USER MANUAL
GT-30 Super-Spec
GT-32 BGO Super-Spec

Portable gamma spectrometers for geological and geophysical applications

Version 2.0

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GT-30 Super-spec
GT-32 BGO Super-Spec

User's manual

Rev 2.0 – May 2014

1 GENERAL

The two spectrometer models GT-30 and GT-32 are the state-of-the art in portable hand-held radiation spectrometer survey instrument for the geological and geophysical industry. They offer an integrated design with full weather protection, large detector, ease of use and the highest sensitivity in the market segment. Both models offer users a full Assay capability with internal data storage and PC data retrieval and display.

NOTE: the only difference between the 2 units covered in this manual are:

- GT-30 has a 103 cm^3 (6.3 cu ins) Sodium-Iodide detector
- GT-32 has a 103 cm^3 (6.3 cu ins) BGO detector that offers performance similar to a 345 cm^3 (21 cu ins) Sodium-Iodide detector

For simplicity the manual refers only to the GT-30 but system operation is identical for GT-32 instruments.

Users are advised that the manual and software supplied with the instrument were current when manufactured however a program of continuous improvement means that many new features are added and old ones improved with time. **Users are advised to contact Georadis directly for new releases including new manuals and software.**

1.1 MAIN FEATURES

- **GT-32 = 2 x 2" (103 cm^3)** Sodium-Iodide detector provides High sensitivity performance due to the large xtal. Energy response from 30 keV – 3000 keV.
- **GT-32 = 2 x 2" (103 cm^3)** BGO detector provides typically 3x equivalent performance over comparably sized Sodium-Iodide detectors.
- Full ASSAY capability with data in **% K and ppm U and Th**.
- **No radioactive sources required for proper operation**.
- **USB** connection for data retrieval.
- **Bluetooth** support for data transfer.
- Large easy to read **5 digit display** updated at 1/sec – giving a wide dynamic range, no overflow, 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** – no parameter setups required for normal operation.
- Fast response, easy-to-hear **AUDIO** at 20/sec sampling making source location easier and eyes free.
- **512K** memory standard on older units – **4 MB** standard on newer units (512K memory units can be upgraded if required).
- New design state-of-the art electronics with advanced CPU/spectrometer capability.
- Special rugged design, robust aluminum 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**.
- **RUGGEDIZED** integrated carrying handle.
- **Full IP66 weatherproofing** – short term water immersion and fully dust protected.
- **Rechargeable battery kit** supplied including NiMH battery pack module (4 x AA) batteries, Universal Charger (110/220 VAC) and a 12 V cigarette lighter charge cable.
- Typical **8+ hour** battery life at 15 °C on NiMH batteries.
- Size 259 x 81 x 91 mm, 2 kg (GT-32 2.2 kg) **with batteries** (10.2" x 3.2" x 3.6" – 4.4 lb).
- Operational Temperature range **-20 to 50 °C** (the display is the limit).
- Spare battery module for "**instant**" replacement.
- **Protective boot** with carry straps.

NOTE: See Section 5 for summary of new software system changes. Note that this manual incorporates all changes in the current release.

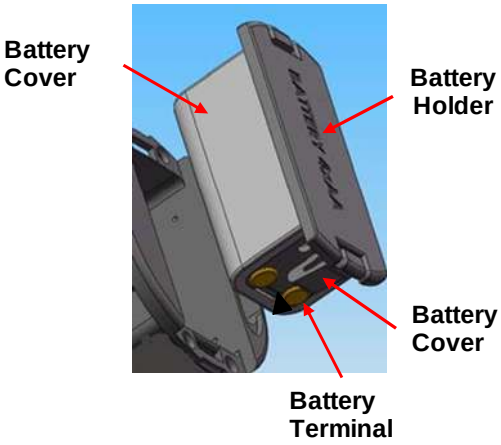
NOTE: USERS ARE REMINDED THAT THE GT-30, IN COMMON WITH OTHER SIMILAR INSTRUMENTS, USES A SODIUM-IODIDE CRYSTAL AS THE DETECTOR (THE GT-32 USES A BGO CRYSTAL). THESE CRYSTALS ARE FRAGILE AND EVEN THOUGH THE UNIT HAS BEEN RUGGEDIZED FOR FIELD USE, GREAT CARE SHOULD BE TAKEN TO AVOID ABUSING THE INSTRUMENT AS THE VERY EXPENSIVE CRYSTAL IS NOT COVERED UNDER WARRANTY.

2 SYSTEM OPERATION

2.1 BATTERIES

a) **LOAD BATTERIES in HOLDER** - the unit is shipped with the batteries separate. Remove the Battery Cover by depressing the Battery Cover Clip at each side. Load the 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 OK the Cover should fit smoothly on.

b) **LOAD BATTERIES in UNIT** – slide the Battery Holder into the base of the GT-30 with the battery Terminals on the side of the copper terminals in the unit (if in incorrectly the unit will not power on). If all is OK the two side mounted clips should "click" into place to hold the Battery Pack solidly into the GT-30 unit.



THE GT-30/GT-32 IS SHIPPED WITH CHARGED BATTERIES. HOWEVER OVER A PERIOD OF TIME THESE BATTERIES WILL DISCHARGE SO USER ARE ADVISED TO FULLY CHARGE BATTERIES BEFORE USE (4 hr MINIMUM).

2.2 BUTTON

The GT-30 Super-Spec instrument has only ONE control that is the front panel PUSH-BUTTON referred to as **BUTTON**.

This Button is actually mounted on the face of the instrument but with the normal handle attached, connection to the Button is via a mechanical link from the Button on the handle. The Button has 3 primary actions:

- **CLICK** – this is a short (less than 1 second) button action
- **LONG** – this a longer action typically 3 sec with display feedback

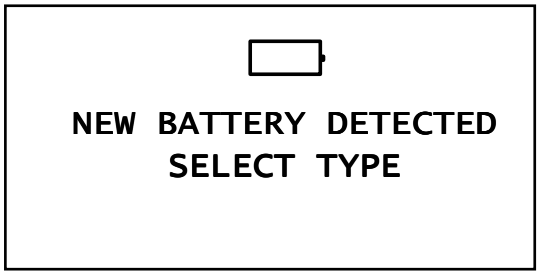
2.3 DISPLAY

The Display is a back lighted 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 so to optimize battery life the backlighting automatically comes on ONLY when required.

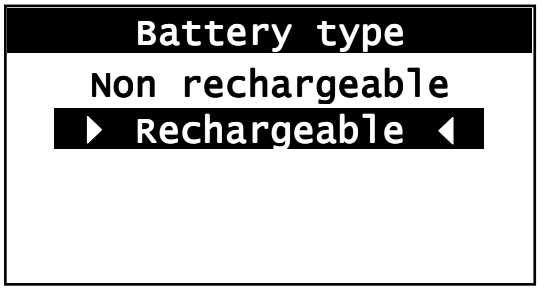
The Display is used for various functions and messages.

2.4 POWER ON after BATTERY CHANGE

Press the **BUTTON** until the unit beeps then release the **BUTTON**. The battery change label is shown:



The next display requires battery type selection:



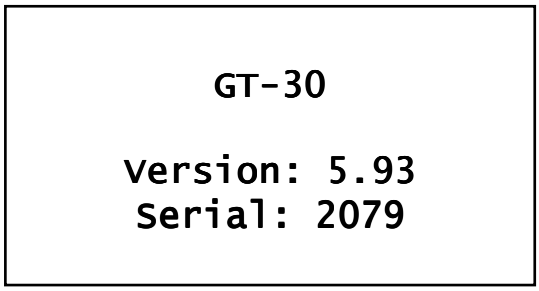
NOTE: The Battery Type selection is required to let the unit know which batteries are used. Battery discharge rates vary between battery types so that for Low Battery detection it is essential the unit knows the correct battery selection. Normally **Rechargeable** batteries are the correct option for the GT-30 as this is what is supplied with the unit – but users can select to suit their requirements.

USERS SHOULD BE CAREFUL NOT TO LOAD NON-RECHARGEABLE BATTERIES SUCH AS ALKALINE, INTO THE UNIT THEN CHARGING THEM. EVEN THOUGH THE UNIT HAS PROTECTION AGAINST THIS EVENTUALLY THE ALKALINE BATTERIES COULD LEAK AND DAMAGE THE INSTRUMENT.

CLICK the **BUTTON** (short less than 1 sec) to move between selections. Once the correct selection is highlighted hold the **Button** (LONG-CLICK) until the selection background changes – release the **Button** for the correct selection.

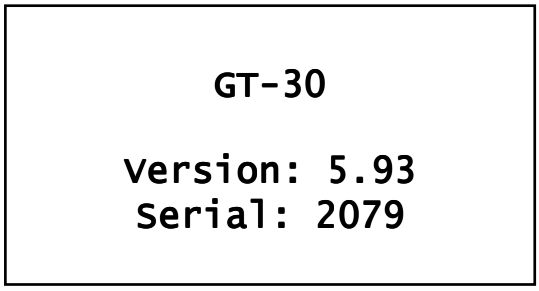
The next display is the start-up display and shows for 3 sec then changes to the **SURVEY** display (2.6 below).

NOTE: The software version will be 5.93 in this case.



2.5 POWER ON normal

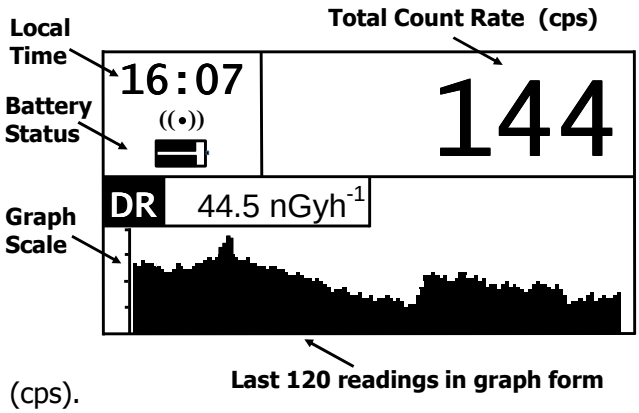
Press the **BUTTON** until the unit beeps and the sign on display is seen then release the **BUTTON**. After 3 sec the sign on display changes to the **SURVEY** display.



NOTE: The Version # is the installed software version of the unit. In any communication with Georadis regarding system performance, it is very helpful to specify the SERIAL # and the SOFTWARE VERSION # to enable better trouble shooting support.

2.6 SURVEY DISPLAY

The Survey Display is segmented as shown in the figure:



Local Time: settable to Local Time in Parameter Setup – see section 3.4.

Battery status: an Icon showing current battery status.

ALKALINE batteries 

RECHARGEABLE batteries 

Total Count Rate: current radiation level in counts/second (cps).

Graph: the last 120 readings are shown in graphical form. The right hand reading is the first (oldest) and the left hand is the latest. This helps the user to look for small changes they might have missed.

2.7 AUDIO

a) **INTERNAL** - The GT-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 INTENSITY will reflect the incoming count rate to provide a varying INTENSITY level that relates directly to count rate and therefore local radiation intensity.

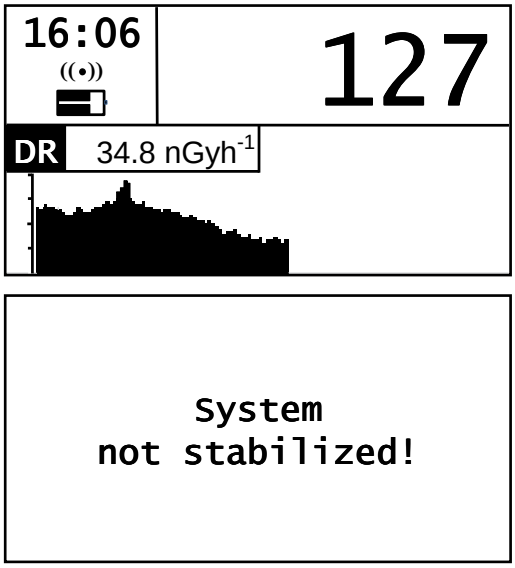
   In this manner a hands-free survey can be carried out that is usually highly recommended in many field situations where often the eyes are selecting the terrain so, without proper audio feedback, some significant count levels could be missed if the eyes are distracted. The Audio system can be fine-tuned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

b) **BLUETOOTH AUDIO** - Since the unit has Bluetooth (BT) connectivity, a new feature is the ability to use a BT earphone system for improved audio in very noisy areas (rivers, rain etc.) See section 3 below to activate the selected BT earphone system and section 4 for special parameter changes for Audio. The GT-30 assumes that VOLUME control is on the earphone as is normal on most units.

2.8 STABILIZATION

Spectrometers like the GT-30 use an integrated SPECTROMETER system to provide data for analysis of ASSAY results. The accuracy of these results is a function of many items but a very significant one is the spectrometer stability. It is crucial that the spectrometer system maintains a stable operational mode independent of temperature etc. To provide accurate Assay data the spectrometer **must be stabilized** – it means that peaks of K, U, and Th are at the correct positions in the measured spectrum.

To achieve this, the GT-30 has an integrated **FULLY AUTOMATIC** spectrum stabilization system that uses the low radiation level from surrounding geology to eliminate disruptive effects. In principle the system accumulates spectra **INTERNALLY** while the system is powered ON and once a high enough counts level has been achieved then a complex analysis takes place to determine the correct gain. This process is completely independent of the user. Typical Automatic Stabilization takes 5 - 10 minutes depending on local conditions.



Once the system is fully stabilized a new icon ((•)) appears on the display above the Battery icon to show the analysis is complete – see the figure. The GT-30 can continue to be used in the SURVEY mode while this fully automatic process is carried out in the background.

If the system is **NOT** stabilized and the user attempts carry out an **Assay**, an error message appears and **the unit beeps 3 times**. **If the user ignores this warning, the Assay continues** – note that under these conditions the quality of the Assay data is questionable as system Stabilization is incorrect so the data could be roughly OK if Stab is close but really bad data if Stab is significantly in error. The Stab status is shown on the data retrieved to the PC for data verification.

In previous software versions, Stabilization was inhibited during Assay to minimize data errors. However if users are taking repeated Assays this means that Stabilization will be suspended for a long period of time and during this period the system could drift causing significant data errors.

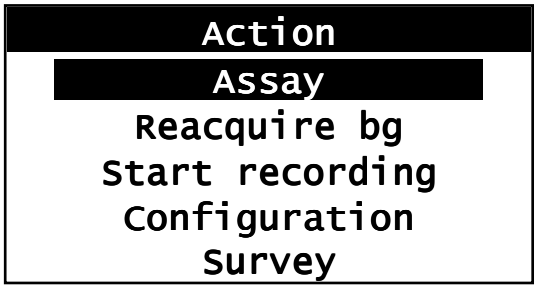
To prevent this happening in the new SW versions the Stabilization accumulation of data is NOT interrupted by the Assay process.

In fact an auto correction is implemented so that if at the end of Assay a Gain correction is required, the system automatically computes the potential Gain error and corrects the data to minimize system errors.

In addition the unit beeps every time it stabilizes as a reminder to the user that all is OK. This can be inhibited if judged to be a problem – contact Georadis.

2.9 ACTION

The GT-30 only has one **BUTTON** as noted above. To achieve the required system functions **CLICK** (short) and a Menu appears. The user navigates up and down this menu using short **CLICK** and the highlighting moves with the selection. Once the selection is made, hold the **Button** until the background changes from Dark to Light (typically 2 - 3 sec) then release the Button to make the selection.



Selections:

a) **Assay** – activates the ASSAY capability of the system (see section 2.10 below).

b) **Reacquire bg** – resets system background (see section 2.11 below).

c) **Start recording** – activates the RECORDING capability of the system (see section 2.12 below).

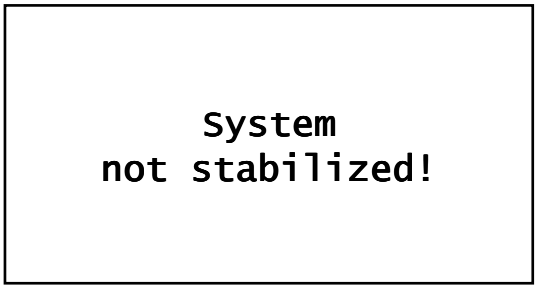
d) **Configuration** – permits parameter change - see section 3 below.

e) **Survey** – this selection returns to the previous SURVEY display with NO change in background setup levels.

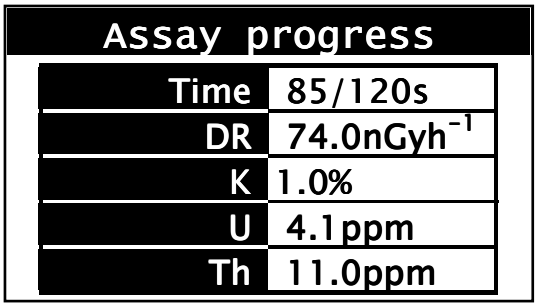
2.10 ASSAY

NOTE: THE DISPLAY MUST SHOW THE STAB ICON ((•)) BEFORE THE ASSAY DATA IS VALID.

If ASSAY is attempted with incorrect Stabilization an error message will appear on the display and the unit will beep 3 times. Correct action is to press the button once to terminate the ASSAY and wait until the unit is stabilized (normally 2 - 5 min max).



When the **ASSAY** selection is made the ASSAY mode starts and a new display is seen:



Meas Time – when the sample starts, a preset Sample Time parameter shows the sample time on the right, and on the left there is a count up timer showing sample progress.

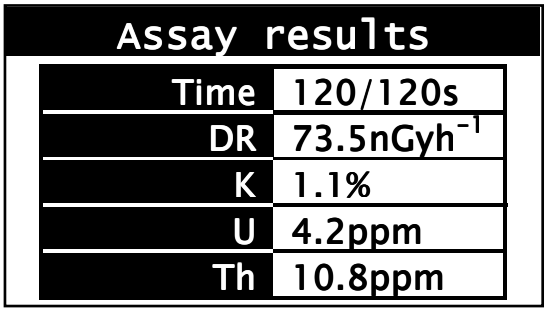
Once the first 30 sec sample point is reached an Assay result is shown. Each additional 30 sec the Assay data is recomputed and updated on the display.

For the best accuracy the full count period should be permitted. However in very anomalous areas sample times as low as 60 seconds give very good data due to the large detector size. Guidelines are:

60 sec – anomalous area – low quality data is fine – fast sampling is required to get maximum data for an area in a short period of time
120 sec – anomalous area – medium quality data is fine – fast sampling is required to get maximum data for an area in a short period of time
180 sec – medium anomalous area – good quality data is required
240 sec – medium to low anomalous area – high quality data is required
300-1800 sec – low anomalous area – maximum quality data is required.

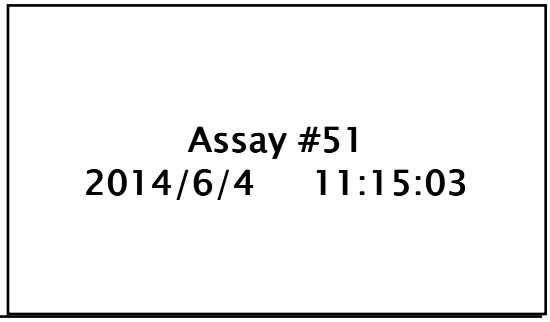
Note if the sample period is set ABOVE 999 sec then for display limitation reason, the "Meas time" is shown as a % of completion starting at 0.1 %.

FOR EASE OF USE THE SAMPLE PERIOD IS NORMALLY SET TO 120 sec AS THIS VALUE GIVES GOOD QUALITY DATA IN MOST CONDITIONS. See Section 3 and 4 to change to suit users requirements.



At the end of the preset Assay period the sample stops and the audio continuously beeps to advise user of the end of sample. The user presses the **Button** to stop the audio and inspect the display results. Note the display top label now shows "Assay results".

Note that the **K** data is shown in **%** and the **U and Th** data in **ppm** (parts/million – N.B. ppm/10000 = %). The **Total Activity** is usually shown in DOSE units (Sv, Gy, R) to give users an idea of the relevant Dose information and can be used as an overall indication of radiation intensity.

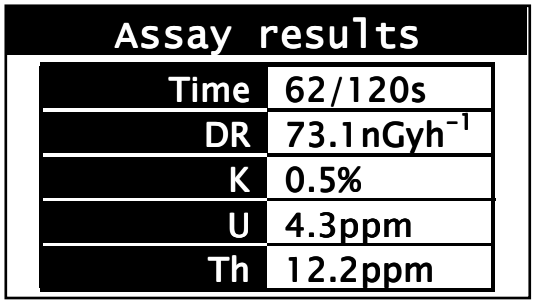


The user can then view/note these results then press the **BUTTON** again and the display shows:

The user has approx. 3 sec to note the DATE and TIME or the SPECTRUM # to enable them to relate the stored data to the actual sample location when data is retrieved from the unit. Alternatively the user can note the **TIME** on the GT-30 display **BEFORE** the sample is started as perhaps an easier way to record the data results relationship to sample location. The data is stored in system memory and can be retrieved later (see Section 4). NOTE: when the unit is initially setup the first spectrum is #0, after that they increment to 1, 2, 3 etc. Even when data is erased this continues so if the last spectrum of the day was #46 then the first spectrum of the next day will be #47 the next #48 etc. This number continues to increment indefinitely so identical sample #'s cannot occur. This method of "universal spectrum numbering" helps in minimizing data confusion.

SHORTEN ASSAY PERIOD

At any time **AFTER THE FIRST 30 SEC** - the user can **stop** the Assay progress by a short **CLICK** of the Button – the display then shows the Assay Results with the time shown at whatever it stopped at. This is NOT recommended as the quality of the data depends a lot on the sample time.



Selecting a fixed sample time (usually 120 sec) and ensuring all users wait for full sample completion, is a sensible way to maintain overall data quality.

DATA MEMORY LIMITS: Refer to section 4.9.3 (MEMORY) to determine system memory limitations and selections. The user is recommended to download data each day to prevent data loss.

GPS with ASSAY

If a GPS unit is configured (linked) to the GT-30 unit then GPS location data is recorded at the end of the Assay period. To conserve GPS battery power it is only necessary for the GPS to be powered ON for a short time during the Assay sample period. To assess this – at the start of Assay power the GPS to ON and there should be a flashing cross-hair below the battery icon. Once the GPS has a good lock on satellite data, the cross-hair goes steady. As soon as this steady-state is seen the GPS coordinated have been transmitted to the GT-30 unit so the GPS can now be powered OFF. Of course the GPS can stay on at all times if battery conservation is not a problem.

SPECIAL FUNCTIONS – See section 4.9. SETTINGS for special Assay actions.

2.11 Reacquire bg

When in the SURVEY mode of operation, the AUDIO THRESHOLD is set using a preset parameter – usually 1 Sigma for Geophysical application. When the unit is powered on, after internal checks the first 3 x 1 second 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 above. 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 briefly touch the **BUTTON** and select the **Reacquire bg** selection. Then the system will return to the SURVEY display and the system will automatically recompute the Audio Threshold and the message "UPDATING BACKGROUND" will be seen on the display for the 3 seconds of the update. This means the user can "retune" the Audio Threshold at any time thus keeping the audio threshold optimized.

2.12 Start RECORDING

The GT-30 now has a RECORDING capability that permits automatic recording of **TOTAL COUNT** data and/or **ASSAY RESULTS** into memory to permit line profiles etc. 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**.

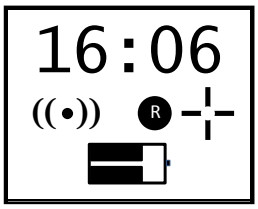
NOTE: **MEMORY** – system memory is allocated to suit users requirements. – See section 4.9 for details and changes.

a) **RECORDING WITH GPS** – the system has been developed to work with the **GARMIN 10** GPS system which has Bluetooth capability and communicates data directly to the GT-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**.

GPS INITIALIZATION
Setup the GPS recording link as described below in Section 3. Once the GPS is activated (linked) to the GT-30, data recording can start.

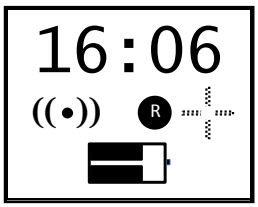
From the Main Menu select "**Start recording**" and new icons appear on the display as shown in the figure.

The "**R**" symbol shows that recording is ON and the **cross-hairs** show the GPS connection. If the cross-hair symbol 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 cross-hair is solid showing proper location data is being recorded.



Note: when the GPS is activated it does nothing until the **Start recording** selection is made. Then the unit starts to automatically acquire satellites to get a good lock. It is very common that it takes 5 - 10 min 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.

b) **WITHOUT GPS** – if no GPS is connected or activated Profile recording can still occur. From the Main Menu select "**Start recording**" and new icons appear on the display as shown in the figure. The "R" symbol shows that recording is ON and the flashing GPS cross-hairs still appears but may be ignored.



2.12.1 DATA RECORDING GENERAL

The data recording action shown with the symbol (R) means that the selected data is being recorded.

Section 3 below permits the user to select whether to record **TOTAL COUNT** data only, **ASSAY RESULTS** only or both.

a) **TOTAL COUNT data only** – set parameters as required:

RECORD TYPE = Total only
Total scan period = 1 – 20 sec (e.g. 1 sec)
MEMORY allocation as in section 4.9, selected to suit recording needs

When **Start recording** is selected then Total Count data is stored in memory at the selected rate (Total scan period) of 1 sample/sec (or as selected).

The data is stored in 30 sample data blocks. If an external GPS is integrated, the GPS data is stored every 30 samples – if no GPS is connected the GPS data is stored as zeros.

Some users want to record GPS data at a faster data rate. This can be done but some memory gets sacrificed – **see Appendix B**.

GeoView is used to retrieve this profile data – see section 4 for more details.

b) **ASSAY RESULTS data only** – the user must select:

RECORD TYPE = Assay only
Assay scan period = 30 – 1800 sec (e.g. 30 sec)
MEMORY allocation as describes in section 4.9

Parameter setup can be done manually as described in section 3 below but it is much easier to do via PC connection as shown in section 4.

When **Start recording** is selected then Assay Results only (no spectra) data is going into memory at the selected rate of 30 sec/sample.

The data is stored in a txt file, if an external GPS is integrated the GPS data is also stored – if no GPS is connected the GPS data is stored as zeros.

When data recording is complete press the Button to see the menu and select **Recording OFF** to terminate recording

Geoview is used to retrieve this profile data as shown below in a space delimited file that can be read into Excel as required – see section 4 for more details.

c) **TOTAL + ASSAY data** – in this case BOTH the Total Count + GPS data and the Assay Results + GPS data are stored in their appropriate memory locations and can be retrieved as described in section 4.

2.13 POWER OFF

To power OFF the unit, press and hold the **BUTTON** and the unit powers OFF. The display shows a countdown "**TURNING OFF 3**", "**TURNING OFF 2**", "**TURNING OFF 1**" then the unit finally powers off. Sometimes this countdown sequence can take a few seconds before initiating if the unit is "busy" but typically no more than 5 seconds before the countdown sequence starts. At any time before power OFF, if the **BUTTON** is released the unit continues to function.

2.14 LOW BATTERY

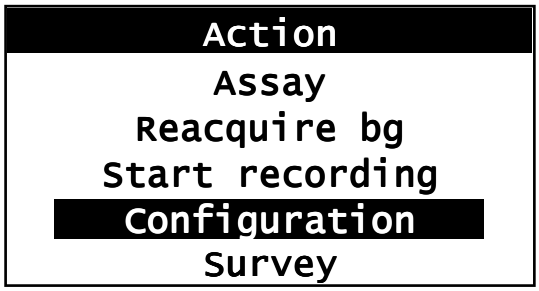
If the Batteries are getting low, an audio beep prompts the user to view the display. If the Battery icon shows very little battery left the battery pack should be changed. Georadis recommends that a spare Battery Pack is carried at all times to prevent field problems as changing is a few seconds task with NO loss of stored data. – 2 Battery modules are supplied with each unit.

3 CONFIGURATION (MANUAL METHOD)

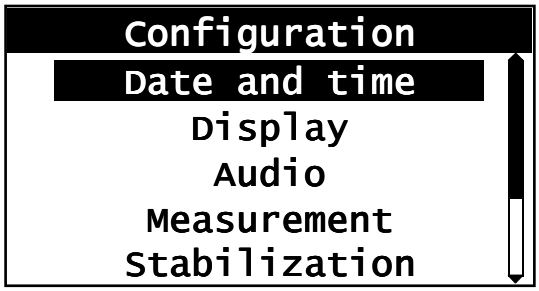
(Section 4 shows a much simpler way of parameter changes via the PC)

Select **Configuration** for the display reached by clicking BUTTON:

CLICK (short press of the BUTTON) to move down the menu. The screen highlights the selection. Move down the menu until the required parameter is reached then **LONG CLICK** (press BUTTON until the backlighting of the display changes from White figures on a Black background to the opposite) – then release the BUTTON to select this item (or parameter).



Once the new submenu is displayed use **CLICK** (short BUTTON) to move down the menu selection. Once the correct item is reached then use **LONG CLICK** (hold BUTTON until the background changes) then release the BUTTON to select.



PARAMETERS

a) **Date and time**

i. **Year –** the YEAR for the internal CLOCK. The display shows 2006, 2007, 2008 etc. **CLICK** to select the right YEAR then **LONG-CLICK** to set this selection.

ii. **Month -** this sets the MONTH for the internal CLOCK. The display shows Apr, May, Jun etc. **CLICK** to select the right MONTH then **LONG-CLICK** to set this selection.

iii. **Day -** this sets the DAY (DATE) for the internal CLOCK. The display shows 1, 2, 3 ……31. **CLICK** to select the right DAY then **LONG-CLICK** to set this selection.

iv. **Hour** – this sets the HOUR for the internal CLOCK. The display shows 0, 1, 2, 3 … 23. **CLICK** to select the right HOUR then **LONG-CLICK** to set this selection.

v. **Minute** - this sets the MINUTES for the internal CLOCK. The display shows 0, 1, 2, 3 … 59. **CLICK** to select the right MINUTE then **LONG-CLICK** to set this selection.

vi. **Go back** – return to the higher menu.

b) **Display**

i. **Contrast** – sets the Display CONTRAST. Selections are -3, -2, -1, 0, 1, 2, 3. -3 to -1 lightens the display, +1 to +3 darkens it. Normally "0" is a good average selection. **CLICK** to select the right setting then **LONG-CLICK** to set this selection.

ii. **Backlight** – this sets the Display BACKLIGHT. 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.

iii. **Go back** – return to the higher menu.

c) **Audio**

i. **Volume** – this enables or disables the audio survey system. Selections are ON, OFF ON = Audio is enabled.
OFF = Audio is disabled.

For Geophysical applications set to **ON** as Audio Survey is an essential operational requirement, the OFF mode is used for special applications.

ii. **Filter lenght** – this sets the filtering parameters to optimize the audio system response for different applications. Selections are 1 - 10 and indicate the number of 50 ms samples are averaged.
1 = shortest filter thus the fastest audio response.
10 = longest filter giving the slowest response.
SHORT filters give fast response but don't give such a "smooth" response to a slowly increasing field.
LONG filters give a very smooth "even" response for a slowly moving field but tend to minimize short term local effects.

For most Geophysical applications a setting of "**9**" is appropriate.

iii. **Threshold** – this sets the Audio response threshold. Selections are 1x to 5x Sigma levels of the average of the first 3 samples. If 3 Sigma is selected then when the unit starts the local radiation BACKGROUND is averaged for a 3 second period (display shows **Updating background**).

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) is 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 to 100 + 3 x Sq Rt of 100 = 100 + 30 = 130. So if the count level goes above 130 cps the audio will sound.

Once the Audio Threshold is exceeded then the Audio INTENSITY will reflect the incoming count rate to provide a varying INTENSITY level that relates directly to count rate and therefore local radiation levels. In this manner a hands-free survey can be carried out that is usually highly recommended in many field situations where often the eyes are selecting the terrain, so without proper audio feedback some significant count levels could be missed if the eyes are distracted. For most GEOPHYSICAL 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.

CLICK to select the right setting then **LONG-CLICK** to set this selection.

iv. **Go back** – return to the higher menu.

d) **Measurement**

i. **Total scan period** – the user selects the SCAN data rate for Recording Total Count data – selections are 1 – 20 sec – **default = 1 sec**.

ii. **Total averaging** – this sets the filtering of the display numeric data. Selections are 1, 2, 3, 4, 5 and these are Moving Average parameters.
1 = NO filtering at all so numeric data is displayed as recorded – normally recommended for Geo users and the **default** setting.
3 = a 3 point filter – the numeric data displayed is a 3 point moving average updated at a 1/sec rate.
5 = a 5 point moving average.
In most geophysical applications the user utilizes the AUDIO to find the approximate peak intensity location and the NUMERIC data to select the actual hot-spot. In this application a setting of "**1**" gives the fastest response but the other settings are available as required.

iii. **Assay time** – the user selects the SCAN data rate for recording Assay Results data – selections are 30 - 1800 sec – **default = 30 sec**. Note that Assay auto scan **SPECTRA** are **NOT** stored in memory to conserve memory space however normal Assay still stores full spectral data.

iv. **OnFlyAssay Window** – sets the period in seconds that the On-the-fly Assay data is averaged for. Assay data below 20 sec is very noisy so normally this parameter should be set to a minimum of 30 (sec). Note that these data are computed as a running average on a 1/sec basis.

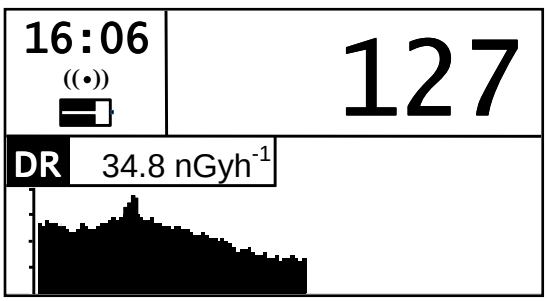
Thus when started, for the first 30 seconds no data is computed until this time period is achieved then a 30 sec average is computed. This average is then updated at a 1/sec rate and used as required.

v. **OnFlyAssay storing** – sets the period in seconds at which the On-the-fly Assay results computed as noted in (iv.) above are stored in data memory during recording.

vi. **Show OnFlyAssay** – sets the period in seconds at which the On-the-fly Assay results computed as noted in (iv.) above are displayed.

vii. **Record type** – this selects the type of data recording method used when START RECORDING (SCAN mode) is selected. Also see MEMORY selection in Section 4.
- **Only total** selection means that only TOTAL COUNT and GPS data is stored.
- **Only assay** selection means that only ASSAY RESULTS and GPS data is stored.
- **Total+Assay** selection means that BOTH TOTAL COUNT data + ASSAY RESULTS and GPS data is stored.

viii. **Show dose** – this allows the user the ability to show the DOSE RATE on the front display. Note the Dose Rate is computed from KUT data results and is referred to as the GEOPHYSICAL ASSAY. Users should note that if (for example) an artificial isotope such as Cesium-137 is placed near the unit, the Count rate will change as the system sees the radiation but the Dose Rate will be essentially unaffected as Cs-137 is outside the K, U, and Th calculation matrix.



ix. **Dose units** – user can selects Gy, Sv or R as required.

x. **Go back** – return to the higher menu.

e) **Stabilization**

i. **Cs stabilization** – permits the user to carry out stabilization using a Cs-137 source. This is a special capability sometimes useful if the unit has serious troubles.

It requires the availability of a Cs-137 source (typically less than 10 kBq) spaced a few inches away from the face of the unit. Once the source is positioned, activate the selection and the unit will stabilize itself automatically on the Cs-137 source. When it says **COMPLETE**, remove the source and carry on as usual. The advantage of this capability is that Cs-137 is a very defined source so if the unit stabilization is completely lost, the **Cs stabilization** can often fully recover it. Huge improvements in the latest SW versions make this feature non-essential but under special circumstances it is useful. Consult Georadis before using this feature if unsure.

ii. **Temp.recovery** – under special circumstances an abrupt change of temperature can sometimes make the Gain adjustment step computed by the automatic system stabilization fail, this is especially true of the BGO detector in the GT-32. To help the system recover if a unit will NOT stabilize within 5 minutes – select this **Temp.recovery** option. The unit will then reload the original calibration data at the factory corrected to the local temperatures. After this action the unit should stabilize OK.

f) **Accessories**

i. **Battery type** – this sets the type of Battery used. Selections are:

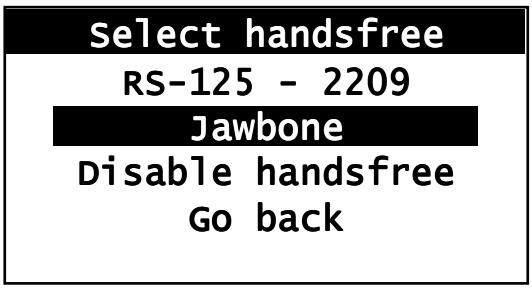
- **Non rechargeable** selection means that Alkaline non-Rechargeable batteries are used. It is highly recommended that if non-rechargeable batteries are used then ONLY ALKALINE batteries are chosen. Some non-Alkaline non-rechargeable batteries can leak and cause problems inside the instrument. If non-Alkaline are used then remove the battery clip after use to avoid this fairly common leak problem.
- **Rechargeable** selection means that NiCd or NiMH batteries are used. However NiMH batteries (2500 series) are highly recommended as NiCd batteries have significant operational limitations in prolonged use (also see Section 5).

ii. **GPS** – this selection is used to couple an external GPS to the system by Bluetooth (BT) link (currently only the GARMIN 10 is supported). The user's manual of the GPS should be consulted to ensure that the unit batteries are charged. Once batteries are OK switch the units BT capability **ON**.

Choose – **Select GPS** – the display shows "**Looking for handsfree devices**" then various messages and finally the "**Select GPS**" display is seen. Use the Button to cursor down to select "**Garmin GPS 10**", then LONG Button down until the reverse video changes to select the device. Message says "**Connecting to device**" and then finally "**GPS connected**" then the display goes back to the main menu. Exit the menu to go back to the Survey screen.

iii. **Handsfree** – this selection is used to connect the GT-30 to an external BT earphone system. In the example below a JAWBONE system is described but most BT compatible earphone are supported. The user's manual of the earphone should be consulted to ensure that the unit batteries are charged. Once batteries are OK switch the units BT capability **ON**.

Choose – **Select HF** – display shows **"Looking for Handsfree devices"** then various messages and finally the "**Select Handsfree**" display is seen as in figure. Use the Button to cursor down to select "**Jawbone**", then LONG Button down until the reverse video changes to select the device.



Message says "**Connecting to device**" and then finally "**Handsfree connected**" then the display goes back to the main menu. Exit the menu to go back to the Survey screen, enable the BT device and a special icon ◠ should be seen on the top left of the display below the clock.

iv. **Go back** – return to the higher menu.

4 PC CONNECTIONS

NOTE: The PC data retrieval and display program supplied to support the GT-30 portable instruments is being frequently updated to add user required features. Georadis supplies software on a CD together with other useful information. The latest software, firmware and documentation version is available for downloading at the following link:

http://www.georadis.com

Note that new versions of GeoView may NOT be compatible with older software but the GeoView update process also permits updates of the firmware inside the GT-30/GT-32 as required. So the rule is if you want to update – then update **BOTH** the Geoview and the unit's internal FIRMWARE as detailed below.

NOTE: the GT-30/GT-32 instruments are a joint development of Georadis and a sister company Radiation Solutions Inc. so some software screens may be labeled Radiation Solutions, RSI or RSAnalyst as required.

4.1 PC SOFTWARE

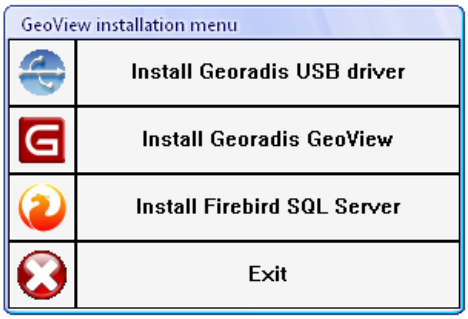
Setup a new sub-directory on the user's PC – named as required - (e.g. **GeoView)**. Click on the link noted above or load it into your Internet browser and click **GO**. Choose **SAVE** then select the correct sub-directory to download the software. Then open this file and **UNZIP** it as required.

4.2 INSTALL PC GeoView

NOTE: This software has been designed to run on all current Microsoft OS systems. The software has been successfully installed and heavily tested on a variety of computers including Win2000, WinXP, WinXP Professional and Win7 A Minority of users have seen some installation problems depending on computer setup configurations. If these problems persist, contact Georadis for support.

Use Windows Explorer to look at the sub-directory where the downloaded file exists – locate the file named **INSTALL.EXE**. Double click this file then select **RUN**.

When this screen is seen – click **"Install Georadis GeoView".**



Follow prompts to complete installation.

N.B. All three products **GeoView**, **USB driver**, and **Firebird SQL Server** are essential for next work and must be installed. Go back to the selection menu and install them.

When this is complete select **EXIT** to terminate the process.

Then click to **FINISH** to complete the final installation.

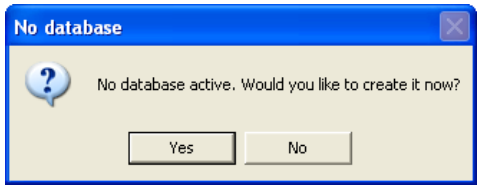
The process is now complete and a new icon is located on the Windows Desktop.

ONCE THE NEW GEOVIEW IS INSTALLED - USERS ARE STRONGLY ADVISED TO UPGRADE THE SYSTEM FIRMWARE TO IMPLEMENT BUG FIXES AND NEW FEATURES (see 4.9 below). HOWEVER WHEN THIS IS DONE ALL DATA IN THE UNIT IS ERASED! USERS SHOULD RETRIEVE STORED DATA FROM THE UNIT BEFORE UPGRADING.

4.3 STARTUP

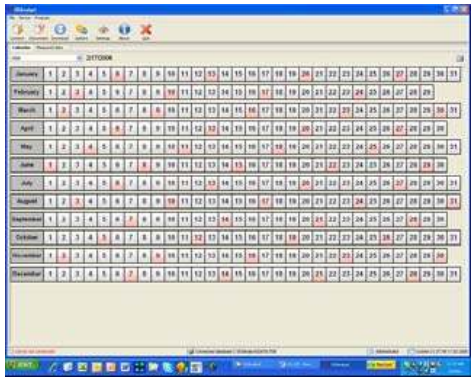
The system stores all data in a Firebird database and this must be created.

Double-click the **GeoView** icon on the desktop. This message is seen – click **YES**, choose the sub-directory (e.g. **GeoView** and choose a database name (e.g. **Data**).

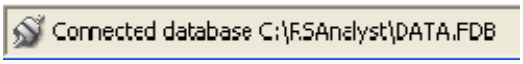


A Firebird formatted data base will be set up named **DATA** on the GeoView sub-directory and all data will be stored there until a different database is created.

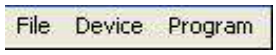
The final display should show as in the figure.



Note the database name at lower right:



This main display has many selections:

a) 

Permits selection of various functions – see 4.4.

b) 

Icons for special functions – see below.

c) 
A calendar for data location – see below.

4.4 FILE menu

File

- **CREATE** local data base – select this to create a new Database stored in a required location with a selected name as required.
- **SELECT** local database – permits users to select a local data base that already exists and add data to it.

Note that a single database can support many GT-30 or GT-32 units with data selection using the units serial number.

Device and **Program** select functions described in the ICON description below.

4.5 CONNECTION

Connection the GT-30/GT-32 unit to the system can be by local **USB** connection or via **Bluetooth (BT)**.

a) **via USB** – connect the supplied USB cable which plugs into the unit below the rubber flap at the end of the unit.

With the GT-30 unit powered ON and the GeoView display showing on the PC, click this icon 

to establish a connection.

The unit's serial number will be shown in a data box (e.g. **2025**) – click **OK**.

Bottom left on the PC screen should say **"Connected device #2025"** and on the GT-30 unit should see a USB icon.

The unit is now fully connected.

c) **via BLUETOOTH**

NOTE: All except the early GT-30 units have BT capability – however in the early units the software did not support this BT technology. In the latest software 5.xx this BT is fully supported. Users are advised that if they need BT capability, then install the new Ver. 5.xx software included in the download package using the USB connectivity THEN test the BT to be sure all is OK. Contact Georadis if problems.

Typically data transfer is 3x faster using USB connections.

The following is a typical Windows setup. Users setup maybe slightly different depending on Operating System but in principle the connection linkage is similar.

Power ON the GT-30/GT-32 and place within 1 m of the PC used.

On the PC select **START – All Programs – Bluetooth – Wireless Data Transfer**.

This display appears as the unit searches for BT devices nearby.

This display shows the unit has been found.
Click the box (green check sign in the picture).

Close this window (red **X** at top right of the box).

At the bottom right tray the BT sign will be seen – right click on this and select Bluetooth settings. 

A new display is seen, click **DETAILS** (sometimes a BT password is asked for – if required enter **0 0 0 0**).

Inspect the second display for **PORT NAME** – in this case **COM40**.

In GeoView – click 

then **Com Por**t on the pop up box.

Select **COM40** and click **CONNECT**.

Bottom left on the PC screen should say **"Connected device #1234"** and on the GT-30 unit should show the BT icon. **The unit is now fully connected**.

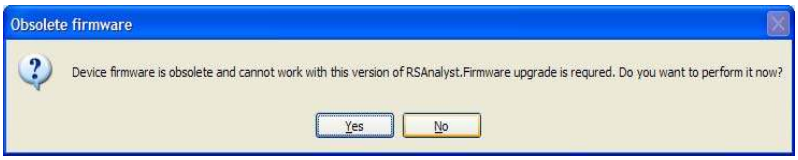
NOTE: this setup is retained in the PC so next time connection is made it is not necessary to relink the BT just use the COM port# previously defined.

4.6 DOWNLOAD data

Click this icon to start data transfer from the GT-30 unit into the PC database – final message is **"Downloaded ### records"** – click **OK**.

4.6.1 DOWNLOAD selection = wrong FIRMWARE

Some older units with non SW Ver. 5.xx need upgrading before GeoView can be used as data formats are very different. If this is the case the following message box appears:



USERS ARE ADVISED TO UPGRADE THE SYSTEM FIRMWARE TO IMPLEMENT BUG FIXES AND NEW FEATURES. HOWEVER WHEN THIS IS DONE ALL DATA IN THE UNIT IS ERASED! USERS SHOULD RETRIEVE STORED DATA BEFORE UPGRADING.

USERS WITH 1.17F SOFTWARE PLEASE CONTACT GEORADIS BEFORE UPGRADING.

Select **YES** – then procedure is the same as described in the section 4.9 NEW SOFTWARE.

4.7 DATA DISPLAY

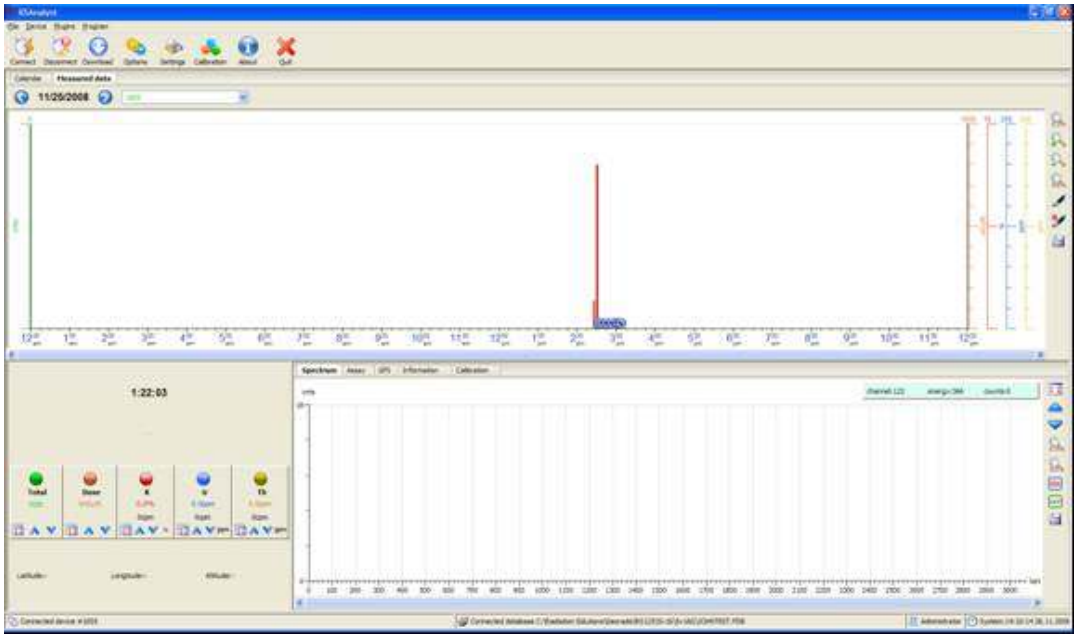
The main Data Display is a calendar format (**Jan - Mar 2008** section shown above).

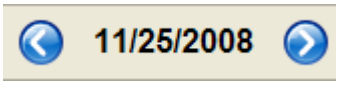
Data is shown on this calendar with colored icons and positioning the cursor over one date block shows the serial # of the data available (example above shows serial # **2210** and **3045).** The database can store data from an essentially unlimited # of RS instruments but for ease of use the data is distributed by DATE to make access easier.

Double-click any **DATE** selection and the data page moves to the **MEASURED DATA** page.

4.7.1 MEASURED DATA PAGE

This complex display is explained as follows:

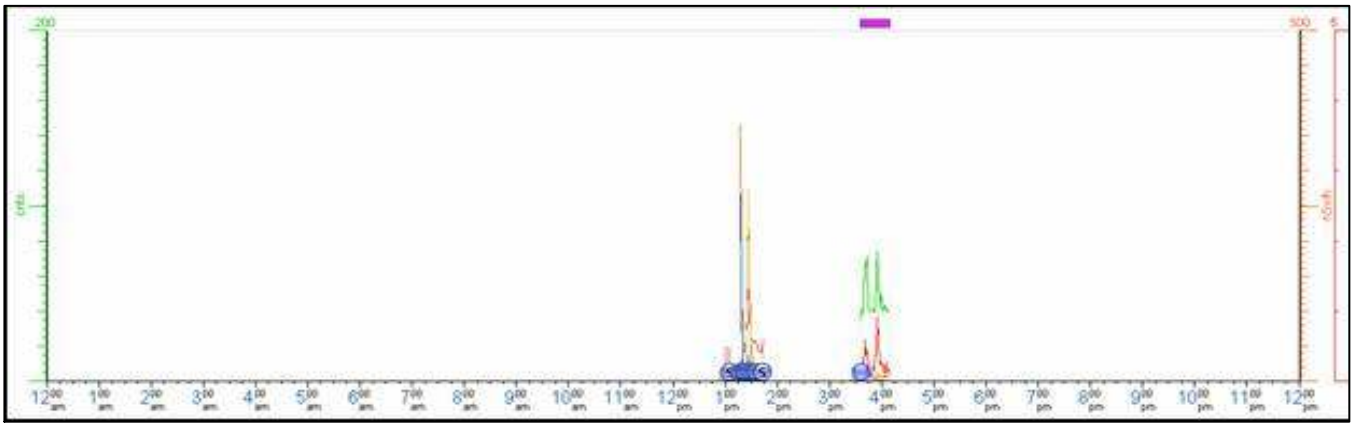




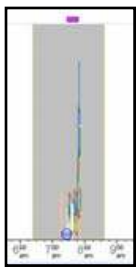
This shows the date of the data selection and the arrows permit moving up down the calendar as required.

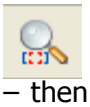
Permits selection of the instrument serial number of interest (as noted previously the database can store data from many instruments – however for simplicity many users open different databases for each instrument to prevent data confusion.

The next data block shown below shows the selected DATE full 24 hr display on which the data is shown at the time it was accumulated.



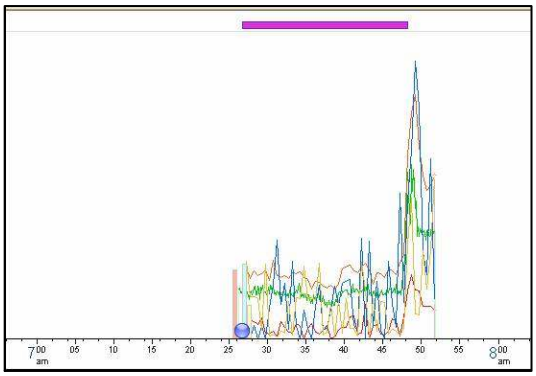
This data for demo purposes shows a mix of data – some ASSAY and some SCAN data as any type of data may be recorded in the instrument and thus be in the database.





This icon is used to **ZOOM** the data display. To zoom data – select this icon first – then use the mouse and left button to select a section of the data – the selection is shown in GREY as in the figure

Release the left button and the data is now **ZOOMED** as shown. This process can be repeated until the data is in a convenient view size.



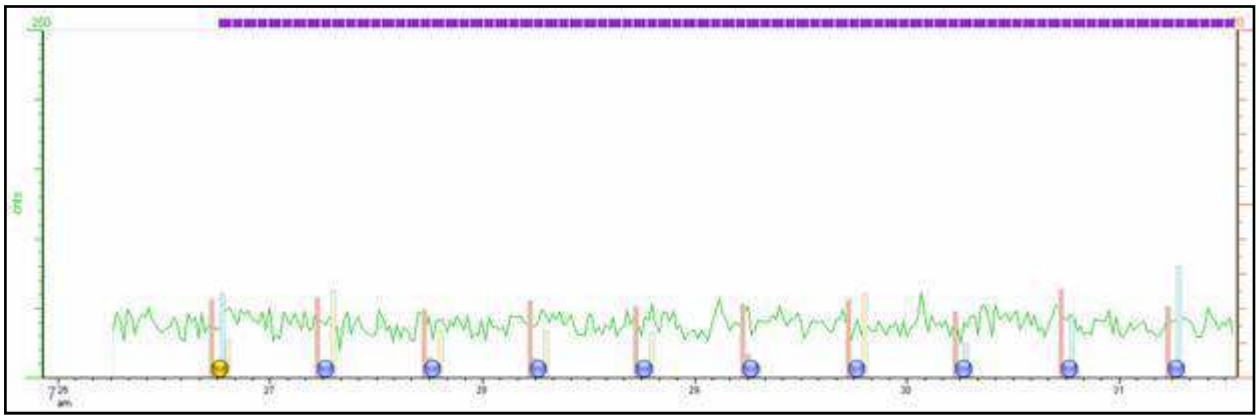
These icons can be used to zoom manually.

This icon zooms fully OUT to show all the data and permit zoom selection as required.

These data were taken with the GT-30 unit set to record TOTAL count at 1/sec and ASSAY data at 1/30 sec. The display is formatted to view the data separately to avoid confusion.

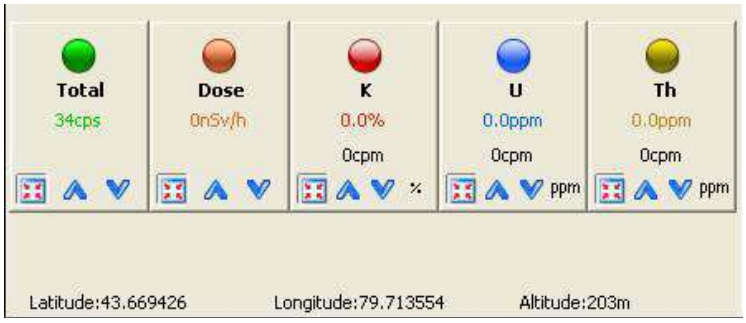
ASSAY SCAN data at selected SCAN rate (typically 30 secs)

In the above example the left side of the display shows some vertical histogram data with a blue ball – this is the **ASSAY** data. To see it, use the ZOOM capability and highlight only this section of the data and zoom it to see a display like below:



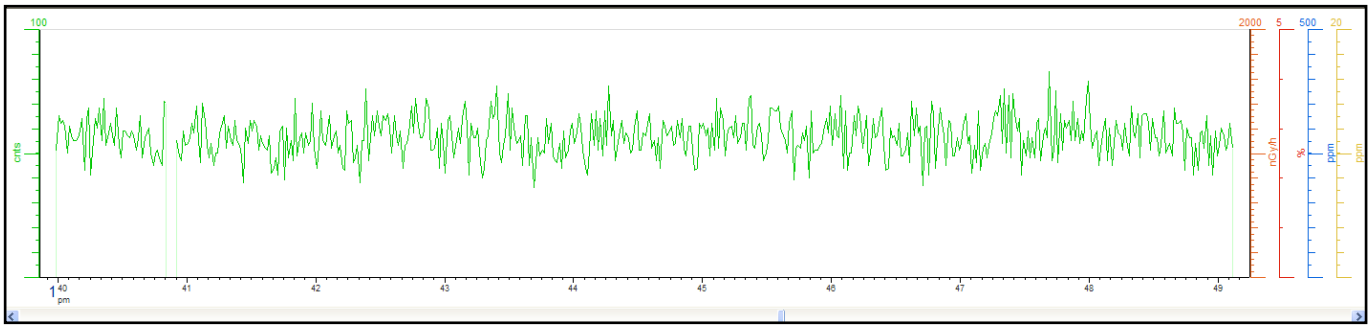
This display shows the individual 30 sec data for K, U and Th in a histogram format with the GREEN line being the Total Count data. The bottom left data block shows the color scheme – **RED = K** etc. Position the cursor over any histogram selection and the lower left data block shows the numeric results. Also the PURPLE line above shows that GPS data was taken so the cursor selection also shows GPS coordinates.

Once again moving the cursor along the data permits numeric and GPS data to be seen in the lower left data box.

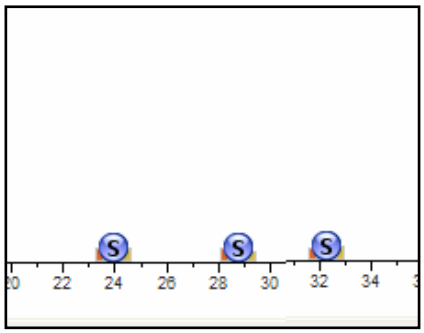


SURVEY DATA at selected rate (typically 1/sec)

If the whole data set is zoomed then the ASSAY data is suppressed and the raw Total Count data is seen as a graph – see figure below:



"NORMAL" ASSAY DATA

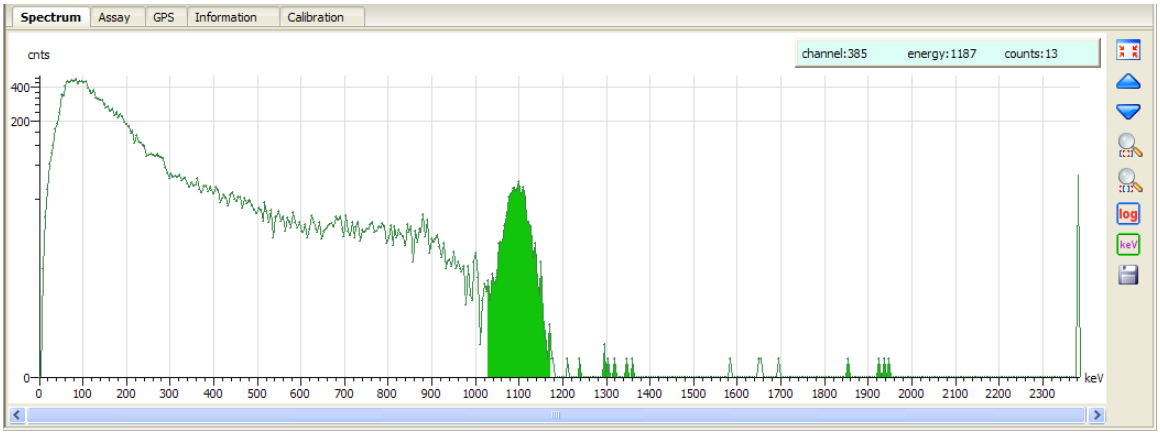


The data stored by the user with the ASSAY selection (typically 120 secs) is also viewable on these displays. The example below is such a data set.

The data marked as **"S"** are the individual stored ASSAY results. Click on any "**S**" to see the data.

SPECTRUM DISPLAY

Click on any of the spectral data (denoted by an "**S**") and the full 1024 channel spectrum is seen. The cursor can be used to see Channel #, keV and cts for any channel in the spectrum. The spectrum can also be vertically scaled using the buttons and a LOG button permits easier viewing of higher energy low count rate events.

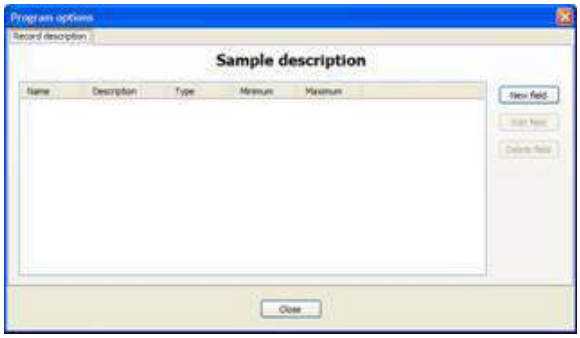


This display has 5 tabs:

SPECTRUM – spectral display of the selected point
ASSAY – Assay data of the selected point
GPS – GPS data of the selected point
INFORMATION – gives additional data
CALIBRATION – gives the full calibration matrix of the selected data point

ADDING COMMENTS/NOTES

A special feature of GeoView is the ability to mark data on the display to add comments related to the data.



ADD COMMENTS FIELD

Select the COMMENTS icon 

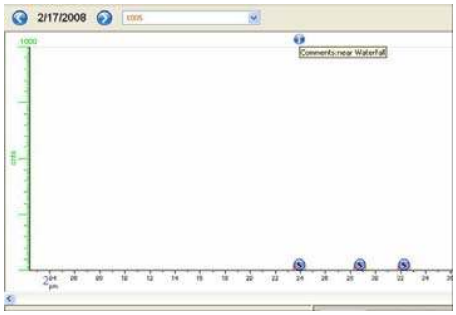
and a new data box appears:

Select **NEW FIELD** – then choose FIELD TYPE on this data box. Select **STRING** as this gives a large space for comments – then **NEXT**.

Then enter in a **FIELD NAME** (e.g. Comments) then a **Field Description** (e.g. Comments) and click **ADD FIELD**.

Now this Comments ability is added, to insert data click the left pen icon (ADD – the one with a red mark is REMOVE). The position the cursor at the data point of interest and click it. Immediately data box will appear and the user can add comments (e.g. near Waterfall).

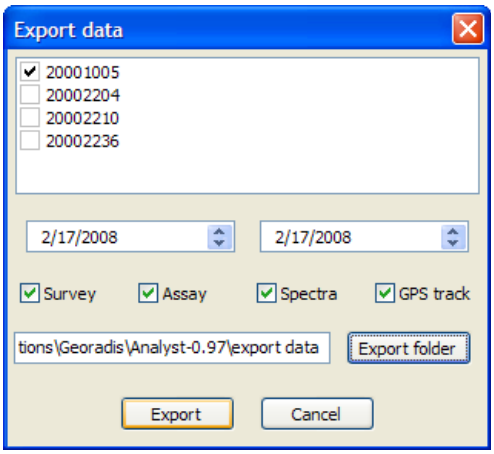
Comments are seen as shown:



If the blue **i** is clicked, then users can enter info in the Comment field created above (e.g. **test data**) and this will appear next to the **i** button to permit users to label the data.

4.8 DATA EXPORT

All recorded/displayed data can be output as txt files.



Selects the EXPORT data process. The data box shows all Serial Numbers of data in the database – select as required.

User can select various data output:

SURVEY – retrieves the SURVEY scan data in a txt file
ASSAY – retrieves the SURVEY scan data in a txt file
SPECTRA – retrieves all stored spectra in full 1024 channel data format as a txt file
GPS TRACK – retrieves GPS data as a txt file

Most users should select ALL options just to be sure.

EXPORT FOLDER – user can select the sub directory where the data is exported to.

Select **EXPORT** – and all data files are transferred to the selected directories where they can be viewed as required (Excel Text data import etc.). The data is exported with embedded headers labeling data columns.

Typical export data into Excel

Use Delimited by semi-colon to properly separate data columns, see examples below:

a) **ASSAY data**

Id	Date	Time	Temperature	Stabilized	Total[ppm]	Total[cpm]	K[%]	K[cpm]	U[ppm]	U[cpm]	Th[ppm]	Th[cpm]	Dose	Dose units	Latitude	Longitude	Altitude
100	29.1.2014	11:01:05	21,5	1	26,7	2757,8	3,6	330,3	7,1	73,6	26,6	39,5	156,5	nGy/h	43.622975	79.669925	190
101	29.1.2014	11:02:28	21,5	1	26,4	2750,5	3,5	335,5	9,2	76,7	21,7	31,1	154,5	nGy/h	43.624885	79.672477	189
102	29.1.2014	11:03:51	21,5	1	26,2	2752,6	3,4	320,9	6,6	73,6	27,7	41,6	155,6	nGy/h	43.626872	79.675147	191
103	29.1.2014	11:05:13	21,5	1	27,6	2841,3	3,1	320,8	10,9	89,2	22,6	33,2	161,2	nGy/h	43.628152	79.677157	197
104	29.1.2014	11:06:36	21,7	1	26,9	2711,9	3,5	332,4	9,1	77,7	22,9	33,2	155,9	nGy/h	43.627118	79.678791	192
105	29.1.2014	11:07:59	21,7	1	27,8	2855,9	3,9	359,6	7,4	74,6	26,9	39,5	164,2	nGy/h	43.626533	79.679532	192
106	29.1.2014	11:09:22	21,8	1	25,3	2713,9	3,2	310,5	8,9	75,6	21,4	31,1	147,8	nGy/h	43.626643	79.679793	193
107	29.1.2014	11:10:45	21,8	1	26,9	2728,6	3,6	328,2	5,7	72,5	30,3	45,7	159,3	nGy/h	43.629507	79.681785	194
108	29.1.2014	11:12:07	21,8	1	27,6	2751,5	2,9	316,8	11,1	91,3	23,3	34,2	162,3	nGy/h	43.632143	79.678108	198
109	29.1.2014	11:13:30	21,7	1	24,5	2667,1	2,8	287,5	10,7	79,8	17,4	24,9	141,2	nGy/h	43.634382	79.672393	196
110	29.1.2014	11:16:22	21,8	1	24,7	2651,3	3,2	300,1	7,2	69,4	23,8	35,3	143,6	nGy/h	43.636583	79.665713	193
111	29.1.2014	11:21:23	21,7	1	27,4	2839,3	3,1	319,9	10,8	88,7	22,3	33,1	160,1	nGy/h	43.635844	79.675722	199

b) **SURVEY**

Id	Date	Time	Temperature	Smp	rate	s1	s2	s3	s4	s5
45	8.4.2014	15:36:12	19,2	30	1	35	44	46	41	40
46	8.4.2014	15:36:41	19,4	30	1	37	36	38	37	41
47	8.4.2014	15:37:11	19,4	30	1	38	44	38	46	35
48	8.4.2014	15:37:41	19,6	30	1	55	34	34	34	24
49	8.4.2014	15:38:11	19,8	30	1	34	36	37	42	40
50	8.4.2014	15:38:41	20,0	30	1	49	45	49	49	44
51	8.4.2014	15:39:11	20,1	30	1	33	39	49	49	39
52	8.4.2014	15:39:41	20,2	30	1	69	72	55	74	62
53	8.4.2014	15:40:11	20,2	30	1	69	57	50	58	61
54	8.4.2014	15:40:41	20,4	30	1	62	64	64	69	65
55	8.4.2014	15:41:11	20,4	30	1	68	69	57	71	70

s26	s27	s28	s29	s30	Latitude	Longitude	Altitude
41	44	47	45	34	43.636005	79.678612	192
34	37	51	44	37	43.636268	79.680163	198
36	25	33	42	39	43.636425	79.679847	203
46	41	45	29	31	43.636427	79.679841	200
28	36	37	45	41	43.636423	79.679840	201
44	40	42	42	41	43.636418	79.679832	193
65	47	51	63	56	43.636413	79.679822	191
69	80	64	68	55	43.636403	79.689815	191
51	70	53	64	73	43.636398	79.679812	191
86	80	80	67	66	43.636393	79.679808	195
64	61	72	68	72	43.636392	79.679801	196

In the above example, the data have been exported from GeoViev and imported to Excel. Some columns have been deleted from data to make the figure above clearer.

Note that the GPS location data shown after sample #30 is the position of Sample #1.

c) **SPECTRA**

The Assay data spectra file is stored in memory as an *.spc file and the example shows one such file imported into Excel. Data assignment as follows:

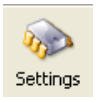
data 1 = LiveTime in msec
data 2 = Clock Time (msec) = (set time - # sec x 39 msec)
data 3 = spectral channel 1
data 1026 = spectral channel 1023 = Cosmic channel
data 1027 = Linearization coefficients

114725	LiveTime
114960	Clock Time
0	chn 1
1	chn 2
0	chn 3
0	....
2	....
0	....
103	chn 1023
7.47 1.880176 2.970002 0.000140	chn 1024

d) **DATA-Serial #.kml**

This data file contains only the GPS coordinate data and is intended for direct import into GOOGLE EARTH. Once imported the track position can be seen with Google's GIS terrain overlays and is useful to confirm and inspect survey location.

4.9 SETTING

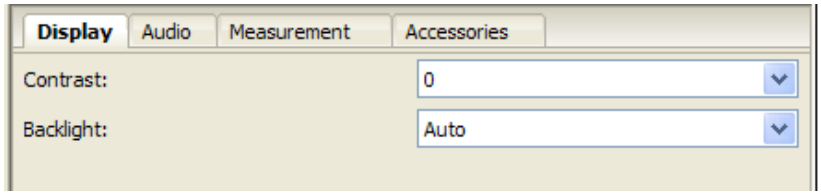


This icon allows various user functions by Tab selection.

4.9.1 DEVICE SETTINGS - TAB

There are four sub-directories for parameter selection:

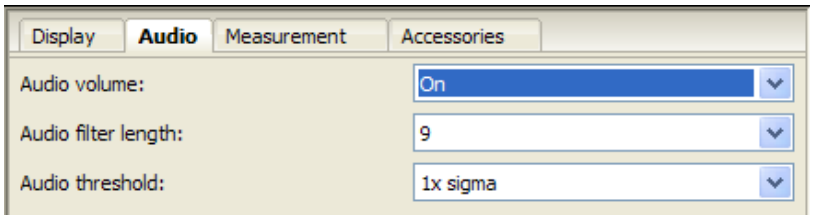
a) **DISPLAY**



Contrast = adjust display contrast – range +3 > -3 – normally **0**.

Backlight = backlight options – selection – ON, OFF, AUTO – normally **Auto**.

b) **AUDIO**

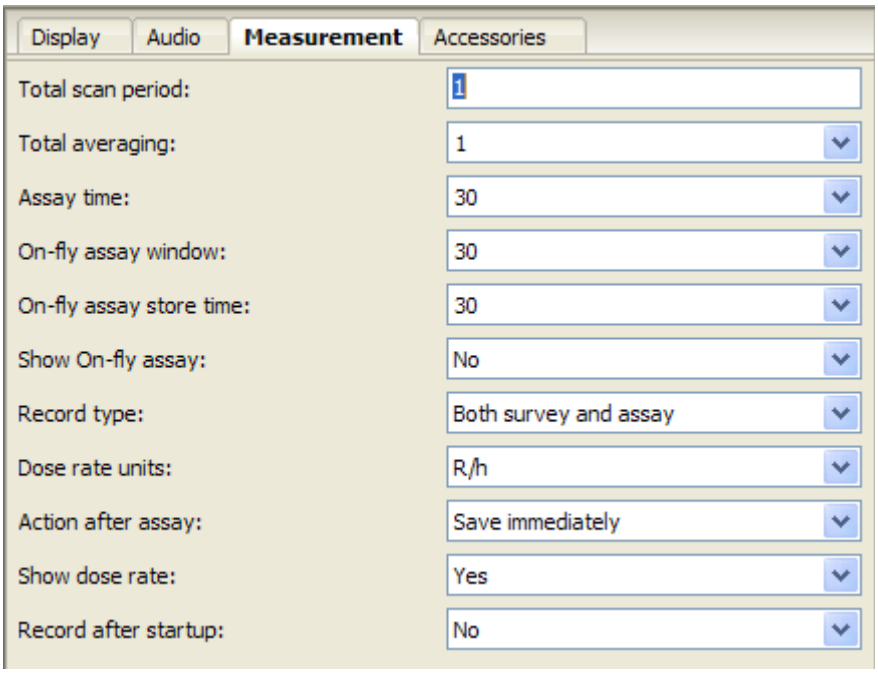


Audio volume = selection ON, OFF – usually **ON** (permits muting if required).

Audio filter length = permits audio response adjustments by filtering changes – for Geophysics usually **9**.

Audio threshold = selection x1 to x6 sigma – for Geophysics usually **1x sigma**.

c) **MEASUREMENT**



Total scan period – the sample period (minimum 1 sec) for K, U, Th, Total data to be stored on the RECORDING (SCAN) mode described above – usually **1 sec** for fast surveys or **2 – 5 sec** for slower traverses.

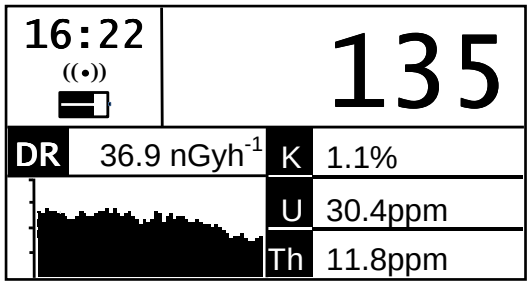
Total averaging = permits the front panel instrument display to use running averaging to "smooth" data viewing – for Geophysics usually **1**.

Assay time = sets the time period used when an ASSAY is taken – selection 30 – 1800 sec – **120** sec is a sensible selection under most conditions.

On-fly assay window = the sample period (30 – 300 sec) for Assay data to be computed on the RECORDING (SCAN) mode described above – usually **30 sec**. This is really a moving average period updated at 1/sec.

On-fly assay store time = the sample period (10 – 300 sec) for Assay data to be stored on the RECORDING (SCAN) mode described above – usually **30 sec** but some users want faster data storage so this parameter can be set to 10 sec if required.

Show on fly assay – YES or NO. If **YES** is selected then during the main data display screen changes to show real-time Assay on the fly.



Record type = permits data selected in RECORDING (SCAN) mode – selections:

- **Only SURVEY** – only Total Count at the selected rate
- **Only ASSAY** – only Assay data at the selected rate
- **Both SURVEY and ASSAY** – both data sets at the selected rates

NOTE: ensure MEMORY selection is adjusted correctly to permit the required amount of data recording space – see section 4.9.

Dose rate unit = selects the Dose units used in the "Total" display on the units display during Assay. Selections are:

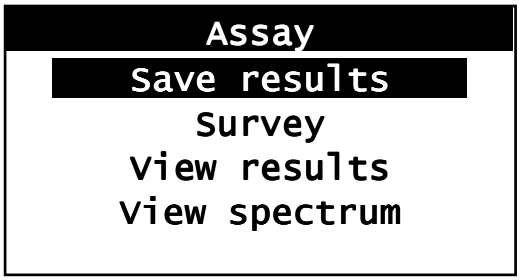
- **R** – Exposure Rate
- **Gy** – Absorbed Dose
- **Sv** – Dose Equivalent

Action after assay – permits the user to add special functions as noted below:

Save immediately – normal action as described in section 2.10 above – after the Assay is complete, the user inspects the data then presses BUTTON to save the data in memory and return to SURVEY.

Show menu – some sophisticated users want to inspect the Assay spectra. If "Show Menu" is selected then at the end of the Assay period the unit beeps and the results are shown.

If the BUTTON is now pressed a new menu is shown:



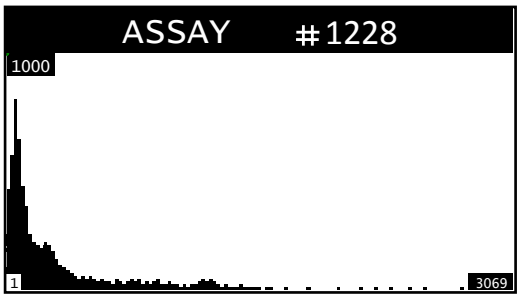
Selections are:

Save results – this saves the data into memory as described in section 2.10 above.

Survey – this cancels the Assay data, does NOT record them in memory and returns to the Survey mode.

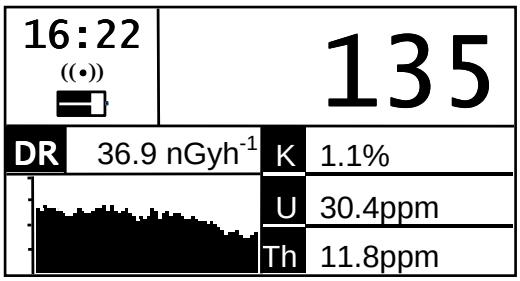
View results – returns the display to the same display that occurred at the end of Assay so the Assay results can be inspected again.

View spectrum – this selection gives the user a graphical display of the 1024 channel spectrum with the Vertical scale shown in cps on the Y-axis and the Energy Level in keV shown on the X-axis:



Pressing BUTTON again gives a split display view of the spectrum accumulated in memory. The upper display shows the full 1024 chn spectrum with the current selection ($1/8^{th}$ of the full spectrum so = 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 Clicks selects the next $1/8^{th}$ section of the spectrum until the whole 1024 spectrum has been covered. Then these actions are repeated. Long Click to exit to the previous menu.

Show dose rate – selections are **YES** or **NO** – this allows the user the ability to show the DOSE RATE on the front display. Note the Dose Rate is computed from K, U, Th data results and is referred to as the GEOPHYSICAL ASSAY. Users should note that if (for example) an artificial isotope such as Cs-137 is placed near the unit, the Count rate will change as the system sees the radiation but the Dose Rate will be essentially unaffected as Cs-137 is outside the K, U, Th Calculation matrix.



Record after startup – normally set to NO. If YES then when the unit is powered ON, it immediately enters the Scan mode (same as selecting Start Recording from the main unit's menu).

d) **ACCESSORIES**

Battery type = non-rechargeable or rechargeable – usually **rechargeable**.

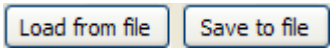
GPS pin – some GPS units require a PIN number for handshaking.

Mute buzzer when HF – if selected the Audio buzzer in the instrument is muted when the BT Headphone is selected.

Synchronize = if this box is checked then the PC will synchronize the time of the GT-30 unit to the current setting on the PC.

PARAMETER CHANGE

Under special conditions some internal parameters of the unit may need to be adjusted. If this is required, Georadis will send the user a special file with these parameter changes embedded. To load this file click the **LOAD FROM FILE** button then selecting the appropriate file and follow the prompts.

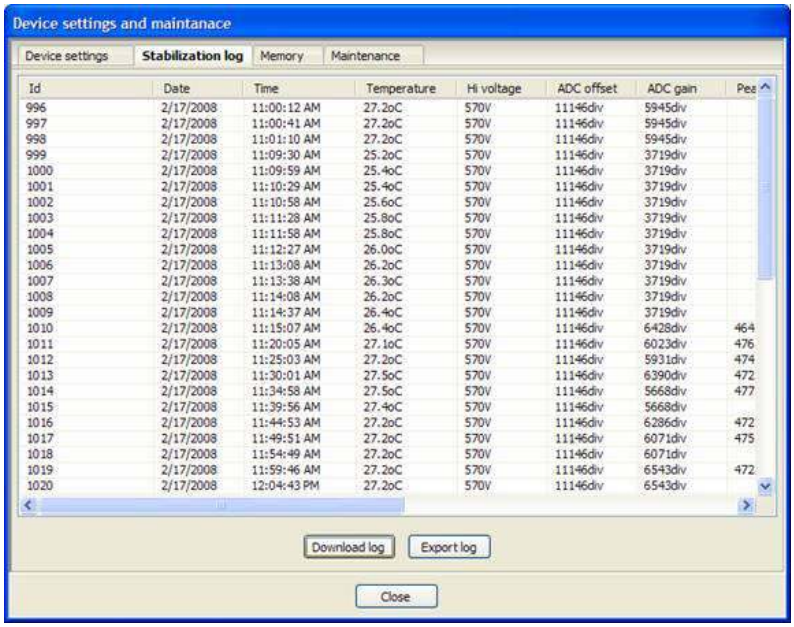


In addition users can save a copy of the parameter file or read in a new one with special parameter settings as required.

Press **Write to device** to load these settings into the unit **(also see 4.9.4 below)**.

4.9.2 STABILIZATION LOG

This tab selection permits users to access the internal Stabilization records of the unit. If the unit is acting incorrectly it is possible that the stabilization is causing problems. This selection permits the Stab Log to be downloaded and viewed (**Download Log**) or more useful is (**Export Log**) which outputs the data into a text file which can be exported and then emailed to Georadis for analysis.

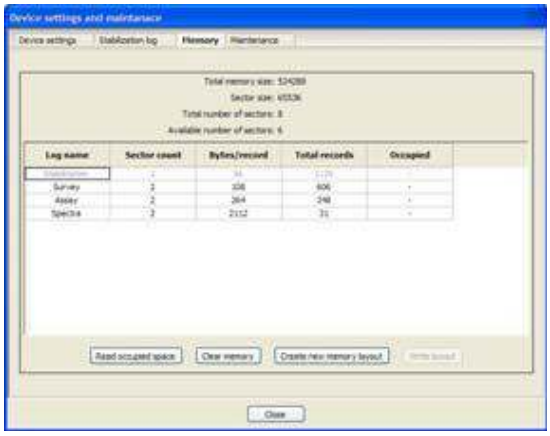


Id	Date	Time	Temperature	Hi voltage	ADC offset	ADC gain	Pea
996	2/17/2008	11:00:12 AM	27.2oC	570V	11146div	5945div	
997	2/17/2008	11:00:41 AM	27.2oC	570V	11146div	5945div	
998	2/17/2008	11:01:10 AM	27.2oC	570V	11146div	5945div	
999	2/17/2008	11:09:30 AM	25.2oC	570V	11146div	3719div	
1000	2/17/2008	11:09:59 AM	25.4oC	570V	11146div	3719div	
1001	2/17/2008	11:10:29 AM	25.4oC	570V	11146div	3719div	
1002	2/17/2008	11:10:58 AM	25.6oC	570V	11146div	3719div	
1003	2/17/2008	11:11:28 AM	25.8oC	570V	11146div	3719div	
1004	2/17/2008	11:11:58 AM	25.8oC	570V	11146div	3719div	
1005	2/17/2008	11:12:27 AM	26.0oC	570V	11146div	3719div	
1006	2/17/2008	11:13:08 AM	26.2oC	570V	11146div	3719div	
1007	2/17/2008	11:13:38 AM	26.3oC	570V	11146div	3719div	
1008	2/17/2008	11:14:08 AM	26.2oC	570V	11146div	3719div	
1009	2/17/2008	11:14:37 AM	26.4oC	570V	11146div	3719div	
1010	2/17/2008	11:15:07 AM	26.4oC	570V	11146div	6428div	464
1011	2/17/2008	11:20:05 AM	27.1oC	570V	11146div	6023div	476
1012	2/17/2008	11:25:03 AM	27.2oC	570V	11146div	5931div	474
1013	2/17/2008	11:30:01 AM	27.5oC	570V	11146div	6390div	472
1014	2/17/2008	11:34:58 AM	27.5oC	570V	11146div	5668div	477
1015	2/17/2008	11:39:56 AM	27.4oC	570V	11146div	5668div	
1016	2/17/2008	11:44:53 AM	27.2oC	570V	11146div	6286div	472
1017	2/17/2008	11:49:51 AM	27.2oC	570V	11146div	6071div	475
1018	2/17/2008	11:54:49 AM	27.2oC	570V	11146div	6071div	
1019	2/17/2008	11:59:46 AM	27.2oC	570V	11146div	6543div	472
1020	2/17/2008	12:04:43 PM	27.2oC	570V	11146div	6543div	

4.9.3 MEMORY

The RT and GT series of units were initially released with **512K** of memory but modern units are shipped with **4M** of memory. Older units can be upgraded to **4M** if required at a nominal fee.

In SW Ver. 5.xx the available memory can be allocated to the various functions and this is done inside GeoView.



NOTE: The memory can be re-allocated at any time but this re-allocation ERASES ALL DATA IN MEMORY so users should download any data before allocation is attempted.

READ OCCUPIED SPACE – shows how much memory is currently in use.

CLEAR MEMORY – this command is used to clear data memory once data has been transferred to the PC – **most users transfer data daily then clear the memory to minimize data confusion and in low memory units.**

CREATE NEW MEMORY LAYOUT – this command allows the users to set the memory to suit their application – refer to the tables below for information to enable correct selection – when this selection is made the unit automatically checks memory size and advises users of the number of sectors available to allocate.

OLDER UNITS with 512K memory = 6 sectors

512K	User set Sectors	Total # of records	# samples/ record	total # samples	Sample rate secs	Data storage Hrs
SCAN - TOTAL	2	630	30	18,900	1	5.3
SCAN - ASSAY	2	248	1	248	30	2.1
ASSAY-spectrum	2	31	1	31	*	*
SCAN - TOTAL	6	3150	30	94,500	1	26.3
SCAN - ASSAY	0	0	1	0	30	0.0
ASSAY-spectrum	0	0	1	0	*	*
SCAN - TOTAL	0	0	30	0	1	0.0
SCAN - ASSAY	6	1241	1	1,241	30	10.3
ASSAY-spectrum	0	0	1	0	*	*
SCAN - TOTAL	0	0	30	0	1	0.0
SCAN - ASSAY	0	0	1	0	30	0.0
ASSAY-spectrum	6	155	1	155	*	*

The user can allocate memory in blocks so user can select 0, 2, 3, 4, 5 or 6 sectors. The table below shows memory allocation and shows what data storage is available so the user can change the sectors to suit the application.

Note that in all memory selections, 1 sector in each selection is reserved for data buffering. So if you choose 4 sectors, you really only get data storage in 3. This is taken into account when the unit displays how much data can be stored and is only relevant if users are attempting to calculate the memory space.

NOTE: The memory can be re-allocated at any time but this re-allocation ERASES ALL DATA IN MEMORY so users should download any data before allocation is attempted.

NOTE: Scan-Total – is in 30 sample data blocks whereas the SCAN-Assay is 1 sample/block. The above table shows these details and also shows how much data storage is available (in hr) for the various combinations.

The **ASSAY-spectrum** of course has no time limit period as this is FULL SPECTRUM recording + ASSAY results at a data rate determined by the user's manual sampling habits.

Some older units have 2M memory = 24 sectors

2MB memory details

2M	user set sectors – max 26	total # of sectors	# samples / record	total # of samples	sample rate secs	data storage hrs
SCAN - TOTAL	4	1890	30	56700	1	15.8
SCAN - ASSAY	8	1737	1	1737	30	14.5
ASSAY - spectrum	14	403	1	403	*	*

Latest units have 4M memory = 58 sectors

4MB memory details

4M	user set sectors – max 58	total # of sectors	# samples / record	total # of samples	sample rate secs	data storage hrs
SCAN - TOTAL	20	11529	30	345870	1	96.1
SCAN - ASSAY	20	4716	1	4716	30	39.3
ASSAY - spectrum	18	527	1	527	*	*

4.9.4 MAINTENANCE

This tab selects various maintenance features.

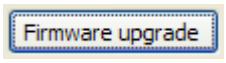
Firmware version – this shows the current software version.

Firmware upgrade – this process permits users to **UPGRADE** software to the latest version.

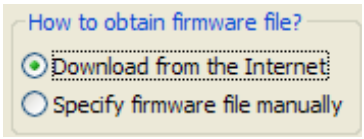
NOTE: The UPGRADE process ERASES data in memory so current data should be downloaded before doing an upgrade.

NOTE: FOR ALL SYSTEM FIRMWARE UPGRADES ENSURE THE UNIT IS POWERED OFF AS SOME EARLIER VERSIONS OF SOFTWARE CAUSE UPLOAD PROBLEMS IF POWER IS ON.

BEFORE STARTING A FIRMWARE UPGRADE, ENSURE THAT THE GT-30 INSTRUMENT IS CONNECTED TO THE CHARGER AS IF BATTERY LEVELS ARE TOO LOW, UNDER SOME CONDITIONS THE FIRMWARE UPGRADE PROCESS CAN CRASH THE MEMORY AND UNIT MUST BE RETURNED TO THE FACTORY TO RECOVER.



Ensure that the unit is connected via USB then click this button to start the process.



In this screen select "Specify firmware file manually".

Follow prompts and select the ***.gfw** file included in the upgrade package.
When this screen is seen - ensure that the batteries are charged up and/or the Charger is plugged in as if the power dips during the upgrade process the memory could crash and the unit would then be unusable and must be returned to the factory.

Then click "NEXT" to start the process. The firmware is then uploaded into the unit via USB and this takes approximately 5 minutes.

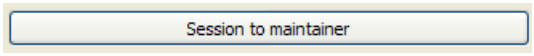
Once the process is complete a new screen appears:

The user selects "FINISH" and the new firmware is "flashed" into the memory of the unit and replaces the old firmware. If all is OK the unit disconnects itself from the PC and restarts - user hears a beep.

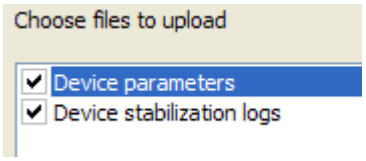
Unplug the USB port – power the unit OFF. The power ON and verify that the latest software version has been loaded.

SERVICE AIDS

For Maintenance support some special features have been added to the GeoView software but they require the system to be connected to a PC that is connected to the Internet to function as designed..



If Maintenance is required, connect the unit via USB then click this button.



User selects a checked box (or cancels all and **OK** to go back).

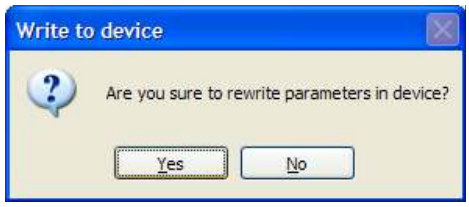
****

Device parameters:

If user is experiencing problems with the unit they should discuss this with Georadis (by email (at **info@georadis.com**). Georadis may ask the user to send the PARAMETER file to Georadis as parameter setting errors can cause problems. In this case check the "**Device parameters**" box only and then click **OK**.

The program then extracts the parameter file from the unit and sends it to Georadis. When Georadis receives this file specialists inspect it and if changes are required Georadis modifies this parameter file and notifies the user by email.

The user then connects the unit to the PC and the PC to the Internet and selects the "**Device parameters**" check box then **OK**. This time the system logs onto the Georadis site, searches for the new parameter file (by unit serial number) and automatically downloads the special customer file that Georadis has loaded there after asking if OK to rewrite as in the figure.



Using these methods, Georadis can make it very easy to help the user fine tune their units to resolve specific problems.

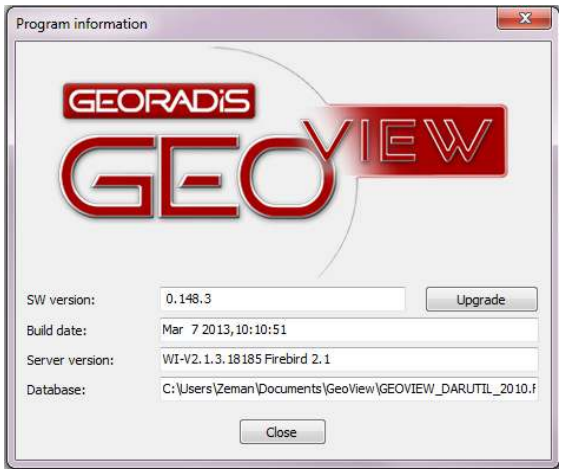
Device stabilization logs:

If users are experiencing problems with the unit's Stabilization performance they should advise Georadis by email (at **info@georadis.com**). When convenient connect the unit to the PC via USB and connect to the Internet. Then click "**Session to maintainer**" and select the "**Device stabilization logs**" then **OK**. The software will then automatically extract all relevant Stabilization data from the system and send it to the Georadis FTP site where Georadis Service can access it. Georadis Service will then analyze and communicate as required to resolve the issues.

Error details – the final data display on the maintenance page is the error status. The RS unit has various internal errors that are messaged on the display of the unit as a **!** below the clock display. Currently the only way to understand what this message is, is to connect to the PC and view this screen display. If errors occur, inspect this screen then contact Georadis for resolution and advice.

4.10 ABOUT

From time to time updates are available for the GeoView program. If the user wants to upgrade the software please contact Georadis. There is an automatic upgrade via the Internet available using the **UPGRADE** button **but this may upgrade undocumented features so is not recommended unless advised by Georadis.**



5 LATEST SOFTWARE (INCLUDED IN THIS MANUAL)

New software release is:

FIRMWARE = 5.94

GeoView = 0.148.25

CONTACT INFORMATION:

I the event of problems please contact Georadis
By phone, fax or email as follows:

Georadis s.r.o.
Novomoravanská 41
691 00 BRNO
Czech Republic

Tel: +420 541 422 231

Email: info@georadis.com

For Export sales information, please contact:

PEKO Geofysik AB
Ängsullsvägen 4
178 52 EKERÖ
Sweden

+46 725 322 099

info@peko-geofysik.se

6 RECHARGEABLE BATTERY SET FOR GT-30/GT-32

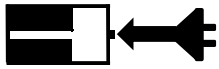
This set comprises 3 items:

- 4 x NiMH AA batteries (2500 mA)
- International line adaptor 115/220 V
- Vehicle charging cable

PROCEDURE:

a) **Batteries** - The user should mount the 4 batteries in the GT-30 unit as described in section 2.1 above.

b) **For AC operation** – Connect the supplied line cord to the DC input connector of the GT-30 unit (hidden under the waterproof tab on the bottom of the unit). The display shows this icon/message to show that charging is taking place:


CHARGING

Once connected to the AC line the unit should take typically 4 hours (at 20 °C) to reach full charge – longer at colder temperatures. Leaving the unit connected to the AC line overnight is OK but don't leave it connected for an indefinite period (more than 24 hours) or potential battery damage could occur.

If the icon labeled POWER SUPPLY appears this means that the **wrong batteries are selected**. Power off the unit, remove and re-plug in the battery holder then on POWER ON, select **RECHARGEABLE** batteries.


POWER SUPPLY

NOTE: The batteries supplied with the GT-30 unit are NiMH rechargeable batteries. It is best to "condition" these batteries when first used to ensure a good battery life. The ideal form of conditioning is:

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

Now the batteries should give their optimum life. Try to ensure at <u>least</u> 2 charge/discharge cycles.

c) **DC operation** – If an AC source is not available the supplied VEHICLE charging cable can be used. This requires access to a 12 V (max 20 V) battery. Connect the supplied Vehicle Charging Cable to the DC input connector of the GT-30 unit (hidden under the waterproof tab on the bottom of the unit). Connect the Cigarette lighter plug on the cable to the appropriate Vehicle connection – GT-30 display should show the "**CHARGING**" message as noted above. Typically 4 hours (at 20 °C) to reach full charge – longer at lower temperatures.

NOTE: Ensure that 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**" label as shown above 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.

APPENDIX A: ASSAY ANALYSIS – COMMENTS RE PRECISION

General - The GT-30 Portable Gamma Spectrometer units have an integrated 6.3 cu ins Sodium-Iodide detector for Gamma Ray detection. This very large sensor coupled with the 1024 channel spectrometer capability of the unit permit high levels of sensitivity for Geophysical prospecting.

However like all instruments, measurement accuracy is dependent on a variety of factors. This note briefly explains the basic errors related to instrument measurement and computes approximate system Precision capabilities.

Errors - There are various primary sources of error.

a) STATISTICAL – If we assume the calibration parameters are 100 % correct then the accuracy of a reading is strictly related to the statistical noise of the counting, so if we count long enough we can reach any degree of precision and accuracy.

b) CALIBRATION – There are some level of errors when the unit is calibrated, so the measured calibration matrix is offset relative to the correct matrix. This will result in a systematic small error component that effects the accuracy. For levels below approximately the pad concentrations of 8 % K, 50 ppm U, and 140 ppm Th – with an Assay Time of 2 min, this systematic error is small compared to the statistical error and can be ignored. At higher levels or if the counting time is extended (4 minutes at 4 % K, 25 ppm U, 70 ppm Th) this error will get comparable to the statistical error and keep increasing faster than the statistical error.

c) GEOMETRY – The other factor that should be considered is the geometry. The assumption in computing the assay results inside the unit is that the detector is looking at a semi-infinite half space of uniform material. In more practical terms this means the instrument is averaging a circular area approximately 1 meter diameter. Thus if the rocks inside this 1 m zone are fully homogenous, then the Assay results from the instrument will approximate that of Chemical assay – however in the field this assumption is difficult to ensure so in most cases the Assay are an excellent INDICATION of the level of actual chemical assay results.

d) COUNTING TIME – The length of the sample (assay) time is a function of the user's requirements. In the past, 300 sec (5 min was used as the standard to suit all field conditions as this gave good results in even low level areas. However much exploration now takes place in relatively high grade areas where this long assay period is not necessary and for many users this 5 min period was considered excessive. For this reason the GT-30 is factory set at 120 sec (but changeable by the user to suit their field requirements). When the sample starts, a preset Sample Time parameter shows the sample time on the right and on the left is a count up timer showing sample progress. Once the first 30 sec sample is reached an Assay result is shown. Each additional 30 sec the Assay data is recomputed and updated on the display. For the best accuracy the full count period should be permitted. However in very anomalous areas sample times as low as 60 seconds give very good data due to the large detector size.

Guidelines are:

60 sec – anomalous area – low quality data is fine – fast sampling is required to get maximum data for an area in a short period of time.
120 sec – anomalous area – medium quality data is fine – fast sampling is required to get maximum data for an area in a short period of time.
180 sec – medium anomalous area – good quality data is required.
240 sec – medium to low anomalous area – high quality data is required.
300 sec – low anomalous area – maximum quality data is required.

IN THE ANALYSIS BELOW 120 sec ASSAY PERIOD IS ASSUMED.

The table below shows the estimated error bars at the 1 Sigma level, so +/- 1 sigma is a good estimate of data precision but only errors (a) are included in this assessment.

a) **GT-30 DATA**

K %	**1 sigma K %**	**1 sigma U ppm**	**1 sigma Th ppm**
0	0.000	0.000	0.000
0.1	0.030	0.041	0.006
1	0.096	0.130	0.019
5	0.214	0.291	0.042
10	0.303	0.412	0.060
U ppm	**1 sigma K %**	**1 sigma U ppm**	**1 sigma Th ppm**
0	0.000	0.000	0.000
1	0.043	0.307	0.027
10	0.135	0.970	0.087
100	0.427	3.067	0.274
1000	1.349	9.698	0.866
10,000	4.27	30.67	2.74
Th ppm	**1 sigma K %**	**1 sigma U ppm**	**1 sigma Th ppm**
0	0.000	0.000	0.000
1	0.023	0.237	0.539
10	0.072	0.750	1.705
100	0.228	2.373	5.391
1000	0.721	7.504	17.047
10,000	2.28	23.7	53.9

NOTE: the above data have been computed taking into account the errors described. However as described above the final absolute precision levels are a factor of many of the errors described, some of which are hard to quantify for the reasons noted. For this reason the quoted error levels should be used in a relative rather than an absolute manner to ensure technical accuracy

ZERO RESULTS – Under certain conditions some Assay results go to zero. This is caused by statistical noise errors interfering with the matrix calculation of Assay computation. Using the statistical noise calculations above, as an example if you have a 120 sec sample and a 100 ppm Thorium sample with 10 ppm Uranium, then the assay result for +/- 1SD will be Th=100 +/- 5.5 ppm and U=10 +/- 3.3 ppm thus in some samples **U could = 0.0**. This "noise" error can be minimized by taking very long Assay samples which reduces the scatter.

CROSS INTERFERENCE – For varying concentrations of e.g. Potassium there are error components for not only K but also U, Th etc. If you have a mix of K, U, Th - the combined errors can be found by taking the square root of the sum of the square of errors. If for example you have 1 % K, 10 ppm U, and 10 ppm Th the combined K error is SQRT(0.096*0.096 + 0.135*0.135 + 0.072*0.072) = 0.18.

b) **GT-32 DATA**

The GT-32 data is approximately 2x better than the GT-30 data noted above due to the BGO detector technology.

REFERENCE

The above data is based on Calibration data derived from Georadis Calibration Pads. These pads are technically defined in the 1991 Geological Survey of Canada paper #90-23 titled "**Transportable Calibration Pads for Ground and Airborne Gamma-Ray Spectrometers**" by Grasty, Holman and Blanchard. This paper fully describes the manufacture and the assay testing of the material to verify the pad calibration results. Window widths of ROIs and cal standards were defined to IAEA standards as required.

APPENDIX B: FAST GPS SAMPLING ON TOTAL

Some users want to record GPS data at a faster rate when recording Total Count data. Version 5.xx permits this but there are some compromises.

In the normal software, Total Count scan data is recorded in data blocks of 30 samples, after which GPS is recorded. This memory block size is not practical to change however users can adapt the scan rate to get faster GPS data.

To do this, users should load a special parameter file named "**GPSfastscan.txt**" that should be supplied with the new software but can be obtained from Georadis as required. This txt file looks like this:

Params.survey_rec_len = 30

Change the number as required for example to **15**, then store the file (only use Notepad or WordPad – don't use WORD as it adds formatting characters that will cause file loading problems) Then load the file into the unit using the method detailed in section 4.9.1 under **PARAMETER CHANGE**.

In the above example if Total Scan Period = 1 and the above file sets "Params.survey_rec_len" = 15 – then when RECORDING is started, the Total Count data is recorded at a 1/sec rate for 15 samples then the GPS is recorded and the recording repeated.

Note that in this case the allotted memory determined during memory partitioning is actually half of what is indicated because memory is allocated for 30 samples of data and only 15 are being recorded. However the new units with 4M of memory have 58 sectors for allocation (see 4.9.3 above) so memory capacity should not be a problem.