



Scientific and Production Unitary Enterprise

Radiation Scanner Assistant

Software User's Manual

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Important! Screenshots in this Software User's Manual can differ from actual "Radiation Scanner Assistant" user interface screens displayed by user's smartphone.

Important! Smartphone specifications listed in this manual can differ from specifications of supplied smartphone.

1 Contents and intended purpose of “Radiation Scanner Assistant”

The “**Radiation Scanner Assistant**” program is intended for running on a smartphone to control and operate AT6101C and AT6101CM Backpack-based Radiation Detectors and AT6103 Mobile Radiation Scanning System (hereinafter the device), which are intended for:

- Spectral radiation monitoring of indoor and outdoor areas with geo-referencing,
- Detection and identification of gamma radionuclides, measurement of ambient gamma radiation dose equivalent rate,
- Detection of neutron radiation sources.

The “**Radiation Scanner Assistant**” requires the Android operating system version 4.2 or later.

“**Radiation Scanner Assistant**” offers the following functions:

1. Connecting to gamma and neutron channels.
2. Automatic setting of gamma and neutron channels parameters.
3. Preparing gamma and neutron channels for operation
4. Stabilizing of gamma channel.
5. Measurement and display of gamma radiation energy distribution.
6. Measurement and display of ambient gamma radiation dose equivalent rate.
7. Measurement of gamma radiation count rate.
8. Measurement of ambient neutron radiation dose equivalent rate.
9. Measurement of detectable neutron radiation count rate.
10. Identification of radionuclides.
11. Voice notifications about all modes of program operation and radiation environment to operator
12. Logging of events and scan results.
13. Snap measurement to location using a GPS receiver and display measurement results.

The program package includes:

- External storage medium containing the software installation package and electronic copy of the Software User’s Manual
- Printed copy of the Software User’s Manual.

Program operator shall be familiar with Android OS and be able to use it. This Software User's Manual does not describe standard principles of how to launch and close programs, as well as how to run commands in menus, tool bars, and other actions.

1.1 How to install the program

1. Turn on the smartphone.
2. Copy the "**Radiation Scanner Assistant.apk**" file to the smartphone memory.
3. Run the "**Radiation Scanner Assistant.apk**" file on the smartphone and wait until the program installation is complete

Before installing a new version of the program, uninstall the previous version of it. Follow by running the "**Radiation Scanner Assistant.apk**" file on the smartphone with the new version of the program.

1.2 How to start/close the program

To start the program, click the "**Radiation Scanner Assistant**" icon (see the Figure 1).



Radiation Scanner Assistant

Figure 1

Open the main menu of the program by swiping the finger from the left edge of the smartphone screen to the right.

Minimizing the window does not close the program and it continues to run in the background.

To close the program, select "**Menu> Exit**".

1.3 How to uninstall the program

To uninstall the "**Radiation Scanner Assistant**" program, use standard uninstall procedures of your Android OS.

Measurement files, event logs, GPS coordinates, saved settings of uninstalled program are stored in the folder located in the internal memory of smartphone, "**Android> data> com.atomtex.scannermobile**"

1.4 How to connect the components

To start operation, connect all components using respective cables from distribution kit and adjust connections between device components.

"**Radiation Scanner Assistant**" uses gamma and neutron channels by connecting to existing BT-DU3 adapter and automatically detects the types of detection units (hereinafter the DU).

The BT-DU3 adapter uses Bluetooth wireless technology to connect to the smartphone.

1.4.1 Pairing the Bluetooth headset

1. Switch the headset to pairing mode as described in the headset manual.
2. Open "**Bluetooth**" settings window and turn **Bluetooth** on.
3. Search for devices.

4. Select headset from the list of devices.
5. After pairing the headset connects automatically (you hear a short melody in the headset when the connection has been established).

1.4.2 Pairing the smart glasses

Smart glasses use Bluetooth wireless interface to connect to the smartphone (see section 4 in the Software User's Manual for the "**RadGlasses**" program).

1.4.3 Establishing connection to BT-DU3 adapter

1. Connect the DU to the BT-DU3 adapter using the supplied DU cables.
2. Start the BT-DU3 adapter by pressing and holding the "**Power**" button until the LEDs are on.

Important! The BT-DU3 adapter powers off automatically in 10 minutes, if no connection has been established to it.

3. Start the "**Radiation Scanner Assistant**" program.
4. In the smartphone turn Bluetooth on and pair the BT-DU3 adapter.
5. When the program starts for the first time, it searches for devices automatically. Use the "**Find Devices**" button to stop and restart the search.
6. Select BT-DU3 in the list of devices.
7. To change the BT-DU3 adapter, select "**Menu — Connect**". A list of devices available for connection will be displayed. Select the BT-DU3 included into the delivery set from the list of devices, which will be used for further operation.

1.5 Running time and battery charge

In autonomous mode, the smartphone runs on the built-in battery and gamma and neutron channels are supplied with energy from BT-DU3 adapter, which are charged by AC adapters. Minimum continuous operation time of a smartphone (with a 3400 mA/h battery) is 10-12 hours in autonomous mode with fully charged batteries. This parameter varies depending on smartphone specifications.

Minimum continuous operation time of BT-DU3 adapter is 20 hours in autonomous mode with fully charged battery and depends on the number of measurement channels connected.

The program keeps track of free memory in the smartphone and if available memory is not enough for 19 minutes (0.3 hours) of scanning, a notification is displayed and the program terminates when the operator closes the notification window.

When BT-DU3 adapter battery charge is below 8 %, the program displays a low battery notification for gamma channel and switches the device to "**Idle**" mode when the operator closes the notification window.

When the smartphone battery charge is below 5 %, the program displays a low battery notification for smartphone and switches the device to "**Idle**" mode after a while.

2 Using the program

How to work with “**Radiation Scanner Assistant**”:

1. Start the “**Radiation Scanner Assistant**” program.
2. Connect to BT-DU3 adapter (see 1.4.3)
3. Wait until “**Radiation Scanner Assistant**” connects to gamma and neutron channels.
4. Use the check sample to stabilize the gamma channel, if required (see 2.3).
5. Make sure the calibration is successful.
6. Type a keyword or scanning place name or comment. It will be added to the name of the result folder. By default, the result folder has a unique name, which includes the date and time the scanning started.
7. Wait until the background acquiring process is complete.
8. Start radiation scanning, carry the device on foot, in car etc.
9. GPS signal appears only if you are in satellite visibility zone (in open ground outdoors).
10. Stop moving when gamma radiation alarm signal sounds and wait until object or source radionuclide content identification process ends.
11. When neutron radiation detection signal is generated, stop and find maximum radiation point according to neutron channel count rate.

Maintaining operability of “**Radiation Scanner Assistant**”:

1. The program periodically generates an audio signal to inform user that it is operating normally.
2. The program provides gamma and neutron channels diagnostics. In case of a failure or error, the program enters the “**Connecting**” mode. In this case power BT-DU3 adapter off and on again. If failure persists, contact manufacturer.
3. If the program finds no gamma channel calibration data, then it will switch to the “**Connecting**” mode. Restart scanning. If failure persists, contact manufacturer.

2.1 User interface description

The user interface is represented as control and indication units shown in Figure 2.

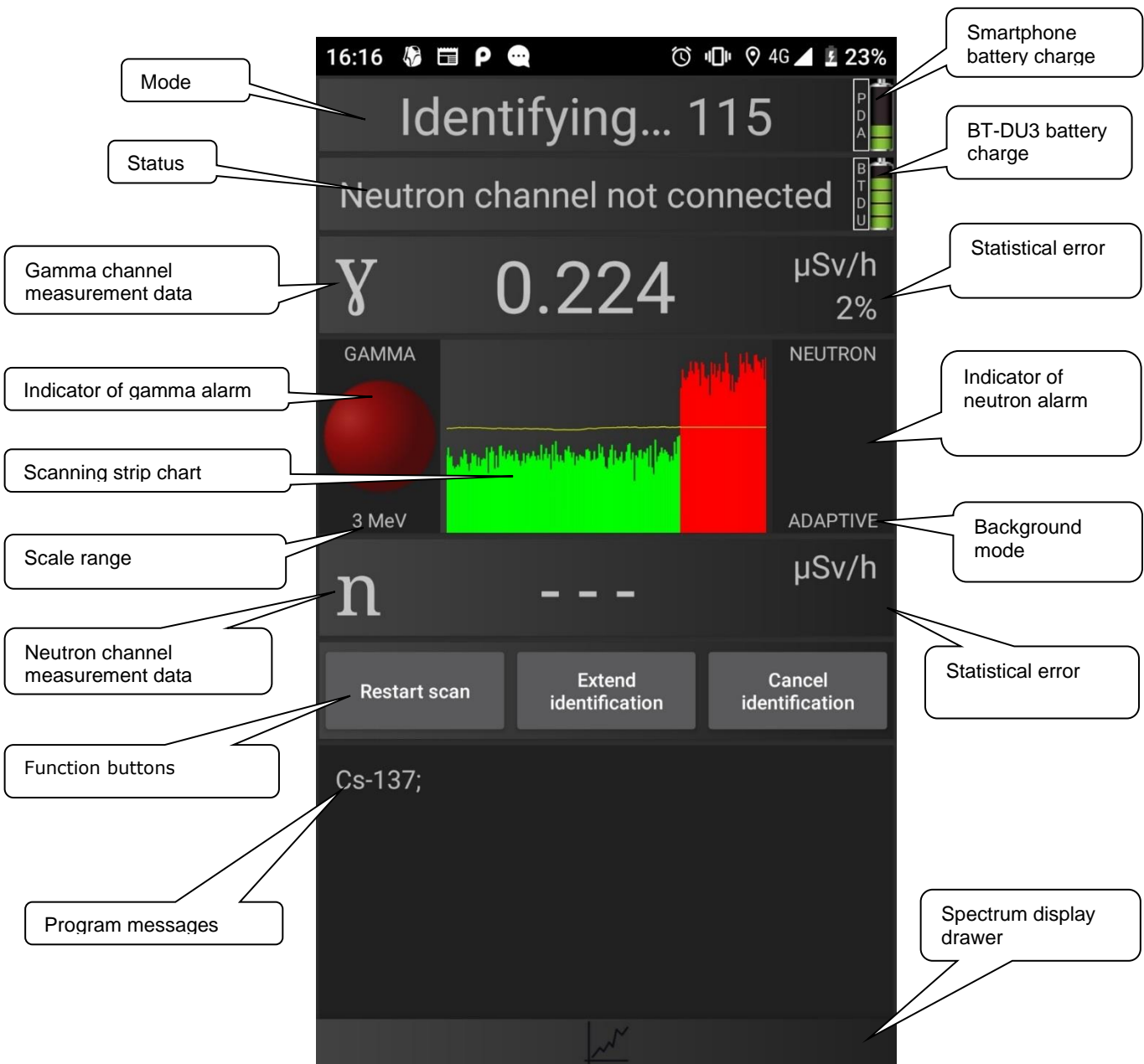


Figure 2 — User interface of the program

Mode — current mode of the device.

Status — current status of the device. Tap this line to display detailed information about status of the device in a new window.

Gamma channel measurement data — Tap this line to cycle gamma radiation dose rate value (μSv/h) and pulse count rate value (cps).

Indicator of gamma alarm — Gamma channel alarm indicator (red).

Neutron channel measurement data — Tap this line to cycle neutron radiation dose rate value (μSv/h) and detectable neutron radiation count rate value (cps).

Program messages — Various messages with a result of radionuclide identification, information of the latest alarm, etc. Tap this line to display event log in a new window.

Scanning strip chart — Strip chart of gamma channel count rate values. Green strip indicates there are no alarms. Blue strip indicates there are neutron channel alarms. Red strip indicates there are gamma channel alarms.

Statistical error — Statistical error of gamma or neutron radiation dose rate or count rate.

Indicator of neutron alarm — Neutron channel alarm indicator (blue).

BT-DU3 battery charge — Charge level of BT-DU3 adapter battery.

Smartphone battery charge — Charge level of smartphone battery.

Spectrum display drawer — Expanding / collapsing panel with gamma radiation spectrum.

Background mode — Type of background under which the measurement is made.

Scale range — Displays the energy scale range of connected DU.

2.2 Connecting mode

In “**Connecting**” mode the program connection to gamma channel and neutron channel. “**Connecting**” mode is shown in Figure 3.

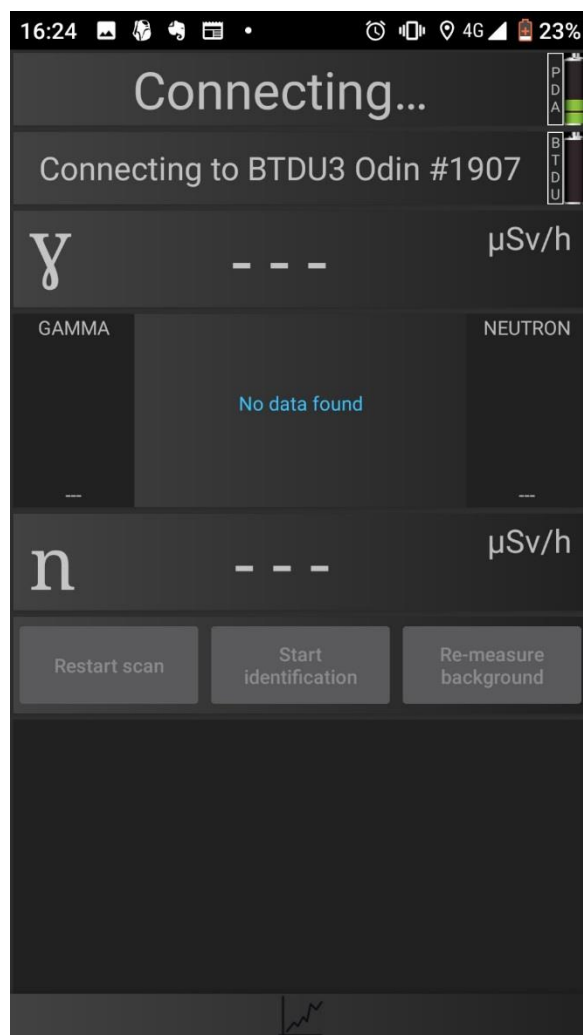


Figure 3 – “Connecting” mode

2.3 Preparing mode

In “**Preparing**” mode the program prepares channels for operation and warms up the gamma channel. The “**Preparing**” mode is shown in Figure 4.

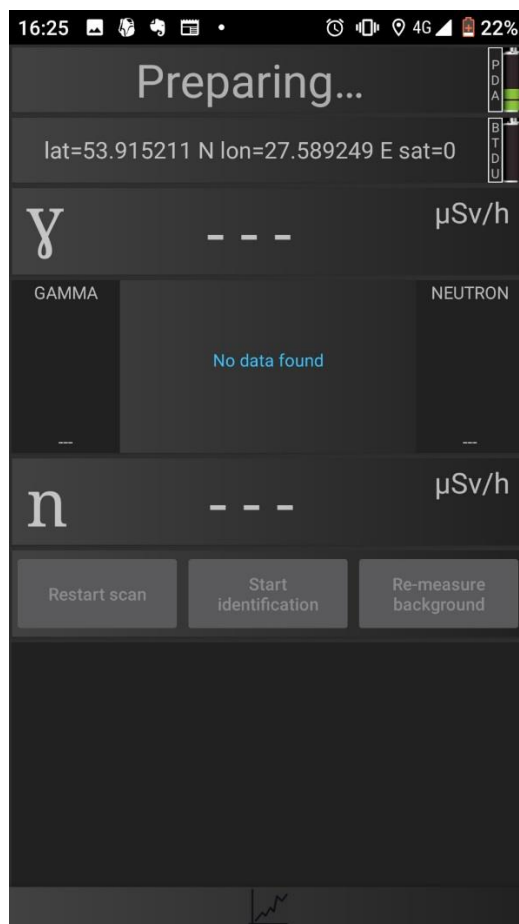


Figure 4 – “Preparing” mode

When the gamma channel is warming up, the program displays an invitation to perform gamma channel calibration (see Figure 5).

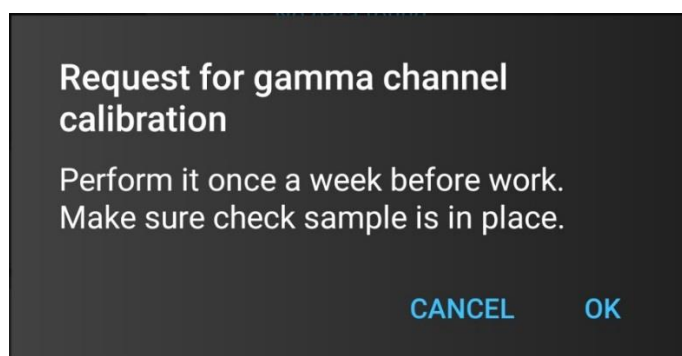


Figure 5 – Invitation to perform gamma channel calibration

Gamma channel calibration is required for normal operation of measurement system. It is recommended to perform gamma channel calibration once a week before operation. **NO** foreign sources of radiation must be present near the device.

During calibration the program acquires spectrum and checks 1461 keV energy peak position from ^{40}K contained in check sample (potassium fertilizer). After calibration, the program checks peak position.

Before starting calibration, place the check sample at the end of the gamma radiation DU. Tap the "OK" button to start calibration. For calibration progress see Figure 6. When stabilization is complete, the program will output the result: **"Calibrated successfully" / "Calibration failed"**.

Tap the **"Cancel"** button to go to scanner mode without performing calibration. You can force gamma channel calibration using the **"Menu > Calibrate"** command.

For more details on calibration see section 2 in User's Manual on the device.

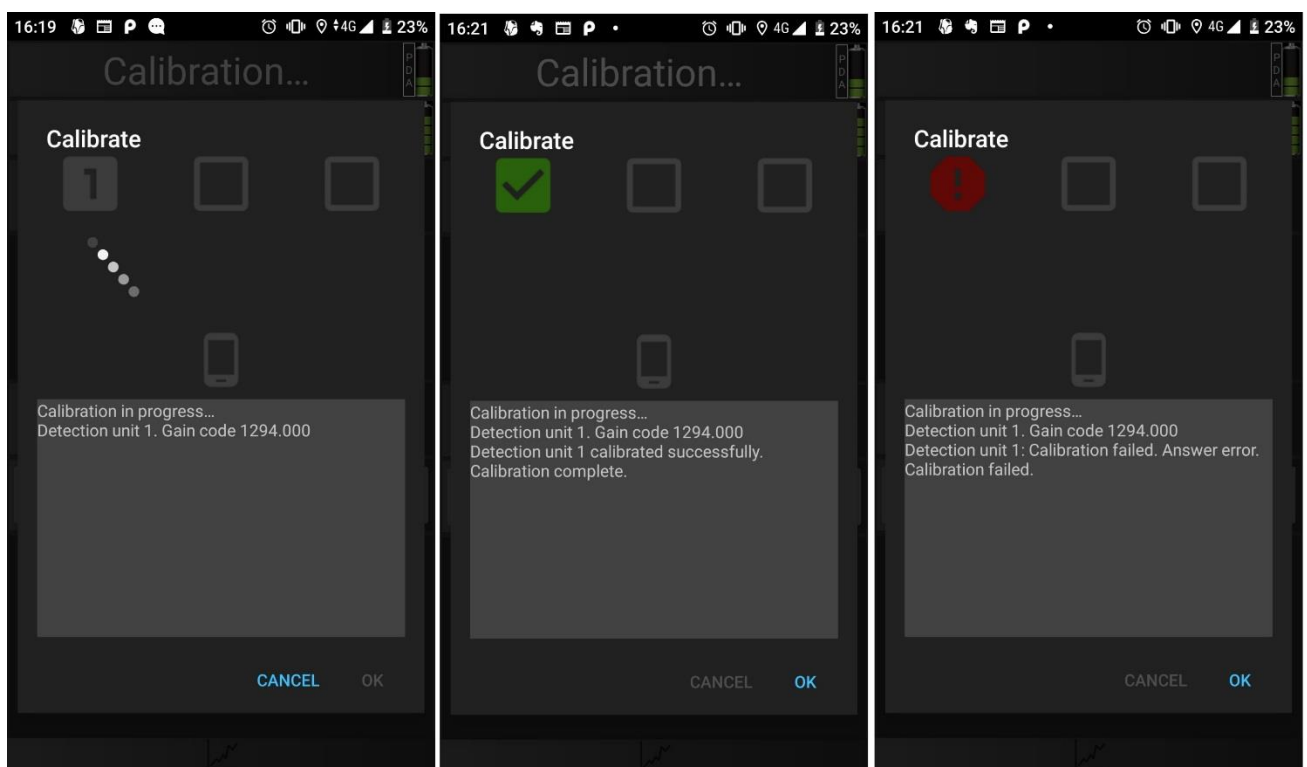


Figure 6 – Calibration progress

2.4 Background mode

Background measurement is necessary for correct search for sources of gamma radiation. The duration time of the **"Background"** mode is 30 seconds; within this time the program measures gamma channel count rate and stores it in memory. The **"Background"** mode is shown in Figure 7.

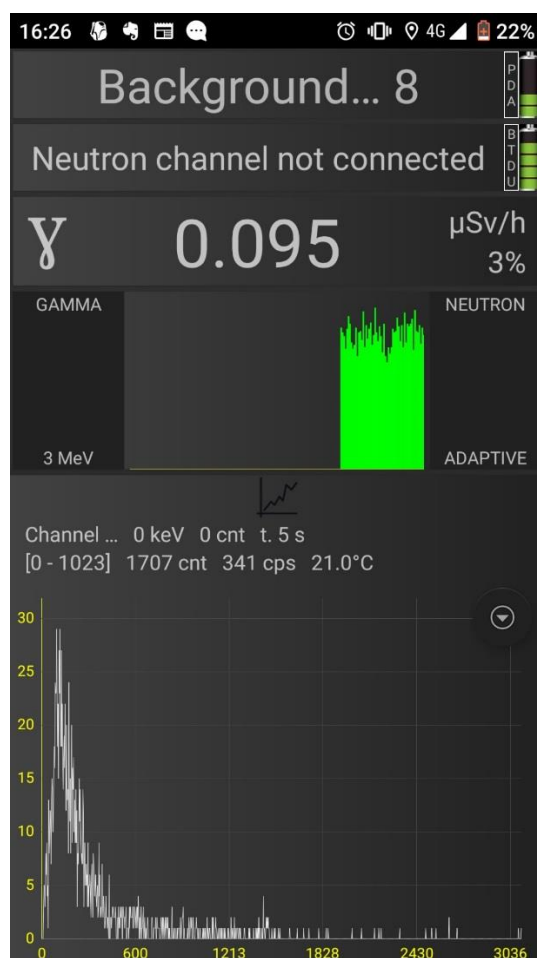


Figure 7 – “Background” mode

It is necessary to acquire background at a distance from examination object since this background serves as a reference for analysis of gamma radiation intensity from detected radioactive source.

2.5 Scanning mode

The “**Scanning**” mode is a process of gamma and neutron radiation sources detection with snap to location and saving all results to a unique folder in smartphone memory.

This is the main mode of program operation. The “**Scanning**” mode is shown in Figure 8.

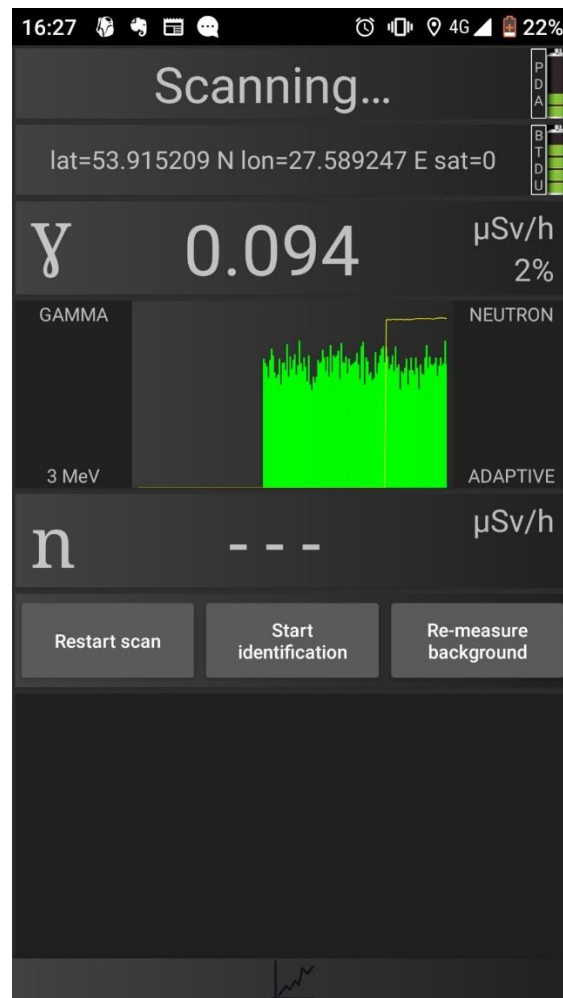


Figure 8 – “Scanning...” mode

The “**Scanning**” mode features:

1. Acquire spectrum with specified period (every 5 seconds by default) and save it to a file with unique name in the scan results folder.
2. Measure gamma channel count rate three times per second and save it to the count rate file with unique name in the scan results folder.
3. Measure neutron channel count rate once per second and save it to the count rate file with unique name in the scan results folder.
4. Perform GPS snap to location and saves snap data to spectra files, count rate files, Google Earth waypoint files in the scan results folder.

Tap the spectrum display drawer to show/hide spectrum being acquired in Scanner mode.

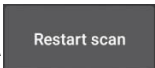
When you search for a radiation source and hear audio signals, start moving in the direction where these sounds are generated at a higher rate to locate the source of radiation.

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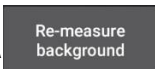
When a radiation source is detected, the gamma channel triggers the sound, voice and light alarm notification and the program switches the device into “**Identifying...**” mode automatically.

The program detects neutron radiation using analysis of neutron radiation count rate overrun over preset thresholds. If a single threshold is exceeded, sound, voice and light alarms for the neutron channel are activated.

Restart the scanning by going to "**Menu> Restart scanning**" or by tapping

the "" button. Then the program suggests adding a comment or name of a place where scanning takes place.

In "**Scanning**" mode you can work in various background modes:

1. *Permanent background* — Background acquired once before scanning and is used for comparison during search for gamma radiation. Permanent background re-measurement can be forced by using the "**Menu > Reset and re-measure background**" command or by pressing the "" button.
2. *Adaptive background* — Background acquired before scanning, however further it constantly changes and adapts to alterations of radiation level. Adaptation runs if there are no gamma channel alarms only. In adaptive background mode the background value is adjusted to current radiation background approximately in 30 seconds.

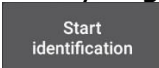
You can switch to desired background mode by going to "**Menu> Settings> General settings>Background mode**" and select the "**Permanent**" or "**Adaptive**" variant.

2.6 Identifying mode

The "**Identifying**" mode is a continuous spectrum acquisition mode for identification of radionuclide content of an object or source of gamma radiation.

The "**Identifying**" mode is shown in Figure 9.

You can force the "**Identifying**" mode by going to "**Menu >**

Start identification" menu or by tapping the "" button.

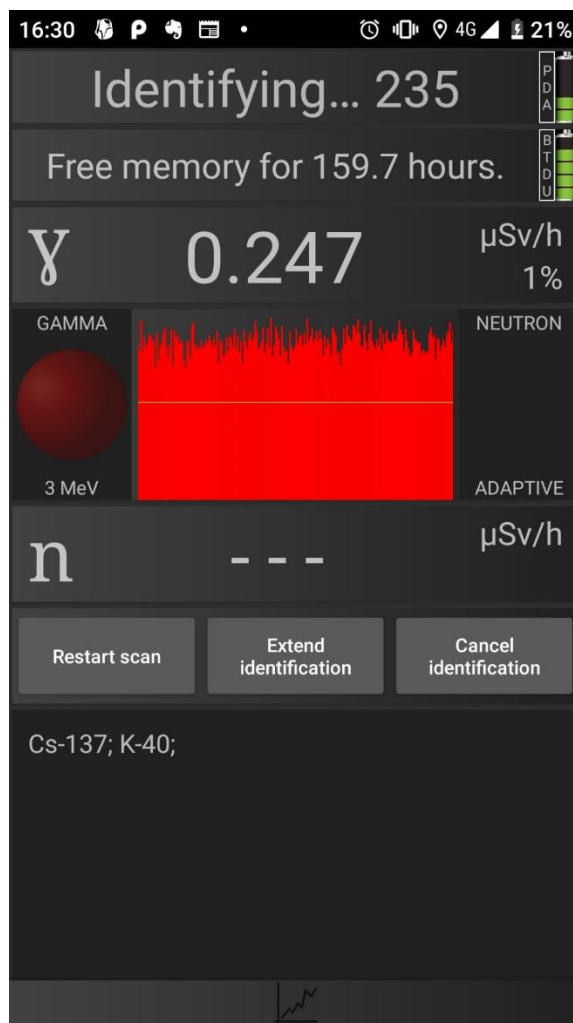


Figure 9 – “Identifying...” mode

In “**Identifying**” mode the program continuously measures spectrum over a set period of time (default setting is 120 s) and identifies radionuclide composition while spectrum is being measured. Operator can change measurement time of identification spectrum: go to “**Menu> Settings> General settings> Spectrum acquiring time (s) In identification mode**”.

The device performs identification of a detected gamma-emitting radionuclide or a mix of gamma-emitting radionuclides provided that radionuclide information is present in the library of the device or that the detected mix allows to find all or some radionuclides in the mix and is present in the library of the device, taking into account gamma channel energy resolution and contribution of each radionuclide in mix.

Tap the spectrum display drawer to show/hide spectrum being acquired in identification mode.

Each identified radionuclide is displayed on the screen accompanied by corresponding voice message.

If the “beta” message is displayed while identification is in progress, the Bremsstrahlung of beta particles is detected.

If the program cannot identify a radionuclide reliably (the so-called unrecognized radionuclide), the operator hears the “Identified. Unknown.” voice message.

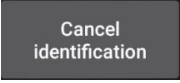
The program can automatically extend identification time due to the following reasons (however not more than two-fold):

1. Presence of unrecognized radionuclides during identification.
2. Gross gamma count rate alarm.

Extend the identification period manually by go to "**Menu> Extend identification**" or by tapping the "" button.

Each identification result the program saves into the "*Identification*" subfolder in the folder with scan results.

The program exits the identification mode after one spectrum measurement cycle. You can force identification stop by going to "**Menu> Stop**

identification" or by tapping the "" button.

Then the device exits the "**Identifying**" mode and switches to the "**Waiting**" mode.

2.7 Waiting mode

Duration time of the "**Waiting**" mode is 30 seconds. This is the period when operator has to move to another place to prevent repeated alarm and switching to "**Identifying**" mode in the same conditions. The "**Waiting**" mode is shown in Figure 10.

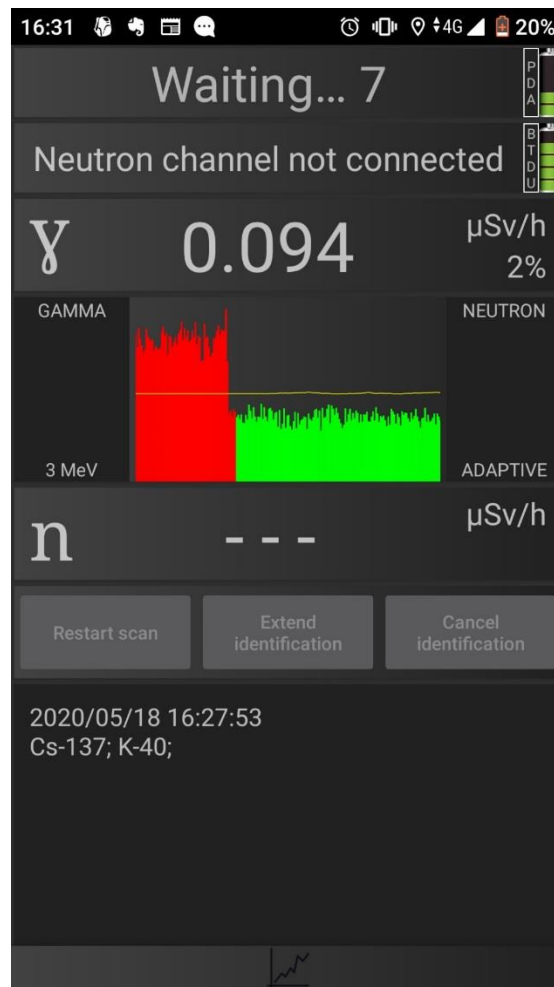


Figure 10 – “Waiting” mode

After “**Waiting**” mode, the device switches to “**Scanning**” mode.

2.8 “Idle” mode

The “**Idle**” mode is an idle operation mode of the device. The “**Idle**” mode is shown in Figure 11.

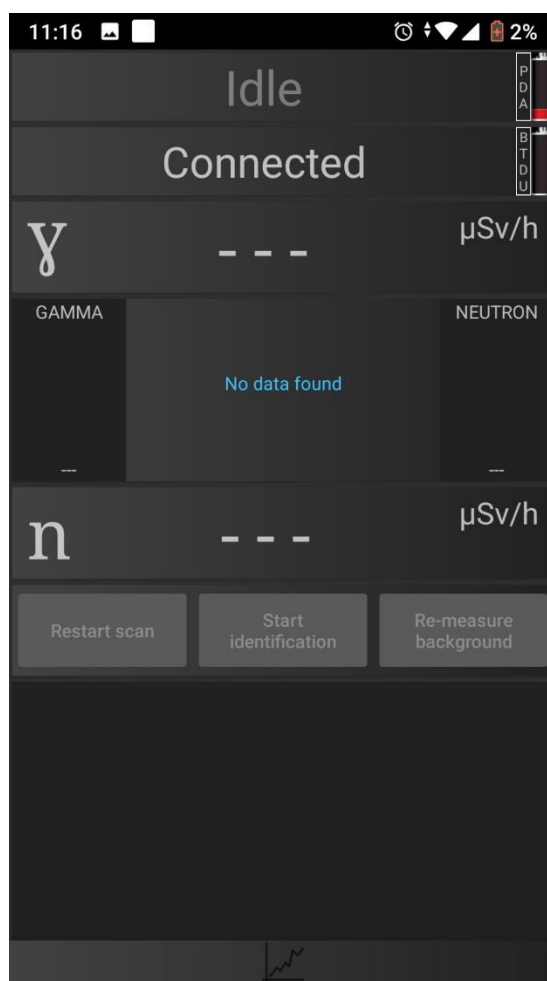


Figure 11 – “Idle” mode

The device switches to this mode in the following cases only:

1. Low smartphone and/or BT-DU3 adapter batteries.
2. Low smartphone memory to store data.
3. Gamma channel has no calibration by energy and/or radionuclide library.
4. Gamma channel fault.

2.9 Spectrometer mode

The **“Spectrometer”** mode is used for manual spectra acquiring and processing. Radionuclides are also identified during this process. The **“Spectrometer”** mode is shown in Figure 12.

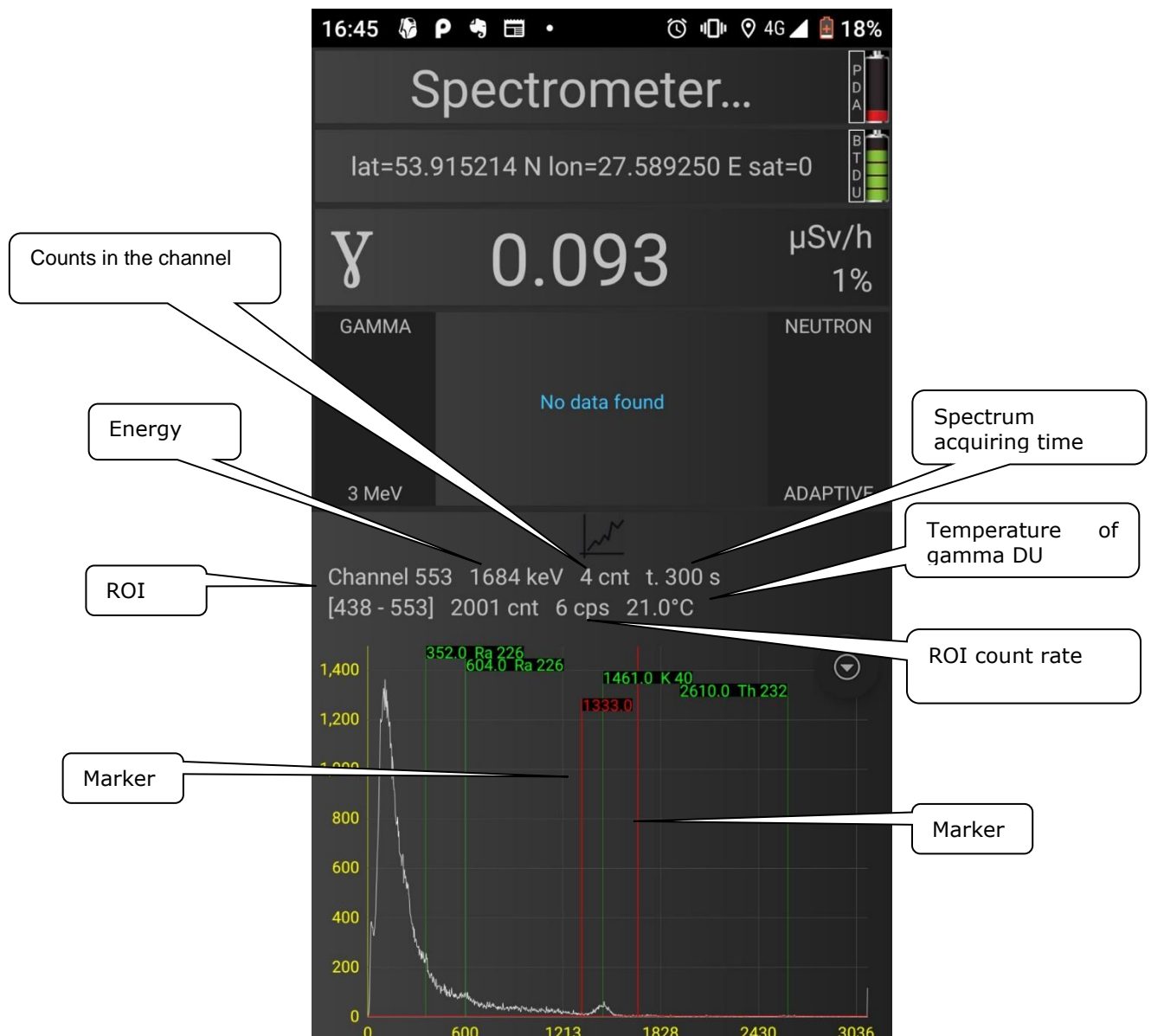


Figure 12 – Spectrometer mode

If there are no two markers in a spectrum, entire spectrum is assumed as ROI, otherwise the spectrum portion between the markers (inclusive) is considered as ROI.

Total counts are calculated within the ROI.

ROI count rate is calculated as total counts divided by spectrum acquire time.

Spectrum acquire in progress is indicated by spectrum time progress.

To zoom the spectrum in or out, pinch or spread your fingers in the spectrum display area. Double-clicking the spectrum display area reverts the spectrum zoom rate to default.



— Expand / collapse the spectrum controls.



— Spectrum display control. Changes the way the spectrum diagram is displayed — as a set of points, or points connected by a line.



— Spectrum display control. Changes the way the spectrum diagram is displayed — Logarithmic or linear view.



— Spectrum display control. Changes the way the spectrum values are displayed — Channel values, or corresponding energy values.



— Spectrum acquiring stop. The spectrum acquiring process resumes according to the actually elapsed time from the acquiring start.



— Set / remove a marker.

Important! In “**Spectrometer**” mode the program allows manual measurement results saving only.

2.9.1 Acquire spectrum

Set the spectrum acquiring time by going to “**Menu> Settings> General settings**”. When specified time elapses, spectrum acquiring stops. The value “0” sets the maximum possible value.

Restart the spectrum acquiring process by going to “**Menu> Restart acquiring**”.

Adjust the spectrum acquiring time by going to “**Menu> Set acquiring time**”. In the “**Set the time in seconds**” dialogue specify spectrum acquiring time in the range from 1 to 65535 seconds.

2.9.2 Save spectrum

To save the spectrum to a file, select “**Menu> Save spectrum**”. Spectrum will be saved under a unique name in the “**ManualSaving**” subfolder in the “**com.atomtex.scannermobile**” folder.

2.9.3 Open spectrum

To open a previously saved spectrum, select “**Menu> Open spectrum**”. Select the spectrum file in the explorer window. Use the controls to analyse the spectrum or send it (e.g., by e-mail) to another user (see Figure 13). Click “**Back**” to return to the main program window from the spectrum view window.

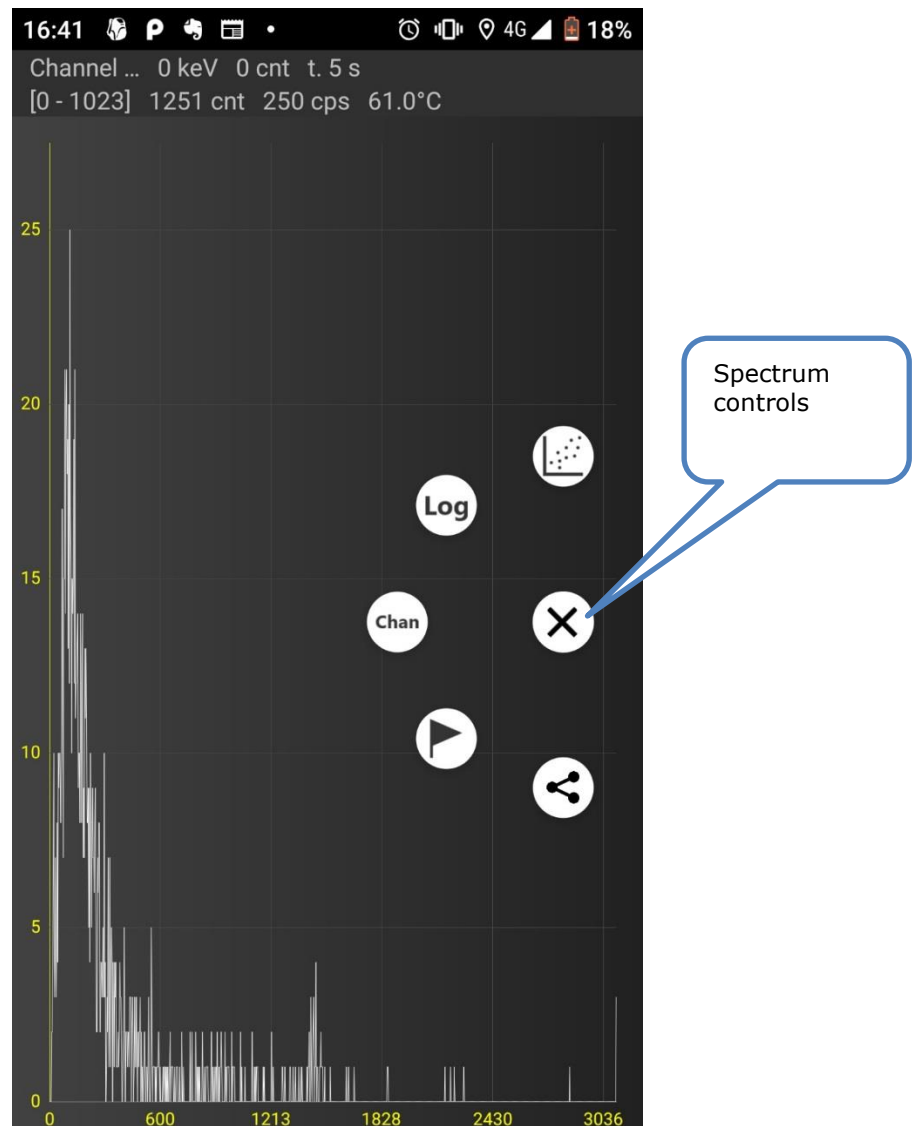


Figure 13 — View saved spectrum

2.10 “Log view” mode

To view the device event log, click the “**Program messages**” field. Select the necessary log from the list. All logs have unique names, which consist of date and time. When you completed viewing the log, click the “**Back**” button on the smartphone screen.

2.11 Program settings

The “**Menu> General settings**” option (see Figure 14) allow to:

1. Set the safety threshold.
2. Set the acquiring time for scanning, identification and spectrometric modes.
3. Set the identification threshold.
4. Enable or disable autostart identification.
5. Set the false alarm period value for gamma channel and neutron channel.

6. Set background options — Selecting the type of background to be acquired (adaptive or constant) for gamma channel, selecting the background value for the neutron channel.
7. Apply default settings.
8. Import saved settings into the program.
9. Export settings to a file.
10. Specify the path to export settings.

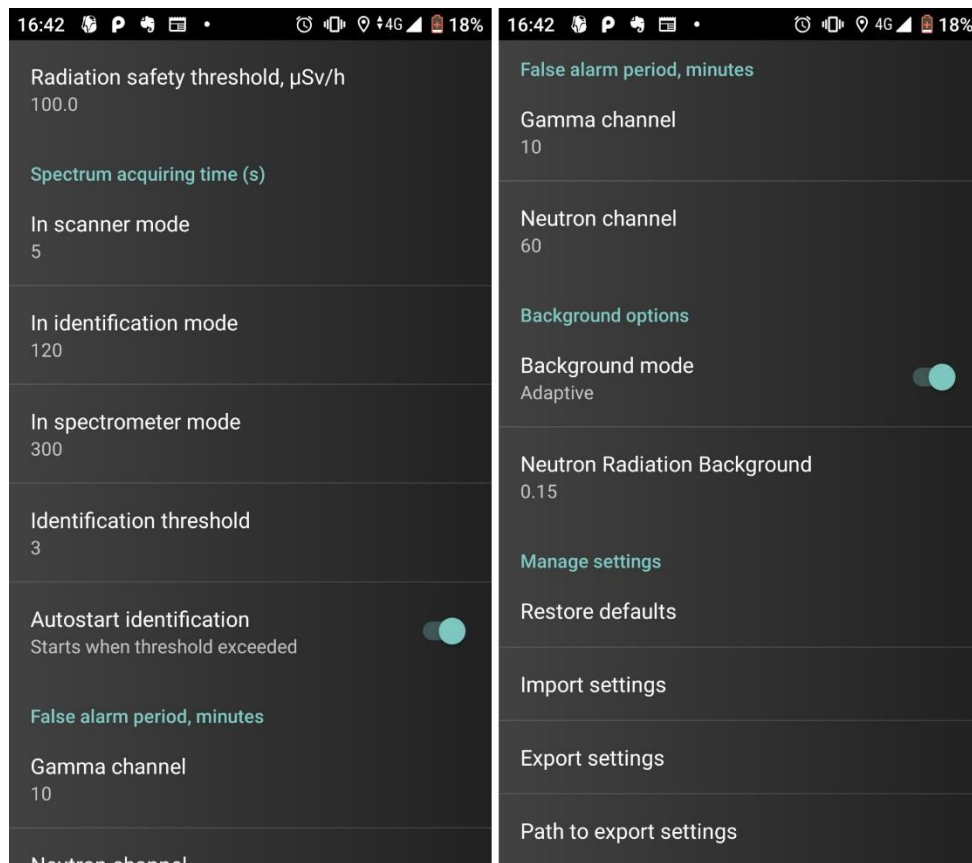


Figure 14 — General settings

Use the **"Menu> Settings> Hardware configuration"** option to specify the device configuration (see Figure 15).

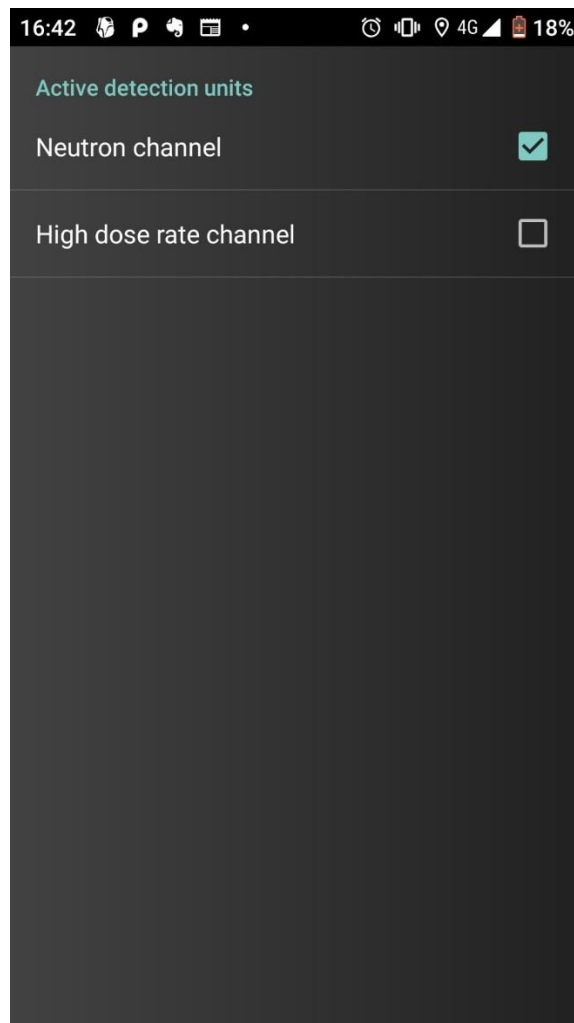


Figure 15 — Select device configuration

If a DU box in the “**Active detection units**” window is selected, the program will periodically try to establish a connection with this type of DU. If communication to the DU is lost; the program will notify the user by a voice message.

To view the “**Radiation Scanner Assistant**” version, go to “**Menu > About software**”.

3 Troubleshooting

1. No GPS signal:
 - Make sure GPS is turned on and smartphone is in open area.
2. No connection to BT-DU3 adapter:
 - Make sure that BT-DU3 adapter is charged and turned on.
 - Make sure BT-DU3 adapter is connected to detection units via DU cables.
 - Check BT-DU3 adapter settings according to section 1.4.3.

3. Low memory messages in "**Radiation Scanner Assistant**":
 - "**Radiation Scanner Assistant**" stores data to the smartphone memory. If the smartphone doesn't have enough free memory, then transfer the measurement results to a desktop computer or delete the measurement results to free the memory.
4. The program doesn't respond:
 - Restart the smartphone. Check operation.
 - Reinstall the program and configure the connection with the BT-DU3 adapter. Check operation.
 - Otherwise, report the problem to manufacturer (<http://www.atomtex.com>).