

A photograph of a worker in a blue jacket and white hard hat, holding a yellow handheld device. The background is a blurred construction site. The text 'RT-30 Series User Manual' is overlaid in the center.

RT-30 Series User Manual

V2.17 April 2018

GEORADIS

Rev.		Date
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V2.16 September 2017	Improved Dose rate measurement by FW version 6.04 and higher, see chapter 7.2, revised the nuclide library, Appendix A	15 September 2017
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1 DECLARATIONS AND CERTIFICATES

1.1 CE Conformity Declaration

We:

GEORADIS s.r.o., 619 00 Brno, Novomoravanska 321/41, Czech Republic

Declare under our sole responsibility that the product:

Hand-held gamma ray spectrometer – Identifier RT-30

To which this declaration relates is in conformity with the following standards:

**Directive 2014/30/EU
EN 61000-6, EN 55011, EN 55022, EN 61000-4
IEC 1017-1, IEC 1017-2**

Instruments of this series obtained certificate according to Directive **2004/108/EC** (electromagnetic compatibility) and fulfil the requirement of EU norms and directives CE.

1.2 Certificate of Origin

This is to certify that GEORADIS s.r.o., Novomoravanska 321/41, 619 00 Brno is only manufacturer of Radiation Detectors series RT-30, RS 220. All instruments are designed, manufactured and assembled in the Czech Republic.

Manufacturer:

GEORADIS s.r.o.

Novomoravanska 321/41

619 00 Brno

Phone: +420 541 422 231

e-mail: info@georadis.com

2 GENERAL

The RT-30 SUPER IDENT series introduces a new generation of compact handheld isotope identification instruments. The RT-30 integrates a radiation survey meter, dose meter and radionuclide identification device in a weather protected, lightweight and easy to use instrument.

The large volume scintillation detector provides high sensitivity paired with excellent resolution for fast and reliable isotope identification. Together with optional GM tube and Neutron detector, the RT-30 series is the right answer to all scanning applications under most difficult conditions.

Quickly determining the location of lost radioactive sources in the environment or scrap, monitoring of waste in hospitals or waste incinerators, scanning people or baggage to disclose illicit trafficking of nuclear materials; all are typical applications for the RT-30 series.

Built-in Bluetooth connectivity allows for integrated GPS location with the measurement. It also provides access for wireless headsets for audio feedback in high noise areas.



Image 1, RT-30 with Protective Boot

2.1 Features

- RT-30 – 2 x 2" (6.3 cu in = 104 cm³) Sodium-Iodide detector provides High sensitivity performance due to the large crystal. Energy response from 20 keV - 3000 keV.
- Large easy to read 5 digit display updated at 1/sec – giving a wide dynamic range, with no overflow and no range controls. Graphic display LCD with white backlight with automatic dimming, 128 x 64 pixels, 28 x 60 mm size
- Simple ONE BUTTON OPERATION.

- Fast response, easy-to-hear AUDIO at 20/sec sampling making source location easier and eyes free
- 1 GB memory standard on all units.
- New design state-of-the art electronics with advanced CPU capability.
- Special rugged design, robust aluminium casting construction with a heavy duty "Rubberized" outer coat which works as a shock absorber and provides thermal isolation.
- Outer coating gives a good grip even when wet, is simple to maintain and permits easy decontamination if required.
- Well balanced, easy to hold and designed for one hand operation.
- RUGGED integrated carrying handle.
- IP-65 Dust and Water resistant
- Rechargeable battery kit supplied including NiMH battery pack module (4 x AA) batteries, Universal Charger (110/220 VAC) with adaptors for different countries.
- Typical 8+ hour battery life at 15°C on NiMH batteries.
- Size 259 x 81 x 91 mm – 2.2 kg with batteries.
- Operational Temperature range -10°C to +50°C (display is the limit).
- Spare battery module for "instant" replacement.
- Sensitivities (1 MBq from 1 m): Am-241 75 cps, Cs-137 160 cps, Co-60 270 cps.
- Modern CPU and spectrometer design.
- Large Graphic LCD with white backlight. Automatic dimming.
- New sophisticated algorithm for nuclide identification.
- Full energy compensated dose rate measurement in wide scale.
- Automatic energy calibration based on natural background radiation. No external radioactive source required.
- USB and Bluetooth connection. Support to GPS and hands free audio sets.



USERS ARE REMINDED THAT THE RT-30, IN COMMON WITH OTHER SIMILAR INSTRUMENTS, USES A NAI(TL) CRYSTAL AS THE PRIMARY DETECTOR. THESE CRYSTALS ARE FRAGILE AND EVEN THOUGH THE UNIT HAS BEEN RUGGEDIZED FOR FIELD USE, GREAT CARE SHOULD BE TAKEN TO AVOID ABUSING THE INSTRUMENT AS THE VERY EXPENSIVE CRYSTAL IS NOT COVERED UNDER WARRANTY

3 SYSTEM INTRODUCTION

3.1 Button

The RT-30 Super-Scint instrument has only ONE control that is the front panel solid state PUSH-BUTTON referred to as **BUTTON**. The **BUTTON** has 3 primary actions:

- **SHORT CLICK** (less than 1 second **BUTTON** action)
- **LONG CLICK** – typically 3 second **BUTTON** action with display feedback
- **EXTRA LONG CLICK** for instrument switch OFF



Image 2, One button Operation

3.2 Batteries

3.2.1 General

LOAD BATTERIES IN HOLDER - the unit is shipped with batteries separate. Remove the Battery Cover by pressing the Battery Holder Clips at both sides. Load 4 x AA cells with negative at the spring end. Slide the battery Cover back in place ensuring that the side guides are lined up – if all is OK the Cover should fit smoothly on.

LOAD BATTERIES IN UNIT – slide the Battery Holder into the base of the RT-30 with the battery Terminals on the side of the copper terminals in the unit (if it is incorrectly the unit will not switch on). If all is OK the two sides mounted clips should “click” into place to hold the Battery Pack solidly into the RT-30 unit.

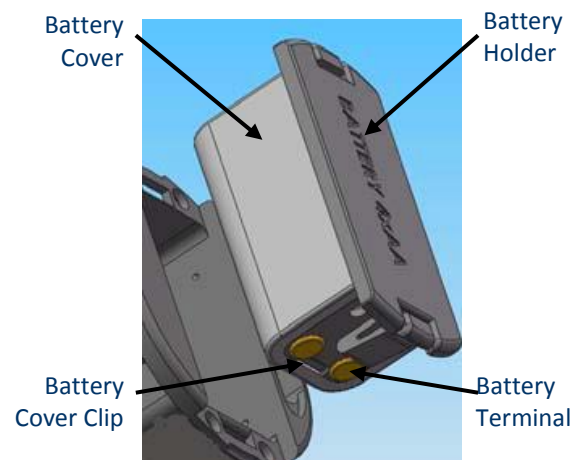


Image 3, Handy battery pack



THE RT-30 UNITS ARE SHIPPED WITH FULLY CHARGED BATTERIES. HOWEVER OVER A PERIOD OF TIME THESE BATTERIES WILL DISCHARGE SO USERS ARE ADVISED TO FULLY CHARGE BATTERIES BEFORE USE (4HRS MINIMUM).

3.2.2 Selecting Battery Type

The Battery Type selection is required to let the unit know which batteries are used. Battery discharge rates vary between battery type so that for Low Battery detection it is essential the unit knows the correct battery selection. Normally Rechargeable batteries are the correct option for the RT-30 as this is what is supplied with the unit.

Press the **BUTTON** until the unit beeps then release the **BUTTON**. At first power on after a Battery Pack insertion, the unit shows the **battery change label**.

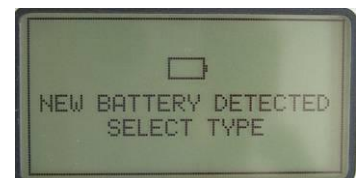


Image 4, battery change label

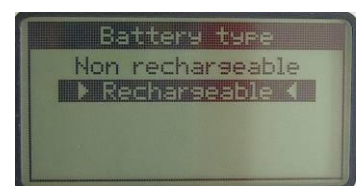


Image 5, battery selection menu

After a few seconds the **battery selection menu** appears, **SHORT CLICK** to move between selections. Once the correct selection is highlighted **LONG CLICK** until the **selection background** changes – release the Button for the correct selection. The next display is the **Start-up display** and shows for 3 Seconds then changes to the **Survey Display** (described below)

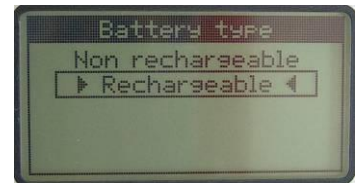




Image 6, selection background

	Shown in display when unit is working with Rechargeable batteries
	Shown in display when unit is working with non-rechargeable batteries.

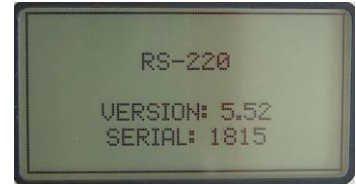


Image 7, Start-up display



WHEN USING ALKALINE OR DRY BATTERIES THE BATTERY TYPE PARAMETER NON RECHARGEABLE MUST BE SELECTED

3.2.3 Low Batteries

To indicate an approximate battery life, the battery icon is somewhat proportional to the battery life. When the Batteries are getting low during normal operation an audible beep is prompting the user to view the display. In case the Battery icon shows very little remaining capacity, see **Empty Battery icon**, the battery pack should be changed. At start-up, the display shows the **Low battery** screen. It is recommended that a spare Battery Pack is carried at all times to prevent field problems as changing is a matter of seconds. The RT-30 design provides NO loss of stored data. The RT-30 unit is supplied with two Battery holders.



Image 8, Empty Battery icon

3.2.4 Charging Batteries

The RT-30 has a built in battery charger which is powered by an external 12Vdc power supply, this allows the batteries to be recharged while operating the unit and without removing the batteries. Only rechargeable NiCd or NiMH batteries are rated for use with the RT-30. Regardless of the capacity of batteries used, the built-in charger will accommodate fully automatic charging.





Image 9, Low battery

To charge the RT-30 connect the unit to the cord of the supplied AC-adaptor or 12Vdc vehicle charging cable to the **12Vdc connector** input. This input connector is located behind the hole in the rear wall under the rubber cover.



Image 10, 12Vdc connector

Charging progress is indicated by an animated icon  as shown in the **Charging Display**. Should instead the power icon  be displayed then non-rechargeable batteries are selected at start-up. Power off the unit, remove and after several seconds re-insert the battery holder then on power on, select rechargeable batteries as described in paragraph **3.2.2 Selecting Battery Type**. Alternatively change the Battery type in the unit configuration, see paragraph **5.7.1 Battery type**.

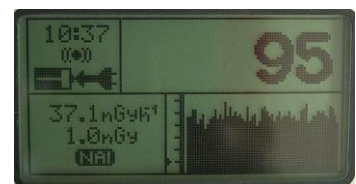


Image 11, Charging Display


Once connected the unit should take typically 4 hours (at 20°C) to reach full charge – longer at colder temperatures. When the unit is switched OFF and then connected to the power source **Charging batteries** is indicated on the screen however the instrument remains switched OFF.



Image 12, Charging batteries

The batteries supplied with the RT-30 unit are NiMH rechargeable batteries. It is best to “condition” these batteries when first used to ensure a good battery life. Try to ensure at least 2 charge/discharge cycles. The ideal form of conditioning is:

- fully charge the batteries in the unit – minimum of 4 hrs
- completely discharge the unit – 10 hours
- fully charge the batteries a second time – minimum of 4 hrs
- completely discharge the unit a second time – 10 hours
- fully charge the batteries a third time – minimum of 4 hrs

Ensure when using the Vehicle Charging Cable the vehicle connection is powered on (red LED on the connector) as some units power OFF when the ignition key is switched off (check that the unit is displaying the  charging icon as shown in **Charging Display** even when ignition is OFF).

NOTE: Starting a vehicle can cause many bad voltage transients on the power line that can damage sensitive electronic equipment. For this reason users are advised to unplug the charger during vehicle starting.



ALKALINE OR DRY BATTERIES MUST NOT BE CHARGED. THE MANUFACTURER WILL NOT BE HELD RESPONSIBLE FOR DAMAGE TO THE UNIT CAUSED BY USE OF IMPROPER BATTERIES. ENTERING A WRONG BATTERY TYPE MAY LEAD TO UNPREDICTABLE DAMAGE ON THE UNIT AND WILL INVALIDATE THE WARRANTY.

3.3 Display

The Display is a back lighted **Graphical LCD display** optimized for high contrast in outdoor conditions. Display Backlighting is required in low light conditions to make the display readable but this reduces battery life.

To optimize battery life the backlighting automatically comes on only when required. Alternatively the backlighting can be activated or disabled permanently as the user finds suitable. The Display is used for various functions and messages.

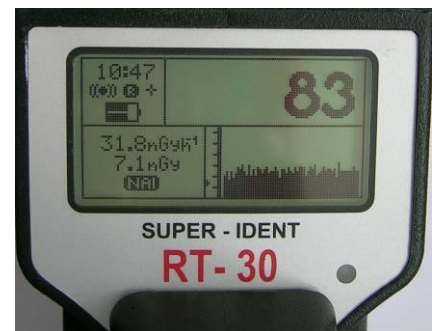


Image 13, Graphical LCD display

3.4 Audio


The RT-30 has an audio speaker inside the unit. The audio system is activated when the radiation level gets above a certain internally computed Audio Threshold. Once the Audio Threshold is exceeded then the audio pulse period pitch (frequency) will reflect the incoming count rate. Hence the audio pulse period pitch (frequency) is somewhat proportional to the incoming count rate or local radiation level.

In this manner a eyes-free search can be carried out that is usually highly recommended in many field situations where often the eyes are selecting the terrain. Without proper audio feedback, some significant count levels could be missed if the eyes are distracted. The Audio system can be fine-tuned in Parameter setup if required.

The Audio Threshold is computed from the background which is measured right after start-up. In case the environment or background has significantly changed, it might be needed to re-acquire the background for proper Audio Threshold, see paragraph **4.2.4 Re-acquire background**



Image 14, External Audio

External Audio for covert scanning is available through Bluetooth by using standard available Bluetooth audio devices. The external audio icon  is displayed to indicate a successful Bluetooth connection to the device.

3.5 Power On

Press the **BUTTON** until the unit beeps and the sign on display is seen, then release the **BUTTON**. After 3 seconds the sign on display changes to the Survey display and the unit goes to Survey Mode, see paragraph **4.2.1 Survey Display**. Should the battery pack be removed before power on, then please refer to paragraph **3.2.2 Selecting Battery Type**.

3.6 Power Off

To power down the unit, press and hold the **BUTTON** for an **EXTRA LONG CLICK** and the unit switches OFF. The display shows a **Countdown** "TURNING OFF 3", "TURNING OFF 2", "TURNING OFF 1" then the unit finally switches off.



Image 15, Countdown

The countdown sequence could take a few seconds before initiating in case the unit is "busy" however typically no more than 5 seconds before the countdown sequence starts. If the **BUTTON** is released before completion of the power OFF sequence, the unit returns to normal operation.

The power off process is independent of the working status of the unit. In rare cases it may happen that the power OFF countdown will not appear on display as the unit might be overwhelmed with other tasks – typical USB or Bluetooth devices. However the power OFF process continues in the background and the unit will power down without further indication.

4 OPERATING MODES

4.1 Action Menu

The **Action Menu** is the main menu of the RT-30. As noted above the RT-30 only has one **BUTTON** to operate the instrument. To achieve the required system functions **SHORT CLICK** in Survey Mode and the **Action Menu** appears.

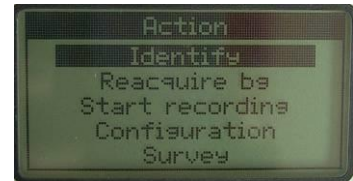


Image 16, Action Menu

The user navigates through a menu using **SHORT CLICK** and the highlighting moves with the selection. Once the selection is made, **LONG CLICK** until the **Selection background** changes from Dark to Light (typically 2-3 secs) then release the **BUTTON** to make the selection.

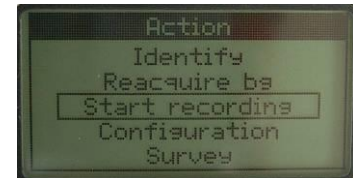


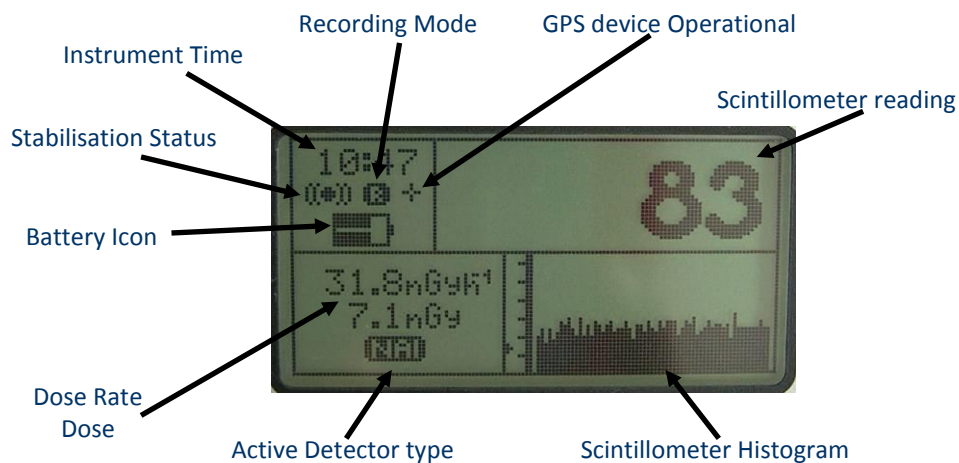
Image 17, Selection background

4.2 Survey Mode












This is the main working mode of the RT-30 and the instrument will immediately enter the Survey mode after start-up. The Survey Mode can also be activated from the Action Menu. In this mode the unit works as a sensitive gamma ray scintillometer. This mode is rated for fast and easy survey of large area or objects in search for lost or hidden radioactive sources.

4.2.1 Survey Display

The Survey display is segmented as outlined below :



Scintillometer reading	Shows the Total Count radiation level from the NaI (Primary) detector in cps (counts per second) units. Please refer to paragraph 5.5.1 Total scan period for optional settings.
Scintillometer histogram	A histogram of the above scintillometer readings, the last 80 measurements are displayed.
Active Detector type	Shows the active detector.
Dose	Shows accumulated dose since last background update.
Dose rate	Shows actual dose rate. Please refer to paragraph 5.5.4 Show dose and 5.5.6 Dose Units for optional settings.

		= Rechargeable battery
Battery icon		= Non-rechargeable battery type
		= Exhausted battery
Stabilisation status		indicates NaI detector has been stabilised.
Instrument time		Local time inside the instrument. Please refer to paragraph 5.2 Date and time to change the date/time setting.
Recording mode		indicates recording mode is active.
GPS device Operational		indicates GPS device is connected,
		flashing icon means GPS has not locked onto satellite(s), steady icon indicates GPS positioning is locked.
Other Icons used (not shown above)		Remote BT connection to GeoView
		Remote USB connection to GeoView
		External BT handsfree connected
		External power connected
		External power connected and charging batteries

4.2.2 Alarms

Currently there are 2 Alarm systems built into the system operation :

HI DOSE RATE; The RT-30 has a large volume NaI/Tl detector which makes it very sensitive to radiation levels. This detector saturates at 65,000 cps on the display which is roughly equivalent to a Dose Rate for Cs-137 of 100 μ Sv/h. The integrated GM tube extends operation Dose Rate to 10mSv/h which is 100x the saturation point of the NaI detector.

The RT-30 is NOT intended for normal use in high Dose rate levels as users wanting to work above 100 μ Sv/h routinely have no need of such a large NaI detector. So the GM tube Dose Rate data is intended as a guide to the user and is not recommended for normal operation. For this reason, when the NaI detector saturates at 65,000 cps the Audio beeps loudly and a special message appears on the display "NaI OVERLOADED" as a warning to the user that they are in a high Dose Rate field



NEUTRON ALARM; The internal Neutron tube has a neutron background at sea level of approx 0.1N/s but for random data reasons normally the background is 0 with occasional 1 Neutron/sec spikes. Internal parameters adjust the Neutron data filter rate to minimize the effect of these spikes and also set an Alarm Threshold of 4N/sec which should be a reasonable alarm level for most applications.

If the Neutron count rate exceeds 4N/second a loud pulsing Audio occurs and the detector indicator changes to He and the display shows the message "NEUTRON ALARM".

4.2.3 Recording mode

The RT-30 provides a recording capability that permits automatic recording of Total count data, Dose Rate data and Neutron count data into memory. In addition an external GPS unit can be interfaced directly into the unit via the Bluetooth connection and the GPS data integrated directly into the internally stored data memory.

There is a huge space allocated in the instruments internal memory for Recording. Data from all detectors (NaI/Tl, GM and He-3) are saved every second, date and time stamp as well as GPS coordinates are added every 30 seconds. Stored data can be retrieved from the instrument by connecting the unit to a PC and run the GeoView Software.

To activate recording while in Survey Mode **SHORT CLICK** and the **Action menu** appears. Using **SHORT CLICK** highlight the option **Start recording** and **LONG CLICK** until the background changes from Dark to Light (typically 2-3 secs) then release the **BUTTON** to activate Recording. The  recording icon appears on the **Survey display** to indicate recording is activated and in case a GPS is connected the  GPS icon is displayed as well. If the GPS icon is flashing this means that the GPS has not found a good satellite lock so data recorded in the system for Lat/Long are zero. When the GPS acquires satellites the GPS icon is solid showing proper location data is being recorded.

To end the recording while in Survey Mode **SHORT CLICK** and the **Action menu** appears again. Using **SHORT CLICK** highlight the option "Stop recording" and **LONG CLICK** until the background changes from Dark to Light (typically 2-3 secs) then release the **BUTTON** to **Stop recording**.

The system has been developed to work with the GARMIN 10 GPS system which has Bluetooth capability and communicates data directly to the RT-30. However the GPS output data stream (GGA format) is common to all units so other GPS units should work fine but they have not been tested at this time. For details how to set-up the GPS connection, please refer to chapter **5.7 Accessories**.

NOTE: when the GPS is activated it does nothing until the "Start recording" selection is made. Then the units starts to automatically acquire satellites to get a good lock. It is very common that it takes 5-10 minutes to get a good lock with as many satellites as are available (this is the equivalent of a cold start). Once it has found ALL the satellites available it only needs 3 to get a good position. This means that once it has got all the satellites available it can continue to give good data even in areas where many satellites are lost.

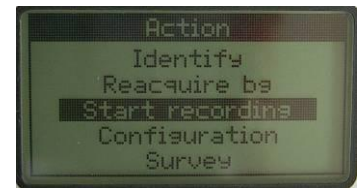


Image 18, Action menu

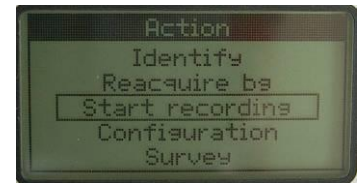


Image 19, Start recording

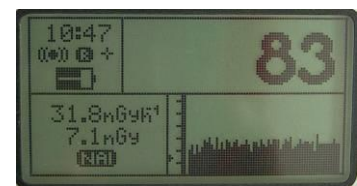


Image 20, Survey display



Image 21, Action menu



Image 22, Stop recording

4.2.4 Re-acquire background

When in Survey mode, the audio threshold is set using a preset parameter – usually 1 Sigma for sensitive and fast response. When the unit is powered on, after internal checks the **first three samples** are averaged and the Audio Threshold is computed from this average – then the Audio is enabled. If the count level exceeds this threshold the audio sounds as described in paragraph **3.4 Audio**. However in many areas the local background changes and this causes threshold problems.

As an example if the local background level was 100 cps then at 1 Sigma the Audio Threshold = 110 cps (100 + 1 Sigma). So if the count rate goes above 110 cps the audio will sound. However if the local Background increases substantially to 300 cps then the audio will be on continuously and the audio will not seem as sensitive to small local changes. Similarly if the local Background goes down to 50 cps then the local radiation would have to increase very substantially before the audio sounds – thus effectively desensitizing the audio system

To overcome this “problem” at any time the user can touch the **BUTTON** and **SHORT CLICK** to highlight **Reacquire bg** from the Action Menu and **LONG CLICK** to **Start Reacquire bg**. Then the instrument will return to the Survey display and automatically re-compute the Audio Threshold. The **first three samples** are taken as noted above and the message “UPDATING BG” appears on the screen. This means the user can “retune” the Audio Threshold at any time thus keeping the audio threshold optimized



Image 23, first three samples

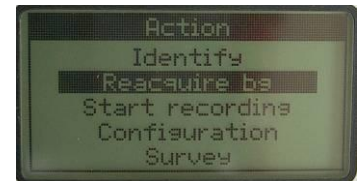


Image 24, Reacquire bg

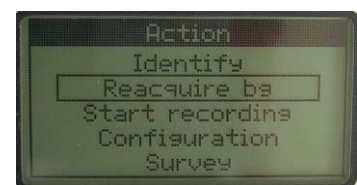


Image 25, Start Reacquire bg



USERS ARE ADVISED THAT “REACQUIRE BG” ALSO RESETS THE ACCUMULATED DOSE DATA ON THE SURVEY DISPLAY

4.3 Identify Mode

RT-30 Super - Ident is a Handheld Isotope Identification Instrument. Build on a high sensitive, large volume NaI/Tl detector combined with 1024 channel analyzer (MCA) provides the RT-30 a solid base for highly sophisticated analysis algorithms. The use of a new and powerful Microprocessor allowed to use complicated statistical methods and apply those to the measured spectrum. The Nuclide Library is tuned to aid the analyses of complicated spectra and determines isotopes with highest reliability. The identification process is fully automated and does not require special user efforts. Information about found nuclides and identification credibility are printed on easy list.

As other devices based on NaI/Tl scintillation detector RT-30 must compensate sensitivity of the detector on ambient temperature. For this the RT-30 profits from the natural background and uses it to provide a precise gain correction. Users are advised to use the Identify Mode only when the instrument is fully stabilised.

4.3.1 Stabilisation

Spectrometer systems like the RT-30 use an integrated spectrometer system to provide data for analysis of nuclide identification results. The accuracy of these results is a function of many parameters but a very significant one is spectrometer stability. It is crucial that the system

spectrometer maintains a stable operational mode independent of temperature etc. To provide accurate Nuclide Identification data the spectrometer must be stabilised to also give data independent of local conditions that could affect the data.

To achieve this, the RT-30 has a fully automatic spectrum stabilisation procedure integrated in the unit that uses the low radiation levels from surrounding geology to perform this analysis. Already in Survey Mode the system accumulates spectra internally while the system is powered on and once a high enough statistics have been achieved then a complex analysis takes place to determine the correct spectrum position. This analysis results in an error measurement that the system uses internally to correct these effects. Note that this process is completely independent of the user. Typical Automatic Stabilisation typically takes 3-5 minutes depending on local conditions but no more than 15 minutes. The RT-30 can continue to be used while this fully automatic process is carried out in the background.



THE AUTOMATIC STABILISATION MIGHT NOT FUNCTION CORRECTLY IN CASE THE NATURAL BACKGROUND IS HIGHLY DISTORTED BY MAN-MADE ISOTOPES OR IN CASE NATURAL BACKGROUND IS NOT AVAILABLE DUE TO HIGH SHIELDING.

If the automatic stabilisation does not function correctly an alternative method of stabilisation is available using the peaks of ^{137}Cs . Please see paragraph **5.6 Stabilisation** for detailed operation.


Once the system is fully stabilised a new icon appears  on the **Survey Mode** screen above the Battery icon to show the analysis is complete. If the system is not yet stabilised the stabilisation icon appears every 30 seconds to indicate the stabilisation process is carried out.



Image 26, Survey Mode

While not stabilised and the user attempts a **Nuclide Identification**, an **Error message System not Stabilised** appears and the unit beeps 3 times. If the user chooses to ignore this warning, the identify continues – note that under these conditions the quality of the data is questionable as system Stabilisation is incorrect. The data could be roughly OK if stabilisation is close but could be really bad data if stabilisation is significantly in error. The stabilisation status is shown on the data retrieved to the PC for data verification.

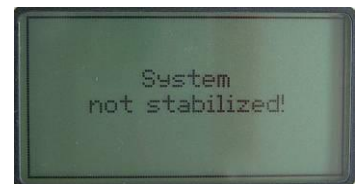



Image 27, Error message System not Stabilised

Accumulation of Stabilisation data is not interrupted by the Nuclide Identification process. In fact when high enough statistics have been accumulated an auto correction is implemented so that if at the end of Identify a gain correction is required, the system automatically computes the potential gain error and applies a correction to the data to minimize system errors. For general practise the user is advised to stabilise the unit before entering the Nuclide Identification process.

Since the NaI/Tl detector is highly sensitive to temperature changes the unit may have to compensate large differences in gain. In order to keep the unit quickly operational users are advised to leave the unit running in Survey mode for all the time identification is not needed. The unit can be powered from external power and while idle, the unit will proportionally compensate temperature drift and hold unit stabilised and ready to go. In case the unit was stabilised and switched off in a very different ambient temperature, the stabilisation process will have to compensate a large drift. The stabilisation might take longer under these conditions but no longer than 15 minutes.

4.3.2 Nuclide Identification

Usually Identification is required after a possible source has been located in the **Survey Mode** (see paragraph 4.2) and the instrument is stabilised as indicated by the stabilisation icon  on the Survey display. The optimal position of the unit varies on the activity of the source and user shall adjust the distance of the instrument to the source to minimize a negative impact of a too strong or too weak radiation level. The source being too strong, the high count rate will overload the unit's ADC and interference and distortion may affect the spectrum resulting in an incorrect nuclide identification. Instead a weak source may be overlapped by local background radiation and useful information may be lost.

The unit aids to user to adjust to the best position of the instrument in relation to the source. At first while in **Survey Mode** the user shall position the unit to obtain a significant reading of Total counts per second but no more then 20000 cps. Changing the distance of the instrument to the source this can be used to achieve the best reading.

To enter the Identify Mode after the optimum instrument position has been identified, **SHORT CLICK** to highlight **Identify** from the Action Menu and **LONG CLICK** to **Activate Identify**. The **Spectrum acquisition** starts immediately and the Elapsed time as well as remaining time to go is displayed in an animated bar graph and numerical counter.

The second aid to best positioning of the instrument is given in the large rectangular box in upper half of the display. If the position of the unit to the source was correct there is a message "OK" and user is requested to wait until the preset measuring time has passed. In case the count rate is low a message "MOVE CLOSER" appears as user is hinted to move the instrument closer to the source. In case of a too strong exposure the message "MOVE AWAY" will alert the user to increase the distance between source and instrument. The user has to increase the distance until the message changes to "OK".

In the real life many sources may be weak and although the source almost touches the unit the message MOVE CLOSER remains. In those cases the measurement time might need to be extended.

After completion of the Spectrum acquisition the unit beeps and **Nuclide identification** starts promptly. Results are displayed on screen in a **Nuclide list**. There are three rows visible and if more nuclides are found a scrolling arrow on the right will alert to this. **SHORT CLICK** will scroll through the list, scrolling is only one directional but circular meaning it will jump to the top after the last entry. Information about average dose rate is just under the window header.

At any time the user can stop the Spectrum acquisition by a **SHORT CLICK** – the display then shows the Nuclide Identification Results for the time period that occurred rather than the full period. This is NOT recommended for daily practise as the quality of the data depends a lot on the acquisition time.

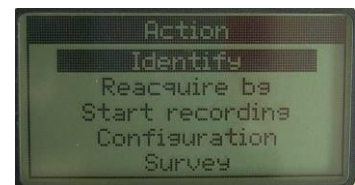


Image 28, Identify

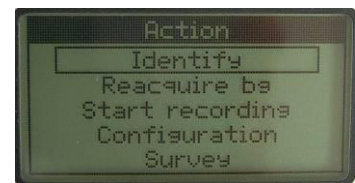


Image 29, Activate Identify



Image 30, Spectrum acquisition

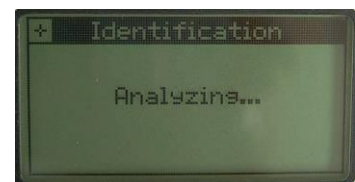


Image 31, Nuclide identification

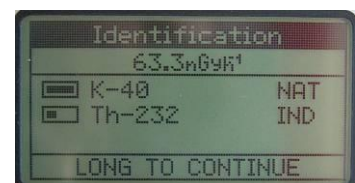


Image 32, Nuclide list

The **Nuclide list** sorts the nuclides found in descent order to their intensities which is indicated using small histograms. The name of the Radionuclide is completed with its category. There are four categories available:

- IND for sources typically used in industry.
- MED for sources in nuclear medicine.
- NAT for sources of natural origin, also called NORM.
- SNM for the most important category. Sources indicated as Special Nuclear Material are in this category indicating a special attention.

In case the radiation is not exceeding local background the **No nuclides found** screen gives the message "NO NUCLIDES IDENTIFIED" to indicate no nuclides were found. This message will also appear when radiation is significantly above the local background but the unit cannot identify a radionuclide. There are several reasons that could cause this:

1. The instrument was not stabilised hence the gain was not adjusted correctly. Users are advised to use the Identify Mode only when the instrument is fully stabilised.
2. Highly scattered radiation where information about energy of primary photons was lost. Typically it is the case with strong and deeply shielded sources.
3. A radionuclide which pattern is not in the unit nuclide library. Users are advised to contact Georadis for possible modification of the Nuclide Library.
4. Finally the radiation could originate from other than gamma ray sources - typically bremsstrahlung of beta sources. The unit will post a message "SHIELDED". This means the radiation was significantly higher then the local background but the unit failed to find valid peaks to perform Identification of the radionuclide.

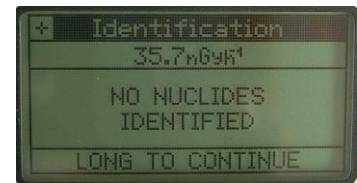


Image 33, No nuclides found

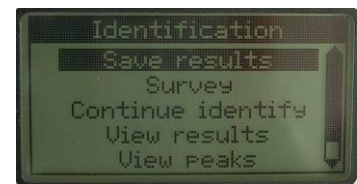


Image 34, Identification Menu

LONG CLICK to leave the Identification screen and to enter the **Identification Menu**.

4.3.3 Save Results

Selecting this option saves the results to memory – the next display shows the **Identification Stamp** of the data by ID# and the Date/Time of the reading. The user has approx 3 secs to note the TIME or the Identification # to enable them to relate the stored data to the actual sample location when data is retrieved from the unit. The data is stored in system memory and can be retrieved later using the GeoView software.

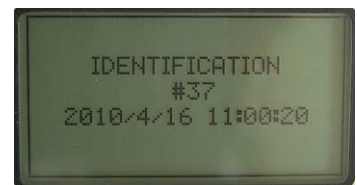


Image 35, Identification Stamp

NOTE: when the unit is initially setup the first sample is #0, after that they increment 1, 2, 3 etc. Even when data is erased this continues so if the last sample of the day was #46 then the first sample of the next day could be #47 the next #48 etc. This number continues to increment indefinitely to 1000 and then resets to zero as the number becomes uncomfortable.

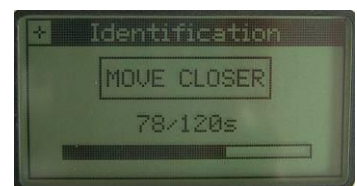


Image 36, Extended acquisition

4.3.4 Continue Identification

Extends the Spectrum acquisition time by another same period. So if the original acquisition time was 60 seconds then this selection takes another 60 second **Extended acquisition** which is accumulated with the already existing data so Nuclide Identification will now occur on the total 120 second sample. This is often used in low signal level areas where ID is difficult. The additional sample time usually makes ID more reliable

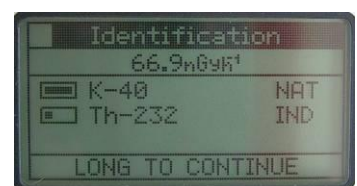


Image 37, Identification Results

4.3.5 View Results

This selection goes back to the **Identification Results** display so the user can "have a second look"

4.3.6 View Peaks

This selection shows the PEAKS in the spectrum that the Nuclide ID engine has discovered and identified as being legitimate **Identified Peaks**. The values in the right-hand column are peak amplitudes, this is the height of peak above its background. The number can be used as a measure to compare peaks in the same list or as a measure of significance of a source related to the background.



Image 38, Identified Peaks

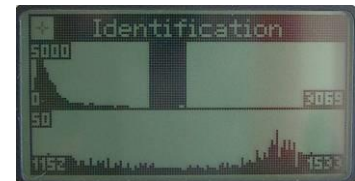


Image 39, Split display View

4.3.7 View Spectrum

This selection gives the user a **Split display View** of the spectrum accumulated in memory and is intended for advanced users. If selected, the first display is the full 1024 channel spectrum in a Linear virtual scale auto scaled to the maximum count level.

SHORT CLICK and the display splits – the upper display shows the full 1024 ch spectrum with the current selection (1/8th of the full spectrum so channel = 128 channels) highlighted, the lower display shows this selected 128 channel section of the spectrum expanded over a larger X-axis to make viewing easier. Repeated **SHORT CLICK** selects the next 1/8th section of the spectrum until the whole 1024 spectrum has been covered. Then these actions are repeated. **LONG CLICK** to exit the Spectrum View and return to the higher menu.

5 CONFIGURATION



CHANGE OR IMPROPER SET UP OF SOME OF THE PARAMETERS MAY HAVE A NEGATIVE IMPACT ON FUNCTIONING OF THE UNIT. IN CASE OF DOUBT ABOUT THE IMPACT OF A PARAMETER CHANGE, PLEASE CONSULT GEORADIS.

5.1 Manual access to Parameters

There is a structured menu to help the user to set up the basic working parameters of the instrument. Access to all parameters is only possible using remote connection from the PC. Only parameters accessible from unit's user interface are described in this chapter.

Menus are placed into functional groups. For ease of use, the selection and activation logic is always the same. To select – **SHORT CLICK**, to activate - **LONG CLICK**. Each discrete parameter holds a set of permitted values. User must select one of them using **SHORT CLICK** and confirm it by **LONG CLICK**. To leave from a menu to the previous level there is the option "Go Back".

5.2 Date and time

Set up unit's date and time is important for correct date/time stamping of stored data. Year, month, day, hour and minute must be set separately from the list of predefined values.

To change the instrument date and time, go to the **Configuration Menu**, **SHORT CLICK** to highlight "Date and Time" from the Configuration Menu and **LONG CLICK** to **Select Date / Time** options.



Image 40, Configuration Menu

The **Date and Time Menu** offers several selections as listed below.

5.2.1 Year

Sets the year for the internal clock. The display shows 2006, 2007, 2008 etc. **SHORT CLICK** to highlight the correct year then **LONG CLICK** to set this selection.



Image 41, Select Date / Time

5.2.2 Month

Sets the month for the internal clock. The display shows apr, may, jun etc. **SHORT CLICK** to select the right month then **LONG CLICK** to set this selection.



Image 42, Date and Time Menu

5.2.3 Day

Sets the day (date) for the internal clock. The display shows 1, 2, 3...31. **SHORT CLICK** to select the right day then **LONG CLICK** to set this selection.

5.2.4 Hour

Sets the hour for the internal clock. The display shows 0,1,2,3...23. **SHORT CLICK** to select the right hour then **LONG CLICK** to set this selection.

5.2.5 Minute

Sets the minutes for the internal clock. The display shows 0,1,2,3...59. **SHORT CLICK** to select the right minute then **LONG CLICK** to set this selection.

5.3 Display

Almost all LCD devices are more or less sensitive on ambient temperature. The LCD used in RT-30 is rated to operating range from -10 °C to +50 °C.

5.3.1 Contrast

This parameter allows correct adjusted contrast in seven steps. The default value is 0, indicating the factory set contrast at room temperature. Selections are -3, -2, -1, 0, 1, 2, 3. -3 to -1 lightens the display, +1 to +3 darkens it. **SHORT CLICK** to select the right contrast then **LONG CLICK** to set this selection.

5.3.2 Backlight

This parameter controls backlighting of the display. Selections are AUTO, ON, OFF.

AUTO the system automatically selects the required Backlighting using a light sensor to set the required level. This is the best selection but in dark shadow areas the Backlighting will come ON to make the display more visible. While often this is a required feature the downside of this is a significant reduction in battery life by typically 40% if the Backlighting is ON all the time

ON overrides the light sensor and sets the Backlighting ON all the time

OFF sets the Backlight permanently Off to conserve battery life.

SHORT CLICK to select the right option then **LONG CLICK** to set this selection.

5.4 Audio

5.4.1 Volume

Sets a percentage of maximum power of the internal voice amplifier. For permanent switch OFF (e.g. if headphones are used) select value OFF. Selections are OFF, 25%, 50%, 75% and 100%. **SHORT CLICK** to select the right volume then **LONG CLICK** to set this selection.

5.4.2 Filter length

The pitch of the audio tone in **Survey Mode** (see paragraph 4.2) depends on the intensity of gamma radiation. The higher the radiation the higher tone is produced. Statistical variation in the radiation (it is a physics, intensity is never a constant value) leads to fast frequency changes. This can create additional tone modulation which could lead to discomfort to the user. The instrument samples the radiation level 20 times per second and to make the tone more smooth the filter length can be adjusted. A moving average filtering over giving number of samples is applied. Selections are a filter length of 1, 2, 3...10 samples. **SHORT CLICK** to select the right filter length then **LONG CLICK** to set this selection.

5.4.3 Threshold

Sets the Audio response threshold. Selections are 1...6 Sigma levels of the average of the first 3 seconds (in total 60 samples as the unit is sampling at 20Hz). **SHORT CLICK** to select the right threshold then **LONG CLICK** to set this selection.

If 3 Sigma is selected then when the unit starts the local radiation BACKGROUND is averaged for a 3 second period (display shows "Updating BG"). This local background average is then

used to compute the selected 3 Sigma (3 Standard deviations) level and this is ADDED to the average background to set the AUDIO THRESHOLD. Each new radiation sample (at a 20/sec rate) are tested against this AUDIO THRESHOLD and if above it then the audio sounds. As an example – a typical local background level could be 100 cps (counts/second). So a selection of 3 Sigma would set the Audio Threshold = $100 + 3 \times \text{SqRt of } 100 = 100 + 30 = 130$. So if the count level goes above 130cps the audio will sound.

For most applications, a 1 Sigma level is recommended and this is the DEFAULT setting. This means that occasionally the unit will “chirp” on local background but this is often comforting as a means of ensuring the unit is functioning. In some other operational areas this random chirping can distract the user so for these SPECIAL applications a 3 Sigma level can be used

5.5 Measurement

5.5.1 Total scan period

Time is an important factor to increase sensitivity in **Survey Mode** (see paragraph 4.2). In case of extremely weak sources the user can extend sampling time in Survey mode up to 20 second per sample. Note that the display will be updated at the same rate as the selected Total Scan Period. Selections are 1, 2, 3...20, default is 1. **SHORT CLICK** to select the right total scan period then **LONG CLICK** to set this selection.

5.5.2 Total averaging

To suppress fast changes of total counts on the **Survey Display** (see paragraph 4.2) a damping can be applied. Note the damping has an impact only on value on the display and is not applied on values stored into the instrument memory. The damping uses a floating average method over a given number of samples, selections are 1, 2, 3...5. **SHORT CLICK** to select the right filter length then **LONG CLICK** to set this selection.

5.5.3 Identify time

This is one of the most important parameters influencing the Nuclide Identification sensitivity. The default spectrum acquisition time is 60 seconds however to increase the probability of a correct identification of weak samples, this value may be extended up to 1800 seconds. Selections are 30, 60, 90, 120, 180, 240, 300, 600, 900 and 1800 sec. **SHORT CLICK** to select the correct Identify time then **LONG CLICK** to set this selection.

5.5.4 Show dose

The user can suppress displaying the dose and dose rate on the **Survey Display** (see paragraph 4.2). Selections are ON and OFF. **SHORT CLICK** to select the correct setting then **LONG CLICK** to set this selection.

5.5.5 Nuclide library

The user can select between the DEFAULT and USER libraries. The basic library is the DEFAULT library. The user can create or ask the producer to help creating a special library according to their needs. This special Library can be uploaded to RT-30 memory using GeoView software. **SHORT CLICK** to select the correct setting then **LONG CLICK** to set this selection.

5.5.6 Dose Units

The instrument is primary calibrated in Air Kerma (Gy/hour). Results in Exposition rate (R/hour) or Ambient Dose rate equivalent $H^*(10)$ (Sv/hour) are recomputed from the primary value. Selections are Gy, Sv and R. **SHORT CLICK** to select the correct Dose Unit then **LONG CLICK** to set this selection.

Note : The setting only applies to the dose and dose rate are displayed on the instrument screen; the values stored in the memory are in Gy/hour.

5.6 Stabilisation

In some unpredictable circumstances it may happen that the system gain stabilisation will fail. To resume correct operation there are two maintenance services available.

5.6.1 Cs stabilisation

Permits the user to carry out stabilisation using a Cesium-137 source. This is a special capability sometimes useful if the unit has serious troubles getting stabilised. It requires the availability of a weak Cesium-137 source, typically 10kBq – 100kBq spaced a few inches away from the face of the unit (10kBq against the face, 100kBq at 10cm away is recommended). Once the source is positioned, activate the selection and the unit will stabilise itself automatically on the Caesium source. When it says "COMPLETE", remove the source and carry on as usual. The advantage of this capability is that Cesium-137 is a very defined source so if the units stabilisation is completely lost, the Cs stabilisation can often fully recover it.

If not already highlighted **SHORT CLICK** to select Cs stabilisation then **LONG CLICK** to activate this function

5.6.2 Temp.recovery

Resets the gain according to the factory predefined function between the Gain and actual temperature. This is recommended for users experiencing unusually bad stabilisation delays and essentially kick-starts the unit back to normal performance (usually after great temperature differences).

If not already highlighted **SHORT CLICK** to select Temp. Recovery then **LONG CLICK** to activate this function

5.7 Accessories

5.7.1 Battery type

Sets the type of Battery used. Selections are "Non rechargeable" or "Rechargeable". **SHORT CLICK** to select the Battery type then **LONG CLICK** to set this selection.

NON RECHARGEABLE selects Alkaline non-Rechargeable batteries. It is highly recommended that if non-rechargeable batteries are used then only alkaline batteries be chosen. Some non-Alkaline non-rechargeable batteries can leak and cause problems inside the instrument. If non-Alkaline are used then remove the battery clip after use to avoid this fairly common leak problem

RECHARGEABLE the internal battery system will automatically select battery type so NiCd or NiMH batteries can be used. However NiMH batteries (2500 series) are highly recommended as NiCd batteries have significant operational limitations in prolonged use.



WHEN USING ALKALINE OR DRY BATTERIES THE BATTERY TYPE PARAMETER NON RECHARGEABLE MUST BE SELECTED

5.7.2 GPS


This selection is used to couple an external GPS to the unit by Bluetooth (BT) link. The users manual of the GPS should be consulted too ensure that the unit batteries are charged. Once batteries are OK switch the units BT capability ON.

Select "GPS" from the Accessories menu by **LONG CLICK** and the display shows **Looking for BT devices** then the messages "Found devices: 1" and "Querying names" follow and finally the **Select GPS Menu** is seen. **SHORT CLICK** to highlight the correct BT device (e.g. "TomTom Wireless", then **LONG CLICK** to select the device. Message says "Connecting to device" and then finally **GPS Connected** then the display goes back to the **GPS Menu**.

To evaluate the readings of the GPS receiver and to verify the correct functioning of it, select "Test GPS" from the **GPS Menu** and **LONG CLICK** to activate this function. The display shows the actual readings from the GPS device, see **GPS Test**. **LONG CLICK** to return to the **GPS Menu**.

The **GPS Test** display offers the following information.

- STA** : Is the Status of the GPS receiver;
 "Not Connected" means there is no GPS receiver connected through BT.
 "Connected" means there is a GPS receiver connected through BT however the GPS has not locked onto satellites.
 "Fixed" means GPS receiver has locked onto satellites.
- SAT** : The number of satellites the GPS has been able to find.
- LAT** : The Lateral position.
- LNG** : The Longitudinal position.
- ALT** : The Altitude.
- SHORT CLICK** to return to the **GPS Menu**.

Note : the **Survey Display** will show the GPS icon  only in **Recording mode** (see paragraph 4.2.3).

5.7.3 Handsfree

This selection is used to connect an external BT earphone system to the unit. In the example below a JAWBONE system is described but most BT compatible earphones are supported. The users manual of the earphone should be consulted too ensure that the unit batteries are charged. Once batteries are OK switch the units BT capability ON.

Make sure the BT earphone is in so called "Pairing Mode", otherwise the RT-30 cannot find the device.

Select "Handsfree" from the Accessories menu by **LONG CLICK** and the display shows **Looking for BT devices** then the messages "Found devices: X" and "Querying names" follow and finally the **Select Handsfree Menu** is seen. **SHORT CLICK** to highlight the correct BT device (e.g. "Jawbone", then **LONG CLICK** to select the device. Message says "Connecting to device" and then finally **Handsfree connected** then the display goes back to the Accessories Menu.

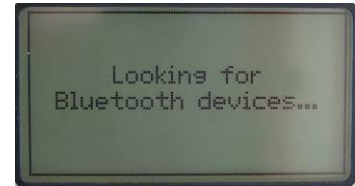


Image 43, Looking for BT devices

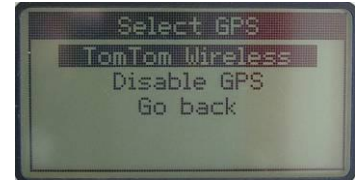


Image 44, Select GPS Menu

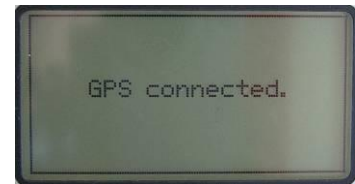


Image 45, GPS Connected

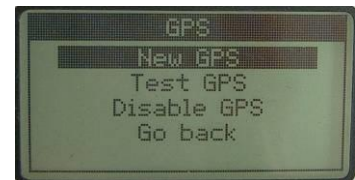


Image 46, GPS Menu



Image 47, GPS Test

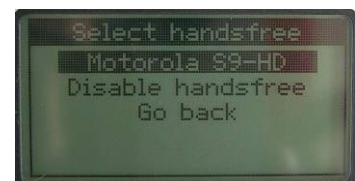


Image 48, Select Handsfree

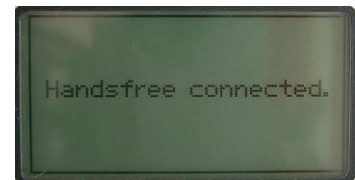



Image 49, Handsfree connected

Now if the unit internal audio activates to sound the presence of radiation the earphone audio mirrors this data.

Note that the **Survey Display** (see paragraph **4.2**) will show the Handsfree icon  and the earphones own audio level control is used to control volume.


6 CONNECTION WITH PC

The RT-30 can be connected to a PC using the USB port or alternatively a Bluetooth connection. Users are advised to use the GeoView Software package which was delivered with the instrument.

Alternatively GeoView can be downloaded from our website www.georadis.com. please consult Georadis for advise on the correct version to be used.

For details on using this software package, see the separate user manual on GeoView.

6.1 USB connection

The RT-30 can be connected to a PC using the USB connection, the  USB icon will appear at the Survey display showing **USB active**.

The RT-30 is supplied a with USB cable to connect to the instrument via the **USB port** which is situated next to the 12Vdc connection and located behind the hole in the rear wall under the rubber cover.

In case the USB connection is made with the RT-30 switched OFF the **USB Remote** screen is shown however the instrument remains switched OFF.

6.2 BT connection

Connecting a PC through a Bluetooth connection can be done using standard BT software as supplied with the PC. The user is required to set-up a Bluetooth connection with COM port to the RT-30, e.g. COM40. In case a BT password is required use 0000 the standard BT password for RT-30.

GeoView offers the option to connect through a COM port and when the connection is successful the  BT icon is shown on the Survey display indicating a **BT remote** connection.

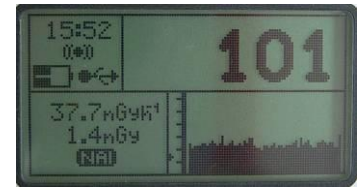


Image 50, USB active



Image 51, USB port



Image 52, USB Remote

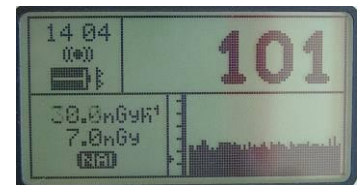


Image 53, BT remote

7 TECHNICAL REFERENCES

7.1 Calibration Reference Points

The RT-30 design incorporates several possible detectors into the instrument. When calibrating the instrument, the various positions of these detectors need to be taken into account.



THE DISTANCE BETWEEN RADIATION SOURCE AND RT-30 REFERENCE POINT AS USED BY METROLOGICAL INSTITUTES MUST BE A MINIMUM OF 100 CM FOR RELIABLE CALIBRATION.

Due to the normal use of the instrument, it is expected that radiation enters the instrument from the bottom side. The RT-30 is calibrated for read the dose rate correctly under these conditions.

For detailed information see [Calibration Reference Points](#) next page.

7.2 Dose rate Linearity

The RT-30 has been fully evaluated against the EN-60846:2002 standard and passed the testing. The [Dose Rate Linearity Graph](#) can be found below.

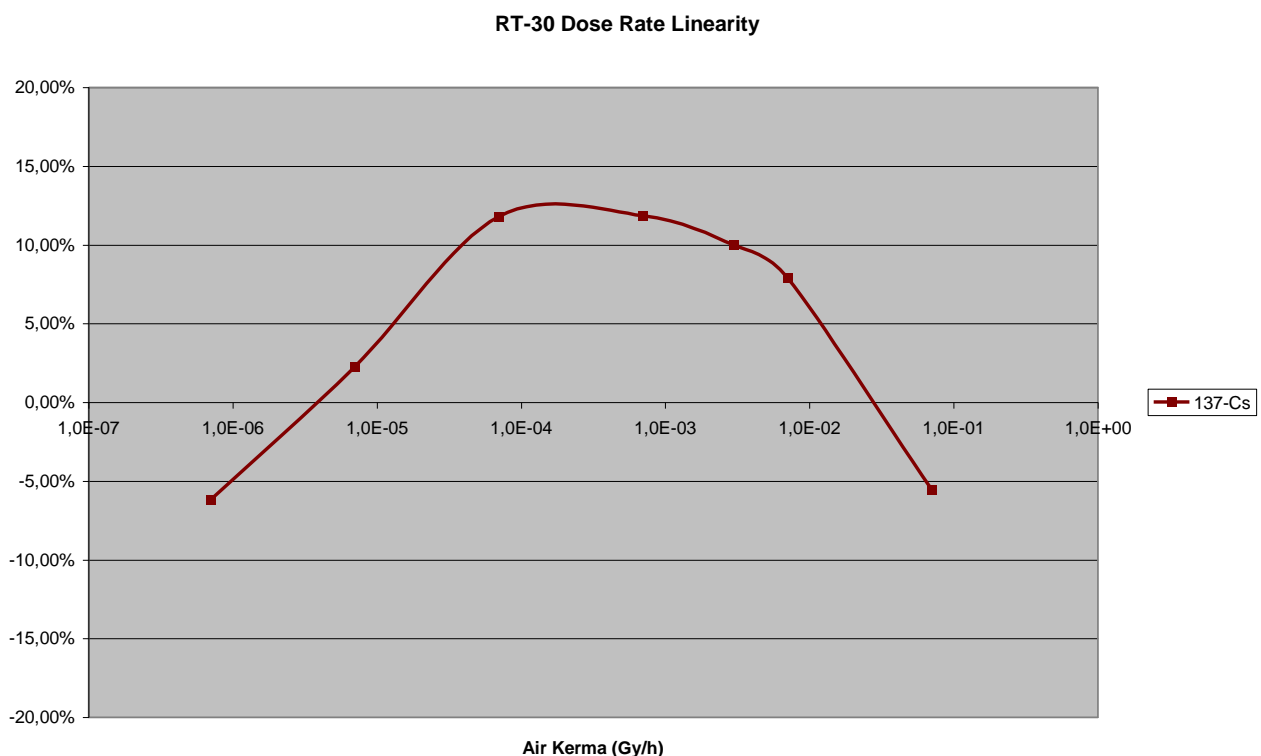


Image 54, Dose Rate Linearity Graph

Since FW version 6.04 the linearization of the dose rate response is provided during the calibration process and the linearity is in the range $\pm 2\%$ of the right value in the whole range measure by NaI(Tl) detector.

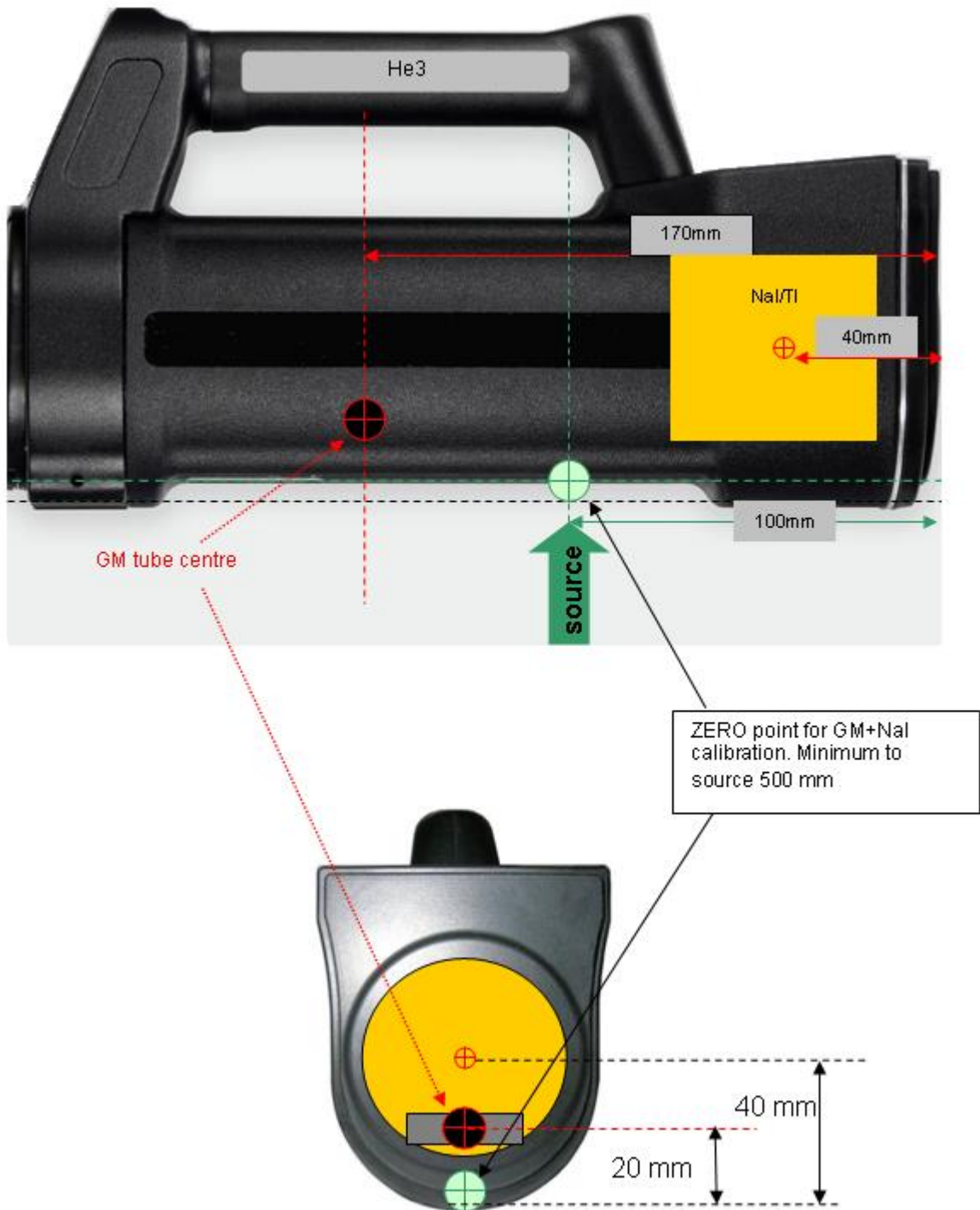


Image 55, Calibration Reference Points

APPENDIX A, NUCLIDE LIBRARY

Isotope Type	Isotope	Note
Natural:	K-40	
	NU	Natural Uranium
Industrial:	Ag-108m	
	Am-241	
	Ba-133	
	Ba-133 shielded	
	Cd-109	
	Co-57	
	Co-60	
	Cs-137	
	Eu-152	
	Ir-192	
	Na-22	
	Ra-226	
	Th-232	
	U-238 shielded	
	Xe-133	
	Zn-65	
	Neut	Neutrons
Medical:	Cr-51	
	F-18	Positron emitter
	Ga-67	
	I-131	
	In-111	
	Kr-81m	
	Mo-99	
	Se-75	
	Sm-153	
	Tc-99m	
	Tl-201	
SNM:	HEU	Highly Enriched Uranium
	LEU	Low Enriched Uranium
	Np-237	
	Pu-239	
	RGPu	Reactor Grade Plutonium
	U-233	

Note that Ra-226 and Th-232 are naturally occurring isotopes but they are commonly used in Industrial gauges so have been classified accordingly.

APPENDIX B, TECHNICAL SPECIFICATIONS

DETECTORS

NaI/(TI), $\Phi 51 \times 51$ mm (2" x 2"), 104 cm³ (6.3 in³), all models RT-30
Energy compensated GM tube with RT-30G and RT-30N
He-3 Neutron tube with RT-30N

SPECTROMETER

1024 channel MCA, bipolar pulse shaping
Energy range 20keV - 3,0 MeV

SCINTILLOMETER

Sampling period 20/second

GAMMA RAY SENSITIVITY AT 1M

160 cps/1MBq for Cs-137
75 cps/1MBq for Am-241
270 cps/1MBq for Co-60

DOSE METER

Energy corrected dose rate for NaI detector
Extended range with GM tube 10 mSv/h (1R/hr)

DISPLAY

Graphic LCD 128x64 pixels 28 x 60 mm
Automatic Backlight

ACOUSTIC INDICATION

miniature piezo speaker, audio frequency is proportional to measured count rate

DATA STORAGE AND TRANSFER

1 GB memory for spectra, search profiles and dose
USB 2.0 and Bluetooth 1.2 Class 2
GPS Support
NMEA 0183

ENVIRONMENTAL

IP-65 Dust and Water resistant
Operating temperature range -10°C to +50°C
RFI/EMF Shielding complies with FCC(47 CFR part 15) for
Class A CE Certification

SIZE AND WEIGHT

LxWxH 260 mm x 81 mm x 96 mm (10.2" x 3.2" x 3.8")
Weight 2 kg (4.4 lb) including batteries

PACKAGE

RT-30 instrument with Protective boot with Carrying Strap
AC Net power adaptor
USB Cable and GeoView Software
Spare battery cartridge
User guide
Rugged Pelican storage and transportation case

APPENDIX C, NOTES AND WARNINGS

The RT-30 (or RS-220) is a delicate instrument and contains components (Crystal, Photomultiplier) very shock sensitive. **The detector assembly is not covered under warranty.**

WARRANTY:

Manufacturer warrants to the original purchaser of Equipment that for the Warranty period, the Equipment will be free from material defects in material and workmanship.

- A. The "Warranty Period" begins on the date the Equipment is delivered and continues for 24 months.
- B. Any repairs under this warranty must be conducted by an authorized Company service representative.
- C. Excluded from the warranty are problems due to accidents, misuse, misapplication, storage damage, negligence, or modification to the Equipment or its components.

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