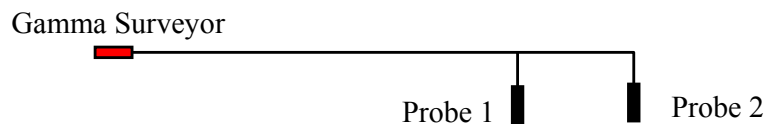
If there is a red or orange control light, the battery is defective and it is necessary to disconnect the external power source immediately and to exchange the battery (To do this press the sides of the battery cover and pull it downwards, exchange the battery pack and return the cover on its original place.)

Connections

Probe Connection

For the measurement with one probe connect the probe and the instrument using the simple connection cable – one (either) end to the connector on the probe, the other one to the right side connector „Probes“ on the instrument.

For measurement with more probes use the connection cable with more connectors according to the figure below.



GPS Receiver Connection

Connect the GPS receiver using its serial port to the connector „GPS receiver“. Set the GPS receiver to the mode for transmitting of the NMEA type data, speed 4800 Bd without parity and activate GGA sentence transmitting.

If the GPS receiver is set correctly, the spectrometer detects the GPS data automatically and displays them in the window for setting of the position.

Connection to PC

To connect the spectrometer and PC use the USB cable and connect it to the „USB“ socket of the instrument and to the related socket of the PC. See chapter Gamma Surveyor software for details.

Basic Operation of the Instrument

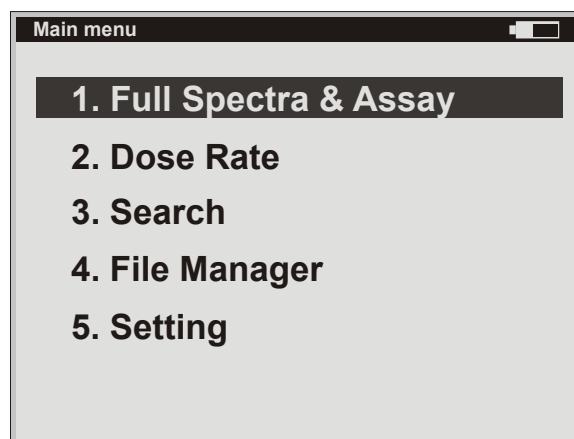
The basic instructions for the operation of the instrument are given in this chapter.

Menu Handling

There are two possibilities how to choose the item from the displayed menu (see fig. below):

- 1) Choose the item using “Up/Down” keys and then press “Yes” key.
- 2) Press the key with the number of the chosen item line. E.g. if you would like to choose the item on the second line, press the key “2”.

For leaving the menu and return press “No” key.



Choice from List of Items

If a list of items (options) is displayed, it is possible to choose one of them using “Left/Right” keys.

E.g. it is possible to choose one from the available options (“Point / Profile / Borehole / Continuous”) at the line “Meas. type” in the screen -see picture below.

New measurement

File name: My test file 1

Locality: Laboratory

Meas. type: Point

Meas. time: 0 m 10 s

Note:

Input of Numerical Values

Numerical values can be entered using keys “0” to “9” and “Minus/Decimal point” key. If the “Minus/Decimal point” key is pressed at first (before entering the number), it is displayed as a sign “minus”, otherwise as a decimal point.

New measurement

File name: My test file 1

Locality: Laboratory

Meas. type: Point

Meas. time: 0 m 10 s

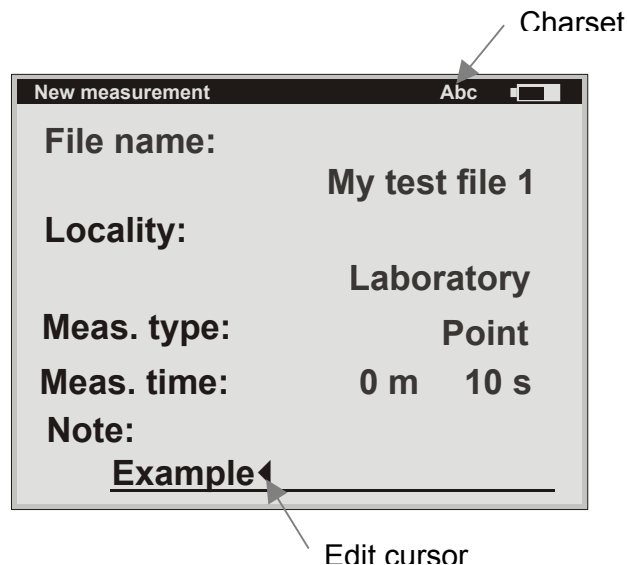
Note:

Text Input

Text can be entered using numerical keys in a way similar to mobile phones. One of the signs available at the key can be chosen by its repeated pressing (within 1 s). The cursor is moved to another sign after approx. 1s (this time is signaled by a change of cursor) or when the “Right” key or some other one is pressed. The “Left” key can be used for erasing of the text - backwards from the last sign.

The type of the signs - capital letters / small letters / numbers – can be chosen using “F-key”. The actual choice is signaled in the upper right corner of the display as follows: “Abc” – initial letter capital, other ones

small, “abc” – small letters and numbers, “ABC” – capital letters and numbers, “123” – numbers only.



Display Backlight

Backlight of the display can be switched on / off using the „Power / Backlight key“. It improves the visibility of the display in worse light conditions, but causes a quicker discharging of the batteries – so it is recommended to use the backlight only if necessary.

Display Contrast

Contrast of the display can be setting by „9“ / „-.“ keys.

Full Spectra & Assay Mode

This mode serves for measurement of the whole spectrum, determination of concentrations of elements K, eU, eTh and measurement of cps in 10 ROIs (regions of interest) - 4 of them preset for K, U, Th, TOT and 6 of them settable by a user.

The instrument always measures the complete spectrum, from which it evaluates the cps values in ROIs and calculates the concentrations of elements K [%], eU [ppm], eTh [ppm]. The concentration of K is determined directly. The eU and eTh concentrations are based on detection of radioisotopes ²¹⁴Bi and ²⁰⁸Tl that are parts of the related disintegration series. The natural dose rate value (in nGy/h) is calculated from these concentrations according to the IAEA recommendations.

The measurement can be performed as point, profile, borehole or continuous. The position of the measured place can be set manually, using GPS data or as a combination of both.

The measured data are displayed using three windows – in the spectrum window there is a complete measured spectrum with the possibility of its viewing and monitoring of the measured cps values in all 512 channels of spectrum. The isotope library is a part of it and allows matching of the measured peak with the isotope. This function is useful for quick distinguishing of the radiation source type right in situ. In the second window the values of calculated concentrations of K, eU, eTh including cps values in the related ROIs, natural dose rate and total count are displayed. The third window contains the information about the cps values in the user defined ROIs.

All measured data including complete spectra, measurement position and settings are currently stored in a file. A user can stop the measurement at any time and continue in any of the measurements later.

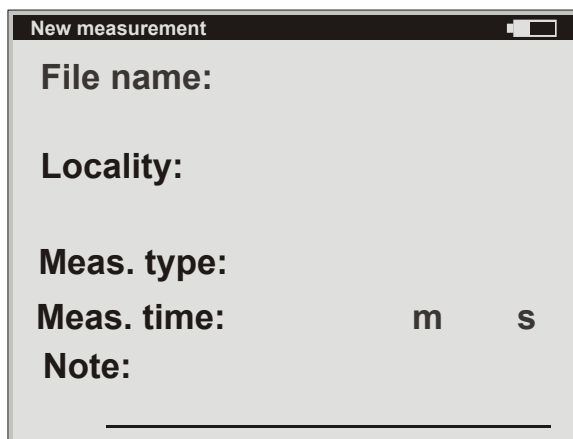
Basic features:

- Measures and stores always the complete 512-channel spectrum
- Direct determination of concentrations of K[%], eU [ppm], eTh [ppm]
- Dose rate measurement

- cps measurement in 10 ROIs – 4 preset (K, U, Th, TOT), 6 user defined
- Built-in isotope library
- Possibility of going through spectrum and matching of the measured peak with the isotope
- Support of point, profile and borehole measurements
- GPS support
- Possibility of later continuation of the interrupted measurement
- All primary measured data and settings stored in a file
- Factory and two user calibrations
- Very easy operation

Measurement

Connect the probe (probes) to the control unit. Then switch the instrument on by pressing and holding the yellow “Power“ key. Choose the item “Full Spectra & Assay“ from the displayed main menu (or press the key “3”).



New measurement

File name:

Locality:

Meas. type:

Meas. time: m s

Note:

To continue in one of the previous measurements do not enter the file name, but press “Yes” key. The list of saved files will appear. From the list you can choose the measurement you would like to continue in.



Main menu

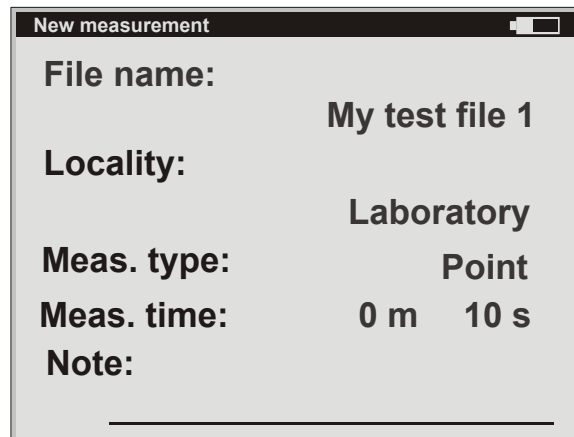
Breclav 01-20

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Brno - Lab 01

To start a new measurement it is necessary to enter the name of the file, where the measured data will be stored.



File name:	My test file 1
Locality:	Laboratory
Meas. type:	Point
Meas. time:	0 m 10 s
Note:	

Meanings of the fields are as follows:

File name – fill in the name of the file.

Locality – name of the measured locality (non compulsory).

Meas. type – type of the measurement. It is possible to choose one of the possibilities: **point** , **profile**, **borehole** or **continuous**.

Meas. time – time of the measurement on one point. The measuring time should be set with regards to the intensity of the measured radiation and required accuracy of the measurement. A convenient measuring time for specific conditions should be chosen experimentally, so that a required accuracy of the results is kept. If the measuring time is set correctly, the measured value is stable at the end of the measurement.

Note – any note

When the required information is entered, one of the following windows (according to the chosen measuring type) for setting of the position will be displayed. If the continuous measurement was chosen, the setting of the position is not required. If the GPS data are available, they will be displayed and saved automatically.

Position for point measurement:

Position	
Latitude:	E 12° 12.567'
Longitude:	N 54° 23.102'
<hr/>	
Point:	18
Note:	<hr/>

Position for profile measurement – first, other points:

Position	
Latitude:	E 12° 12.567'
Longitude:	N 54° 23.102'
<hr/>	
Profile:	2
Step:	5.0 m
Station:	125.0 m
Note:	<hr/>

Position for borehole measurement:

Position	
Latitude:	E 12° 12.567'
Longitude:	N 54° 23.102'
<hr/>	
Borehole:	2
Step:	2.0 m
Depth:	42.0 m
Note:	<hr/>

Meanings of the fields are as follows:

Latitude, Longitude – GPS position data

Point – number of the measured point

Profile no. – number of the measured profile

Step – distance between the measured points on the profile

Station – position on the measured profile in meters

Borehole – borehole number

Depth – position (depth) of the probe in the borehole (in meters)

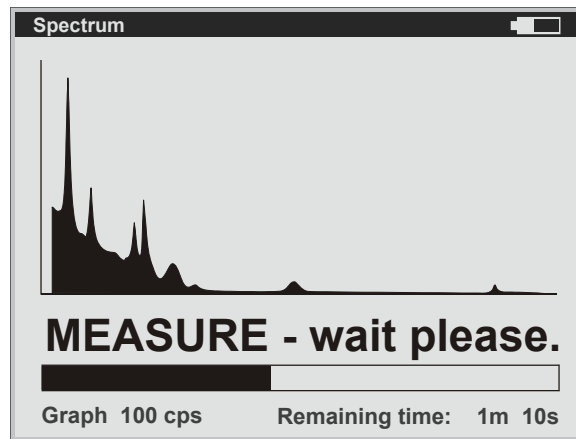
Note – note to the measured point

After entering of the position (non compulsory) the measurement will be started automatically. To stop the measurement leave this window by repeated pressing of the “No” key.

If the internal Cs reference source is used the stabilization will be done automatically (without user’s operation) and as soon as it is finished, the measurement will start automatically. In this case skip the following paragraph.

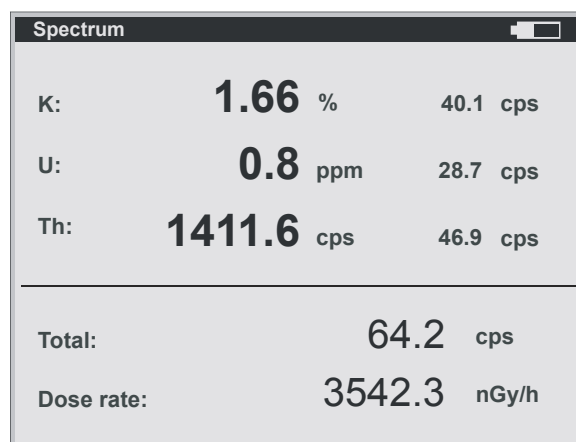
If the internal Cs reference source is not used and the validity of the last stabilization has expired already, a user will be asked to place an external source on the vertical rear side of the instrument under the handle and hold it there. When the stabilization is finished you will be asked to take the source off and place it out of range of the probe.

During the measurement the window with the measured spectrum and information about the remaining measuring time are displayed.



By pressing the “No” key the whole measurement is terminated.

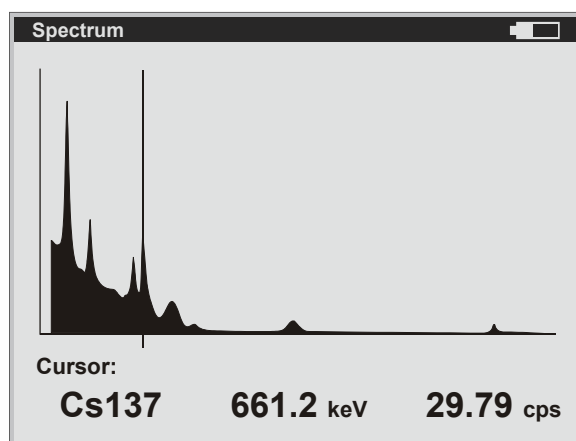
When the measurement is finished, the following window with the measured cps values in ROIs and calculated concentrations of K, eU, eTh is displayed. The natural dose rate values calculated from the related concentrations are displayed as well. It is possible to switch to this window by pressing “2” key.



Using the key “3” it is possible to switch to the window with the cps values in six user defined ROIs.

ROI	
ROI 1:	1163.1 cps
ROI 2:	120.6 cps
ROI 3:	40.2 cps
ROI 4:	11.6 cps
ROI 5:	6.0 cps
ROI 6:	3.2 cps

The spectrum view window can be opened using “1” key.

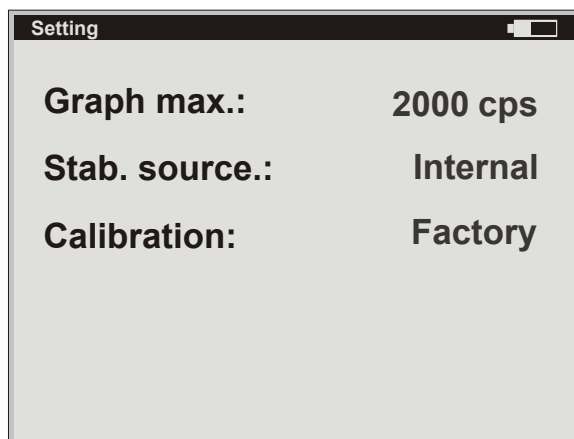


In this window you can move the cursor using “Left” and “Right” keys. In the bottom part of the window the energy, related cps value and information about the isotope matching the peak are given. The displayed scale of the graph can be changed using “Up” and “Down” keys.

By pressing the “Yes” key in any of the three windows above you can save the measured data and move to measurement of the next point. If you press “No” key, the measurement will not be saved. The result windows can be switched using the keys : “1” – spectrum, “2” – concentrations and “3” – cps in user defined ROIs.

Setting

Choose “Setting“ from the main menu and then “Spectrum & Assay“. The following window will appear:



Graph max. – scale (maximum value) in cps for a basic display of spectrum graph.

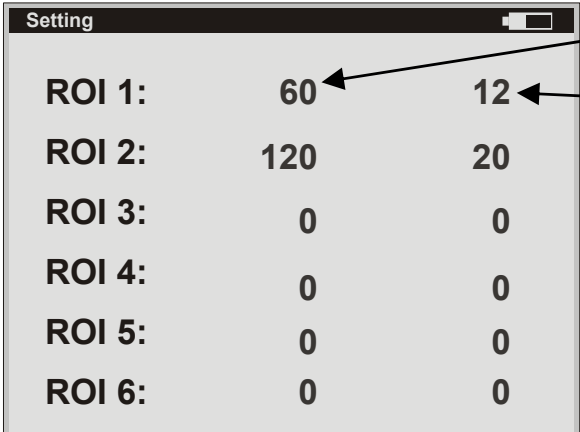
Stab. source – setting of the stabilization type. There is a choice from the following options:

- **Internal** – built-in Cs source. The source must be either built inside the instrument or a user must insert it before the measurement. Stabilization will be done automatically without user’s operation.
- **Cs-emmitter** – external Cs source. Before the start of the stabilization procedure a user will be asked to place the reference source on the probe and to take it off when the stabilization is finished.
- **K-natural** – the natural K peak is used for stabilization. This option can be used only if this peak is present on the place of measurement.
- **K-emitter** – external K source. Before the start of the stabilization procedure a user will be asked to place the reference source on the probe and to take it off when the stabilization is finished.

Calibration – serves for setting of the calibration that should be used for the calculation of concentrations. One of the following options can

be chosen: “Factory“ (factory calibration) or “User #1 / User #2“ (two user defined calibrations).

Then the window, where up to six user defined ROIs can be set, appears. The first value on the line is the number of the channel where the ROI starts and the second value on the line is a width of the ROI (in number of channels). One channel is equal to 5.877 keV (middle energy of the channel = $5.877 * \text{channel number} + 2.994$ [keV], width of the ROI = $5.877 * \text{number of channels}$ [keV]).



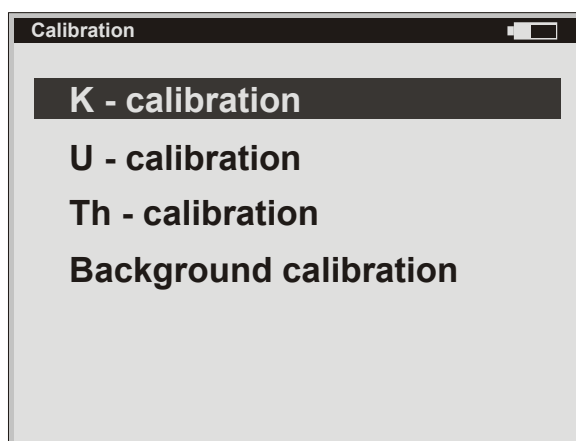
	ROI start	ROI width
ROI 1:	60	12
ROI 2:	120	20
ROI 3:	0	0
ROI 4:	0	0
ROI 5:	0	0
ROI 6:	0	0

Calibration

The instrument is delivered with a factory calibration (“Factory“). The recommended time for recalibration is 3 – 5 years. A user can create two own calibrations “User #1 / User #2” according to his specific needs.

To create a new user calibration, connect the probe that should be calibrated to the control unit and switch the instrument on by pressing and holding the yellow “Power” key.

Choose item “Setting“ from the main menu, and then “Calibration“ and “Assay - User #1“ or “Assay - User #2“. The following window will appear:



The “assay” calibration is done on four calibration pads – K, U, Th and background. It is always necessary to do the calibration procedure on all pads, their succession is not important.

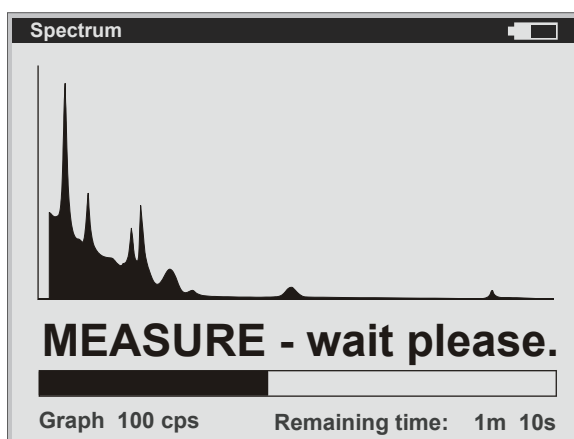
Place the probe on the middle of the calibration pad and choose the actually used type of the pad from the menu. The following window serves for entering of the real known concentrations of K, U and Th corrected by the geometry of the calibration pads.

Calibration		
Concentrations - K etalon:		
K:	20.82	%
U:	18.67	ppm
Th:	31.96	ppm
Meas. time:	45	min

K, U, Th – related concentrations of the calibration pad corrected by the geometrical factor (i.e. multiplied by the geometrical factor value). Geometrical factor $G = 1-h/r$, where h is the height of the middle of the detector above the pad (the value is given in the description of the probes) and r is the diameter of the pad.

Meas. time – calibration time. The recommended value for calibration is 30 min. The calibration time can be shorter for pads with a high dose rate value and vice versa.

When the concentrations are entered, the stabilization of the peak will be done and the calibration starts – see the following window.



When the measurement is finished, the calibration data are saved in the probe and the whole calibration is finished too. Do not perform the calibration in extreme temperatures; the best conditions are about 20~25°C.

Dose Rate Mode

This mode serves for measurements of a dose rate in nGy/h, effective dose rate in nSv/h and for registration of incoming pulse number in cps in the energy range of 410keV ~ 2.815MeV (according to the recommendation of IAEA).

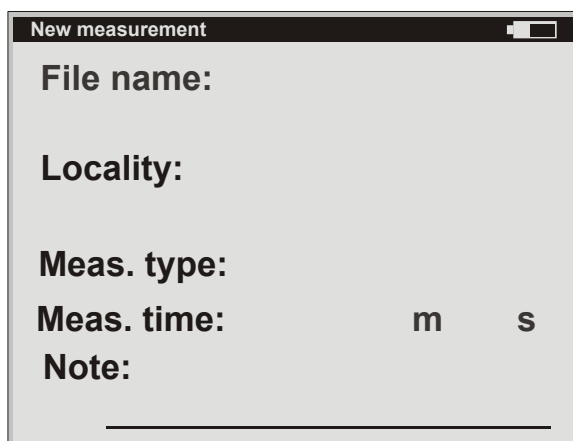
The measurement can be performed as point-, profile, borehole or continuous. The position of the measured place can be set manually, using GPS data or as a combination of both. Besides the measured value displayed currently both in nGy/h and cps there are displayed also the maximum measured value and measured points as a bar graph. The maximum value can be reset at any time. All measured data including position and settings are currently stored in a file. A user can stop the measurement at any time and continue in any of the measurements later.

Basic features:

- Measurements of dose rate in nGy/h, effective dose rate in nSv/h and of incoming pulses in cps
- Graph of the measured values history
- Maximum measured value record with a reset possibility
- Support of point, profile, borehole and continuous measurements
- GPS support
- Possibility of later continuation of the interrupted measurement
- All primary measured data and settings stored in a file
- Factory and two user calibrations
- Very easy operation

Measurement

Connect the probe (probes) to the control unit. If the factory calibration is used, the reference source must not be inserted in the instrument. Please, check this and then switch the instrument on by pressing and holding the yellow “Power“ key. Choose the item “Dose Rate” from the displayed main menu (or press the key “2”). The following windows will appear:



New measurement

File name:

Locality:

Meas. type:

Meas. time: m s

Note:

To continue in one of the previous measurements do not enter the file name, but press “Yes” key. The list of saved files will appear. From the list you can choose the measurement you would like to continue in.



Main menu

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To start a new measurement it is necessary to enter the name of the file, where the measured data will be stored.

New measurement

File name: My test file 1

Locality: Laboratory

Meas. type: Point

Meas. time: 0 m 10 s

Note:

Meanings of the fields are as follows:

File name – fill in the name of the file.

Locality – name of the measured locality (non compulsory).


Meas. type – type of the measurement. It is possible to choose one of the possibilities: **point** , **profile**, **borehole** or **continuous**.

Meas. time – time of the measurement on one point. The measuring time should be set with regards to the intensity of the measured radiation and required accuracy of the measurement. A convenient measuring time for specific conditions should be chosen experimentally, so that a required accuracy of the results is kept. If the measuring time is set correctly, the measured value is stable at the end of the measurement.


Note – any note

When the required information is entered, one of the following windows (according to the chosen measuring type) for setting of the position will be displayed. If the continuous measurement was chosen, the setting of the position is not required. If the GPS data are available, they will be displayed and saved automatically.


Position for point measurement:

Position 	
Latitude:	E 12° 12.567'
Longitude:	N 54° 23.102'
<hr/>	
Point:	18
Note:	<hr/>

Position for profile measurement:

Position 	
Latitude:	E 12° 12.567'
Longitude:	N 54° 23.102'
<hr/>	
Profile:	2
Step:	5.0 m
Station:	125.0 m
Note:	<hr/>

Position for borehole measurement:

Position 	
Latitude:	E 12° 12.567'
Longitude:	N 54° 23.102'
<hr/>	
Borehole:	2
Step:	2.0 m
Depth:	42.0 m
Note:	<hr/>

Meanings of the fields are as follows:

Latitude, Longitude – GPS position data

Point – number of the measured point

Profile no. – number of the measured profile

Step – distance between the measured points on the profile

Station – position on the measured profile in meters

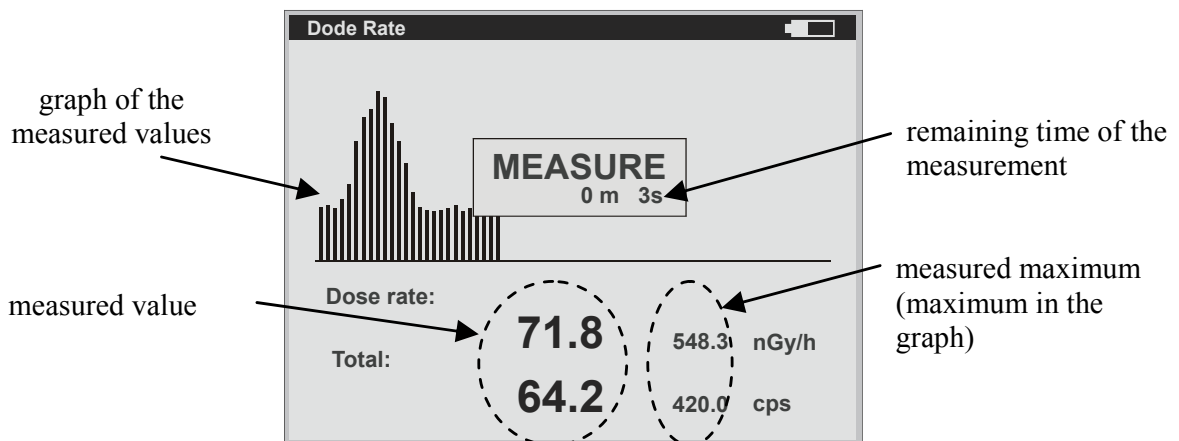
Borehole – borehole number

Depth – position (depth) of the probe in the borehole (in meters)

Note – note to the measured point

After entering of the position (non compulsory) the measurement will be started automatically. To stop the measurement leave this window by repeated pressing of the “No” key.

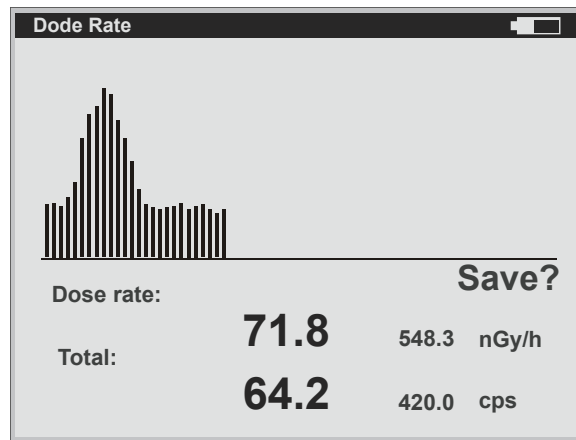
During the measurement the following window is displayed.



“F-key“ can be used for switching between the displayed units: nGy/h a nSv/h.

By pressing “No” key the whole measurement is terminated.

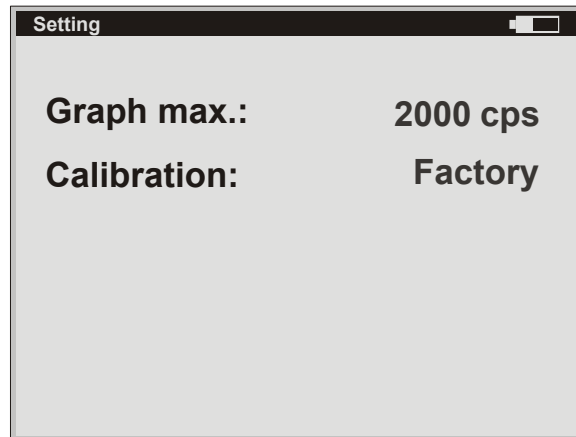
When the measurement is finished, the window with the measured values and the question about their saving is displayed.



If you like to save the data and move to another point, press the “Yes” key. If you need to cancel the measurement, press “No” key. The window for setting of the new measurement position will follow.

Setting

Choose item „Setting“ and then „Dose Rate Setting“ from the main menu. The following window will appear:

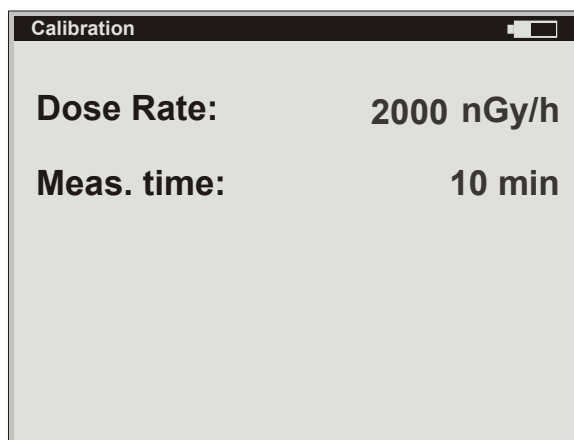


- **Graph max.** – scale (maximum value) in cps for a basic display of the measured values history graphs.
- **Calibration** – serves for setting of the calibration that should be used for calculation of the concentrations. One of the following possibilities can be chosen: “Factory“ (factory calibration), “User #1 / User #2“ (two user calibrations).

Calibration

The instrument is delivered with a factory calibration (“Factory”) done at the high-volume standards, without internal reference source. This source must not be inserted in the instrument during the measurement when the factory calibration is used. The recommended time for recalibration is 3 – 5 years. A user can create two own calibrations “User #1 / User #2” according to his specific needs. The calibration is to be created and used with the internal reference source inserted or without this source. For example - it is not possible to do the calibration without the reference source and to measure with it.

To create a new user calibration, place the probe at the middle of the calibration pad. Connect it to the control unit and switch the instrument on by pressing and holding the yellow “Power” key. Choose item “Setting” from the main menu, and then “Calibration” and “Dose Rate - User #1” or “Dose Rate - User #2”. The following window will appear:



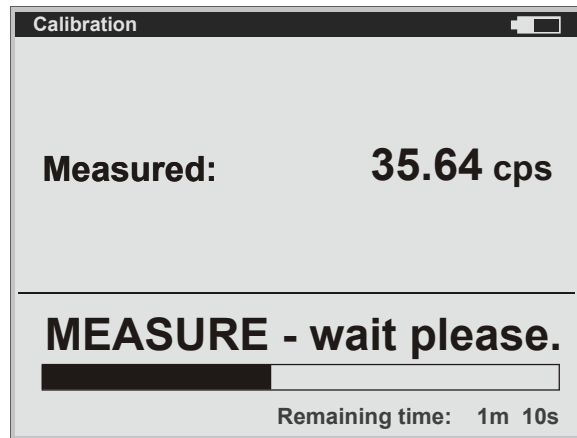
The screenshot shows a window titled "Calibration" with a battery status icon in the top right corner. Inside the window, there are two lines of text: "Dose Rate: 2000 nGy/h" and "Meas. time: 10 min".

Dose Rate:	2000 nGy/h
Meas. time:	10 min

Dose Rate – related concentrations of the calibration pad corrected by the geometrical factor (i.e. multiplied by the geometrical factor value). Geometrical factor $G = 1-h/r$, where h is the height of the middle of the detector above the pad (the value is given in the description of the probes) and r is the diameter of the pad.

Meas. time – calibration time. The recommended value for calibration is 10 min. The calibration time can be shorter for pads with a high dose rate value and vice versa.

When the parameters are entered, the following window is displayed and the measurement started.



As soon as the measurement is finished, the calibration data are stored in the probe and the whole calibration is finished too.

Do not perform the calibration in extreme temperatures; the best conditions are about 20~25°C.

Search Mode

This mode serves for quick search for radiation sources or radioactive anomalies in field. The searching is performed in the whole energy range available.

For better orientation the measured value is displayed both as a numerical value and in a bar-graph. In the upper part of the window the history of the measured data (previous measured values) are displayed, which allows easy finding of radiation maxima and minima. During the measurement the maximum measured value is displayed as well. It can be reset at any time. The search mode can be started by pressing one key. The measured values are currently displayed on the screen and they are not saved.

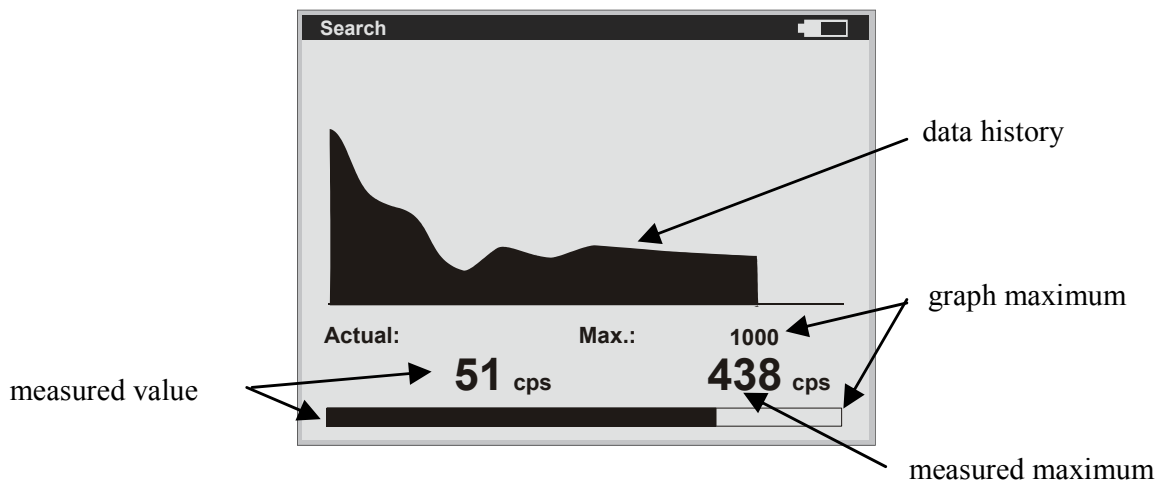
For a detailed investigation of the radiation source found this way the spectrometric measurement can be used – see next chapter.

Basic features:

- Quick measurement and displaying of the current value 500 ms
- Graphical displaying of the current value in a bar-graph
- Graph of the measured values history: 256 values (1s interval)
- Recording of the maximum measured value (can be reset)
- Acoustic signalization of user set threshold exceeding
- Acoustic signalization varying according to the current measured cps value (settable)
- Start by pressing of one button and a non-attended measuring mode

Measurement

Connect the probe (probes) to the control unit. Then switch the instrument on by pressing and holding of the yellow “Power“ key. Choose “Search” from the displayed main menu (or press “1” key). The measurement starts and the following window is displayed:



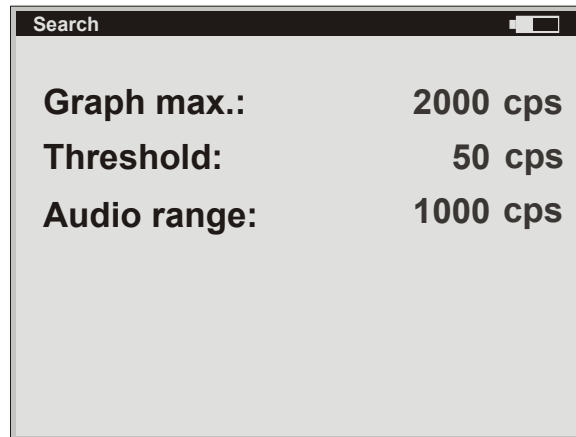
The instrument measures and currently displays measured data – current measured value in numerical and graphical form (in the 500 ms time), maximum measured value, which can be reset using “0” key. Up to 255 previously measured values are displayed as a data history graph.

If the measured value exceeds the preset threshold, this is signaled either by a monotone warning sound or (if variable acoustic response was set) by a signal with a keying interval varying proportionally to the intensity of the radiation.

The measurement can be finished by pressing of the “No“ key.

Setting

Choose item “Setting“ and then “Search setting“ from the main menu. The following window will appear:



Graph max. – scale (maximum value) for a history graph and bar graph in cps.

Threshold – threshold value – if exceeded the warning signal is activated.

Audio range – if set to 0, a monotone warning signal is generated when the “threshold” value is exceeded. If “audio range” is set to a value higher than 0, then this value is a range, in which an interrupted acoustic signal (with a period 500 ms and a keying interval proportional to the measured value) will be activated in the case of exceeding the preset “threshold”. If a measured value exceeds the “audio range”, the acoustic signal is monotone again.

File manager

This choice allows displaying of the measured data, deleting of the useless files from the memory or deleting of the whole instrument memory.

Measured Data Displaying

Choose “File Manager“ from the main menu and then “View Dose Rate File“ for displaying of the dose rate type file, respectively “View Sp. & Assay File“ for displaying of the spectrum & assay file type. Choose the file you like to view from the list and confirm the choice by pressing “Yes” key. At first the basic information about the measurement is displayed, then it is possible to go through the measured data using “Left / Right” keys.

Deletion of the File

Choose “File Manager“ from the main menu and then “Delete Dose Rate File“ for deleting of the dose rate type file, respectively “Delete Sp. & Assay File“ for deleting of the spectrum & assay file type. From the displayed list of files choose the one to be deleted and confirm the choice by pressing the „Yes“ key.

Erasing of the Whole Memory

Choose “File Manager“ from the main menu and “Memory erase“ from the next one.

Measuring Probes

Basic features of the probes:

- 512 channels, max. 250 000 pulses per second
- Measuring range from 100 keV to 3 MeV
- Multi-grade automatic stabilization of the peak position
- All probes can work in internal or external reference source modes.
- All probes listed below can be connected to any Gamma Surveyor control unit.
- The probes are supplied from the control unit (they are not to be charged separately).
- For enlargement of the detection volume and thus achievement of a more precise and faster measurement it is possible to connect more probes (of the same type, if possible) to the control unit. It is not necessary to recalibrate the probes for this purpose.
- All calibration data are saved in a probe and a user can create two more user defined calibrations.

Small Handheld probe

The small handheld probe with the attachable control unit creates one compact instrument. It serves for surface measurements.



The carrying belt delivered with the probe allows hanging and carrying of measuring set.

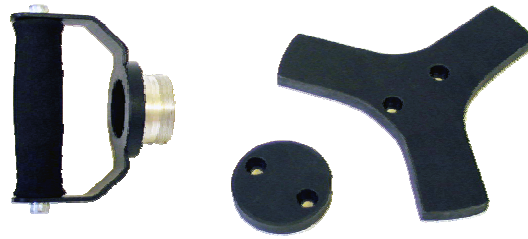
Internal Cs source is fixed under the holder at the right side of the instrument. If you want to insert or remove the source, you must take off the holder.

2" and 3" Combined Probes

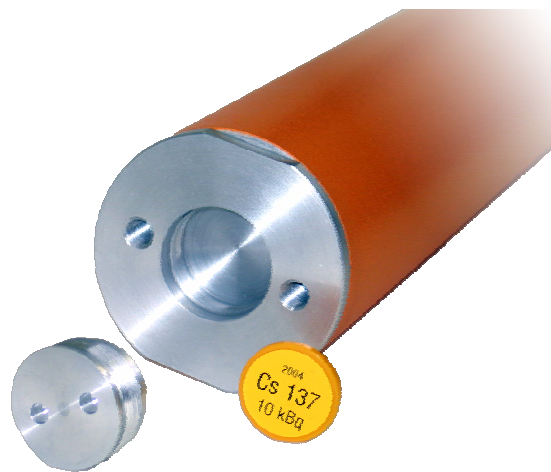
Combined probes are separate probes designed for surface and borehole measurements (with optional accessories). Standard probes are equipped with either NaI(Tl) crystal, diameter 3", length 3" (volume 6.3 in³) or BGO crystal, diameter 2", length 2" (volume 21.2 in³).



For surface measurement the tripod base can be attached to the bottom of the probe to ensure its stability during the measurement. If the tripod base is not attached to the probe, use the small round base in order to keep the distance from the measured surface. The handle fixed to the upper part of the probe serves for its carrying during the measurement. You can see the mentioned parts in the picture below.



Internal Cs source is fixed under the removable holder in the bottom part of the probe – see picture below. If you want to insert or remove the source, you must unscrew the holder.



Borehole Accessories

The borehole accessories enhance the possibilities of use of the combined probes by measurements in boreholes. Standard borehole accessories are available in versions for 2" and 3" combined probes.

The borehole accessories consist of a borehole tip, which can be fixed to the bottom of the probe (replacing the tripod base) and serves for leading the probe in a borehole. The borehole head with the cable can be fixed to the upper part of the probe after removing the handle – see picture below. The other accessories belonging to the borehole set are two cable holders for fixing the cable position in a borehole and securing the end of the cable and the mounting wrench.



Reminder: The borehole cable head ensures the watertightness of the probe. Before mounting it is necessary to check the sealing rubber o-rings, clean the contact surfaces of the probe and cable head and apply grease (vaseline) on them. Before attaching the cable head pre-screw the cable with connector 7 times anticlockwise, fix the connector and then

screw the cable head in to the probe. If water leaks into the probe as a result of not keeping these instructions, the complaint will not be accepted.

Gamma Surveyor Software

Installation of the Software

Insert the installation CD Gamma Surveyor to the PC. Connect the instrument with the PC using USB cable from accessories and turn it on. Then wait till the dialog screen is shown and continue according with it (the USB driver is installed).

Start the “Setup.exe” file from the directory GammaSurveyor. Then follow the displayed dialog.

Measured Data Download

Connection of the Instrument to PC

The instrument can be connected to PC using USB cable – its one connector is to be placed to the instrument “USB” socket (middle round socket), the second one to the USB socket of the PC. Then switch the instrument on by pressing and holding the yellow “Power” key. Leave the instrument in the main menu.



Note: The instrument can be connected e.g. to the AC adapter for battery charging at the same time. The small handheld probe can remain connected to the control unit as well.

The screenshot shows a Windows-style dialog box titled "Gamma-Ray / Download...". It features a blue title bar with standard window controls (minimize, maximize, close) on the right. The main area contains a list of items, each preceded by a checked checkbox:

- ☒ A (assay)
- ☒ A (dose rate)
- ☒ A_j (assay)
- ☒ A_j (dose rate)
- ☒ D (assay)
- ☒ D (dose rate)
- ☒ Dm (dose rate)
- ☒ Dmd (assay)
- ☒ Kanc (assay)
- ☒ Test dr (dose rate)
- ☒ Test sp (assay)

To the right of the list are four buttons: "Download", "Delete", "Close", and "All". Below these are three more buttons: "None", "Rename", and "Folder". At the bottom, there is a label "Destination folder:" followed by the path "C:\Documents and Settings\David\Dokumenty". A mouse cursor is visible at the bottom right corner.

File Rename

Data Download and Export of the Files

All selected files will be downloaded and saved in the destination folder. The destination folder can be chosen by click on “Folder” button and is displayed in the bottom part of the window.

When the download of the main file with all measured data is finished, a set of related export files (see the description of the file types) is generated automatically. These export files serve for easy import and processing of the measured data e.g. in MS Excel, Surfer etc.

File Deleting

Select all files you are going to delete and click on “Delete” button. It is possible to select all files by clicking on the button “All” or to delete all selections using the button “None”.

Finishing of the Work

If you are going to finish your work, close the window by click on “Close” button. The instrument will be automatically switched off consequently. Now the instrument can be disconnected from the PC.

Output File Format

All output files are text ASCII files and can be opened in any text editor. During downloading the following files are generated:

Dose Rate Measurement

- *.gsdr – main data file containing all measured data including header and settings of the instrument.
- *.gsdr.dat – exported file of XYZ type containing measured data, ready for direct opening e.g. in Surfer or for import to MS-Excel.

Spectrum & Assay

- *.gssp – main data file containing all measured data including header and settings of the instrument.
- *.gsas – main data file containing measured concentrations and ROI values, including header and instrument settings.
- *.gsas.dat – exported file of XYZ type containing measured concentrations and ROI values, ready for direct opening e.g. in Surfer or for import to MS-Excel.

Technical Specifications

Control Unit:

- Works with all types of probes
- Attached to the small handheld probe forms a compact instrument
- Possibility of connection of more probes, GPS receiver, PC (USB)
- Data memory: max. 32 MBit, max. 100 files
 - 100 000 measured points (dose rate continuous mode)
 - 58 000 measured points (dose rate)
 - 1 800 measured points (full spectra & assay)
- Graphical LCD display 320x240, white backlight
- Combined keyboard (mobile phone style), 19 keys
- Acoustic signalization
- Power supply from internal exchangeable battery pack (lithium-ion) or external power supply 12V (6-14V, AC adapter and cable for car socket supply included in standard accessories)
- Integrated fully automatic intelligent battery charger activated by external 12 V source connection
- Possibility of firmware upgrade via Internet
- Dimensions: 256 x 90 (145) x 60 mm
- Weight: 0.5 kg

Probes:

- Compact handheld or combined for surface and borehole measurements
- 512 channels, max. 250 000 pulses per second

- Measuring range 100keV to 3MeV / NaI(Tl) detector
150keV to 3MeV / BGO detector
- Zero dead time
- Detectors: NaI(Tl), BGO, volumes 21.2 in³ (0.35 l) and 6.3 in³ (0.1 l), or other ones on request
- For enlargement of the detection volume and thus achievement of a more precise and faster measurement it is possible to connect more probes (of the same type, if possible) to the control unit. It is not necessary to recalibrate the probes for this purpose.
- Multi-grade automatic stabilization of the peak position.
- Stabilization using built-in or external reference source ¹³⁷Cs, possibly natural isotope K.
- All probes can work in modes with internal, external reference source or using natural isotope.
- The probes are supplied from the control unit (no charging of the probes).
- All calibration data are stored in the probe and a user can create two more user defined calibrations.
- Possibility of firmware upgrade via Internet
- Height of the detector centre above the surface:
 - 40 mm (handheld probe)
 - 66 mm (2" combined probe)
 - 79 mm (3" combined probe)
- Dimensions of probes:
 - 90 x 120(90) x 290 mm, height with the handle 180 mm (handheld probe)
 - Ø70 x 420 mm (2" combined probe)
 - Ø100 x 420 mm (3" combined probe)

- Weights:
 - 1.6 kg (handheld probe)
 - 2.8 kg (2" combined probe)
 - 5.3 kg (3" combined probe)

For warranty or after warranty repair contact the producer at the address:

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