Model GK-604D

Digital Inclinometer Reader Application

Instruction Manual

GEOKON®

Document Revision: B.2 | Release date: 05/31/24

WARRANTY STATEMENT

GEOKON warrants its products to be free of defects in materials and workmanship, under normal use and service for a period of 13 months from date of purchase. If the unit should malfunction, it must be returned to the factory for evaluation, freight prepaid. Upon examination by GEOKON, if the unit is found to be defective, it will be repaired or replaced at no charge. However, the WARRANTY IS VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion or current, heat, moisture or vibration, improper specification, misapplication, misuse or other operating conditions outside of GEOKON's control. Components that wear or are damaged by misuse are not warranted. This includes fuses and batteries.

GEOKON manufactures scientific instruments whose misuse is potentially dangerous. The instruments are intended to be installed and used only by qualified person el. There are no warranties except as stated herein. There are no other warranties, expressed or implied, including but not limited to the implied warranties of merchant-ability and of fitness for a particular purpose. GEOKON is not responsible for any damages or losses caused to other equipment, whether direct, indirect, incidental, special or consequential which the purchaser may experience as a result of the installation or use of the product. The buyer's sole remedy for any breach of this agreement by GEOKON or any breach of any warranty by GEOKON shall not exceed the purchase price paid by the purchaser to GEOKON for the unit or units, or equipment directly affected by such breach. Under no circumstances will GEOKON reimburse the claimant for loss incurred in removing and/or reinstalling equipment.

Every precaution for accuracy has been taken in the preparation of manuals and/or software, however, GEOKON neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damages or losses that result from the use of the products in accordance with the information contained in the manual or software.

TABLE OF CONTENTS

FIGURES

TABLES

EQUATIONS

1. INTRODUCTION

The GK-604D is made up of four components: An Inclinometer Probe, the Remote Module, a Pulley Assembly and the Readout Unit. The Readout Unit must have an Android operating system of at least version 6.0 (Marshmellow) and the GK-604D Reader | aos application installed on it. This application is available on Google Play or on the GEOKON website. Primarily, this manual will cover the operation of the GK-604D Reader | aos application.

1.1 READOUT UNIT

The Readout Unit consists of a handheld field PC (Model FPC-3), running the GK- 604D Reader | aos Application (see Figure 1).

Figure 1: *FPC-3 Running the GK-604D Reader App*

Features Include:

- Rugged
- Reliable
- All the benefits of an Android device (Cell capability, Wi-Fi, file system, USB and Bluetooth connectivity). Many apps available via Google Play
- Long battery life
- Ease of use

1.1.1 GK-604D READER APPLICATION

The GK-604D Inclinometer Reader | aos Application installs and runs on an Android Device such as the Model FPC-3, (see Figure 1) and is designed to communicate via Bluetooth with Remote Modules connected to digital MEMS probes.

2. INSTALLATION AND OPERATION

2.1 BEFORE USING THE GK-604D READER APPLICATION

The readout software runs as an application under the Android operating system (OS) installed on a handheld PC (FPC-3) or other Android device. If an FPC-3 has been purchased from GEOKON then the GK-604D Reader | aos will already be installed.

Note: Please consult the GK-604D Inclinometer System manual for inclinometer equipment setup, measurement procedures, inclinometer theory and maintenance. Before installing the GK-604D Reader, the user should familiarize themselves with the following:

- The operation of the FPC-3 (or other Android device).
- Use of the Back and Home buttons, Settings and Files applications and have the ability to launch other applications.
- Tapping the keyboard icon to use the on-screen keyboard for text and number entry.

If the icon shown in Figure 2 does not appear in the *Apps drawer* of the FPC-3 (or other Android device) then the GK-604D Reader application must be installed. Proceed to Section 2.2.

***Figure 2**: GK-604D Reader Icon*

2.2 INSTALLING THE GK-604D READER APP

The installation of the GK-604D Reader App requires the following:

- Android device with cell phone capability (and data plan) or wireless internet connection to allow access to Google Play Store.
- Alternatively, a USB connection from the Android device to a host PC, allowing file transfer of the application ".apk" install file.
- Android device with version 6.0 (Marshmellow) or higher operating system.
- The Android device must have at least 50 Mbytes of free memory and be Bluetooth enabled.

2.2.1 INSTALLING GK-604D READER FROM GOOGLE PLAY STORE

From the Android device, tap on the Google Play icon to launch the Google Play application. This icon is usually found on the main screen of the Android device as well as in the Apps drawer (see
Figure 3). Enter the text string "GK-604D Reader" into the Google Play search bar to find the GK-604D reader app Install page (see Figure 4).

***Figure 3**: Google Play icon*

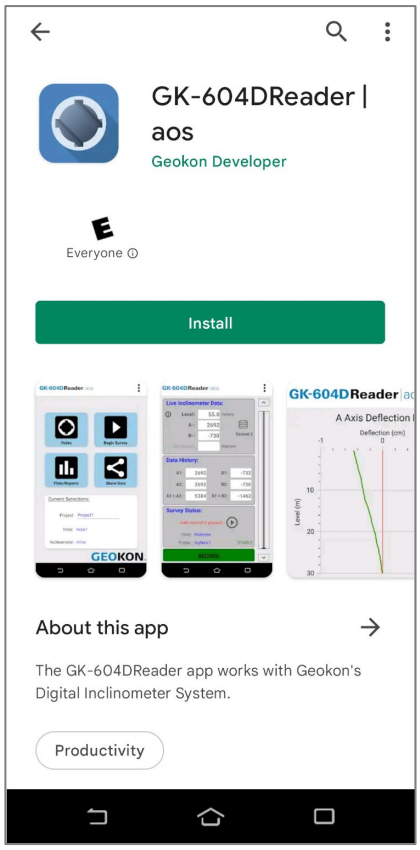


***Figure 4**: GK-604D Install page*

After tapping on "Install", the app will begin the install process. Follow the on-screen instructions to finish the GK-604D Reader install.

2.2.2 INSTALLING GK-604D READER VIA USB LINK TO HOST PC

The GK-604D Reader | aos application can also be installed by copying an Android Application Package (.apk) file to the Android device from a host PC. The process is as follows:

1. Download the zipped installer from GEOKON's software download webpage. The file is called: "com.GEOKON.GK604D_Reader.zip ".

2. Open a Windows Explorer window and unzip the downloaded GK-604D Reader installer.

3. Copy this installer (com.GEOKON.GK604D_Reader.apk) to a directory on the Android device that can be easily accessed from the device's internal File Manager such as "Card" or "Internal Storage".

   Note: directory names can vary with different versions of Android as well as different manufacturers of Android devices.

4. Disconnect the USB cable from the PC to the Android device.

5. Using an Android file manager application, find the file copied from the PC and tap on it to start the install process.

6. If asked, select "Complete action using Package Installer".

7. Follow the on-screen instructions to finish the install.

3. STARTING THE GK-604D READER APP THE FIRST TIME

The readout software is launched by entering the Android *Apps drawer*, then selecting the GK-604D Reader | aos icon (see Figure 2). When starting the application for the first time, the screen shown in Figure 5 will be shown.

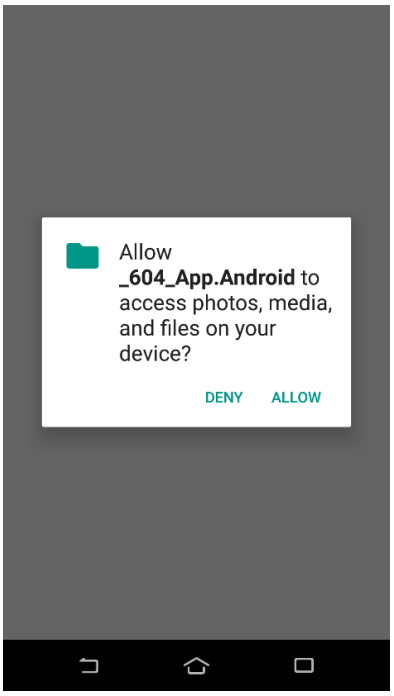


***Figure 5**: Permission Request*

Click "ALLOW" to grant permission to the application to save surveys and photos to the Android file system. Clicking "DENY" will not allow the application to start up. If permission is denied, the app will request the same permissions the next time the app is launched. After file access permission is granted, the screen shown in Figure 6 is shown.

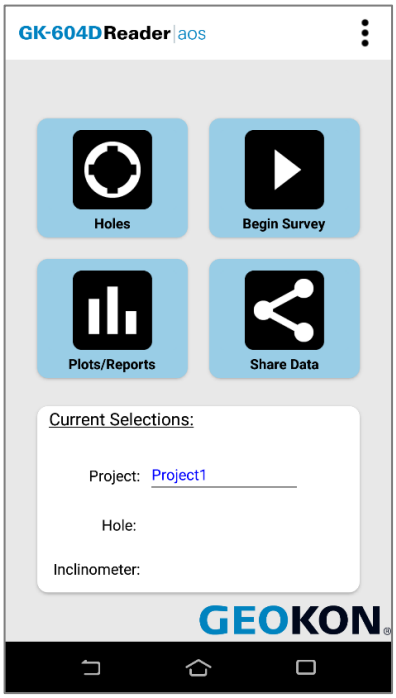


***Figure 6**: Main Screen*

While a default project is created automatically, new projects can be created by tapping the “kebab” menu (3 vertical dots in the top-right corner) and selecting “Projects” from the Menu Items (see Figure 7).
(For a detailed description of all menus items see Section 4.1.)

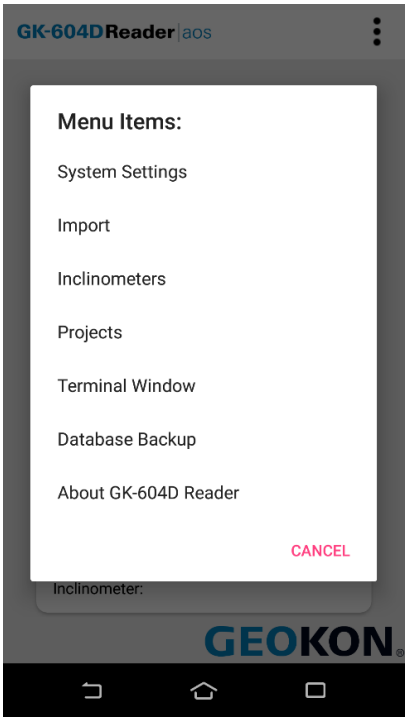


***Figure 7**: Main Screen "Kebab" Menu Items*

3.1 CREATING A NEW “HOLE”

Since most boreholes are unique, no default “Hole” exists when the app is first launched. From the Main Screen (see Figure 6), tap the “Holes” button to view the “Holes” screen (see Figure 8).

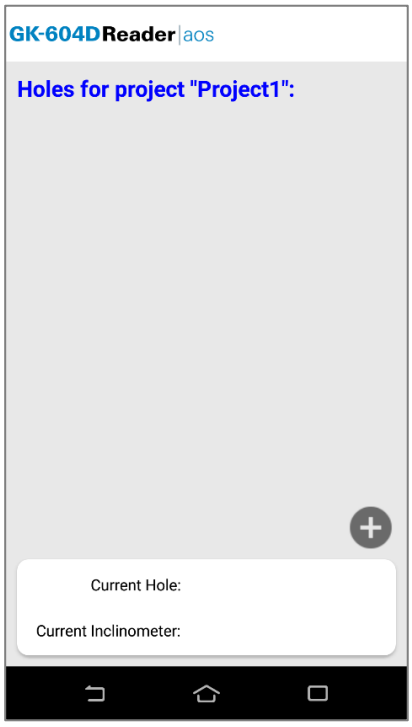


***Figure 8**: Holes Screen*

To create a new “hole”, tap the circular “+” icon which displays the Hole Editor screen (see Figure 9)

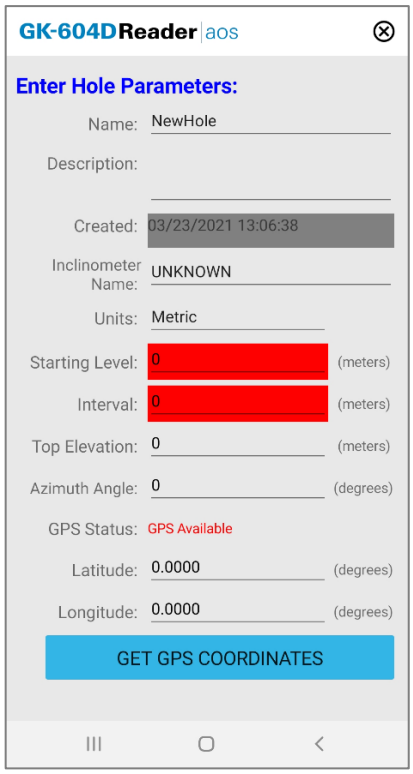


***Figure 9**: Hole Editor Screen*

To create a hole, a user must supply a Name, Units, Starting Level and Interval from the hole editor. To save the new hole, tap the back button, “<”.

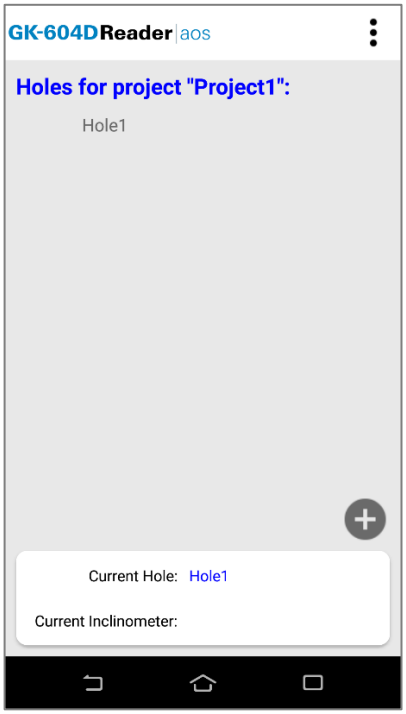


***Figure 10**: Holes Screen (with new hole shown)*

Tap the back button again to return to the Main Screen (see Figure 6).

3.2 SETTING THE SYSTEM PARAMETERS

From the Main Screen Menu Items (see Figure 7) select “System Settings” to display the System Settings Editor (see Figure 11).

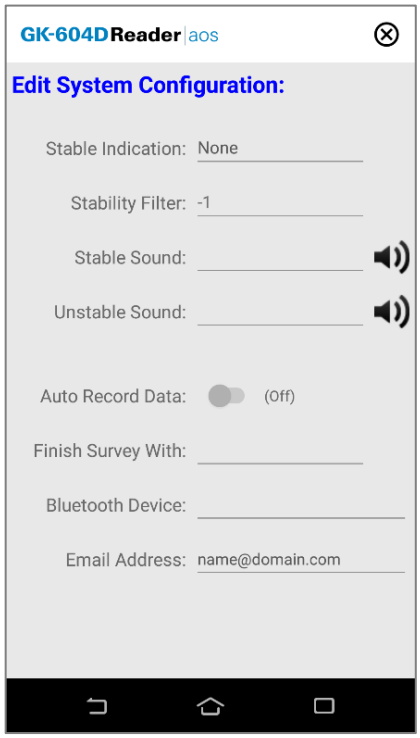


***Figure 11**: System Settings Editor*

The System Settings are individually described below:

3.2.1 STABLE INDICATION

Valid choices for this parameter are:

None:
When “None” is selected, the only indication of the inclinometer reading's stability is to monitor the A and B readings on the Live Readings Screen.

Visual Only:
When “Visual Only” is selected, the “Record” button on the Live Readings Screen will be displayed red if the A and B readings are unstable and green if the readings are stable. Text will also be displayed in the Survey Status pane, either “Stable” or “Unstable”.

Visual/Audible:
When “Visual/Audible” is selected, in addition to the “Visual” display described above, an audible indication is played, indicating the reading's stability or instability.

3.2.2 STABILITY FILTER

If the "Stable Indication" (see Figure 11) selection is set to something other than "None", this parameter will be used to determine readings stability (a value less than 10 is recommended).

When taking live readings, if the difference between two subsequent readings of the A **and** B channels are less than or equal to the "Stability Filter" then the reading will be deemed stable.

3.2.3 STABLE SOUND

Tapping this parameter (see Figure 11) will display a dropdown list of choices of sounds that the FPC-3 can make when the reading in the "Live Readings" screen is determined to be stable. This parameter has no effect if “Visual/Audible” was not selected as the “Stable Indication”.
Tapping plays a preview of the actual sound heard.

3.2.4 UNSTABLE SOUND

Tapping this parameter (see Figure 11) will display a dropdown list of choices of sounds that the FPC-3 can make when the reading in the "Live Readings" screen is determined to be unstable. This parameter has no effect if “Visual/Audible” was not selected as the “Stable Indication”.
Tapping plays a preview of the actual sound heard.

3.2.5 AUTO RECORD DATA

This parameter (see Figure 11) determines whether a survey is taken in a semi-automatic fashion or completely manual. Sliding the “switch” to the right will enable the Auto Record function and will take effect the next time a survey is taken. See Section 5.3 for more info on Auto Record.

3.2.6 FINISH SURVEY WITH

This parameter (see Figure 11) deals exclusively with "unfinished" survey data files. A survey is unfinished if readings were not taken at each level from starting up to the zero level. Many surveys may not completely finish because the geometry of the probe will not allow the last reading or two to be taken while the probe is still in the casing.
Valid choices for this selection include:

NOTHING: The survey will not be filled in and will remain unfinished. "READINGS" will be modified to reflect the actual number taken.

NAN(S): Each missing level "row" of the survey will be filled in with "NaN(s)" which is the floating-point representation of a non-numerical value. NaN is an abbreviation for "Not a Number”.

BLANKS: Each missing level "row" of the survey will be filled in with blank characters.

3.2.7 BLUETOOTH DEVICE

This parameter must be a previously paired Bluetooth device that is selected from a list of known Bluetooth devices.

NOTE: No connection will be possible to the Remote Module and a survey will not be performed if this parameter is not set correctly. Please see Section 3.2 (Establishing Contact with the Remote Module) of the Digital Inclinometer System Manual for more information regarding Bluetooth pairing.

3.2.8 EMAIL ADDRESS

This parameter allows entry of an email address so that the Android device can export a data file as an email attachment.

4. GK-604D READER APPLICATION MAIN SCREEN

4.1 OVERVIEW

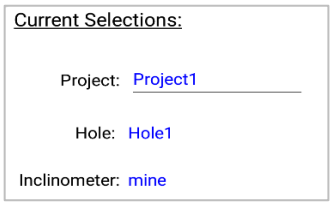
The GK-604D Reader Main Screen (see Figure 6) contains several "Button" and menu controls designed to make it easy to select features of the application. These controls are described below:

Tapping the "Holes" button causes the "Holes" screen to be displayed. This screen (see Figure 10) is where existing holes can be selected or edited and where new holes can be created. The Holes screen is covered in Section 3.1 and Section 6.1.

Tapping the "Begin Survey" button begins the process of connecting to the Remote Module. See Section 5 for a full description of the "Live Readings" screen and connecting to the Remote Module.

Tapping the "Plots/Reports" button displays the "Plots/Reports" Selection screen (see Figure 45). See Section 8 for a full description of the various plots and reports available for the Reader application.

Tapping the "Share Data" button begins the process of exporting survey data either to a file or via email. The process is described in more detail in Section.
7.2



The "Status" pane of the Main Screen displays the currently selected elements of the Reader application. In the example to the left the current project is "Project1", the selected hole is "Hole1", and the current inclinometer probe is "mine".

The project can be changed by tapping the project name and selecting the desired project from the list of available projects. A different hole will need to be selected because "Holes" are contained within "Projects".

Additional functions are available from the Main Screen "kebab" menu (shown left). These menu items are described below:

System Settings: Described in Section 3.2 above, these parameters are used to determine readings stability, survey operation and Remote Module connection.

***Import*:** This feature is described in Section 7.1

Inclinometers: Tapping this menu item displays the Inclinometers Screen. The Inclinometers Screen is described in Section 6.2.

Projects: Tapping this menu item displays the Projects Screen, allowing creation, editing and removal of Projects. See Section 6.3 for more information.

Terminal Window: Tapping this menu item displays the Terminal Window, allowing direct diagnostic connection to the Remote Module. See Section 9 for more information.

Backup Database: See Section 10 for more information.

About GK-GK604D Reader: See Section 11 for more information.

5. CONNECTING TO THE REEL AND CONDUCTING A SURVEY

The "Live Readings" window is the main interface seen while a survey is being taken. It shows the status of the probe and keeps track of where the probe is, vertically, in the casing. Tapping on the "Begin Survey" button from the main screen initiates the Remote Module connection process and after a successful connection, the Live Readings screen will be displayed (see Figure 12). Should the connection attempt fail, the window shown in Figure 13 will be displayed with suggestions for correcting any issues before retrying.

Note: When attempting to connect to the Remote Module (reel), please ensure that the "Power On/Off" button on the Remote Module has been pressed (blue light will be blinking) before tapping the "Begin Survey" button.

After the Remote Module successfully connects to the Android device, the blue POWER ON indicator will transition from blinking to steadily lit. If the GK-604D Reader app recognizes the attached inclinometer AND if the selected hole references this inclinometer, then the Live Readings screen will be displayed (see Figure 12).

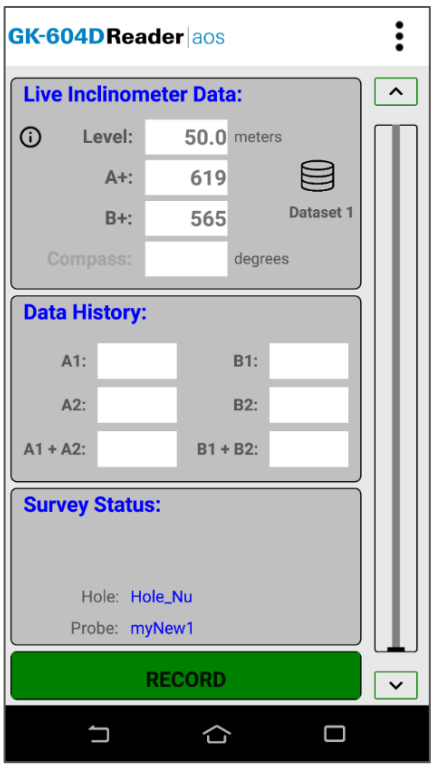


***Figure 12**: Live Readings Screen*

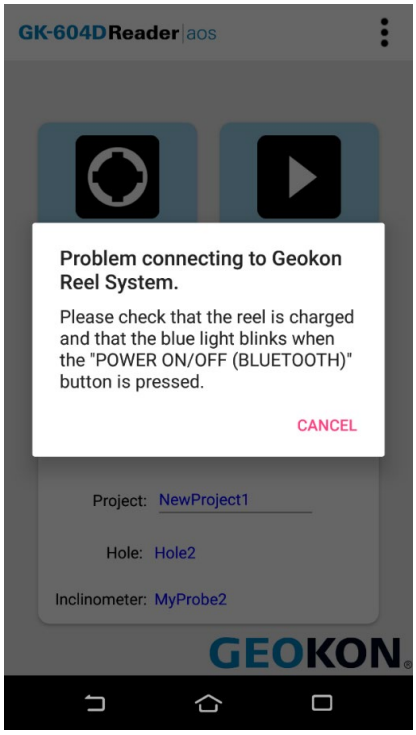


***Figure 13**: Problem Connecting to Reel*

If the GK-604D Reader app does not recognize the attached inclinometer, the dialog shown in Figure 14 will be displayed.

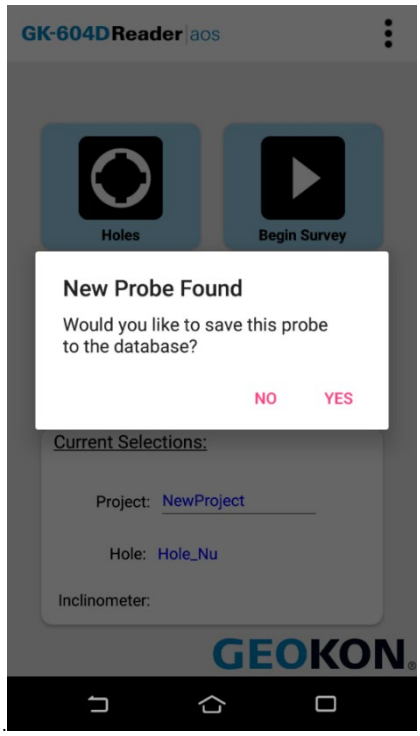


***Figure 14**: New Probe Found*

Answering "No" to the query above will cause the "Live Readings" window to be shown (see Figure 12) and the survey to be performed with the currently connected probe, but will not save the probe in the database.

Answering "Yes" to the query above will cause the Inclinometer Editor window to be shown (see Figure 15), allowing the new probe to be named. When done, tap the "Back" button (←) to save the new probe.

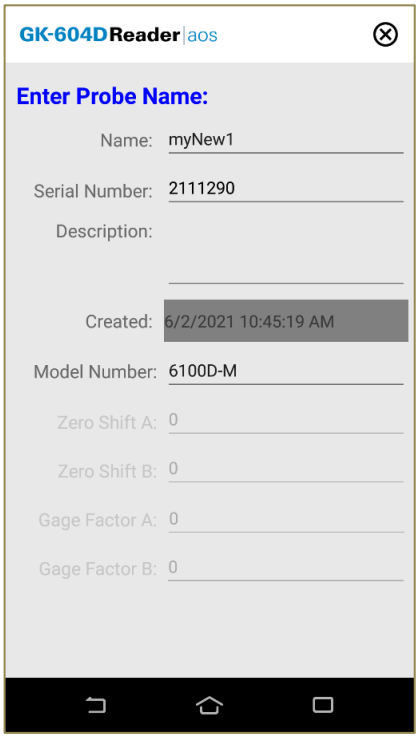


***Figure 15**: Inclinometer Editor*

If the hole selected for surveying does not have a probe selected (Probe Name = UNKNOWN), a prompt will be displayed asking if the user would like to assign the current probe to the selected hole (see Figure 16). Tap "Yes" to save the probe name in the selected hole or "No" to continue without saving.

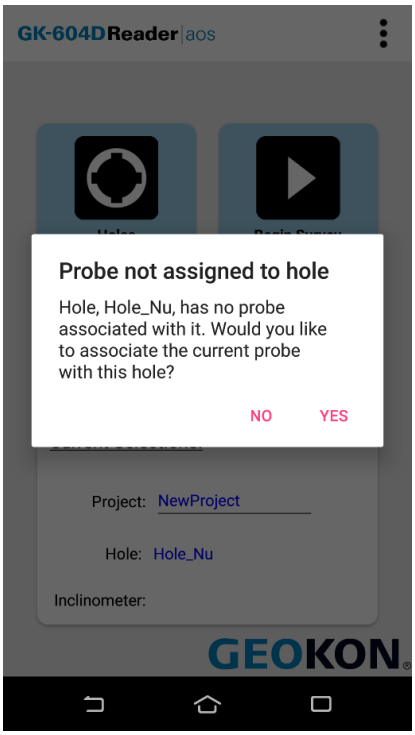


***Figure 16**: Probe Not Assigned*

See Section 3.2 of the Digital Inclinometer System Manual and Section 3.3 above for more information about setting up the readout and inclinometer system.

5.1 LIVE READINGS WINDOW

The following is a description of the various features and functions of the Live Readings Window:

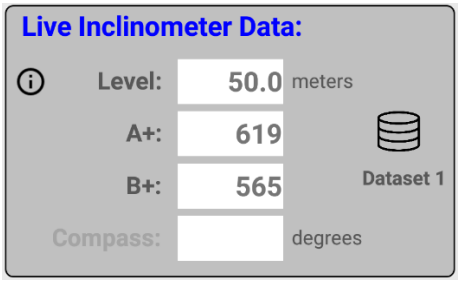


***Figure 17**: Live Inclinometer Data*

In the Live Inclinometer Data section, readings are continuously updated from the Remote Module. The data set always starts with "Dataset 1" but can be switched at any time to "Dataset 2" (usually after rotating the probe 180 degrees). The “Level” can be entered directly at any time by tapping the value (in the white box) directly, bringing up an editor. The inclinometer must then be moved to the new “level” within the well.

At the start of a survey, the "Level" is set to the "Starting Level" configured for a particular hole. Pressing the “RECORD” button (with a tap of a finger or stylus) records that set of A and B values and automatically changes the "Level" (on screen) by the amount based on the hole configuration "Interval" value (see Section 6.1). There is a graphical view of where the inclinometer is in relation to the depth of the surveyed well. This graphical view is also updated when “RECORD” is pressed.

The compass heading can also be displayed if a Compass Survey is enabled (see Live Readings Kebab Menu). Displaying the compass value can increase the time to complete a survey by up to 30%.

Note: The compass built-in to the 6105 inclinometer is very sensitive to nearby ferrous metals. Any section of the well that contains a metal casing will not yield accurate compass headings.

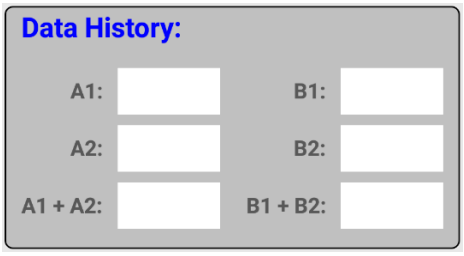


***Figure 18**: Data History*

The Data History pane allows a snapshot of the inclinometer values at each level. It is most useful when scrolling manually through the “levels” to review where a reading might have gone awry. The displays for A1/B1 correspond to the A and B axes on Dataset1, while those for A2/B2 correspond to axes A and B for Dataset2. The readings for A1/B1 are not displayed until the Dataset1 portion of the survey is performed. When the Dataset2 portion of the survey is being performed, the previous readings for Dataset1 (A1/B1) are displayed, as well as, the current readings for A2/B2 and checksums “A1 + A2” and “B1 + B2”. This gives a running indicator of how the second portion of the survey compares to the first.

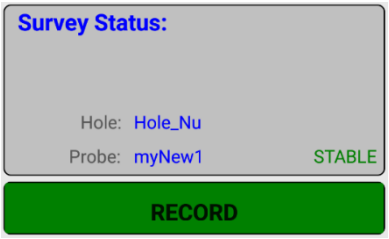


Figure 19: *Survey Status and RECORD Button (STABLE)*

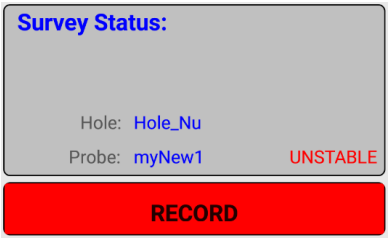


Figure 20*: Survey Status and RECORD Button (UNSTABLE)*

Figure 19 and Figure 20 show Survey Status pane (along with the RECORD button) in two different states. Figure 19 shows the status as "STABLE" and in addition, the color of the RECORD button is green to indicate it is ready to record readings.

Figure 20 shows the status as "UNSTABLE" and the color of the RECORD button is red, indicating that it is not a good time to record readings. The STABLE/UNSTABLE status along with the changing color of the RECORD button are only seen if the System Settings parameter, "Stable Indication" is set to "Visual Only" or "Visual/Audible" (see Section 3.2)

Additionally, the Survey Status pane allows control over the Auto-Record Data feature if enabled (see Section 3.2 and Section 5.3).

5.1.1 LIVE READINGS SCREEN KEBAB OPTIONS

Figure 21 shows the available options from the Live Readings menu when a Digital Inclinometer/Compass probe is detected. These options are described below.

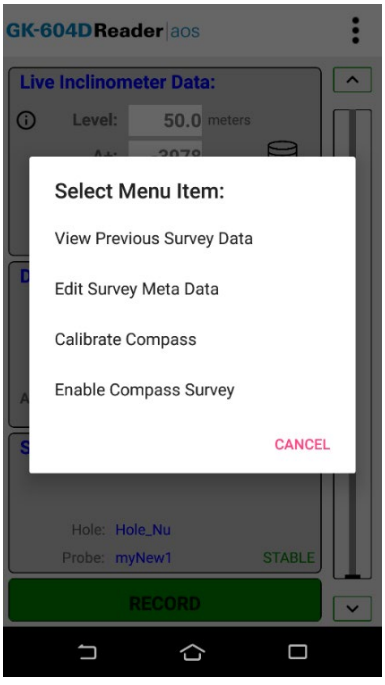


Figure 21*: Live Readings "Kebab" Options*

VIEW PREVIOUS SURVEY DATA:

Allows viewing and loading of previous survey data. When tapped, the user must first select the previous survey file to view. After selecting a file, the survey data viewer is shown (see Figure 22), filled with survey data. After dismissing this window, a dialog prompt is displayed giving the user an opportunity to load the previous data or continue with the current survey.

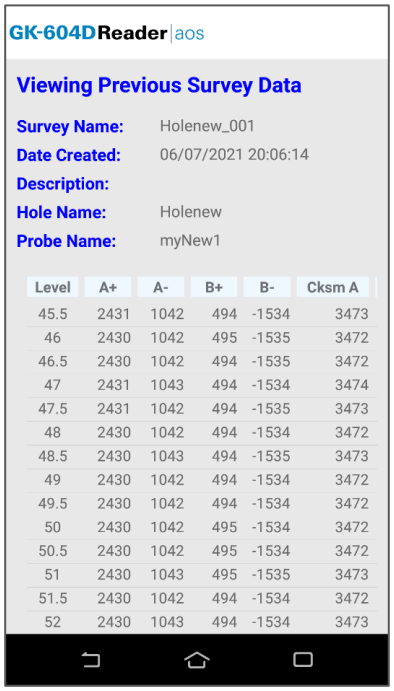


***Figure 22**: Previous Survey Data Viewer*

EDIT SURVEY META DATA:

When tapped, the edit screen shown in Figure 23 will be shown. The Meta Data Editor allows a survey to be named and a brief description added. Optionally, a picture can be selected/taken of the site and saved to the Android file system.

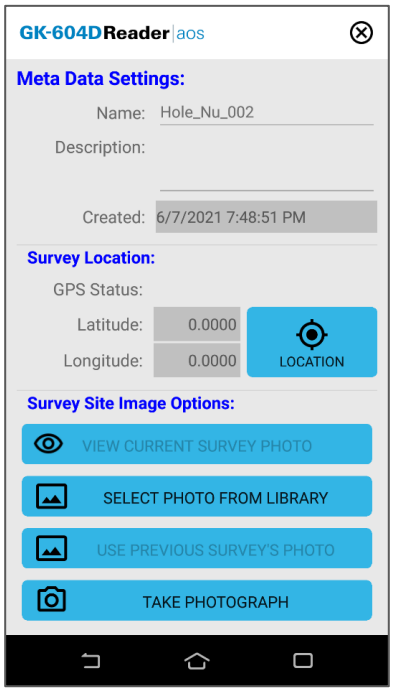


***Figure 23**: Meta Data Editor*

CALIBRATE COMPASS:

For optimum accuracy, the digital inclinometer/compass probe should be calibrated for each survey site. (A compass survey does not need to be enabled to perform the calibration.)

The GK-604D Reader application provides a dialog to facilitate compass calibration, (see Figure 21). Tapping the “Calibrate Compass" menu item causes the warning shown in Figure 24 to appear.

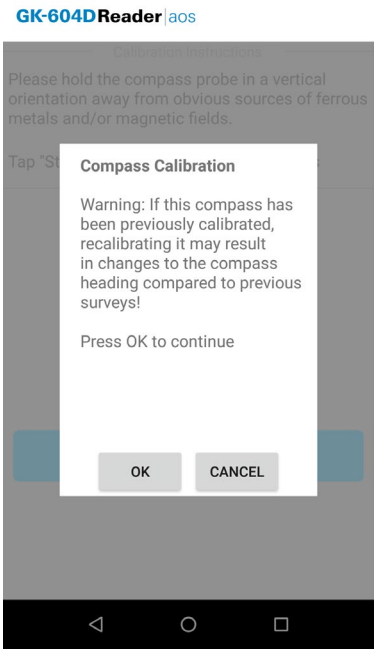


***Figure 24**: Previous Calibration Warning*

Tapping “OK” displays the initial calibration screen (Figure 25).

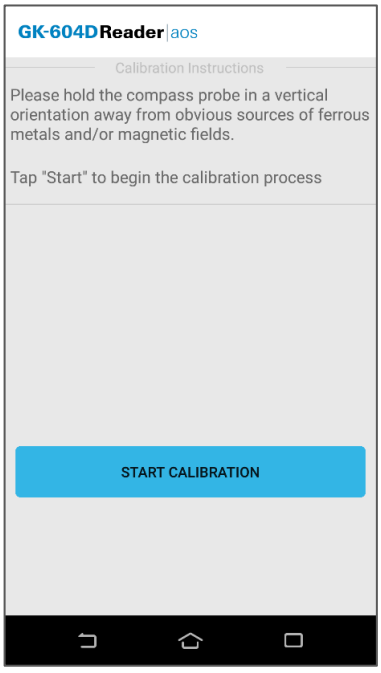


***Figure 25**: Initial Compass Calibration Screen*

Tapping "Start" begins the calibration process (Figure 26).

***Figure 26**: Calibration In-Process Screen*

Hold the probe in an upright position and slowly rotate through at least 360 degrees. The large rotating blue "arrow" serves two purposes: one, it indicates to the user that the probe should be turned and two, it provides feedback that the calibration routine is still running. Tapping the "STOP CALIBRATION" button ends the compass calibration, and the Live Readings screen is redisplayed.

ENABLE COMPASS SURVEY:

This menu item is only shown if a compass probe is detected. Though all new probes have a built-in compass, previously sold GK-604D systems must have been shipped with a reel firmware version of V2.7 (or greater) AND a probe firmware version of V2.7 (or greater) to have the included compass.

The compass sensor, coupled with two axes of MEMS, allows a compass survey to be performed at the same time as the inclinometer survey (see Section 5.2).

Tapping the menu option, "Enable Compass Survey", will display “Compass enabled, survey will take longer” in the Survey Status pane for approximately five seconds and will enable the “Compass:” heading value in the “Live Inclinometer Data” window (see Figure 17). With the compass enabled; an inclinometer survey will take approximately 30% longer and:

- A+ data is always in degrees.
- A- and B- are always zero (0)
- B+ data is always 90 degrees greater than A+

The compass heading data can be viewed (select "Raw Data as Table") and/or exported for later use in analysis. See Appendix B.6 for an example ".gks" file.

5.2 CONDUCTING A SURVEY

The following is a synopsis of the steps involved in taking a survey of the inclinometer casing:

1. Use a clean working surface, e.g., place a tarp around the top of the inclinometer casing. This reduces potential for debris to be collected on the inclinometer equipment and transmitted into the casing.

2. Attach the cable to the probe. (Make sure the connector is clean and the O-ring undamaged.) Twist the ring of the connector until it is hand tight, properly tightening the connector ensures the connection is watertight.

3. Attach the pulley assembly to the top of the casing (or casing extension). Use of the pulley assembly is highly recommended, as it reduces fatigue on the user during monitoring and it helps provide repeatable and consistent placement of the probe at each reading interval, which improves measurement accuracy.

4. Align the probe so that the uppermost wheel fits into the casing groove that faces the direction of the anticipated movement (in the case of a slope this would be downhill, or, in the case of a shoring wall, in the direction of the excavation.

5. Remove the wheel from the pulley assembly. Compress the probe's wheel assemblies as the probe is introduced into the casing and lower the inclinometer probe into the casing. Slowly lower the probe and cable down through the casing, exercising care not to let the probe strike against the bottom of the hole to reduce potential for damage to the probe.

6. Place the wheel into the pulley assembly and lift the inclinometer until the first cable marker sits in the groove located in the metal plate on top of the pulley assembly (or sits in the cable hold if a cable hold is being used). Allow for at least 6 inches of clearance from the bottom of the probe to the bottom of the casing. If using telescoping sections in the casing, allow for an additional 6 inches of clearance for each telescoping section installed.

7. Allow the probe to rest in this position for about 10 minutes. This allows the electronics in the probe to acclimate to the temperature in the casing and will reduce the potential for bias-shift errors caused by thermal differences in the probe between the first and second pass.

8. During this 10-minute period, switch on the FPC-3 and then launch the GK-604D Reader | aos application. Follow the instructions for setting up a new "hole" casing as indicated in Section 3.1. For new casings, take note of the starting depth indicated on the cable (typically where the cable is supported) and the reading intervals (half-meter / two foot). End depth is zero by default.

9. If an existing "hole" casing has been previously saved in the GK-604D Reader | aos database, select it from the app in the "Holes" page. After the 10-minute "soak" period has expired, turn on the Remote Module (blue light blinking) and click on the Begin Survey menu, then press "OK" at the prompt to display the Live Readings Page.

Make sure "Dataset 1" is shown in the upper right portion of the screen. If "Dataset 2".is displayed, tap the Dataset button to select "Dataset 1".

10. Take the first reading by tapping the "RECORD" button then pull up on the cable until the next cable marker sits in the groove located in the metal plate on top of the pulley assembly (or sits in the cable hold if a cable hold is being used). After the readings have stabilized, take another reading.

As the cable is being pulled out of the casing, place it on a tarp (or clean surface) to the side of the borehole. The cable should be collected in a figure eight-shaped arrangement. This will reduce the potential for damaging the cable. Do not wind the cable back onto the reel. Repeated winding of the cable in the same direction will cause the cable to spiral and lead to kinking or damage of the internal leads.

11. Continue in this way until the top marker is reached, then remove the wheel from the pulley assembly, and pull the inclinometer probe out of the hole.

12. Rotate the probe 180 degrees, so that the uppermost wheel is aligned with the grooves of the A- direction (opposite of the first pass). Carefully lower it to the bottom of the hole, and then pull the cable up to the first reading depth.

13. Allow for a few minutes (up to 5 minutes) for the probe to stabilize. The probe should be mostly acclimated to the temperature in the casing, unless the probe was out of the casing for an extended period following the first pass. Tap the Dataset button to select "Dataset 2".

14. Repeat steps 10 through 12.

15. Tap the back button to exit the Live Readings Page. A prompt will be displayed asking if the user would like to save the data. Tapping "Yes" will cause the reel to shut down and the main page to be displayed.

16. Disconnect the probe from the signal cable, wiping any moisture from both, then attach protective caps to the probe and the cable. Collect the pile of inclinometer cable and flip it over on the tarp. Retract the cable back onto the reel. If the cable is difficult get back on the reel without causing kinked sections, it is suggested to lower the cable (without probe and with end cap) into the inclinometer casing to allow it to release any twist it may have developed, and then wind in up on the reel.
17. Wipe down the probe and spray a light lubricant (WD-40, or similar) on the springs, wheel assemblies, and yokes prior to placing in the case. Do not apply this lubricant to the electrical connection end of the probe.

5.3 AUTO RECORD SEQUENCE

If "Auto Record Data" is set to "On" (see Section 3.2), upon entry into the "Live Readings" screen, the "Auto Record" feature will be enabled (Figure 27).

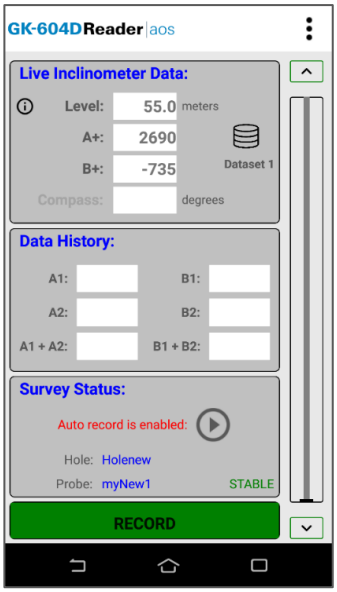


***Figure 27**: Auto Record Enabled*

To activate the "Auto Record" feature, tap on the icon. The "Play" icon to the right of the red message status text will be replaced with a "Pause" icon and the red text status message will change to "Auto record mode is active". If the readings are stable, the first reading will automatically be recorded (Figure 28).

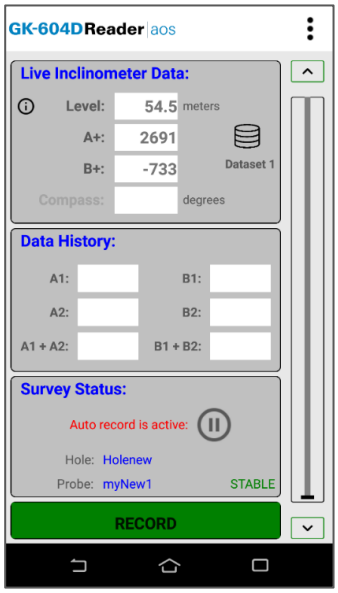


***Figure 28**: Auto Record is Active*

The list of steps below (1-9) illustrates the proper way to utilize the "Auto Record" feature. For the purpose of this example, the following is assumed:

- The Android device is connected wirelessly to the Remote Module
- In the System Settings (Section 3.2), the "Stable Indication" parameter is set to "Visual/Audible" and the "Auto Record Data" parameter is set to "On".
- At the start of an "Auto Record" sequence, the probe should be down the casing at the starting level, in the "A+" orientation.

NOTE: An "Auto Record" survey can be paused at any time and restarted as long as the probe is moved to the proper level reflected by the "Level:" display. When an Auto Record survey is paused, the data can still be recorded in the "normal" fashion by tapping on the "Record Data" buttons.

1) From the Main Screen, tap "Begin Survey" button.

2) The survey begins and readings are continuously updated from the remote module. The data set is automatically set to 'Dataset 1', but can be changed to 'Dataset 2' if necessary. The "Level" is set to the "Starting Level", previously set in the Hole Settings screen (Section 6.1).

3) Tap on the ⊙ icon to activate the "Auto Record" feature. The red status text message will change to "Auto record is active" and the "Play" icon will change to the "Pause" icon. If the readings are stable, the initial A & B readings will be taken and a "beep" sound should be heard, confirming that the readings have been stored (see Figure 28). If no beep is heard, tap the "volume" control at the top of the screen and adjust the volume.

4) By pulling on the inclinometer cable, move the probe to the next level, ensuring that the cable marker/ferrule sits just above the cable grips in the pulley assembly, (or securely in the cable hold if one is used). Approximately one second after moving the probe, the system will determine that the readings are no longer stable. Instability will be indicated by the "Record" button turning red and the "Unstable" sound selected in the "System Configuration" screen (see Figure 11) will be played.

5) Approximately two seconds after the cable marker/ferrule is locked in the cable grips, (or cable hold), the system will determine that the readings are again stable and respond by indicating stability ("Record" button goes green) and the "Stable" sound selected in the "System Configuration" screen (see Figure 11) will be played. Immediately following the stable sound, the current readings are stored, the record "beep" is heard, and the level is decremented by the preselected interval.

6) Repeat steps four and five until all the "A+" readings have been taken.

7) Tap the "Dataset 1" icon and observe that the red status text message will change to "Auto record is paused" and the "Pause" icon will change to the "Play" icon while "Dataset 1" becomes "Dataset 2" (Figure 29).

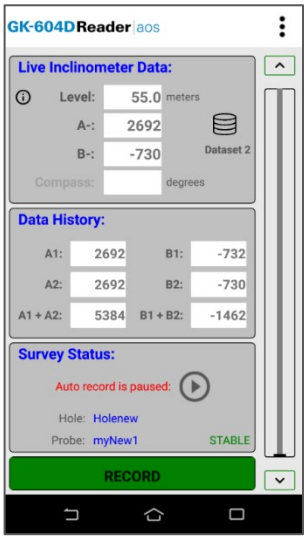


***Figure 29**: Auto Record Paused, Dataset 2 Selected*

8) After rotating the probe 180 degrees, lower it back to the "Starting Level" appropriate for this hole. Repeat step three.

9) Repeat steps four and five until all the "A-" readings have been taken.

10) When done taking readings, tap the "Back" button to dismiss the Live Readings screen. The application will detect if readings have been recorded and if so, an opportunity to save the readings will be presented to the user (see Figure 30)

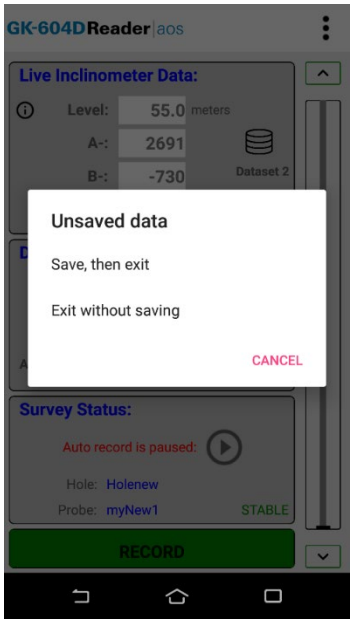


***Figure 30**: Unsaved Data Prompt*

- If "Exit without saving" is selected from the Unsaved Data Prompt (Figure 30), the readings will be saved to a temporary database table and can be restored the next time "Live Readings" is entered.

- If "Save, then exit" is selected from the Unsaved Data Prompt (see Figure 30), then the readings will be saved to the database and the survey will be saved with the name given to it in the Survey Metadata Settings (see Section 5.1.1, Survey Metadata topic). If no name was entered in the Survey Metadata Settings, the survey will be saved using a three-digit numerical suffix combined with the "Hole" name. For example, if there were four previous surveys saved for a hole with the name of "HL123_Dam75", the new survey would be named: "HL123_Dam75_005".

6. WORKING WITH APPLICATION CONFIGURATION ELEMENTS

The Reader application contains configurable elements, such as Projects, Holes, and Inclinometers. Each of these elements contain settings consisting of, at a minimum, name and description. Elements such as Holes and Inclinometers require more configuration parameters. These settings can be adjusted to meet the user's needs and the specifications of the survey. The Reader app currently supports two different Inclinometer types.

6.1 HOLE CONFIGURATION

Figure 31 shows the Edit Hole Parameter screen. Additional parameters can be seen by scrolling the screen down (see Figure 32). When done editing, the settings can be saved by tapping the hardware back button.

NAME:
Tapping the field to the right of the label brings up the on-screen keyboard. Use it to enter a unique and descriptive hole name.

DESCRIPTION:
Optional parameter. Using the on-screen keyboard, enter a brief description pertaining to the hole's location and purpose.

CREATED:
Read-only date and time value, generated when the hole was created.

INCLINOMETER NAME:
Select the Inclinometer Name from the drop-down list. This associates a hole with a particular inclinometer. Enter "UNKNOWN" if the probe has not been "found".

UNITS:
The units for the hole level and interval. Select either meters or feet from the dropdown list.

STARTING LEVEL:
Using the on-screen keyboard; enter a value for the initial level of the survey for this hole

INTERVAL:
Enter an interval to be used for the survey. This value is dependent on Hole Units and is typically a half-meter or two feet.

TOP ELEVATION:
This optional parameter corresponds to the elevation at the top of the hole.

AZIMUTH ANGLE:
This optional parameter allows correction of any casing deviation from the appropriate A+ direction.

LATITUDE:
Double floating-point value corresponding to the "Y" location of the hole to be surveyed. This parameter can be entered directly if the GPS hardware is disabled or unavailable.

LONGITUDE:
Double floating-point value corresponding to the "X" location of the hole to be surveyed. This parameter can be entered directly if the GPS hardware is disabled or unavailable.

GET GPS COORDINATES:
This button may be "hidden" below the screen of the Android device. Scroll up to expose the last two parameters (see Figure 32). This button is enabled if the "GPS Status" (above) displays "GPS Available". If the button is enabled, tapping it will cause the application to access the GPS hardware, read the current location and populate the Latitude and Longitude parameters (described above).

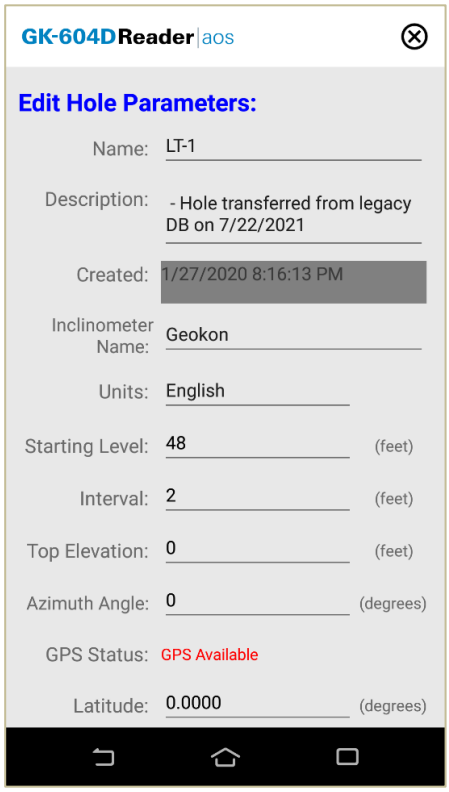


***Figure 31**: Edit Hole Parameters, Screen 1*

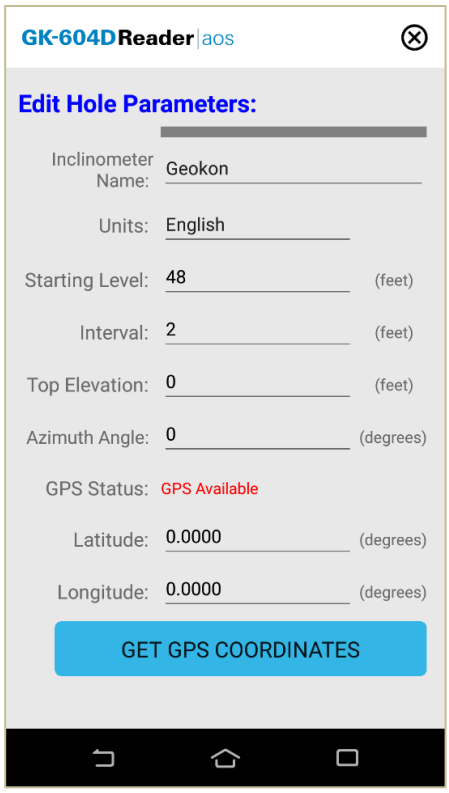


***Figure 32**: Edit Hole Parameters, Screen 2*

6.2 INCLINOMETER CONFIGURATION

Figure 33 shows the Inclinometer Parameters screen. When done editing, the settings can be saved by tapping the hardware back button.

NAME:

Use the on-screen keyboard to enter a user-friendly name for the probe.

SERIAL NUMBER:

Read from the inclinometer probe of digital systems. This parameter is a read/write parameter for Inclinometer configurations created for obsolete analog systems.

DESCRIPTION:

Optional parameter. Enter a brief description pertaining to the probe.

CREATED:

Read-only date and time value, generated when the probe was created.

MODEL NUMBER:

Select an Inclinometer model from dropdown list. Choices are: 6105-M, 6105-E, 6100D-E*, 6100D-M*, 6100-1E*, 6100-1M*, 6000-1E* and 6000-1M*.
**OBSOLETE MODELS*

Note: The model numbers, 6100-1E, 6100-1M, 6000-1E,6000-1M, are for *analog* GK-604 systems. These obsolete models require the GK-604-3 Analog Reel System or the GK-604-4 Interface Module.

ZERO SHIFT A:

Digital inclinometer probes will have this value programmed at the factory and will be read-only. For analog inclinometer probes, to compensate for any offset at zero in the A axis, enter appropriate values for the Zero Shift A value. See the Inclinometer manual and Calibration sheet for more information.

ZERO SHIFT B:

Digital inclinometer probes will have this value programmed at the factory and will be read-only. For analog inclinometer probes, to compensate for any offset at zero in the B axis, enter appropriate values for the Zero Shift B value. See the Inclinometer manual and Calibration sheet for more information.

GAUGE FACTOR A:

Digital inclinometer probes will have this value programmed at the factory and will be read-only. For analog inclinometer probes, enter appropriate numbers for the A-axis gauge factors. See the Inclinometer manual and Calibration sheet for more information.

GAUGE FACTOR B:

Digital inclinometer probes will have this value programmed at the factory and will be read-only. For analog inclinometer probes, enter appropriate numbers for the B-axis gauge factors. See the Inclinometer manual and Calibration sheet for more information.

***Figure 33**: Edit Inclinometer Parameters*

6.3 PROJECT CONFIGURATION

Figure 34 shows the Project Parameters screen. When done editing, the settings can be saved by tapping the hardware back button.

NAME:
Use the on-screen keyboard to enter a unique and descriptive project name.

DESCRIPTION:
Optional. Use the on-screen keyboard to enter a brief description of the project.

CREATED:
Read-only date and time value, generated when the project was created.

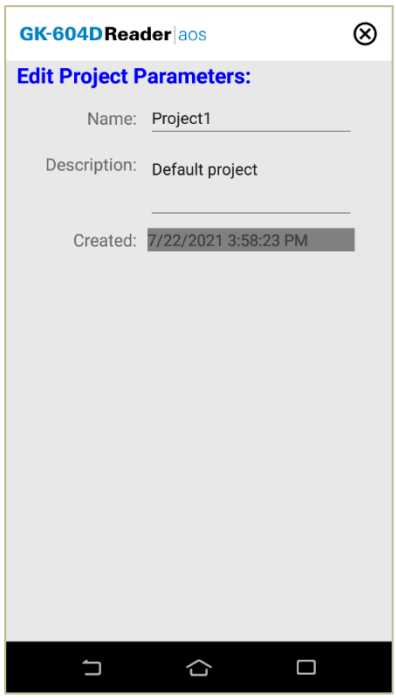


***Figure 34**: Project Parameters*

7. IMPORTING AND SHARING (EXPORTING)

7.1 IMPORT

The Import feature allows the importing of previous projects or holes or entire databases. When "Import" is selected from the Main Screen Menu items (see Figure 7*)*, a new screen is displayed with explanatory text regarding valid file types that can be imported (see Figure 35) . When ready, tap the "IMPORT FILE" button to display the import file selector (see Figure 36).

***Figure 35**: Import Screen*

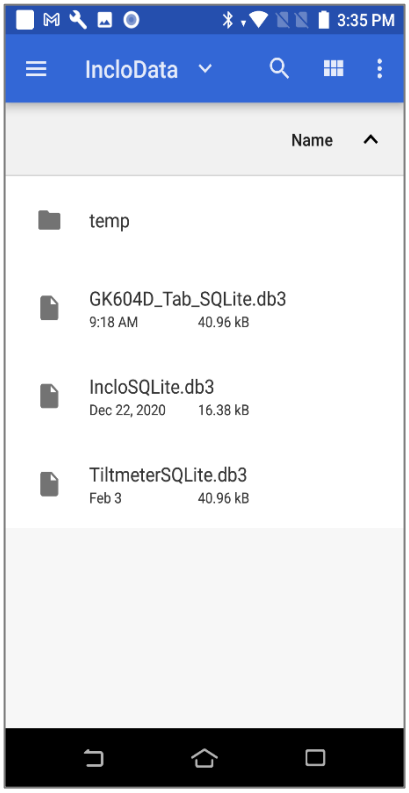


***Figure 36**: Import File Selection*

Note: When copying files for import onto an Android device, please note what folder they were copied to so they can be retrieved later. Depending on the Android device and version, not all folders are available from the File Chooser selected from the Import page, however the "Download" folder (often referred to as "Downloads") is generally available and GEOKON recommends using this folder for importing.

The following file types can be imported into the GK-604D Reader database:

.lvhe: A compressed file that contains information about an inclinometer "hole" or well and may contain data files from previously performed surveys. These "import" files are created by the "Export" function of the Windows Mobile version of GK-604D IRA .

.lvpe: A compressed file that contains information about a project. The project will likely also contain one or more inclinometer "holes" or wells and these "holes" may contain data files from previously performed surveys. These "import" files are created by the "Export" function of the Windows Mobile version of GK-604D IRA .

.gkpe: A compressed file that contains information about an inclinometer probe. These "import" files are created by the "Export" function of the Windows Mobile version of GK-604D IRA .

.db3: Files with this extension consist of two types:

Legacy DB: Database file named "IncloSQLite.db3" containing database information for the previous Android application, "GK-604D | aos". This file can be renamed but must contain "IncloSQLite" within the name and have a .db3 extension.

Current DB: Database file named "GK604D_Tab_SQLite.db3" containing database information for the current Android application, "GK-604D Reader |aos". This file can be renamed but must have a .db3 extension.

After selecting a file for importing, the Import Status Screen is displayed (See Figure 37).

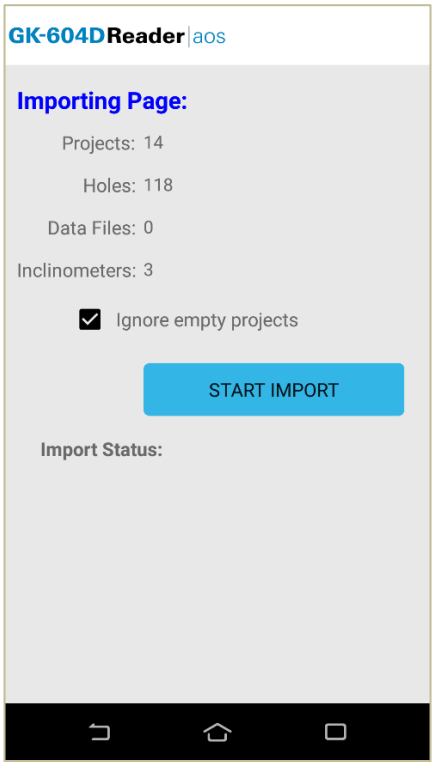


***Figure 37**: Importing Page*

Tap the “START IMPORT” button to begin importing. After a short delay, the Import Status will be populated with the results of the import (see Figure 38).

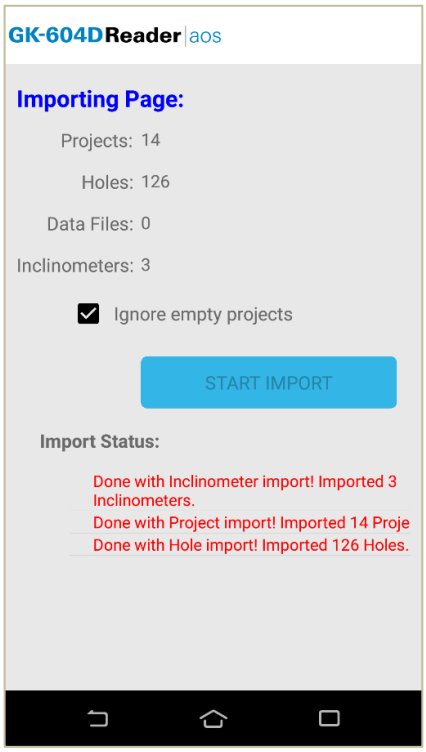


***Figure 38**: Importing Page, Import Done*

7.2 SHARING (EXPORTING)

The Export Options menu is shown when the Share Data button is tapped, allowing the export of survey data, log files or entire databases (see Figure 39).

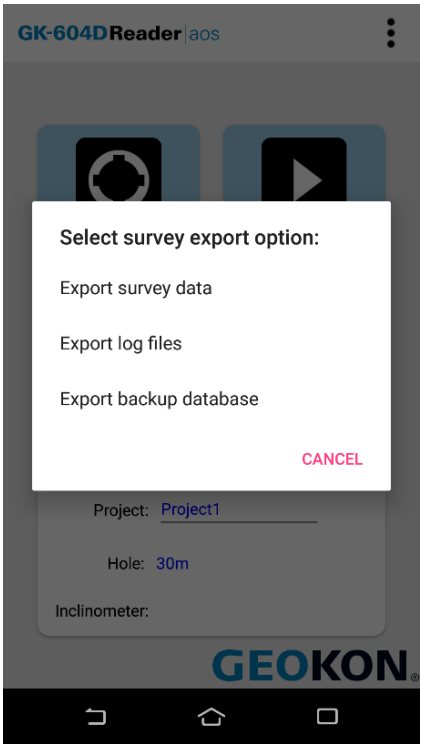


***Figure 39**: Survey Export Options*

When exporting survey data, a survey must be selected (see Figure 40):

***Figure 40**: Survey List*

Then select an export method (see Figure 41):

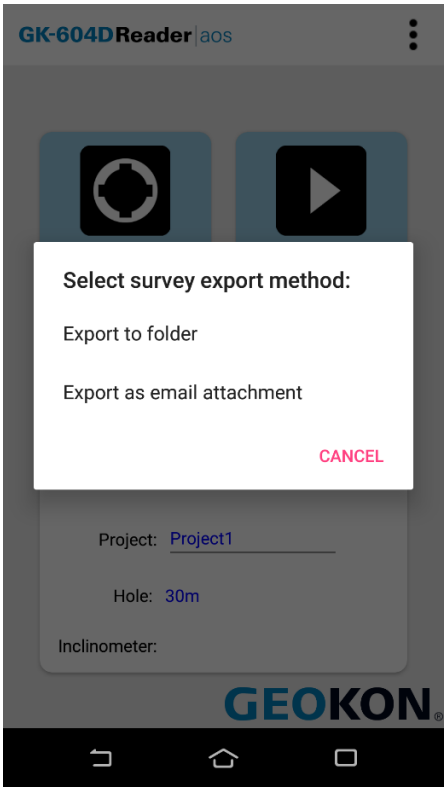


***Figure 41**: Select Survey Export Method*

If the user selects "Export to folder", the GK-604D Reader will show an Android Folder Chooser, allowing a folder location to be selected to export to (see Figure 42).

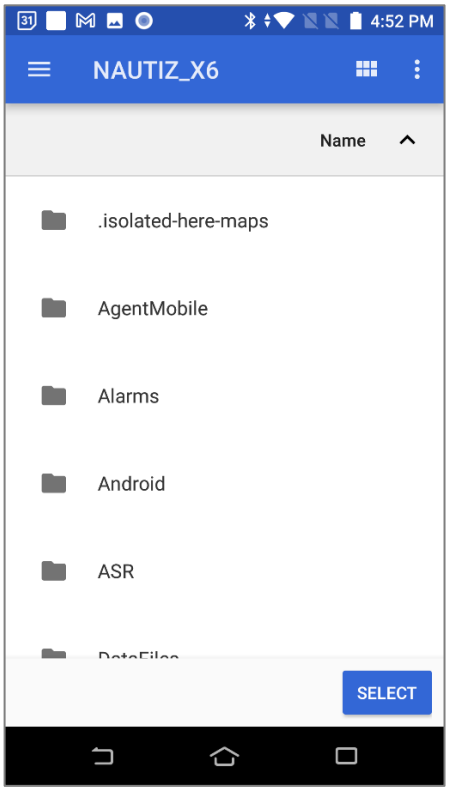


***Figure 42**: Folder Chooser*

If the user selects "Export as email attachment", the GK-604D Reader will show an Android Email Chooser, allowing the user to select which email application they want to use to export with (see Figure 43).

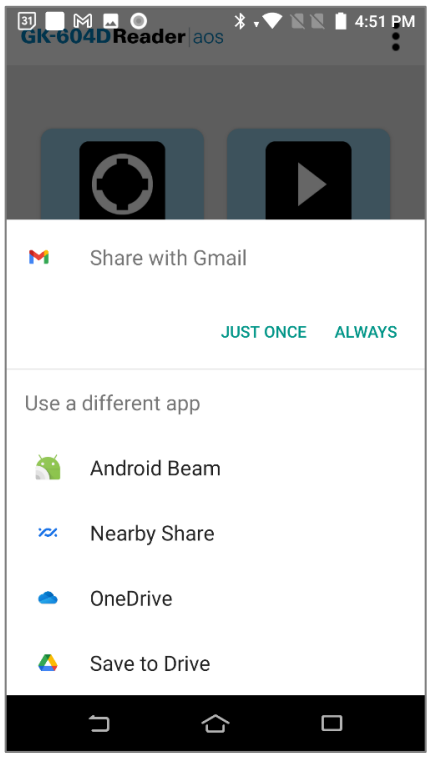


***Figure 43**: Choose Email Provider*

Figure 44 shows an Email Composer where an email can be written. The default email address is taken from The System Parameters (see Section 3.2 and Figure 11) and can be changed inside the email composer. The exported document appears as a “zipped” attachment in the email.

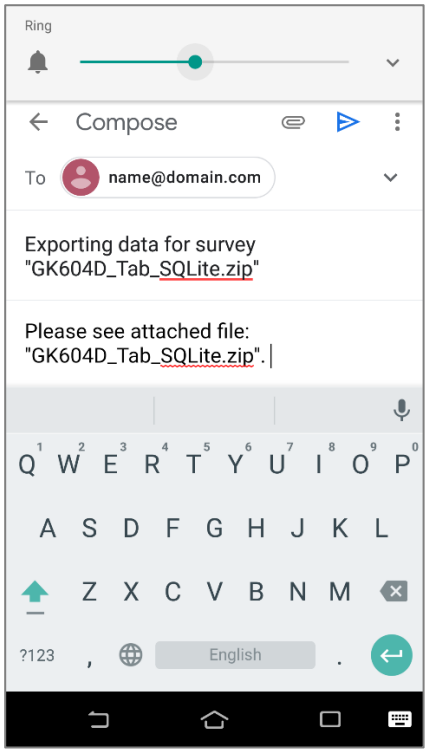


***Figure 44**: Email Composer*

8. PLOTS/REPORTS

When the "Plots/Reports" button is tapped (see Figure 6 & Section 4.1) the screen displayed in Figure 45 is shown. This screen is used to select the survey to view, set a report type, and change the report options. Click the icon to view the plot/report as a graphical or tabular report.

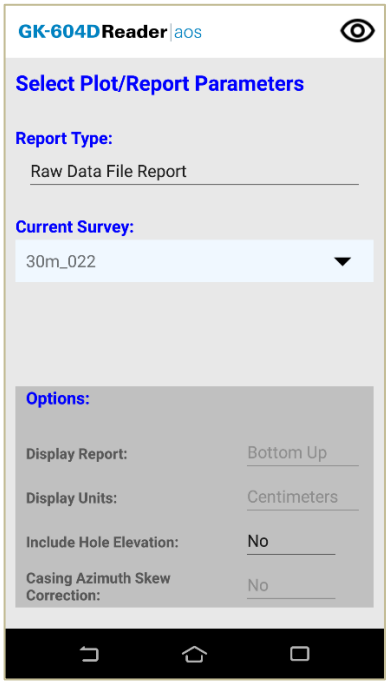


***Figure 45**: Plots/Reports Screen*

The survey or surveys are selected from rolling lists and, depending on the report type selected, requires the selection of one or two surveys. Deflection reports or plots require two surveys to generate the report or plot (see Figure 46).

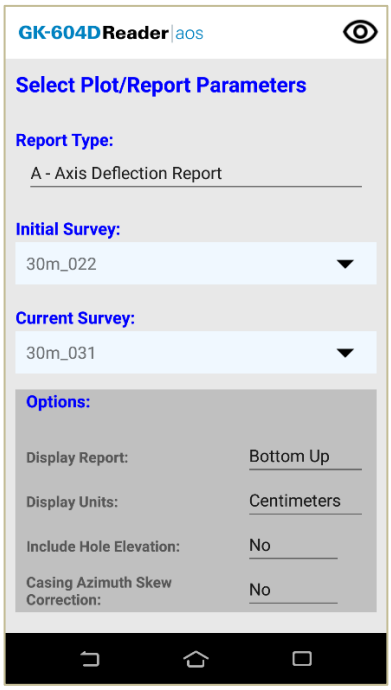


***Figure 46**: Two Surveys Selected*

Tapping on “Report Type” will open the window shown in Figure 47. The available report and plot types are described in the sub-sections below.

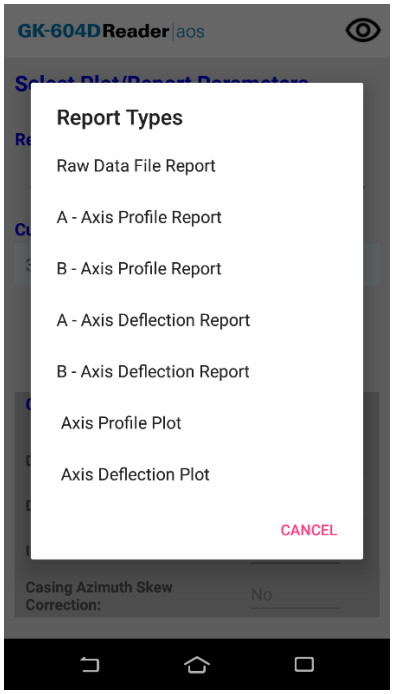


Figure 47: *Report Types List*

8.1 RAW DATA FILE REPORT

This selection will cause the selected “hole” raw data to be displayed in tabular form. Figure 48 shows the report as viewed on an Android device. The column and row data will scroll left and right and up and down so that all rows and columns can be seen. This report can be viewed in landscape or portrait mode.

Note: The column, “Cmps Hdg” will not be shown if the survey was not performed with the compass enabled. See Appendix B.1 for an example of a raw data report saved in text form.

Figure 48*: Raw Data Report (Landscape View)*

8.2 AXIS PROFILE REPORT

Selecting this option allows viewing of hole profile data for the A or B axis. The profile is calculated from the magnitude of the readings at each level (see Figure 49). This report lists the profile of the casing as calculated from the bottom of the casing upward or from the top down (see the “Options” pane in Figure 45). See Appendix B for an example of a profile report saved in text form.

This report can be viewed in landscape or portrait mode.

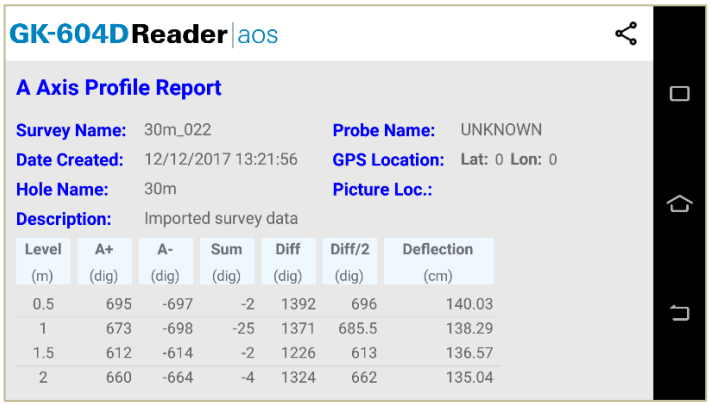


***Figure 49**: Profile Report (Landscape View)*

8.3 AXIS DEFLECTION REPORT

Selecting this option allows viewing of hole deflection data for the A or B axis. Deflection is determined from the accumulated change in deflection between the two selected data files at each level. This report lists the deflection of the casing as accumulated from the bottom of the casing upward or from the top down (see Figure **51**)

See Appendix B for an example of a deflection report saved in text form. The readings data portion of the report can be scrolled left and right to see different column set. This report also displays in Landscape view if the Android device supports it.

As initially displayed, the "Hole Data" header portion of the report is visible (see Website: www.GEOKON.com) The header can be scrolled up to see the metadata information for both the "Initial Data" and "Current Data" file. This report may also be saved in comma-separated value (.csv) format.

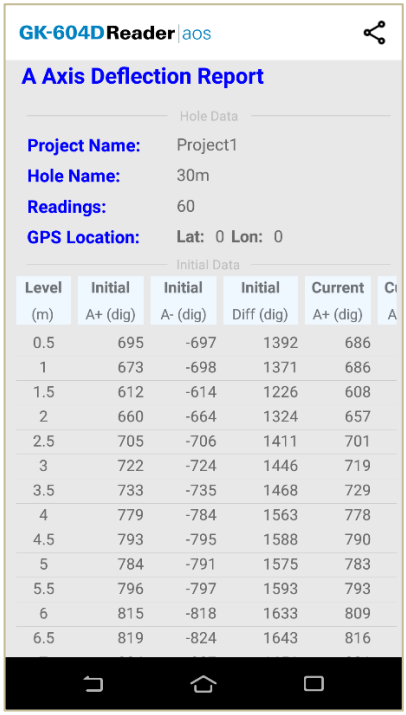


Figure 50: Deflection Report (Portrait View)

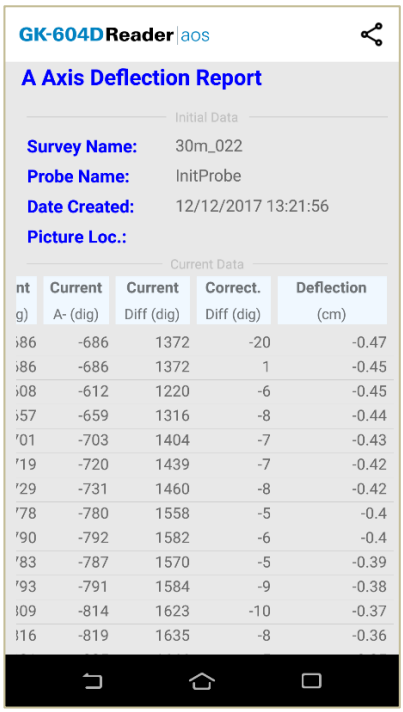


Figure 51: Deflection Report (Scrolled Left)

8.4 AXIS PROFILE PLOT

Selecting this option allows a graphical view of hole profile data and is useful for visualizing the actual installed characteristics (inclination, couplings, anomalies, etc.) of the casing. Figure 52 shows a typical profile plot for A and B axes. "Screen-shots" of plots may be saved in ".jpg" format.

This plot can also be displayed in Portrait view and scrolled left and right between A and B plots.

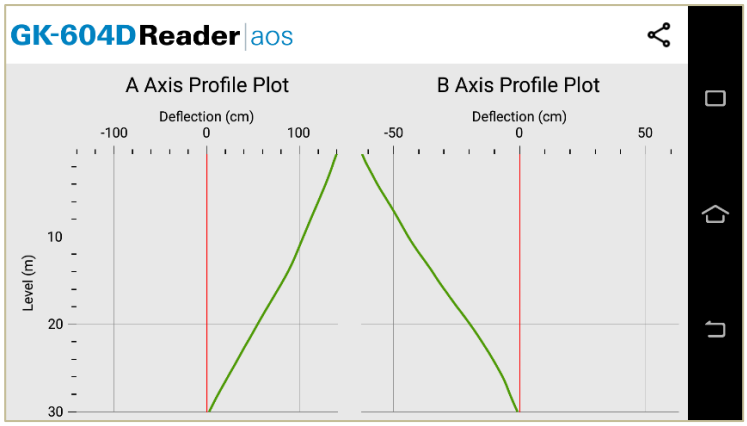


***Figure 52**: A & B Axis Profile Plot*

8.5 AXIS DEFLECTION PLOT

Selecting this option allows a graphical view of hole deflection data for both A and B axes and is useful for visualizing magnitude and direction of any movement of the borehole (see Figure 53). "Screen-shots" of graphical reports may be saved in ".jpg" format".

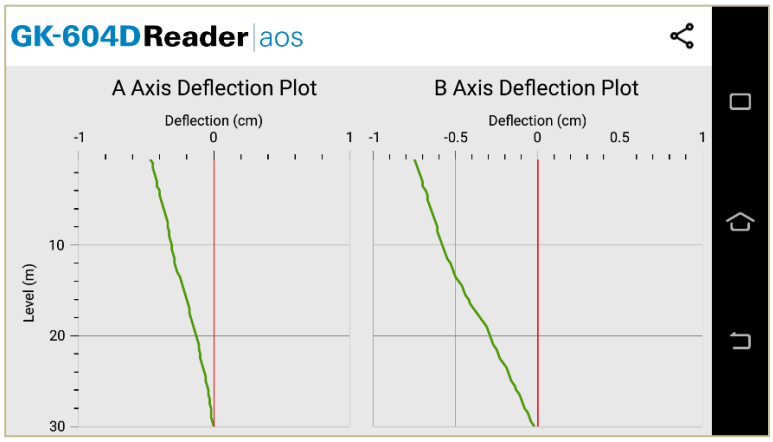


***Figure 53**: A & B Axis Deflection Plots*

In addition to saving reports and plots to the Android file system, each report or plot can also be emailed as attachment to the email address specified in Section 3.2.8. Much like when exporting data via email (see Section 7.2), the plot or CSV file is compressed into a "zip" file and then sent via email as an attachment (see Figure 44).

9. TERMINAL WINDOW PAGE

The Terminal Window Page allows commands to be sent to the digital reel and Inclinometer Probe to ensure that the system is functioning as it should. Figure 54 shows the Terminal Window Page prior to connection. To connect to the reel and probe, press the "Power On/Off" button on the reel, ensure that the (blue) light is blinking, then tap the "CONNECT" button. Figure 55 shows the Terminal Window Page after connection.

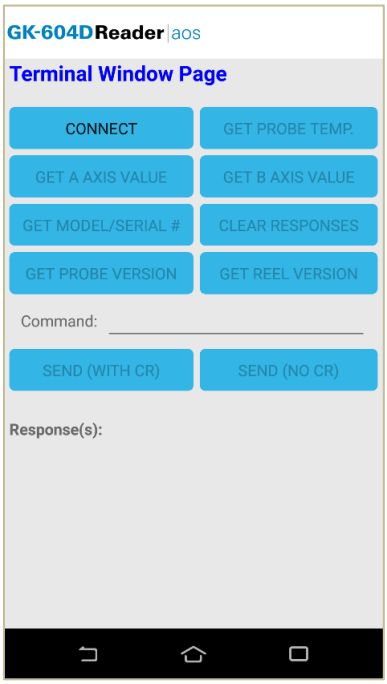


***Figure 54**: Terminal Window Page*

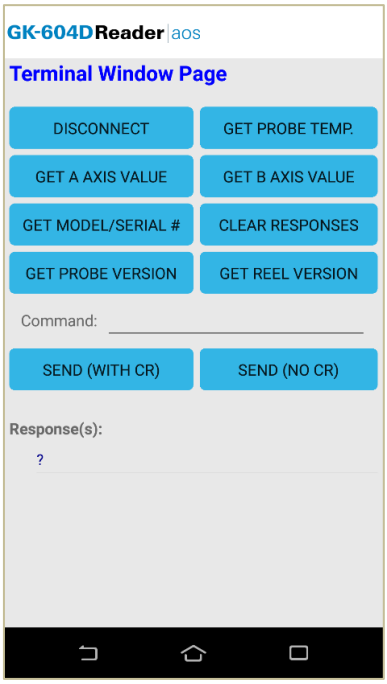


***Figure 55**: Terminal Window Page (Connected)*

Many of the available commands have buttons associated with them but it is also possible to enter the command directly in the field to the right of the "Command:" prompt, followed in most case by a "SEND CR" button tap. See Appendix C. for more information about commands.

10. DATABASE BACKUP

The Database Backup feature allows the GK-604DReader | aos database to be backed up to a folder of the user's choosing. When "Database Backup" is selected from the Main Screen Menu items (see Figure 7), an Android Folder Chooser is displayed (see Figure 56).

When the appropriate folder has been selected, tap the "SELECT" button and the GK-604D Reader app will make a copy of the current database and place it in the selected folder (see Figure 56). The Reader app will then return to the Main Screen (see Figure 6).

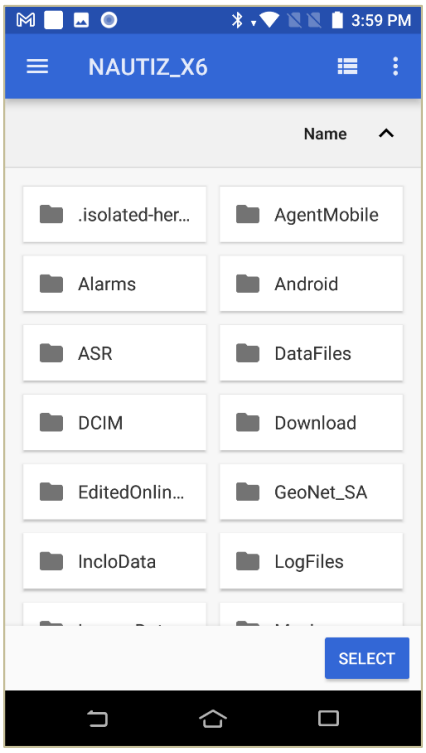


***Figure 56**: Android Folder Choose*

11. ABOUT GK-604D READER

When "About GK-604D Reader" is selected from the Main Screen Menu items (see Figure 7), an information screen is displayed giving copyright information as well as the application version (see Figure 57).

Tapping on the "Remote Module Status" button will display another screen reminding the user to press the "Power On" button (blue light blinking) before continuing (see Figure 58).

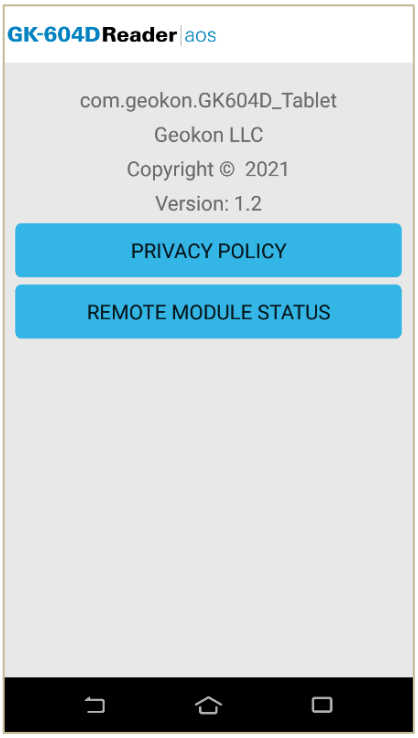


Figure 57: *About GK-604D Reader*

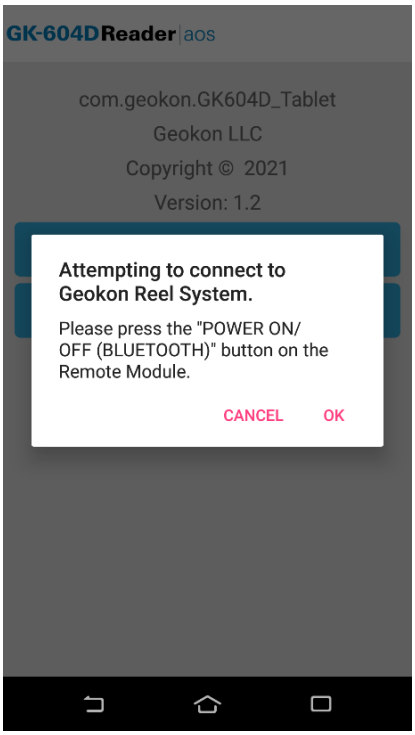


Figure 58*: Attempting to Connect Dialog*

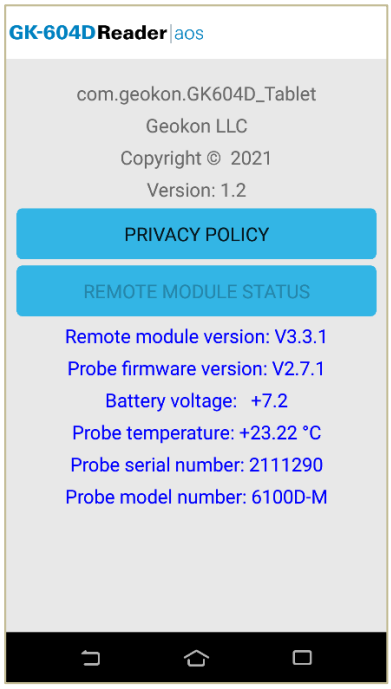


***Figure 59**: About GK-604D with Probe Status*

The full text of GEOKON's Privacy Policy can be read by tapping the "PRIVACY POLICY" button from the About GK-604D Reader screen(s) (see Figure 57 and Figure 59). GEOKON's Privacy Policy can also be accessed from our website at the following link:

https://www.GEOKON.com/Privacy

APPENDIX A. HOLE DATA GKN FILE FORMAT

***
GK 604M(v1.0.1.0,01/13);2.0;FORMAT II
PROJECT : myHoles
HOLE NO. : newHole
DATE: 01/02/13
TIME: 14:32:13
PROBE NO: testProbe
FILE NAME: newHole_001.gkn
#READINGS: 61
FLEVEL, A+, A-, B+, B-
30.0, 1013, -1052, -380, 320
29.5, 945, -985, -377, 315
29.0, 946, -981, -346, 290
28.5, 945, -978, -331, 276
28.0, 995, -1048, -337, 278
27.5, 1014, -1050, -318, 263
27.0, 1034, -1068, -316, 265
26.5, 1046, -1078, -348, 288
26.0, 1037, -1075, -376, 326
25.5, 1042, -1075, -415, 366
25.0, 1079, -1116, -430, 366
24.5, 1053, -1087, -440, 378
24.0, 1027, -1066, -449, 385
23.5, 1024, -1061, -477, 413
23.0, 1020, -1054, -474, 422
22.5, 1029, -1063, -500, 448
22.0, 1099, -1131, -485, 437
21.5, 1080, -1116, -503, 439
21.0, 1047, -1082, -514, 462
20.5, 1043, -1075, -518, 454
20.0, 1042, -1077, -527, 469
19.5, 1062, -1096, -542, 480
19.0, 1074, -1105, -551, 487
18.5, 1085, -1118, -553, 490
18.0, 1104, -1140, -572, 513
17.5, 1097, -1128, -541, 483
17.0, 1090, -1125, -549, 500
16.5, 1069, -1105, -545, 493
16.0, 1103, -1139, -567, 497
15.5, 1082, -1129, -566, 506
15.0, 1065, -1100, -553, 495
14.5, 1052, -1086, -529, 467
14.0, 1009, -1045, -519, 452
13.5, 956, -991, -534, 468
13.0, 899, -933, -558, 492
12.5, 841, -874, -557, 493
12.0, 800, -836, -568, 499
11.5, 778, -808, -547, 482
11.0, 755, -789, -522, 464
10.5, 752, -785, -489, 440
10.0, 754, -789, -465, 409
9.5, 766, -802, -433, 378
9.0, 769, -804, -429, 371
8.5, 765, -800, -435, 372
8.0, 762, -795, -442, 379
7.5, 785, -819, -441, 386
7.0, 811, -844, -456, 388
6.5, 809, -842, -450, 394
6.0, 802, -837, -472, 414
5.5, 786, -817, -464, 398
5.0, 776, -809, -475, 412
4.5, 788, -818, -468, 404
4.0, 777, -808, -447, 381
3.5, 707, -757, -435, 375
3.0, 707, -739, -408, 354
2.5, 686, -721, -407, 359
2.0, 647, -680, -413, 356
1.5, 608, -643, -412, 357
1.0, 559, -599, -359, 298
0.5, 564, -600, -361, 300
0.0, 565, -600, -359, 300

***Table 1**: Hole Data GKN File Format*

Note: The "DATE" value in the data file above is displayed in the "Short date" format from Regional Settings of the Nautiz. The "TIME"value in the data file above is always displayed as "HH:mm:ss".

APPENDIX B. TEXT REPORTS

B.1 RAW DATA TEXT REPORT

Hole Survey Raw Data Report					
	Project Name:	myHoles		Reading Date:	01/02/13
	Hole Name:	newHole		Reading Time:	14:32:13
	Top Elevation:	186.6		Probe Name:	testProbe
	File Name:	newHole_001.gkn			
LEVEL (M)	A+ (DIG.)	A- (DIG.)	B+ (DIG.)	B- (DIG.)	ELEV. (M)
0.5	564	-600	-361	300	186.1
1	559	-599	-359	298	185.6
1.5	608	-643	-412	357	185.1
2	647	-680	-413	356	184.6
2.5	686	-721	-407	359	184.1
3	707	-739	-408	354	183.6
3.5	707	-757	-435	375	183.1
4	777	-808	-447	381	182.6
4.5	788	-818	-468	404	182.1
5	776	-809	-475	412	181.6
5.5	786	-817	-464	398	181.1
6	802	-837	-472	414	180.6
6.5	809	-842	-450	394	180.1
7	811	-844	-456	388	179.6
7.5	785	-819	-441	386	179.1
8	762	-795	-442	379	178.6
8.5	765	-800	-435	372	178.1
9	769	-804	-429	371	177.6
9.5	766	-802	-433	378	177.1
10	754	-789	-465	409	176.6
10.5	752	-785	-489	440	176.1
11	755	-789	-522	464	175.6
11.5	778	-808	-547	482	175.1
12	800	-836	-568	499	174.6
12.5	841	-874	-557	493	174.1
13	899	-933	-558	492	173.6
13.5	956	-991	-534	468	173.1
14	1009	-1045	-519	452	172.6
14.5	1052	-1086	-529	467	172.1
15	1065	-1100	-553	495	171.6
15.5	1082	-1129	-566	506	171.1
16	1103	-1139	-567	497	170.6
16.5	1069	-1105	-545	493	170.1
17	1090	-1125	-549	500	169.6
17.5	1097	-1128	-541	483	169.1
18	1104	-1140	-572	513	168.6
18.5	1085	-1118	-553	490	168.1
19	1074	-1105	-551	487	167.6
19.5	1062	-1096	-542	480	167.1
20	1042	-1077	-527	469	166.6
20.5	1043	-1075	-518	454	166.1
21	1047	-1082	-514	462	165.6
21.5	1080	-1116	-503	439	165.1
22	1099	-1131	-485	437	164.6
22.5	1029	-1063	-500	448	164.1
23	1020	-1054	-474	422	163.6
23.5	1024	-1061	-477	413	163.1
24	1027	-1066	-449	385	162.6
24.5	1053	-1087	-440	378	162.1
25	1079	-1116	-430	366	161.6
25.5	1042	-1075	-415	366	161.1
26	1037	-1075	-376	326	160.6
26.5	1046	-1078	-348	288	160.1
27	1034	-1068	-316	265	159.6
27.5	1014	-1050	-318	263	159.1
28	995	-1048	-337	278	158.6
28.5	945	-978	-331	276	158.1
29	946	-981	-346	290	157.6
29.5	945	-985	-377	315	157.1
30	1013	-1052	-380	320	156.6

***Table 2**:* Raw Data Text Report

B.2 A-AXIS PROFILE DATA TEXT REPORT

Raw Data Report

Survey Name:	30m_022
Reading Date:	12/12/2017
Reading Time:	13:21:56
Hole Name:	30m
Probe Name:	UNKNOWN
Interval:	0.5 (m)

Level (m)	A+ (dig)	A- (dig)	B+ (dig)	B- (dig)	Checksum A (dig)	Checksum B (dig)	Compass Hdg (deg)
0.5	695	-697	-276	328	-2	52	150.3
1	673	-698	-275	328	-25	53	150.3
1.5	612	-614	-349	395	-2	46	138.3
2	660	-664	-342	397	-4	55	124.4
2.5	705	-706	-340	397	-1	57	174.6
3	722	-724	-337	396	-2	59	138.3
3.5	733	-735	-348	412	-2	64	310.6
4	779	-784	-368	422	-5	54	313
4.5	793	-795	-404	447	-2	43	182.8
5	784	-791	-413	453	-7	40	335.7
5.5	796	-797	-397	456	-1	59	318.9
6	815	-818	-409	461	-3	52	202.8
6.5	819	-824	-385	437	-5	52	112
7	824	-827	-379	434	-3	55	27.5
7.5	802	-806	-373	418	-4	45	254.9
8	784	-789	-371	419	-5	48	171.2
8.5	783	-789	-365	414	-6	49	335.2
9	788	-792	-362	416	-4	54	328.8
9.5	788	-792	-377	426	-4	49	137.4
10	776	-781	-407	448	-5	41	204.8
10.5	770	-776	-424	482	-6	58	78.7
11	773	-777	-445	499	-4	54	19.1
11.5	782	-785	-456	518	-3	62	176.4
12	804	-807	-488	533	-3	45	84.9
12.5	840	-844	-479	527	-4	48	135.8
13	900	-903	-473	519	-3	46	1.1
13.5	954	-960	-448	490	-6	42	281.3
14	1006	-1010	-424	466	-4	42	35.3
14.5	1053	-1058	-433	477	-5	44	342.6
15	1072	-1076	-457	509	-4	52	304.8
15.5	1107	-1110	-469	514	-3	45	247.5
16	1128	-1133	-478	534	-5	56	260.7
16.5	1096	-1104	-462	512	-8	50	261.8
17	1118	-1122	-483	537	-4	54	258.9
17.5	1120	-1121	-480	534	-1	54	259.4
18	1125	-1127	-518	564	-2	46	259.4
18.5	1097	-1103	-499	544	-6	45	258.8
19	1082	-1091	-496	538	-9	42	258.2
19.5	1075	-1079	-484	528	-4	44	257.3
20	1052	-1057	-475	512	-5	37	256.7
20.5	1051	-1051	-454	493		39	255.7
21	1060	-1062	-439	482	-2	43	254.9
21.5	1095	-1100	-430	472	-5	42	254.7
22	1115	-1118	-419	465	-3	46	254.7
22.5	1045	-1046	-424	479	-1	55	252.8
23	1041	-1042	-394	455	-1	61	252.2
23.5	1049	-1036	-391	432	13	41	252.3
24	1035	-1054	-381	428	-19	47	251.8
24.5	1064	-1065	-372	412	-1	40	251.2
25	1080	-1103	-358	408	-23	50	250.5
25.5	1069	-1050	-349	398	19	49	249.9
26	1054	-1056	-302	359	-2	57	249.2
26.5	1063	-1065	-269	318	-2	49	248.7
27	1058	-1056	-236	292	2	56	248.2
27.5	1032	-1034	-243	295	-2	52	247.7
28	1020	-1024	-271	313	-4	42	247
28.5	949	-950	-268	318	-1	50	246.2
29	954	-955	-282	336	-1	54	245.7
29.5	956	-961	-298	343	-5	45	245
30	1027	-1027	-304	350		46	245.5

***Table 3**: Axis A Profile Data Text Report*

B.3 B-AXIS PROFILE DATA TEXT REPORT

Report: B-Axis Change in Digits and Deflection in (cm) (Bottom Up)

Project Name:	Project1				
Hole Name:	30m				
Top Elevation:	0				
Azimuth Angle:	0				
Hole Location:	Lat:	0	Lon:	0	

Survey Name:	30m_022
Reading Date:	12/12/2017
Reading Time:	13:21:56
Probe Name:	UNKNOWN
Picture Name:	

Level (m)	B+ (dig)	B- (dig)	Sum (dig)	Diff (dig)	Diff/2 (dig)	Deflectio (cm)
0.5	-276	328	52	-604	-302	-62.53
1	-275	328	53	-603	-301.5	-61.77
1.5	-349	395	46	-744	-372	-61.02
2	-342	397	55	-739	-369.5	-60.09
2.5	-340	397	57	-737	-368.5	-59.16
3	-337	396	59	-733	-366.5	-58.24
3.5	-348	412	64	-760	-380	-57.33
4	-368	422	54	-790	-395	-56.38
4.5	-404	447	43	-851	-425.5	-55.39
5	-413	453	40	-866	-433	-54.32
5.5	-397	456	59	-853	-426.5	-53.24
6	-409	461	52	-870	-435	-52.18
6.5	-385	437	52	-822	-411	-51.09
7	-379	434	55	-813	-406.5	-50.06
7.5	-373	418	45	-791	-395.5	-49.04
8	-371	419	48	-790	-395	-48.06
8.5	-365	414	49	-779	-389.5	-47.07
9	-362	416	54	-778	-389	-46.1
9.5	-377	426	49	-803	-401.5	-45.12
10	-407	448	41	-855	-427.5	-44.12
10.5	-424	482	58	-906	-453	-43.05
11	-445	499	54	-944	-472	-41.92
11.5	-456	518	62	-974	-487	-40.74
12	-488	533	45	-1021	-510.5	-39.52
12.5	-479	527	48	-1006	-503	-38.24
13	-473	519	46	-992	-496	-36.99
13.5	-448	490	42	-938	-469	-35.75
14	-424	466	42	-890	-445	-34.57
14.5	-433	477	44	-910	-455	-33.46
15	-457	509	52	-966	-483	-32.32
15.5	-469	514	45	-983	-491.5	-31.12
16	-478	534	56	-1012	-506	-29.89
16.5	-462	512	50	-974	-487	-28.62
17	-483	537	54	-1020	-510	-27.4
17.5	-480	534	54	-1014	-507	-26.13
18	-518	564	46	-1082	-541	-24.86
18.5	-499	544	45	-1043	-521.5	-23.51
19	-496	538	42	-1034	-517	-22.21
19.5	-484	528	44	-1012	-506	-20.91
20	-475	512	37	-987	-493.5	-19.65
20.5	-454	493	39	-947	-473.5	-18.42
21	-439	482	43	-921	-460.5	-17.23
21.5	-430	472	42	-902	-451	-16.08
22	-419	465	46	-884	-442	-14.95
22.5	-424	479	55	-903	-451.5	-13.85
23	-394	455	61	-849	-424.5	-12.72
23.5	-391	432	41	-823	-411.5	-11.66
24	-381	428	47	-809	-404.5	-10.63
24.5	-372	412	40	-784	-392	-9.62
25	-358	408	50	-766	-383	-8.64
25.5	-349	398	49	-747	-373.5	-7.68
26	-302	359	57	-661	-330.5	-6.75
26.5	-269	318	49	-587	-293.5	-5.92
27	-236	292	56	-528	-264	-5.19
27.5	-243	295	52	-538	-269	-4.53
28	-271	313	42	-584	-292	-3.85
28.5	-268	318	50	-586	-293	-3.12
29	-282	336	54	-618	-309	-2.39
29.5	-298	343	45	-641	-320.5	-1.62
30	-304	350	46	-654	-327	-0.82

***Table 4**: Axis B Profile Data Text Report*

B.4 A-AXIS DEFLECTION DATA TEXT REPORT

Report: A-Axis Change in Digits and Deflection in (cm) (Bottom Up)

Project Name:	Project1							
Hole Name:	30m							
Top Elevation:	0							
Azimuth Angle:	0							
Hole Location:	Lat:	0	Lon:	0				
	--Initial Data--		--Current Data--					
Survey Name:	30m_022		30m_029					
Reading Date:	######		2/15/2018					
Reading Time:	13:21:56		10:34:01					
Probe Name:	UNKNOWN		UNKNOWN					
Picture Name:								

Level	--Initial (digits)--			--Current (digits)--			Corr.	Deflection
(m)	A+	A-	Diff.	A+	A-	Diff.	Diff.	(cm)
0.5	695	-697	1392	681	-693	1374	-18	-0.15
1	673	-698	1371	682	-693	1375	4	-0.13
1.5	612	-614	1226	604	-618	1222	-4	-0.13
2	660	-664	1324	652	-668	1320	-4	-0.13
2.5	705	-706	1411	698	-711	1409	-2	-0.12
3	722	-724	1446	713	-728	1441	-5	-0.12
3.5	733	-735	1468	725	-740	1465	-3	-0.11
4	779	-784	1563	773	-789	1562	-1	-0.11
4.5	793	-795	1588	786	-801	1587	-1	-0.11
5	784	-791	1575	779	-795	1574	-1	-0.11
5.5	796	-797	1593	788	-800	1588	-5	-0.11
6	815	-818	1633	805	-823	1628	-5	-0.1
6.5	819	-824	1643	810	-828	1638	-5	-0.09
7	824	-827	1651	817	-832	1649	-2	-0.09
7.5	802	-806	1608	795	-812	1607	-1	-0.09
8	784	-789	1573	777	-794	1571	-2	-0.08
8.5	783	-789	1572	776	-794	1570	-2	-0.08
9	788	-792	1580	782	-798	1580	0	-0.08
9.5	788	-792	1580	779	-799	1578	-2	-0.08
10	776	-781	1557	771	-788	1559	2	-0.08
10.5	770	-776	1546	764	-783	1547	1	-0.08
11	773	-777	1550	766	-781	1547	-3	-0.08
11.5	782	-785	1567	776	-793	1569	2	-0.08
12	804	-807	1611	797	-815	1612	1	-0.08
12.5	840	-844	1684	831	-850	1681	-3	-0.08
13	900	-903	1803	888	-906	1794	-9	-0.08
13.5	954	-960	1914	946	-964	1910	-4	-0.07
14	1006	-1010	2016	1000	-1017	2017	1	-0.06
14.5	1053	-1058	2111	1045	-1063	2108	-3	-0.06
15	1072	-1076	2148	1063	-1082	2145	-3	-0.06
15.5	1107	-1110	2217	1099	-1117	2216	-1	-0.05
16	1128	-1133	2261	1117	-1137	2254	-7	-0.05
16.5	1096	-1104	2200	1091	-1109	2200	0	-0.04
17	1118	-1122	2240	1110	-1128	2238	-2	-0.04
17.5	1120	-1121	2241	1113	-1129	2242	1	-0.04
18	1125	-1127	2252	1118	-1132	2250	-2	-0.04
18.5	1097	-1103	2200	1088	-1108	2196	-4	-0.04
19	1082	-1091	2173	1077	-1094	2171	-2	-0.04
19.5	1075	-1079	2154	1066	-1084	2150	-4	-0.03
20	1052	-1057	2109	1045	-1063	2108	-1	-0.03
20.5	1051	-1051	2102	1041	-1060	2101	-1	-0.03
21	1060	-1062	2122	1052	-1069	2121	-1	-0.02
21.5	1095	-1100	2195	1088	-1107	2195	0	-0.02
22	1115	-1118	2233	1109	-1127	2236	3	-0.02
22.5	1045	-1046	2091	1036	-1053	2089	-2	-0.03
23	1041	-1042	2083	1033	-1051	2084	1	-0.02
23.5	1049	-1036	2085	1040	-1035	2075	-10	-0.03
24	1035	-1054	2089	1028	-1062	2090	1	-0.01
24.5	1064	-1065	2129	1055	-1071	2126	-3	-0.02
25	1080	-1103	2183	1073	-1110	2183	0	-0.01
25.5	1069	-1050	2119	1060	-1055	2115	-4	-0.01
26	1054	-1056	2110	1045	-1063	2108	-2	-0.01
26.5	1063	-1065	2128	1056	-1072	2128	0	0
27	1058	-1056	2114	1050	-1062	2112	-2	0
27.5	1032	-1034	2066	1026	-1040	2066	0	0
28	1020	-1024	2044	1011	-1030	2041	-3	0
28.5	949	-950	1899	944	-957	1901	2	0
29	954	-955	1909	948	-963	1911	2	0
29.5	956	-961	1917	949	-966	1915	-2	0
30	1027	-1027	2054	1022	-1032	2054	0	0

***Table 5**: Axis A Deflection Data Text Report*

B.5 B-AXIS DEFLECTION DATA TEXT REPORT

Report: B-Axis Change in Digitz and Deflection in (cm) (Bottom Up)

Project Name:	Project1
Hole Name:	30m
Top Elevation:	0
Azimuth Angle:	0
Hole Location:	Lat: 0 Lon: 0

	--Initial Data--	--Current Data--
Survey Name:	30m_022	30m_029
Reading Date:	12/12/2017	2/15/2018
Reading Time:	13:21:56	10:34:01
Probe Name:	UNKNOWN	UNKNOWN
Picture Name:		

Level	--Initial (digitz)--			--Current (digitz)--			Corr.	Deflectio
(m)	B+	B-	Diff.	B+	B-	Diff.	Diff.	(cm)
0.5	-276	328	-604	-299	306	-605	-1	0
1	-275	328	-603	-299	306	-605	-2	0
1.5	-349	395	-744	-366	375	-741	3	0
2	-342	397	-739	-365	371	-736	3	0
2.5	-340	397	-737	-359	374	-733	4	-0.01
3	-337	396	-733	-355	374	-729	4	-0.01
3.5	-348	412	-760	-369	389	-758	2	-0.02
4	-368	422	-790	-393	399	-792	-2	-0.02
4.5	-404	447	-851	-421	419	-840	11	-0.02
5	-413	453	-866	-431	430	-861	5	-0.03
5.5	-397	456	-853	-425	431	-856	-3	-0.04
6	-409	461	-870	-427	440	-867	3	-0.03
6.5	-385	437	-822	-404	418	-822	0	-0.04
7	-379	434	-813	-403	411	-814	-1	-0.04
7.5	-373	418	-791	-396	395	-791	0	-0.04
8	-371	419	-790	-392	392	-784	6	-0.04
8.5	-365	414	-779	-389	391	-780	-1	-0.04
9	-362	416	-778	-385	395	-780	-2	-0.04
9.5	-377	426	-803	-397	407	-804	-1	-0.04
10	-407	448	-855	-425	431	-856	-1	-0.04
10.5	-424	482	-906	-447	460	-907	-1	-0.04
11	-445	499	-944	-466	485	-951	-7	-0.04
11.5	-456	518	-974	-483	494	-977	-3	-0.03
12	-488	533	-1021	-512	511	-1023	-2	-0.02
12.5	-479	527	-1006	-504	500	-1004	2	-0.02
13	-473	519	-992	-498	495	-993	-1	-0.02
13.5	-448	490	-938	-471	468	-939	-1	-0.02
14	-424	466	-890	-451	447	-898	-8	-0.02
14.5	-433	477	-910	-455	458	-913	-3	-0.01
15	-457	509	-966	-480	484	-964	2	-0.01
15.5	-469	514	-983	-490	496	-986	-3	-0.01
16	-478	534	-1012	-500	513	-1013	-1	-0.01
16.5	-462	512	-974	-483	500	-983	-9	0
17	-483	537	-1020	-505	522	-1027	-7	0.01
17.5	-480	534	-1014	-498	516	-1014	0	0.02
18	-518	564	-1082	-539	543	-1082	0	0.02
18.5	-499	544	-1043	-521	521	-1042	1	0.02
19	-496	538	-1034	-518	516	-1034	0	0.01
19.5	-484	528	-1012	-503	501	-1004	8	0.01
20	-475	512	-987	-490	489	-979	8	0
20.5	-454	493	-947	-477	469	-946	1	-0.01
21	-439	482	-921	-465	460	-925	-4	-0.01
21.5	-430	472	-902	-453	448	-901	1	0
22	-419	465	-884	-435	442	-877	7	0
22.5	-424	479	-903	-448	459	-907	-4	-0.01
23	-394	455	-849	-414	428	-842	7	-0.01
23.5	-391	432	-823	-411	409	-820	3	-0.02
24	-381	428	-809	-405	403	-808	1	-0.02
24.5	-372	412	-784	-395	391	-786	-2	-0.02
25	-358	408	-766	-381	385	-766	0	-0.02
25.5	-349	398	-747	-365	380	-745	2	-0.02
26	-302	359	-661	-321	339	-660	1	-0.02
26.5	-269	318	-587	-288	298	-586	1	-0.02
27	-236	292	-528	-262	270	-532	-4	-0.02
27.5	-243	295	-538	-264	276	-540	-2	-0.02
28	-271	313	-584	-289	296	-585	-1	-0.02
28.5	-268	318	-586	-288	300	-588	-2	-0.02
29	-282	336	-618	-300	317	-617	1	-0.01
29.5	-298	343	-641	-320	328	-648	-7	-0.01
30	-304	350	-654	-326	332	-658	-4	0

***Table 6**: Axis B Deflection Data Text Report*

B.6 COMPASS SURVEY DATA

```
***
GK 604M(v1.0,01/24);2.0;FORMAT II
PROJECT  :Project1
HOLE NO. :metric
DATE     :01/05/2024
TIME     :12:49:27
PROBE NO.:newProbe(6105)
FILE NAME:metric_047_Compass.GKS
#READINGS:17
FLEVEL,     A+,     A-,     B+,     B-
   8.0, 190.6,      0, 280.6,      0
   7.5, 187.0,      0, 277.0,      0
   7.0, 184.3,      0, 274.3,      0
   6.5, 182.6,      0, 272.6,      0
   6.0, 182.6,      0, 272.6,      0
   5.5, 180.0,      0, 270.0,      0
   5.0, 178.2,      0, 268.2,      0
   4.5, 178.2,      0, 268.2,      0
   4.0, 176.9,      0, 266.9,      0
   3.5, 176.0,      0, 266.0,      0
   3.0, 173.7,      0, 263.7,      0
   2.5, 174.2,      0, 264.2,      0
   2.0, 173.0,      0, 263.0,      0
   1.5, 174.2,      0, 264.2,      0
   1.0, 167.3,      0, 257.3,      0
   0.5, 167.6,      0, 257.6,      0
   0.0, 167.8,      0, 257.8,      0
```

***Table 7**: Compass Survey Data*

APPENDIX C. REMOTE MODULE COMMAND STRUCTURE

Command	Function	Syntax	Return Value
0	Take VA Reading		(+/-)#####
1	Take VB Reading		(+/-)#####
2	Take Battery Reading		<Sp><Sp>+#.#
3	Take -12v Reading[1]		<Sp>-12.0
4	Firmware Version[2]		Ver#.#
5	(See Note 3)		<Cr>
6	(See Note 3)		000<Sp><Sp><Sp>
7	Take +12v Reading[1]		<Sp>+12.0
8	Take +5v Reference Reading		<Sp><Sp>+#.#
9	Take 3.3v Reading[1]		<Sp><Sp>+3.3
D	Load Probe Defaults[4]		See Example D
G	Display Gauge Parameters[4]		See Example G2
G	Enter Gauge Parameters[4]	G70a/(Lorp)/#/#/# Or G70b/(Lorp)/#/#/# See Example G Below	See Example G1
T	Probe Temperature (°C)[4]		(+/-)##.####
V	Firmware Version (Remote Module)[4]		Ver #.#
#	Display Probe Serial #[4]		See Example #
#sn	Enter Probe Serial #[4,5]	#sn (16 Alphanumeric Characters Or Symbols)	See Example #sn

Table 8: *Remote Module Commands*

Notes:

1 These commands exist only for GK-604 analog systems and are included in the digital system for compatibility.

2 Firmware Version (Command 4) returns the Remote Module version for analog systems and the probe firmware version for digital systems.

3 Like Note1 but for internal use only.

4 These commands exist only for GK-604D digital system.

5 The command is not functional for the 6105-E and 6105-M probes. These parameters can only be set at the factory.

EXAMPLE 1: LOAD PROBE DEFAULTS

Loads probe default gauge parameters (calibration factors):

Command: D<CR>
Response: GT:70A ZR:0.0000 GF:1.0000 GO:0.0000 GT:70B ZR:0.0000 GF:1.0000 GO:0.0000

Channels VA and VB: Linear Conversion

Zero Read Offset = 0
Gauge Factor = 1
Gauge Offset = 0

Results in digits display = 2500(Vout)

EXAMPLE 2: ENTER GAUGE PARAMETERS

Enter and store gauge parameters for each axis:

A-axis: Linear Conversion
Zero Read Offset = 0
Gauge Factor = .62
Gauge Offset = 0

Command: G70A/L/0/.62/0<CR>
Response: GT:70A ZR:0.0000 GF:0.6200 GO:0.0000 GT:70B ZR:0.0000 GF:1.0000 GO:0.0000

B-axis: Linear conversion
Zero Read Offset = 0
Gauge Factor = 1.005
Gauge Offset = 0

Command: G70B/L/0/1.005/0<CR>
Response: GT:70A ZR:0.0000 GF:0.6200 GO:0.0000 GT:70B ZR:0.0000 GF:1.005 GO:0.0000

EXAMPLE 3: DISPLAY GAUGE PARAMETERS

Display gauge parameters stored in the probe:

Command: G<CR>
Response: GT:70A ZR:0.0000 GF:0.6200 GO:0.0000 GT:70B ZR:0.0000 GF:1.005 GO:0.0000

EXAMPLE 4: DISPLAY PROBE SERIAL NUMBER

Display the serial number that is stored in the probe:

Command: #<CR>
Response: 6105/6100D-E,126543

EXAMPLE 5: ENTER PROBE SERIAL NUMBER

Note: The GK-604D Reader Application uses the serial number to determine the inclinometer probe units (metric or English) by reading the model number portion of the serial number string (the part to the left of the comma). If the model number does not contain an "-E" or a "–M" then unpredictable results may occur.

Enter and store probe serial number:
(Up to 16 alphanumeric characters and symbols may be stored.)

Command: #sn6100D-E,126543<CR>
Response: 6100D-E,126543

APPENDIX D. DATA REDUCTION FORMULAS

D.1 DEFLECTION CALCULATIONS

D.1.1 Deflection Calculations for 6000, 6100 and 6100D probes

Label	Description
ZZ	Correction Angle (usually 0)
RINT	Absolute Reading Interval in feet or meters
IA+, IA-	Initial A-axis Data in Digits (2sinθ=10000 @ 30, 2.5sinθ=12500 @ 30)
PA+, PA-	Present A-axis Data in Digits (2sinθ=10000 @ 30, 2.5sinθ=12500 @ 30)
IB+, IB-	Initial B-axis Data in Digits (2sinθ=10000 @ 30, 2.5sinθ=12500 @ 30)
PB+, PB-	Present B-axis Data in Digits (2sinθ=10000 @ 30, 2.5sinθ=12500 @ 30)
SA	Calculated Digit Change for A-axis
SB	Calculated Digit Change for B-axis
M	Multiplier, where: GEOKON probe Sinco Probe configuration 2sinθ 2.5sinθ Metric units, millimeters 0.05 0.04 Metric units, centimeters 0.005 0.004 Imperial units, inches 0.0006 0.00048
CA	Deflection A (in inches, English units, not corrected) Deflection A (in centimeters or millimeters, Metric units, not corrected)
CB	Deflection B (in inches, English units, not corrected) Deflection B (in centimeters or millimeters, Metric units, not corrected)
DA	Deflection A (in inches, English units, corrected for angle) Deflection A (in centimeters or millimeters, Metric units, corrected for angle)
DB	Deflection B (in inches, English units, corrected for angle) Deflection B (in centimeters or millimeters, Metric units, corrected for angle)
cos	Cosine function
sin	Sine function

***Table 9**: Data Reduction Variables (Deflection)*

$$SA = ((PA+) - (PA-))/2 - ((IA+) - (IA-))/2$$
$$SB = ((PB+) - (PB-))/2 - ((IB+) - (IB-))/2$$

***Equation 1:** Change in Digits Calculation (Deflection) (6100D)*

$$CA = M \times RINT \times SA$$
$$CB = M \times RINT \times SB$$
$$DA = (CA \times \cos(ZZ)) - (CB \times \sin(ZZ))$$
$$DB = (CA \times \sin(ZZ)) + (CB \times \cos(ZZ))$$

***Equation 2:** Deflection Calculation (6100D)*

Note: Accumulate (Σ) DA and DB results at each depth increment (from the bottom up or the top down) to obtain the deflection change (see Table 5).

D.1.2 Deflection Calculations for 6105 probes

Label	Description
ZZ	Correction Angle (usually 0)
RINT	Absolute Reading Interval in feet or meters
IA+, IA-	Initial A-axis Data in Digits
PA+, PA-	Present A-axis Data in Digits
IB+, IB-	Initial B-axis Data in Digits
PB+, PB-	Present B-axis Data in Digits
SA	Calculated Digit Change for A-axis
SB	Calculated Digit Change for B-axis
DM	Digits Multiplier = 2500
M	Multiplier (1000 for millimeters, 100 for centimeters, 12 for inches)
DGV	Degrees per Volt = 0.133333
Θ_A	Degrees of deflection for Axis A
Θ_B	Degrees of deflection for Axis B
CA	Deflection A (in inches, English units, not corrected) Deflection A (in centimeters or millimeters, Metric units, not corrected)
CB	Deflection B (in inches, English units, not corrected) Deflection B (in centimeters or millimeters, Metric units, not corrected)
DA	Deflection A (in inches, English units, corrected for angle) Deflection A (in centimeters or millimeters, Metric units, corrected for angle)
DB	Deflection B (in inches, English units, corrected for angle) Deflection B (in centimeters or millimeters, Metric units, corrected for angle)
cos	Cosine function
sin	Sine function

***Table 10**: Data Reduction Variables (Deflection) (6105)*

$SA = ((PA+) - (PA-))/2 - ((IA+) - (IA-))/2$

$SB = ((PB+) - (PB-))/2 - ((IB+) - (IB-))/2$

$\Theta_A = SA / (DM * DGV)$

$\Theta_B = SB / (DM * DGV)$

Equation 3: *Degrees of Deflection Calculation (6105)*

$CA = RINT * \sin(\Theta_A * (PI/180)) * M$

$CB = RINT * \sin(\Theta_B * (PI/180)) * M$

$DA = (CA \times \cos(ZZ)) - (CB \times \sin(ZZ))$

$DB = (CA \times \sin(ZZ)) + (CB \times \cos(ZZ))$

Equation 4: *Deflection (inches, mm or cm) Calculation (6105)*

Note: Accumulate (Σ) DA and DB results at each depth increment (from the bottom up or the top down) to obtain the deflection change (see Table 5).

D.2 PROFILE CALCULATIONS

D.2.1 Profile Calculations for 6000, 6100 and 6100D probes

Label	Description
ZZ	Correction Angle (usually 0)
RINT	Absolute Reading Interval in feet or meters
A+, A-	A-axis Data in Digits (2sinθ=10000 @ 30, 2.5sinθ=12500 @ 30)
B+, B-	B-axis Data in Digits (2sinθ=10000 @ 30, 2.5sinθ=12500 @ 30)
SA	Calculated Digit Change for A-axis
SB	Calculated Digit Change for B-axis
M	Multiplier, where: GEOKON probe Sinco Probe configuration 2sinθ 2.5sinθ Metric units, millimeters 0.05 0.04 Metric units, centimeters 0.005 0.004 Imperial units, inches 0.0006 0.00048
CA	Deflection A (in inches, English units, not corrected) Deflection A (in centimeters or millimeters, Metric units, not corrected)
CB	Deflection B (in inches, English units, not corrected) Deflection B (in centimeters or millimeters, Metric units, not corrected)
DA	Deflection A (in inches, English units, corrected for angle) Deflection A (in centimeters or millimeters, Metric units, corrected for angle)
DB	Deflection B (in inches, English units, corrected for angle) Deflection B (in centimeters or millimeters, Metric units, corrected for angle)
cos	Cosine function
sin	Sine function

Table 11*: Data Reduction Variables (Profile)*

$SA = ((A+) - (A-))/2$

$SB = ((B+) - (B-))/2$

Equation 5: *Change in Digits Calculation (Profile)*

$CA = M \times RINT \times SA$

$CB = M \times RINT \times SB$

$DA = (CA \times \cos(ZZ)) - (CB \times \sin(ZZ))$

$DB = (CA \times \sin(ZZ)) + (CB \times \cos(ZZ))$

Equation 6*: Profile Calculation*

Note: Accumulate (Σ) DA and DB results at each depth increment (from the bottom up or the top down) to obtain the profile.

D.2.2 Profile Calculations for 6105 probes

Label	Description
ZZ	Correction Angle (usually 0)
RINT	Absolute Reading Interval in feet or meters
A+, A-	A-axis Data in Digits
B+, B-	B-axis Data in Digits
SA	Calculated Digit Change for A-axis
SB	Calculated Digit Change for B-axis
DM	Digits Multiplier = 2500
M	Multiplier (1000 for millimeters, 100 for centimeters, 12 for inches)
DGV	Degrees per Volt = 0.133333
CB	Deflection B (in inches, English units, not corrected) Deflection B (in centimeters or millimeters, Metric units, not corrected)
DA	Deflection A (in inches, English units, corrected for angle) Deflection A (in centimeters or millimeters, Metric units, corrected for angle)
DB	Deflection B (in inches, English units, corrected for angle) Deflection B (in centimeters or millimeters, Metric units, corrected for angle)
cos	Cosine function
sin	Sine function

***Table 12**: Data Reduction Variables (Profile) (6105)*

$$SA = ((A+) - (A-))/2$$
$$SB = ((B+) - (B-))/2$$
$$\Theta_A = SA / (DM * DGV)$$
$$\Theta_B = SB / (DM * DGV)$$

***Equation 7:** Change in Degrees Calculation (Profile) (6105)*

$$CA = RINT * \sin(\Theta_A * (PI/180)) * M$$
$$CB = RINT * \sin(\Theta_B * (PI/180)) * M$$
$$DA = (CA \times \cos(ZZ)) - (CB \times \sin(ZZ))$$
$$DB = (CA \times \sin(ZZ)) + (CB \times \cos(ZZ))$$

***Equation 8**: Profile Calculation (6105)*

Note: Accumulate (Σ) DA and DB results at each depth increment (from the bottom up or the top down) to obtain the profile.

D.3 GTILT USERS

When using GTILT with the GK-604D data files, use a Probe Constant of 10000 for both English and Metric "2.0sin" probes. For 2.5sin Units (Sinco) use a Probe Constant of 12500.

D.4 SITEMASTER USERS

When using SiteMaster with the GK-604D, use a Probe Constant of 20000 for both English and Metric probes.

GEOKON

GEOKON
48 Spencer Street
Lebanon, New Hampshire
03766, USA

Phone: +1 (603) 448-1562
Email: info@GEOKON.com
Website:
www.GEOKON.com

GEOKON
is an **ISO 9001:2015**
registered company