

OPERATING INSTRUCTIONS

EM61MK2 DATA LOGGING SYSTEM
FOR FIELD COMPUTER Allegro CX Field PC

EM61MK2

Version 1.15

August, 2011

Geonics Limited

1745 Meyerside Drive, Mississauga, Ontario, Canada L5T 1C6
Tel: (905) 670 9580 Fax: (905) 670 9204

E-mail: geonics@geonics.com

Table of Contents

1.	Introduction	1
1.1	Program Requirements	2
1.2	Installing EM61MK2	2
1.3	Data Files Transfer	2
1.4	Running EM61MK2 Program	3
1.5	Main Menu	3
	Short description of Main Screen options	4
2.	Survey Setup	5
3.	Logger Setup.....	9
4.	Set Port for GPS.....	13
4.1	Monitoring GPS Receiver Output	15
5.	Set Output Port	17
6.	Display Options	21
7.	Logging Data	23
7.1	Monitoring Mode	23
	Description of Monitoring Mode options.....	25
7.2	Stand By Mode.....	31
7.3	Logging Mode.....	32
7.4	Stand By Mode Field Options	33
8.	View Data Files.....	43
	Appendix A.....	47
A.1	Description of Data File in EM61MK2 Allegro CX Format.....	47
A.2	Conversion Factors.....	50
A.3	Example of File in EM61MK2 (Allegro CX) Format.....	52
	Appendix B.....	53
B.1	Using the EM61MK2 with a GPS Receiver.....	53
B.2	Description of GGA and GSA Data Messages.....	54
B.3	Example of Converted Output Format	55

1. Introduction

The Geonics EM61MK2 Data Logging System (DAS70-CX) consists of a field computer Allegro CX, data logging program EM61MK2, and associated cable to connect the Allegro CX to the Geonics EM61-MK2 instrument. The program EM61MK2 is designed for the Allegro CX field computer and its MS Windows CE.NET V4.2 operating system.

The EM61MK2 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 text 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 EM61MK2 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. 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 EM61MK2 will accept NMEA-0183 compatible data from a GPS receiver directly connected to an Allegro field computer. GPS data which are embedded in the EM61MK2 data file can be processed later in the Geonics DAT61MK2 program. The connected GPS must be able to stream NMEA-0183 compatible messages. The EM61MK2 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 EM61MK2 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 file, therefore they can be automatically used during subsequent data collection sessions.

The program has an option that allows you to view data files. Data files are saved to the programs current data directory by default. 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 transferred to a PC computer using a memory card, or by a serial or USB port using the MS ActiveSync program.

Over 1,000,000 readings can be collected in the Allegro field computer with a standard memory of 64 Mb. The maximum speed of data collection is approximately 16 readings per second assuming 1 Hz (or less) GPS input. In graphic display mode, a profile containing the last 150 data readings is displayed for each channel.

1.1 Program Requirements

To successfully use this software, you will need :

Computer

Field computer Allegro CX

Installed MS ActiveSync software (Version 3.50 or later) in desktop PC, or alternatively PCMCIA memory card to transfer files.

Geonics EM61-MK2

The EM61-MK2 instrument with associated cables.

The EM61MK2 program for Allegro CX is stored on DAT61MK2 CD disk. All necessary initial files (with extension names .INI) as well as data folder (DATA61MK2) are created in your field computer after the program is run for the first time. Check that the file EM61MK2.EXE is included in AllegroCX directory on the CD disk.

1.2 Installing EM61MK2

While using the Allegro CX the EM61MK2.exe file should be transferred from a desktop PC using MS ActiveSync software and USB or serial cable provided by manufacturer. Optionally the program can be transferred to an Allegro using the PC memory card.

It is recommended that the program be placed in non-volatile solid state storage. This memory is represented in the Allegro by the C_Drive icon. In the My Computer on the Allegro, double-tap on C_Drive icon, then folder C_Program Files will appear. The EM61MK2 program can be placed in C_Program Files. Folders for data files should be also created in C_Drive, which is a safe area to store data. The program creates folder DATA61MK2 which is the default folder for EM61-MK2 files.



For more information about data storage options, refer to Chapter 3 of the Allegro CX manual.

1.3 Data Files Transfer

Data files are saved in the Allegro with extension R61. Transfer of files to desktop PC can be performed with MS ActiveSync or by PC memory card. Data files with extension R61 are binary raw data files. These files have to be converted to DAT61MK2 format with extension M61 (option "Convert Files" in DAT61MK2). Then they can be loaded and processed in the DAT61MK2 program.

1.4 Running EM61MK2 Program

To run the EM61MK2 locate program in C_Program Files and double-tap program icon. The EM61MK2 is a Windows CE based, button and dialog driven program designed to be simple to use. Although the program fully supports touchscreen interface, the keyboard entry may be more convenient in most field applications. The EM61MK2 can be fully operated from the keyboard when touchscreen functions are disabled by the user.

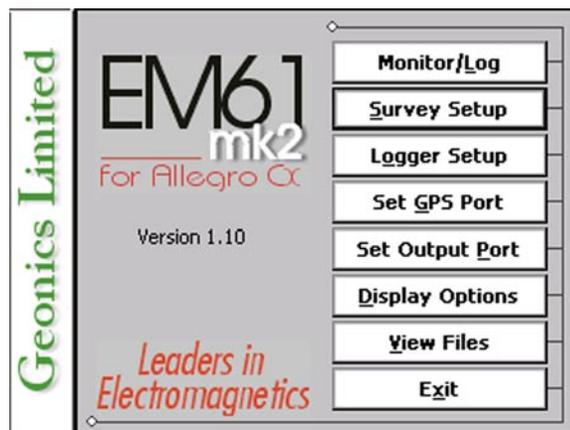


Options represented by the command buttons can be accessed by a single tap on the button. Buttons can also be selected from the keyboard by using shortcuts (pressing key corresponding to underline letter in button caption or by selecting button by pressing **TAB** and then execute by pressing **ENTER**. Shortcuts are the fastest way of accessing options represented by buttons.

Most options in the dialog windows are given in the form of text boxes and drop-down boxes which can be accessed using touchscreen or by the keyboard. Each dialog window has a title bar with a caption describing the dialog function and two buttons **OK** and **X (Cancel)**. The **OK** button (or key **ENTER**) confirms dialog selection. Tapping on the **Cancel** button (or pressing **Esc** key) closes the dialog and returns to the initial selection.

1.5 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 EM61MK2 Main Screen is displayed below.



These options are selected by using tapping 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

Monitor/Log

This option allows to monitor and log the EM61-MK2 output. Monitor/Log 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 and Allegro battery level, etc.

Survey Setup

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

Logger Setup

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

Set GPS Port

The GPS Port Setup dialog allows to disable and enable GPS data acquisition. This option is also used to set the serial port number used for GPS input and to specify necessary serial port communication settings. GPS monitoring window can be accessed from this dialog as well.

Set Output Port

This option can be used to enable simultaneous output of collected data through selected serial port. Data can be sent to other logging devices, including remote computers connected by wireless modem or digital radio. This option is also used to set the serial port number used for output and to specify necessary serial port communication settings.

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

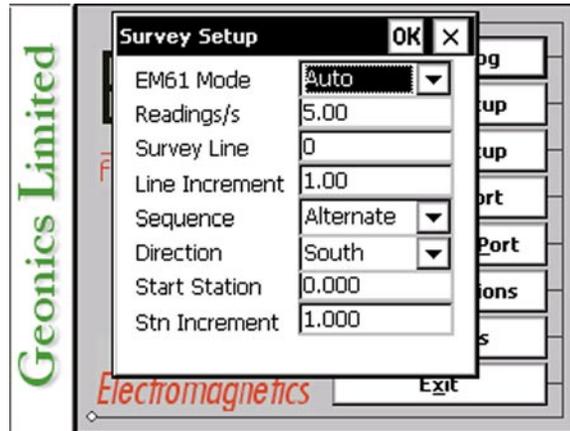
This option allows to review data files saved in Allegro.

Exit

This option will terminate the program execution.

2. Survey Setup

The Survey Setup dialog, presented below, contains several parameters which affect two important procedures: instrument settings (instrument mode, frequency of data collection, etc.) and survey geometry layout (survey line names, line spacing, start station, station increment, etc.).



Description of Options and Parameters:

EM61 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

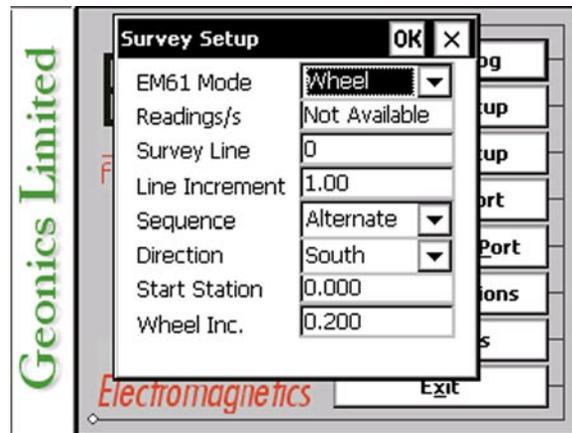
Readings will be triggered automatically at a specified frequency (see option Readings/s).

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.

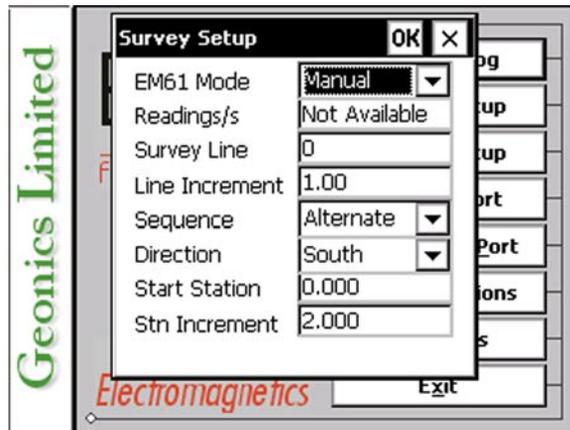
When Wheel mode is selected option Reading/s is not available, see figure below. Please note that while in former data acquisition system (DAS70) Stn Increment (station increment) had only two options: Positive or Negative, in the current program this parameter is optional and its value has to be entered 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 is not available.



Readings/s

When this option is available (only in Auto mode) activate text box by tapping or using TAB key and then enter desired value.

This parameter describes number of readings per second that will be taken. Any number larger than zero can be entered, however the EM61-MK2 maximum frequency of data output is 16 readings per second.

Survey Line (survey line name)

Activate text box by tapping 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 tapping 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

Tapping on the down arrow next to the text box opens a drop-down box showing the available settings, or when the keyboard is used activate the text box and then by using up or down arrow keys select one of two available items: *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

Tapping 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 tapping 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 tapping or using **TAB** key and then enter the desired value for the station increment.

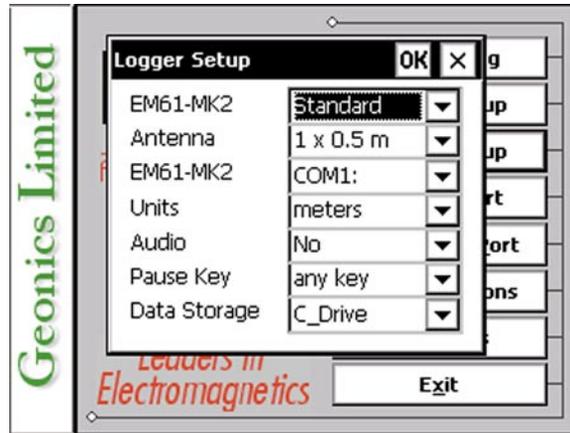
This parameter specifies the station increment for the selected survey line. This value is used in conjunction with Start Station to calculate the current station number for display purposes.

After all the parameters in the Survey Setup dialog are updated tap 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) tap **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. Logger Setup

This option allows you to specify used type of the instrument, antenna size and set several parameters in the logger. The Logger Setup dialog is presented below.



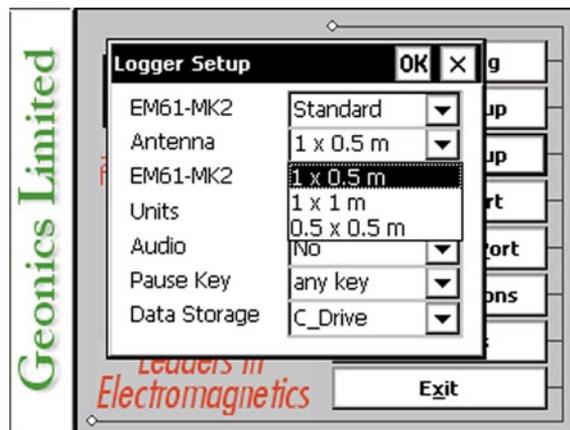
Description of Parameters:

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.

Antenna

The Antenna 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. 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 Antenna.

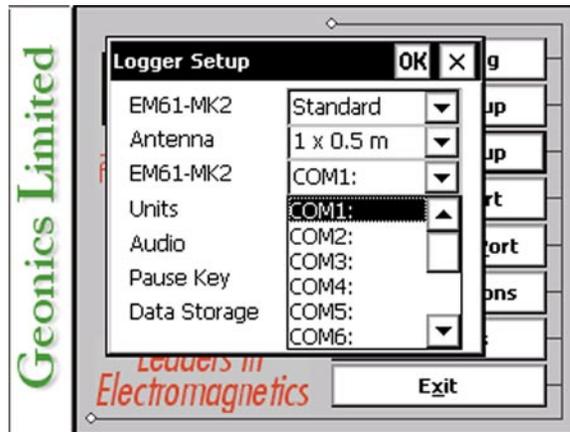


EM61 Port

The number of serial port that is assigned to the EM61-MK2. Available selections: COM1, COM2, COM3, and COM4. 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 serial port specified in the Set Port for GPS and Set Output Port options (see later chapter), otherwise a message will be displayed and ports will have to be reassigned.

Select port number in the drop-down list box (see Figure below).



Units

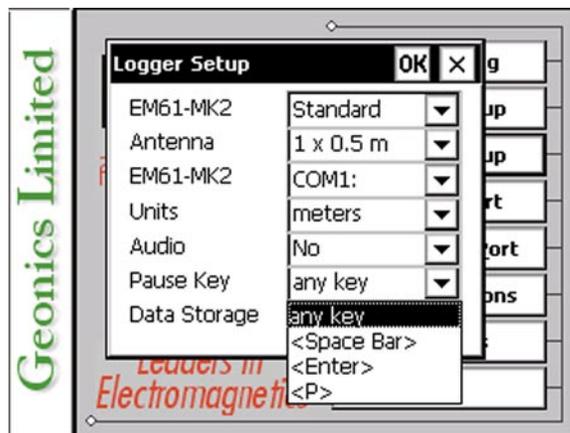
Two selections are available: **Meters** or **Feet**.

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.

Pause key

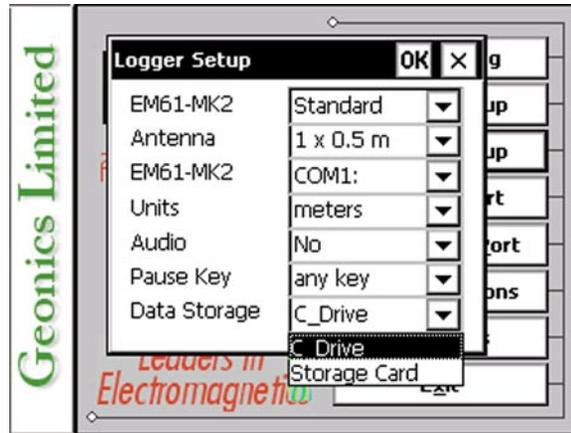
Four selections are available: **any key**, **Space Bar**, **Enter**, and **P**. This feature is used to pause data recording during logging session. Default setting **any key** can be changed to one of the three specific keys for field conditions where a logger key can be accidentally pushed causing unwanted stop of data logging.



Data Storage

A tap on the down arrow next to the text box opens a drop-down box showing the available settings, or when the keyboard is used navigate to the text box by TAB key and then by using up or down arrow keys select one of two available options.

Two options are available: **C_Drive** (default) or **Storage_Card**. The C_Drive option will create data files in the built in non volatile memory of the Allegro CX field computer. The Storage_Card option is available only when PC memory card is inserted in to Allegro CX PCMCIA slot (located behind the display).

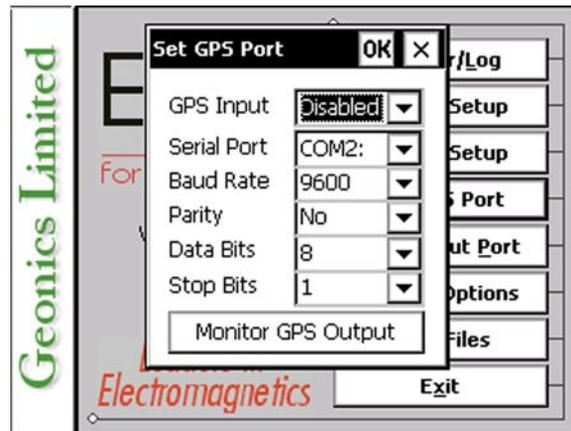


After all the parameters in the Logger Setup dialog are updated tap the button **OK** or press **ENTER** key to accept the displayed settings. The program will return to the Main Screen. Updated settings will be written to the initial file and they will be given as default parameters in the subsequent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

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

4. Set Port for GPS

After the Set Port for GPS button was tapped (or executed from the keyboard) in the Main Screen the Set Port for GPS dialog window appears on the screen. This dialog allows you to enable and disable the GPS input, specify serial communication parameters matching GPS receiver settings, and to monitor the GPS output in terminal mode (the bottom button). The dialog is presented below.



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 Allegro. In such case data file will contain proper sequence of EM61-MK2 readings without any GPS input.

Tapping 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: Enable and Disable.

Serial Port

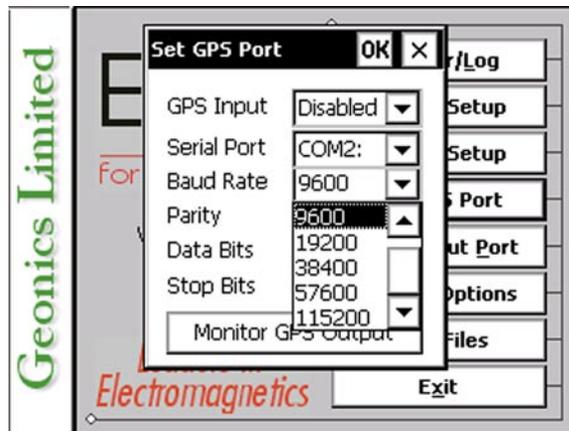
The number of serial port that is assigned to the GPS input. Available selections: COM1 to COM12. The program default is COM2. Communication parameters for the selected serial port can be determined in options described below.

This port must be different than the port specified in the Logger Set Up menu (for EM61-MK2) and Set Output Port dialog, otherwise a message will be displayed and ports will have to be reassigned.

Tapping 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.



Tapping 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.

Tapping 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 match settings in the GPS receiver, default is 8. Other available selection is 7.

Tapping 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 match settings in the GPS receiver, default is 1. Available selections are 1 or 2.

Tapping 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.

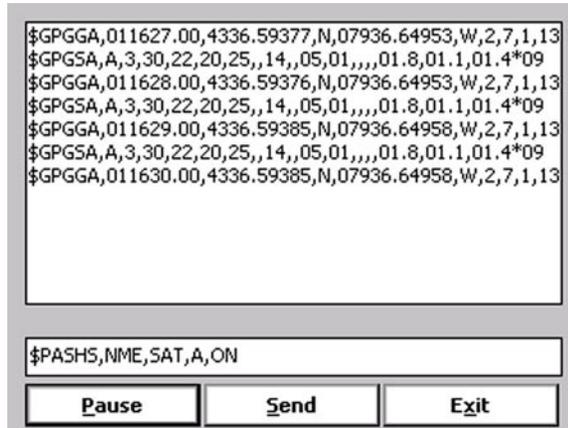
After all the parameters in the Set GPS Port dialog are updated tap the button **OK** or press **ENTER** key to accept the displayed settings. The program will return to the Main Screen. Updated settings will be written to the initial file and they will be given as default parameters in the subsequent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

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

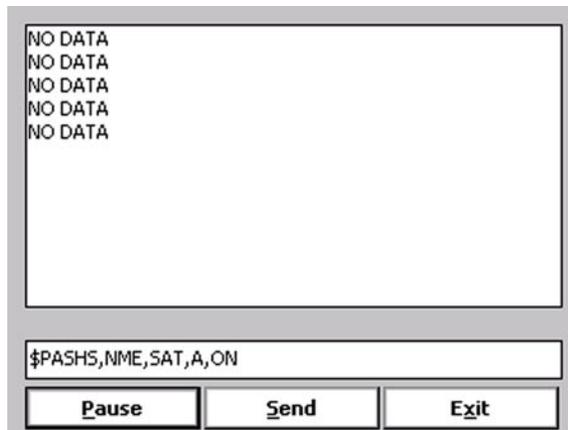
To activate terminal mode which allows you to monitor GPS receiver output tap the button labeled Monitor GPS Output, or when using keyboard select this button using **TAB** key and press **ENTER**. The monitoring mode will work regardless of the GPS Input being Enabled or Disabled. This option is described in the following section.

4.1 Monitoring GPS Receiver Output

After the button Monitor GPS Output is tapped or executed by the keyboard the program will display the screen in terminal mode. In this mode the screen is divided into three parts. The largest, top portion of the screen displays the GPS receiver output. The middle portion shows that last NMEA command sent to the GPS receiver (by default command shown in Figure below), and at the bottom three buttons representing available options: Pause/Go, Send, and Exit. These buttons can be tapped, executed by TAB key and ENTER keys, or by using shortcuts (pressing underlined letter keys). This screen is shown below.



As soon as the EM61MK2 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.



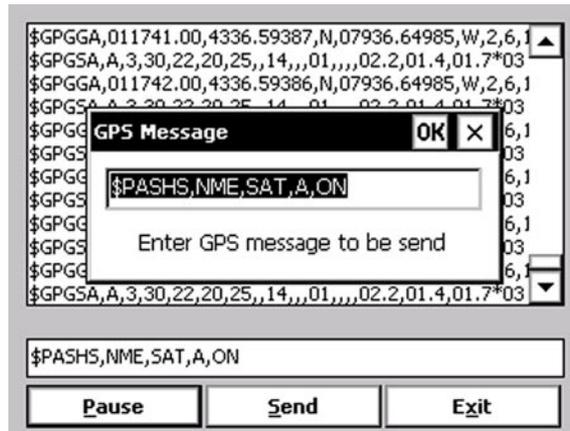
The message NO DATA is normally updated with a rate of 7 seconds. This may indicate the following: serial port number not correctly specified in Set Port for GPS dialog, GPS receiver not sending any data, and not working or not connected GPS receiver. If the message is updated more often than 7 seconds (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 tap (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 tapped 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, tap **OK** button or press the key <ENTER> to send the command to the GPS receiver. Tapping **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).



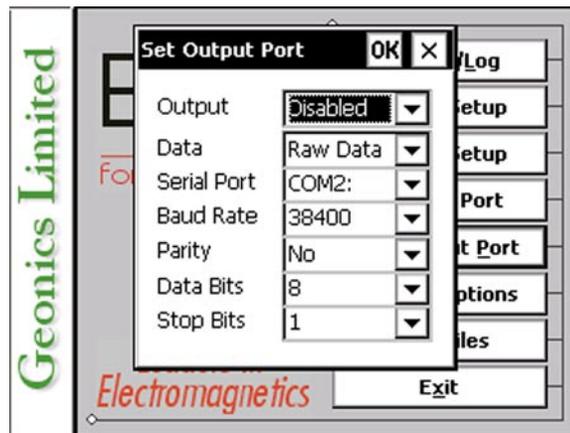
After this command is received by the GPS receiver, the confirmation message will be send by the receiver (\$PASHR, ACK*3D) and data stream will contain the message SAT (\$PASHR, SAT,..... in the above figure).

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. Set Output Port

This option is used to enable simultaneous output of data collected through a selected serial port. Data can be sent to other logging devices, including remote computers connected by wireless modem or digital radio. EM61-MK2 data and optional GPS stream is sent by the Allegro serial port output only during Logging session when readings are written to a data file.

After the Set Output Port button is tapped (or executed from the keyboard) in the Main Screen the Set Output Port dialog window appears on the screen. This dialog allows you to enable and disable the output, specify format of output, and specify serial communication parameters matching external device settings. The dialog is presented below.



Description of Options and Parameters:

Output

This option allows you to Enable/Disable a serial port data output. The Output can be Enabled even if there is no receiving device connected to the Allegro.

Tapping 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 the two available items: Enable and Disable.

Format

This option allows you to specify the format of the output string: Raw Data or Converted. The Raw Data format indicates that the string will be sent in binary format (24 bytes long records) and the format is exactly the same as the raw data file format (R61) described in Appendix A. All GPS messages are broken to 24 bytes long records as described in Appendix A. Data files collected with an external device may be converted to ASCII format (assuming the entire data set was collected) using the option Convert in the data processing program DAT61MK2.

If Converted is selected then the string sent by the output serial port will contain converted data in mV and GPS NMEA message will be sent as it is received from the employed GPS receiver. The converted format also includes station number according to start station and increment specified in corresponding dialogs, and a time stamp in milliseconds for each reading. An example of the output data format is shown in Appendix B.

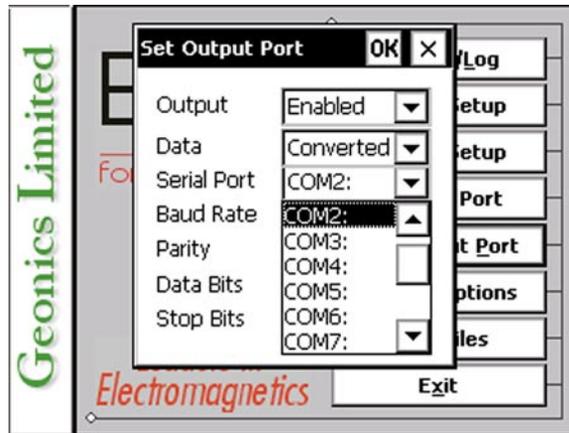
The Raw Data format is preferable since it is more than three times smaller.

Serial Port

The number of serial port that is assigned to the GPS input. Available selections: COM1 to COM12. 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 ports specified in the Logger Set Up (for EM61-MK2) and GPS Port Setup dialogs, otherwise a message will be displayed and ports will have to be reassigned.

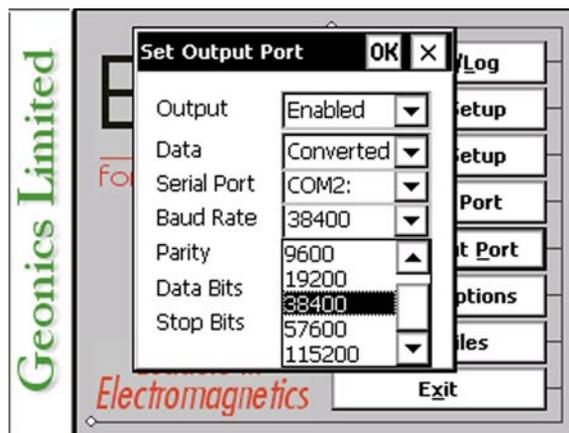
Tapping on the down arrow next to the text box labeled Serial Port opens a drop-down box showing the available ports, or when the keyboard is used activate the text box by pressing TAB key and then by using up or down arrow keys select one of available items.



Baud Rate

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

Tapping 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 external device. Available settings are None, Even, and Odd; default is N.

Tapping 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 match settings in the receiving device, default is 8. Other available selection is 7.

Tapping 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 match settings in the external device, default is 1. Available selections are 1 or 2.

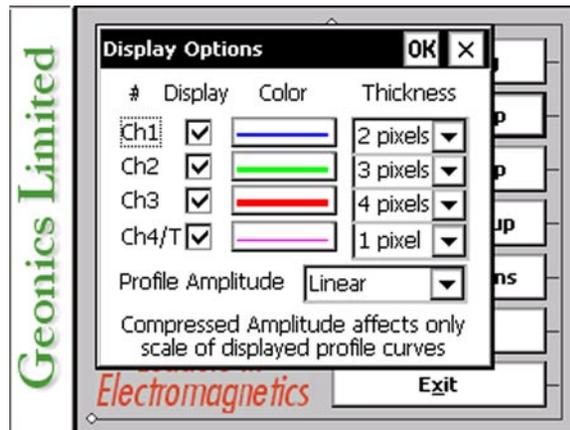
Tapping on the down arrow next to the text box labeled Stop Bits opens a drop-down box showing the available parameters, or when the keyboard is used activate this text box by pressing TAB key and then by using up or down arrow keys select one of available items.

After all the parameters in the Set Output Port dialog are updated tap 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 Set Output Port dialog.

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

6. Display Options

After the **Display Options** button was tapped (or executed from the keyboard) in the Main Screen 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.



Description of Options and Parameters:

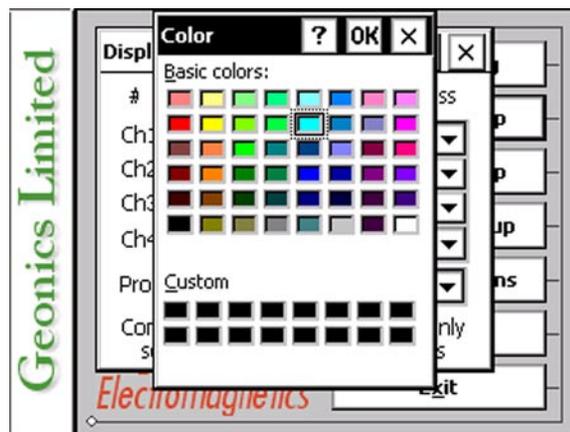
Display

To enable or disable displaying of each channel profile tap on the corresponding button labeled Display. 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 tap the corresponding button (with colour line) labeled Color. The following dialog titled Color will appear.



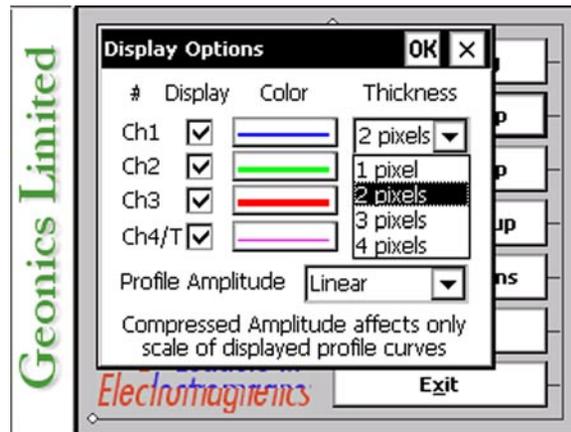
Select desired colour by tapping on a colour box (the selected colour box will be highlighted).

Tap 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 tap **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.

Tapping 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 tapping 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.

Tapping 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.

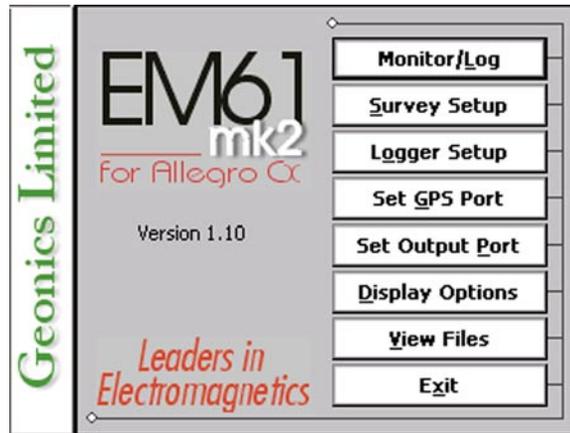
Please note, that readings in numeric form are always given in mV (linear scale) regardless of the Profile Amplitude selection. Further, graphic display in the compressed scale does not affect readings saved in the data file. Data are always written to file in original form.

After all the parameters in the Display Options dialog are updated tap 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) tap **Cancel (X)** button or press **Esc** key. All parameters will be reset to initial settings and the dialog window will disappear.

7. Logging Data

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

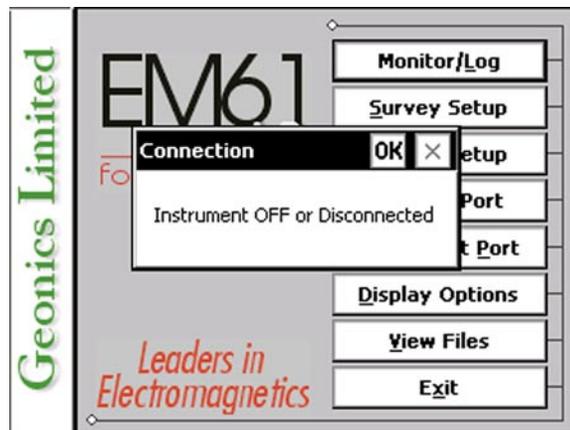


parameters can be quickly examined and some functions (creating data file, nuling, QC coil check) can be performed. After a data file is created in Monitoring mode, the program switches to Stand By mode and allows access to Logging mode. In Stand By mode instrument output can be monitored and some survey 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.

7.1 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.

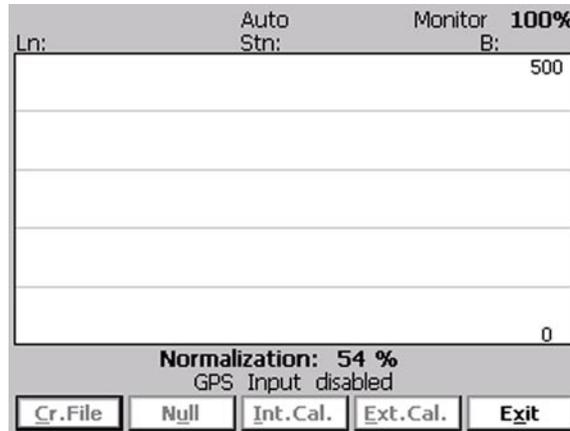
It is assumed that the instrument is turned ON prior to using this option. If the instrument is OFF or the instrument console is not connected to the computer the following message will appear:



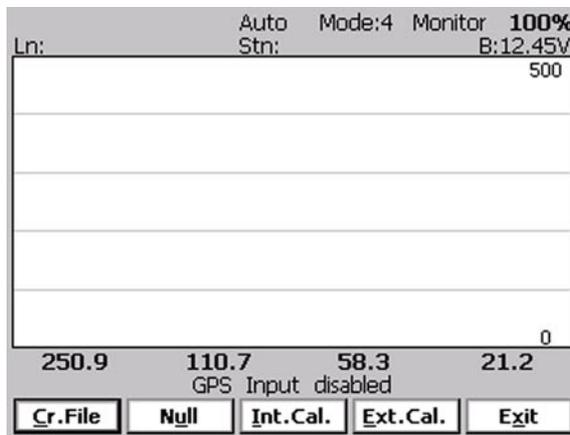
Check the connection or turn the instrument ON and select the Monitor/Log option again.

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. At this stage the Monitor window will display the following message:

After the normalization is finished the layout of the Monitor window is as follows:



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



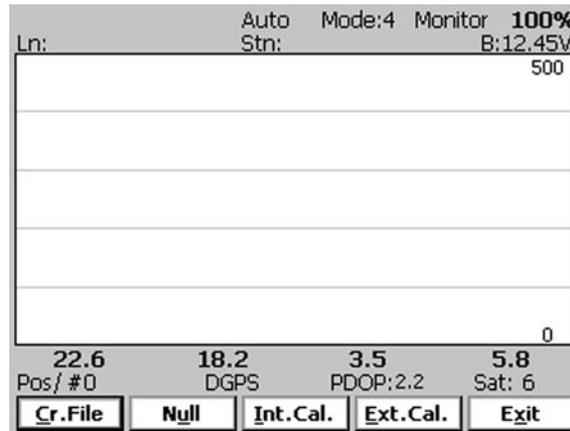
Two lines of text in the top section provides survey parameters (used in Stand By and Logging modes) and instrument information. In Monitor mode this section displays: instrument mode (4 or D), current display mode (Monitor, Stand By or Logging), Allegro battery level (in % of full charge), and the EM61-MK2 battery level in Volts (following label **B:**). When fiducial marker is pressed then **M** is displayed next to label **Stn:**.

The second, largest graphic section will be used to display profiles during logging data.

The third section contains two lines of text. The first line is used to display EM61-MK2 readings and the second line of text provides GPS related information.

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 in the Monitoring window. Channels are not labeled and they are displayed from the left in ascending order: 1, 2, 3, and 4, or 1, 2, 3, and T. The EM61-MK2 readings are updated approximately 10 times per second during the monitoring session.

When GPS was Disabled in the Set GPS Port dialog a message **GPS Input: 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 **Pos/#** will be used during data acquisition, it will provide the number of GPS positions saved in the data file. In Monitor mode this label indicates GPS activity by toggling between forward (/) and back (\) slash (that follows label **Pos**) every time the program receives a message from the GPS receiver. If the slash is not changing for long periods of time it means that the GPS receiver is not working or that it is not connected to the field computer. 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. 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 9 (Set Port for GPS), Appendix A, and to GPS manuals for more information about GPS parameters.

The fourth section of the Monitor window lists the program functions available directly in the Monitor mode given at the bottom of the screen in form of buttons. Available options are as follows: **Cr.File** - create data file, **Null** - Nulling, **Int.Cal.** - Internal QC-coil calibration, **Ext.Cal.** - External QC-coil calibration, **Exit** - exits the Monitor mode and returns program to Main Screen.

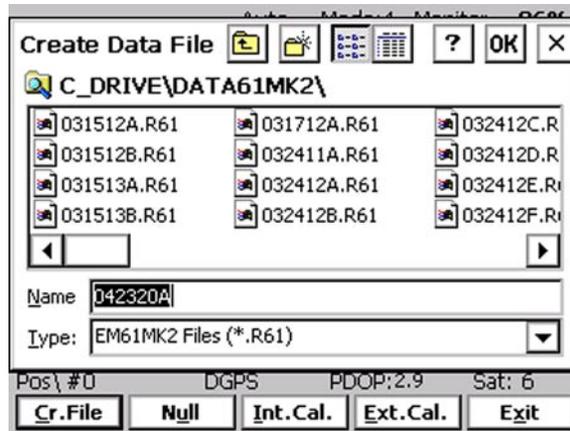
Description of Monitoring Mode Options

Cr.File (*create data file*)

When a data file is created the program will switch to Stand By mode automatically.

The log file can be created in the given default directory (DAT61MK2) or in any other directory in the Allegro CX. If other directories are used, please note that only subdirectories of C_Drive represent save, non volatile memory.

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 EM61-MK2 data files cannot be appended.

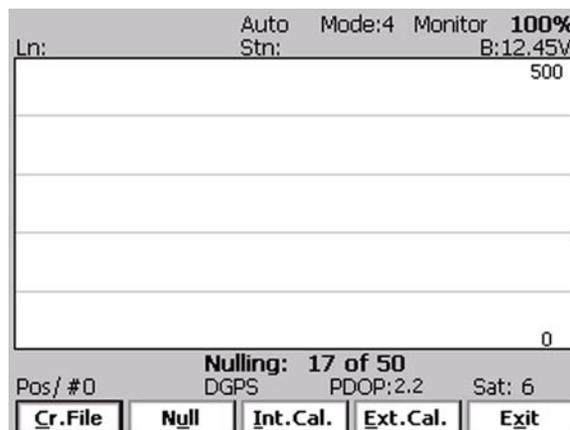
Each data file in the field computer (raw data file) has an extension name R61 and it is created in the directory specified in Create Data File dialog. The R61 files are created in the instrument binary format. They can be viewed using the Main Screen option “View Files”. These files can be also converted to ASCII format and processed in the Geonics DAT61MK2 program.

After the file is specified tap 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 tap 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.

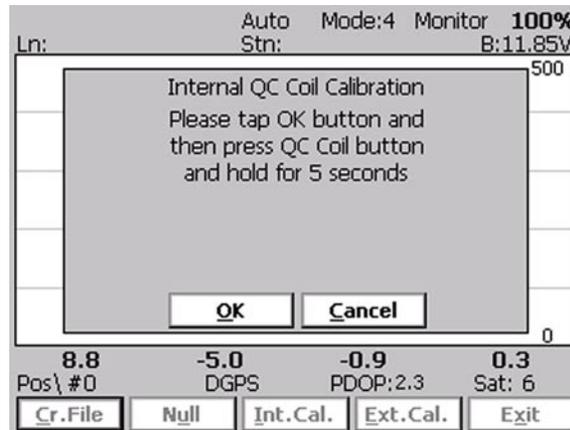


The calculated offset is applied to all the readings that follow this operation. If needed, this procedure can be repeated several times until satisfactory results are obtained. However, there is no associated “Undo” function. If original values (without calculated offsets) of the EM61-MK2 readings are 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.

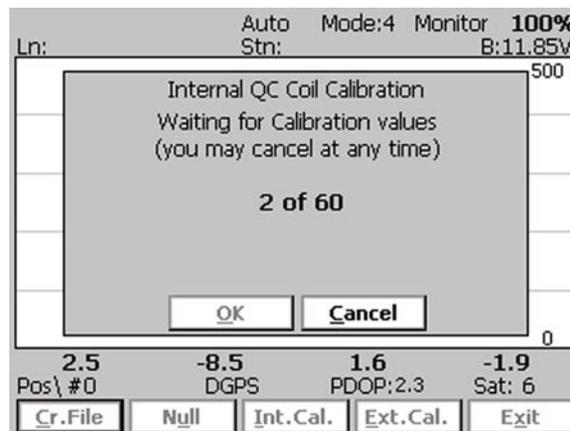
Int.Cal. (*Internal QC Coil Calibration*)

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

To start the calibration using Internal QC coil tap the key labeled **Int.Cal.** 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.



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 Allegro screen.



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

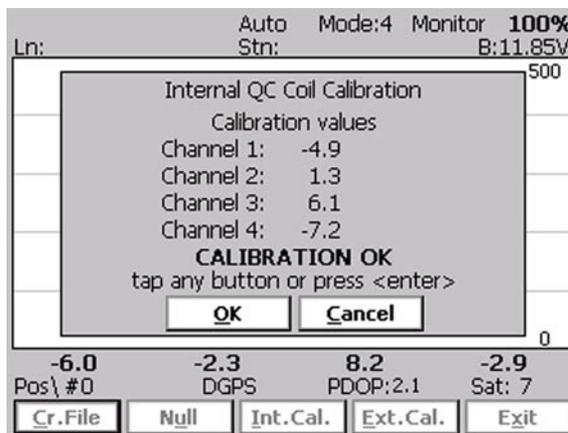
The process can be stopped by an operator at any time by tapping **Cancel** button or pressing shortcut key **C**.

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

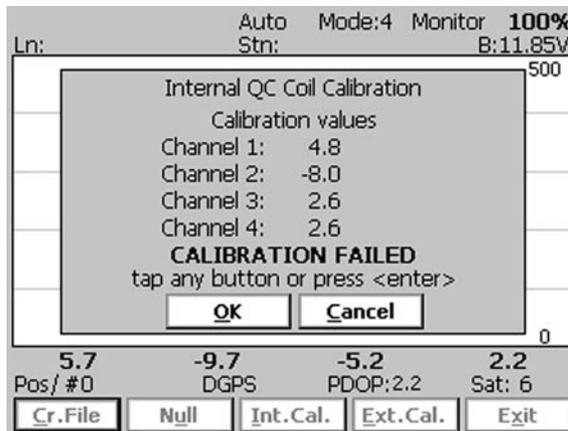


After pressing any key the program returns to Monitoring window. To repeat Internal QC coil calibration please tap the **Int.Cal.** button again.

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 (see below).



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

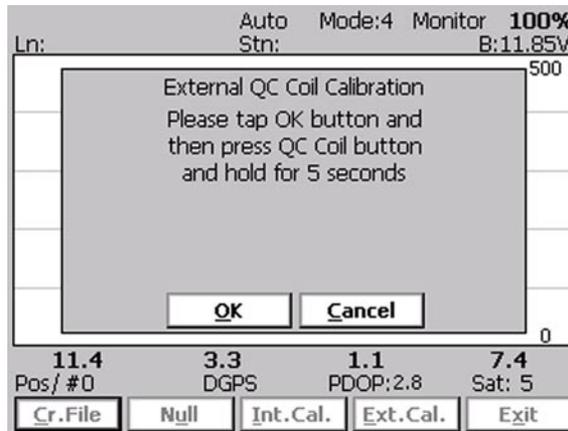


Regardless of the test result (OK or FAILED) the readings will be saved on screen. The program returns to Monitoring window after any button is tapped or ENTER key is pressed. Then the Internal QC coil calibration process can be repeated.

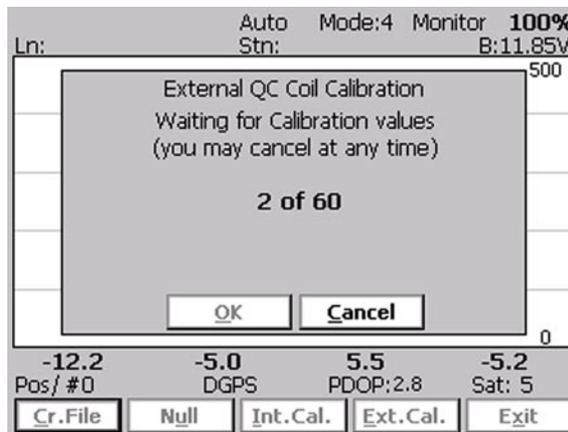
External QC Coil Calibration

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

To start the calibration using the Internal QC coil tap the button labeled **Ext.Cal.** 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.



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 Allegro screen.



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

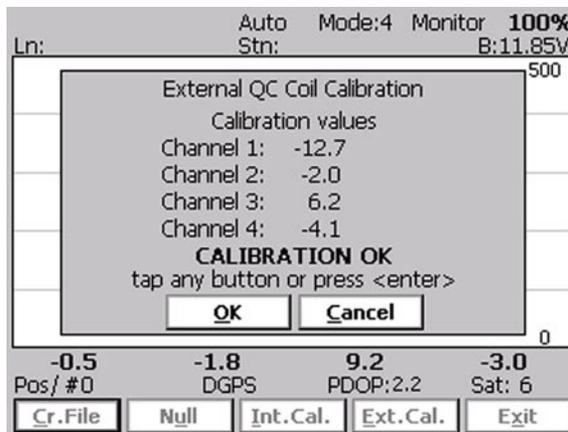
The process can be stopped by an operator at any time by tapping **Cancel** button or pressing shortcut key **C**.

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 **Int.Cal.** 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.



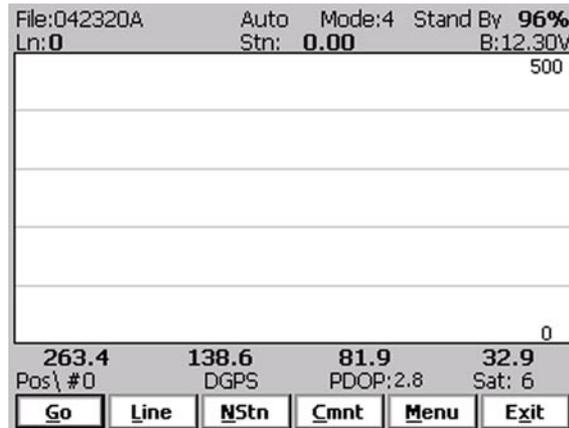
Regardless of the test result (OK or FAILED) the readings will be saved on screen. The program returns to Monitoring window after any button is tapped or ENTER key is pressed. Then the Internal QC coil calibration process can be repeated.

Exit (exit Monitor mode)

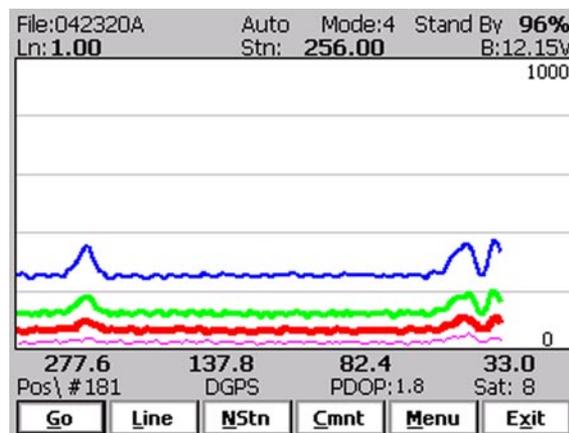
After tapping Exit button (or executing this option using keyboard) the program immediately returns to Main Screen.

7.2 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, and 4 (or T) are shown in numeric form below the plot area. Channel labels are not displayed due to the small screen of the Allegro. Values of readings are displayed in the following order (from the left): Channel 1, 2, 3, and 4 (or T). 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 two lines of text displaying survey and instrument related parameters. These are (from top left): current data file name (labeled **File:**), survey mode (**Auto**, **Wheel** or **Manual**), instrument mode **4** or **D** (labeled Mode:)), logging mode **Stand By** or **Logging**, Allegro internal battery level (in % of full charge, not labeled), current survey line (labeled **Ln:**), current station (labeled **Stn:**), and EM61-MK2 battery level in Volts (labeled **B:**). When fiducial marker is active a label **M** is displayed between station label and station value.

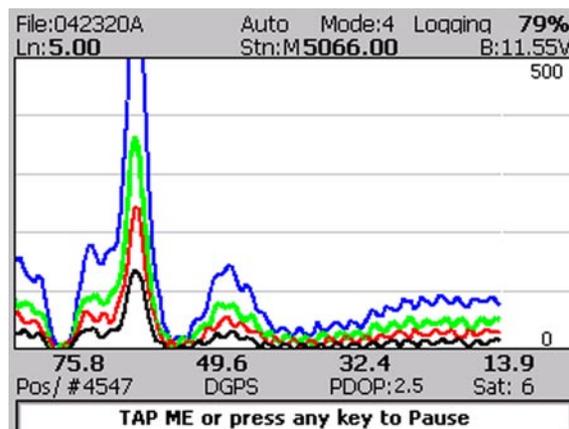
In the Stand By mode the station number will not change. Stations in the EM61MK2 program are incremented by station increment value after each reading is written to the data file.

One line of the display is dedicated to showing the GPS status. A number following the label **Pos/#** 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). However this label indicates GPS activity by toggling between forward (/) and back (\) slash (that follows label **Pos**) every time the program receives a message from GPS receiver. If the slash is not changing for long periods of time (larger than GPS receiver update rate) it means that the GPS receiver is not working or that it is not connected to the field computer. 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. 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 A, and to GPS manuals for more information about GPS parameters.

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

7.3 Logging Mode

The Logging mode is enabled by tapping on the **GO** button 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.



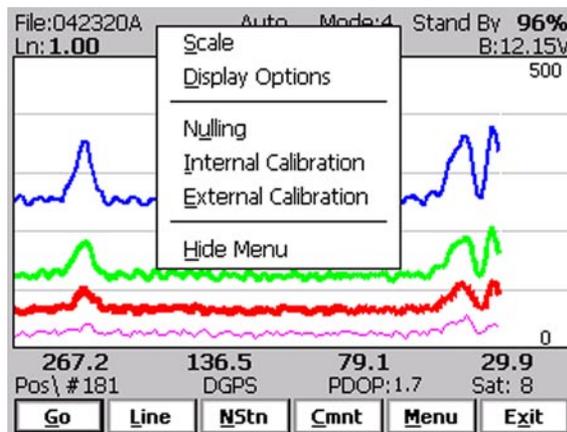
After the screen changes to Logging mode the current station (label **Stn:**) is updated according to the station interval. Similarly, if GPS Input was enabled, total number of GPS positions (label **Pos**) in the data file is incremented every time (usually once a second) GPS position is written to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

There is only one option available in the Logging mode - pause logging. After a Pause button is tapped 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.

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

7.4 Stand By Mode Field Options

Several field options are available while the Logging window is in the Stand By mode. More frequently used options can be accessed directly from command buttons and others can be used from pop up menu activated by button **Menu** (displayed below). Command buttons can be used by tapping 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.



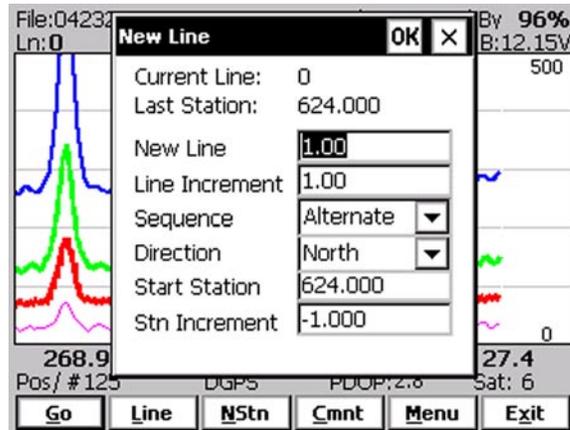
Options listed in the menu can be accessed directly (without displaying pop up menu from Menu button) by using keyboard shortcuts, i.e. pressing key S will display Scale dialog. While menu is displayed options can be selected by tapping on the appropriate proper option, or from the keyboard by pressing the shortcut keys or by navigating using <**Up**> and <**Down**> arrow keys and executing by <**ENTER**>

GO *(start data logging)*

Tap 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.

Line (New Survey Line)

The New 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 menu.



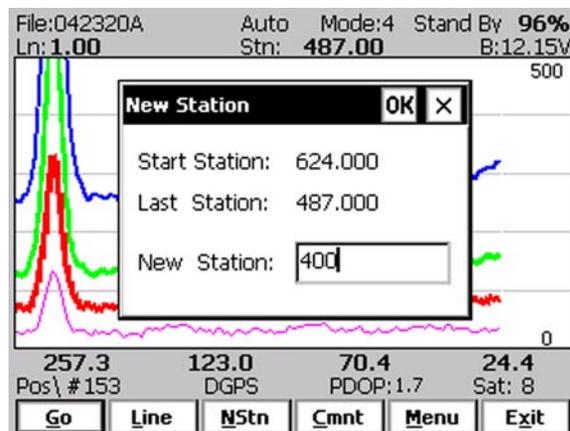
At the top of the dialog the last survey line name and the last logged station are displayed. Default name for the new line is given based on the Line Increment parameter. The default Start Station, direction of the Station Increment, and Direction are determined based on Sequence selection. All these 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 tap 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 (**Ln:**) name and current station (**Stn:**) 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) tap **Cancel (X)** button or press **Esc** key, the dialog window will disappear.

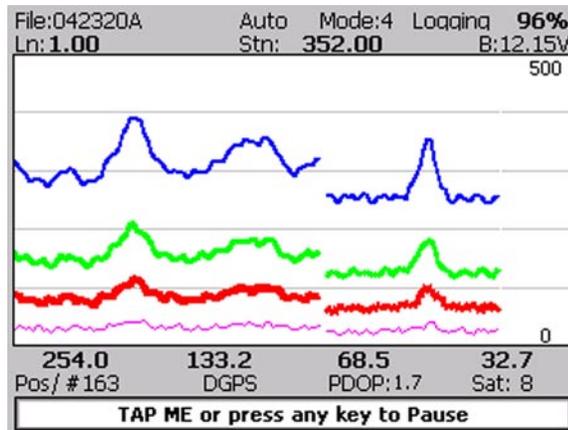
NStn (New Station)

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



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.

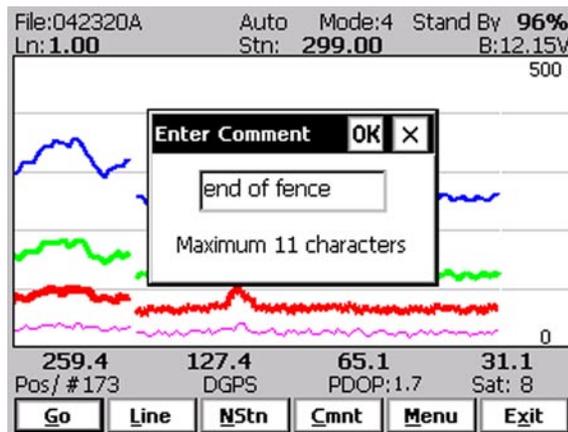
Tap the button **OK** or press **ENTER** key to accept the new value. The program will return to the Logging window in Stand By mode. Current station (**Stn:**) value will be updated and after data logging is activated the profile curves will have a small gap (two pixels) showing the new station entry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



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

Cmnt (*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.

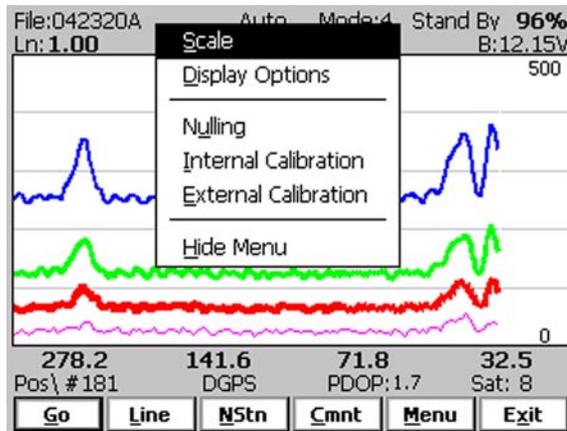


Tap the button **OK** or press **ENTER** key to accept the comment entered in a text box of the dialog. The text of the comment is saved in the file with a corresponding time stamp and the program will return to the Logging window in Stand By mode.

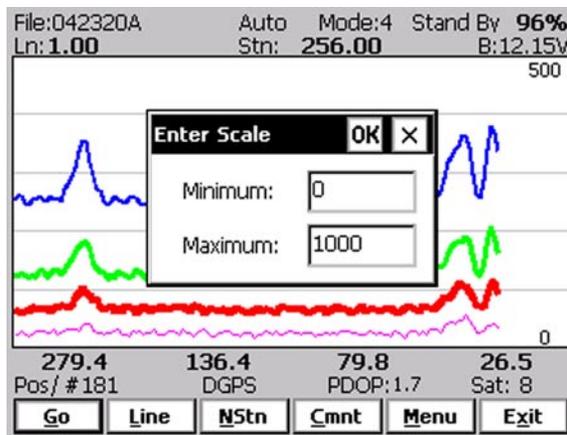
To ignore an entry and return to Stand By mode tap **Cancel (X)** button or press **Esc** key, the dialog window will disappear and measurements can be continued.

Scale (New Scale for Profile Plot)

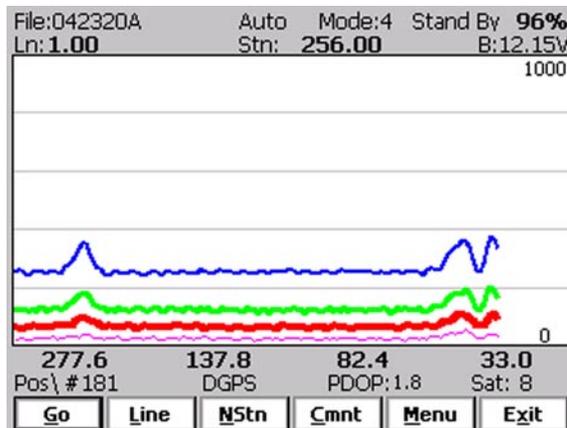
Selecting New Scale option allows the operator to enter new scale parameters for the profile plot. This option is available only from pop up menu (accessible from **Menu** button) or directly from keyboard by using shortcut key <S>.



The Enter 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 tap the button **OK** or press **ENTER** key to accept to accept new values and the profile plot area will be redrawn (see Figure below).

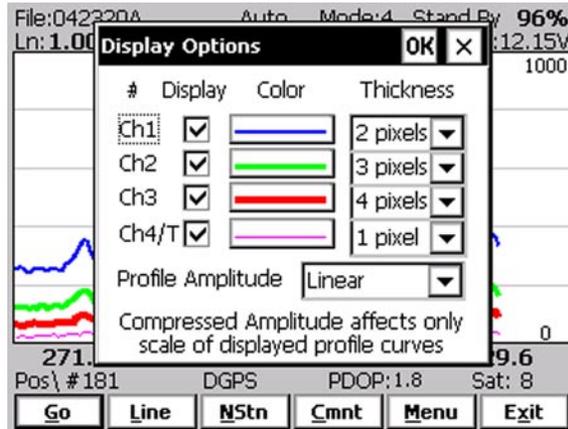


To ignore an entry and return to Stand By mode tap the **Cancel (X)** button or press **Esc** key, the dialog window will disappear and measurements can be continued.

Display Options *(new options for profile plot display)*

This option is available only from pop up menu (accessible from **Menu** button) or directly from keyboard by using shortcut key <D>.

After the **Display Options** item was selected in the pop up menu 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.

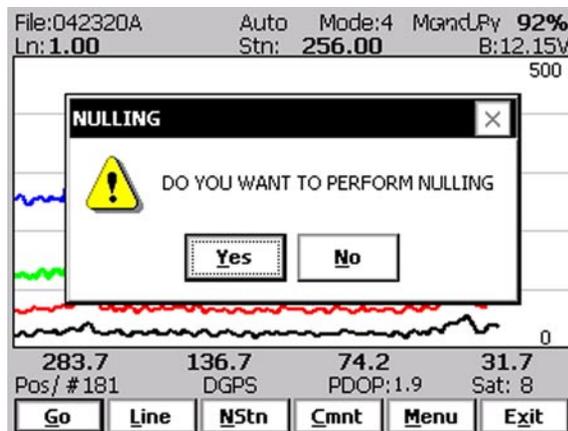
Tap the button **OK** or press **ENTER** key to accept updated display parameters. The dialog will disappear and profile plot area will be redrawn in Stand By mode.

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

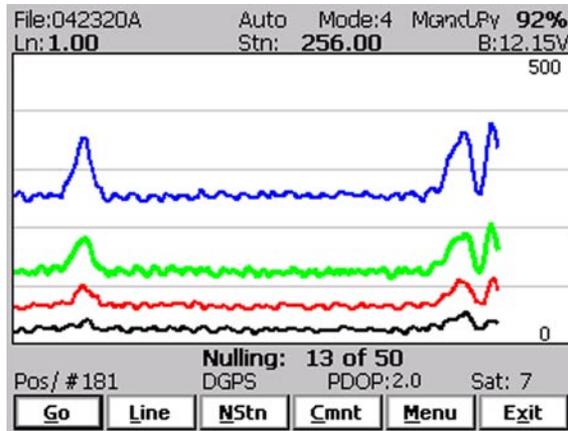
Nulling

This option is available only from pop up menu (accessible from **Menu** button) or directly from keyboard by using shortcut key <U>.

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.



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

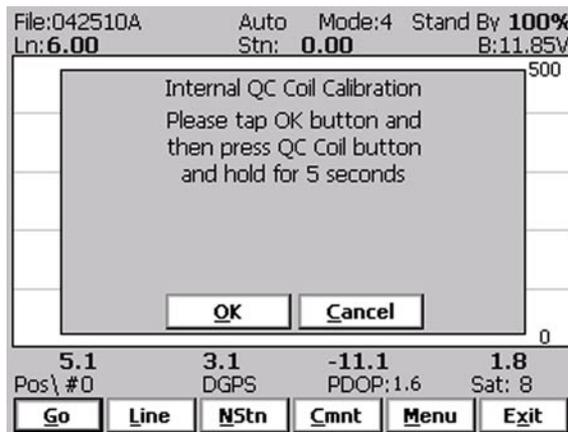


The calculated offset is applied to all the readings that follow this operation. If needed, this procedure can be repeated several times until satisfactory results are obtained. However, there is no associated “Undo” function. If original values (without calculated offsets) of the EM61-MK2 readings are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

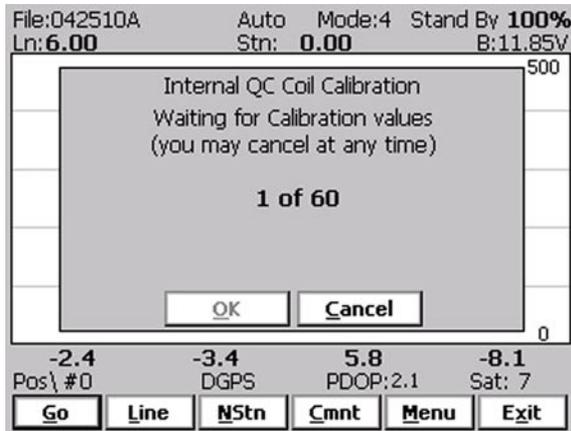
Internal Calibration (*Internal QC coil calibration*)

The Internal QC coil calibration is described in detail in the EM61-MK2 Operating Instructions. During data logging in Stand By mode this option is available only from the pop up menu (accessible from **Menu** button) or directly from the keyboard by using shortcut key <I>.

The Internal Calibration process 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.



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 Allegro screen.



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

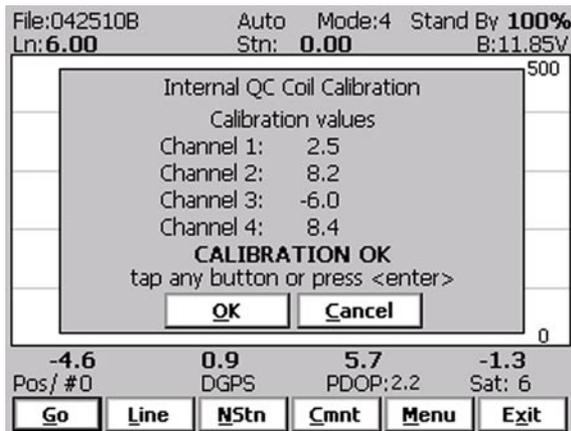
The process can be stopped by an operator at any time by tapping **Cancel** button or pressing shortcut key **C**.

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

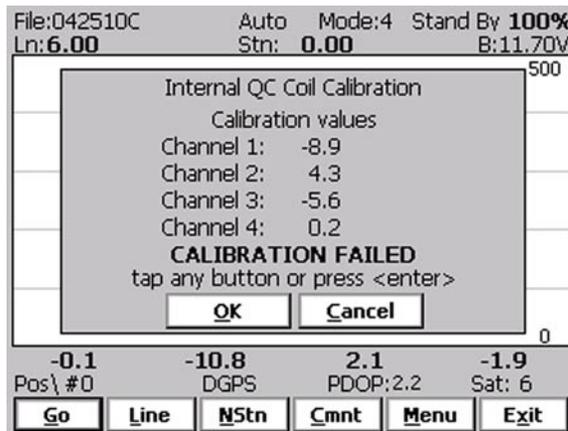


After pressing any key the program returns to logging window in Stand By mode. To repeat Internal QC coil calibration please repeat the procedure.

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 (see below).



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

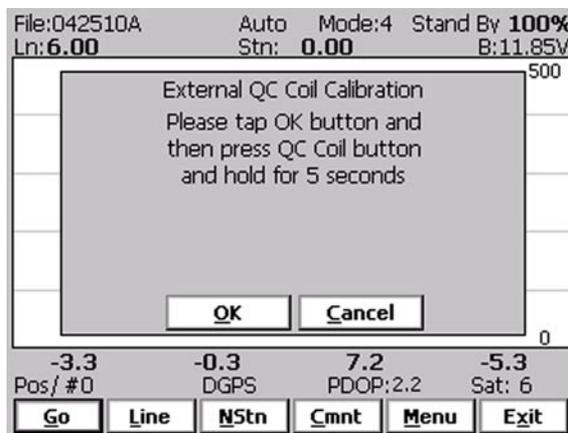


Regardless of the test result (OK or FAILED) the readings will be saved on screen. The program returns to logging window in Stand By mode after any button is tapped or ENTER key is pressed. Then the Internal QC coil calibration process can be repeated.

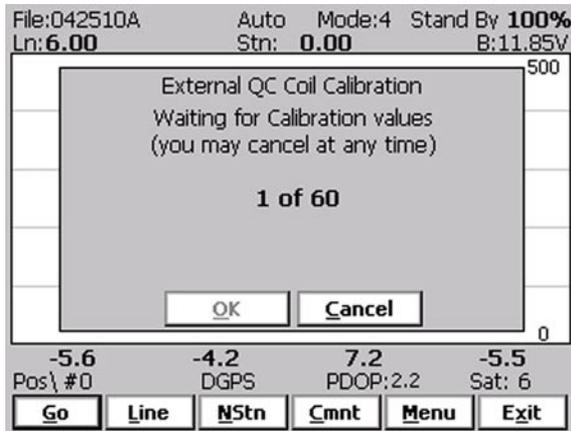
External Calibration (*External QC coil calibration*)

The External QC coil calibration option is described in detail in the EM61-MK2 Operating Instructions. During data logging (when logging window is in Stand By mode) this option is available only from pop up menu (accessible from **Menu** button) or directly from keyboard by using shortcut key <E>.

The External calibration 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.



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



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

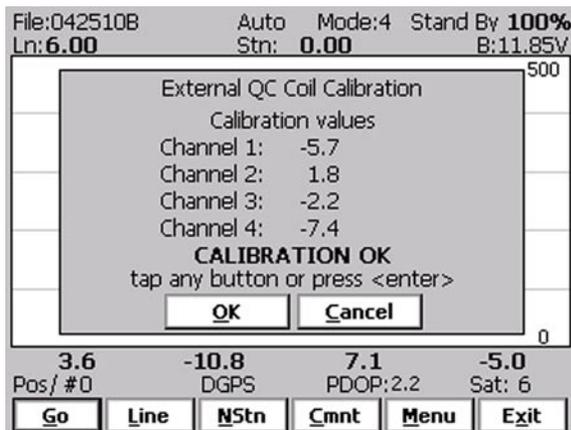
The process can be stopped by an operator at any time by tapping **Cancel** button or pressing shortcut key **C**.

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).

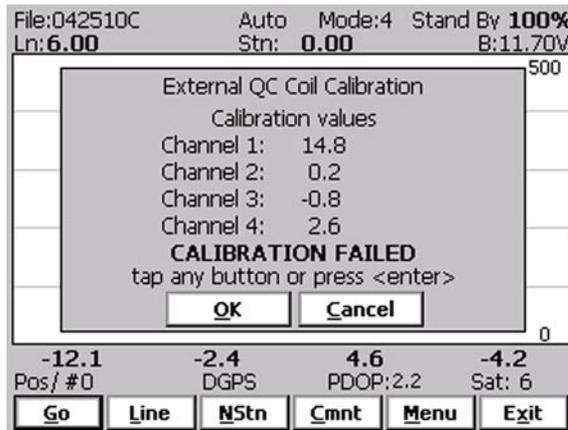


After pressing any key the program returns to Stand By mode window. To repeat External QC coil calibration please repeat the procedure.

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.



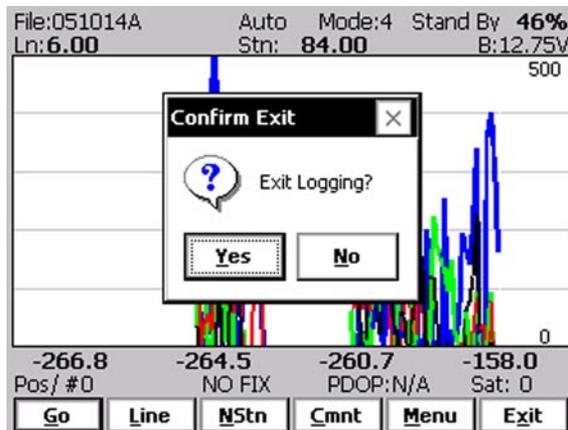
Otherwise, if the program determines that the reading is outside of the test values range the corresponding message “CALIBRATION FAILED” is displayed.



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 tapped or ENTER key is pressed. Then the Internal QC coil calibration process can be repeated.

Exit (*exit data logging*)

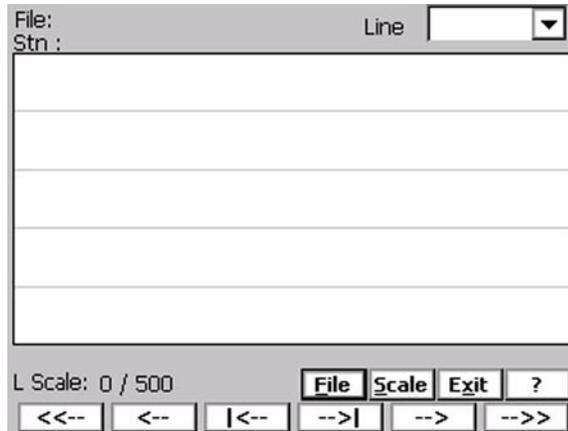
During data collection (in Stand By mode) a confirmation message will be displayed (there is no such message if **Exit** is performed in Monitoring mode) before program exits logging window.



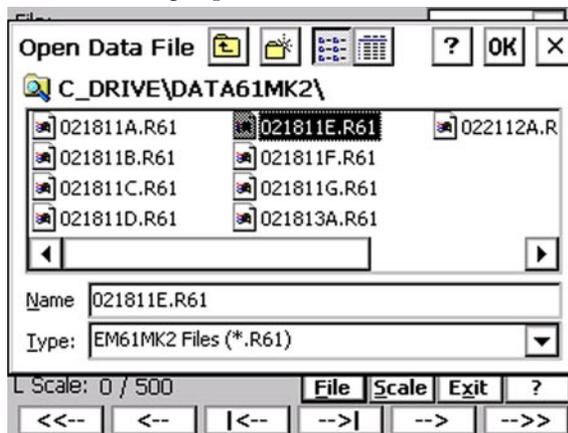
After above message is confirmed the program stops logging, closes data file and returns to Main Screen.

8. View Data Files

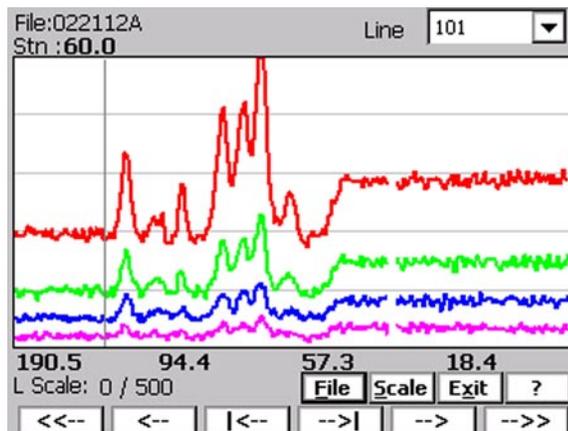
This option allows you to view recorded data files. After the View Files button is tapped (or executed from the keyboard) in the Main Screen the View Data Files window will be displayed.



To open the data file tap 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.



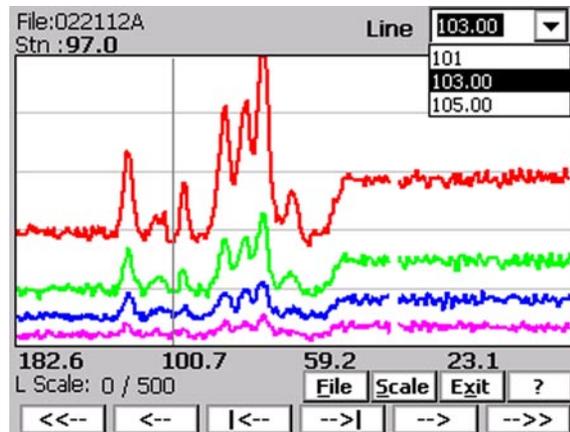
The file name can be selected in the Open Data File dialog using the Windows standard interface procedure. After the file is selected (highlighted) tap the button **OK** or press **ENTER** key to accept and display data file (to cancel selection tap **Cancel** (X) button or press **Esc** key). After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



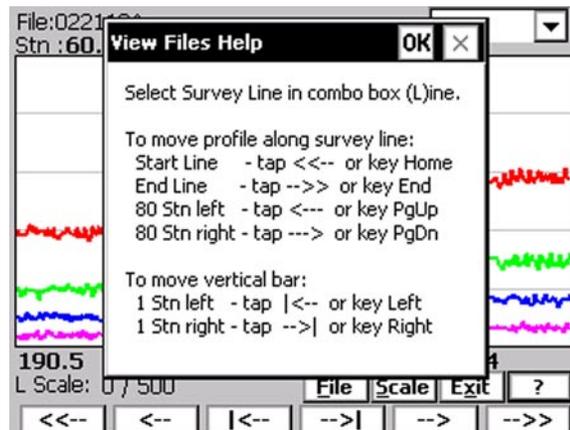
Name of the currently displayed data file is shown in the left top corner of the window. The main portion of the screen is occupied by the plot area which displays profiles. Readings in the plot area can be displayed in linear or compressed amplitude scale. Amplitude scale as well as display range (minimum and maximum value) is given by label located at the left bottom of the window (i.e. **L Scale: 0/500** means linear scale from 0 to 500 mV). The amplitude scale is set only in the Display Options window (see chapter 5) and range of scale display can be changed by tapping the button labeled **Scale**. 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.

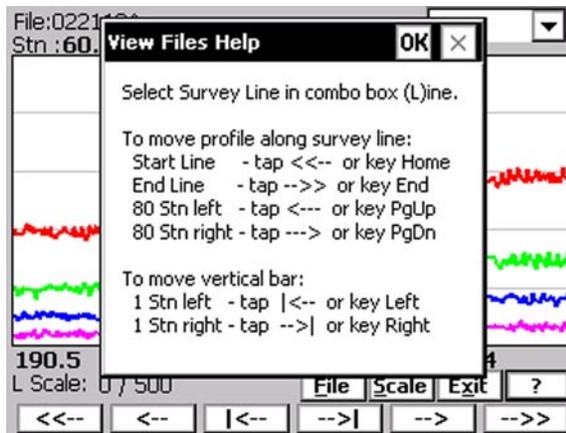
A vertical bar (grey vertical line) indicates currently displayed station. The station is displayed above the plot area, next to label **Stn:** and readings at this station for channels 1, 2, 3, and 4 (or **T**) are shown in numeric form below the plot area. Channel labels are not displayed due to the small screen of the Allegro. Values of readings are displayed in the following order (from the left): Channel 1, 2, 3, and 4 (or T). EM61-MK2 readings (in numeric form) are updated every time vertical bar is moved.

To change the currently displayed survey line use the drop-down box labeled **Line** located in the top right corner of the window. Tapping on the down arrow next to the text box labeled **Line** opens a drop-down box showing the 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 below).



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. A help screen containing info related to each button can be displayed at any time by tapping (or executing from keyboard) the Help button labeled **?**. The Help screen is shown below.





When moving displayed profile along survey line:

- button labeled <<-- or key **Home** moves display to the start of the currently displayed survey line, the left most station is the start station of the line,
- button labeled -->> or key **End** moves display to the end of the currently displayed survey line, the right most station is a final station of the survey line,
- button labeled <--- or key **PgUp** moves display 80 stations to the left,
- button labeled ---> or key **PgDn** moves display 80 stations to the right.

When changing stations and corresponding readings:

- button labeled |<-- or key **Left** (left arrow) moves vertical bar (station) one station to the left,
- button labeled -->| or key **Right** (right arrow) moves vertical bar (station) one station to the right.

To exit the View Files window tap the button labeled **Exit** (or from keyboard use shortcut key **X** or press key **ENTER** when the button is highlighted) to close file (if open). The program will return to Main Screen.

Appendix A

A.1 Description of Data File in EM61MK2 Allegro CX 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	1	0	Survey Type	UT	IT	IM								10
H																							10
																							10
																							10
																							10
																							10

EM61MK2	-	identification of program file
W110	-	version number (1.10, 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)
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
																							10
																							10
																							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:
T	-	Standard, Mode 4, channels 1, 2, 3, 4
D	-	Standard, Mode D, channels 1, 2, 3, T
E	-	Hand Held, Mode 4, channels 1, 2, 3, 4
F	-	Hand Held, Mode D, channels 1, 2, 3, T
J	-	Hand Held, Mode D, channels 1, 2, 3, T
M	-	Standard, Mode 4, channels 1, 2, 3, 4 +Marker
N	-	Standard, Mode D, channels 1, 2, 3, T +Marker
P	-	Hand Held, Mode 4, channels 1, 2, 3, 4 +Marker
Q	-	Hand Held, Mode D, channels 1, 2, 3, T +Marker
K	-	Hand Held, Mode D, channels 1, 2, 3, T +Marker
		(J & K indicates opposite direction if option available)
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

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 EM61MK2 (Allegro CX) 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
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 EM61MK2 with a GPS Receiver

The EM61MK2 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 EM61MK2. Normally, the EM61MK2 running in Allegro CX logger 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 EM61MK2 data. If message GSA is not available in a particular system, the EM61MK2 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 EM61MK2 dedicates one line of the display to show GPS status. A label **DGPS** (Differential Global Positioning System) that GPS readings are differentially corrected in real time. Label **AGPS** (Autonomous Global Positioning System) indicates lack of differential correction. On the right side of the **POS** a label a slash character is displayed. This slash alternates between forward and back slash with the frequency of GPS update rate (usually 1 second intervals). If the slash is not moving for longer period of time it means that GPS system is not working or that it is not connected to the field computer. Number of recorded GPS positions are displayed on the right side of the alternating slash following # sign. This number is updated only in the logging mode, when the data are recorded. (In Stand By mode or during Monitoring only the alternating slash, and updated values of PDOP and number of tracked satellites, indicate presence of GPS input).

Two more GPS parameters are displayed on the logger screen. These are index PDOP shown by label **PDOP** and number of tracked satellites represented by label **Sat**. The index called PDOP (Position Dilution of Precision) 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.

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

B.3 Example of Converted Output Format

If Output in Set Output Port was enabled and the option labeled Format was set to Converted the data will be sent through serial port to external device in the following format.

```

082216G.R61
L1010
AS
Z08222002 16:42:44.000
E      14.00   164.60   90.09   40.10   123.70   4287123
E      13.00   166.18   88.16   40.48   124.96   4287622
$GPGGA,214218.00,4336.59343,N,07936.65086,W,2,7,1,139.61,M,-35,M,4,118*50   4287623
E      12.00   161.02   91.85   41.33   120.28   4288018
E      11.00   165.47   92.22   37.72   123.65   4288520
$GPGGA,214219.00,4336.59342,N,07936.65088,W,2,7,1,139.50,M,-35,M,5,118*5D   4288623
E      10.00   168.53   90.49   41.03   127.45   4289023
E      9.00    168.09   89.97   42.26   126.31   4289523
$GPGGA,214220.00,4336.59340,N,07936.65086,W,2,7,1,139.48,M,-35,M,4,118*53   4289622
E      8.00    161.19   83.53   45.38   120.79   4290123
E      7.00    167.16   87.46   44.43   125.57   4290523
$GPGGA,214221.00,4336.59344,N,07936.65087,W,2,7,1,139.71,M,-35,M,5,118*5C   4290623
E      6.00    163.30   91.15   42.72   121.75   4290993
$GPGGA,214222.00,4336.59342,N,07936.65087,W,2,7,1,139.55,M,-35,M,6,118*5C   4291619
Ccars      16:43:28.940
S      0.00   16:43:40.910
E      0.00   159.82   87.55   41.14   120.02   4311505
$GPGGA,214242.00,4336.59338,N,07936.65084,W,2,7,1,139.31,M,-35,M,4,118*54   4311619
E     -1.00   164.09   85.39   42.08   123.52   4312019
E     -2.00   168.11   89.50   38.59   125.47   4312549
$GPGGA,214243.00,4336.59333,N,07936.65081,W,2,7,1,139.40,M,-35,M,5,118*5C   4312621
E     -3.00   163.27   91.27   39.43   121.26   4313033
$GPGGA,214244.00,4336.59338,N,07936.65082,W,2,7,1,139.39,M,-35,M,4,118*5C   4313620
E     -4.00   173.31   85.18   39.15   129.80   4314076
E     -5.00   167.73   86.50   40.46   125.44   4314501
$GPGGA,214245.00,4336.59337,N,07936.65082,W,2,7,1,139.39,M,-35,M,5,118*53   4314625
E     -6.00   160.22   89.60   41.87   119.69   4315012
E     -7.00   156.22   86.11   41.21   116.17   4315543
$GPGGA,214246.00,4336.59340,N,07936.65081,W,2,7,1,139.39,M,-35,M,6,118*50   4315620
E     -8.00   166.34   82.56   42.52   124.57   4316112
E     -9.00   162.43   91.53   41.76   122.31   4316598
L1011
AN
Z08222002 16:43:52.000
E     -13.00   164.46   86.29   42.02   123.07   4323150
E     -12.00   166.59   90.96   38.07   124.89   4323623
$GPGGA,214255.00,4336.59338,N,07936.65086,W,2,7,1,139.40,M,-35,M,5,118*57   4324050
E     -11.00   162.35   84.26   36.85   121.94   4324152
E     -10.00   164.98   84.38   39.85   122.63   4324650
$GPGGA,214256.00,4336.59336,N,07936.65084,W,2,7,1,139.56,M,-35,M,4,118*5E   4325045
E     -9.00   158.19   83.68   42.57   118.85   4325145
E     -8.00   160.18   89.11   41.25   120.10   4325644
$GPGGA,214257.00,4336.59339,N,07936.65086,W,2,7,1,139.69,M,-35,M,5,118*5F   4326048
E     -7.00   162.64   88.78   37.40   122.74   4326123
E     -6.00   166.85   89.09   39.56   124.83   4326677
$GPGGA,214258.00,4336.59338,N,07936.65082,W,2,7,1,139.59,M,-35,M,6,118*55   4327042
E      3.00   167.44   84.42   40.87   124.98   4327112
E      4.00   165.91   82.21   37.78   124.29   4327633
$GPGGA,214304.00,4336.59336,N,07936.65084,W,2,6,1,139.48,M,-35,M,6,118*54   4328041
E      5.00   167.22   86.83   38.72   125.98   4328126
E      6.00   164.38   90.12   39.10   122.34   4328652
$GPGGA,214305.00,4336.59336,N,07936.65083,W,2,6,1,139.45,M,-35,M,5,118*5C   4329044
E      7.00   166.56   86.78   39.47   125.00   4329156
E      8.00   163.56   84.19   40.42   124.17   4329634
$GPGGA,214306.00,4336.59336,N,07936.65088,W,2,6,1,139.49,M,-35,M,5,118*58   4330051
E      9.00   168.66   87.61   42.58   128.10   4330122

```

