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Instruction Manual

Model GK-403

Vibrating Wire Readout

(Doc Rev P, 4/2013)

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1. INTRODUCTION

The GK-403 Vibrating Wire Readout provides precise measurements of vibrating wire instruments with increased flexibility over similar instruments. The GK-403 provides complete compatibility with the GK-401 readout, but with many enhancements:

- Larger, multi-line backlit LCD Display
- 5 digit readout of vibrating wire measurements
- Temperature readout (in Celsius units)
- Two modes (A-F and G) of data acquisition and storage
- Internal real-time clock
- Battery-backed clock and memory
- Serial communications port for remote operations and transfer of data to computer
- Easy-to-use control panel

A major feature of the GK-403 is its ability to allow the user to customize nearly every aspect of the instrument's measurement and display functions. The user can:

a. Enter any values for the parameters used if calculating the vibrating wire reading (calibration factor(k), zero reading, and offset)
b. Enter an identifier name (up to 10 characters) for each vibrating wire sensor (up to 256)
c. Enter the units (up to 3 characters) for the vibrating wire readings display
d. Select various parameters used in exciting the vibrating wire sensor to optimize performance

The GK-403 was designed primarily as an easy-to-use readout instrument. The novice and occasional user will find it very simple to operate. Taking readings, storing new data, and viewing old data are all one keystroke operations.

1.1 Front Panel Controls

The front panel of the GK-403 provides the following features:

a. 15 column x 8 line LCD.
b. TRANSDUCER connector.
c. Battery CHARGER connector.
d. ON/OFF switch.
e. I/O connector (RS-232 communication port).
f. 7 position rotary switch (DISPLAY) to select local display mode (A-F are GK-401 compatible).
g. Joystick, for option selection and cursor movement.
h. Two push buttons for selection of options and data storage (MENU/ESCAPE and SELECT/STORE).

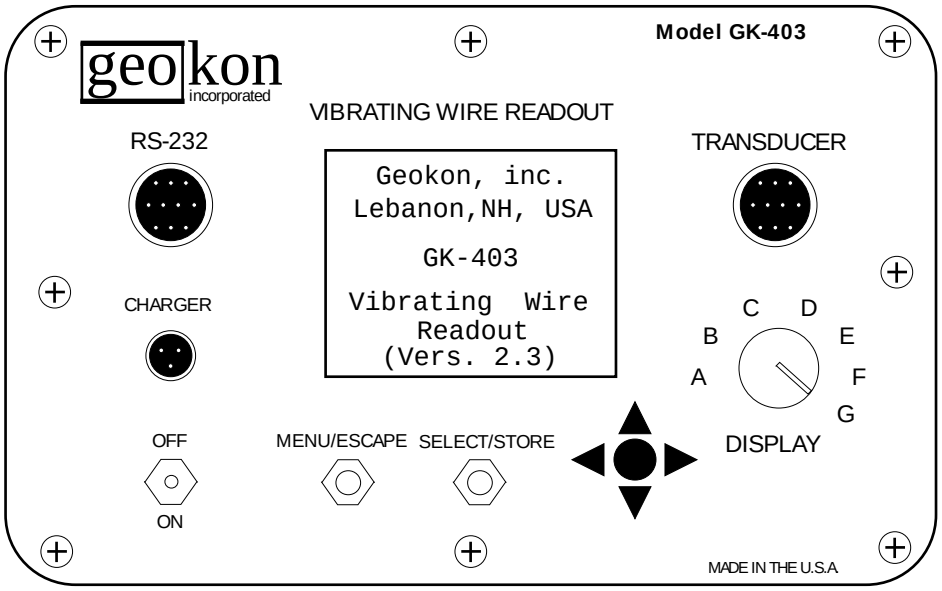


Figure 1 - GK-403 Front Panel

1.2 Getting Started

The GK-403 Vibrating Wire Readout should arrive with a patchcord for connecting to the vibrating wire gages. One end will consist of a 10 pin plug for connecting to the respective socket on the faceplate of the GK-403. The other end will consist of 4 or 5 leads terminated with alligator clips. The 4 lead clip is used for convenience when the box is used in areas of low electro-magnetic noise. The 5 lead clip has an additional shield which is connected to the shield wire from the vibrating wire gage cable. Note the colors of the alligator clips are red, black, green, white, and blue. The colors represent the positive vibrating wire gage lead, negative vibrating wire gage lead, positive thermistor lead, negative thermistor lead, and drain wire (shield) lead, respectively. The clips would be connected to their respectively colored leads from the vibrating wire gage cable. In the absence of the blue clip on the 4 clip set the gage cable drain wire (bare) may be connected to the black or green clip.

In the case of connecting the GK-403 leads to direct burial cable (brand Rex) the red lead would connect to the orange wire from the gage, the black lead to the blue wire, the white lead to the white with orange, the green lead to the white with blue, and the shield lead to the aluminum sheath.

Pulling down on the ON/OFF switch turns the unit on. Upon power-up the GK-403 performs several internal systems tests. It checks its battery-backed memory for lost data, the battery voltage, and the real-time clock. While these tests are being done, the LCD displays a title screen (see Figure 2) and the status of the systems test. These tests normally take less than a second to perform, but if any test fails, a warning message will be displayed for several seconds. See Appendix E for descriptions on the possible warning messages and corrective action.

After approximately 1 second, the GK-403 will start taking readings and process and display them based on the setting of the DISPLAY MODE selector. No special action needs to be taken; the GK-403 will continue to make measurements and display the results until automatic power-off caused by;

a. The user turns the power switch off, or
b. no front panel activity occurs for 2 minutes.

If the DISPLAY MODE selector is on positions A-F see Section 2 for an explanation of modes A-F. If the DISPLAY MODE selector is on position G see Section 3 for an explanation of mode G.

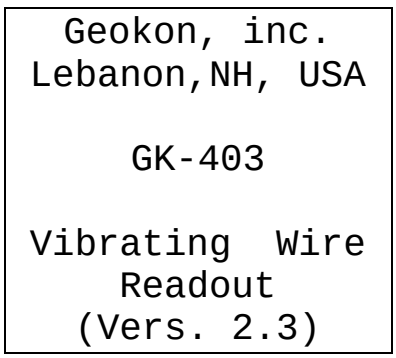


Figure 2 - Power-Up Display

2. MODES A-F

2.1 Readings Display

With the DISPLAY MODE selector in positions A-F the readout will display its vibrating wire and temperature output in large (.6 inch) characters. It will also display the date and time, a REFerence number (REF,1-256), the DISPLAY MODE selection (SWPOS, A-F), and the default units of the reading.

Each DISPLAY MODE option (A-F) has different preprogrammed parameters which are optimized for certain instruments. Each option also has different scaling and processing characteristics. See Table 1 to determine the best choice for your sensors.

DISPLAY MODE	Use with Geokon Model No.	Calculation	Units	Frequency Sweep (Hz)
A	all	period, T* in μseconds	μseconds*	450-6000
B	4300BX,4400, 4500,4600,4700, 4800,4900	$F^2 \times 10^{-3}$	Digits	1200-3500
C	4000	$F^2 \times 10^{-3} \times 4.062$	μStrain (ε)	450-1000
D	4200	$F^2 \times 10^{-3} \times 3.304$	μStrain (ε)	450-1000
E	4100	$F^2 \times 10^{-3} \times 0.39102$	μStrain (ε)	1000-3500
F	4300EX	$F^2 \times 10^{-3}$	Digits	2500-6000

where;

T = Period
F = Frequency in Hertz

*In DISPLAY MODE position G SWITCH POS A outputs the same as B

Table 1 - DISPLAY MODE options (A-F)

2.2 Reading Storage

Memory for Modes A-F can simply be understood as a single dimensional format. Each vibrating wire gage reading is stored with a REFerence number to indicate its position in the single dimension. This REFerence number ranges from 1 to 256, giving a maximum number of readings stored in Modes A-F of 256. Stored with the gage reading and the appropriate REFerence number are the Julian day, time (24 hour format), temperature, and switch POSition (1-6 representing DISPLAY MODE A-F, respectively).

See Appendix C.1 for a Modes A-F sample data file.

2.3 Modes A-F Front Panel Controls

The controls on the front panel take on these functions:

▲ ▼ **:** Scrolls through the available REFerence numbers (1 dimensional data storage).

◀ ▶ **:** Views the data stored with the selected REFerence number. Shows stored date, time, temperature, vibrating wire reading, and DISPLAY MODE setting when readings were stored. (Blank readings indicate nothing was stored.)

SELECT/STORE: Stores the current readings in memory with the currently displayed REFerence number. Also stores the time, date, and DISPLAY MODE selection. This action will overwrite any previously stored data. The REFerence indicator may be updated depending on the auto increment selection (Section 2.7).

MENU/ESCAPE: Displays main option menu.

The main option menu in modes A-F is as follows:

```
  A-F Main Menu
  1.Send Data
  2.Clear Data
  3.Set Date/Clk
  4.Auto Incrmt


 Select Option?
```

Figure 3 - Modes A-F Main Menu

Pushing ▲ ▼ will advance through these options. When the desired option is reached (indicated by the number being in reverse video) press SELECT/STORE to select. Each selection will be explained in the following sections.

2.4 Send Data

Selection of this option will subsequently send all the Modes A-F data currently stored in memory. In Modes A-F there is a possibility of 256 readings. Each reading would include the REFerence number, day, time, temperature, switch POSition, as well as the actual gage reading (collectively called an array). See Appendix C.1 for a Modes A-F sample data file.

The units of the stored reading would depend on the switch POSition (DISPLAY MODE) when the reading was taken. See Section 2.1 for further information on the units and DISPLAY MODE setting.

The receiving computer should be powered, on-line, and waiting for the data **BEFORE** depressing the SELECT/STORE button with the Send Data option selected. See Appendix H for information on IBM compatible Personal Computer configuration and Hyperterminal to receive files.

Pressing MENU/ESCAPE after selecting Send Data will abort the transmission. Upon transmitting all its Modes A-F data (or aborting) the user will be returned to the Modes A-F Main Menu. Pressing MENU/ESCAPE will return the user to the readings display.

2.5 Clear Data

As the name suggests, this option allows the user to clear all of its Modes A-F storage. Press SELECT/STORE to continue with the clearing, or MENU/ESCAPE to abort. **ONLY Modes A-F data will be cleared with this option!** Upon clearing memory (or escaping) the user will be returned to the Modes A-F Main Menu. Pressing MENU/ESCAPE will return the user to the readings display.

2.6 Set Date/Clk

Used to set the date and clock information of the GK-403. Normally this option need only be used when first receiving the readout to adjust to local time, to periodically make minor monthly corrections to the date and/or time, or for daylight savings adjustments.

First the user will be asked to modify the date. Scroll through the date components (month:day:year) using ◄ ► and adjust them accordingly using ▲ ▼. When finished, press SELECT/STORE to accept and advance to the time entry. Press MENU/ESCAPE to abort the option and return to the Modes A-F Main Menu. Scroll through the time components (hour:minutes) using ◄ ► and adjust them accordingly using ▲ ▼. When finished, press SELECT/STORE to accept and return to the Modes A-F Main Menu. Press MENU/ESCAPE to return to the readings display.

2.7 Auto Incrmt

This option allows the user to AUTOmatically INCReMenT the REFerence designator of the gage reading. Using ▲ ▼ select option 1 for no increment or 2 for an INCReMenT of 1 after storing the gage reading. Press SELECT/STORE to accept the selection or MENU/ESCAPE to abort. Upon returning to the Modes A-F Main Menu press MENU/ESCAPE to return to the readings display.

The +1 INCReMenT is useful where the user is connected to a large terminal box where measurements will be made sequentially on a large number of gages. It can eliminate having to toggle ▲ ▼ after each gage is read to increment the REFerence designator.

3. MODE G

3.1 Readings Display

With the DISPLAY MODE selector in position G, the readout displays the information in normal (small) characters. It shows both the current and stored measurements simultaneously. Screen will look as below:

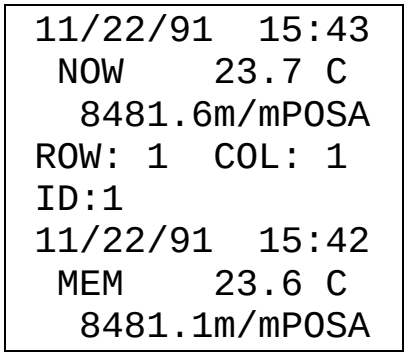


Figure 4 - Mode G Readings Display

The top three lines of the display represent the current (NOW) date, time, temperature, vibrating wire reading, and switch POSition. The three characters(m/m) to the right of the vibrating wire gage reading is the default units descriptor. This can be modified by the user for each vibrating wire sensor (1-256). See Section 3.8.6 for additional information on the switch POSition.

ROW and COL indicate the currently active ROW and COLumn in storage memory.

ID indicates the user defined code associated with the active COLumn. Default ID is equal to the COLumn number.

The bottom three lines of the display represent the stored (MEM) date, time, temperature, vibrating wire reading, and switch POSition used at the time of measurement.

If no readings are stored at the current ROW/COLumn setting, the following will display:

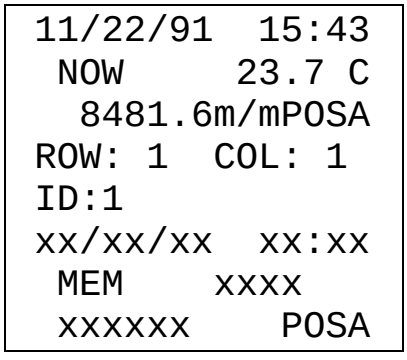


Figure 5 - Mode G Readings Display (no readings)

3.2 Reading Storage

Readings in Mode G are stored using a 2-dimensional format. It can be visualized as follows:

ROWs (1-256)	COLumns (1-256)								
	1	2	3	4	5	. . .	256
1	x	x	x	x	x	. . .	x
2	x	x	x	x	x	. . .	x
3	x	x	x	x	x	. . .	x
4	x	x	x	x	x	. . .	x
5	x	x	x	x	x	. . .	x
.	.	.	.	.	.		.
.	.	.	.	.	.		.
.	.	.	.	.	.		.
256	x	x	x	x	x	. . .	x

Table 2. 2-Dimensional Storage

ROWs would represent the readings taken for all the vibrating wire sensors at a particular time. Each gage reading is itself part of an array consisting also of the ROW and COLumn headings, date, time, temperature, and switch POSition. Normally, when the user takes readings in the field on a number of different sensors at the same time, the ROW designation would be used to isolate one set of readings from another. The ROWs value ranges between 1 and 256, allowing the user to store up to 256 sets of readings.

COLumns would represent the readings for a particular vibrating wire gage. Also associated with the COLumn number is a particular gages calibration Factor, Zero reading, Offset, Switch POSition, ID value and Units designator. Changing the COLumn position will apply a new set of values (Factor, Zero, Offset, Switch POSition, ID, Units) to the raw vibrating wire gage reading. Section 3.3 will explain how to change the COLumn setting in the course of use. The COLumns value also ranges between 1 and 256, allowing the user to enter up to 256 sets of sensor information (Factors, Zero, Offset, Switch POSitions, ID's, Units).

COLumn information can be modified using the control panel (Section 3.7) or via the RS-232 port (see Appendix I).

The x's represent the intersection of ROWs and COLumns where readings are stored.

3.3 Mode G Front Panel Controls

The controls on the front panel provide the following functions:

▲ ▼**:** Increments/Decrements the active ROW (1-256). Any stored data for the ROW (MEM) is shown.

◀ ▶**:** Increments/Decrements the active COLumn (1-256). Any stored data (MEM) is shown.

SELECT/STORE: Stores the current reading (at the current ROW/COLumn settings). The vibrating wire gage reading is stored as well as the temperature, date, and time. This action will overwrite any previously stored data at that ROW/COLumn.

MENU/ESCAPE: Displays Mode G main option menu.

The Mode G main option menu is as follows:

```
  G Main Menu
 1.Send Data
 2.Clear Data
 3.Set Date/Clk
 4.Auto Incrmt
 5.Gage Params

Select Option?
```

Figure 6 - Mode G Main Menu

Pushing ▲ ▼ will advance through the options When the desired option is reached (indicated by the number being in reverse video) press SELECT/STORE to select. The Mode G Main Menu is very similar to the Modes A-F Main Menu with the exception of the addition of option 5 (Gage Params). The other options are more involved in Mode G though. Each option will be explained in detail in the following sections.

3.4 Send Data

Selecting this option invokes the following menu:

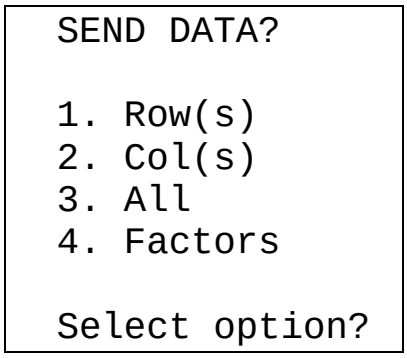


Figure 7 - Mode G Send Data Menu

Following are the sub-option explanations:

3.4.1 Row(s) allows the user to transmit sets of readings from all the gages read. Each reading in the set would include the ROW and COLumn designators, day, time, temperature, and switch POSition. See Appendix C.2 for a Mode G sample data file.

Selecting this option will bring up a screen that informs the user of the START and END ROW. The default STARTing ROW would be the ROW as indicated in the Mode G readings display. To change this default, exit back out to the Mode G readings display (press MENU/ESCAPE thrice) and toggle ▲ ▼ to the appropriate ROW.

The default END ROW matches that of the START, therefore only the current ROW will be transmitted. To modify the END ROW, toggle ▲ ▼. Press SELECT/STORE to transmit based on the START and END ROW parameters.

The receiving computer should be powered, on-line, and waiting for the data **BEFORE** depressing the SELECT/STORE button with the Send Data, Row(s) option selected. See Appendix H for information on IBM or compatible Personal Computer configuration and use of Hyperterminal to receive files.

Pressing MENU/ESCAPE after SELECTing START and END ROWs will abort the transmission. Upon transmitting all its Mode G data (or aborting) the user will be returned to the Mode G Send Data menu. Pressing MENU/ESCAPE will return the user to the Mode G Main Menu. Press MENU/ESCAPE again to return to the Mode G readings display.

3.4.2 Col(s) allows the user to transmit all the readings from a particular gage read. Each reading in the set would include the ROW and COLumn designators, day, time, temperature, and switch POSition. See Appendix C.2 for a Mode G sample data file.

Selecting this option will bring up a screen that informs the user of the START and END COLumn. The default STARTing COLumn would be the COLumn as indicated in the Mode G readings display. To change this default exit back out to the Mode G readings display (press MENU/ESCAPE thrice) and toggle ◄ ► to the appropriate COLumn.

The default END COLumn matches that of the START, therefore only the current COLumn will be transmitted. To modify the END COLumn, toggle ▲ ▼**.** Press SELECT/STORE to transmit based on the START and END COLumn parameters.

The receiving computer should be powered, on-line, and waiting for the data **BEFORE** depressing the SELECT/STORE button with the Send Data, Col(s) option selected. See Appendix H for information on IBM or compatible Personal Computer configuration and use of Hyperterminal to receive files.

Pressing MENU/ESCAPE after SELECTing START and END COLumns will abort the transmission. Upon transmitting all its Mode G data (or aborting) the user will be returned to the Mode G Send Data menu. Pressing MENU/ESCAPE will return the user to the Mode G Main Menu. Press MENU/ESCAPE again to return to the Mode G readings display.

3.4.3 All selects all the arrays of data in the readouts Mode G memory. Depending on the number of active ROWs and Columns this option could take some time.

The receiving computer should be powered, on-line, and waiting for the data **BEFORE** depressing the SELECT/STORE button with the Send Data, All option selected. See Appendix H for information on IBM or compatible Personal Computer configuration and use of Hyperterminal to receive files.

Pressing MENU/ESCAPE after SELECTing All will abort the transmission. This option can take a while due to the search that is undertaken to locate the data to transmit. Upon transmitting all its Mode G data (or aborting) the user will be returned to the Mode G Send Data menu. Pressing MENU/ESCAPE will return the user to the Mode G Main Menu. Press MENU/ESCAPE again to return to the Mode G readings display.

3.4.4 Factors transmits all the user entered or default calibration Factors, Zero readings, Offsets, Switch POSitions, ID values, and Units designators for each active COLumn in Mode G memory. See Appendix C.3 for a Mode G Factors sample data file. See Appendix H for file transfer instructions. This file is useful in verifying the unique information (calibration Factor, Zero reading, Offset, Switch POSition, ID value, and Units designator) for each gage being read. See Section 3.8 in regard to configuring the gage information.

The receiving computer should be powered, on-line, and waiting for the data **BEFORE** depressing the SELECT/STORE button with the Send Data, Factors option selected. See Appendix H for information on IBM or compatible Personal Computer configuration and use of Hyperterminal to receive files.

Pressing MENU/ESCAPE after SELECTing Factors will abort the transmission. Upon transmitting all its Mode G Factors (or aborting) the user will be returned to the Mode G Send Data menu. Pressing MENU/ESCAPE will return the user to the Mode G Main Menu. Press MENU/ESCAPE again to return to the Mode G readings display.

3.5 Clear Data

Selecting this option invokes the following menu:

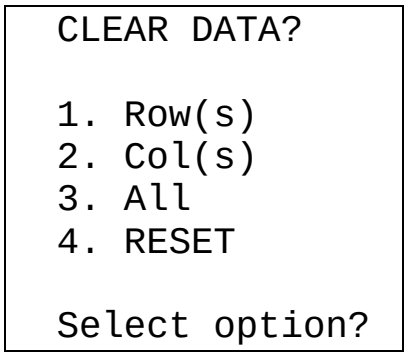


Figure 8 - Mode G Clear Data Menu

Following are the sub-option explanations:

3.5.1 Row(s) allows the user to clear sets of readings from Mode G memory. Selecting this option will bring up a screen that informs the user of the START and END ROW. The default STARTing ROW would be indicated in the Mode G readings display. To change this default exit back out to the Mode G readings display (press MENU/ESCAPE thrice) and toggle ▲ ▼ to the appropriate ROW.

The default END ROW matches that of the START, therefore only the current ROW will be cleared. To modify the END ROW toggle ▲ ▼**.** Press SELECT/STORE to clear based on the START and END ROW parameters.

Upon clearing the selected ROWs (or aborting by pressing MENU/ESCAPE) the user will be returned to the Mode G Clear Data menu. Pressing MENU/ESCAPE will return the user to the Mode G Main Menu. Press MENU/ESCAPE again to return to the Mode G readings display.

3.5.2 Col(s) allows the user to clear all the readings from a particular gage in Mode G memory. Selecting this option will bring up a screen that informs the user of the START and END COLumn. The default STARTing COLumn would be indicated in the Mode G readings display. To change this default exit back out to the Mode G readings display (press MENU/ESCAPE thrice) and toggle ◄ ► to the appropriate COLumn.

The default END COLumn matches that of the START, therefore only the current COLumn will be cleared. To modify the END COLumn toggle ▲ ▼. Press SELECT/STORE to clear based on the START and END COLumn parameters.

Upon clearing the selected COLumns (or aborting by pressing MENU/ESCAPE) the user will be returned to the Mode G Clear Data menu. Pressing MENU/ESCAPE will return the user to the Mode G Main Menu. Press MENU/ESCAPE again to return to the Mode G readings display.

3.5.3 All clears all the arrays of data in the readouts Mode G memory. Upon selecting the user will be asked to verify their intentions by pressing SELECT/STORE. Pressing MENU/ESCAPE will abort the option.

While clearing press MENU/ESCAPE to abort. This option can take a while due to the search that is undertaken to locate the data to clear.

Upon clearing all its Mode G memory (or aborting) the user will be returned to the Clear Data menu. Press MENU/ESCAPE to return to the Mode G Main Menu, press again to return to the Mode G readings display.

3.5.4 RESET will erase all user configurable settings of the GK-403 Vibrating Wire Readout (except for Modes A-F data and date and time settings). This includes all Mode G readings, and gage information (calibration Factors, Zero readings, Offsets, Switch POSitions,ID values, and Units designators).

The user will be asked to verify their intentions before the RESET occurs. Pressing SELECT/STORE will proceed with the RESET while MENU/ESCAPE will abort.

Upon clearing all its memory (or aborting) the user will be returned to the Clear Data menu. Press MENU/ESCAPE to return to the Mode G Main Menu, press again to return to the Mode G readings display.

3.6 Set Date/Clk

Used to set the date and clock information of the GK-403. Normally, this option need only be used when first receiving the readout to adjust to local time, to periodically make minor monthly corrections to the date and/or time, or for daylight savings adjustments.

First, the user will be asked to modify the date. Scroll through the date components (month:day:year) using ◄ ► and adjust them accordingly using ▲ ▼.When through press SELECT/STORE to accept and advance to the time entry. Press MENU/ESCAPE to abort the option and return to the Mode G Main Menu.

Scroll through the time components (hour:minutes) using ◄ ► and adjust them accordingly using ▲ ▼. When through press SELECT/STORE to accept and return to the Mode G Main Menu. Press MENU/ESCAPE to return to the readings display.

3.7 Auto Incrmt

Two displays are associated with this option. The first refers to the PRE-INCREMENT of the ROW and COLumn information upon taking a measurement. In other words, the amount the ROW and COLumn references are changed after storing a measurement. The readings obtained would be stored to the modified ROW and COLumn references.

The second refers to the POST-INCREMENT of the ROW and COLumn information. The measurements obtained are stored to the currently displayed ROW and COLumn references yet, after storing, they are updated according to the selected POST-INCREMENT amounts.

The initial, PRE--INCREMENT screen looks as follows:

```
PRE--INCREMENT?
1. (continue)
BEFORE storage,
auto-inc ROW?
2. 0 (default)
3. +1  4. -1
COL?   5. 0
6. +1  7. -1
```

Figure 9 - Mode G Pre--Increment Screen

Move the cursor through options 1-7 (using ▲ ▼ and ◄ ►). To select, press SELECT/STORE. Pressing MENU/ESCAPE returns control to the Mode G Main Menu. Pressing SELECT/STORE advances the user to the POST-INCREMENT option screen as follows:

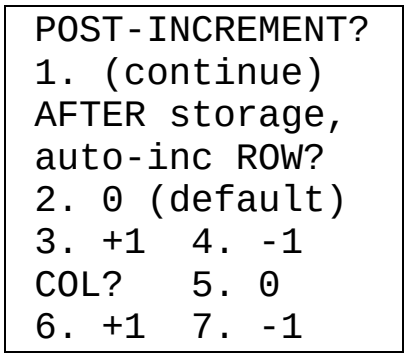


Figure 10 - Mode G Post-Increment Screen

Move the cursor through options 1-7 (using ▲ ▼ and ◀ ▶), to select press SELECT/STORE. Pressing MENU/ESCAPE returns control to the Mode G Main Menu. Pressing SELECT/STORE the user to the Mode G Main Menu. Press MENU/ESCAPE to return to the Mode G readings display.

3.8 Gage Params (Also see Appendix E on Application Notes)

Prompts the user with the following menu:

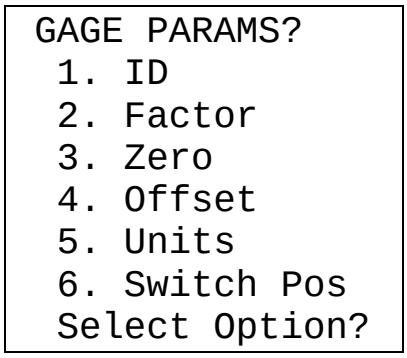


Figure 11 - Mode G Gage Params

Each selection is explained as follows;

3.8.1 ID allows the user to modify the descriptor for each gage being read. For example, a descriptor could be entered such as "Well #NE8". When the appropriate COLumn is selected in the Mode G readings display, the ID will display to aid in correlating the COLumn reference to the gage being read. The COLumn that the ID will be associated with is selected in the Mode G readings display using ◀ ▶ .

The maximum number of characters allowable for the ID is 10. Use ◀ ▶ to move among the 10 positions, then use ▲ ▼ to select the character. The characters available are as follows: lower-case a-z, upper-case A-Z, 0-9, space, question mark, colon, semicolon, left and right angle bracket, equals, ampersand, left and right brackets, apostrophe, underscore, quote, left and right slash, pound, dollar, percentage, asterisk, plus, hyphen, and period.

Press SELECT/STORE to accept the entry, MENU/ESCAPE to abort. Press MENU/ESCAPE to return to Mode G Main Menu, again for Mode G readings display.

3.8.2 Factor allows the user to apply the calibration factor to the sensor being read. The Factor is entered in scientific notation, use ◄ ► to move among the digits, ▲ ▼ to change them. BE SURE the exponent is in the correct magnitude and sign. The calibration Factor is normally found on the calibration sheet supplied by Geokon, Inc. for the particular sensor in use. See Appendix E for further information on range and sign conventions.

Press SELECT/STORE to accept, MENU/ESCAPE to abort. Press MENU/ESCAPE twice to return to Mode G readings display.

3.8.3 Zero allows the user to enter a zero reading for the gage being read. Upon selecting, the user has the option of using the current reading or entering one. In normal use the user would obtain this reading on the sensor prior to installation, although the Zero reading as found on the calibration sheet can be used.

The Zero reading is entered in scientific notation, use ◄ ► to move among the digits, ▲ ▼ to change them. BE SURE the exponent is in the correct magnitude and sign.

Press SELECT/STORE to accept, MENU/ESCAPE to abort. Press MENU/ESCAPE twice to return to Mode G readings display.

3.8.4 Offset allows the user to apply an additional Offset to the measurement being made. For example, the elevation of a piezometer could be added to the feet of water being measured above it to output elevation of the water column. The elevation of the piezometer would be entered as the Offset.

The Offset is entered in scientific notation, use ◄ ► to move among the digits, ▲ ▼ to change them. BE SURE the exponent is in the correct magnitude and sign.

Press SELECT/STORE to accept, MENU/ESCAPE to abort. Press MENU/ESCAPE twice to return to Mode G readings display.

3.8.5 Units is a 3 character reference to indicate the engineering units being used. The default is "m/m". To change use ◄ ► to move between the 3 digits, ▲ ▼ to change the selected digits. See the list in Section 3.8.1 of the possible character types.

Press SELECT/STORE to accept, MENU/ESCAPE to abort. Press MENU/ESCAPE twice to return to Mode G readings display.

3.8.6 Switch Pos is a most critical GAGE PARAMeter entry. Selection of this option brings up the following menu:

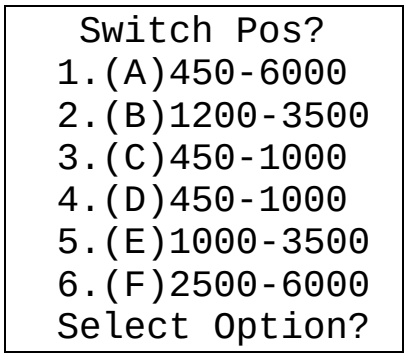


Figure 12 - Mode G Switch POSition Screen

The user should configure the selected COLumn for the type of gage being read. Select option 1-6 to correspond to the position A-F that would be used if the DISPLAY MODE selected was A-F. See Table 1 for a list of gage model numbers and the appropriate switch POSition. Selecting POSitions C,D,or E, (3,4,or 5) will automatically enter a gage Factor and clear the Zero Reading and Offset entries. See Table 1 regarding the Factor that will be entered.

For example, for a Geokon Model 4500 piezometer select number 2 (DISPLAY MODE position B). The default is position A (1).

The number ranges to the right of the switch position settings (i.e. 450-6000 for A) refer to the frequency range (in Hertz) for that position.

Press SELECT/STORE to accept, MENU/ESCAPE to abort. Press MENU/ESCAPE twice to return to Mode G readings display.

4. MAINTENANCE

The GK-403 Vibrating Wire Readout is designed to operate in field environments, nevertheless there are some basic maintenance procedures that should be followed to insure maximum reliability and functionality. They are as follows:

4.1 Cleaning: Clean the reader periodically with a soft cloth dampened with soap and water. DO NOT USE ANY TYPES OF SOLVENTS OR CLEANING AGENTS on the faceplate of the readout. Be careful that no debris of any sort is rubbed on the faceplate as damage to the clear portion covering the LCD may occur.

The connector sockets can be cleaned using a small stiff brush (small painters brush) dipped in soap and water. The sockets are waterproof so the internal electronics will not be adversely affected by them filling with water or other liquids. Be aware however, readings could be affected by shorting or other effects of an improper connection due to moisture present in the connector. Be sure to dry the connectors thoroughly before taking measurements.

4.2 Charging: When the unit is not in use, especially for extended periods of time, it should be left connected to the charger. This will ensure a proper charge maintained on the batteries, hence a reduction of the risk of battery failure. Due to the use of Lead-acid batteries in the GK-403, there is little chance of over-charging or memory effects, as is often experienced with Ni-cad type batteries.

4.3 Calibration: The readout should be sent periodically (every 12 months) back to the manufacturer for inspection, cleaning, and calibration. A nominal fee will be charged for the service, but it is highly recommended.

5. TROUBLESHOOTING

Listed below are a few commonly experienced problems and remedial action. Contact the factory should a problem arise not explained herein.

5.1 Unit will not come on

Internal battery is probably dead. Charge overnight (8-12 hours). If the unit still fails to come on the fuse may need to be replaced. Follow these steps for fuse replacement;

1. Disassemble according to steps 1-3 of Appendix G.
2. Note fuse under mass-termination connector and inspect for outage (break in filament).
3. Replace fuse if blown.
4. Re-assemble according to steps 8-10 of Appendix G.
5. If unit still fails to power on see Section 5.9.

5.2 After charging unit stays powered for very short time

Internal Lead-acid battery is dead. Consult the factory to schedule battery replacement. Batteries are NOT covered under warranty.

5.3 Stored readings are not retained at power-off

Internal Lithium cell for memory retention is dead. Consult the factory to schedule replacement.

5.4 Vibrating wire gage measurement shows dashes

Check Alligator Clip connections to vibrating wire gage leads. If okay, check gage with Ohmmeter. It should read 50, 90 or 180 ohms depending on the type of gage. (Consult individual spec. sheets). If gage resistance is okay, check Readout with another gage. If still doesn't work consult the factory to schedule return and repair of Readout.

5.5 Vibrating wire gage reading unstable

Improper DISPLAY MODE switch POSition selected. Verify gage model number against Table 1 recommended setting. If switch POSition checks out, gage is marginal or dysfunctional.

5.6 Vibrating wire gage reading is 9999999 (DISPLAY MODE G)

One or more of the constants (Factor, Zero, Offset) are entered incorrectly. This is the overrange indicator. Check all entries. Additional information on appropriate values can be found in Appendix E.

5.7 Thermistor measurement shows dashes

Check Alligator Clip connections to Thermistor leads. If okay, check Thermistor with Ohmmeter. It should read between 10K ohms and 2.4K ohms (0 to +30 degrees Celsius). If Thermistor checks out okay consult factory to schedule repair of Readout. Note: Dashes will display if no Thermistor is connected!

5.8 Thermistor measurement shows 999999

This is an overrange indication caused by a short of the Thermistor leads. Check the connections to the Thermistor. Check the Thermistor resistance. If zero ohms is indicated (or close to) consult the factory to schedule repair of the transducer.

5.9 Readout has "locked-up" (Readings not updated, unresponsive)

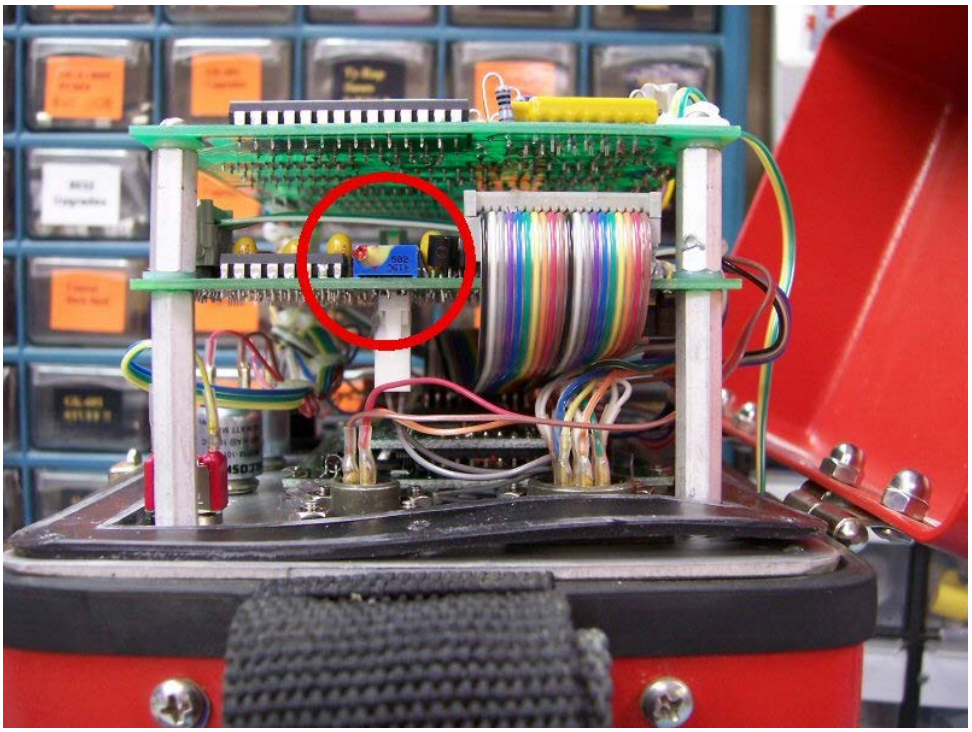
There are many reasons why this condition may arise, for example, the internal Lithium cell may be running low. To reset the unit power it off, then back on. If the Readout still fails to power-up properly then hold both the MENU/ESCAPE and SELECT/STORE buttons down while turning the readout on. **THIS ACTION WILL RESET ALL THE INTERNAL SETTINGS OF THE READOUT**, including the date/time information. **IT SHOULD ONLY BE USED AS A LAST RESORT!**. If the Readout still fails to power-on consult the factory to schedule return and repair of the Readout. Warranty covers all parts (except batteries) and labor for 13 months (12 months plus 1 month grace period) from date of purchase.

5.10 Cannot communicate with GK-403 via RS-232

Check communications settings. See Specifications (Appendix A.5) for a list of the proper values. Check the computers COM port with another RS-232 communications device (Modem, Terminal, PC, etc.). If all else fails contact the factory for assistance.

5.11 Contrast needs adjusting

Refer to the photo on the next page to locate Trimpot R13 on the CPU circuit board. Turn clockwise to lighten the display, counter-clockwise to darken.



6. LIMITS OF LIABILITY

The GK-403 Vibrating Wire Readout has been developed specifically for use with Geokon, Inc. vibrating wire gages and, as such, Geokon, Inc. assumes no responsibility for its use with other systems. Every effort has been made to ensure reliable operation, but the user must be aware that there is no warranty against uninterrupted or trouble-free operation. For the user conducting particularly unusual or sensitive analysis, or for those not familiar with vibrating wire gage data processing, it is recommended that the problems be double checked using another measurement system.

Also, the readout is provided 'as is' and Geokon, Inc. assumes no responsibility as to results, performance, or interpretation associated with the GK-403 Vibrating Wire Readout. Warranty shall cover parts (except batteries) and labor for a period of 1 year from the date of purchase. In addition, there is a 1 month grace period to the warranty for a total of 13 months.

We reserve the right to revise this publication and/or readout from time to time with no obligation to notify users of these changes.

All things considered, Geokon, Inc., is not liable for any claims, injuries, or damages caused directly or indirectly by the proper or improper use of the GK-403 Vibrating Wire Readout, beyond the purchase price of the Readout.

APPENDIX A - SPECIFICATIONS

A.1 Vibrating Wire Readout:

Excitation Range: 400 Hz to 6000 Hz, 5 volt square wave
Measurement Resolution: 0.1µs
Time base Accuracy: ± 50ppm

A.2 Temperature Readout:

Sensor Type: Thermistor, Dale #1C3001-B3 (YSI 44005)
Sensor Accuracy: ±0.5° Celsius
Measurement Range: –50° to +150° Celsius
Measurement Resolution: 0.1° Celsius
Measurement Accuracy: 0.5% to1.0% FSR

A.3 Memory:

RAM: 64K Static, 48K Used
ROM: 32K EPROM, 16K Used
Reading Storage: 2000 arrays
Array Partition: 256 arrays for Modes A-F, remaining for Mode G

A.4 Real-Time Clock:

Features: Full calendar with automatic leap year correction
Time Format: 24 hour (hhmm)
Date Storage Format: Julian Day
Date Display Format: month/day/year (mm/dd/yy)
Oscillator: 32.768 kHz
Accuracy: ±1 minute per month

A.5 Communications:

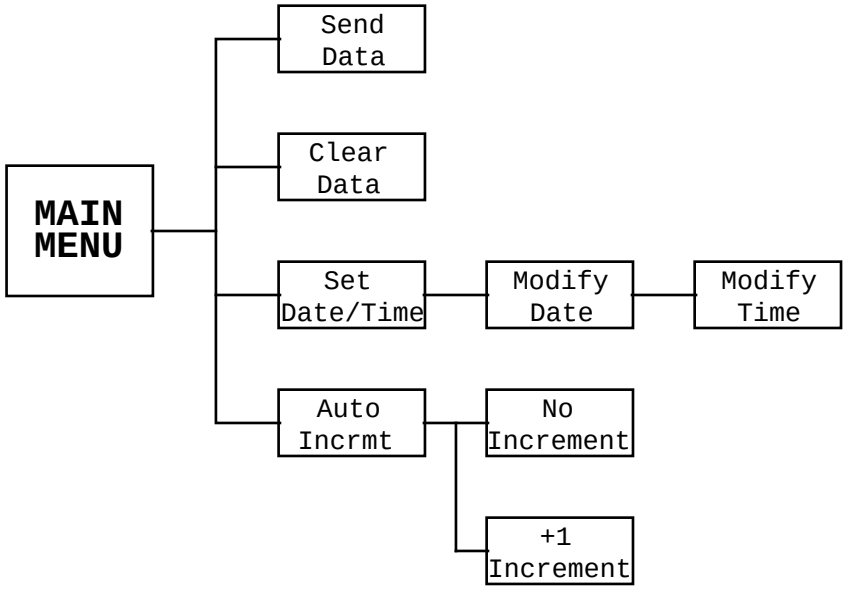
Parameters: 9600 baud, 8 data bits, 1 stop bit, no parity, full duplex, user configurable
Handshake: XON/XOFF
Transmission Format: ASCII

A.4 Physical:

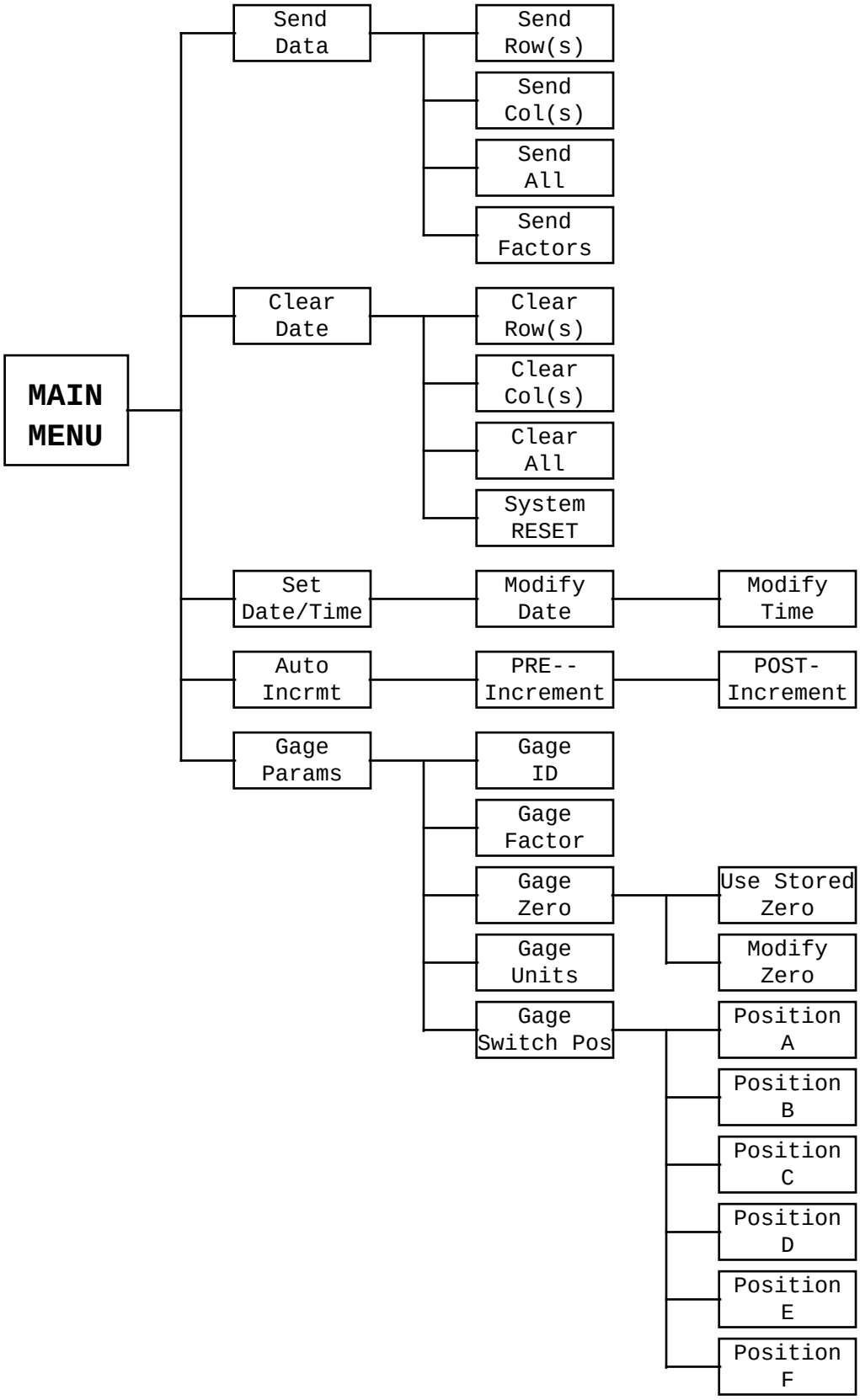
Display: 15 Column x 8 Line Backlit LCD
Dimensions: 19.1cm (7.5") x 13.3cm (5.25") x 23.5cm (9.25")
Weight: 2.7kg (6 lbs.)
Temperature Range: -10° to +50° Celsius
Battery: 12 volt, 3.4 AHr (Powersonic PS-1230)
Operating Time: approx. 10 hours

APPENDIX B - MENU TREES

B.1 Modes A-F Menu Tree



B.2 Mode G Menu Tree



APPENDIX C - SAMPLE DATA FILES

All data files are comma delineated ASCII format. In other words, the data points in each array are separated by commas.

C.1 Modes A-F Data File

```
1,326,1345,8480.2,21.3,2
2,326,1345,8480.1,21.3,2
3,326,1345,8480.0,21.3,2
4,326,1345,8480.2,21.3,2
5,326,1345,8480.5,21.3,2
6,326,1345,8479.6,21.3,2
7,326,1345,8480.4,21.3,2
8,326,1345,8480.1,21.3,2
9,326,1345,8479.9,21.3,2
10,326,1345,8480.0,21.3,2
11,326,1345,8480.1,21.3,2
12,326,1345,8480.2,21.3,2
13,326,1345,8480.1,21.3,2
14,326,1345,8480.2,21.3,2
15,326,1345,8480.1,21.3,2
16,326,1345,8480.2,21.3,2
17,326,1345,8479.7,21.3,2
18,326,1345,8479.8,21.3,2
19,326,1345,8480.3,21.3,2
20,326,1345,8479.9,21.3,2
21,326,1345,8479.8,21.3,2
22,326,1345,8480.1,21.3,2
23,326,1345,8480.0,21.3,2
24,326,1345,8479.9,21.3,2
25,326,1345,8480.1,21.3,2
26,326,1346,8480.2,21.3,2
27,326,1346,8480.0,21.3,2
28,326,1346,8479.9,21.3,2
29,326,1346,8479.6,21.3,2
30,326,1346,8479.7,21.3,2
```

where;

Column 1 represents the REFerence number (1-256)
Column 2 represents the Julian Day
Column 3 represents the Real Time (24 Hr. format)
Column 4 represents the vibrating wire gage reading
Column 5 represents the temperature (degrees Celsius)
Column 6 represents the switch POSition (1-6 for A-F, respectively)

C.2 Mode G Data File

```
1,  1,331,1030, 8472.90,24.7,2
1,  2,331,1032, 9894.70,24.7,2
2,  1,331,1031, 8473.00,24.7,2
2,  2,331,1032, 9893.70,24.7,2
3,  1,331,1031, 8472.90,24.7,2
3,  2,331,1032, 9894.50,24.7,2
4,  1,331,1031, 8472.70,24.7,2
4,  2,331,1032, 9895.10,24.7,2
5,  1,331,1031, 8472.70,24.7,2
5,  2,331,1032, 9895.40,24.7,2
6,  1,331,1031, 8473.30,24.7,2
6,  2,331,1032, 9895.00,24.7,2
7,  1,331,1031, 8473.30,24.7,2
7,  2,331,1032, 9895.00,24.7,2
8,  1,331,1031, 8473.30,24.7,2
8,  2,331,1032, 9895.30,24.7,2
9,  1,331,1031, 8473.30,24.7,2
9,  2,331,1032, 9895.20,24.7,2
10,  1,331,1031, 8473.30,24.7,2
10,  2,331,1032, 9895.20,24.7,2
11,  1,331,1031, 8472.80,24.7,2
11,  2,331,1032, 9895.20,24.7,2
12,  1,331,1031, 8472.80,24.7,2
12,  2,331,1032, 9895.20,24.7,2
13,  1,331,1031, 8472.80,24.7,2
13,  2,331,1032, 9895.20,24.7,2
14,  1,331,1031, 8472.80,24.7,2
14,  2,331,1032, 9895.60,24.7,2
15,  1,331,1031, 8472.80,24.7,2
15,  2,331,1032, 9895.10,24.7,2
```

where;

Column 1 represents the ROW (1-256)
Column 2 represents the COLumn (1-256)
Column 3 represents the Julian Day
Column 4 represents the Real Time (24 Hr. format)
Column 5 represents the vibrating wire gage reading
Column 6 represents the temperature (degrees Celsius)
Column 7 represents the switch POSition

C.3 Mode G Factors File

```
1, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,1
2, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,2
3, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,3
4, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,4
5, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,5
6, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,6
7, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,7
8, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,8
9, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,9
10, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,10
11, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,11
12, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,12
13, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,13
14, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,14
15, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,15
16, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,16
17, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,17
18, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,18
19, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,19
20, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,20
 .       .            .             .         .  .   .
 .       .            .             .         .  .   .
 .       .            .             .         .  .   .
254, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,254
255, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,255
256, 1.000000E+00, 0.000000E 00, 0.000000E 00,1,m/m,256
```

where;

Column 1 represents the COLumn number (1-256)
Column 2 represents the Factor (scientific notation)
Column 3 represents the Zero (scientific notation)
Column 4 represents the Offset (scientific notation)
Column 5 represents the switch POSition (1-6 for A-F, respectively)
Column 6 represents the Units (up to 3 ASCII characters)
Column 7 represents the ID (up to 10 ASCII characters)

APPENDIX D - ACCESSORIES

The following accessories arrive with the GK-403 Vibrating Wire Readout:

1. 100-240VAC 50/60 Hz 18VDC Power Supply.
2. Vibrating wire gage interconnect cable (flying leads).
3. 9 Pin RS-232 communications cable.
4. USB-to-Serial adapter cable.
5. GK-403 Vibrating Wire Readout manual.
6. Spare 1A fuses (5).
7. Geokon Terminal Window Software

The following are optional accessories:

1. Load Cell Module (for connecting to Vibrating Wire Load Cell).
2. Model 8032 16 or 32 channel Multiplexer.
3. GK-403-4 Audio Option.

APPENDIX E - APPLICATION NOTES

E.1 Mode G Equation and Display Units

For vibrating wire transducers, the output frequency of the gage responds according to the following equation:

With a negative Factor;

$$\textbf{Output} = \textbf{Factor} \times (\textbf{Zero Reading} - \textbf{Current Reading}) + \textbf{Offset}$$

With a positive Factor;

$$\textbf{Output} = \textbf{Factor} \times (\textbf{Current Reading} - \textbf{Zero Reading}) + \textbf{Offset}$$

where;

Output is Psi, force, ft water, etc.
Factor translates to the new units
Zero Reading is the vibrating wire frequency squared reading ($\times 10^{-3}$) at the zero condition
Current Reading is the vibrating wire frequency squared reading ($\times 10^{-3}$) at the moment
Offset scales the reading accordingly

Note that for gages under compression, the frequency of oscillation of the gage decreases with increasing force. See Table E-1 for the appropriate sign given the gage model number.

Geokon Model	Description	Factor Sign
4000	Strain Gage	+
4100/4150	Strain Gages	+
4200/4210	Strain Gages	+
4300BX	BX Borehole Stressmeter	+
4300EX	EX Borehole Stressmeter	+
4300NX	NX Borehole Stressmeter	+
4350	Biaxial Stressmeter	+
4360	Stress Ring	+
4400	Embedment Jointmeter	+
4420	Crackmeter	+
4450	Displacement Transducer	+
4500	Piezometer	–
4600/4651/4675	Settlement Systems	+/–
4700	Temperature Sensor	+
4800/4850	Pressure Cells	–
4900	Load Cell	–
4910/4911/4912	Load Bolts	+

Table E-1 - Vibrating Wire Gage Factor Signs

E.2 Mode G Decimal Point Placement

The decimal point placement of the gage reading is decided by the position of the exponent in the Factor. For example, a Factor of +1.0 will cause a reading of ±12345.6, with leading zeros and the plus sign suppressed. Possible decimal point positions range from ±0.123456 to ±123456. Equivalent Factor exponents are from 1×10^{-5} to 1×10^{1}.

E.3 Terminal Emulation with GK-403

The various Gage Parameters the GK-403 retains in its Mode G memory (Factor, Zero Reading, Offset, etc.) can be altered 3 ways. As has been discussed in Section 3.8, values can be entered via the front panel controls. Secondly, Appendix I details entering these parameters by creating a file on the PC and downloading it to the Readout. A third method will be discussed in this section, namely; changing or entering values in a terminal emulation mode with the GK-403.

The format for entering Factors, Zero Readings, etc., is as follows:

COLumn,Factor,Zero Reading,Offset,Switch POSition,Units,ID <CR>

For example, type: **3,.001,7034,35,2,Psi,MAINPUMP <CR>**

The above example selected COLumn 3 gage, entered a Factor of .001, Zero Reading of 7034, Offset in Psi of 35, Units of Psi, and ID of MAINPUMP.

The proper entry of these values can be verified by typing a question mark and the COLumn number to check. For example, **?3 <CR>** will return "3,.001,7034,35,2,Psi,MAINPUMP".

The format is comma-delineated so to change one value commas can be supplied to skip values NOT to be changed. For example, **3,,,40 <CR>** will enter a new Offset of 40. No other parameters will be changed. Type **?3 <CR>** to verify the change.

Another example, **3,,,,,,OLDPUMP <CR>** will change only the ID. Type **?3 <CR>** to verify.

When through changing values, disconnect the RS-232 cable interface. The values entered will be retained in the Readout at power-off.

APPENDIX F - CONNECTOR PINOUTS

F.1 Transducer Plug Pinout

10-pin Bendix Plug (PT06F-12-10P)	Wire Color	Alligator Clip Boot Color (Flying Leads)	Description
A	Red	Red	VW Gage +
B	Black	Black	VW Gage -
C	White	White	Thermistor +
D	Green	Green	Thermistor -
E	Bare	Blue	Shield
F			+12 VDC Power
G			Power Ground
H			Mux Sense
J			Mux Clock
K			Mux Type

F.2 Charger Pinout

3-pin Bendix Plug (PT06E-8-3P)	Wire Color	Description
A	Red	System Ground
B	Brown	VWG+
C	Orange	Charger Input

F.3 RS-232 Plug Pinout

10-pin Bendix Plug (PT06F-12-10P)	Wire Color	DB-9 RS-232	DB-25 RS-232	Description
A	Brown	5	7	Ground
B	Red	3	2	TXD
C	Orange	2	3	RXD
D	Yellow	7	4	RTS
E	Green	8	5	CTS
F	Blue			Ground
G	Violet	4	20	DTR
H				
J	White			Ground
K	Black			+12 VDC

APPENDIX G - SOFTWARE REPLACEMENT

Instructions:

1. Remove the 8 screws located on the perimeter of the GK-403 faceplate.

2. Remove the faceplate and electronics assembly by pulling on the selector knob. Gently lift the assembly from the enclosure so that no wires catch on the faceplate brackets and are damaged.

3. Disconnect the 2 and 3 pin Molex connectors between the battery pack and LCD backlighting power supply and electronics assembly.

4. Turn electronics assembly so that the front of the faceplate faces away. Note 4 screws securing printed circuit board (PCB) to assembly. Remove screws.

5. Disconnect the two 16-pin mass termination connectors located near the Serial Number designation on the component side of the bottom-most PCB. Disconnect the 16-pin mass termination connector located near the fuse on the component side of the same PCB.

6. Lift the bottom-most PCB from the electronics assembly. Note the existing EPROM (part 27C256) with the label "GK-403 MAIN" on it. Note orientation of notch on one end of the installed EPROM. Gently pry either side of the EPROM with the small regular screwdriver until it is free from its socket.

7. Insert new EPROM with same orientation as former into socket. Before pushing gently into the socket make sure ALL the pins on the new EPROM line up with their respective holes in the socket!

8. Re-connect mass termination connectors, re-affix PCB onto assembly, re-connect MOLEX connectors, and re-insert electronics assembly in the enclosure. Make sure when lowering assembly into the enclosure that no wires are pinched against the faceplate brackets!

9. Fasten faceplate and electronics assembly into enclosure using the 8 Phillips head screws.

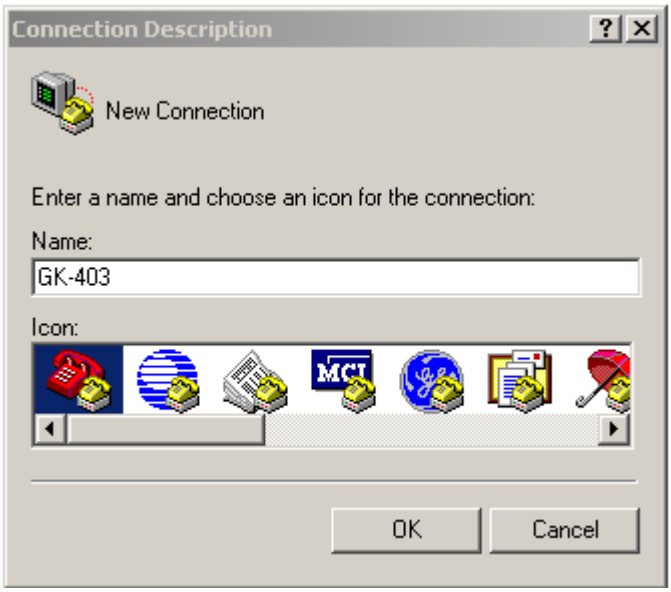
10. EPROM replacement complete.

APPENDIX H - FILE TRANSFER FROM GK-403 TO IBM PC VIA HYPERTERMINAL

NOTE: ***EFFECTIVE APRIL 2013, GEOKON'S TERMINAL WINDOW SOFTWARE(GEO-TWS) IS INCLUDED WITH NEW GK-403 SHIPMENTS. SHOULD THE COMPUTER USED FOR FILE TRANSFER OPERATE USING WINDOWS VISTA/ W7 / W8, THESE OPERATING SYSTEMS DO NOT HAVE THE HYPERTERMINAL PROGRAM PRE-INSTALLED AS PREVIOUS VERSIONS OF THE WINDOWS OS DID. PLEASE INSTALL THE GEOKON TERMINAL WINDOW SOFTWARE AND READ THE ON-LINE HELP SECTIONS FOR USING THIS SOFTWARE TO TRANSFER DATA. THE SOFTWARE IS ALSO AVAILABLE FOR DOWNLOAD AT:*** ***www.geokon.com/software***

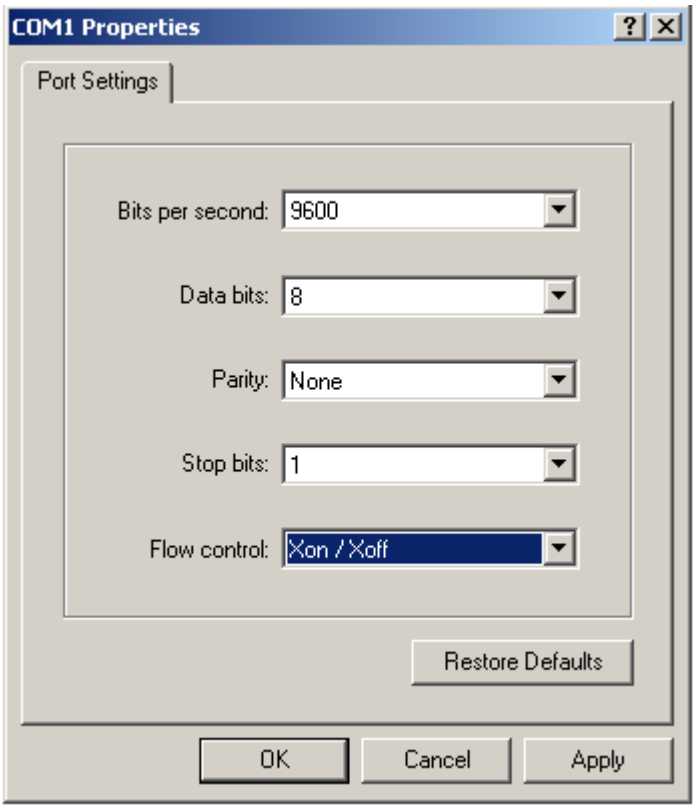
Start Hyperterminal: Start | Programs | Accessories | Communications

Enter a name for the Connection. Select OK.

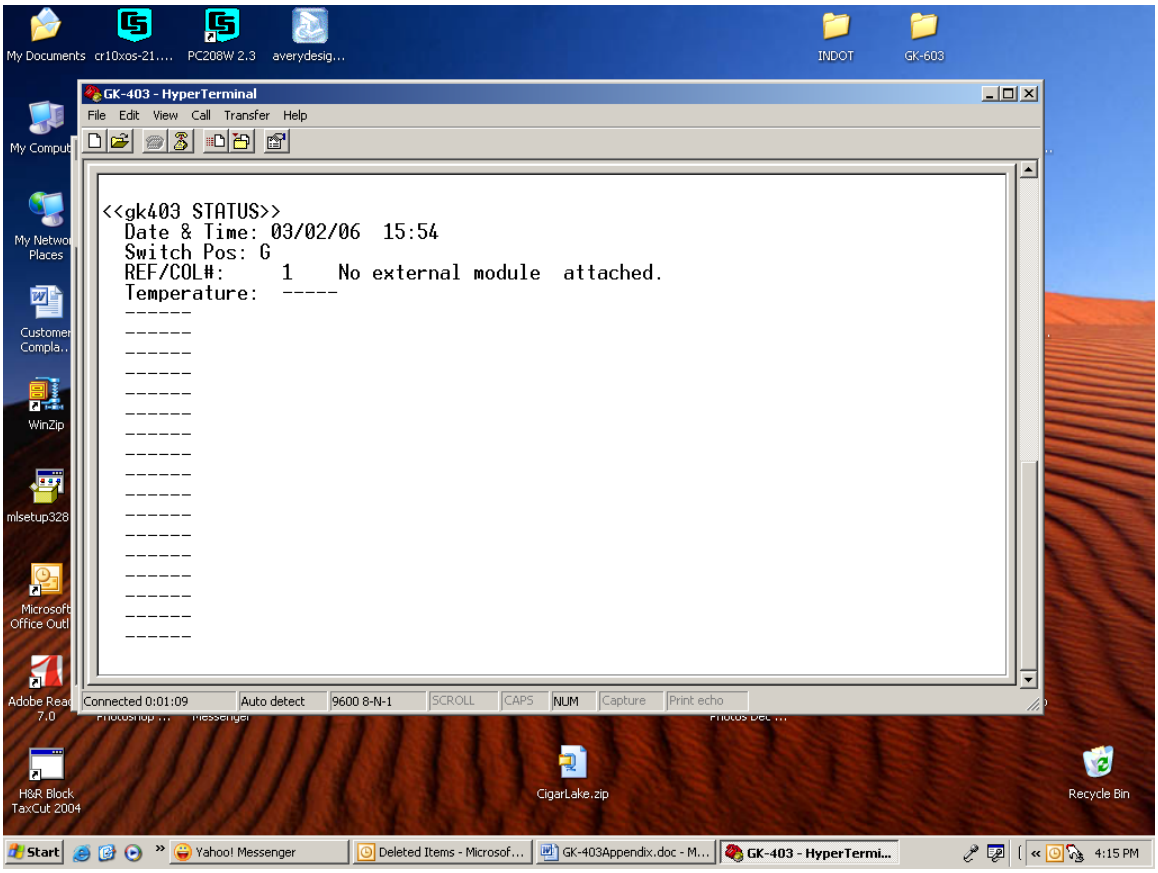


Change the Connect Using setting to the appropriate COM port for the computer being used. Select OK.

Enter the Port Settings as shown. Select Apply. Select OK.

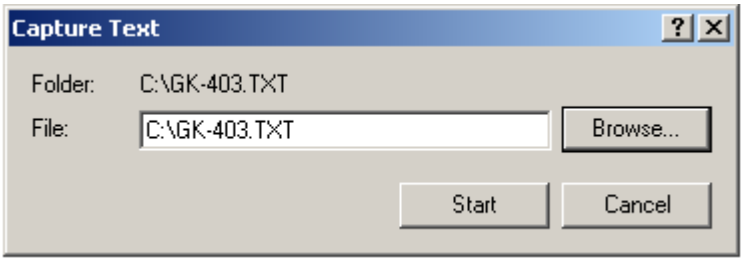


With the RS232 cable connected to the RS232 port on the GK-403 and the unit turned on and in DISPLAY position G put the cursor in the Hyperterminal display screen and push the Enter key a few times to verify communications has been established. The text as shown below should appear.

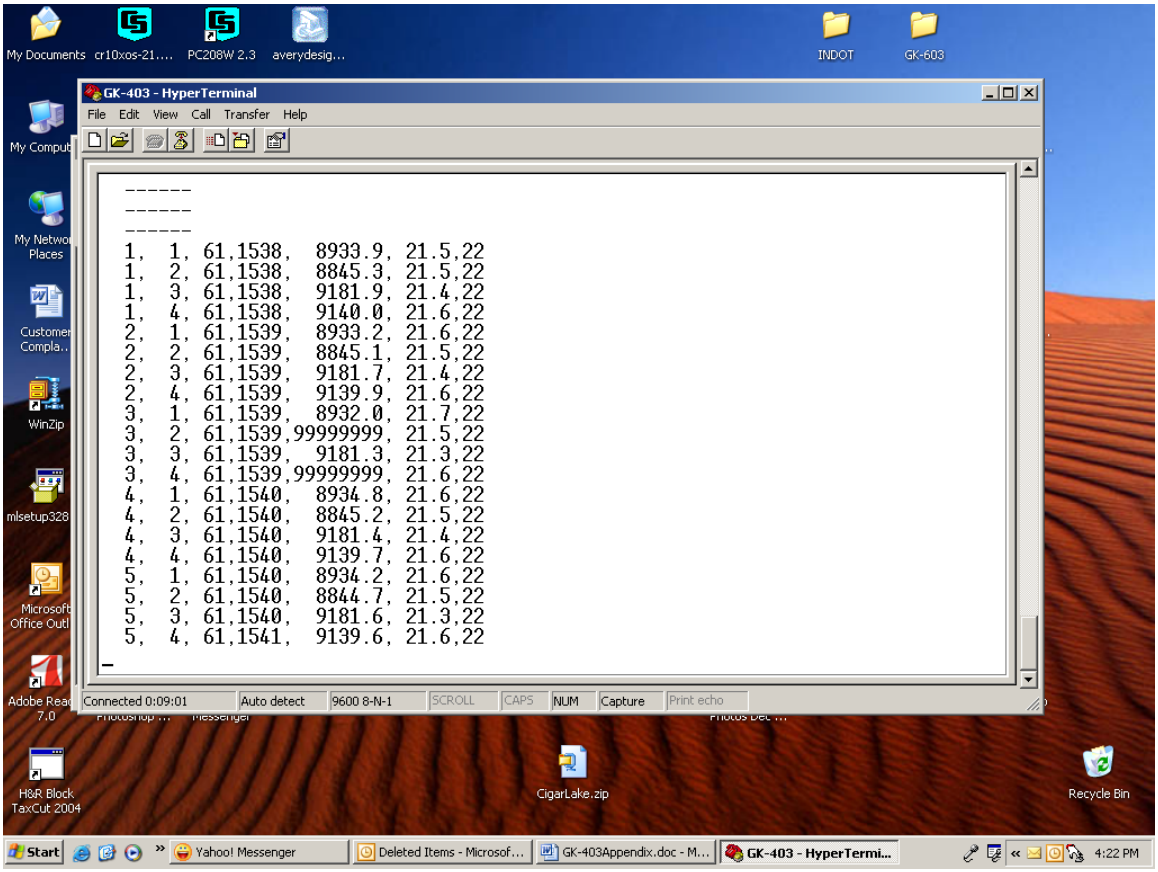


Upon confirmation of communications select Transfer | Capture Text.

Enter the Path and name of the file you wish to create, either directly or with the Browse button. Select Start.



The display of the GK-403 should be set to position G. Push the Menu/Escape button and put the toggle on No. 1 Send Data. Push the Select/Store button. Depending on what information is required (Row (s), Col(s) All, or Factors) move the cursor to the appropriate selection. Push Select/Store. The data should scroll across the screen as shown below.



The download is now complete. A text file now exists as specified by the User. You can open this file in NotePad or WordPad. It can also be opened in Excel.

Push the Menu/Escape button twice to take you back to the main display mode. Exit Hyperterminal and save the settings as appropriate.

APPENDIX I - CONFIGURING GK-403 VIA RS-232

All unique gage information (calibration Factors, Zero readings, Offsets, Switch POSitions, ID values, and Units) used in Mode G of the Readout can be downloaded to the reader to save having to enter manually. This file can be created on the PC using an editor (see Appendix C.3 for details on the file format) or uploaded from the GK-403 after entering the appropriate values manually. After uploading, the file can be modified as need be, then downloaded back into the GK-403. See Appendix C.3 regarding details of the Factors file format.

APPENDIX J - LOAD CELL MODULE

Refer to the Model 4900 VW Load Cell Manual

APPENDIX K - THERMISTOR TEMPERATURE DERIVATION

Thermistor Type: YSI 44005, Dale #1C3001-B3, Alpha #13A3001-B3

Resistance to Temperature Equation:

$$T = \frac{1}{A + B(LnR) + C(LnR)^3} - 273.2$$

where: T = Temperature in °C.
LnR = Natural Log of Thermistor Resistance
$A = 1.4051 \times 10^{-3}$ (coefficients calculated over the –50 to +150° C. span)
$B = 2.369 \times 10^{-4}$
$C = 1.019 \times 10^{-7}$

Resistance versus Temperature Table:

Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp
201.1K	-50	16.60K	-10	2417	+30	525.4	+70	153.2	+110
187.3K	-49	15.72K	-9	2317	31	507.8	71	149.0	111
174.5K	-48	14.90K	-8	2221	32	490.9	72	145.0	112
162.7K	-47	14.12K	-7	2130	33	474.7	73	141.1	113
151.7K	-46	13.39K	-6	2042	34	459.0	74	137.2	114
141.6K	-45	12.70K	-5	1959	35	444.0	75	133.6	115
132.2K	-44	12.05K	-4	1880	36	429.5	76	130.0	116
123.5K	-43	11.44K	-3	1805	37	415.6	77	126.5	117
115.4K	-42	10.86K	-2	1733	38	402.2	78	123.2	118
107.9K	-41	10.31K	-1	1664	39	389.3	79	119.9	119
101.0K	-40	9796	0	1598	40	376.9	80	116.8	120
94.48K	-39	9310	+1	1535	41	364.9	81	113.8	121
88.46K	-38	8851	2	1475	42	353.4	82	110.8	122
82.87K	-37	8417	3	1418	43	342.2	83	107.9	123
77.66K	-36	8006	4	1363	44	331.5	84	105.2	124
72.81K	-35	7618	5	1310	45	321.2	85	102.5	125
68.30K	-34	7252	6	1260	46	311.3	86	99.9	126
64.09K	-33	6905	7	1212	47	301.7	87	97.3	127
60.17K	-32	6576	8	1167	48	292.4	88	94.9	128
56.51K	-31	6265	9	1123	49	283.5	89	92.5	129
53.10K	-30	5971	10	1081	50	274.9	90	90.2	130
49.91K	-29	5692	11	1040	51	266.6	91	87.9	131
46.94K	-28	5427	12	1002	52	258.6	92	85.7	132
44.16K	-27	5177	13	965.0	53	250.9	93	83.6	133
41.56K	-26	4939	14	929.6	54	243.4	94	81.6	134
39.13K	-25	4714	15	895.8	55	236.2	95	79.6	135
36.86K	-24	4500	16	863.3	56	229.3	96	77.6	136
34.73K	-23	4297	17	832.2	57	222.6	97	75.8	137
32.74K	-22	4105	18	802.3	58	216.1	98	73.9	138
30.87K	-21	3922	19	773.7	59	209.8	99	72.2	139
29.13K	-20	3748	20	746.3	60	203.8	100	70.4	140
27.49K	-19	3583	21	719.9	61	197.9	101	68.8	141
25.95K	-18	3426	22	694.7	62	192.2	102	67.1	142
24.51K	-17	3277	23	670.4	63	186.8	103	65.5	143
23.16K	-16	3135	24	647.1	64	181.5	104	64.0	144
21.89K	-15	**3000**	**25**	624.7	65	176.4	105	62.5	145
20.70K	-14	2872	26	603.3	66	171.4	106	61.1	146
19.58K	-13	2750	27	582.6	67	166.7	107	59.6	147
18.52K	-12	2633	28	562.8	68	162.0	108	58.3	148
17.53K	-11	2523	29	543.7	69	157.6	109	56.8	149
								55.6	150

APPENDIX L - AUDIO OPTION

L.1 Introduction

The audio option, when connected to the GK-401 or GK-403 Readout Box is a useful tool for assessing the quality of a vibrating wire sensor installation. It is roughly the equivalent of having an oscilloscope connected to the readout box, when, instead of a visual trace of the frequency output, there is an audible tone produced in a head set worn by the installer. The audio option can be useful in diagnosing the reasons for poor gage performance and in selecting a remedy.

L. 2 Construction

The audio option consists of a headset connected to an audio amplifier/battery pack which plugs into the charger socket of the face plate of the readout box.

L. 3 Application

Good installations are characterized by a clear strong audible tone which decays slowly. The shorter the length of the sensor vibrating wire and the greater its tension the higher is the tone or pitch of the output signal. In general, the ringing of the gage can be heard to continue from one excitation pulse to the next.

Gages in which the output signal decays rapidly due to a dampening of the natural frequency of vibration of the gage wire may have dirt or moisture on the wire. A temporary fix, in emergencies, might be to dislodge the dirt or moisture by knocking on the gage.

In some cases, the body of the gage vibrates at a resonant frequency which dampens the natural frequency of the wire itself. These effects often disappear as soon as the body or ends of the gage are properly restrained. This sometimes happens where concrete embedment gages are held in place using iron wire: as soon as the concrete is poured, the output signals become clear and strong. This problem can often be remedied by altering the tension of the iron wire, or by using a more rigid method of holding the gages in place prior to pouring the concrete.

In rare instances, resonance of the gage body interferes with the output signal over a very narrow band of frequencies. On either side of this frequency band, the signal is clear and strong. Sometimes raising or lowering the transducer relative to the water level will eliminate the problem.

Gages may emit an unsteady tone due to the presence of noise or harmonics. The general effect is to cause unsteadiness in the readout digits.

Noise can sometimes be caused by the proximity of power lines and electrical machinery. It can often be removed by connecting the sensor shield to the ground wire

clip on the readout box or by shielding the transducer itself. Harmonics are most frequently encountered in longer sensors (strain gages) where the longer wire is at a low tension. In these cases it may be possible to remove the harmonics by plucking the gage at a lower frequency or by retensioning the wire.

L. 4 Weak gages

Weak gages give an output signal with a low amplitude. Perhaps the gage is being plucked at the wrong frequency in which case the signal might be improved by switching to another DISPLAY position (403 readout box) or by adjusting the pluck frequencies on a datalogger. With strain gages using detachable coils, the coil may have slipped and needs repositioning. By using the audio option, it is possible to find the optimum position for the coil.

Weak gages may also be the result of cable damage, in which case repair or replacement of the cable or its connector could solve the problem.