

OPERATING INSTRUCTIONS  
EM61-MK2 DATA LOGGING SYSTEM  
FOR WINDOWS 10 BASED FIELD TABLET COMPUTER

# EM61MK2win

Version 1.10

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# 1. Introduction

The Geonics EM61MK2win Data Logging System (DAS70-win) consists of a tablet/laptop field computer, data logging program EM61MK2win, and associated cable to connect the computer to the Geonics EM61-MK2 instrument. The program EM61MK2win is designed for a IBM PC compatible computer and MS Windows 10 (or 7) operating system.

The program is prepared for the MS Windows 10 tablet Mesa2 (manufactured by Juniper Systems) operated in the vertical mode display with the default setup. However the program can be used in other Windows 10( or 7) based field computers with vertical and horizontal oriented displays. The minimum supported display resolution is 800 x 600 pixels. In case high resolution display is employed, it is advised to set fonts to 125% or 150% to increase legibility of the screen. The maximum size of program main windows is 1024 x 762 pixels.

The EM61MK2win program acquires and records survey data from the EM61-MK2 system, under the control of the operator. It also records various field information such as survey line number (line name), starting station, increment, comments, etc. Readings are displayed in graphic and numeric mode. Readings are displayed in real time in mV. In addition, the program allows you to monitor the instrument output while data is not recorded. The EM61MK2win program continuously monitors the condition of the instrument battery, without leaving the program. The EM61MK2 also provides the possibility of automatic nulling of the instrument output at any time during the survey.

The program allows the user to set the EM61-MK2 into a specific instrument mode of operation: AUTO, Wheel, or Manual modes. In AUTO mode readings can be automatically recorded in desired time intervals. In WHEEL mode readings are triggered by a counter installed at the EM61-MK2 wheel assembly, and in MANUAL mode readings are triggered manually by the operator.

The program supports the standard EM61-MK2 instrument as well as EM61-MK2 High Power unit. It also recognizes all versions of instrument firmware automatically. The program allows you to record data while using various EM61-MK2 antenna (1 x 0.5 m, 1 x 1 m, or 0.5 x 0.5 m sensors) and Geonics EM61HH-MK2 Hand Held sensor.

The EM61MK2win will accept NMEA-0183 compatible data from a GPS receiver directly connected to a logging field computer and it will record roll and pitch readings if the EM61-MK2 is equipped with Geonics installed Tilt Meter. GPS receiver as well as Tilt Meter records which are embedded in the EM61MK2win data file can be processed later in the Geonics DAT61MK2 program. The connected GPS must be able to stream NMEA-0183 compatible messages. The EM61MK2win uses two NMEA messages GGA and GSA. While message GGA is mandatory, the GSA string is used only to provide information related to the GPS signal quality during data collection.

The EM61MK2win program records data together with a time stamp at each station. Data files created with this program can be used to position a survey according to locations recorded separately by a Global Positioning System (GPS).

Survey setup parameters are saved in a configuration file, therefore they can be automatically used during subsequent data collection sessions.

Data files are saved to the user selected data directory. Data file names, which can be set by the program based on the computer clock or user specified, have extension names R61. Files can be converted to M61 format and viewed in DAT61MK2 program. Number of readings in a data file is limited only by the hard drive capacity, however it is strongly recommended to avoid huge data files (i.e one to two hours long data files are adequate). The maximum speed of data collection is approximately 18 readings per second assuming 5 Hz (or less) GPS input.

## 1.1 Program Requirements

To successfully use this software, you will need :

### Computer

- Mesa2 field computer (or similar) operating under Windows 10 or 7,
- minimum 4 Gb of RAM memory,
- USB port or other mean to transfer files,
- minimum 800 x 600 pixel display resolution,
- serial Ports:
  - one serial port for instrument plus one serial port if directly connected GPS receiver is to be used (USB to multiple RS-232 ports adapters can be used) or available Bluetooth connection in serial port mode.

### Geonics EM61-MK2

The EM61-MK2 instrument with associated cables (or Bluetooth option).

The EM61MK2win installation program SetupEM61MK2win.exe can be stored on DAT61MK2 CD disk and it is available for download from the Geonics web site. A necessary configuration file (with extension name .INI) is created in your field computer after the program is run for the first time.

## 1.2 Installing EM61MK2win

The program must be installed by running the SetupEM61MK2win that will setup the EM61MK-2win in the field computer. The installation program follows standard Windows procedure.

If the SetupEM61MK2win.exe program file is included on the DAT61MK2 CD disk, or it is downloaded from the web site it can be conveniently installed by copying the SetupEM61MK2win.exe to USB drive and running installation from USB drive inserted in Mesa2 or similar field computer.

After you run the program for the first time it will create permanent configuration file (.INI) which contains program settings. The configuration file is created in the folder ProgramData/Geonics/EM61MK2win/. The EM61MK2win data files contain extension name R61 and their base names should be limited to 8 characters.

## 1.3 Running EM61MK2win Program

Start EM61MK2win by double clicking the EM61MK2win icon in the Start|Programs menu, in Windows Explorer, or on the desktop if a shortcut was created. At the start, EM61MK2win displays the following screen.

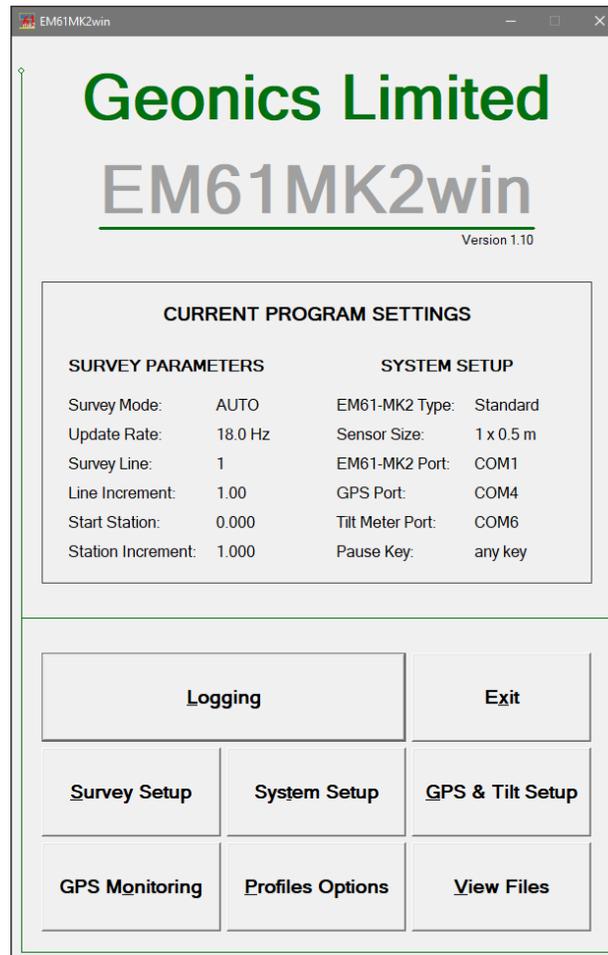
The EM61MK2win is a command button and dialog driven program. Command buttons can be executed by taping (if touch screen is used) or clicking with the left mouse button, or by pressing the indicated (underlined) character on the keyboard, or by using TAB to scroll through the buttons and ENTER to execute. In the Main Screen of the program Up and Down arrow keys can be also used to scroll through the buttons.

The Main Screen appears always as the first window after the program is started. It contains the name of the program, its version number, and list of command buttons with available options on

the right side in landscape screen orientation or at the bottom if portrait screen orientation is used. The major, left portion of the window contains information about current survey and system settings. This section is updated in real time as soon as the program parameters are changed in dialogs.

## 1.4 Main Screen

The Main Screen always appears after the program is started. It contains the name of the program, its version number, and a list of buttons representing the available options. The EM61MK2win Main Screen is displayed below.



These options are selected by clicking on buttons, or from keyboard using TAB/ENTER or shortcuts indicated by underline label characters. In case of Main Screen buttons the **Down** and **Up** arrow keys and <ENTER> can be used as well.

Short description for each of the options follows.

### Short description of Main Screen options

#### Logging

This option allows to monitor and log the EM61-MK2 output. The Logging screen starts always in Monitor mode, and then after a data file is created Logging mode is available. Monitor mode provides several options: the instrument nulling, performing Internal and External QC coil calibration, monitoring EM61-MK2 battery level, monitoring quality of GPS signal, etc.

## Survey Setup

The Survey Setup dialog will be displayed. All survey settings (survey line name, increments, etc.) can be specified in this dialog.

The Survey Setup dialog box is titled "Survey Setup" and contains the following settings:

- EM61-MK2 Settings:**
  - EM61MK2 Mode: Auto
  - Update Rate: 6 Hz
- Stations Parameters:**
  - Start Station: 0.000
  - Station Increment: 1.000
- Survey Line Parameters:**
  - Survey Line: 1
  - Line Increment: 1.00
  - Line Sequence: Alternate
  - Direction: North

Buttons: Cancel, OK

## System Setup

Dialog window that is associated with this option is used to set the instrument type, antenna size, serial port numbers, battery warning level, and type of pause key.

The System Setup dialog box is titled "System Setup" and contains the following settings:

- EM61-MK2 Setup:**
  - EM61-MK2 Type: Standard
  - Sensor Size: 1 x 0.5 m
  - Battery Warning: 10.50 V
- Serial Ports:**
  - EM61-MK2 Port: COM1
  - GPS Port: COM4
- Program Settings:**
  - Audio: Yes
  - Display Units: meters
  - Pause Key: any key
  - Disable Pause Button:  for Touch Screen/Mouse

Buttons: Cancel, OK

## GPS & Tilt Setup

The GPS & Tilt Setup dialog allows to disable and enable GPS and Tilt Meter (if available) data acquisition. This option is also used to set the serial port number used for GPS and Tilt Meter inputs and to specify necessary GPS serial port communication settings.

## GPS Monitoring

The program enters terminal mode and displays input from GPS. This function is very convenient to test communication with GPS receiver and examine GPS stream type.

## Display Options

The dialog which will allow you to specify colour and thickness of profile lines will appear. This dialog provides also choice of linear or compressed amplitude used for profile display.

## View Files

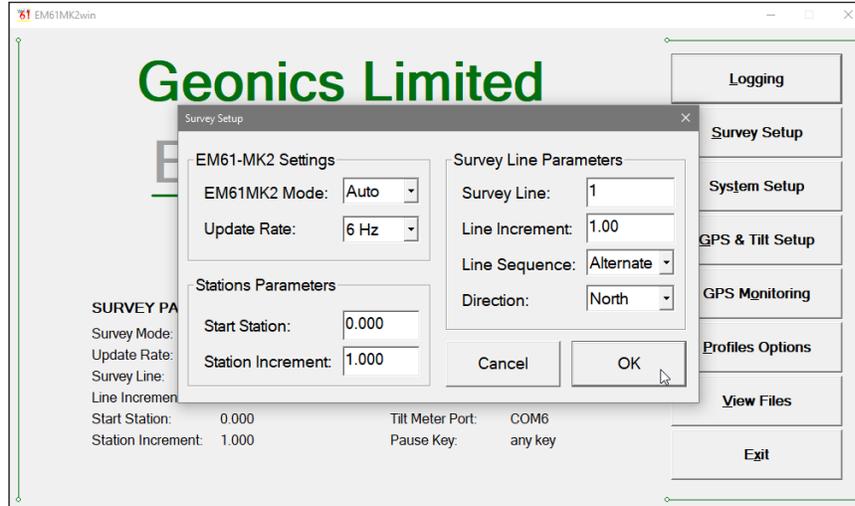
This option can be used to open collected data file and display survey line profiles.

## Exit

This option will terminate the program execution.

## 2. Survey Setup

The Survey Setup dialog, presented below for program in landscape display mode, contains several parameters which affect two important procedures: instrument settings (instrument mode, update rate, etc.) and survey geometry layout (survey line names, start station, station increment, etc.).



To select any option click on the corresponding drop-down list box or text box, or use TAB key to scroll to the option and then use mouse or the **Down** and **Up** keys in drop-down box (parameters that have only a few possible options), or keyboard for text box entry.

Description of Options and Parameters:

### EM61-MK2 Mode

This option allows you to select the type of instrument used. In the drop-down list box select Standard for the EM61-MK2 or High Power if EM61-MK2 High Power (HP) modification is used.

Set the EM61-MK2 mode of operation by selecting an item from the drop-down listbox labeled EM61 Mode. Available modes are: Auto, Wheel, and Manual. These modes of operation are described below.

#### Auto Mode

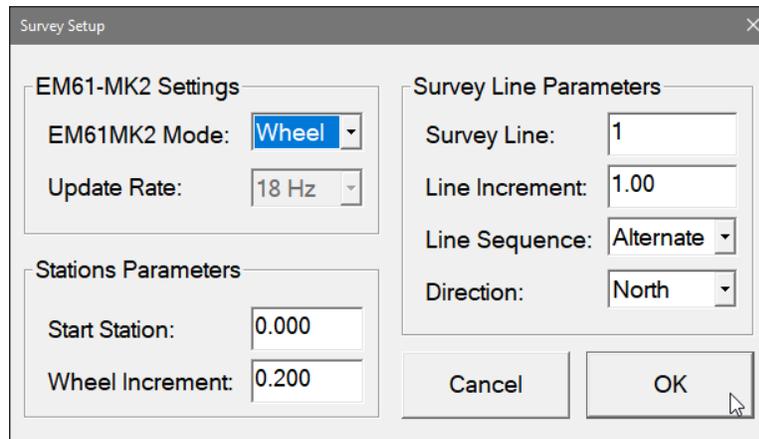
Readings will be triggered automatically at a specified frequency (see option Update Rate).

Please note that while in the former data acquisition system (DAS70) Stn Increment (station increment) had only two options: Positive or Negative, in the current program this value is optional.

#### Wheel Mode

Readings will be triggered automatically by a counter attached to the wheel. Wheel increment is approximately 20 cm (or 0.64 foot) for the EM61-MK2 equipped with 1 x 0.5 m or 1 x 1 m antennas. The Hand Held EM61HH-MK2 has two wheel increments 0.1 and 0.2 m. Check the wheel increment setting on the antenna assembly.

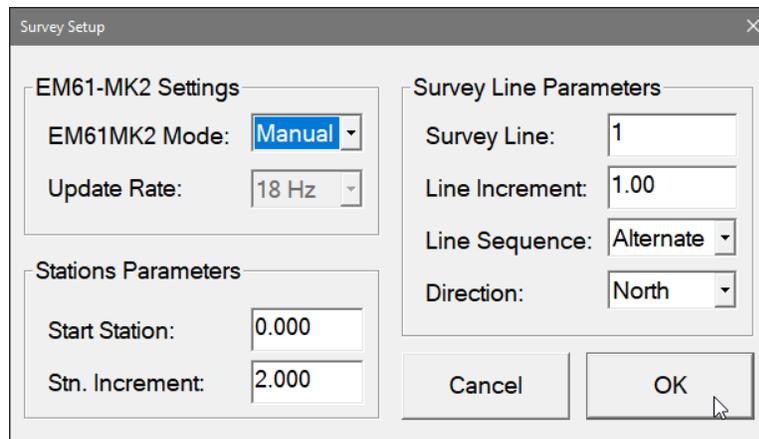
When Wheel mode is selected option Reading/second is not available, see figure below. Please note that while in former data acquisition system (DAS70) Stn



Increment (station increment) had only two options: Positive or Negative, in the current program this parameter is optional and its value has to be entered according to used wheel increment.

### Manual Mode

Readings will be taken only while the manual trigger (switch on the logger cable) is pressed. This mode may be used only in very specific applications since the highly



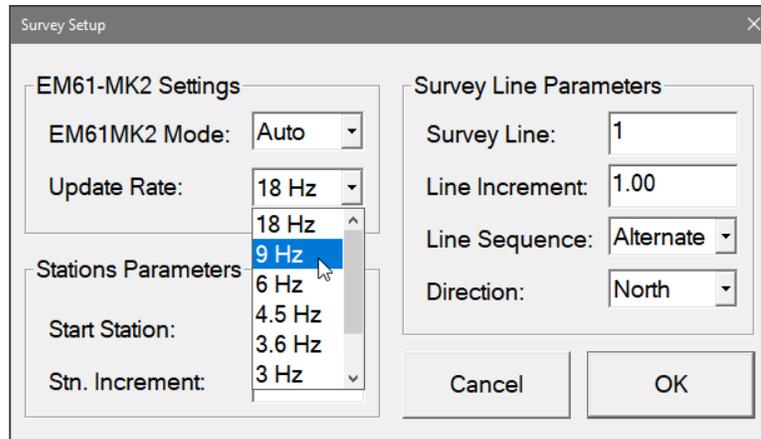
dynamic EM61-MK2 response requires finely spaced data points. Please note that when Manual mode is selected option Reading/second is not available.

### Update Rate

This option is available only in Auto mode. Clicking on the down arrow next to the text box labeled Update Rate opens a drop-down box showing available settings: 18 Hz, 9 Hz, 6 Hz, 4.5 Hz, 3.6 Hz, 3 Hz, 2 Hz, and 1 Hz.

This parameter describes number of readings per second that will be taken. The EM61-MK2 frequency is based on the base data output of above 18 readings per second. Therefore selections reflect the nearest possible base frequency of the instrument, i.e. at user selection of 18 Hz program will record every record (effectively close to 18.5 Hz), at selection 9 Hz the program will record every 2nd reading (result frequency very close to 9 readings/s), selection 6 Hz will cause program to record every 3 rd reading, and so on.

There is a difference between EM61-MK2 units whether they include the communication option or not.



In cases of older units not using Bluetooth any number larger than zero can be entered, however the EM61-MK2 maximum frequency of data output is approximately 12 readings per second. For values lower than 12 readings/s the real rate of data collection will be relatively close to specified value.

The EM61-MK2 with Bluetooth communication has a slightly different way of streaming data and values of selected update rate will be very close to effective number of readings per second.

#### Survey Line (survey line name)

Activate text box by clicking with a mouse left button or using TAB key and then enter desired name (number) for the survey line.

This is a user's tag number/name for the profile line. The length of the name can not exceed 8 characters. The line name is usually used as a coordinate perpendicular to the survey lines direction. For example, when survey lines are laid out along W-E direction stations describe W-E coordinate, while Line names may describe S-N (vertical on a map) coordinate.

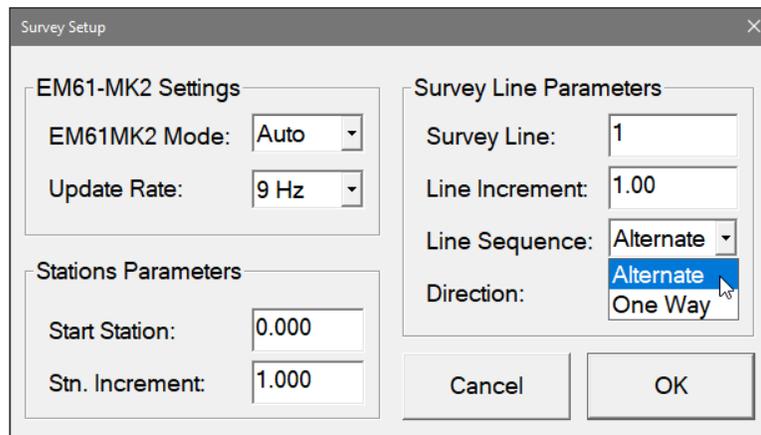
#### Line Incr. (survey line name)

Activate text box by clicking with a mouse or using TAB key and then enter desired for the survey line increment.

This parameter specifies the distance by which survey lines will be separated. This setting will be used to determine number (name) of the next survey line.

#### Sequence

When this option is highlighted and drop-down box is expanded use mouse or use **Down** or **Up** cursor key to toggle between two available settings: Alternate and One Way.



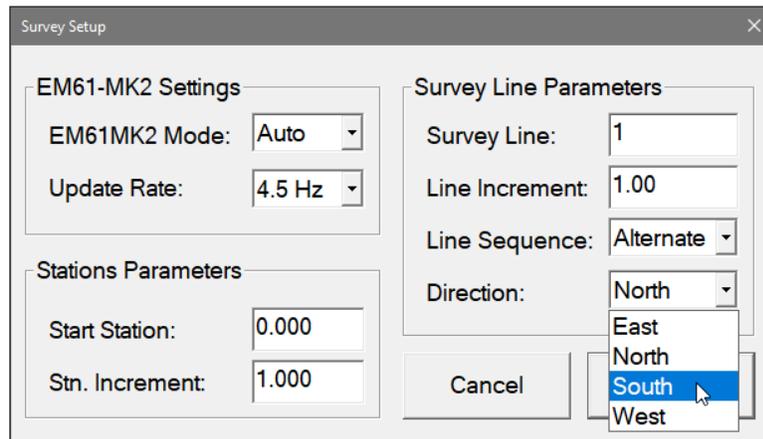
Alternate is used when neighboring lines are surveyed in the opposite direction, which is the most common procedure during field surveys.

One Way is used when each survey line is traversed in the same direction.

The choice of this parameter will affect the default start station, a signature of the station increment, and line direction when parameters for the next survey lines is determined.

### Direction

Clicking on the down arrow next to the text box opens a drop-down box showing the available options, or when the keyboard is used activate the text box and then by using up or down arrow keys select one of four available settings: East, West, South, and North. This parameter indicates the heading of the survey line.



### Start Station (start station of a survey line)

Activate text box by clicking or using **TAB** key and then enter the desired value for the start station.

This parameter specifies the starting station number for the selected survey line. This value is used in conjunction with Station Increment to calculate the current station number for display purposes.

### Stn Increment (station increment)

Activate text box by clicking with a mouse or using **TAB** key and then enter the desired value for the station increment.

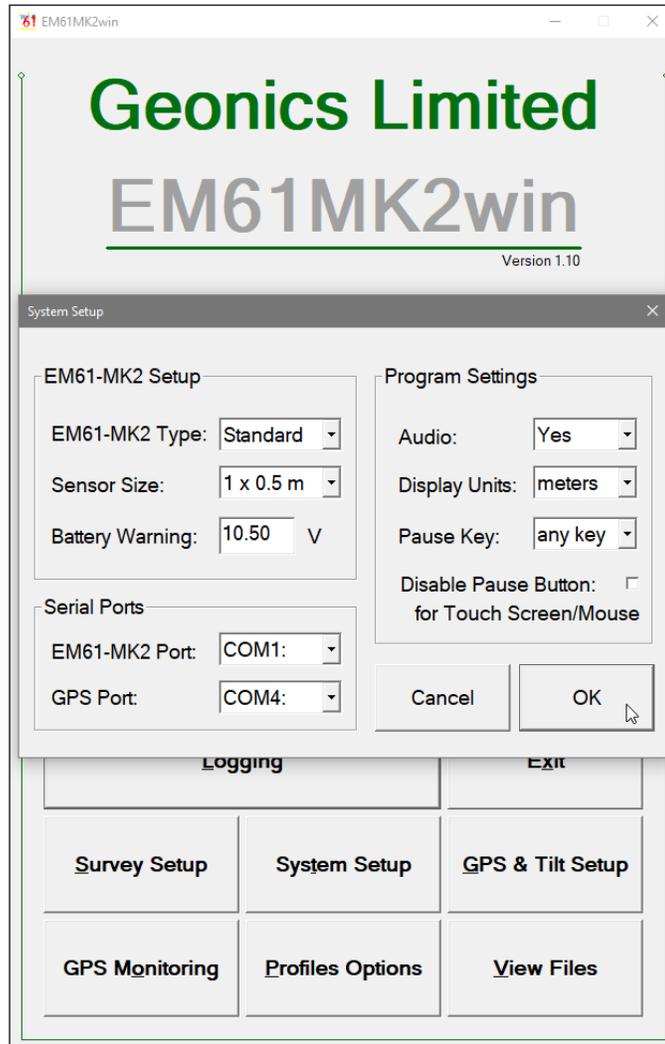
This parameter specifies the station increment for the selected survey line. This value is used in conjunction with Start Station to calculate the current station number for display purposes.

After all the parameters in the Survey Setup dialog are updated click on the button **OK** or press **ENTER** key to accept the displayed settings. The program will return to the Main Screen. Updated settings will be written to the initial file and they will be given as default parameters in the subsequent Survey Setup dialog.

To return to original settings (state before this dialog was selected) click on the **Cancel** (X) button or press **Esc** key. All parameters will be reset to initial settings and the program will return to the Main Screen.

### 3. System Setup

This dialog allows you to specify used type of the instrument, EM61-MK2 antenna size and set several parameters in the logging program. The System Setup dialog is presented below.



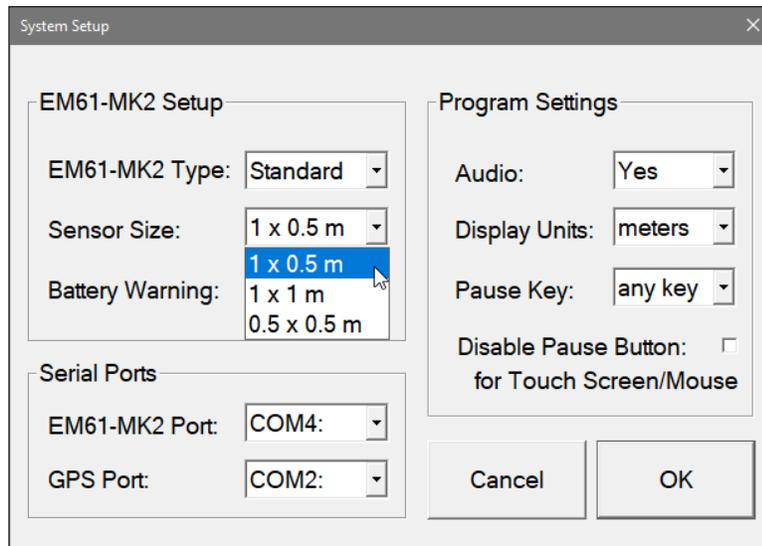
Description of Parameters:

#### EM61-MK2

This option allows you to select type of used instrument. In the drop-down list box select Standard for the EM61-MK2 or High Power if EM61-MK2 High Power (HP) modification is used.

#### Sensor Size

The Sensor Size option allows you to select the size of the EM61-MK2 sensor. If the EM61HH-MK2 Hand Held antenna is used this option can be ignored, the program recognizes Hand Held antenna connection automatically. If the standard antennas are used (1 x 0.5 m, 1 x 1 m, or 0.5 x 0.5 m) the size of the sensor must be specified before monitoring the instrument output. Select proper size of the EM61-MK2 sensor in the drop-down list box labeled Sensor Size.

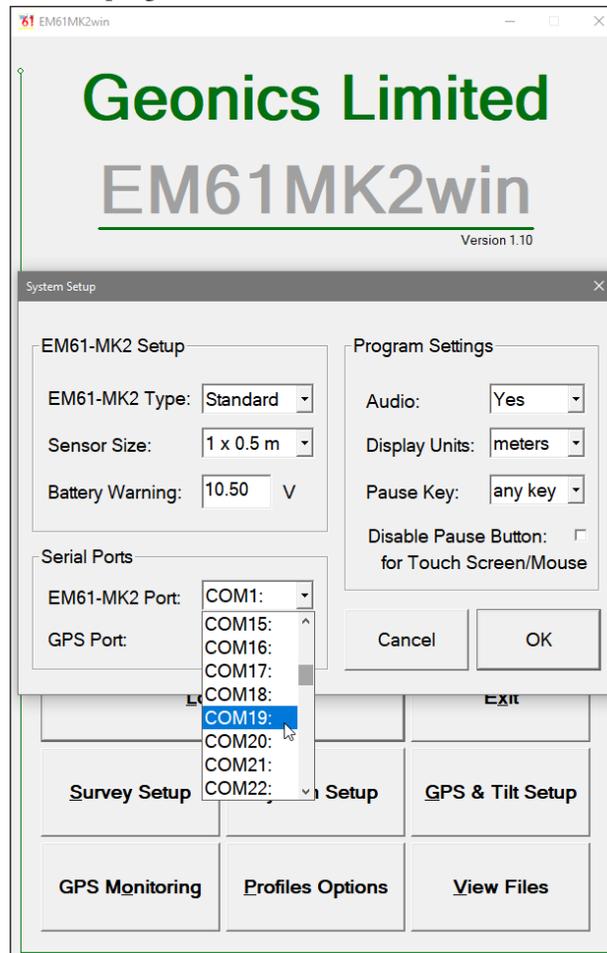


### Battery Warning

Specify instrument battery warning level. When the EM61-MK2 battery voltage will reach and drop below specified value the program will display battery voltage on the red background.

### EM61 Port

The number of serial port that is assigned to the EM61-MK2. Available selections: COM1 to COM60. The program default is COM1. Communication parameters for the selected



serial port are set by the program, since the EM61-MK2 operates at fixed settings: Baud Rate (9600), Parity (N), Data Bits (8), and Bit Stop (1).

This port must be different than the port specified in the list box "GPS Port:" (see below) or in the GPS Port Setup dialog window (see chapter 4), otherwise a message will be displayed and ports will have to be reassigned.

Select port number in the drop-down list box.

### GPS Port

The number of serial port that is assigned to the GPS receiver. Available selections: COM1 to COM60. The program default is COM2. Communication parameters for the selected serial port can be set in GPS Port Setup dialog. The GPS port can be also assigned in the latter dialog.

This port must be different than the port specified as the EM61-MK2 serial port and serial port assigned for Tilt Meter (if employed).

Select port number in the drop-down list box similarly to EM61-MK2 port assignment procedure.

### Audio

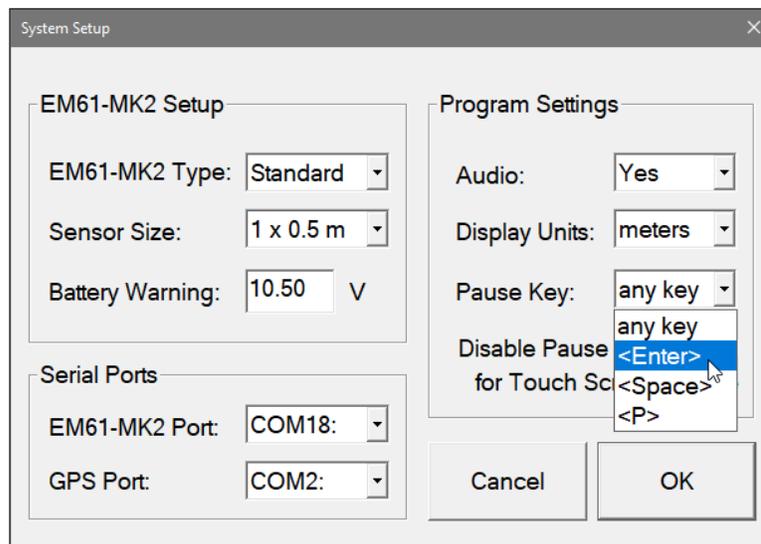
Two selections are available: **Yes** or **No**. The audible click will be generated at each reading when this option is enabled. At fast rate (above 5 readings/s) the sound may appear not uniform, however this does not affect quality of data acquisition.

### Display Units

Three selections are available: **Meters**, **Feet** or **US Survey Feet**.

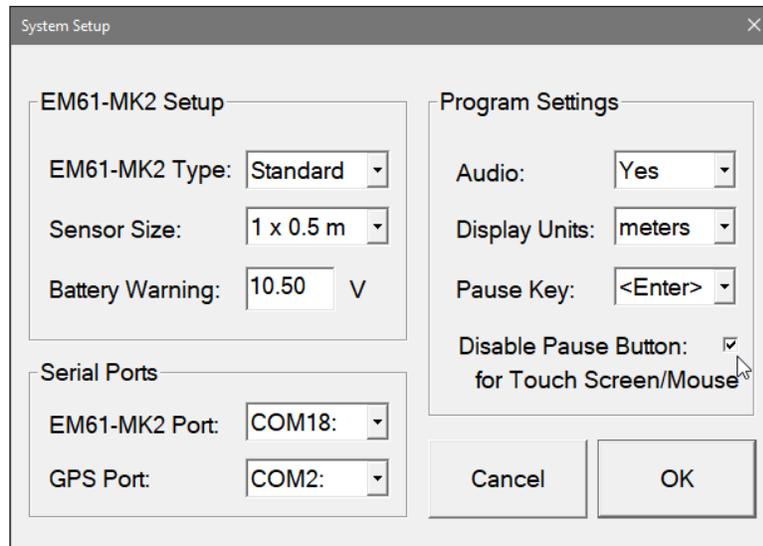
### Pause key

Four selections are available: **any key**, **Enter**, **Space Bar**, and **P** This feature is used to pause data recording during logging session. Default setting **any key** can be changed to one of the three specific keys for field conditions where a logger key can be accidentally pushed causing unwanted stop of data logging. When Windows based tablet computer Mesa2 is used the best setting is **<ENTER>** key, since user specified keys P1, P2, and P3 may have various assignment, and when **<any key>** is selected then only four arrow keys and Enter key are reliable.



### Disable Pause Button (for Touch Screen)

This option is useful when Mesa2 and similar computer with enable touch screen are used. It helps avoiding logging procedure by accidental touch of the computer display. When this option is checked the touch operation is disabled for the Pause button and logging can be paused only by pressing computer key (for example <Enter>).



In case of a conflicting Pause Key (lack of specified key in the computer) a soft keyboard can be opened and used at any moment. This option affects only sensitivity of the Pause button, other touch enabled functions are not affected.

After all the parameters in the System Setup dialog are updated click on the button **OK** or press **ENTER** key to accept the displayed settings. The program will return to the Main Screen. Updated settings will be written to the initial file and they will be given as default parameters in the subsequent System Setup dialog.

To return to original settings (state before this dialog was selected) click on the **Cancel** (or window X) button or press **Esc** key. All parameters will be reset to initial settings and the program will return to the Main Screen.

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## 4. GPS and Tilt Meter Setup & GPS Monitoring

The GPS and Tilt Meter Ports Setup dialog allows for enabling GPS and Tilt Meter inputs, setting communication parameters for serial port associated with GPS, and enabling Tilt Meter device and selecting its Serial Port number. GPS Monitoring window allows you monitoring the GPS output in terminal mode and to send NMEA commands to GPS receivers.

### 4.1 GPS and Tilt Meter Ports Setup

After the GPS & Tilt Setup button was clicked on (or executed from the keyboard) in the Main Screen the GPS and Tilt Meter Ports Setup dialog window appears on the screen. This dialog is divided into two sections: GPS Settings and Tilt Meter Settings. The GPS section allows you to enable and disable the GPS input, select serial port for GPS input, and to specify serial communication parameters matching GPS receiver settings. The Tilt Meter section allows you to enable Tilt Meter sensor (assuming the EM61-MK2 is equipped with the Geonics installed sensor), select its Serial Port number, and to specify GPS Antenna height above the ground. The dialog is presented below.

The screenshot shows a dialog box titled "GPS and Tilt Meter Ports Setup". It is divided into two main sections: "GPS Settings" and "Tilt Meter Settings".

- GPS Settings:**
  - GPS Input: Enabled
  - Serial Port: COM4
  - Baud Rate: 9600
  - Parity: No
  - Data Bits: 8
  - Stop Bits: 1
- Tilt Meter Settings:**
  - Tilt Meter: Enabled
  - Serial Port: COM6
  - GPS Height [m]: 1.65

Below the Tilt Meter Settings section, there is a note: "If Grid Positioning is used enter Height of the Main Sensor". At the bottom of the dialog, there are two buttons: "Cancel" and "OK".

Description of Options and Parameters:

#### GPS Input

This option allows you to Enable/Disable a serial port for GPS input. When Disabled is chosen logging and monitoring screens will display message "GPS disabled" in place of GPS parameters.

The GPS Input can be Enabled even if there is no GPS system connected to the computer. In such case data file will contain proper sequence of EM61-MK2 readings without any GPS input.

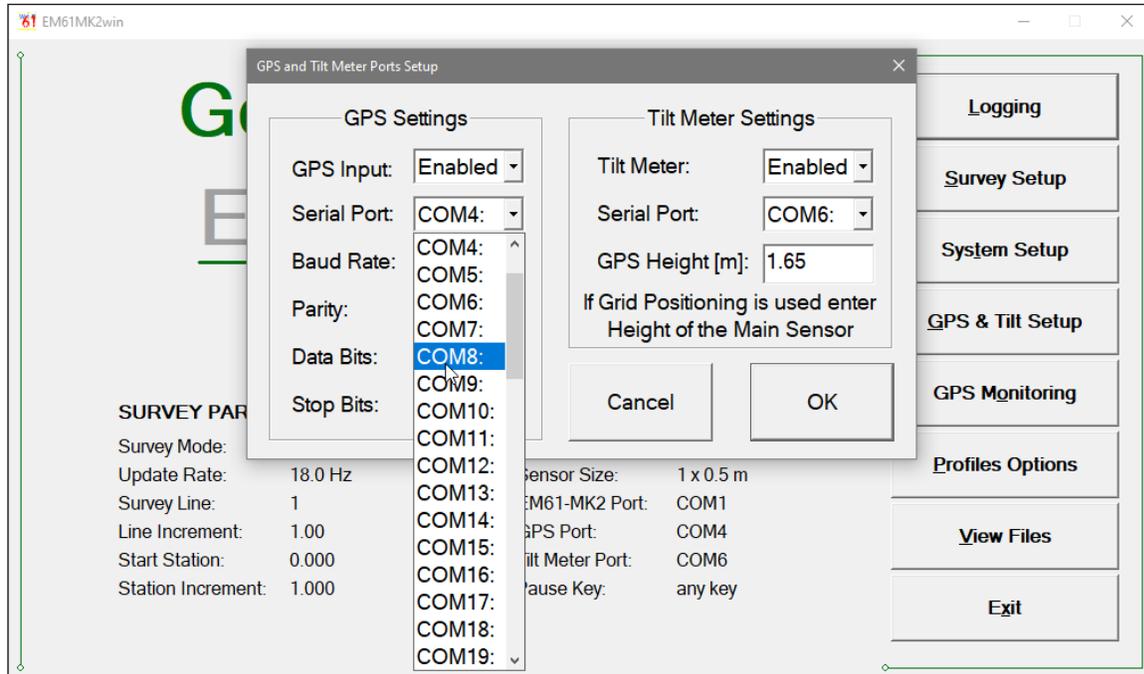
Clicking on the down arrow next to the text box labeled GPS Input opens a drop-down box showing the available settings, or when the keyboard is used activate the text box by pressing TAB key and then by using up or down arrow keys select one of two available items: Enabled and Disabled.

#### Serial Port

The number of serial port that is assigned to the GPS input. Available selections: COM1 to COM60. The program default is COM2. Communication parameters for the selected serial port can be determined in options described below.

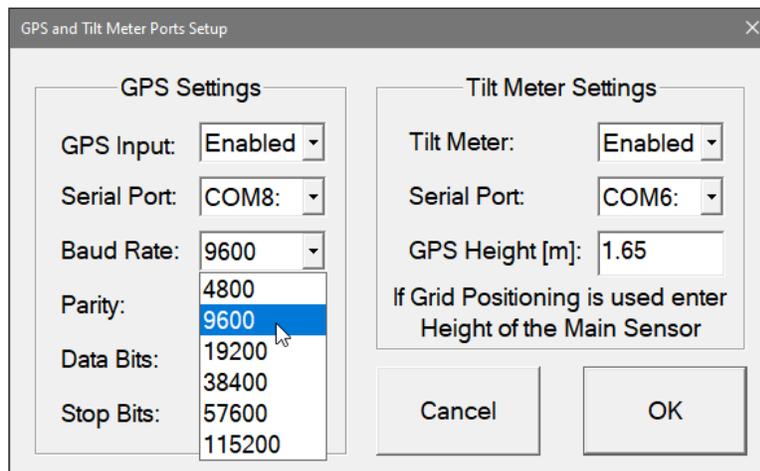
This port must be different than the port specified in the System Setup menu (for EM61-MK2), otherwise a message will be displayed and ports will have to be reassigned.

Clicking on the down arrow next to the text box labeled Serial Port opens a drop-down box showing the available ports, or when the keyboard is used activate the text box by pressing TAB key and then by using up or down arrow keys select one of available items.



### Baud Rate

Specify Baud Rate for the output port, the selected value should match the Baud Rate of the GPS system, default is 9600. Available settings are: 4800, 9600, 19200, 38400, 57600, and 115200.



Clicking on the down arrow next to the text box labeled Baud Rate opens a drop-down box showing the available parameters, or when the keyboard is used activate this text box by pressing TAB key and then by using up or down arrow keys select one of available items.

### Parity

Select Parity for the output port, the parameter should match the Parity set in the GPS serial port settings. Available settings are None, Even, and Odd; default is N.

Clicking on the down arrow next to the text box labeled Parity opens a drop-down box showing the available parameters, or when the keyboard is used activate this text box by pressing TAB key and then by using up or down arrow keys select one of available items.

### Data Bits

Specify Data Bits for the output port, the selected value should much settings in the GPS receiver, default is 8. Other available selection is 7.

Clicking on the down arrow next to the text box labeled Data Bits opens a drop-down box showing the available parameters, or when the keyboard is used activate this text box by pressing TAB key and then by using up or down arrow keys select one of available items.

### Stop Bits

Specify Stop Bits for the output port, the selected value should much settings in the GPS receiver, default is 1. Available selections are 1 or 2.

Clicking on the down arrow next to the text box labeled Stop Bits opens a drop-down box showing the available parameters, or when the keyboard is used activate this text box by pressing TAB key and then by using up or down arrow keys select one of available items.

### Tilt Meter

This option allows you to Enable/Disable a serial port for Tilt Meter input. When Disabled is chosen logging and monitoring screens will display message “Tilt Meter Disabled” in place of Pitch and Roll parameters.

If the Tilt Meter is Enabled and if there is no Tilt Meter sensor connected to the computer the program will prompt and the input must be Disabled.

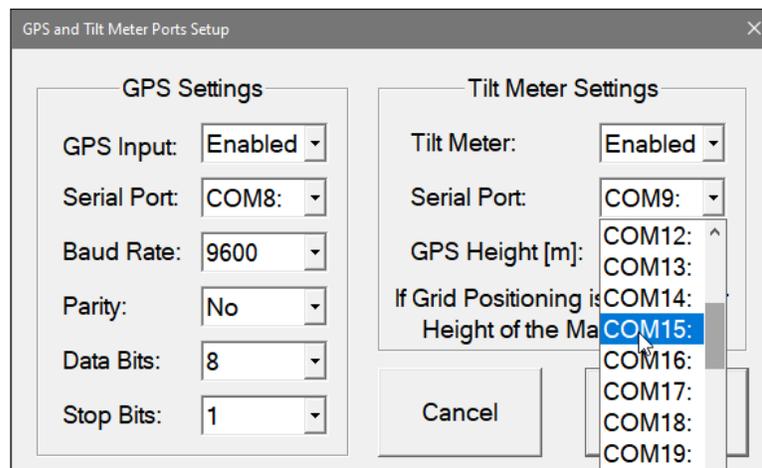
Clicking on the down arrow next to the text box labeled Tilt Meter opens a drop-down box showing the available settings: Enabled and Disabled.

### Serial Port

The number of serial port that is assigned to the GPS input. Available selections: COM1 to COM60. The program default is COM2. Communication parameters for the selected serial port are fixed.

This port must be different than ports specified in the System Setup menu (for EM61-MK2) and Tilt Meter, otherwise a message will be displayed and ports will have to be reassigned.

Clicking on the down arrow next to the text box labeled Serial Port opens a drop-down box showing the available ports, or when the keyboard is used activate the text box by pressing TAB key and then by using up or down arrow keys select one of available items.



## GPS Height [m]

This option allows you to specify the GPS Antenna height above the ground. The height must be specified in meters. This parameter is necessary for procedure calculating Roll and Pitch corrections while determining coordinates during creating XYZ data file.

In case Grid Positioning is used, or GPS antenna has no rigid fix with the EM61-MK2 then enter Height of the main (bottom) EM61-MK2 sensor.

After all the parameters in the GPS and Tilt Meter Ports Setup dialog are updated click on the button **OK** or press **ENTER** key to accept the displayed settings. The program will return to the Main Screen. Updated settings will be written to the initial file and they will be given as default parameters in the subsequent Survey Setup dialog.

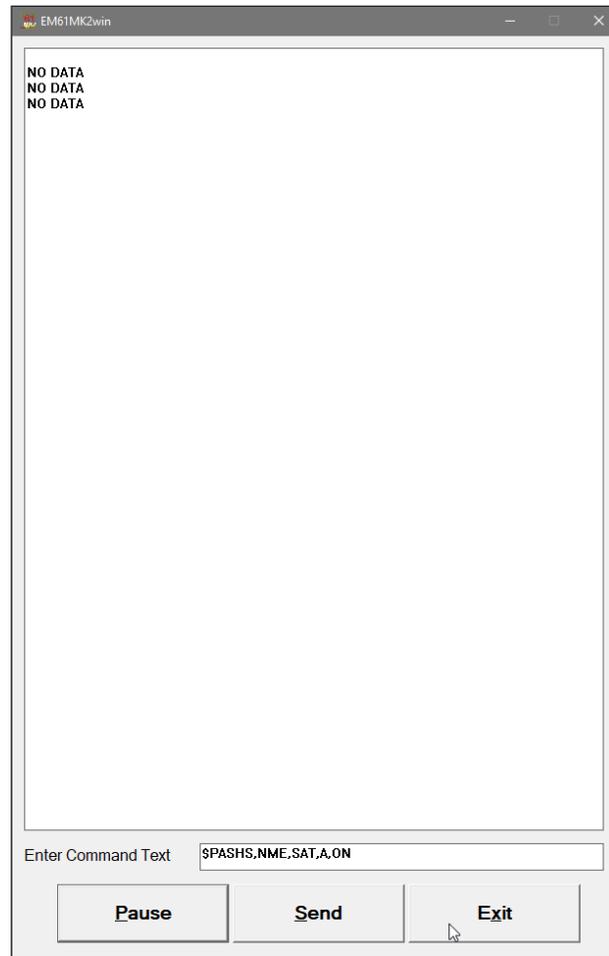
To return to original settings (state before this dialog was selected) click on the **Cancel** button. All parameters will be reset to initial settings and the dialog window will disappear.

## 4.2 Monitoring GPS Receiver Output

After the Main Screen command button **GPS Monitoring** is clicked or executed by the keyboard the program will display the GPS Monitoring window in terminal mode. In this mode the screen is divided into three parts. The terminal window in the top portion of the screen displays the GPS receiver output. The middle portion labeled NMEA Command is used to display entered NMEA commands previously sent to the GPS receiver, and at the bottom, command buttons with available options (Pause/Go, Send, and Exit) is displayed. These buttons can be clicked on, executed by TAB key and ENTER keys, or by using shortcuts (pressing underlined letter keys). This screen is shown below.

```
EM61MK2win
$GPRMC,031.442,V,4336.8263,N,07937.6651,W,0.0,0.0,070518,10.8,W,S*2F
$GPRMB,V,9.99,L,TOUR4,TOUR5,3512.7660,N,07630.8760,W,523.914,163.0,,V,S*6F
$GPGGA,031.442,4336.8263,N,07937.6651,W,8.10,2.0,190.0,M,-35.4,M,*7E
$GPGSA,A,3,02,05,06,09,12,13,15,20,25,29,,3.6,2.0,3.0*35
$GPGSV,3,1,10,02,54,088,48,05,82,039,51,06,13,097,39,09,09,035,37*76
$GPGLL,4336.8263,N,07937.6651,W,031442,V,S*53
$GPBOD,325.5,T,336.2,M,TOUR5,TOUR4*43
$GPBWC,031442,3512.7660,N,07630.8760,W,163.0,T,173.8,M,523.914,N,TOUR5,S*4F
$GPVTG,0.0,T,10.8,M,0.0,N,0.0,K*77
$GPXTE,V,V,9.99,L,N,S*18
$GPRMC,031.444,V,4336.8263,N,07937.6651,W,0.0,0.0,070518,10.8,W,S*29
$GPRMB,V,9.99,L,TOUR4,TOUR5,3512.7660,N,07630.8760,W,523.914,163.0,,V,S*6F
$GPGGA,031.444,4336.8263,N,07937.6651,W,8.10,2.0,190.0,M,-35.4,M,*78
$GPGSA,A,3,02,05,06,09,12,13,15,20,25,29,,3.6,2.0,3.0*35
$GPGSV,3,2,10,12,18,214,37,13,26,157,43,15,10,189,37,20,29,243,44*77
$GPGLL,4336.8263,N,07937.6651,W,031444,V,S*55
$GPBOD,325.5,T,336.2,M,TOUR5,TOUR4*43
$GPBWC,031444,3512.7660,N,07630.8760,W,163.0,T,173.8,M,523.914,N,TOUR5,S*49
$GPVTG,0.0,T,10.8,M,0.0,N,0.0,K*77
$GPXTE,V,V,9.99,L,N,S*18
$GPRMC,031.446,V,4336.8263,N,07937.6651,W,0.0,0.0,070518,10.8,W,S*2B
$GPRMB,V,9.99,L,TOUR4,TOUR5,3512.7660,N,07630.8760,W,523.914,163.0,,V,S*6F
$GPGGA,031.446,4336.8263,N,07937.6651,W,8.10,2.0,190.0,M,-35.4,M,*7A
$GPGSA,A,3,02,05,06,09,12,13,15,20,25,29,,3.6,2.0,3.0*35
$GPGSV,3,3,10,25,21,252,42,29,48,306,47*7E
$GPGLL,4336.8263,N,07937.6651,W,031446,V,S*57
$GPBOD,325.5,T,336.2,M,TOUR5,TOUR4*43
$GPBWC,031446,3512.7660,N,07630.8760,W,163.0,T,173.8,M,523.914,N,TOUR5,S*4B
$GPVTG,0.0,T,10.8,M,0.0,N,0.0,K*77
$GPXTE,V,V,9.99,L,N,S*18
Enter Command Text SPASHS,NME,SAT,A,ON
Pause Send Exit
```

As soon as the EM61MK2win screen is in terminal mode and the GPS is streaming data, each message transmitted by GPS receiver will appear in the top portion of the display (the end may be cut off if an NMEA message is longer than screen). The display is updated with the frequency the GPS receiver outputs data. This allows you to recognize the GPS update rate and type of messages being sent by the connected GPS. In cases where the GPS data is not received by the logger a message NO DATA and current time will appear in the top window of the display, as shown below.



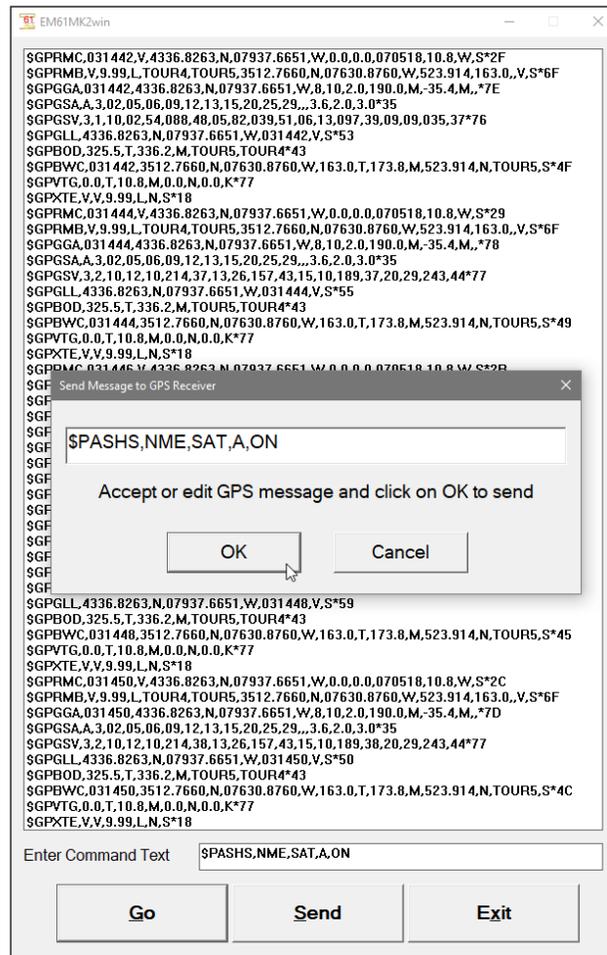
The message NO DATA is normally updated with a rate of 7 seconds. This may indicate the following: serial port number not correctly specified in Set Port for GPS dialog, GPS receiver not sending any data, and not working or not connected GPS receiver. If the message is updated more often than 7 seconds (i.e. every 1 or 2 seconds) or the display does not show legible characters, it is possible that the GPS is working correctly and is connected to the proper serial port, however communication parameters are not specified correctly. In most cases the Baud Rate or Parity must be adjusted.

The NO DATA message may also appear if the GPS data are received correctly, but the GPS receiver was set to send data with a time interval longer than 7 seconds. In this case the NO DATA message will be displayed in between GPS messages. This indicates that the GPS is working correctly, however the operator should consider adjustment of the GPS receiver output update rate. Most high resolution geophysical surveys require positioning update of 1 or 2 seconds, and a 5 seconds interval can be used only when the survey is carried out at an even pace and along relatively straight survey lines.

The monitoring display can be stopped any time by using button labeled **Pause**. At that time scrolling of the GPS output will be stopped, and the button will be labeled **Go**. The next click (or keyboard action) on this button will activate receiving and display of GPS data.

The button labeled **Send** allows you to send a NMEA command to the GPS receiver. It is preferable if the GPS receiver parameters are set using the GPS manufacturer software or controller (GPS logger or panel keys). However, **when the operator is familiar with NMEA protocol and structure of commands for a given GPS system**, this function can be very convenient and useful when the update rate and enabling or disabling messages in the data stream is required.

After the button **Send** is clicked a dialog titled GPS Message is displayed and the beginning of the standard NMEA command, **\$PASHS**, or the last entered command is displayed. After the entire NMEA command is typed in, click **OK** button or press the key **<ENTER>** to send the command to the GPS receiver. Clicking the **Cancel** button or pressing the **<Esc>** key will cancel the command and hide the NMEA Message dialog. An example of a command that will enable the NMEA message **SAT** is given in the below figure (it is assumed that the GPS receiver output serial port is A).

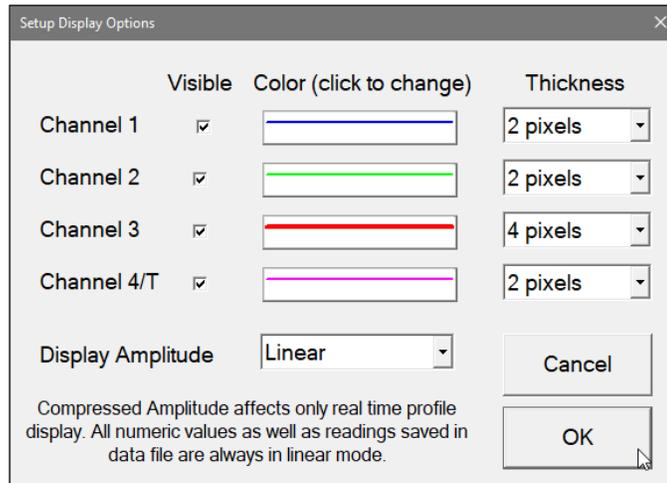


After this command is received by the GPS receiver, the confirmation message will be sent by the receiver (**\$PASHR, ACK\*3D**) and data stream will contain the message **SAT** if it is available in the connected GPS receiver.

Please note, that not every GPS system accepts and uses the same standard set of NMEA commands and messages. In addition, some GPS systems do not accept commands sent by the serial port at all. The configuration of these type of receivers can be updated only by the controlling device (usually GPS logger, controller, or the receiver panel keys).

## 5. Display Options

After the **Display Options** button was clicked (or executed from the keyboard) in the Main Screen the Setup Display Options dialog window appears on the screen. This dialog allows you to enable and disable the display of each channel profile, specify color and thickness of profiles, and select linear or compressed amplitude for profiles. The dialog is presented below.



Description of Options and Parameters:

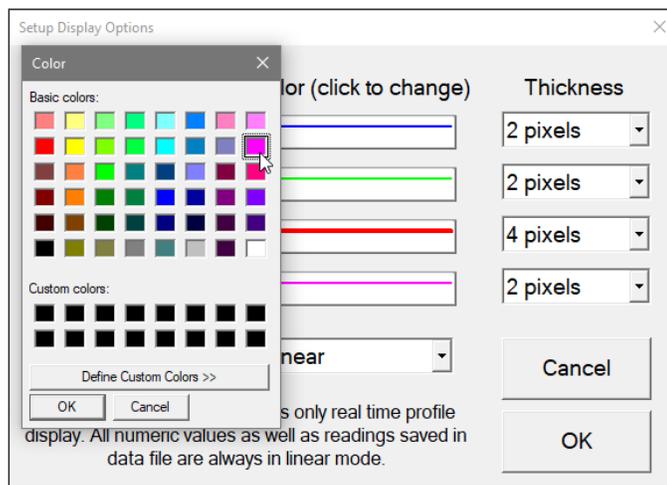
### Visible

To enable or disable displaying of each channel profile click on the corresponding button labeled Visible. Profiles of all channels with checked buttons will be displayed during data logging.

Regardless of which channels are chosen to be displayed as profiles, data for all four channels will be displayed in numeric form below profile display.

### Color

To change colour of each profile click on the corresponding button (with colour line) labeled **Color (click to change)**. The following dialog titled Color will appear.



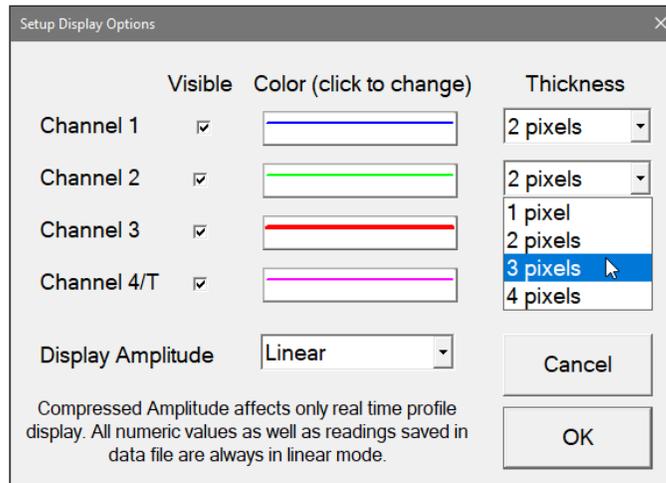
Select desired colour by clicking on a colour box (the selected colour box will be highlighted).

Click on the button **OK** or press **ENTER** key to accept the highlighted colour. The Color dialog will disappear and the colour of the appropriate channel button will updated. To cancel colour selection click **Cancel** (X) button or press **Esc** key.

### Thickness

Specify thickness of a profile for a desired channel by using one of four drop-down boxes labeled thickness. Thickness of a profile curve is expressed in pixels. Available settings are: 1, 2, 3, or 4 pixels.

Clicking on the down arrow next to the text box (labeled by number of pixels) opens a drop-down box showing available selection (see Figure below). Select thickness by clicking on the desired selection. If keyboard is used activate text box by pressing TAB key (till the box is highlighted) and then by using up or down arrow keys select one of available items.



### Profile Amplitude

This option allows you to select Linear or Compressed amplitude scale for profiles. The compressed amplitude (square root function) allows you to display the high dynamic range of the EM61-MK2 data in a legible way and it is recommended.

Clicking on the down arrow next to the text box labeled Profile Amplitude opens a drop-down box showing available parameters, or when keyboard is used activate this text box by pressing TAB key and then by using up or down arrow keys select one of available items.

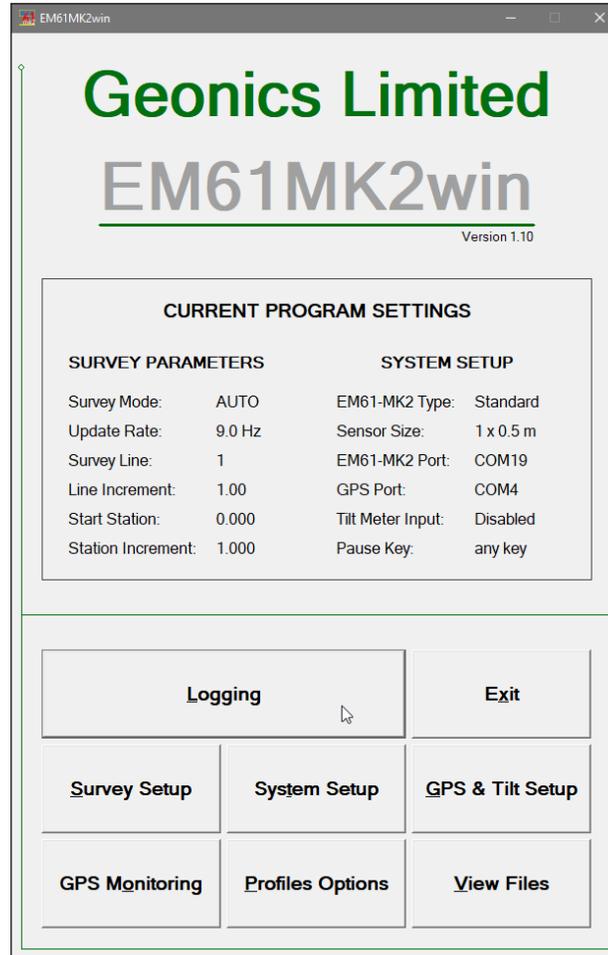
**Please note, that readings in numeric form are always given in mV (linear scale) regardless of the Profile Amplitude selection. Further, graphic display in the compressed scale does not affect readings saved in the data file. Data are always written to file in original form.**

After all the parameters in the Display Options dialog are updated click the button **OK** or press **ENTER** key to accept the displayed settings. The program will return to the Main Screen. Updated settings will be written to the initial file and they will be given as default parameters in the subsequent Survey Setup dialog.

To return to original settings (state before this dialog was selected) click the **Cancel** (X) button or press **Esc** key. All parameters will be reset to initial settings and the dialog window will disappear.

## 6. Logging Data

After the **Logging** button (in Main Screen) is clicked or executed by the keyboard, the program enters the logging session which contains three modes: Monitoring, Stand By and Logging. The program starts the logging session always in Monitoring mode. In this mode EM61-MK2 readings

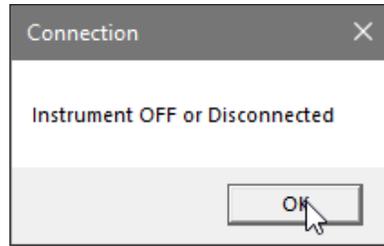


and GPS parameters can be quickly examined and some functions (creating data file, nuling, QC coil check) can be performed. After a data file is created in Monitoring mode, the program switches to Stand By mode and allows access to Logging mode. In Stand By mode instrument output can be monitored and some survey and logging parameters can be changed, and Logging mode is used only to record data. Two modes Stand By and Logging are toggled by **GO** and **Pause** buttons.

### 6.1 Monitoring Mode

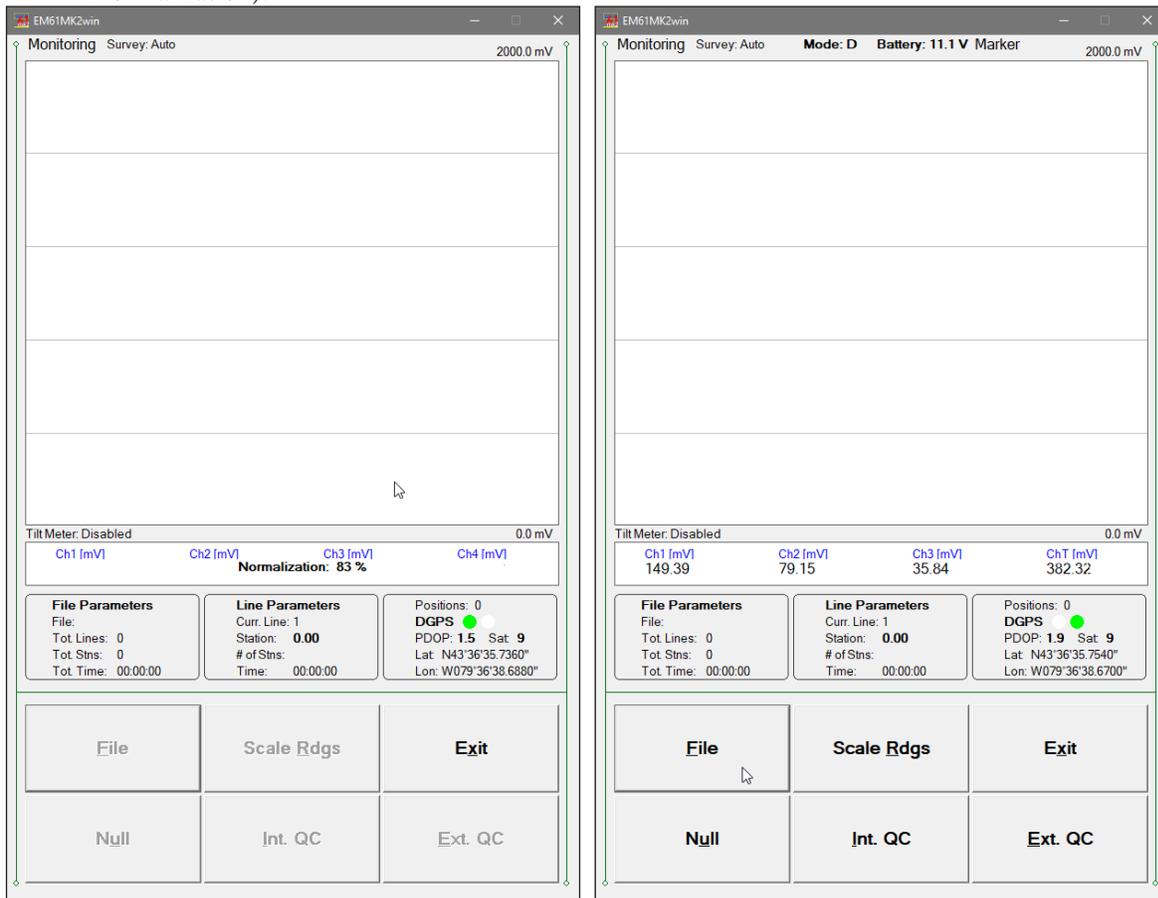
The Monitor mode allows initial inspection of the range of the instrument readings at a particular site, monitoring the instrument performance, quick inspection of the condition of the instrument battery, perform QC Coil check, and setting zero level of the instrument.

It is assumed that the instrument is turned ON prior to using this option. If the instrument is OFF or the instrument console is not connected to the computer the following message shown below will appear.



Check the connection or turn the instrument ON and select the Monitor/Log option again.

Assuming that the instrument works properly the program will display the Monitor mode window and will start normalization session which lasts less than 10 seconds. After the normalization is finished the layout of the Monitor window is as follows (left - during Normalization, right - after Normalization):



The Monitor (as well as Stand by and Logging) window is divided into five sections.

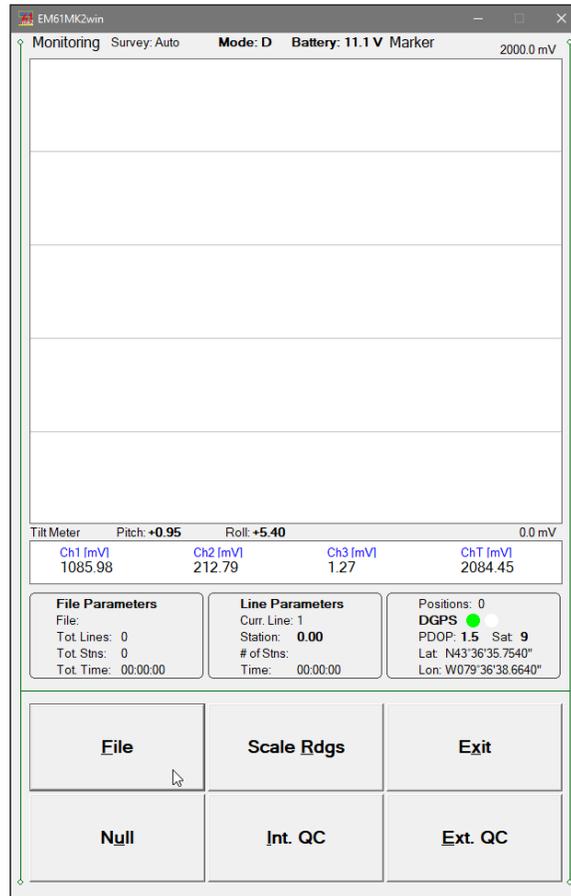
One line of text in the top section provides survey parameters (used in Stand By and Logging modes) and instrument information. In Monitor mode this section displays: instrument mode (4 or D), current display mode (Monitor, Stand By or Logging), and the EM61-MK2 battery level in Volts (following label **B:**). When fiducial marker is pressed then label **Marker** is displayed.

The second, largest graphic section will be used to display profiles during logging data. Numeric labels on the right side of profile window correspond to scale minimum (below the profile window) and maximum (above the profile window).

The remaining bottom section contains a window with current EM61-MK2 readings, three frames (File Parameters, Line Parameters, and GPS information), and command buttons located on the right side of the screen.

If Mode 4 was selected on the instrument panel (it is displayed at the top of the screen) channels 1, 2, 3, and 4 will be displayed under profile window, and when Mode D was selected (for Top and Bottom antennas) channels 1, 2, 3, and T will be given as labels in numeric window. The EM61-MK2 readings are updated approximately 10 times per second during the monitoring session.

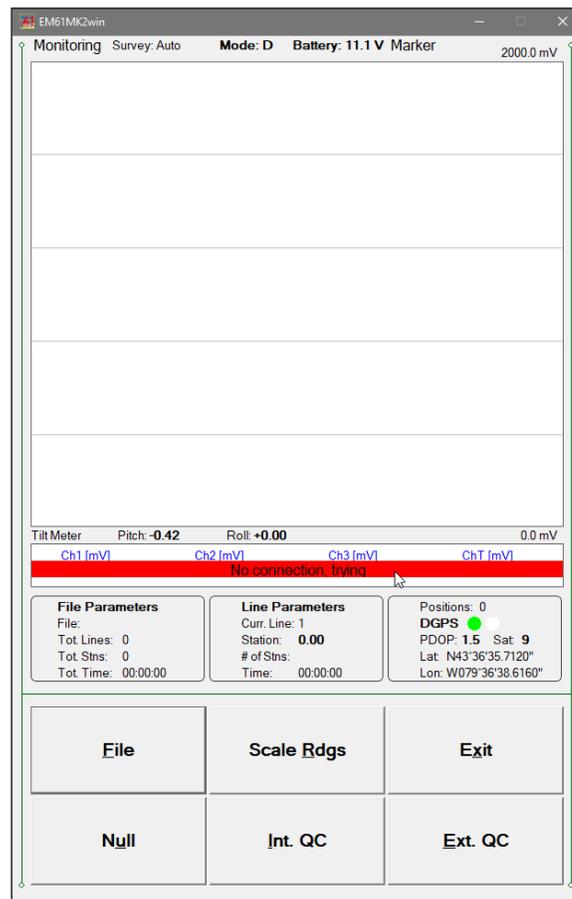
When GPS is Disabled in the Set GPS Port dialog a message **GPS Disabled** will be displayed. If the GPS port is Enabled and a working GPS receiver is connected to the field computer the Monitoring screen will display GPS parameters, as presented below.



In the above Figure one line of the display is dedicated to show the GPS status. A label **Positions** will be used during data acquisition, it will provide the number of GPS positions saved in the data file. Below, two lines display the parameters describing the quality of GPS positions. A label **DGPS** (Differential Global Positioning System) indicates that GPS readings are differentially corrected in real time, while label **AGPS** (Autonomous Global Positioning System) indicates lack of differential correction. On the right side of **DGPS** or **AGPS** label two green and white circles alternate. These two circles should alternate colours with the frequency of GPS update rate (usually 1 second intervals). If the circles do not change colours for long periods of time it means that the GPS system is not working or that it is not connected to the field computer. The next label **PDOP** with a value varying between 0 and 99.9 represents an index called Position Dilution of Precision (**PDOP**). This value is available only when messages both, GGA and GSA are received from GPS. The last label **Sat** and following number shows number of currently tracked satellites. Refer to section 4 (Set Port for GPS), Appendix B, and to GPS manuals for more information about GPS parameters. Two bottom lines of the frame give current Latitude and Longitude of the instrument position (datum WGS1984). Position is updated with frequency of GPS receiver stream.

Six command buttons located in the right bottom corner of the Monitor window lists the program functions available directly in the Monitor mode. Available options are as follows: **File** (create data file), **Scale Readings** (change scale for EM61-MK2 readings in profile window), **Exit** (exits the Monitor mode and returns the program to Main Screen, **Null** (perform nulling function), **Int. QC** (internal QC-coi calibration), **Ext. QC** (external QC-coil calibration).

In case of any problems with instrument connection, battery failure, or accidental instrument Turn Off a message "No Communication, trying" will be displayed in numeric values window. The message is highlighted by red background to alert operator as fast as possible. The EM61MK2win will try to re-establish communication and after the problem is corrected the program will start communication automatically. Alternatively, the Monitor mode can be stopped by clicking on the Exit button or executing this function by a keyboard. The Monitoring window with alerting message is shown below.



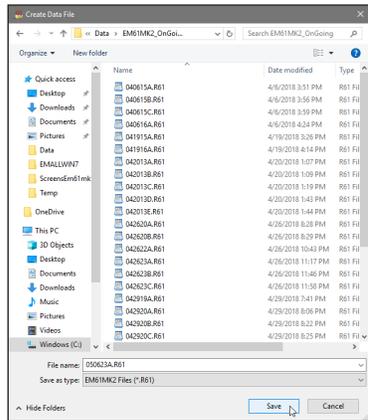
## Description of Monitoring Mode Options

### **File** (create data file)

The log data file can be created in any directory. The name of the file is given by the field computer clock and it consists of month (2 digits), day (2 digits), hour (2 digits), and one alphabetic character A, B, C, etc. (If all letters during one hour are used use the Overwrite option). The Create Data File dialog is presented below.

The file name can be specified in the Create Data File dialog using the Windows standard interface procedure. The EM61MK2win data files cannot be appended.

Each data file in the field computer (raw data file) has an extension name R61 and it is created in the directory specified in Create Data File dialog. The R61 files are created in the



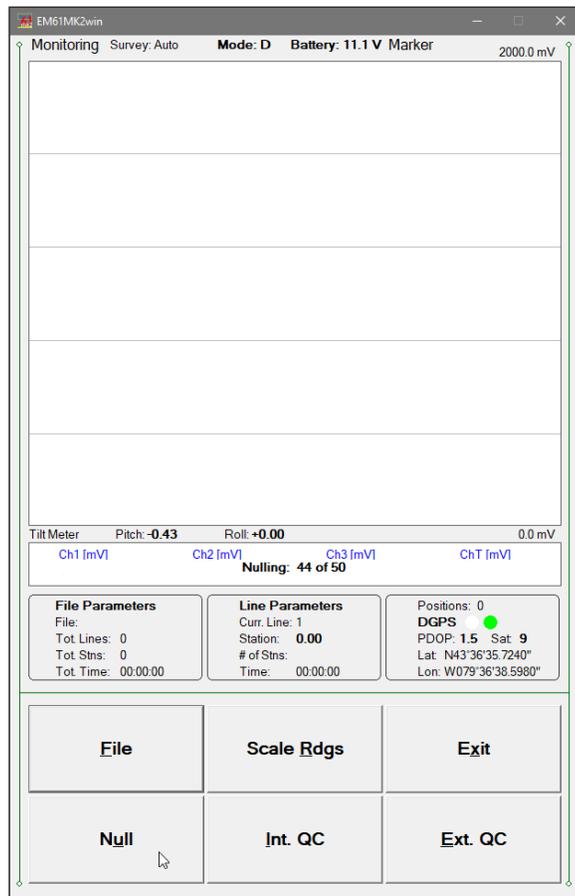
instrument binary format. These files can be also converted to ASCII format and processed in the Geonics DAT61MK2 program.

After the file is specified click on the button **OK** or press **ENTER** key to accept and create data file. The program will switch Monitor mode to Stand By mode and the data file will be displayed on the screen.

To cancel selection and return to Monitoring mode tap the **Cancel (X)** button or press **Esc** key.

## Null

To perform a null of the instrument click on the button labeled **Null** or execute this option using the keyboard (navigate to the button by pressing **TAB** key and when highlighted press **ENTER** key, or use shortcut - press key **U**). At this moment the computer takes 50 readings and calculates the instrument offset.

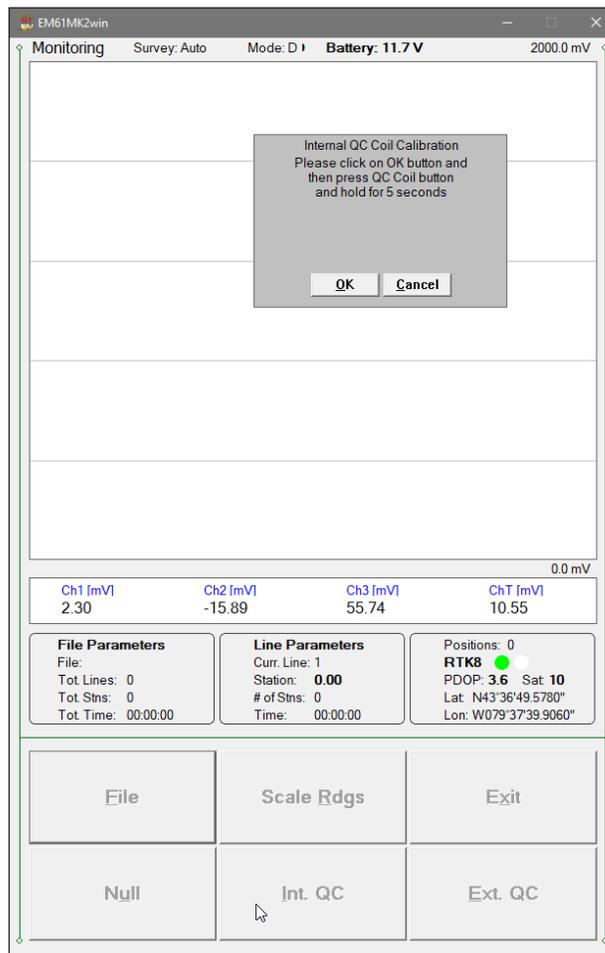


The calculated offset is applied to all the readings that follow this operation. If needed, this procedure can be repeated several times until satisfactory results are obtained. However, there is no associated “Undo” function. If original values (without calculated offsets) of the EM61-MK2 readings are needed, exit the EM61MK2 program and run it again. The EM61-MK2 instrument does not have to be turned OFF. Null operation can be also performed later during data collection.

### Int.QC (*Internal QC Coil Calibration*)

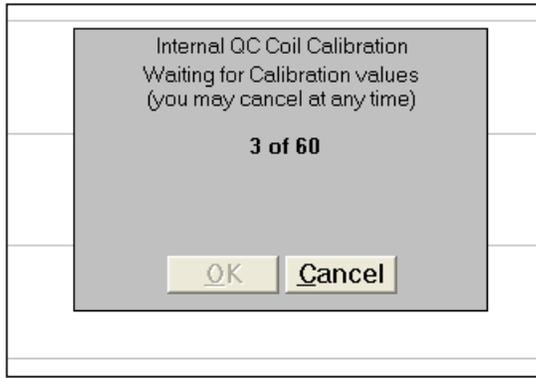
The Internal QC coil calibration is described in detail in the EM61-MK2 Operating Instructions.

To start the calibration using Internal QC coil click on the key labeled **Int. QC** or execute this option by keyboard (navigate to the button by pressing **TAB** key and when highlighted press **ENTER** key, or use shortcut - press key **I**). This action begins by performing the automatic nulling which in this case is only in effect for the duration of the calibration process. It will not affect EM61-MK2 readings. After the nulling is completed (less than 5 seconds) the Internal QC coil Calibration window is displayed. All command buttons in the bottom right corner of logging windows are disabled during Calibration procedure.



*When Calibration window is displayed please use keyboard keys (O or C) rather than a mouse to execute buttons labeled OK and Cancel. Clicking on buttons by mouse will work, however several mouse button clicks may be required.*

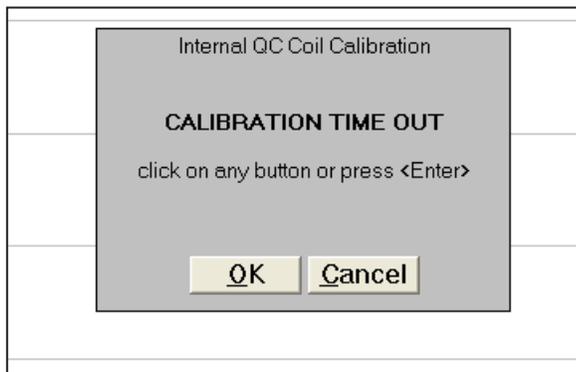
After **OK** button is clicked (or shortcut key **O** is pressed) the window displays timer with elapsed seconds and EM61-MK2 readings. This display lasts for 60 seconds. During this time please follow the instructions provided on the EM61MK2win display.



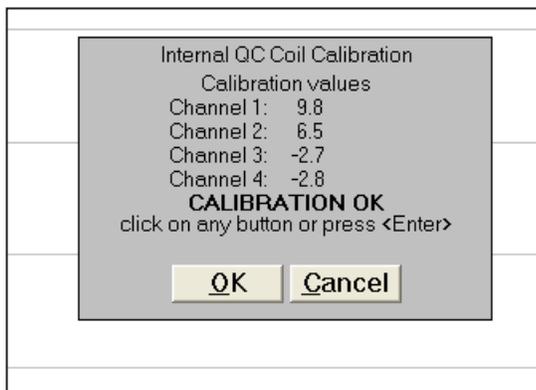
Internal QC coil calibration can end in the following four ways:

The process can be stopped by an operator at any time by clicking on the **Cancel** button or pressing shortcut key **C**.

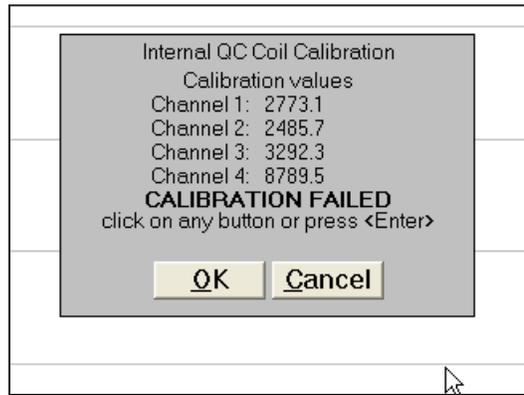
The calibration may end by time out (60 seconds) if QC coil button was not pressed or this action did not activate QC coil. The following screen will then be displayed: After pressing any key the program returns to Monitoring window. To repeat Internal QC coil calibration please click on the **Int. QC** button again.



The logging program will determine if the instrument has passed test. If after activating the QC coil, the program determines that the reading is inside the standard values within +/- 10% tolerances then a message "CALIBRATION OK" will be displayed (see below).



Otherwise, if the program determines that the reading is outside of the test values range the corresponding message "CALIBRATION FAILED" is displayed.

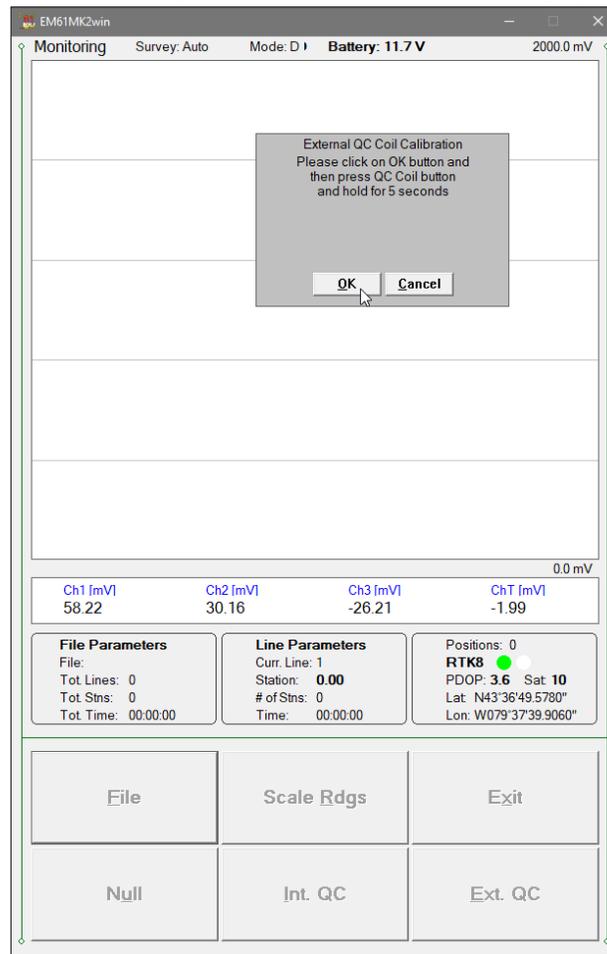


Regardless of the test result (OK or FAILED) the readings will be saved on screen. The program returns to Monitoring window after any button is tapped or ENTER key is pressed. Then the Internal QC coil calibration process can be repeated.

**Ext. QC**      (*External QC Coil Calibration*)

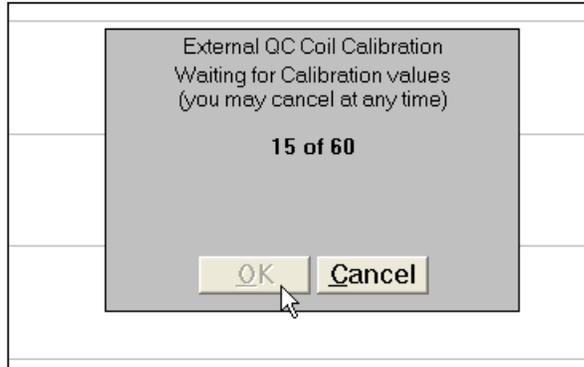
The External QC coil calibration is described in detail in the EM61-MK2 Operating Instructions.

To start the calibration using the External QC coil tap the button labeled **Ext. QC** or execute this option by keyboard (navigate to the button by pressing **TAB** key and when highlighted press **ENTER** key, or use shortcut - press key **E**). This action begins by performing the automatic nulling which in this case is only in effect for the duration of the calibration process. It will not affect EM61-MK2 readings. After the nulling is completed (less than 5 seconds) the External QC coil Calibration window is displayed (Figure below).



When Calibration window is displayed please use keyboard keys (O or C) rather than a mouse to execute buttons labeled OK and Cancel. Clicking on buttons by mouse will work, however several mouse button clicks may be required.

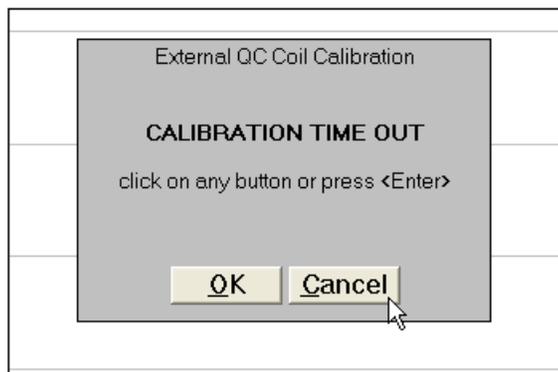
After **OK** button is tapped (or shortcut key **O** is pressed) the window displays timer with elapsed seconds and EM61-MK2 readings. This display lasts for 60 seconds. During this time please follow the instructions provided on the computer display screen.



External QC coil calibration can end in the following four ways:

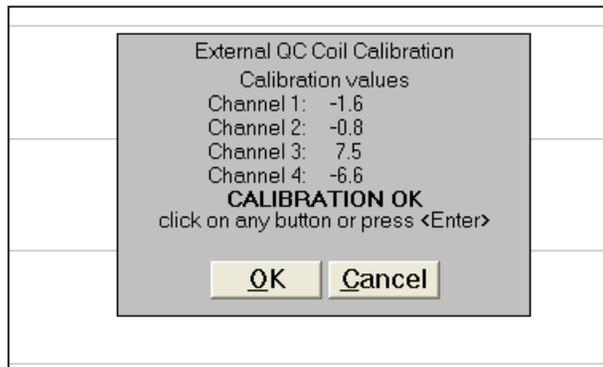
The process can be stopped by an operator at any time by tapping **Cancel** button or pressing shortcut key **C**.

The calibration may end by time out (60 seconds) if the External QC coil button was not pressed or this action did not activate QC coil. The following window will then be displayed (see below).

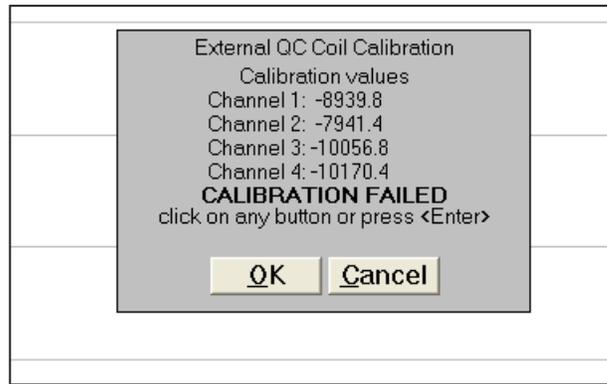


After pressing any key the program returns to Monitoring window. To repeat External QC coil calibration please tap the **Ext. QC.** button again.

The logger will determine if the instrument has passed test. If after activating the QC coil, the program determines that the reading is inside the standard values within +/- 10% tolerances then a message "CALIBRATION OK" will be displayed.



Otherwise, if the program determines that the reading is outside of the test values range the corresponding message “CALIBRATION FAILED” is displayed.

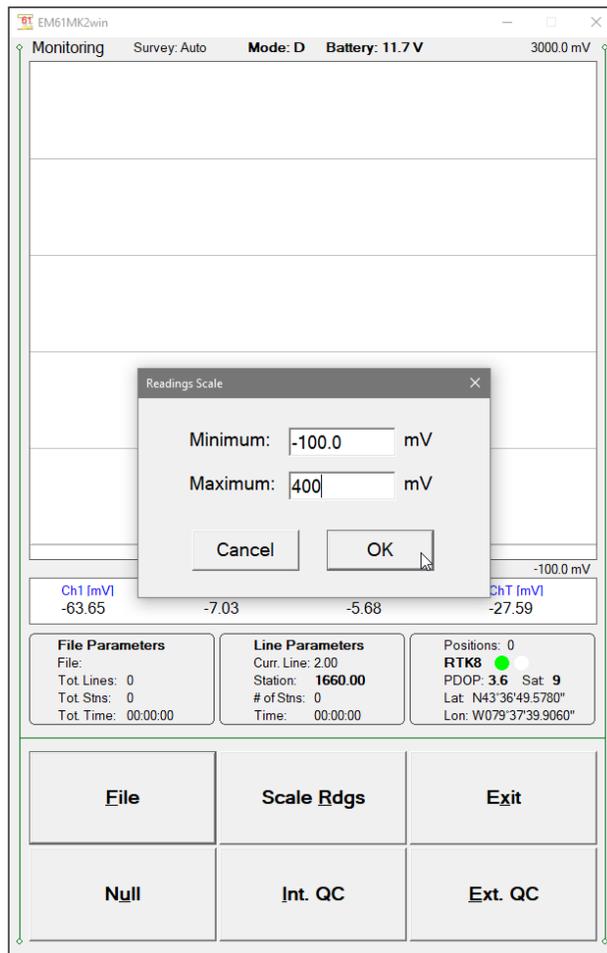


Regardless of the test result (OK or FAILED) the readings will be saved on screen. The program returns to Monitoring window after any button is clicked or ENTER key is pressed. Then the External QC coil calibration process can be repeated.

**Scale** *(New Scale for Profile Plot)*

Selecting New Scale option allows the operator to enter new scale parameters for the profile plot. This option is available by clicking on the command button labeled Scale Rdgs. or directly from keyboard by using shortcut key <R>.

The Readings Scale dialog will be displayed. It contains two text boxes for Minimum and Maximum values of a new scale for profile plot. Current settings (minimum and maximum



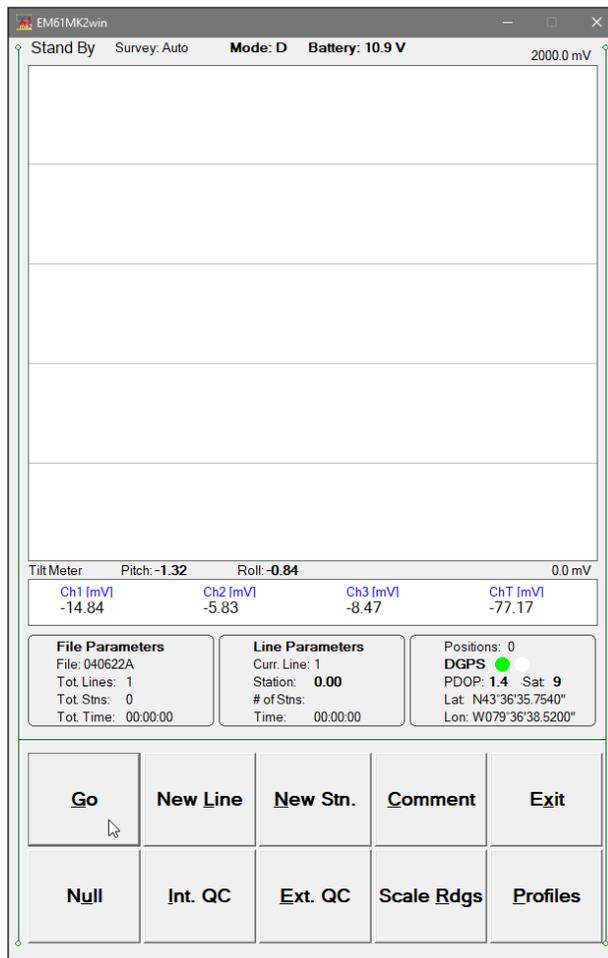
values) for the scale are displayed in the bottom right and top right corners of the plot area. After minimum and maximum values are specified click on the button **OK** or press **ENTER** key to accept to accept new values and the profile plot area will be redrawn. To ignore an entry and return to Stand By mode click on the **Cancel** (X) button or press **Esc** key, the dialog window will disappear and measurements can be continued.

**Exit** (exit Monitor mode)

After clicking on the Exit button (or executing this option using keyboard) the program immediately returns to Main Screen.

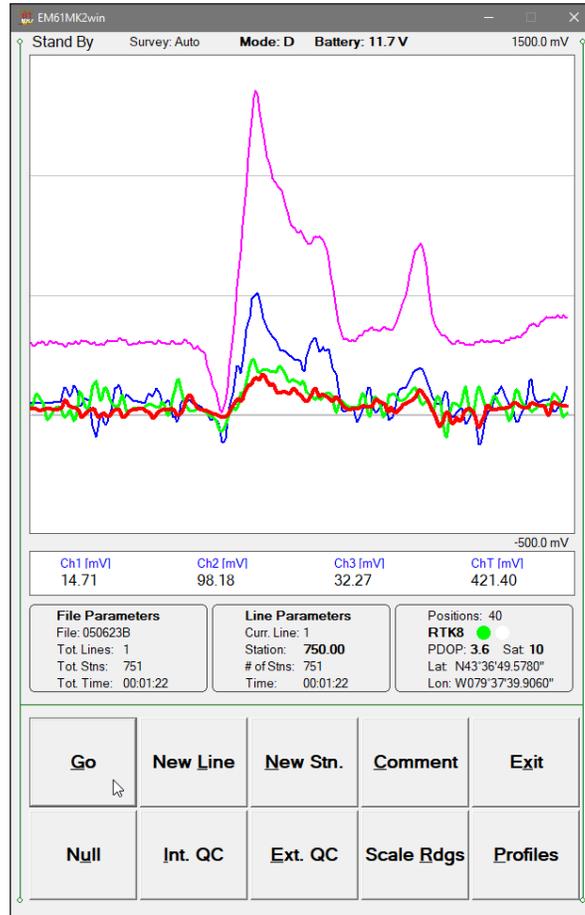
## 6.2 Stand By Mode

After data file is created in Monitoring mode the program automatically switches logging window to Stand By mode. This windows is similar to Monitor mode however it contains survey parameters (file name, survey line name, etc.) and different set of options represented by buttons displayed at the bottom of the screen. The logging window in Stand By mode in initial state (before any data is recorded) is presented below.



The main portion of the screen is occupied by the plot area which displays profiles (see Figure below which shows Stand By mode after some data were collected). Readings in the plot area can be displayed in compressed amplitude scale, which corresponds to Square Root of the amplitude. In compressed amplitude scale 0 to 100 corresponds to 0 to 10,000 mV, and compressed range 0 to 200 corresponds to 0 to 40,000 mV. Plotting data in compressed amplitude allows you to show

details in the low range of amplitude, as well as relatively good resolution in the high range of data on the small screen. **Please note, that data displayed in the numeric form are always given in the standard, linear scale.** The amplitude scale is divided by four or five grey grid lines. In the case where the amplitude scale starts with a negative value, then the grid line corresponding to zero is always plotted as a thicker line.



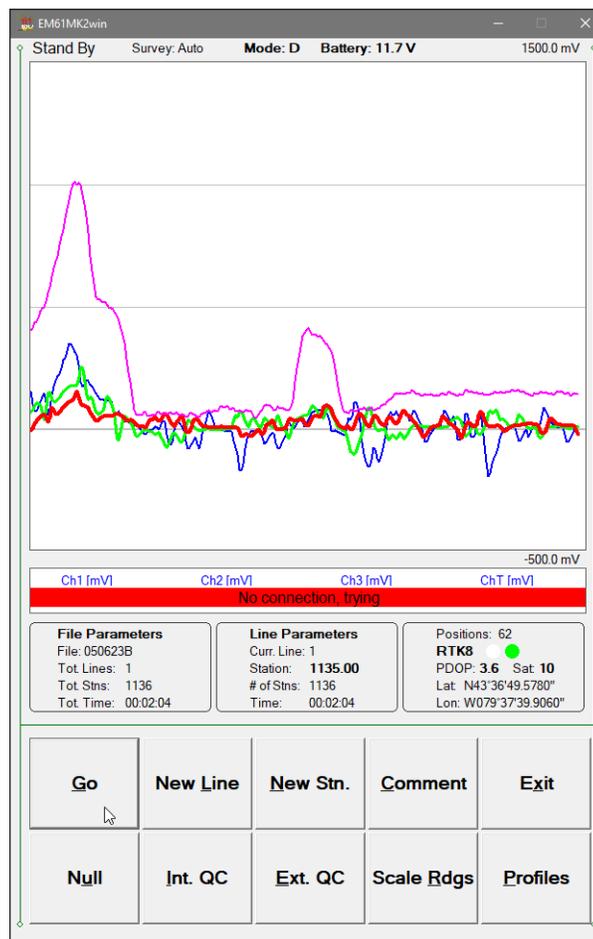
Readings for Channels 1, 2, 3, 4 or T are shown in numeric form in a window below the plot area. Values of readings are labeled: **Ch1**, **Ch2**, **Ch3**, **Ch4** or **ChT**. The program checks instrument mode continuously, therefore label **Ch4** indicates mode 4 while label **ChT** corresponds to instrument mode **D**. EM61-MK2 readings (in numeric form) are updated in Stand By mode approximately 10 times per second. Profiles in the plot area are updated only during Logging mode when data are actually saved in the data file.

A section of the window at the top of the screen contains one line of text displaying survey and instrument related parameters. These are (from top left): logging mode **Stand By** or **Logging**, survey mode (**Auto**, **Wheel** or **Manual**), instrument mode 4 or **D** (labeled Mode:), and EM61-MK2 battery level in Volts (labeled **Battery**:). When fiducial marker is active a label **Marker** is displayed in this line.

File and Survey Line parameters, and GPS information are displayed in three framed boxes at the bottom of the Stand By window. File Parameters frame displays: name of the data file, total number of survey lines, total number of stations collected in the file, and total time of surveying. The Line Parameters frame contains: name of current survey line, current station, number of stations in the current survey line, and time of surveying current line. In the Stand By mode the station number will not change. Stations in the EM61MK2win program are incremented by station increment value after each reading is written to the data file.

The third frame is dedicated to showing the GPS status. A number following the label **Position** provides the number of GPS positions saved in the current data file. In Stand By mode the number of positions is not incremented (it is updated only when GPS position is written to the file). Next two lines in this frame display parameters describing quality of GPS positions. A label **DGPS** (Differential Global Positioning System) indicates that GPS readings are differentially corrected in real time, while label **AGPS** (Autonomous Global Positioning System) indicates lack of differential correction. On the right side of **DGPS** or **AGPS** label two green and white circles alternate. These two circles should alternate colours with the frequency of GPS update rate (usually 1 second intervals). If the circles do not change colours for long periods of time it means that the GPS system is not working or that it is not connected to the field computer. The next label **PDOP** with a value varying between 0 and 99.9 represents an index called Position Dilution of Precision (**PDOP**). This value is available only when messages both, GGA and GSA are received from GPS. The last label **Sat** and following number shows the number of currently tracked satellites. Two bottom lines of the frame give current Latitude and Longitude of the instrument position (datum WGS1984). Position is updated with frequency of GPS receiver stream.

In case of any problems with instrument connection, battery failure, or accidental instrument Turn Off a message "No Communication, trying" will be displayed in numeric values window. The message is highlighted by red background to alert operator as fast as possible. The EM61MK2win will try to re-establish communication and after the problem is corrected the program will start communication automatically. Alternatively, click on the Exit button or execute this command from a keyboard. The program window in Stand By mode and the alert message is shown below.



Several available field options (in form of command buttons) are listed at the bottom right corner of the Stand By mode window. They will be described in the following section 6.4.

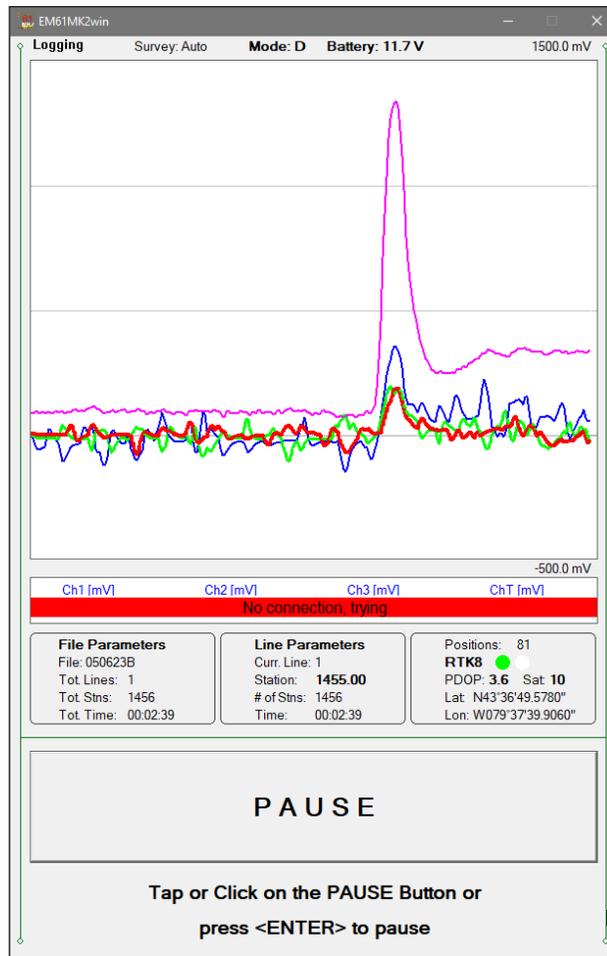
## 6.3 Logging Mode

The Logging mode is enabled by clicking on the button labeled **GO (log data)** or pressing the shortcut key **G** (or the **<ENTER>** key if button **GO** is highlighted) in Stand By mode. After this button is pressed the list of buttons at bottom of the screen will be replaced by one **PAUSE** button, label Stand By will be replaced by label **Logging** (at the top of the display) and data will be logged in the mode corresponding to the selected EM61-MK2 mode in the Survey Setup menu. All labels and parameters (with the exception of buttons representing Stan By mode options) are the same as in Stand By mode and they are described in the preceding section 6.2. The screen in Logging mode is presented below.



After the screen changes to Logging mode the current station (labeled **Station:**) is updated according to the station interval. Similarly, if GPS Input was enabled, total number of GPS positions (label **Positions**) in the data file is incremented every time (usually once a second) GPS position is written to the file. Profile curves (for channels selected in Display Options window) are updated after each reading is written to the data file.

In case of any problems with instrument connection, battery failure, or accidental instrument Turn Off a message "No Communication, trying" will be displayed in numeric values window. The message is highlighted by red background to alert operator as fast as possible. The EM61MK2win will stop collecting data and will try to re-establish communication. After the problem is corrected the program will start communication automatically. Alternatively, click on the Pause button to return to Stand By mode. The program window in Stand By mode and the alert message is shown below.



There is only one option available in the Logging mode - pause logging. After a Pause button is clicked or Pause key (any key or other Pause Key selected in Logger Setup window) is pressed the recording is stopped and the Logging mode returns to the Stand By mode. In Stand By mode the EM61-MK2 data will be displayed with the update rate approximately 10 readings per second, however data will not be saved in the log file and profile curves will be not updated.

Exiting from the logging session and access to various field options are available only from the logging window in Stand By mode.

## 6.4 Stand By Mode Field Options

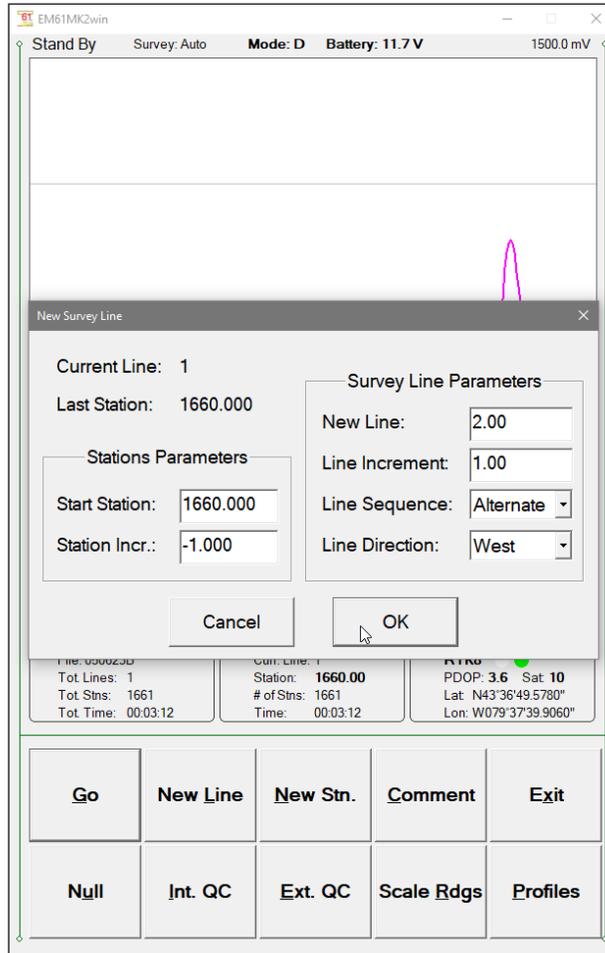
Several field options are available while the Logging window is in the Stand By mode. Options can be accessed directly from command buttons. Command buttons can be used by clicking on the desired button, or from the keyboard by pressing one of the shortcut keys (underlined characters on button labels) or by navigating using <TAB> key (sets button as a default button - default button is highlighted) and pressing <ENTER> key.

### **GO (log data)** *(start data logging)*

Click on the **GO** button, or while using the keyboard press shortcut key <G> or if the button is a default button (highlighted) press <ENTER>. The logging window in Stand By mode will change to Logging mode and logging data starts immediately.

## New Line (New Survey Line)

The New Survey Line dialog is displayed (see Figure below). Selecting this option allows the operator to enter a new survey line number (name) and associated line parameters (Line Increment, Line Sequence, Direction, Start Station, and Station Increment). The new line number and associated parameters are prompted by the program based on parameters specified in the Survey Setup dialog.



At the top of the dialog the last survey line name and the last logged station are displayed. Default name for the new line is given based on the Line Increment parameter. The default Start Station, direction of the Station Increment, and Direction are determined based on Sequence selection. All these parameters can be overwritten by the user as described in the Survey Setup menu description (chapter 2).

After all the parameters in the New Line dialog are updated click on the button **OK** or press **ENTER** key to accept the displayed settings. The program will return to the Logging window in Stand By mode. Survey line name (**Curr. Line**) name and current station (**Station**) value will be updated and profile curves plot for former survey line will disappear.

To return to Stand By mode and current survey line settings (state before this dialog was selected) click on the **Cancel** (X) button or press **Esc** key.

## New Stn. (New Station)

Selecting this option allows the operator to enter a new station number (within the same survey line). The New Station dialog is displayed (see Figure below on the left).

Current survey line, Start and Current station are displayed at the top of the dialog. The New Station can be entered in the provided edit box labeled New Station.

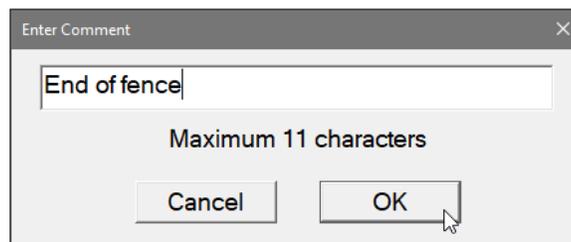


Click on the button **OK** or press **ENTER** key to accept the new value. The program will return to the Logging window in Stand By mode. Current station (**Station:**) value will be updated and after data logging is activated the profile curves will have a small gap (two pixels) showing the new station entry (see Figure above on the right).

To return to Stand By mode and current survey line settings (state before this dialog was selected) click on the **Cancel** (X) button or press **Esc** key, the dialog window will disappear and measurements can be continued.

#### **Comment** (*Field Comment*)

Selecting this option allows the operator to enter a comment at any point of the survey. A maximum of 11 characters can be entered as a comment. The Enter Comment dialog is displayed.



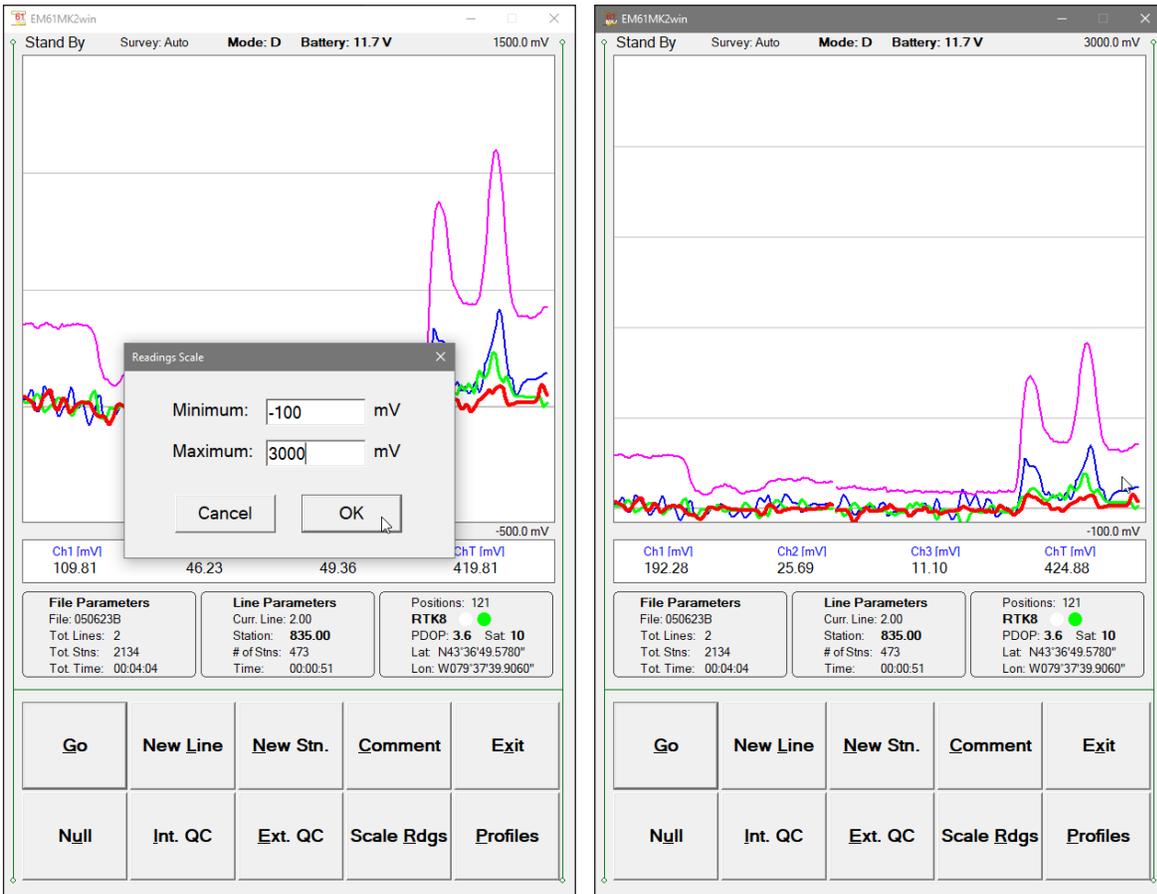
Click on the button **OK** or press **ENTER** key to accept the comment entered in a text box of the dialog. The text of the comment is saved in the file with a corresponding time stamp and the program will return to the Logging window in Stand By mode.

To ignore an entry and return to Stand By mode click on the **Cancel** (X) button or press **Esc** key, the dialog window will disappear and measurements can be continued.

### Scale Rdgs (New Scale for Profile Plot)

Selecting New Scale option allows the operator to enter new scale parameters for the profile plot.

The Enter Scale dialog will be displayed (see Figure below on the left). It contains two text boxes for Minimum and Maximum values of a new scale for profile plot. Current settings (minimum and maximum values) for the scale are displayed in the bottom right and top right corners of the plot area.



After minimum and maximum values are specified click on the button **OK** or press **ENTER** key to accept new values and the profile plot area will be redrawn (see Figure above on the right).

To ignore an entry and return to Stand By mode tap the **Cancel** (X) button or press **Esc** key, the dialog window will disappear and measurements can be continued.

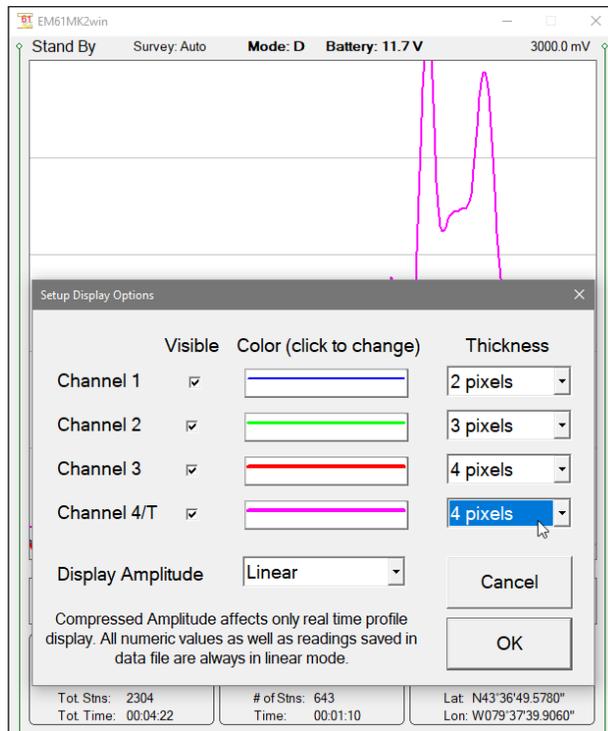
### Profiles (new options for profile plot display)

After the **Profiles** button was clicked or executed from the keyboard the Display Options dialog window appears on the screen. This dialog allows you to enable and disable the display of each channel profile, specify color and thickness of profiles, and select linear or compressed amplitude for profiles. The dialog is presented below.

Please refer to chapter 5 where this dialog and its parameters are described in detail.

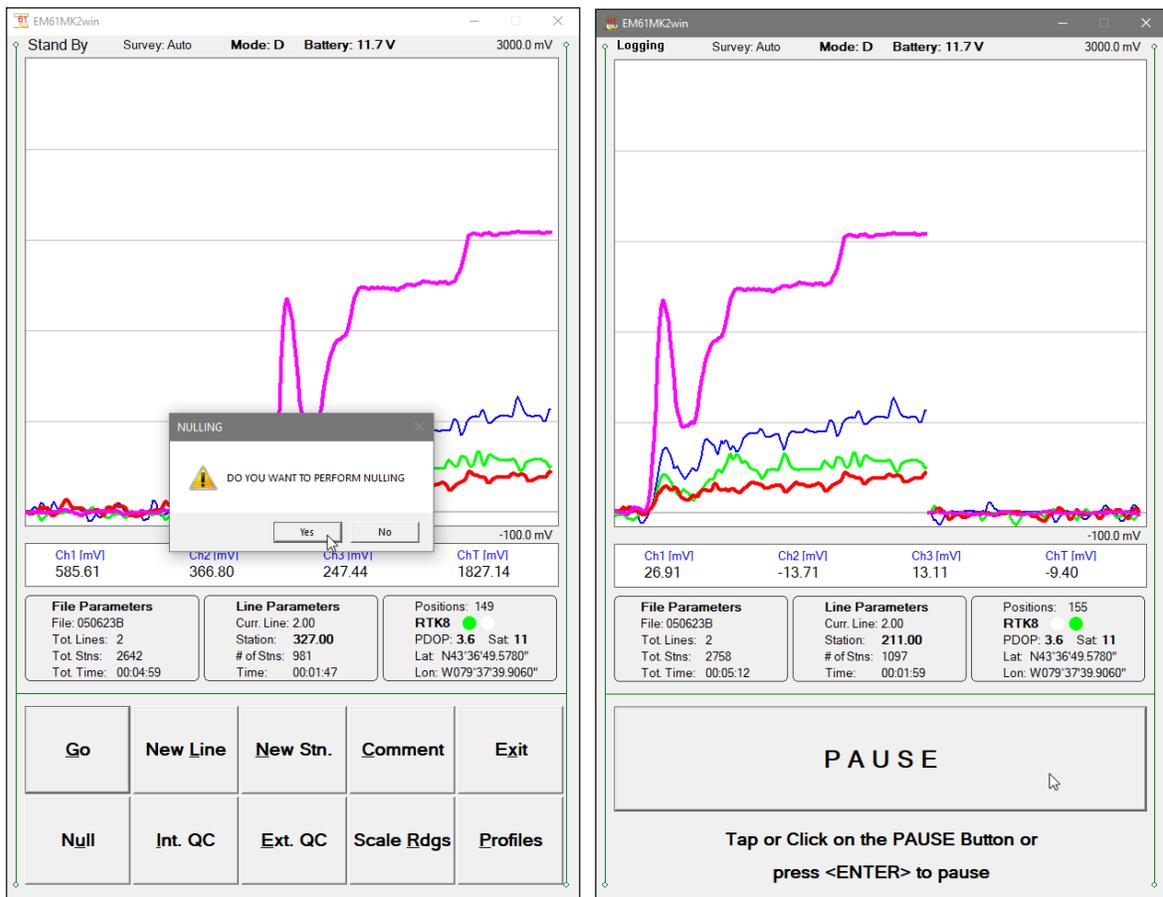
Click on the button **OK** or press **ENTER** key to accept updated display parameters. The dialog will disappear and profile plot area will be redrawn in Stand By mode.

To return to Stand By mode and current display options (state before this dialog was selected) click on the **Cancel** (X) button or press **Esc** key, the dialog window will disappear.



## Null

During data collection (in Stand By mode) a confirmation message will be displayed (there is no such message if Nulling is performed in Monitoring mode) before actual operation is applied (see below Figure on the left).



After above message is confirmed the program collects 50 readings and calculates the instrument offset.

The calculated offset is applied to all the readings that follow this operation (see Figure above on the right). If needed, this procedure can be repeated several times until satisfactory results are obtained. However, there is no associated “Undo” function. If original values (without calculated offsets) of the EM61-MK2 readings are needed, exit the EM61MK2 program and run it again. The EM61-MK2 instrument does not have to be turned OFF.

### **Int. QC** (*Internal QC coil calibration*)

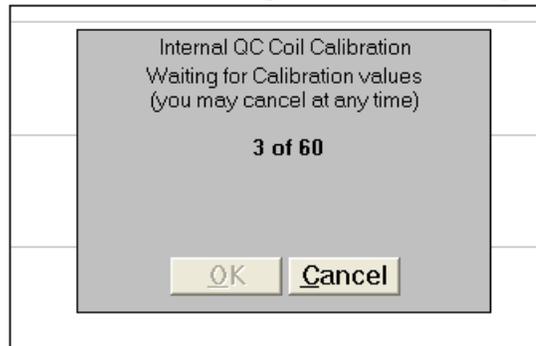
The Internal QC coil calibration is described in detail in the EM61-MK2 Operating Instructions.

The Internal QC coil procedure in Stand By mode is identical as in Monitoring mode. Please refer to section 6.2 (Description of Monitoring Mode Options) for more screen shots examples.

To start the calibration using Internal QC coil click on the key labeled **Int. QC** or execute this option by keyboard (navigate to the button by pressing **TAB** key and when highlighted press **ENTER** key, or use shortcut - press key **I**). This action begins by performing the automatic nulling which in this case is only in effect for the duration of the calibration process. It will not affect EM61-MK2 readings during later data collection. After the nulling is completed (less than 5 seconds) the Internal QC coil Calibration window is displayed. All command buttons in the bottom right corner of the logging window in Stand By mode are disabled during Calibration procedure.

*When Calibration window is displayed please use keyboard keys (O or C) rather than a mouse to execute buttons labeled OK and Cancel. Clicking on buttons by mouse will work, however several mouse button clicks may be required.*

After **OK** button is clicked (or shortcut key **O** is pressed) the window displays timer with elapsed seconds and EM61-MK2 readings. This display lasts for 60 seconds. During this time please follow the instructions provided on the computer screen.



Internal QC coil calibration can end in the following four ways:

The process can be stopped by an operator at any time by clicking on the **Cancel** button or pressing shortcut key **C**.

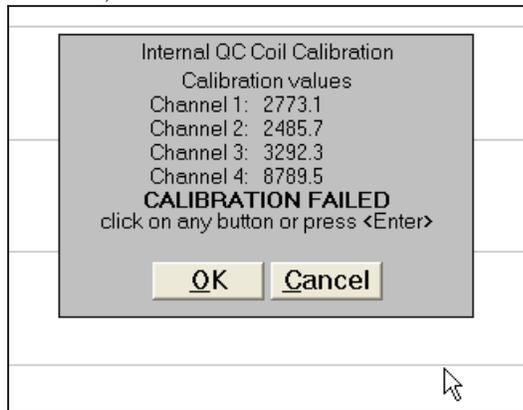
The calibration may end by time out (60 seconds) if QC coil button was not pressed or this action did not activate QC coil.

After pressing any key the program returns to Monitoring window. To repeat Internal QC coil calibration please click on the **Int. QC** button again.

The logging program will determine if the instrument has passed test. If after activating the QC coil, the program determines that the reading is inside the standard

values within +/- 10% tolerances then a message “CALIBRATION OK” will be displayed.

Otherwise, if the program determines that the reading is outside of the test values range the corresponding message “CALIBRATION FAILED” is displayed (see Figure below).



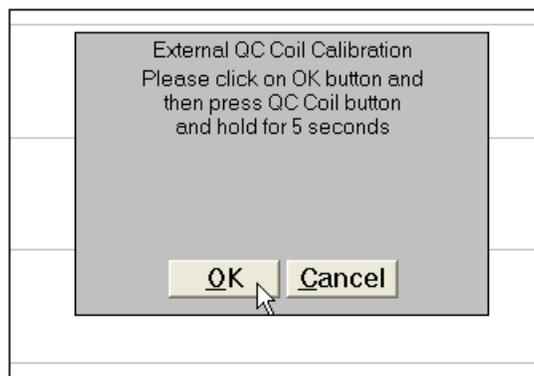
Regardless of the test result (OK or FAILED) the readings will be saved on screen. The program returns to Monitoring window after any button is tapped or ENTER key is pressed. Then the Internal QC coil calibration process can be repeated.

**Ext. QC**      (*External QC Coil Calibration*)

The External QC coil calibration is described in detail in the EM61-MK2 Operating Instructions.

The External QC coil procedure in Stand By mode is identical as in Monitoring mode. Please refer to section 6.2 (Description of Monitoring Mode Options) for more screen shots examples.

To start the calibration using the External QC coil click on the button labeled **Ext. QC** or execute this option by keyboard (navigate to the button by pressing **TAB** key and when highlighted press **ENTER** key, or use shortcut - press key **E**). This action begins by performing the automatic nulling which in this case is only in effect for the duration of the calibration process. It will not affect EM61-MK2 readings. After the nulling is completed (less than 5 seconds) the External QC coil Calibration window is displayed (Figure below).



*When External QC Coil Calibration window is displayed please use keyboard keys (O or C) rather than a mouse to execute buttons labeled OK and Cancel. Clicking on buttons by mouse will work, however several mouse button clicks may be required.*

After **OK** button is tapped (or shortcut key **O** is pressed) the window displays timer with elapsed seconds and EM61-MK2 readings. This display lasts for 60 seconds. During this time please follow the instructions provided on the computer display.

External QC coil calibration can end in the following four ways:

The process can be stopped by an operator at any time by tapping **Cancel** button or pressing shortcut key **C**.

The calibration may end by time out (60 seconds) if the External QC coil button was not pressed or this action did not activate QC coil.

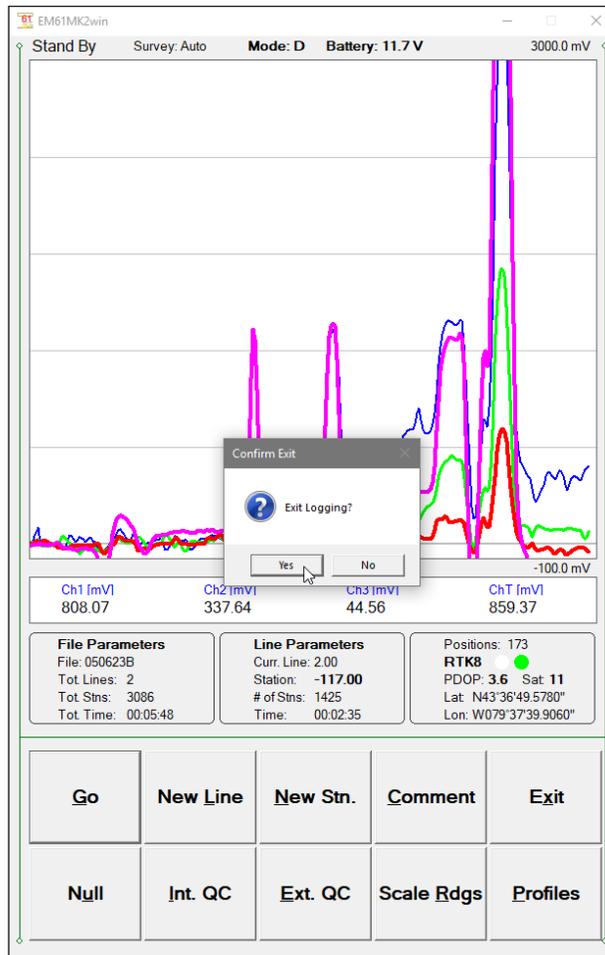
After pressing any key the program returns to Monitoring window. To repeat External QC coil calibration please tap the **Ext. QC.** button again.

The logger will determine if the instrument has passed test. If after activating the QC coil, the program determines that the reading is inside the standard values within +/- 10% tolerances then a message "CALIBRATION OK" will be displayed. Otherwise, if the program determines that the reading is outside of the test values range the corresponding message "CALIBRATION FAILED" is displayed.

Regardless of the test result (OK or FAILED) the readings will be saved on screen. The program returns to Monitoring window after any button is clicked or ENTER key is pressed. Then the External QC coil calibration process can be repeated.

**Exit** (*exit data logging*)

During data collection (in Stand By mode) a confirmation message will be displayed (there is no such message if **Exit** is performed in Monitoring mode) before program exits logging window.



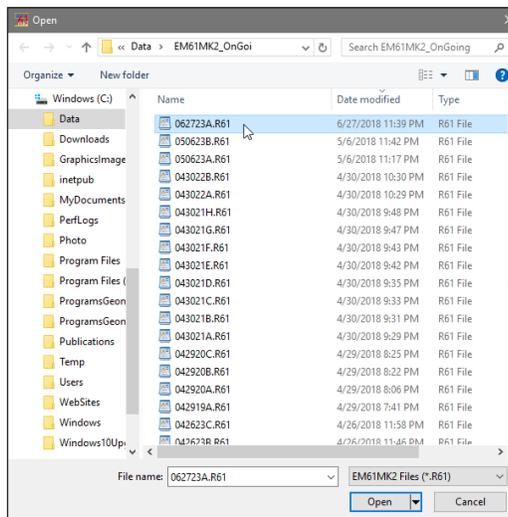
After above message is confirmed the program stops logging, closes data file and returns to Main Screen.

## 7. View Data Files

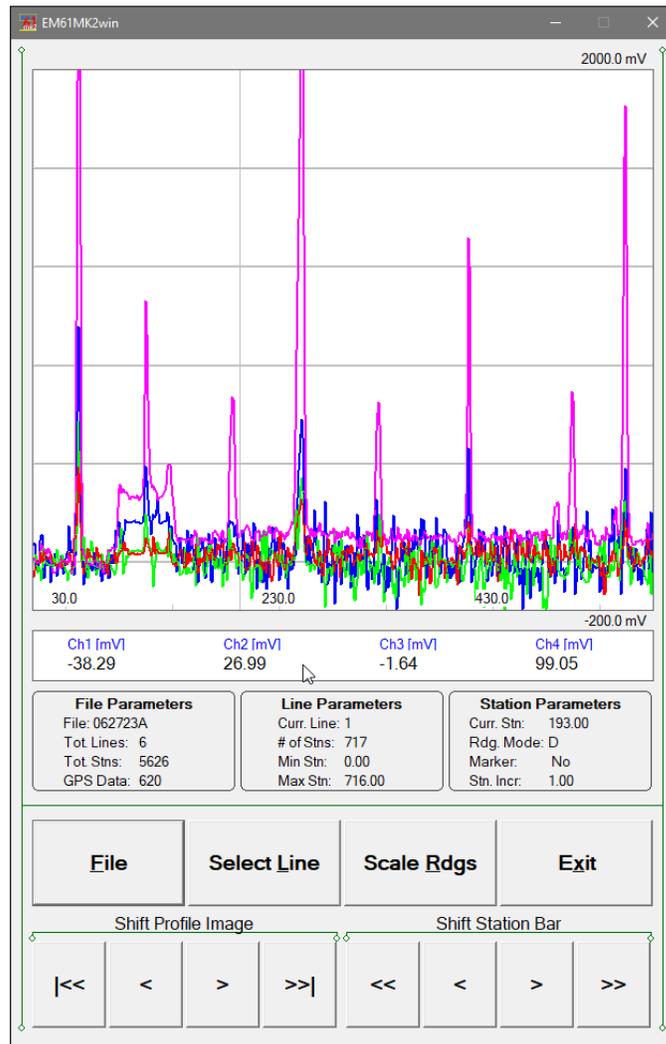
This option allows you to view recorded data files. After the View Files button is clicked or tapped (or executed from the keyboard) in the Main Screen the View Data Files window will be displayed.



To open the data file click or tap on the button labeled File or execute this option using the keyboard (navigate to the button by pressing TAB key and when highlighted press ENTER key, or use shortcut - press key F). The Open Data File dialog is presented below.



The file name can be selected in the Open Data File dialog using the Windows standard interface procedure. After the file is selected (highlighted) tap the button OK or press ENTER key to accept and display data file (to cancel selection tap Cancel (X) button or press Esc key). After the file is opened readings taken at the beginning of the first survey line in the file are displayed, as shown below.



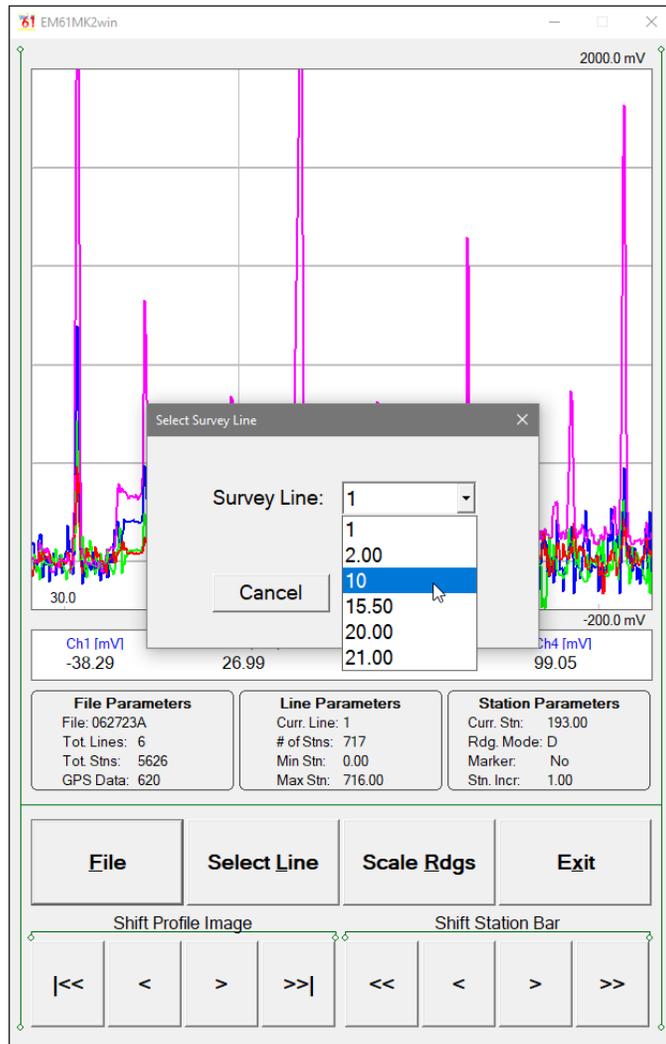
The main portion of the screen is occupied by profile plot of currently displayed survey line. Readings in the plot area can be displayed in linear or compressed amplitude scale. Amplitude display range (minimum and maximum value) is given by labels located at the right side of the plot area. Range of scale display can be changed by tapping the button labeled Scale Rdgs. The plot area is divided by four or five grey grid lines. In cases where the amplitude scale starts with a negative value, then the grid line corresponding to zero is always plotted as a thicker line. Profiles for each channel are plotted with colours and line thickness as selected in the Plot Options (see section Chapter 5).

A vertical bar (grey vertical line) indicates currently displayed station. The station is displayed in the window labeled Station Parameters (see description in the next paragraph) next to label Curr.Stn: and readings at this station for channels 1, 2, 3, and 4 (or T) are shown in numeric form below the plot area. The EM61-MK2 readings (in numeric form) are updated every time vertical bar is moved.

There are three windows describing file, survey line, and station parameters. The left window labeled File Parameters lists file name, number of survey lines in the file, total number of stations, and total number of GPS positions if GPS positioning was used during the survey. The center window

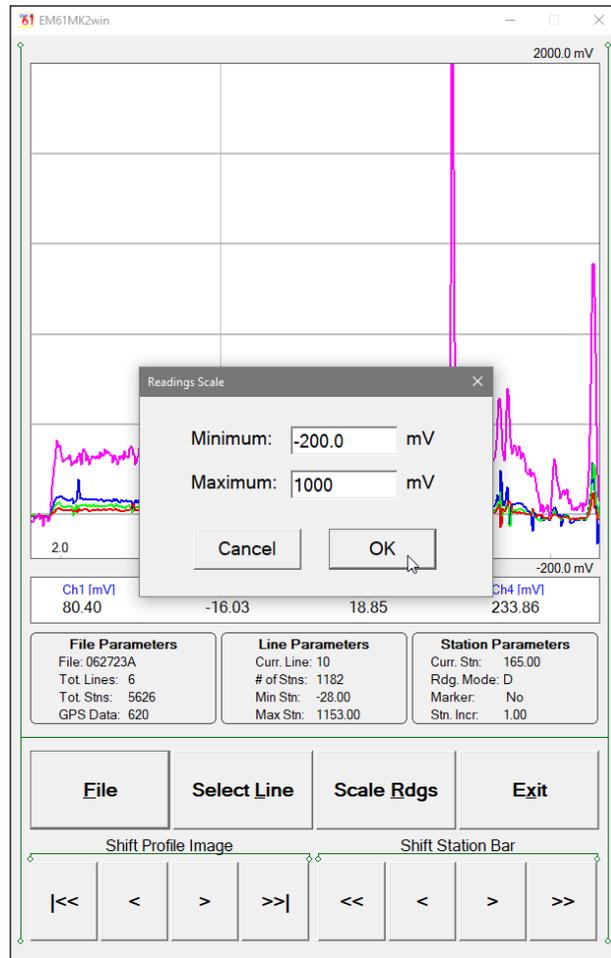
labeled Line Parameters contains parameters associated with currently displayed survey line: line name, number of stations in the current line, minimum and maximum stations. The right window labeled Station Parameters displays currently indicated station parameters: station number, reading mode, marker presence, and station increment within line.

To change the currently displayed survey line click or tap on the button labeled Select Line. A dialog labeled Select Survey Line will be displayed.



Tapping on the down arrow next to the text box labeled Line opens a drop-down box showing all available survey lines. When the keyboard is being used you can activate the text box by pressing the TAB key until the drop down box is highlighted and then by using Up or Down arrow keys select one of available lines (as shown above). After the survey line is selected and the button labeled OK is clicked on the dialog disappears and selected survey line is plotted. Please see next Figure where Survey Line 10 is displayed.

To change range of displayed values click on the Scale Rdgs button. A dialog labeled Reading Scale will be displayed. Specify new Minimum and Maximum values and then press OK. The plot area will be re-drawn with new range values.



To shift the range of the displayed stations and to move the vertical bar indicating the currently displayed station, use the buttons located along the bottom of the View Files window. These buttons can be activated by tapping or by pressing the keyboard keys. They are divided in two groups: four buttons labeled Shift Profile Image are used to move image while four buttons labeled Shift Station Bar move grey vertical bar selecting current station and displaying its numeric values.

Shift Profile Image buttons:

button labeled |<< moves display to the minimum station of the currently displayed survey line,  
 button labeled >>| moves display to the maximum station of the survey line,  
 button labeled < moves display about 40% of the displayed range to the left,  
 button labeled > moves display about 40% of the displayed range to the right.

When using Shift Station Bar buttons:

button labeled << moves the bar 50 stations to the left,  
 button labeled >> moves the bar 50 stations to the right,  
 button labeled < moves the bar one station to the left,  
 button labeled > moves the bar one station to the right.

To exit the View Data Files window tap or click on the button labeled Exit. The program will return to Main Screen.

# Appendix A

## A.1 Description of Data File in EM61MK2win (R61) Format

Each record contains 24 characters, including line feed at the end of each record.

**Header of the file (contains six records starting with characters E, H, O, O, O, and O)**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
E	M	6	1	M	K	2		W	1	O	1	Survey Type	UT	IT	IM					IP	10		
H																							10
O																							10
O																							10
O																							10
O																							10

EM61MK2	-	identification of program file
W101	-	version number (1.00, W - indicates file created by Windows CE program)
Survey Type	-	GPS (if GPS Input Enabled) or GRD (grid)
UT	-	unit type (0 = meters, 1 = feet)
IT	-	instrument type (0 =sensor 1x0.5m, 1 = 1x1m, 2 = 0.5x0.5m, 3 = HH61)
IM	-	instrument mode (0 =Auto, 1 =Wheel, and 2 =Manual)
IP	-	not used (=1 fixed)
File Name	-	file name, maximum 8 characters
Time Increment	-	time increment (Auto Mode) in seconds
Offset	-	offset for indicated channels in mV
IC	-	QC coil calibration (=N not performed, <>N otherwise)
QC coil value	-	value of QC coil calibration for indicated channels in mV
10	-	Line Feed character

**Header at the start of survey line (eight records starting with L, B, A, Z, O, O, O, O)**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
L																							10
B																							10
A	Dir																						10
Z	D	D	M	M	Y	Y	Y	Y		H	H	:	M	M	:	S	S						10
O																							10
O																							10
O																							10
O																							10

Line Name	-	Line Name, maximum 8 characters
Start Station	-	Start Station for the Line, format F11.2
Dir	-	Direction of the Line (E, W, N, or S)
Station Inc.	-	Station Increment, format F11.3
Date	-	Date when Line was created, format DD-MM-YYYY
Time	-	Real Time when Line was created, format HH:MM:SS
Offset	-	Offset for indicated channels in mV at the start of Line
Former Offset	-	Former offset for indicated channels in mV
10	-	Line Feed character

### Timer Relation

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
*	Computer Time (Format HH:MM:SS.sss)											Time Stamp in milliseconds										10	

Indicates relation between computer clock and the program timer. This record links timer in milliseconds and computer time (local time) in format HH:MM:SS.sss. This record is written to the file each time a new new line is entered.

### Reading

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
I	Gn	1h	1l	2h	2l	3h	3l	4h	4l	5h	5l	6	Time Stamp in ms (10 digits)										10

I	-	indicator T, D, E, F, M, N, P, or Q. Each record representing reading starts with one of the following character, which indicates type of reading:
<b>T</b>	-	Standard, Mode 4, channels 1, 2, 3, 4
<b>D</b>	-	Standard, Mode D, channels 1, 2, 3, T
<b>E</b>	-	Hand Held, Mode 4, channels 1, 2, 3, 4
<b>F</b>	-	Hand Held, Mode D, channels 1, 2, 3, T
<b>M</b>	-	Standard, Mode 4, channels 1, 2, 3, 4 +Marker
<b>N</b>	-	Standard, Mode D, channels 1, 2, 3, T +Marker
<b>P</b>	-	Hand Held, Mode 4, channels 1, 2, 3, 4 +Marker
<b>Q</b>	-	Hand Held, Mode D, channels 1, 2, 3, T +Marker
Gn	-	one character parameter (Hex format), contains Gain, see table of ranges at the end of this section.
1h	-	higher byte of the 2's complement Hex number of Channel 1
1l	-	lower byte of Channel 1
2h	-	higher byte of the 2's complement Hex number of Channel 2
2l	-	lower byte of Channel 2
3h	-	higher byte of the 2's complement Hex number of Channel 3
3l	-	lower byte of Channel 3
4h	-	higher byte of the 2's complement Hex number of Channel 4
4l	-	lower byte of Channel 4
5h	-	higher byte of the 2's complement Hex number of TX current
5l	-	lower byte of TX current
6	-	fraction of current (5h 5l), Hex number
Time Stamp	-	time in ms from the Windows start (resets every 49.7 days)
10	-	Line Feed character

**Comment**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
<b>C</b>	Comment (maximum 11 characters)												Time Stamp in ms (10 digits)									<b>10</b>	

**New Station**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
<b>S</b>	New Station (Format 11.2)												Time Stamp in ms (10 digits)									<b>10</b>	

**Nulling**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
<b>O</b>	Offset for Ch1 (F9.2)												Former Offset for Ch1 (F9.2)									<b>10</b>	
<b>O</b>	Offset for Ch2 (F9.2)												Former Offset for Ch2 (F9.2)									<b>10</b>	
<b>O</b>	Offset for Ch3 (F9.2)												Former Offset for Ch3 (F9.2)									<b>10</b>	
<b>O</b>	Offset for Ch4 (F9.2)												Former Offset for Ch4/T (F9.2)									<b>10</b>	

**QC Coil Calibration**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
<b>I</b>	<b>C</b>	Offset for Ch1 (F9.2)																					<b>10</b>
<b>I</b>	<b>C</b>	Offset for Ch2 (F9.2)																					<b>10</b>
<b>I</b>	<b>C</b>	Offset for Ch3 (F9.2)																					<b>10</b>
<b>I</b>	<b>C</b>	Offset for Ch4 (F9.2)																					<b>10</b>

IC - **II** indicates Inrenal QC coil calibration,  
**IE** indicates External QC coil calibration.

**GPS Data Message Records**

Each GPS record (GGA Message) is broken in to several 22 characters strings and placed in the EM61MK2 data file which contains 24 characters records, including one character indicator and line feed at the end of each record. The GPS sequence starts at the line which contains character @ as the first character, then records that contain continuation of the same message start with character #. The GPS sequence ends with a line starting with the character !. The last line contains logger time stamp in milliseconds for given GPS reading. A sample of the GPS message written in EM61MK2 format is given below.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
<b>@</b>	\$	G	P	G	G	A	,	h	h	m	m	s	s	.	s	s	,	d	d	m	m	.	<b>10</b>	
<b>#</b>	m	m	m	m	m	,	s	,	d	d	d	m	m	.	m	m	m	m	m	,	s	,	<b>10</b>	
<b>#</b>	n	,	q	q	,	p	p	.	p	,	s	a	a	a	a	a	.	a	a	,	u	,	<b>10</b>	
<b>#</b>	±	x	x	x	x	.	x	,	M	,	s	s	s	,	a	a	a	*	c	c	CR	LF	<b>10</b>	
<b>!</b>																							Time Stamp in milliseconds	<b>10</b>

The GPS sequence may contain 4 to 6 records. Component of the GGA message may differ in length, however they are placed in the same number of columns. Refer to Appendix B (section B.2) for definition of each component of GGA data message.

## A.2 Conversion Factors

EM61MK2 has four channels. Channels 1, 2, and 3 are common for Mode 4 and Mode D. Channel 4 in Mode D is named Channel T (it corresponds to Top coil).

The instrument response is converted to output voltage in mV for each sampling channel as given below.

Channel 1 to 4 - converted data  
DATA1 (to 4) - instrument output for each channel as recorded in logger  
RANGE - range is controlled by the EM61MK2, it can be 1, 10, 100

**Standard Unit - Mode 4** (One Sensor 1 x 0.5 m or 1 x 1 m)

$$\text{Channel 1} = (\text{DATA1} \times 4.8333 \times 2) / \text{RANGE}$$

$$\text{Channel 2} = (\text{DATA2} \times 4.8333 \times 2) / \text{RANGE}$$

$$\text{Channel 3} = (\text{DATA3} \times 4.8333 \times 2) / \text{RANGE}$$

$$\text{Channel 4} = (\text{DATA4} \times 4.8333 \times 2) / \text{RANGE}$$

**Standard Unit - Mode D** (Two Sensors 1 x 0.5 m or 1 x 1 m, Top and Bottom coils)

$$\text{Channel 1} = (\text{DATA1} \times 4.8333 \times 2) / \text{RANGE}$$

$$\text{Channel 2} = (\text{DATA2} \times 4.8333 \times 2) / \text{RANGE}$$

$$\text{Channel 3} = (\text{DATA3} \times 4.8333 \times 2) / \text{RANGE}$$

$$\text{Channel T} = (\text{DATA4} \times 4.8333 \times 4) / \text{RANGE}$$

if coil is 1 x 0.5 m Channel T is further multiplied by a factor 1.114.

**Hand Held Unit - Mode 4** (One Sensor)

$$\text{Channel 1} = 0.902500 \times (\text{DATA1} \times 4.8333) / \text{RANGE}$$

$$\text{Channel 2} = 1.363000 \times (\text{DATA2} \times 4.8333) / \text{RANGE}$$

$$\text{Channel 3} = 2.026795 \times (\text{DATA3} \times 4.8333) / \text{RANGE}$$

$$\text{Channel 4} = 3.018856 \times (\text{DATA4} \times 4.8333) / \text{RANGE}$$

**Hand Held Unit - Mode D** (Two Sensors, Top and Bottom coils)

$$\text{Channel 1} = 0.9025 \times (\text{DATA1} \times 4.8333) / \text{RANGE}$$

$$\text{Channel 2} = 1.3630 \times (\text{DATA2} \times 4.8333) / \text{RANGE}$$

$$\text{Channel 3} = 2.0430 \times (\text{DATA3} \times 4.8333) / \text{RANGE}$$

$$\text{Channel T} = 12.152 \times (\text{DATA4} \times 4.8333) / \text{RANGE}$$

Further each channel is normalized by current following formula:

**Standard Unit**

$$\text{Channel} = \text{Channel} \times 3000 / \text{Current}$$

**Hand Held Unit**

$$\text{Channel} = \text{Channel} \times 1800 / \text{Current}$$

where, current is a value represented by **5h**, **5l**, and **6** in EM61MK2 data file (see section B.1)

Table of Ranges Determined by the EM61-MK2 Microprocessor

HEX	Ch1	Ch2	Ch3	Ch4	HEX	Ch1	Ch2	Ch3	Ch4	HEX	Ch1	Ch2	Ch3	Ch4
0	1	1	1	1	40	10	1	1	1	C0	100	1	1	1
1	1	1	1	10	41	10	1	1	10	C1	100	1	1	10
3	1	1	1	100	43	10	1	1	100	C3	100	1	1	100
4	1	1	10	1	44	10	1	10	1	C4	100	1	10	1
5	1	1	10	10	45	10	1	10	10	C5	100	1	10	10
7	1	1	10	100	47	10	1	10	100	C7	100	1	10	100
C	1	1	100	1	4C	10	1	100	1	CC	100	1	100	1
D	1	1	100	10	4D	10	1	100	10	CD	100	1	100	10
F	1	1	100	100	4F	10	1	100	100	CF	100	1	100	100
10	1	10	1	1	50	10	10	1	1	D0	100	10	1	1
11	1	10	1	10	51	10	10	1	10	D1	100	10	1	10
13	1	10	1	100	53	10	10	1	100	D3	100	10	1	100
14	1	10	10	1	54	10	10	10	1	D4	100	10	10	1
15	1	10	10	10	55	10	10	10	10	D5	100	10	10	10
17	1	10	10	100	57	10	10	10	100	D7	100	10	10	100
1C	1	10	100	1	5C	10	10	100	1	DC	100	10	100	1
1D	1	10	100	10	5D	10	10	100	10	DD	100	10	100	10
1F	1	10	100	100	5F	10	10	100	100	DF	100	10	100	100
30	1	100	1	1	70	10	100	1	1	F0	100	100	1	1
31	1	100	1	10	71	10	100	1	10	F1	100	100	1	10
33	1	100	1	100	73	10	100	1	100	F3	100	100	1	100
34	1	100	10	1	74	10	100	10	1	F4	100	100	10	1
35	1	100	10	10	75	10	100	10	10	F5	100	100	10	10
37	1	100	10	100	77	10	100	10	100	F7	100	100	10	100
3C	1	100	100	1	7C	10	100	100	1	FC	100	100	100	1
3D	1	100	100	10	7D	10	100	100	10	FD	100	100	100	10
3F	1	100	100	100	7F	10	100	100	100	FF	100	100	100	100

## A.3 Example of Data File in EM61MK2win (R61) Format

The Em61MK2 data file records are written in binary format, therefore the file may have different shape when displayed or printed, depending on particular video or printer settings.

```

EM61MK2 W100GPS000 1
H 042320A 0.200
O 0.00E 0.00
O 0.00E 0.00
O 0.00E 0.00
O 0.00E 0.00
LO
B 0.00
AS 1.000
Z23042005 20:02:51
O 0.00 0.00
O 0.00 0.00
O 0.00 0.00
O 0.00 0.00
*20:02:51.000 4179829
@$GPGGA,020412.00,4336.
#59410,N,07936.64856,W,
#2,6,2,141.56,M,-35,M,5
#,119*55
! 4287423
@$GPGSA,A,3,30,,25,,20
#,,14,,06,,01,02.8,02.1
#,02.0*0D
! 4287441
Eÿø \/^ "N 4287673
Eÿ +/" "Q 4287879
C comment text 4287983
Eÿ; G/yi "O 4288089
Eÿ$ h/ib "W 4288279
@$GPGGA,020413.00,4336.
#59408,N,07936.64857,W,
#2,6,2,141.51,M,-35,M,6
#,119*58
! 4288338
Eÿ¶ 5/ # "S 4288488
@$GPGSA,A,3,30,,25,,20
#,,14,,06,,01,02.8,02.1
#,02.0*0D
! 4288419
Eÿb °/j "O 4288677
EÿL t/k "Q 4288885
@$GPGGA,020414.00,4336.
#59411,N,07936.64846,W,
#2,6,2,141.68,M,-35,M,6
#,119*5D
! 4289337
Eÿ4 (/± . 4290288
@$GPGGA,020415.00,4336.
#59411,N,07936.64845,W,
#2,6,2,141.69,M,-35,M,7
#,119*5F
! 4290338
EÿÈ 1/Y . 4290496
@$GPGSA,A,3,30,,25,,20
#,,14,,06,,01,02.8,02.1
#,02.0*0D
! 4290417
Eÿtr /F 4290687
Eÿkø/ à :
! 4290893
Eÿh/lA .
! 4291101
Eÿ2 Å/5Ñ . 4291293
@$GPGGA,020416.00,4336.
#59420,N,07936.64848,W,
#2,6,2,142.11,M,-35,M,4
#,119*5C
! 4291335
E
tsY3 . 4291502
@$GPGSA,A,3,30,,25,,20
#,,14,,06,,01,02.8,02.1
#,02.0*0D
! 4291414
Eÿ* bE "Y 4291691
C building 4291793
E
# *â "V 4291900
E_/D "C 4292299

```

---

# Appendix B

## B.1 Using the EM61MK2win with a GPS Receiver

The EM61MK2win program accepts input from GPS receiver that stream NMEA-0183 compatible data through their output port. The program uses two NMEA messages: GGA and GSA. The entire GGA message is used later by the DAT61MK2 program, while the GSA message is used only to display PDOP index on the logger screen.

The GPS system means (control device, receiver panel, or manufacturer software) must be used to set GPS receiver communication parameters, to specify frequency of GPS output, and number and type of NMEA messages sent by the GPS system output port. Any GPS system can send various NMEA messages. **It is important to select only two messages (GGA and GSA) that are actually used by EM61MK2.** The program will accept any GPS string sent by the GPS receiver, however it uses time to process GPS data that is not being used. Therefore, selecting a larger number of NMEA messages for GPS output will result in slower data acquisition of EM61MK2win. Normally, the EM61MK2win running in a Windows XP based computer uses less than 100 ms to process and record GPS data from two NMEA messages, GGA and GSA.

Only message GGA is necessary to position EM61-MK2 data. If message GSA is not available in a particular system, the EM61MK2win will function and record position data based on GGA message. Lack of GSA message will result in PDOP index displayed as Not Available (N/A) on the logger display. Using message GGA alone will also result in slightly faster operation of the program. The speed can be further improved by setting higher Baud Rate (if it is supported by the employed GPS receiver) in Set GPS Port menu.

The EM61MK2win dedicates portion of the display and shows GPS status in a frame box. A number following the label **Position** provides the number of GPS positions saved in the current data file. Next two lines in this frame display parameters describing quality of GPS positions. A label **DGPS** (Differential Global Positioning System) indicates that GPS readings are differentially corrected in real time, while label **AGPS** (Autonomous Global Positioning System) indicates lack of differential correction. On the right side of **DGPS** or **AGPS** label two green and white circles alternate. These two circles should alternate colours with the frequency of GPS update rate (usually 1 second intervals). If the circles do not change colours for long periods of time it means that the GPS system is not working or that it is not connected to the field computer.

The next label **PDOP** with a value varying between 0 and 99.9 represents an index called Position Dilution of Precision (**PDOP**). This value is available only when messages both, GGA and GSA are received from GPS. This index measures the strength of satellite coverage for a given area. PDOP is affected by the number of satellites visible and their relative positions in the sky. The smaller the number of PDOP the stronger the satellite coverage is. When there are more than 5 satellites widely spaced visible, the PDOP is 4 or less. However, when there are less satellites visible, or they are unevenly spaced in the sky, PDOP values can be 6 or higher. In most cases, the PDOP in an open sky is less than 3, and most accuracies given for many GPS systems are given for this norm. Refer to GPS documentation and literature for more information related to error sources of GPS positioning. The last label **Sat** and following number shows number of currently tracked satellites.

Two bottom lines of the frame give current Latitude and Longitude of the instrument position (datum WGS1984). Position is updated with frequency of GPS receiver stream.

## B.2 Description of GGA and GSA Data Messages

### GGA Data Message

The GGA message contains the GPS position information and it is the most widely used NMEA data message. This message takes the following form:

```
$GPGGA,hhmmss.ss,ddmm.mmmmm,s,dddmm.mmmmm,s,n,qq,pp.p,saaaa.aa,u,  
±xxxx.x,M,sss,aaaa*cc<CR><LF>
```

Definition of GGA message component:

hhmmss.ss	UTC time in hours, minutes, seconds of the GPS position
ddmm.mmmmm	Latitude in degrees, minutes, and decimal minutes
s	s=N or s=S, for North and South latitude
dddmm.mmmmm	Longitude in degrees, minutes, and decimal minutes
s	s=E or s=W, for East and West longitude
n	Quality indicator, 0 = no position, 1 = raw, no differentially corrected position, 2 = differentially corrected position, 9 = position computed using almanac information
qq	Number of satellites used in position computation
pp.p	HDOP = 0.0 to 99.9
saaaa.aa	Antenna altitude
u	Altitude units, M=meters
±xxxx.x	Geoidal separation (requires geoidal height option)
M	Geoidal separation units, M = meters
sss	Age of differential corrections in seconds
aaaa	Base station identification
*cc	Checksum
<CR><LF>	Carriage return and Line feed

### GSA Data Message

The GSA message contains active satellites and PDOP value. The GSA message is given in the following form:

```
$GPGSA,c1,d1,d2,d3,d4,d5,d6,d7,d8,d9,d10,d11,d12,d13,f1,f2,f3*cc<CR><LF>
```

Definition of GSA message components:

c1	Mode, M = manual, A = automatic
d1	Mode, 2 = 2D, 3 = 3D
d2-d13	Satellites used in position computation (range 0 to 32)
f1	PDOP (range 0 to 99.9)
f2	HDOP (range 0 to 99.9)
f3	VDOP (range 0 to 99.9)
*cc	Checksum
<CR><LF>	Carriage return and Line Feed