

RTmap

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RTmap 61MK2

**Version 2.16**

*for Windows 10/7 Field Computer*

data acquisition, navigation & real time imaging  
software for the Geonics EM61-MK2 and GPS receiver

# User's Manual

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# Table of Contents

1.	Introduction .....	1
1.1	About the RTmap61MK2 Program .....	1
1.2	Program Requirements .....	4
1.3	Contents of RTmap61MK2 Disk .....	5
1.4	Installing RTmap61MK2 .....	5
1.5	Software Key .....	5
1.6	Data Files .....	6
1.7	Running RTmap61MK2 Program .....	7
1.8	RTmap61MK2 Program Overview .....	8
1.9	Surveys Carried Out With GPS Positioning .....	13
1.10	The RTmap61MK2 System Geometry .....	14
2.	Main Menu .....	17
2.1	Short Description of Main Screen Options.....	18
3.	Survey Setup .....	23
4.	System Setup.....	29
5.	Geometry Setup .....	35
6.	GPS Port Setup & Monitoring .....	39
6.1	GPS Port Setup.....	39
	GPS Port Setup Parameters.....	40
	GPS Warning Mask Parameters.....	42
6.2	Monitoring GPS Receiver Output .....	44
6.3	Sending Command to GPS Receiver .....	46
7.	Map and Profile Options.....	49
7.1	Map Display Options.....	49
7.2	Profile Display Options.....	55

8.	Logging.....	59
8.1	Logging Screen Layout and Monitoring Mode .....	60
	Mapping Mode .....	61
	Navigation Mode .....	63
	Profile Mode .....	64
8.2	Options Available in Monitoring Mode .....	65
8.3	Stand By Mode.....	81
8.4	Logging Mode.....	84
8.5	Field Options Available in Stand By Mode.....	85
8.6	No Connection Message .....	110
8.7	No Connection for GPS Receiver .....	111
Appendix A.	RTmap61MK2 Data File .....	113
A.1	Description of RTmap61MK2 Data File Format (T61).....	113
A.2	Conversion Factors .....	117
A.3	Example of RTmap61MK2 Data File.....	119
A.4	Description of GXY Data File .....	120
A.5	Background File Format .....	120
Appendix B.	RTmap61MK2 and GPS Input.....	121
B.1	Using the RTmap61MK2 with a GPS System.....	121
B.2	Description of Selected NMEA Data Messages .....	123
	GGA Data Message .....	123
	GSA Data Message .....	124
	POS Data Message .....	124
	LLK Data Message.....	125
	LLQ Data Message.....	126
	GLL Data Message .....	126
	GGK Data Message .....	127
B.3	Configuring GPS Trimble Pathfinder ProXRS System.....	128

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# Introduction

# 1

The Geomar RTmap61MK2 Data Logging System for Geonics EM61-MK2 consists of a data acquisition program RTmap61MK2 and associated PC computer data processing program RTM61MK2. This manual describes the use of the RTmap61MK2 program used with the laptop or tablet field computer (operating under MS Windows 10 or 7) with display in landscape as well as portrait mode, Geonics EM61-MK2 or EM61-MK2HP instrument, and Global Positioning System (GPS) receiver or selected Robotic Total Station (RTS).

The associated program RTM61MK2 is used to process data files recorded under the control of program RTmap61MK2. Main function of this program is to position the EM61-MK2 sensor based on the recorded GPS position and the configuration of the system. The RTM61MK2 also allows you to correct the collected GPS positions with post-processed GPS files. In case of grid based surveys (without GPS positioning) the program will layout the survey grid based on survey setup parameters and the system geometry. Alternatively, the grid based data files can be exported to Geonics DAT61MK2 (M61) format and data can be processed using the Geonics program DAT61MK2.

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## 1.1 About the RTmap61MK2 Program

Program RTmap61MK2 acquires and records survey data from the EM61-MK2 unit, 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 given in real time in mV. In addition, the program allows you to monitor the instrument output while data are not recorded. The RTmap61MK2 continuously monitors the GPS receiver signal quality, the EM61-MK2 measured channels, level of the instrument battery and TX current, and state of fiducial marker without leaving the program.

During data collection the program can work in three display modes: mapping, navigation, and profile mode. Mapping mode is a special case of Navigation mode, while providing all functions of navigation mode, mapping mode displays colour image that represents measured amplitude variations. Therefore Navigation and Mapping mode labeling may be used interchangeably for both modes in this manual. While in navigation mode, the main portion of the screen displays all logged positions marked by a swath bars or dots, and current position of the system denoted by cross mark based on GPS input. This type of real time display allows the operator for real time control of the survey coverage and helps in avoiding unnecessary overlaps and skips without any on

ground guidance hardware. Mapping mode (real time colour imaging) helps in control quality during surveying since in any areas of anomalous response density of survey coverage can be increased instantly. There is no dot representation in mapping mode, all data points are drawn continuously as small bars separately for each sensor resulting in pseudo-grid colour image. The size of swath bar representing the EM61-MK2 footprint is user selectable, it depends on intended survey resolution across the survey line direction. However the swath bar width is set by default to the EM61-MK2 antenna width, usually 1 m. The swath bar is drawn to scale in the employed map scale with correction for the GPS antenna offsets. The RTmap61MK2 does not require that survey has to be conducted along parallel straight lines. In Mapping and Navigation modes the instrument output is also shown in windows containing profiles. The display can be switched to Profile mode at any time. In this mode Map window disappears and profile windows are extended in length. Mapping and Navigation modes are available only when working GPS receiver is connected to the field computer.

In any display mode readings are additionally displayed in real time as numeric values in mV as well as in graphic mode, as profiles and moving graphic bars. The output of the instrument is represented by a window containing profiles (updated only in Logging mode) and by four graphic bars, for Channels 1, 2, 3 and 4 or T (depending on the instrument mode). This allows for very fast visual information about each channel.

The RTmap61MK2 can act as a standalone GPS logger if required. This feature can be useful while mapping topographical features (roads, fences, etc.) that are to be presented together with EM61-MK2 data. These files have extension GXY and they can be used in Geomar data processing software for any other instrument (i.e. TrackMaker61MK2, TrackMaker31, Multi61MK2, etc.).

When program operates in mapping or navigation mode the display is not limited to the current set of data. The user may also display positions from previously recorded RTmap61MK2 (or GXY) file, including last data file and continue data collection. This allows for the easy and fast location of the last recorded positions (i.e. from former day), as well as fill any gaps in the survey coverage. In addition up to 10 data files (any RTmap or TrackMaker data files V2.00 or later) or prepared text files (with coordinates) can be displayed as background files. This option is useful to show site outline, areas of special interest, any specific lines to follow, etc..

The RTmap61MK2 accepts NMEA-0183 compatible data from a GPS receiver directly connected to an Allegro field computer. GPS data which is embedded in the RTmap61MK2 data file can be processed later in the Geomar RTM61MK2 program. The connected GPS must be able to stream NMEA-0183 compatible messages. The RTmap61MK2 uses one of the following types of NMEA messages: a pair GGA/GSA, GGA, POS, GLL, LLK, LLQ, GLL, and GGK, as well as positions given by Robotics Total Station streaming pseudo-GGA message (for example Leica TPS1100/TPS1200

and some Trimble models) and Trimble label messages. Messages GGA, GGK, and pair GGA/GSA are preferred since they contain all necessary information. GPS readings Latitude and Longitude (or UTM meters or feet coordinates), as well as parameters indicating quality of GPS signal: status of differential corrections, number of satellites, and PDOP parameter, are displayed in real time.

The program RTmap61MK2 is designed to work with GPS receiver. If for any reason the employed GPS cannot stream NMEA data and positions are logged separately in GPS field computer please use Geonics standard Windows based data acquisition programs EM61MK2win or EM61MK2xp. If data was collected with RTmap61MK2 please convert files to Geonics M61 format using RTM61MK2. Later an option "Combine EM61MK2 and GPS files" of the program DAT61MK2 can be used to position EM61-MK2 records.

If GPS data are not differentially corrected in real time and post processed GPS data will be used for positioning please log GPS data concurrently in RTmap61MK2 and in GPS logger. An option "Position Readings using External GPS file" in RTM61MK2 which uses satellite time recorded in both devices is much more accurate than any method that uses computer clock.

The program allows you to record data while using the standard EM61-MK2 antennas (1.0 x 0.5 m in two configurations, and 1 x 1 m,) as well as Geonics EM61MK2 Hand Held sensor. The RTmap61MK2 supports two basic types of EM61-MK2, Standard and High Power.

System and survey setup parameters are saved in the program configuration file, therefore they can be automatically used during subsequent data collection sessions.

Data files can be saved in user specified directory. Data file names, which can be set by the program based on the computer clock or they are user specified, have extension names T61. Data files can be appended, therefore already collected data is displayed on the screen map and survey can be continued to assure proper area coverage. When append data file is used, size of the entire data file (past and currently logged portions) is subject to limitation described in below paragraph.

One EM61-MK2 record takes 27 bytes. The RTmap61MK2 can process, display, and record up to 18 readings per second with GPS receiver streaming positions at 1 Hz or 2 Hz. Actual frequency of data collection depends on the EM61-MK2 model used (it is slightly slower when older model of EM61-MK2 console is used).

The maximum number of 28,800 GPS positions is allowed in one file. This corresponds to 8 hours of continuous data collection if GPS positions are collected every second, or

16 hours if GPS data is taken every 2 seconds. However, it is strongly advised to limit files to for example approximately 1 to 2 hours blocks.

Data files are permanently saved every time a Pause button is used (whenever logging mode is changed from Logging to Stand By) during data logging. Therefore it is recommended to use Pause button as often as possible, at any turns between survey lines, breaks, etc.

It is strongly advised that even if your GPS receiver supports faster rates the 1 Hz update for GPS positions is used. RTmap61MK2 will work with rates higher than 1 Hz, however operation may not be fast when re scaling display and data files will unnecessarily large in size. The data processing program RTM61MK2 will interpolate all EM61-MK2 stations between GPS positions in the very similar way as GPS receiver in real time.

## 1.2 Program Requirements

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To successfully use this software, you will need :

### Computer

- PC field computer operating under Windows 10 or 7,
- CD drive, USB port for memory module, or other mean to transfer files,
- minimum 800 x 600 pixel display resolution,
- serial ports:
  - one serial port for instrument and one serial port if directly connected
  - GPS receiver is to be used (USB to RS-232 ports adapters or wireless Bluetooth connection can be used for EM61-MK2 and/or GPS),
- one USB port (if the Geomar USB security key is used).

### Geonics EM61-MK2

The EM61-MK2 or EM61-MK2-HP instrument with associated cables.

### GPS Receiver

The GPS receiver capable of streaming NMEA messages (GGA, POS, GLL, LLQ, LLK, GGK), or supported Robotics Total Station.

### Geomar USB Security Key (previous versions only, it is replaced by Software Key)

The Geomar USB security key (dongle) must be inserted into the computer USB port while running the data acquisition program RTmap61MK2.

The program interacts with the dongle only during non critical activity. Therefore, any potential vibrations during the field work cannot affect quality of data logging while USB dongle is connected.

The Geomar USB dongle supplied with RTmap61MK2 is a driverless type and it does not require any special installation procedure.

## 1.3 Contents of RTmap61MK2 disk

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The program RTmap61MK2 is stored on RTmap61MK2 USB drive or CD distribution disk. All necessary configuration files (with extension names .INI) are created in your computer after the program is run for the first time. Check that the file SetupRTmap61MK2.exe that installs RTmap61MK2 is included on the USB or CD disk. This file can be also downloaded from the Geomar web site. In general four files are needed:

<b>SetupRTmap61MK2.exe</b>	-	installs data acquisition program file RTmap61MK2
<b>Setup61MK2R.exe</b>	-	setup for the data processing program RTM61MK2
<b>RTmap61MK2win.pdf</b>	-	manual for RTmap61MK2 program
<b>RTM61MK2.pdf</b>	-	manual for RTM61MK2 program

## 1.4 Installing RTmap61MK2

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Execute supplied or downloaded setup program **SetupRTmap61MK2** (another setup program Setup61MK2R installs data processing program RTM61MK2). The RTmap61MK2 is a stand alone program and does not require any additional drivers nor run time libraries.

The RTmap61MK2 data files contain extension name T61 and their base names should be limited to 8 characters.

## 1.5 Software Key

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The data acquisition program RTmap61MK2 is licensed for one field computer. The program is secured with Software Key (some previous versions can be secured by USB security key - USB dongle). Initialization of the program requires a software key that is based on the computer unique ID number generated by the program. During the first run (after any the Logging button is pressed or tapped) the program will display the Enter Software Key window (Figure 1.1) and the ID number for this computer will be displayed at the bottom of the window as 11 character string. Please forward this number to Geomar Software and the Software Key will be provided.

Please enter the software key in the appropriate box in the Enter Software Key window (Figure 1.2) and click the OK or press the Enter key. From now on the program will run without any interruption, unless program will be moved without key file to another folder or key file will be deleted. Any future updates of the program will not require entry of the software key.

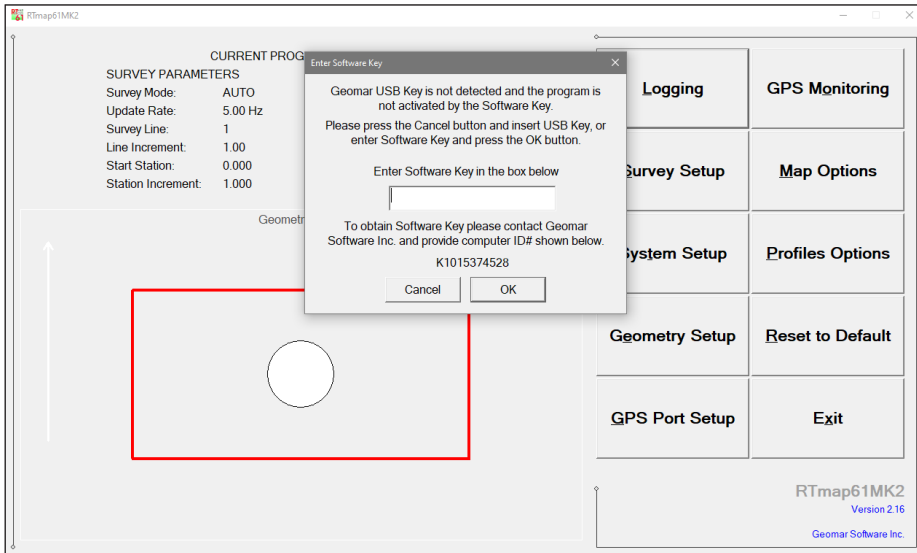


Figure 1.1: Enter Software Key window

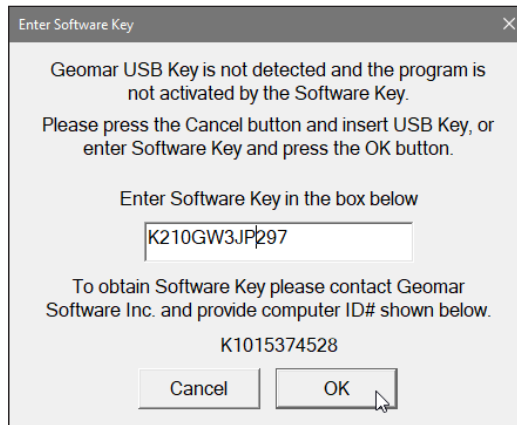


Figure 1.2: Entering the Software Key

## 1.6 Data Files

Data files are saved in the user specified folder with extension name T61. All RTmap61MK2 data files with extension T61 (or GXY if standalone GPS files are created) are binary data files. These data files can be loaded to and processed in the RTM61MK2 program.

**Please do not open binary T61 files in a text editor. While it is possible to view these files in text editor, any accidental Save will damage data file. If any binary data file is to be viewed in text editor please make a copy of the file first.**

Also, if T61 files are sent by e-mail it is safer to zip them since some e-mail server treat attached binary files as text files and add Carriage Return or Line Feed characters. This action corrupts any binary file. In any case, please retain raw binary data files in the logging computer till end of the project.

## 1.7 Running RTmap61MK2 Program

Start RTmap61MK2 by double clicking the RTmap61MK2 icon in the Start | Programs menu, in Windows Explorer, or on the desktop shortcut created by the setup program. At the start, RTmap61MK2 displays the following screen (Figure 1.3):

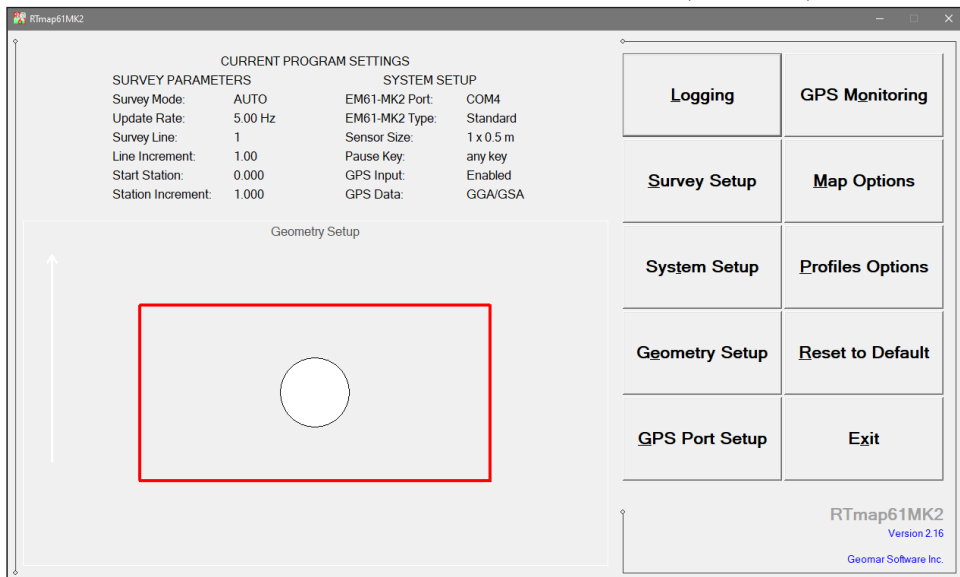


Figure 1.3: The RTmap61MK2 Main Screen

The RTmap61MK2 is a command button and dialog driven program. Command buttons can be executed by clicking with the left mouse button, or by tapping if touchscreen is available, or by pressing the indicated (underlined> character on the keyboard, or by using TAB or arrow keys to scroll through the buttons and ENTER to execute. In the Main Screen of the program Up and Down arrow keys can be also used to scroll through the buttons.

The Main Screen appears always as the first window after the program is started. It contains the name of the program, its version number (right bottom corner), and list of command buttons with available options on the right side. The major, left portion of the window contains information about current survey and system settings, and a graphic diagram illustrating current system geometry (EM61-MK2 sensor and GPS antenna). The graphic diagram is updated in real time as soon as the system geometry parameters are changed in Array Geometry dialog. A description of the Main Screen functions and information is given in Chapter 3.

## 1.8 RTmap61MK2 Program Overview

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The data acquisition program RTmap61MK2 was designed with field use in mind. This was the main thought while preparing the program flow. Once all necessary parameters are set in the program they are saved in initial files. Assuming that the survey set up is the same as in previous logging session: when the program is started, the instrument and GPS receiver are turned on, output of the connected EM61-MK2 can be monitored after one key stroke. Obviously any parameters can be modified any time, however as long as the field procedure remains the same the program needs very minor adjustments, especially when survey is conducted using GPS positioning.

When all settings for the system and survey (discussed in later sections) are specified, the user selects Logging option in Main menu of the program. This sets the program in Monitoring mode (Figure 1.4) which allows you to examine the EM61-MK2 each channel output and GPS performance. To record data one has to specify the data file name. The program will allow you to append data to an existing file (any file in T61 format created by the RTmap61MK2 version 2.00 for Windows or later), or recall the last file. After the data file is created the program will switch to Stand By mode. The Stand By mode allows for continuous data monitoring as well as use available field options. Clicking on the **Go** button (or pressing key G or <ENTER> if it is default button) will change the program to Logging mode and EM61-MK2 and GPS data will be recorded in the data file according to selected mode of operation.

The instruments output is shown in the form of numeric values for channels 1, 2, 3 and 4 or T (depending on the instrument mode used) in mV, in the form of profile plots, as well as plotted in graphic mode (Figures 1.4 to 1.8). An equalizer type (graphic bars) displays data for EM61-MK2 channels as four bars. Left bar represents always Channel 1 readings, second bar Channel 2 and so on. Moving graphic bars are displayed with different colours that correspond to profile curves colours specified in Profile Display Options dialog. Range of displayed amplitudes is common for moving bars window and profile window. Currently set range is labeled at the bottom and top of moving bars windows.

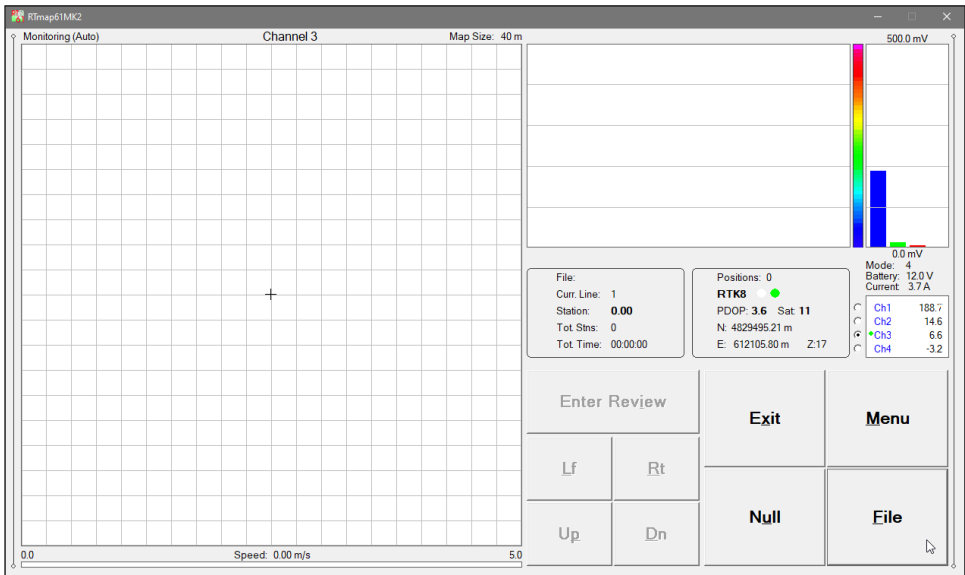


Figure 1.4: RTmap61MK2 logging screen in the Mapping (Monitoring) mode

This type of display allows for a legible and very quick estimation of the EM61-MK2 performance. When more detailed monitoring is required each measured channel is displayed in numeric form in mV as well. In addition the program displays windows with profile curves. If longer profile curves are needed the program can be switched to Profile View mode at any time during the survey. Change of display type between Mapping (or Navigation) and Profile modes can be performed by pressing key T (toggle) in the Monitoring or Stand By mode.

When working GPS receiver is connected to the field computer then program uses Navigation or Mapping (depending on settings) mode by default. The RTmap61MK2 screen in Navigation mode is shown in Figure 1.5 (EM61-MK2 position and footprint represented by selected swath bar) and Figure 1.6 (EM61-MK2 position is represented by a dot). Each swath bar or dot shows position recorded at the moment the GPS station is recorded, positions of recorded EM61-MK2 data (located between GPS points) are not shown in Navigation mode.

Mapping mode that provides navigation, survey coverage and data quality control at the same time is similar to Navigation mode, however it shows positions of EM61-MK2 readings (not only at GPS points). Readings are shown as a coloured image of amplitude for each measurement. Due to screen resolution and specified map size readings points may be decimated or filled in (expanded) to show coverage in continuous mode. The RTmap61MK2 screen in Mapping mode example is shown in Figure 1.7.

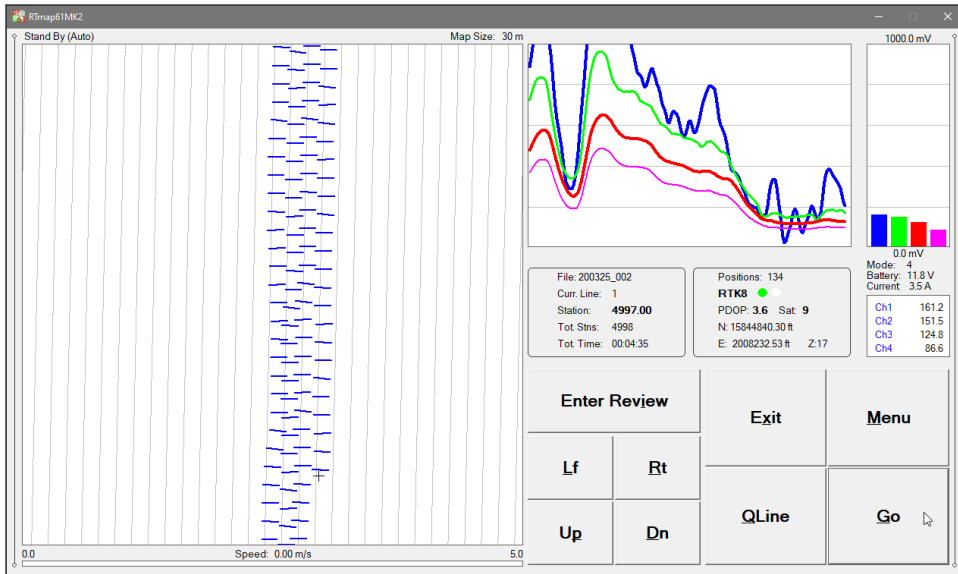


Figure 1.5 *RTmap61MK2 screen in Navigation (Stand By) mode, Swath Bars represent selected footprint as 1 m on a 30 m map size with 1 m guiding lines separation.*

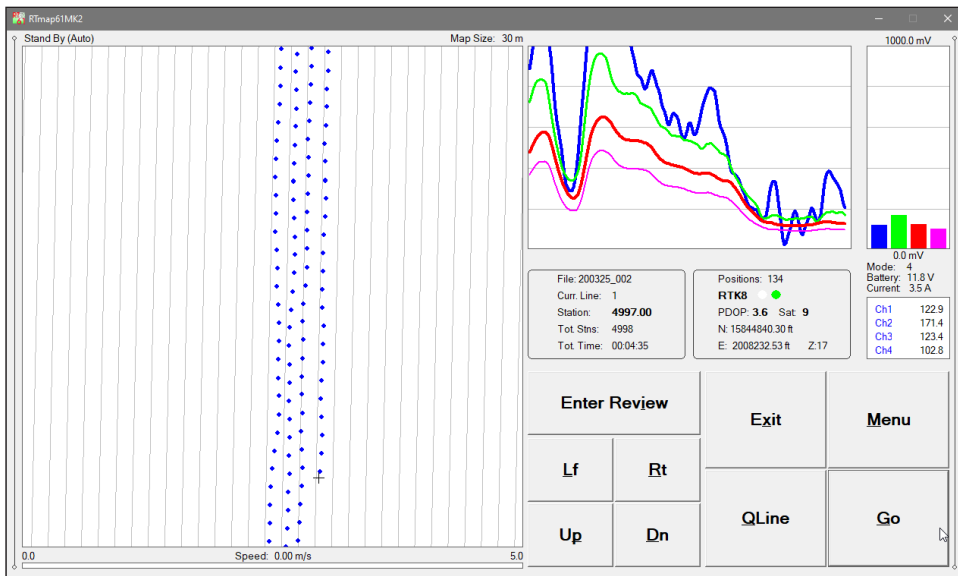


Figure 1.6 *The RTmap61MK2 screen in Navigation (Stand By) mode, EM61-MK2 positions are represented by dots (parameters as in Fig. 1.5).*

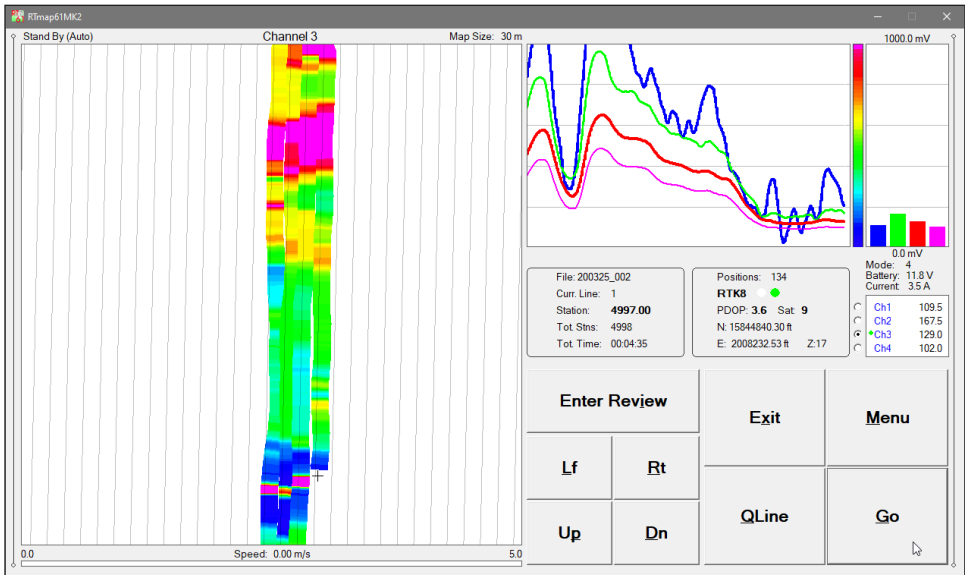


Figure 1.7: The RTmap61MK2 in the Mapping (Stand By) mode, mapped is Channel 3 (parameters as in Figure 1.5)

When all settings for the system and survey (discussed in later sections) are specified, the user selects Logging option in Main menu of the program. This sets the program in Monitoring mode which allows you to examine the EM61-MK2 outputs and GPS performance. To record data one has to specify the data file name. The program will allow you to append data to an existing file (in T61 format), or recall the last file. After the data file is created the program will switch to Stand By mode. The Stand By mode allows for continuous data monitoring as well as use available field options. Clicking or tapping on the Go button (or pressing key G or <ENTER> if it is default button) will change the program to Logging mode and EM61-MK2 and GPS data will be recorded in the data file according to selected mode of operation. Updated map, profile windows as well as green background in numeric values window clearly indicate Logging mode and data recording, Figure 1.8.

Positions of sensors are calculated in real time in Navigation and in Mapping modes and properly reflect preset GPS antenna offsets. Actual position of GPS antenna is shown by "+" cursor.

If GPS is not used during the survey the default type of display is Profile mode and Mapping and Navigation modes are not accessible. Example of the RTmap61MK2 screen in Profile mode is given in Figure 1.9. When changing display from Profile to Naviga-

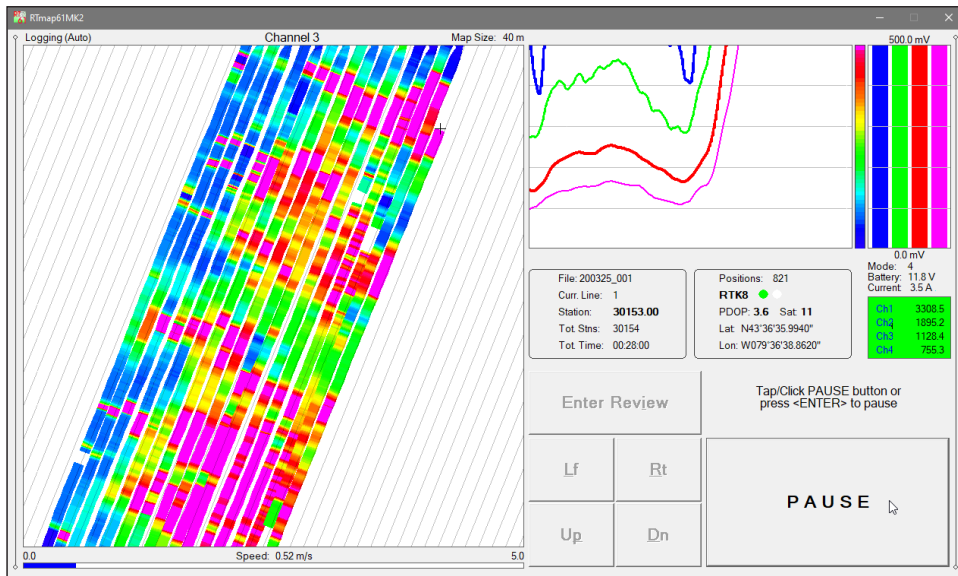


Figure 1.8: The RTmap61MK2 in the Mapping (Logging) mode, mapped is Channel 3, (cursor indicates instant position of the GPS antenna, and green background in numeric window indicates data recording)

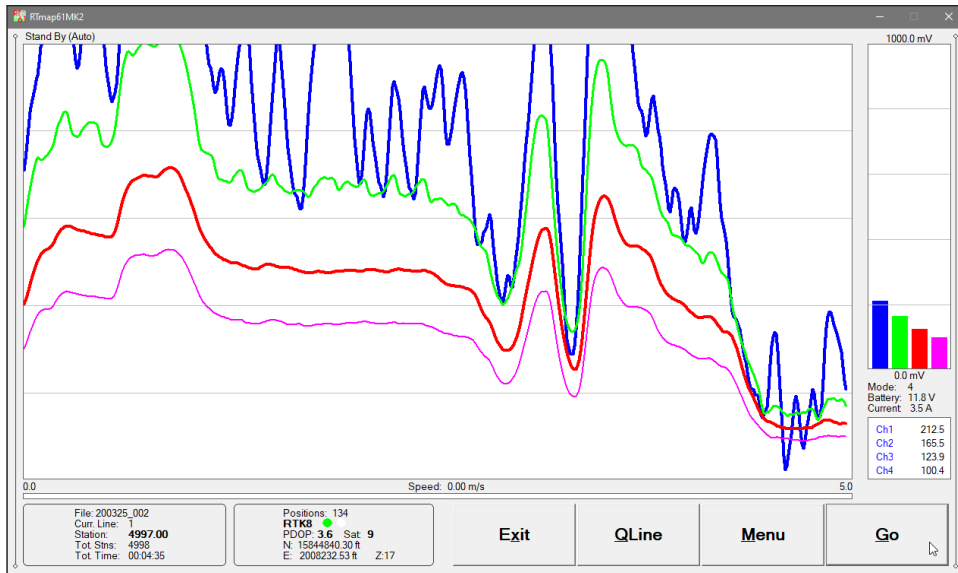


Figure 1.9: The RTmap61MK2 in the Profile (Stand By) mode

tion mode while large amount of data is collected, a message Wait is displayed and the program may take several seconds to select the needed coordinates while scanning the entire database of collected positions. There is no such delay during scrolling since the program keeps track of survey path while in navigation mode.

The maximum number of 28,800 GPS positions is allowed in one file. This corresponds to 8 hours of continuous data collection if GPS positions are collected every second, or 16 hours if GPS data is taken every 2 seconds. However, it is strongly advised to limit files for example to approximately 1 hour blocks, especially when using high frequency of EM61-MK2 data collection. In case of any possible error in data file it is much easier to correct smaller file. Data files are permanently saved every time PAUSE key is used. In case of accidental computer lock up, data file will contain all readings till the Pause Key was used last time. Therefore, it is good practice to pause data recording at any possible moment, for example at the end of each survey line, at any obstruction, etc.

## 1.9 Surveys Carried Out With GPS Positioning

---

Most of the stations positions for surveys positioned with GPS receiver will be calculated based on the GPS antenna position and instant heading of the array. The data processing program RTM61MK2 uses sophisticated calculations to apply GPS antenna offsets, however in order to achieve highest possible quality of data positioning the survey should be carried out along relatively smooth pathways, especially if GPS antenna is located not in the center of the instrument.

When the direction of the survey line is changed it is advised to pause recording of data for the duration of U-turn. Toggling between Stand By mode (pause) and Log mode is relatively easy in the most difficult field conditions, it is done by one key stroke (Pause and Start keys), and it can save time during data processing.

Similar approach applies to situations when the system is stopped. In this case if readings are not paused, the random distribution of small GPS errors will likely result in unreliable locations of calculated sensor positions. If the offset of GPS antenna is used it may appear that the instrument is rotating since GPS errors occur in many directions. Pausing readings while the system is stopped will save time during data processing and will result in better data presentation.

## 1.10 The RTmap61MK2 System Geometry

When a survey is positioned by GPS system the program allows to specify the GPS antenna offset from the EM61-MK2 sensor center. Two parameters, GPS X Offset and GPS Y offset describe location of GPS antenna. This location is represented by the distance which is measured from the center of the conductivity meter to the center of the GPS antenna, while facing direction of the movement, see Figure 1.10. Another example of RTmap61MK2 is presented in Figure 1.11.

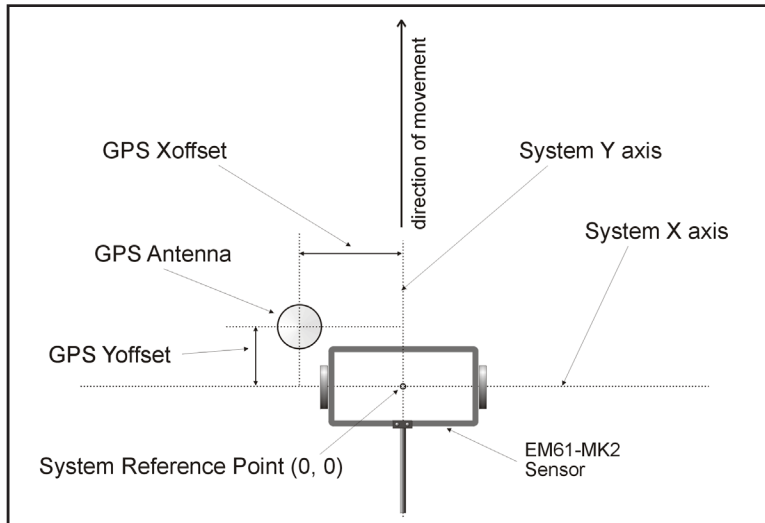


Figure 1.10: The RTmap61MK2 system geometry

The antenna can be placed anywhere in relation to the instrument center. However to achieve higher accuracy of the calculated positions the GPS antenna must be placed as close to the center of the system as possible.

This option is provided mainly for common situations where the operator pushes the EM61-MK2 cart, and GPS antenna (placed in backpack) is located above his left or right shoulder. In this case GPS Y offset is negative and GPS X offset can be negative as well as positive.

During the survey RTmap61MK2 applies GPS antenna offsets in real time, and calculates and displays the EM61-MK2 real scaled positions in Mapping/Navigation mode.

In the case where a wrong value was entered in the field, GPS X Offset and GPS Y Offset parameters can be corrected later during data processing in the program RT-M61MK2.

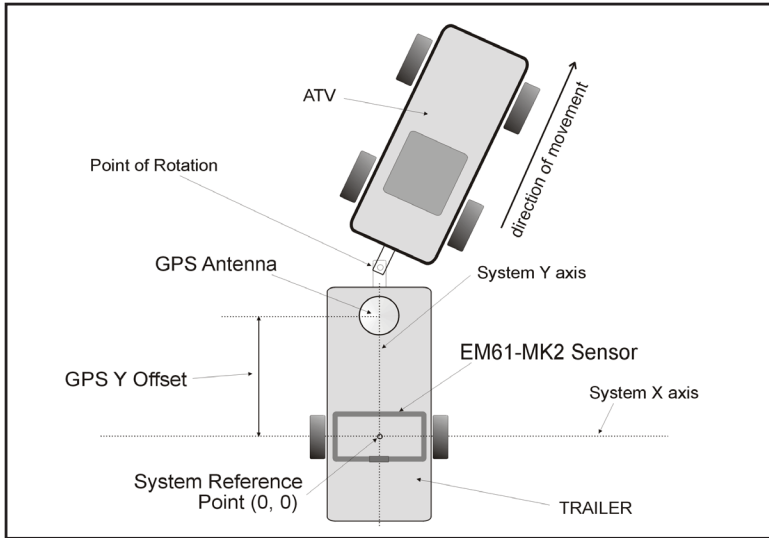


Figure 1.11: Geometry of the EM61-MK2 and GPS antenna during towing



# Main Screen

# 2

The Main Screen appears always as the first window after the program is started. It contains the name of the program, its version number, and list of command buttons with available options on the right side. The major, left portion of the window contains information about current survey and system parameters settings, and graphic illustrating current system geometry (sensor size and GPS antenna location). The graphic diagram is updated in real time as soon as geometry parameters are changed in the Geometry Setup dialog. The RTmap61MK2 Main Screen is shown below in Figure 2.1.

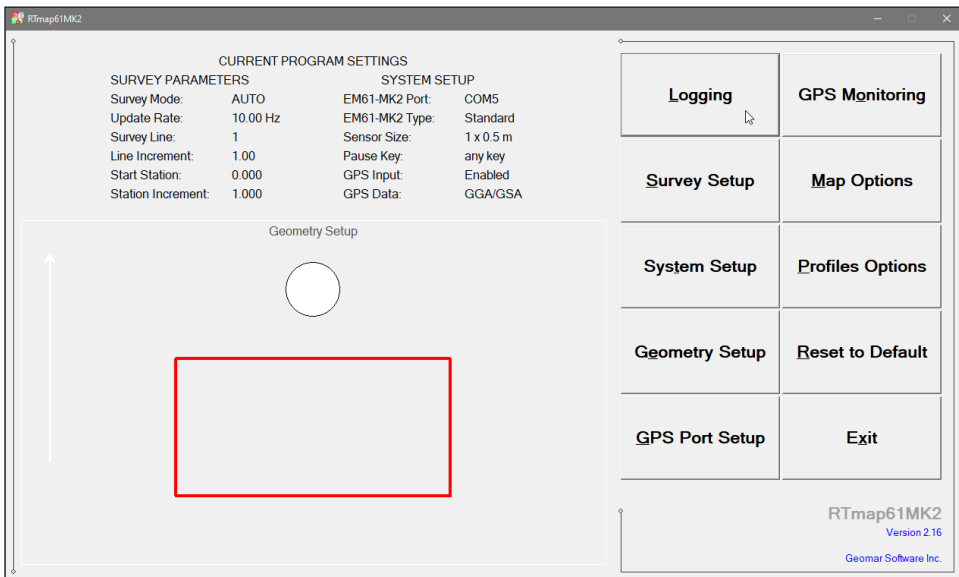


Figure 2.1: The RTmap61MK2 Main Screen window

The RTmap61MK2 is a command button and dialog driven program. Command buttons can be executed by taping touch sensitive screen, clicking with the left mouse button, or by pressing the indicated (underlined) character on the keyboard, or by using TAB to scroll through the buttons and ENTER to execute. Up and Down (or Left and Right) arrow keys can be also used to scroll through buttons of the program Main Screen. Short description for each of the options follows.

## 2.1 Short Description of Main Screen Options

---

### Logging

This option allows you to monitor and log the EM61-MK2 output and GPS receiver positions. Logging screen starts always in Monitor mode, and then after a data file is created Logging mode is available. Monitor mode provides initial inspection of the range of the instrument readings at the particular site, and quick inspection of the instrument settings and GPS receiver performance.

### Survey Setup

Dialog that is associated with this option is used to set data collection update rate, dipole mode, survey line name, line and station increments, and other parameters which are necessary to determine survey settings.

Dialog window that is associated with this option is used to set instrument survey mode, update rate, dipole mode, survey line name, start station, line and station increments, and other parameters which are necessary to determine survey settings (Figure 2.2).

The Null Values parameter determines whether Nulling Factors from the last session are applied (Last Survey) or they are re-set to zero (None).

The image shows a 'Survey Setup' dialog box with the following fields and controls:

- EM61-MK2 Settings:**
  - EM61-MK2 Mode: Auto (dropdown)
  - Readings/second: 10.00 (text input)
  - Null Values: Apply None (dropdown)
- Stations Parameters:**
  - Start Station: 0.000 (text input)
  - Station Increment: 1.000 (text input)
- Survey Lines Parameters:**
  - Survey Line: 1 (text input)
  - Line Increment: 1.00 (text input)
  - Line Sequence: Alternate (dropdown)
  - Direction: North (dropdown)
- Buttons: Cancel, OK

Figure 2.2: The Survey Setup dialog

### System Setup

This option (see Figure 2.3) allows user to enable and disable (if GXY file is to be collected) instrument connection, to select type of EM61-MK2 instruments connected to the field computer, and to assign serial port number for the EM61-MK2 and GPS. The Pause Key, Speed Bar units, Coordinates Display type (geodetic or UTM with units), Audio indicating recording as well as Audio Alarm for disconnection can be also selected in this dialog.

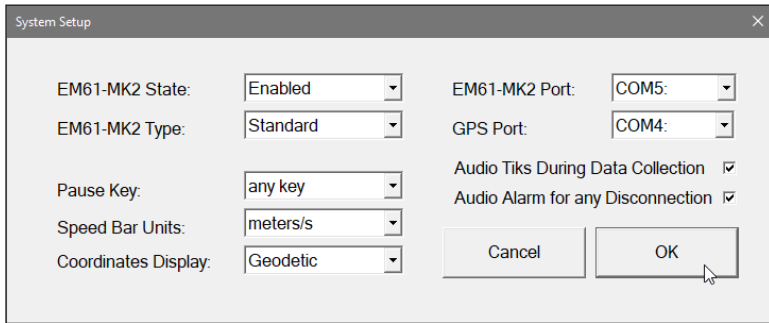


Figure 2.3: System Setup dialog

### Geometry Setup

This dialog allows you to select sensor size, to specify GPS antenna offsets, and units used in this dialog. The dialog is shown in Figure 2.4. Small graphic window illustrates meaning of geometry parameters (this is reference graphic, the drawing is not updated as graphic diagram in Main Screen which represents actual layout of the system). After the button OK is clicked or tapped the dialog disappears and layout of the system configuration is updated in the Main Screen.

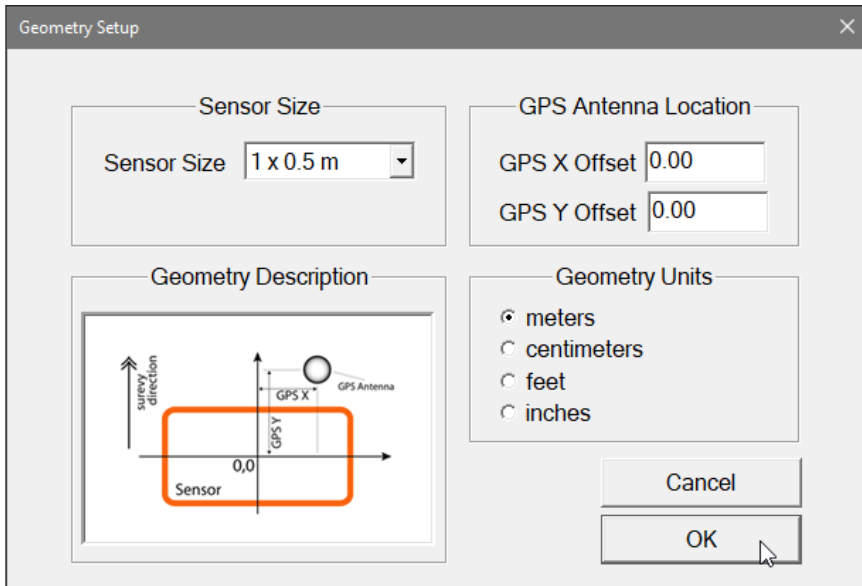


Figure 2.4: Array Geometry Setup dialog

## GPS Port Setup

The GPS Port Setup dialog (Figure 2.5) allows you to disable and enable GPS data acquisition. It is also used to specify NMEA message that is streamed by GPS receiver or Robotic Total Station interface, set the serial port number used for GPS input (it can be also set in System Setup dialog), and to specify all necessary serial port communication settings.

This dialog provides also set of parameters that enable and determine GPS Warning Mask function.

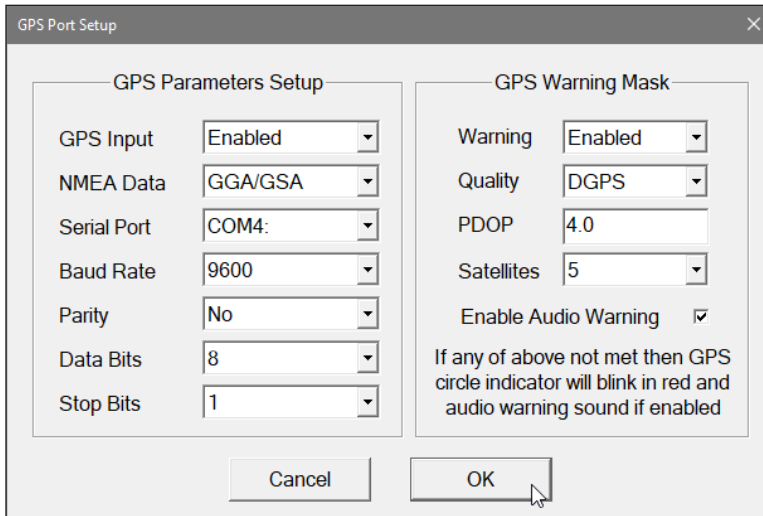


Figure 2.5: GPS Port Setup dialog

## Monitor GPS

After the button labeled Monitor GPS is clicked or tapped on the GPS Monitoring will be displayed. Any string streamed by GPS receiver will be displayed in the monitoring window. In addition to monitoring GPS output, this window allows to send NMEA command to GPS receivers (if supported by connected GPS model).

## Map Options

The Map Display Options dialog (Figure 2.6) allows you to specify size and colour of the cursor showing current GPS antenna position, as well as a size of dot or swath bar representing recorded position. The option labeled Colour Map View can be used to set Navigation mode (by selecting item: GPS Positions, No Color Amplitude) and Mapping mode (any other item in this combo box selection with choice of displaying colour map of one of EM61-MK2 channels: Ch1, Ch2, Ch3, or Ch4/T. An item "Sensors Positions, No Colour Image" is selected in Figure 2.6 for Navigation mode.

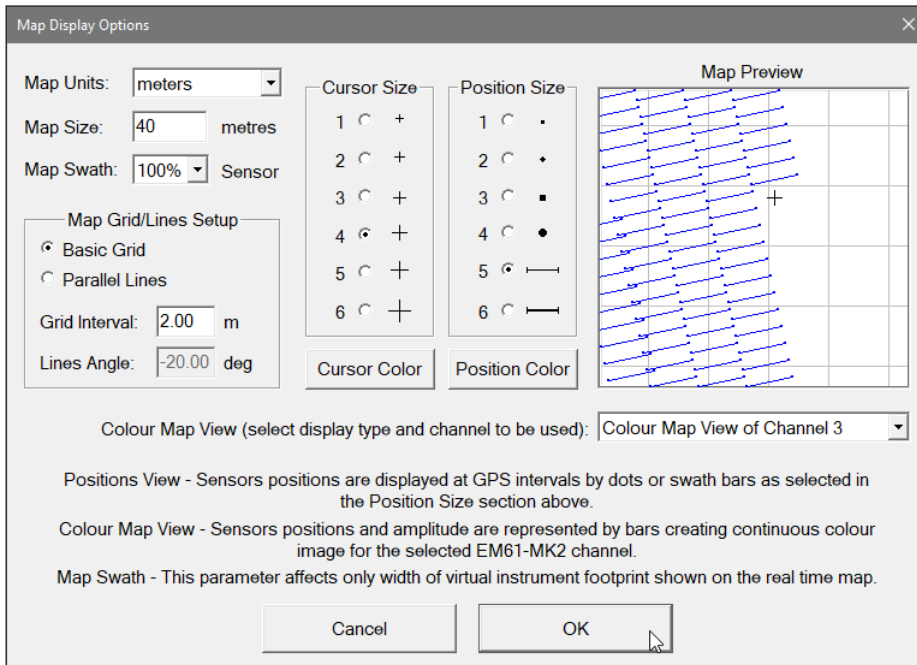


Figure 2.6: Map Display Options dialog

The default value for the Map Swath is the width of the EM61-MK2 antenna. The size of Map Swath is optional and it can be selected in meters. It will represent width of the instrument footprint drawn and scaled to displayed map. The Map Swath width should be selected based on intended survey line spacing and lateral resolution of the survey.

In addition the Map Size, Map Unit, selection of Grid or Parallel Lines (together with Lines Tilt Angle), as well as Grid (or Lines) interval can be specified in this dialog.

This dialog can be also displayed and all parameters with the exception of Map Swath and Map Units (both must be selected before Logging session) can be adjusted at any time during data collection in Logging mode. **Profile Options**

This option allows you to select profiles to be displayed, including colour as well as thickness of each profile separately.

### Profile Options

The Setup Display Options dialog (Figure 2.7) allows you to specify colour and thickness of profile line for each channel (component, dipole mode, and coils separation).

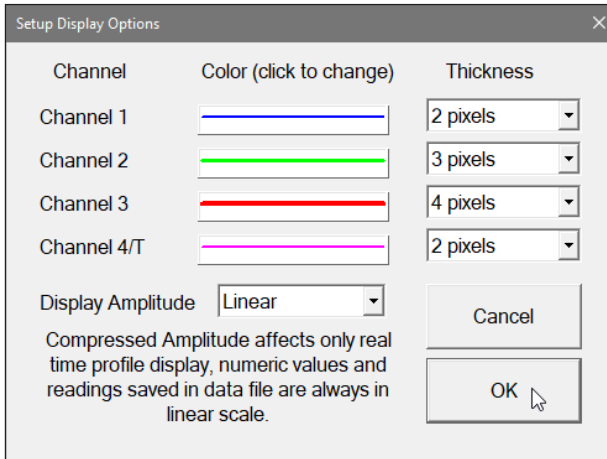


Figure 2.7: Setup Display Options dialog

### Reset to Default

A warning message will appear (Figure 2.8). The program reloads its default settings and it closes. When it will be run again a new fresh configuration file will be created.

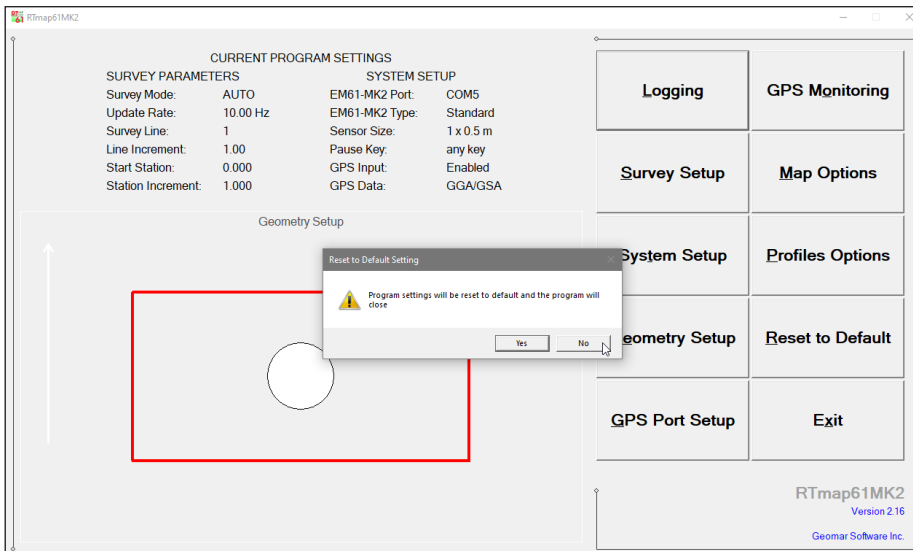


Figure 2.8: Reset parameters to default values procedure

### Exit

Selecting this option will terminate the program execution.

The Survey Setup dialog, presented below in Figure 3.1, contains several parameters which affect two important procedures: instrument settings (update rate and Null Factors application) and survey geometry layout (survey line names, line spacing, start station, station increment, etc.).

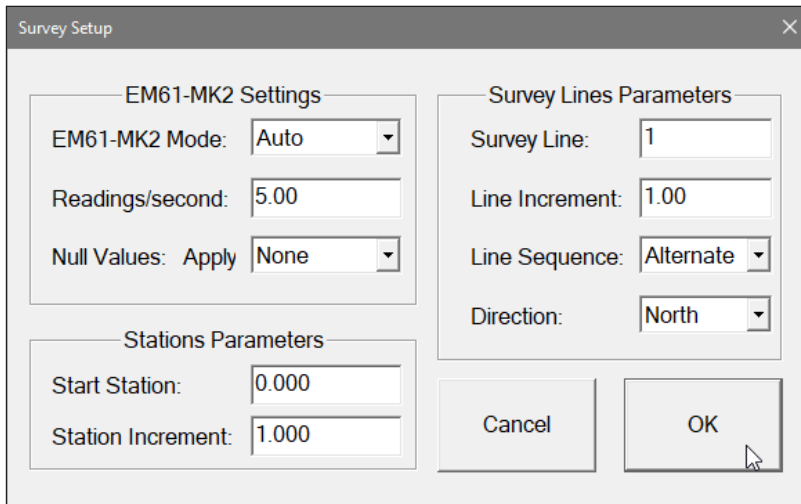


Figure 3.1: Survey Setup dialog

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

Description of the Survey Setup dialog options and parameters.

### EM61-MK2 Mode

Set the survey mode of operation by selecting an item from the drop-down list box labeled EM61-MK2 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/second).

### Wheel Mode

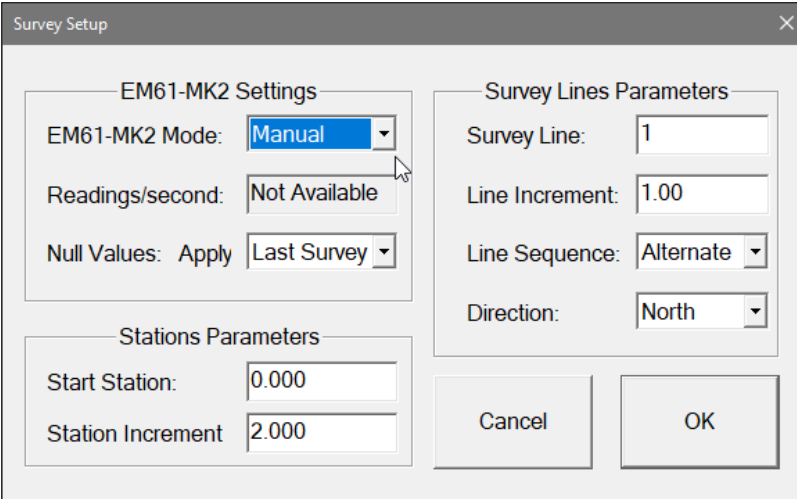
Readings will be triggered automatically by a counter attached to the wheel. Wheel increment is approximately 20 cm (or 0.64 foot) for the EM61-MK2 equipped with 1 x 0.5 m or 1 x 1 m antennas. The Hand Held EM61HH-MK2 has two wheel increments 0.1 and 0.2 m. Check the wheel increment setting on the antenna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

When Wheel or Manual mode is selected option Reading/second is not available, Figure 3.2.

### Manual Mode

Readings will be taken only while the manual trigger (placed on console or switch on the logger cable, depending on instrument model) is pressed. This mode may be used only in very specific applications since the highly dynamic EM61-MK2 response requires finely spaced data points.

Please note that when Manual mode is selected option Reading/second is not available, Figure 3.2.



The image shows a 'Survey Setup' dialog box with three main sections: EM61-MK2 Settings, Stations Parameters, and Survey Lines Parameters. In the EM61-MK2 Settings section, 'EM61-MK2 Mode' is set to 'Manual', 'Readings/second' is 'Not Available', and 'Null Values' is set to 'Apply Last Survey'. In the Stations Parameters section, 'Start Station' is 0.000 and 'Station Increment' is 2.000. In the Survey Lines Parameters section, 'Survey Line' is 1, 'Line Increment' is 1.00, 'Line Sequence' is 'Alternate', and 'Direction' is 'North'. There are 'Cancel' and 'OK' buttons at the bottom right.

Figure 3.2: Survey Line Sequence options

### **Readings/second** (update rate)

This parameter is displayed only when the Auto Mode was selected. Activate text box by clicking with a mouse or using TAB key and then enter desired value. The edit box accepts only positive numerical values.

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 depends on a type of EM61-MK2 model used.

When the older model of EM61-MK2 with Request Character is employed the maximum is approximately 15 readings per second.

Higher maximum frequency is possible with a newer model of EM61-MK2 (with the instrument cable labeled Bluetooth, or model equipped with a new type of Eprom). In this case program can achieve maximum update rate of the instrument, approximately 18 readings per second. At the same time, while using this instrument, the program uses only native instrument frequency. Possible update rates are: 18 Hz (all streamed readings), 9 Hz (every 2nd reading), 6 Hz (every 3rd reading), and so on. Values Readings/s entered at this option will be rounded to the nearest base frequency (for example 10 rdgs/s will result in approximately 9 readings/s).

### **Survey Line** (survey line name)

Activate text box for this option by clicking with a mouse 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.

In case the survey is positioned with GPS system, the Survey Line (and all following parameters described below) can be ignored. The Survey Line, however, can have informative meaning, it can be used to divide or to distinguish certain portions of the survey, without creating new file for each set of data.

During surveys conducted along grid (no GPS positioning) 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. If survey is conducted along grid (no GPS positioning) use negative numbers to indicate South and West direction. Letters associated with direction (S, N, W, E) can be used, however they must follow numbers and they will be ignored during creating XYZ file in the Geonics DAT61MK2 program format (i.e. Line -20S, will be assigned to coordinate -20, South or West depending on the survey layout, while Line 20S will indicate coordinate 20, North or East depending on the survey layout). Letters used in Survey Line name have only informative meaning, they can be used also for naming the same lines, either portions of the same line or if a survey line is repeated (computer program will assign the same coordinate for lines 10, 10A, and so on).

### **Line Increment**

Activate text box for this option by clicking with a mouse or using TAB key and then enter desired value.

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 and will provide automatic survey line name while executing option Quick Line. This parameter can be ignored if survey is positioned with GPS system.

## 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 (Figure 3.3).

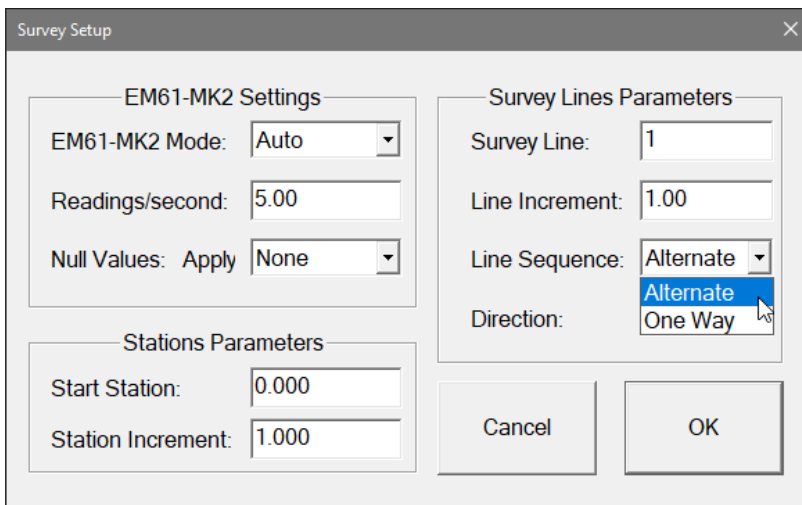


Figure 3.3: Survey Line Sequence options

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.

This parameter can be ignored if survey is positioned with GPS system.

## Direction

When this option is highlighted and drop-down box is expanded use mouse or use Down or Up cursor key to toggle between four available settings: East, West, South, and North (Figure 3.4).

This parameter indicates the heading of the survey line and it can be ignored if survey is positioned with GPS system.

When survey is conducted along a grid, the Direction has only informative meaning. During generating XYZ file, only three parameters: Survey Line Name, Start Station and Station Increment, will be used to determine geometry of the survey layout.

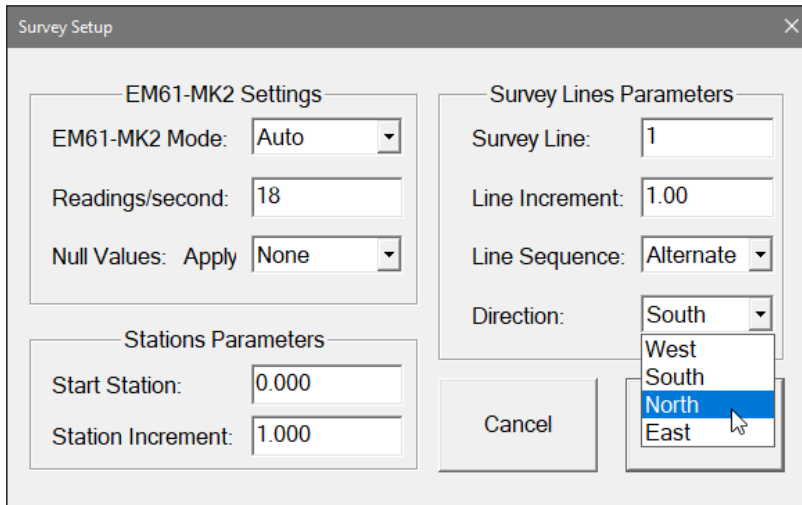


Figure 3.4: Survey Line Direction selection

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

Activate text box for this option by clicking with a mouse or using TAB key and then enter desired value.

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.

If GPS positioning is used, this parameter has only informative meaning. The most convenient is to set Start Station to 0, then Station Increment = 1 and the current station will indicate number of stations taken since the start of the data file.

**Station Increment** (station or wheel increment)

Activate text box for this option by clicking with a mouse or using TAB key and then enter desired value.

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.

If GPS positioning is used the most convenient is to set the Station Increment equal 1. The station displayed during data recording will indicate number of stations taken since the start of the data file.

**Null Values**

When this option is highlighted and drop-down box is expanded use mouse or use Down or Up cursor key to toggle between two available settings: None and Last Survey (Figure 3.5).

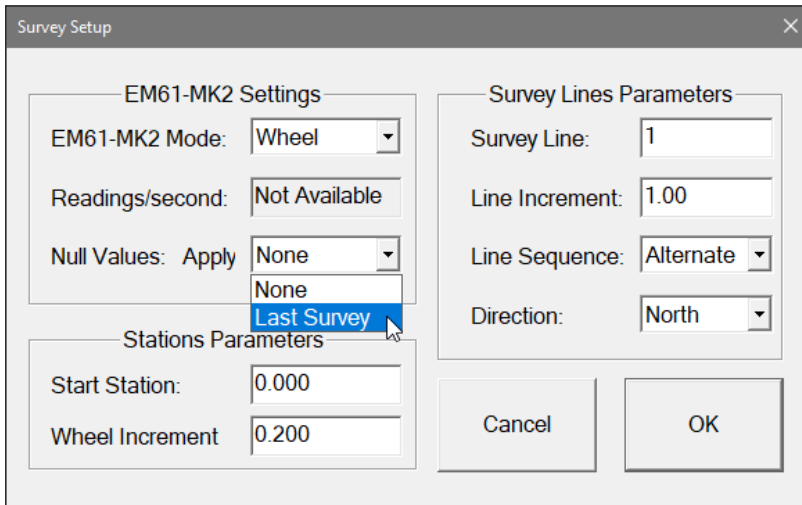


Figure 3.5: Null Values selection

This parameter indicates whether Nulling offsets (see Nulling in Monitoring section) are to be applied same as in the Last Survey (or file) or they are reset to zero. In the latter case select None.

If Nulling operation is to be performed later in this logging session then this parameter is not important, new Nulling factors will overwrite former values.

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

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

# System Setup

# 4

The System Setup dialog, presented below in Figure 4.1, contains several parameters. It allows you to enable and disable instrument connection, select the instrument type, a pause key selection, speed bar units used during survey, coordinates display, serial ports assignment and audio options.

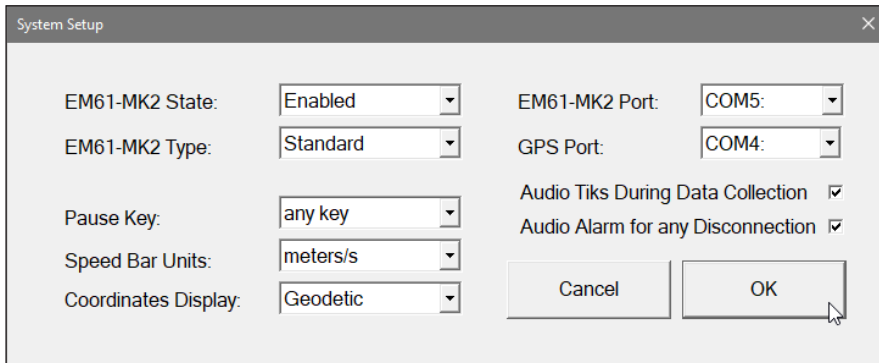


Figure 4.1: System Setup dialog

To select any option click on the corresponding drop-down list box or radio button, or use TAB key to scroll to the option and then use mouse or the Down and Up keys in drop-down box or radio buttons section.

Description of the System Setup dialog options and parameters.

## EM61-MK2 State (Enable/Disable)

Click or 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 activate the text box and then by using up or down arrow keys select one of two available items: **Enabled** or **Disabled**.

Select Enable for normal operation when EM61-MK2 are to be recorded.

When Disabled is selected the program will not record, nor will check for presence of the EM61-MK2 instrument. This feature is used when only GPS positions are to be recorded. In this case created data file will have extension name GXY. These files can be used to survey roads, fences, buildings, or any other topographical features.

## EM61-MK2 Type

When this option is highlighted and drop-down box is expanded (Figure 5.2) use mouse or use Down or Up cursor key to toggle between two available EM61-MK2 types: Standard and High Power (Hand Held antenna is recognized by the EM61-MK2 electronics automatically).

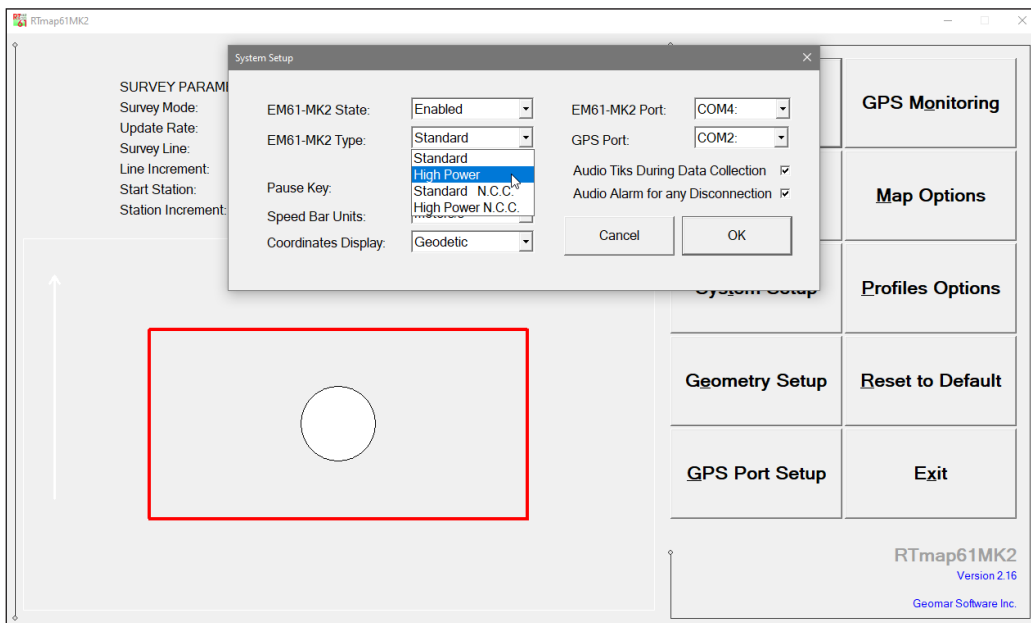


Figure 4.2: Selection of the EM61-MK2 Type

Standard and High Power items correspond to standard EM61-MK2 and high power EM61-MK2-HP consoles. The transmitter current is measured and applied during current normalization procedure to each type of console individually. If Standard N.C.C. or High Power N.C.C. option is selected then readings do not contain TX current normalization.

## Pause Key

When this option is highlighted and drop-down box is expanded use mouse or use Down or Up cursor key to toggle between available options (Figure 4.3). Four selections are available: Any key, Enter, Space bar, and P key. This feature is used to pause data recording during logging session. Default setting **any key** can be changed to a single key for field conditions where a logger key can be accidentally pushed causing unwanted stop of data logging.

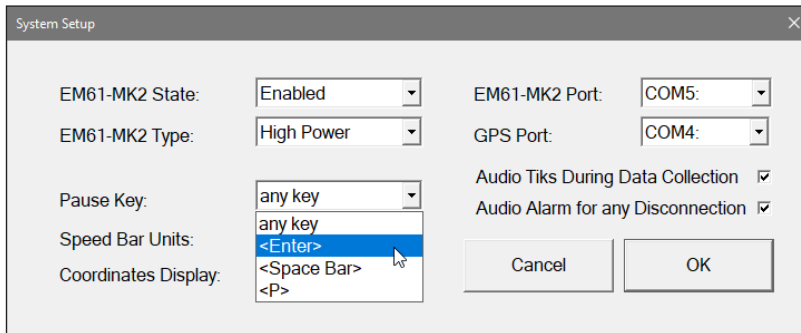


Figure 4.3: Selecting Pause Key in the System Setup dialog

### Speed Bar Units

When this option is highlighted and drop-down box is expanded use mouse or use Down or Up cursor key to toggle between available options (Figure 4.4).

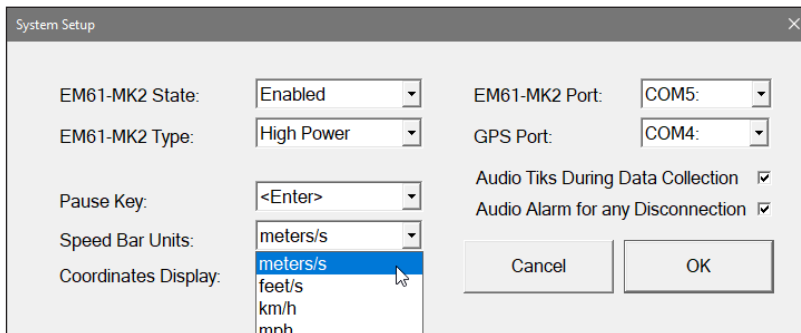


Figure 4.4: Selecting Speed Bar units

Four selections are available: meters/s , feet/s, km/h, and mph. These units will be used to calculate the system speed based on the current and former GPS antenna position. Speed is displayed graphically as a speed bar and in numeric form while logging data during GPS based surveys.

This parameter can be changed later using Menu options during data logging.

### Coordinates Display

When this option is highlighted and drop-down box is expanded use mouse or use Down or Up cursor key to toggle between available options (Figure 4.5). Four selections are available: Geodetic, UTM meters, UTM feet, and UTM US Feet. A selected type of coordinates will be calculated and displayed in real time below map during data collection (please see numerous examples in Chapter 8).

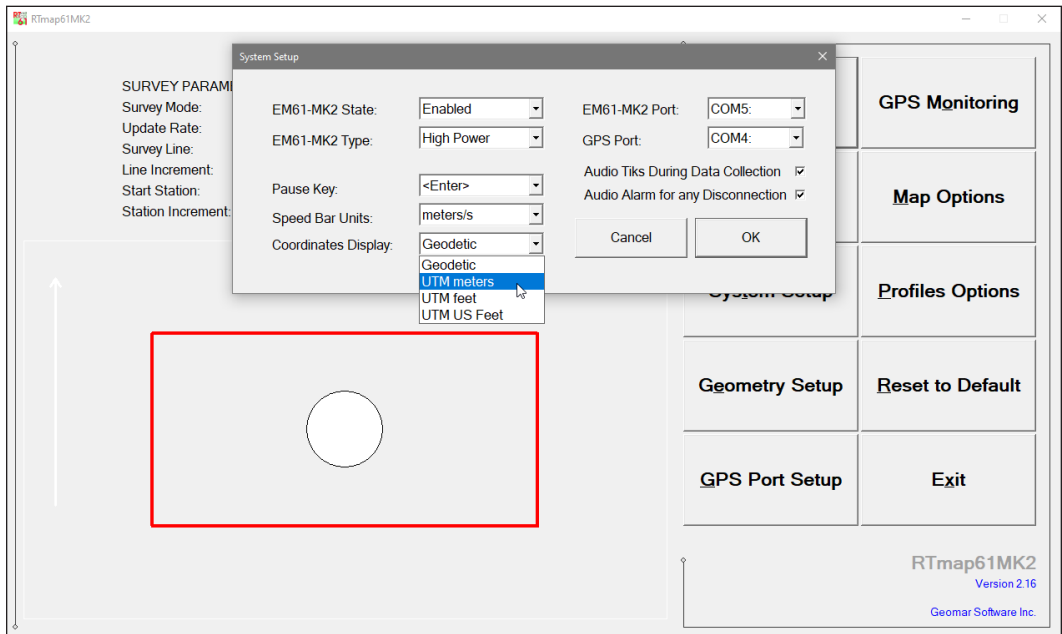


Figure 4.5: Selecting type of Coordinates display

It affects only display (data file contains always original GPS readings). Regardless of the coordinates type selection positions are always displayed in datum WGS1984.

This parameter cannot be changed later during data logging.

### EM61-MK2 Port and GPS Port

Navigate with mouse or TAB key to each Sensor Port (EM61-MK2 or GPS) and when the option is highlighted and drop-down box is expanded use mouse or use Down or Up cursor key to toggle between available settings. The program supports ports from COM1 to COM60 for the EM61-MK2 and for GPS receiver (see Figure 4.6).

Select proper serial port for the instrument and GPS receiver (GPS Port can be also modified in the GPS Port Setup dialog). Selected ports are checked by the program for assignment conflict at the time data logging starts.

The program supports Serial Ports 1 to 60. Any serial port can be assigned, however care should be taken that the EM61-MK2 instrument and GPS receiver are connected to proper (indicated here) serial ports.

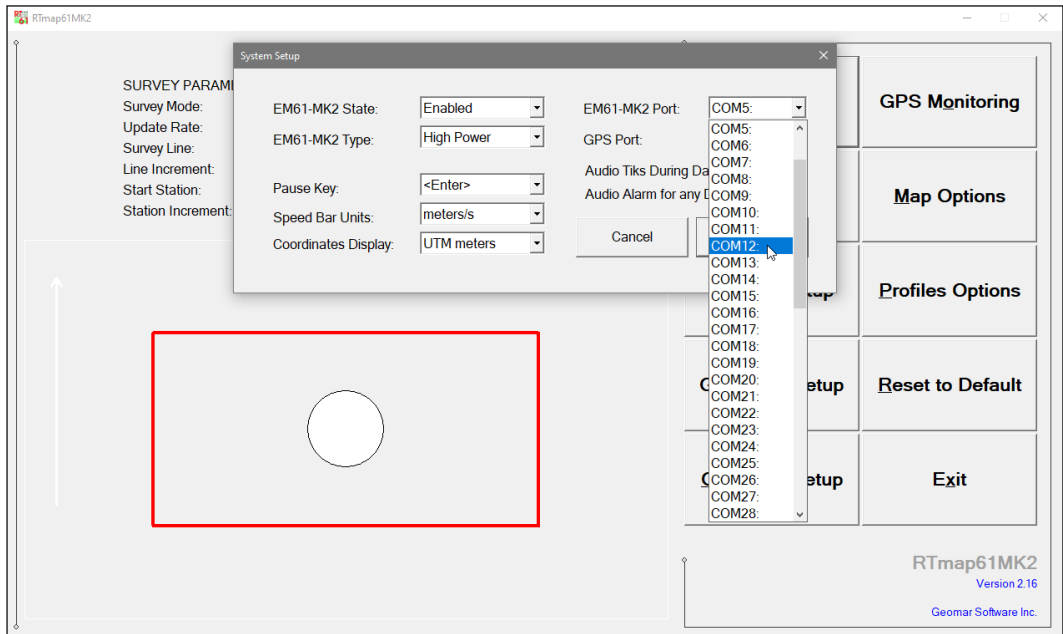


Figure 4.6: Selecting Serial Port in the System Setup dialog

### Audio Ticks During Data Collection

The program will provide tik-tak sound during data recording (in the Logging mode only). The tick sounds with frequency approximately 3 Hz. This audio feature may be helpful as a confirmation that the button Go has been pressed (or tapped) and data is being collected and saved in data file. This audio function can be enabled or disabled by check button as shown in Figure 4.5.

### Sound Alarm

The program will sound loud ring in case of any serial port disconnection, or in case any EM61-MK2 unit or GPS receiver will stop streaming data. The audio alarm function does not depend on the visual alarm that is always enabled regardless of audio alarm setting. The audio alarm function can be enabled or disabled by check button at the Sound Alarm for any Disconnection label as shown in Figure 4.5.

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

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

# Geometry Setup

# 5

The Geometry Setup dialog, presented below in Figure 5.1, contains parameters which describe the system configuration: size of the instrument antenna and location of GPS antenna. The dialog contains a graphic window labeled Geometry Description which illustrates meaning of parameters used to specify geometry of a system. This graphic window is used only as a reference, it does not reflect actual system layout.

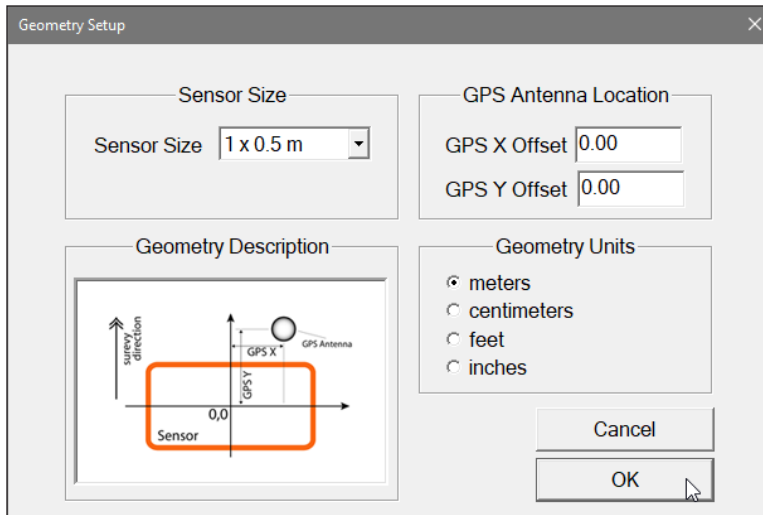


Figure 5.1: Logger Setup dialog

The current layout of a system is displayed in graphic diagram located in Main Screen. As soon as the button OK in Geometry Setup dialog is clicked (or executed by keyboard) the dialog is closed, the program calculates positions of sensor and GPS antenna using new parameters and displays its layout in the Main Screen window. This visual approach helps to notice immediately a case when wrong parameters were entered.

Description of the Logger Setup dialog options and parameters.

## Sensor Size

The Antenna Size option allows you to select the size of the EM61-MK2 sensor. The available selections are: 1.0 x 0.5 m, 0.5 x 1.0 m, 1.0 x 1.0 m, Hand Held. The Hand Held sensor is automatically detected by EM61-MK2 receiver and recorded in the RTmap61MK2 file. Difference between first two options is in the same size coil orientation. The 1.0 x 0.5 m selection indicates sensor with longer

side parallel to X axis (see image in Figure 5.2), and the 0.5 x 1.0 m selection indicates the same coil with its shorter side (0.5 m) along X direction. Click 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 four available items (Figure 5.2).

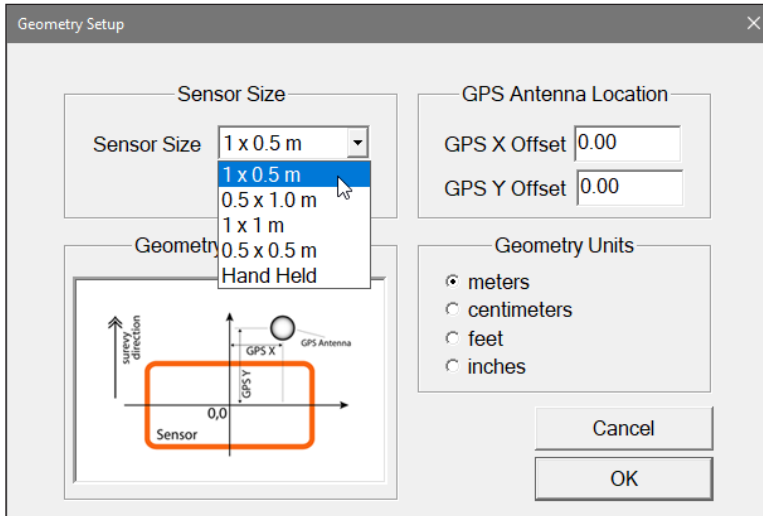


Figure 5.2: Selecting Sensor Size in the Geometry Setup dialog

If for any reason, the Sensor Size is not specified correctly in the field, this parameter can be easily modified later during data processing while using program RTM61MK2.

### GPS X Offset

### GPS Y Offset

Activate GPS X Offset or GPS Y Offset text box by tapping or using TAB key and then enter value for corresponding offset

These two options apply only when a survey is positioned by GPS system. The GPS X and Y offsets describes location of GPS antenna. This location is represented by the distance which is measured from the center of the EM61-MK2 coil to the center of the GPS antenna, while facing direction of the movement, see Figure 5.3.

The GPS Antenna offset distances can be given in meters or feet depending on the Geometry Units setting in this dialog.

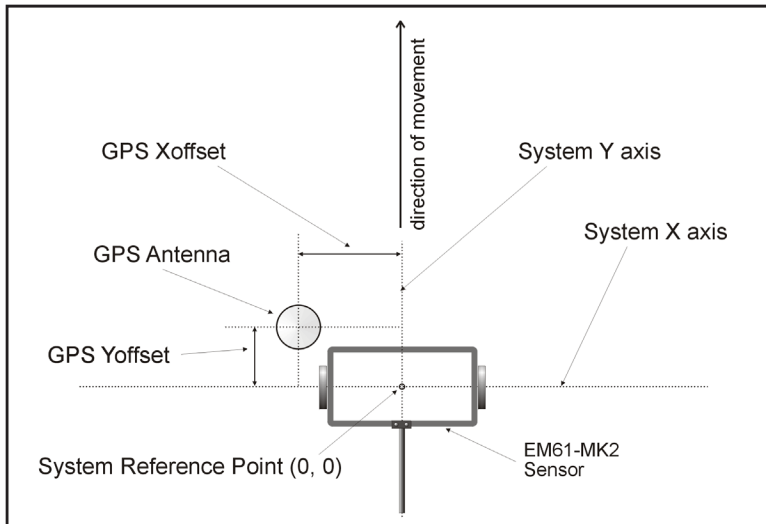


Figure 5.3: Geometry description for the RTmap61MK2 system

GPS antenna can be placed anywhere in relation to the instrument center. However to achieve higher accuracy of the calculated positions the GPS antenna must be placed as close to the center of the sensor as possible.

### Geometry Units

Four selections are available: Meters, Centimeters, Feet, and Inches (Figure 5.2). These units will be used to calculate positions for sensors in the program RTM61MK2. All parameters that describe geometry of the system must be specified using units selected at this option.

Since EM61-MK2 sensors are described in meters, it is more natural and easier to use meters during specifying GPS antenna offsets parameters.

In case wrong selection was entered, units or other parameters can be corrected later in the program RTM61MK2.

After all the parameters in the Geometry Setup dialog are updated click or tap on the button OK or press O key (or ENTER if button OK is highlighted) to accept the displayed settings. The program will return to the Main Screen and diagram illustrating system layout will be updated immediately. Updated settings will be written to the initial file and they will be given as default parameters in the subsequent Geometry Setup dialog.

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



# GPS Port Setup & Monitoring

# 6

The GPS Port Setup dialog, presented in Figure 6.1, allows for enabling or disabling GPS input, choice of NMEA data string, setting communication parameters for serial port associated with GPS input, and GPS Warning Mask parameters. The GPS Monitoring window allows you to monitor the GPS output in terminal mode as well as to change GPS receiver settings by sending a NMEA command.

## 6.1 GPS Port Setup Dialog

The GPS Port Setup dialog allows for enabling or disabling GPS input, choice of NMEA data string, setting communication parameters for serial port associated with GPS receiver input, as well as specifying GPS Warning Mask parameters (Figure 6.1).

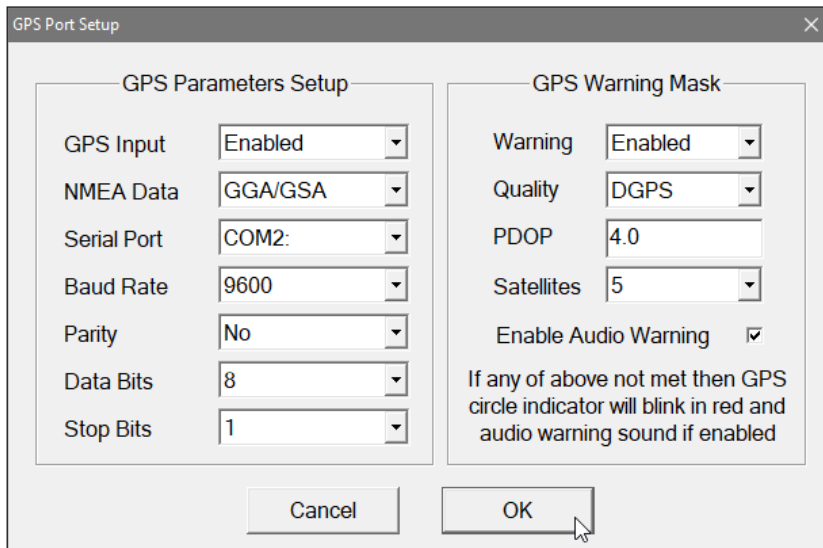


Figure 6.1: The GPS Port Setup dialog window

To select any option click on the corresponding drop-down list box or use TAB key to scroll to the option and then use mouse, touch screen features, or the Down and Up keys to select option.

Description of the GPS Port Setup menu options and parameters.

## GPS Port Setup Parameters

### GPS Input

Tapping or clicking 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 by navigating with Tab key and then by using Up or Down arrow keys select one of the available items: Enabled and Disabled.

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. Also, when the Disabled item is selected the RTmap61MK2 will work only in Profile View mode, and Mapping nor Navigation modes will be unavailable.

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

### NMEA Data

This option allows you to choose NMEA message. The RTmap61M can make use of messages: GGA, GGA with associated GSA sentence, POS, GLL, LLK, LLQ, GLL, GGK, Leica TPS (includes Leica TPS 1100 and 1200 models, and several later Trimble RTS models supporting pseudo-GGA ), Pseudo GLL (used in some marine positioning systems), Figure 6.2.

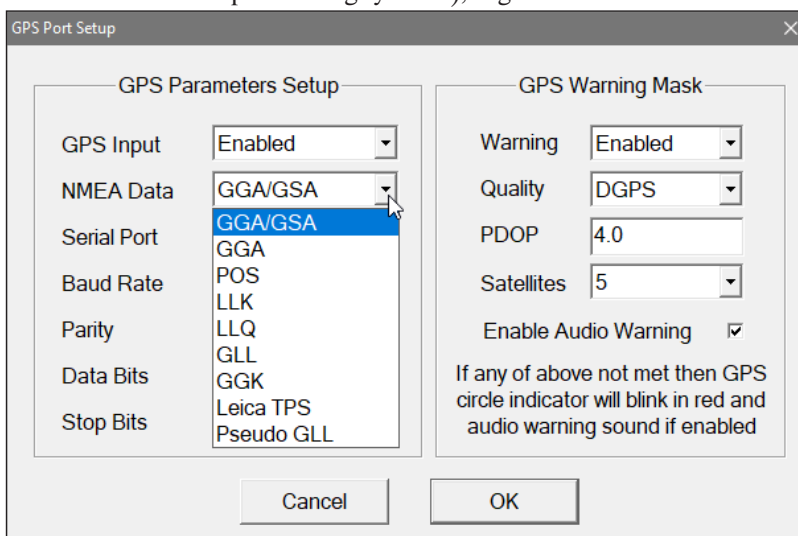


Figure 6.2: Selecting NMEA Data message

The NMEA Data option has nine selections: GGA/GSA, GGA, POS, LLK, LLQ, GLL, GGK, and Leica TPS equivalent to pseudo-GGA (covers Leica TPS1100 and TPS1200 and several Trimble RTS), and pseudo-GLL devices. Message GGA is supported by almost all GPS receivers. This string is used to record GPS position, while associated message GSA is used to display parameter PDOP which indicates quality of GPS signal. If a GPS receiver supports only GGA string and option GGA/GSA is selected, GPS positions will be recorded using GGA message and PDOP parameter will be displayed as N/A (not available). In such case user should monitor quality of GPS signal using GPS receiver display or can monitor number of available satellites. If GGA option is selected a parameter HDOP will be displayed on the screen.

Messages POS and GGK which are supported by a smaller number of manufacturers (however POS is available in all Ashtech receivers and GGK in some Trimble receivers) are preferable since they contain all necessary information, including the PDOP, in one sentence. If your GPS receiver supports POS or GGK and GGA messages, and PDOP parameter is required, select POS or GGK which provide faster operation for the field computer.

Messages LLK and LLQ are used in some Leica GPS systems and provide positions in meters in local coordinate system. When LLK is selected a parameter GDOP will be displayed on the screen. Message LLQ provides precision of positioning in meters and this parameter will be provided on the logger screen. Various NMEA messages support different Dilution parameters therefore selected message will affect label of Dilution parameter in Warning Mask section of the dialog (compare Figure 6.1 and 6.3). Message GGA/GSA supports PDOP, GGA supports HDOP, GGK supports DOP, etc. (please refer to your GPS manual or Appendix B).

### **COM Port**

The number of serial port that is assigned to the GPS input. Available selections are from COM1 to COM 60. 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 a port specified in the Logger Setup menu for the EM61-MK2 input, otherwise a warning message will be displayed and ports will have to be reassigned.

### **Baud Rate**

Specify Baud Rate for the output port, the entered value should much the Baud Rate of the GPS system, default is 9600.

### **Parity**

Select Parity for the output port, the entered parameter should much the Parity set in the GPS serial port settings, default is N.

### Data Bits

Specify Data Bits for the output port, the entered value should much settings in the GPS system, default is 8.

### Stop Bits

Specify Stop Bits for the output port, the entered value should much settings in the GPS system, default is 1.

## GPS Warning Mask Parameters

### Warning

Clicking 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 by navigating with Tab key and then by using Up or Down arrow keys select one of the available items: Enabled and Disabled.

This option allows you to Enable/Disable a GPS Warning Mask that contains three parameters: Quality Indicator (degree of differential corrections), Dilution Parameter (PDOP or other label depending on the selected NMEA message), and number of available satellites (Figure 6.3).

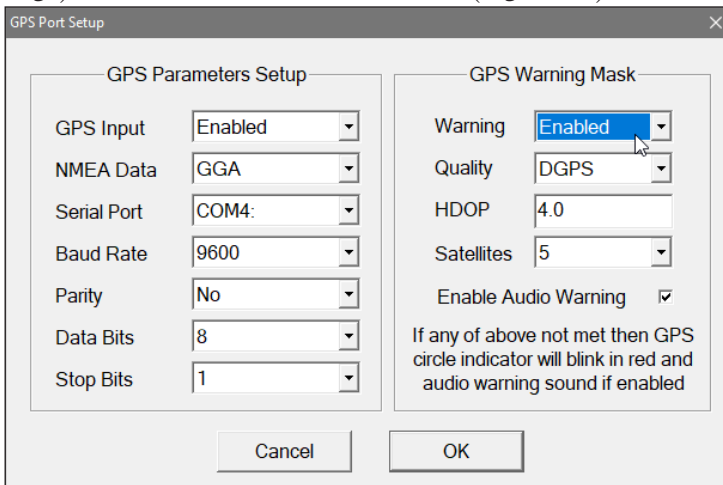


Figure 6.3: GPS Mask Warning Section enabled

When Enabled is chosen GPS two circle indicator will be alternating in green and white if conditions for specified parameters setting will be met. When any of the parameters is below set values then GPS indicators will alternate in red and white colours. In case Warning parameter is disabled then GPS indicator will be displayed in green and white colours regardless of GPS signal quality. All GPS data is logged, GPS Warning Mask affects only display.

## Quality

This parameter describes Quality Indicator (degree of differential corrections). 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 by navigating with Tab key and then by using Up or Down arrow keys select one of the available items: AGPS (Raw), DGPS, RTK3, RTK4, and RTK5, Figure 6.4. If Quality Indicator received from GPS receiver will be worse than specified then GPS indicator will alternate in red and white colours.

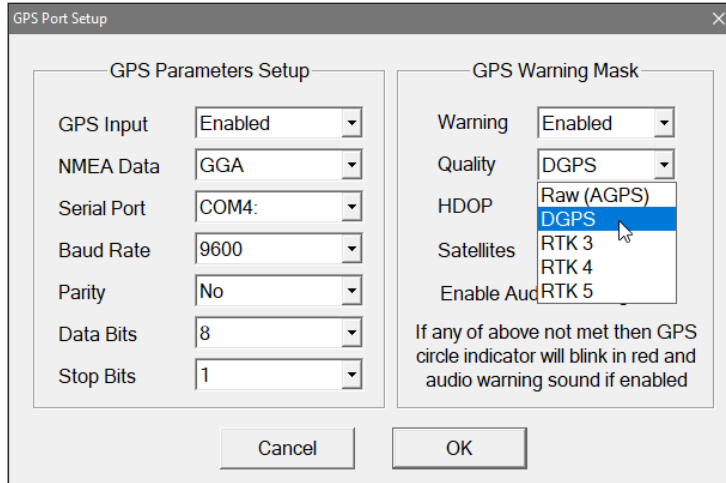


Figure 6.4: GPS Mask Warning Section, Quality selection

## PDOP

This parameter can be labeled PDOP, HDOP, DOPG, DOP depending on the selected NMEA message. It can be also named Quality m (accuracy in meters) if LLQ was selected, or it is not available (labeled N/A) when messages GLL or Leica TPS are used.

Activate text box by a mouse click or using TAB key and then enter the chosen acceptable maximum value of Dilution parameter.

If PDOP (or other similar parameter) is larger than specified value then GPS indicator will alternate in red and white colours.

## Satellites

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 by navigating with Tab key and then by using Up or Down arrow keys select one of the available items: 3 to 12.

If number of available satellites will be smaller than specified then GPS indicator will alternate in red and white colours.

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

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

## 6.2 Monitoring GPS Receiver Output

After the Main Screen command button GPS Monitoring is clicked or executed by the keyboard the program will display the GPS Monitoring window in terminal mode. In this mode the screen is divided into three parts. The terminal window in the top portion of the screen displays the GPS receiver output. The middle portion labeled NMEA Command is used to display entered NMEA commands previously sent to the GPS receiver, and at the bottom, command buttons with available options is displayed. The RTmap61MK2 screen in terminal mode is shown in Figure 6.5.

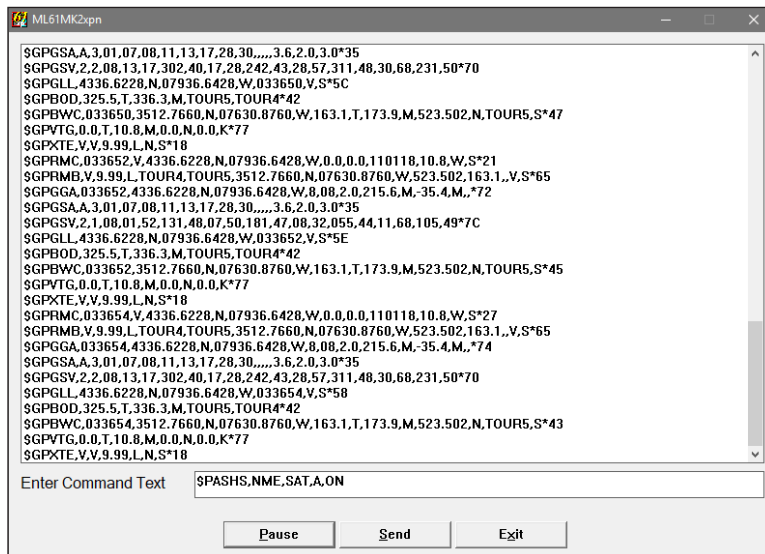


Figure 6.5: Monitoring GPS output in monitoring (terminal) mode

As soon as the RTmap61MK2 GPS Monitoring window is displayed and the GPS receiver is streaming data, the contents of each message will appear in the top portion of

the display. 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.

Example in Figure 6.5 shows output of GPS receiver which sends three NMEA messages GGA and GSA updated every second. 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 in Figure 6.6.

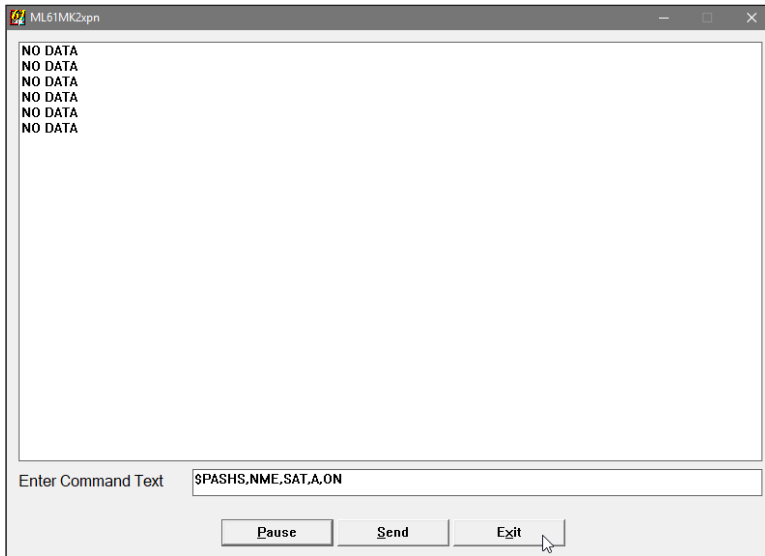


Figure 6.6: GPS Monitoring window when no GPS data is available

The message NO DATA is normally updated with a rate of 6 seconds. This indicates the following:

- serial port number not correctly specified in Set Port for GPS menu,
- the GPS receiver not sending any data,
- not connected or not working GPS receiver.

If the message is updated more often than 6 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 6 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 paused any time by clicking on the button **Pause** or pressing the **P** key (or **ENTER** if the button is highlighted). At that time scrolling of the GPS output will be stopped, and the **Pause** button will be replaced by the button labeled **Go** (Figure 6.7). The next click on this button or pressing the **G** key (or **ENTER** if the button is highlighted) will activate receiving and display of GPS data.

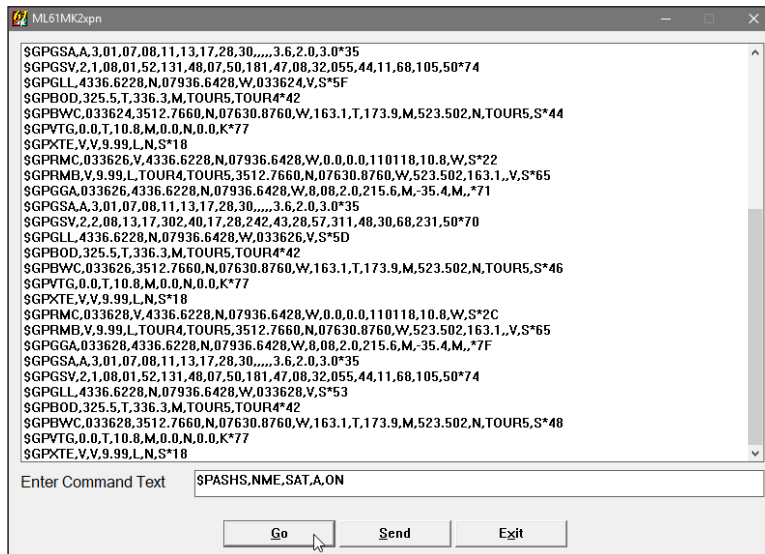


Figure 6.7: Paused GPS Monitoring window

### 6.3 Sending Command to GPS Receiver

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. In this case resetting the GPS can be done from the RTmap61MK2 without using any other software.

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 (Figure 6.8). After the entire NMEA command is typed in, tap **OK** button

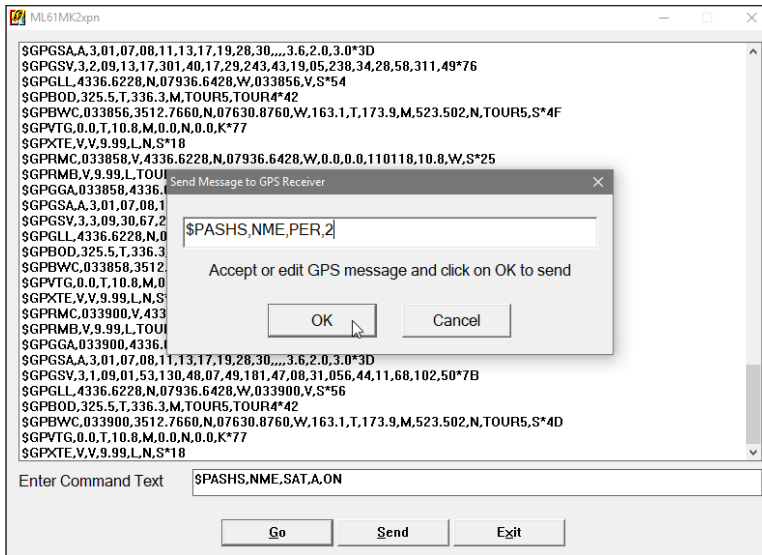


Figure 6.8: GPS Monitoring screen after button Send is executed

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 Figure 6.9 (it is assumed that the GPS receiver output serial port is A).

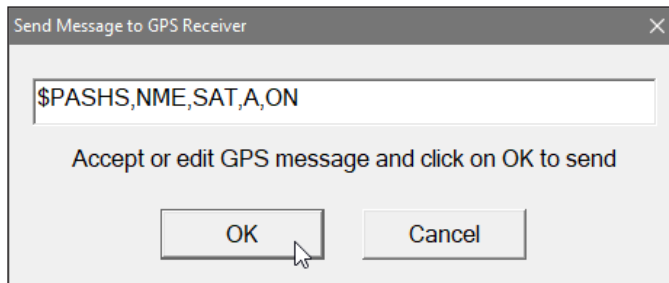


Figure 6.9: Example of the NMEA command entry

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 not contain the message POS (\$PASHR, POS,..... ), as shown in Figure 6.10.

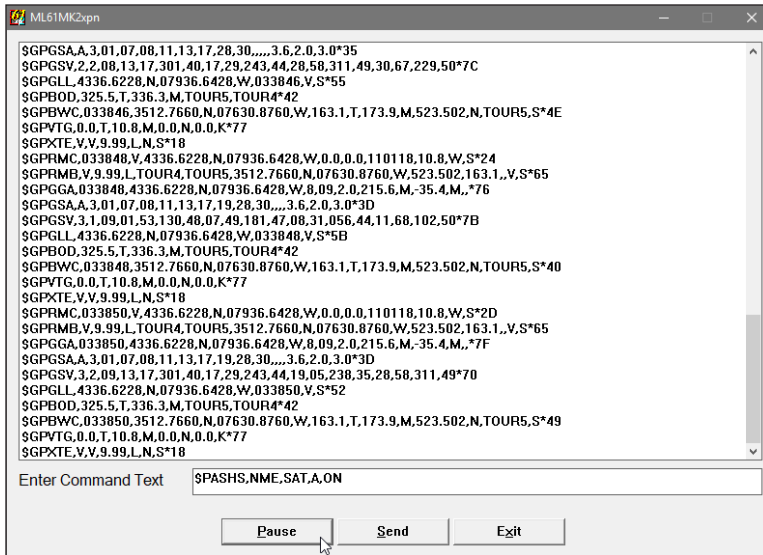


Figure 6.10: GPS Monitoring screen after NMEA command is sent

When the button **Send** is executed next time, the text of the former NMEA command is displayed in NMEA Command dialog. This text can be edited and send to GPS receiver by tapping the button **OK** in dialog window.

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 (i.e. Trimble ProXRS or ProXL). The configuration of these type of receivers can be updated only by the controlling device (usually GPS logger, controller, or the receiver panel keys). Please refer to the documentation of a given GPS system before using NMEA Command function.

# Map & Profile Options

# 7

The Map Display Options dialog is used to specify plotting parameters for map display, colours and size of cursor and positions, the displayed position type (navigation mode), and displayed EM61-MK2 channel (mapping mode), while the Profile Options dialog allows you to select profiles to be displayed, including colour (applied also to moving graphic bars) as well as thickness of profiles.

## 7.1 Map Display Options

In general the RTmap61MK2 can display map in two modes: Mapping and Navigation. Mapping mode displays swath bar for each instrument reading with a colour reflecting amplitude value creating colour image of collected data (this mode is the program default). In the Navigation mode position of the sensor is displayed as a dot of specified size or as a bar that has Map Swath width, positions are plotted at GPS update rate in this mode. Samples of various map displays are provided in Chapter 1 of this manual.

After the **Map Options** button was tapped (or executed from the keyboard) in the Main Screen the Map Display Options window appears on the screen (Figure 7.1).

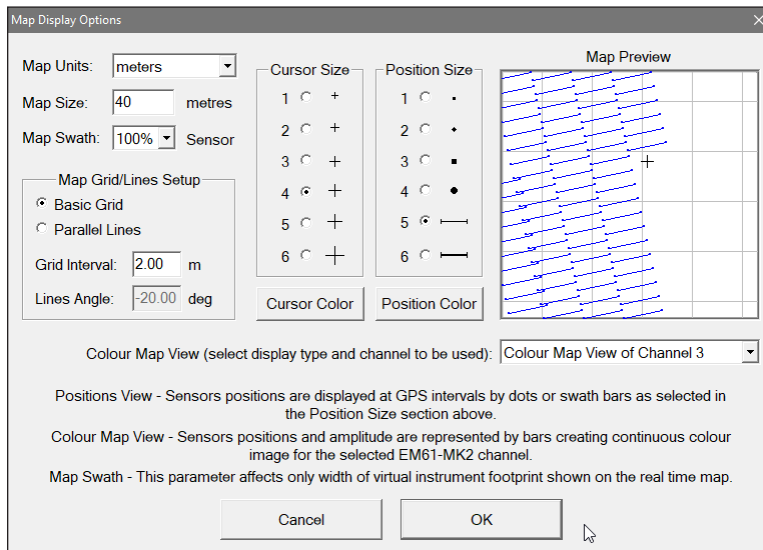


Figure 7.1: The Map Display Options dialog

This window is divided into five main sections. The first section located at the left specifies map units, map size, map swath, and grid lines options. The next section, second from the left, labeled Cursor Size is used to set size and colour of the cursor indicating current position of the GPS antenna. The third section, labeled Position Size allows you to specify size and colour of a dot or swath bar marking saved position on the Navigation map. The section on the right labeled Map Preview shows sample map with current settings (specified in the first three sections), it is updated in real time. The fifth section, combo box labeled Colour Map View is used to select Navigation mode or Mapping mode for a selected EM61-MK2 channel to be displayed as real time color image.

All parameters selected in this dialog can be adjusted later during data collection with the exception of Map Units and Map Swath.

### **Map Units**

Three selections are available: **meters**, **feet**, or **US Survey Feet**. These units will be used to display positions and scale map in mapping and navigation modes, and to calculate positions for the instrument in program RTM61MK2 if one of the offsets for GPS antenna is different than zero.

### **Map Size**

Specify Map Size in units selected in the System Setup dialog. Map size describes length of each side of the map (map is always square regardless of the display size). This value can be also adjusted in Map Size option during data collection.

### **Map Swath**

The size of Map Swath can be selected as a percentage of the EM61-MK2 sensor width, Figure 7.2. It will represent width of the instrument footprint drawn and scaled to map size. The default is 100%, it means width of the EM61-MK2 sensor, 1 meter in most cases. The Map Swath width should be selected based on intended survey line spacing and lateral resolution of the survey.

This parameter must be selected before Logging session starts, it cannot be adjusted at any time during data collection in Logging mode.

### **Map Grid/Lines Setup**

Map can display gray grid or parallel lines at specified intervals as a background to help with navigation and survey coverage. When the radio button labeled Basic Grid is selected an interval between grid lines can be specified in below text box labeled Grid Interval. In case the Parallel Lines radio button is selected available parameters are Line Interval and Lines Angle.

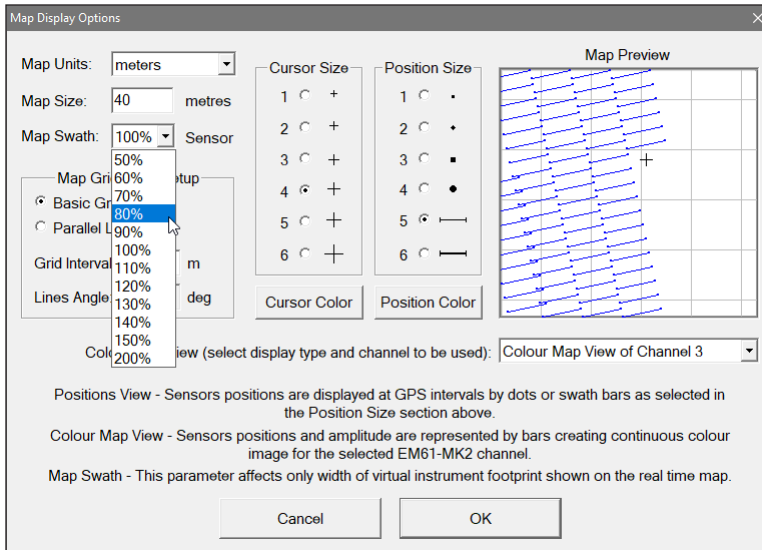


Figure 7.2: Selecting width of Map Swath bar (as percentage of the antenna width) in Map Display Options dialog

Grid lines can be plotted only in as perpendicular lines SN and WE drawn at specified interval (Figure 7.2), while selection Parallel Lines allows for Lines Interval as well as Lines Angle entries (Figure 7.3). Lines tilt angle is measured in degrees clockwise from North.

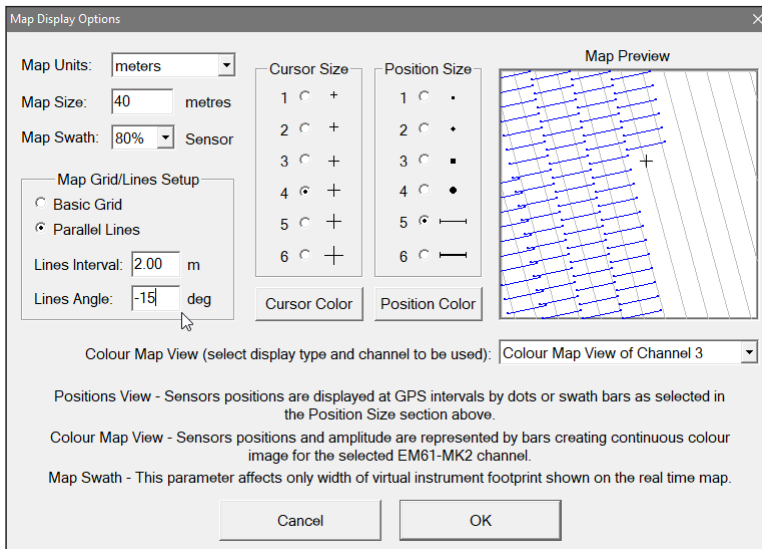


Figure 7.3: Specifying Parallel Lines and Lines Angle in Map Display Options dialog

## Size of Cursor and Position

Clicking or tapping on a radio button in any of two sections will select a size of Cursor or Dot as shown by a graphic image placed next to the radio button. The selection will be immediately reflected in the Preview window, as shown in Figure 7.2 (please compare with Figure 7.1).

Size of Cursor and Position dots shown in the Preview window will be used in Mapping and Navigation modes during data collection. These parameters can be changed at any time during the survey.

Cursor Size (+ symbol) represents position of GPS antenna while Position Size (dot or swath bar) represents position of the sensor (dot) or selected instrument footprint (map swath bar with the position of the sensor in its center) in Navigation mode.

When Mapping mode (colour image) is selected then position of the instrument is represented by a swath bar by default. Each swath bar in Mapping mode is drawn with colour corresponding to the reading amplitude at the corresponding location. Position of the instrument sensor is located in the center of swath bar. Therefore instrument trace in Mapping mode is represented by one continuous bar of varying colour.

Clicking on a radio button in any of two sections will select a size of Cursor or Dot (or Swath Bar) as shown by a graphic image placed next to the radio button. The selection will be immediately reflected in the Preview window, as shown in Figure 7.4 (please compare with Figure 7.3).

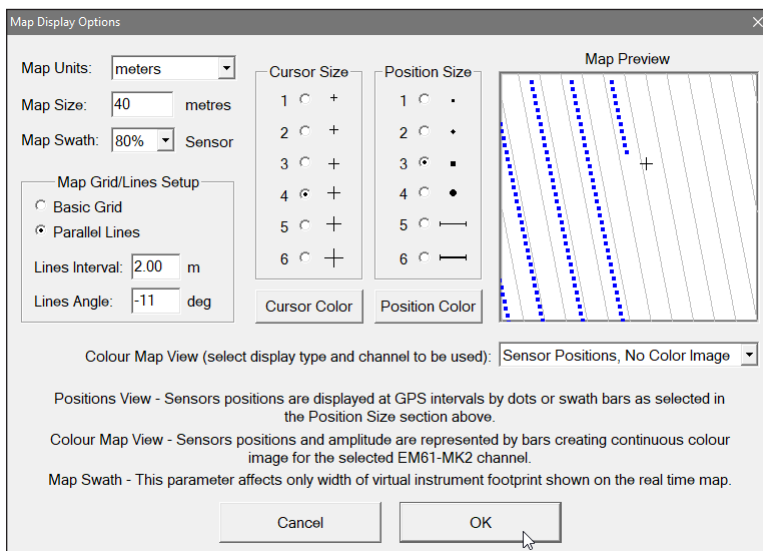


Figure 7.4: Selecting Displayed Position Type (Navigation mode)

Swath Bar in Navigation mode can be selected in two thicknesses and it will be plotted to the real scale of the map.

Size of Cursor and Position dots shown in the Preview window will be used in Navigation mode during data collection. These parameters can be changed at any time during the survey.

### Cursor Color/Position Color

To change colour of the Current Position Cursor or Position dot click on the corresponding button labeled Color. The Color dialog will appear (Figure 7.5). Select desired colour by clicking on a colour box (the selected colour box will be highlighted). Other colours can be specified by clicking on the **Custom** button. The selected color will be used to plot corresponding parameter.

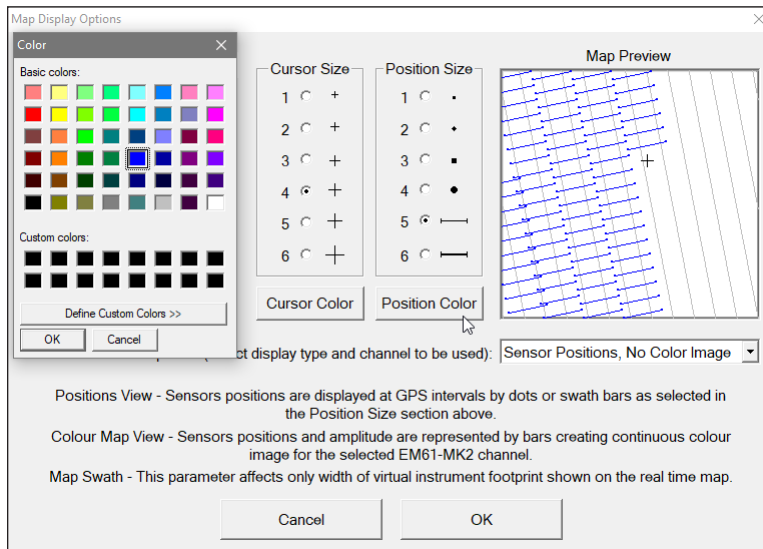


Figure 7.5: Selecting Color for Cursor or Dot and Swath Bar in Map Display Options dialog

Click on the button **OK** or press **ENTER** key (if highlighted) to accept the highlighted colour. The Color dialog will disappear and the colour of the selected parameter (Cursor or Position) will be updated in the Preview window. To cancel colour selection click on the **Cancel** (or X button) button or press **Esc** key. Selected colours of Cursor and Position dots shown in the Preview window will be used in Navigation mode during data collection. Colour for each parameter can be changed later at any time during the survey.

When Mapping mode is selected the colour of Saved Position will be ignored since position will use colour that depends on the reading amplitude and assigned colour scale.

## Colour Map View (select display type and EM61-MK2 channel to be used)

Items available in this option are shown after clicking on and expanding the combo box labeled "Colour Map View", Figure 7.6.

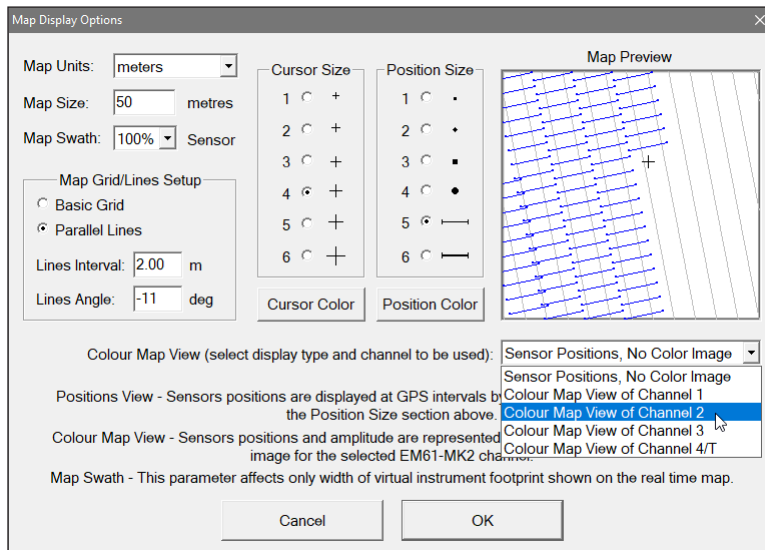


Figure 7.6: Selecting Navigation mode or Color Map View of selected channel in the Mapping mode

When the first item "Sensor Positions, No Color Amplitude" is selected the program will display map in Navigation mode. Positions drawn on map (dots or swath bar) indicate locations of EM61-MK2 antenna center that include corrections for GPS antenna offsets. In Navigation mode instrument positions are drawn with the frequency of GPS update rate. GPS antenna positions is continuously updated and shown on the map by cursor "+" symbol".

Selecting one of four remaining items will set the program in Mapping mode. The map will show colour image of the selected EM61-MK2 channel measurements. Colour image of data collected for any EM61-MK2 channel (one at a time) can be selected during data collection session at any time.

All four measured values are shown in profile view, moving graphic bars, and as numeric values, and all available data is recorded in data file regardless of the selected map display.

Scale of colour image amplitude can be specified and adjusted in the Readings Scale dialog accessible in menu in Logging mode.

After all the parameters in the Map Display Options window are updated click on the button **OK** or press **ENTER** key (if the button is highlighted) 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 Map Display Options windows.

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

## 7.2 Profile Display Options

After the **Profile Options** button was clicked (or executed from the keyboard) in the Main Screen the Setup Display Options dialog appears on the screen. This window is used to specify plotting parameters for Profile window as well as for the program Profile View mode. The window allows you to specify color and thickness of line representing each channel (1, 2, 3, 4 or T) profile, and to select amplitude of displayed profiles - linear or compressed. The Profile Display Options window is presented in Figure 7.7.

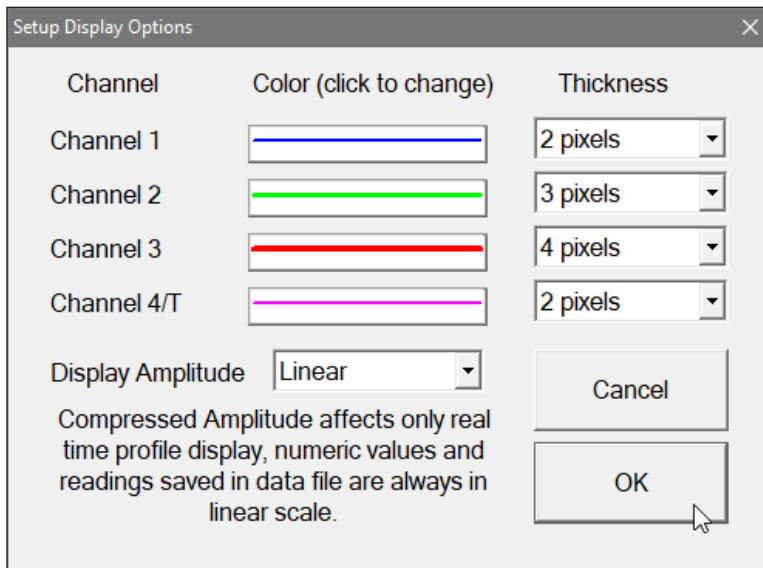


Figure 7.7: Profile Display Options dialog

Description of the Survey Setup dialog options and parameters.

### Color

To change color of the profile line and moving bar click on the corresponding button (with color line) labeled **Color (click to change)** as shown in Figure 7.8.

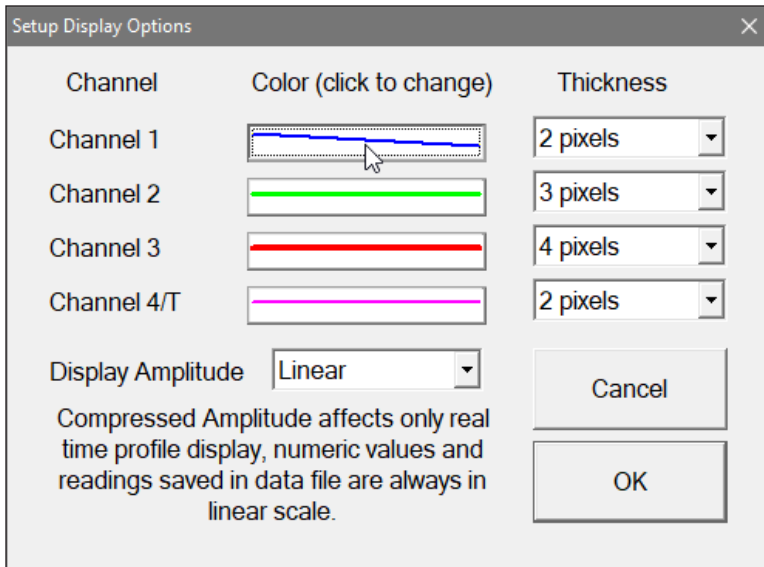


Figure 7.8: Clicking on the Color button

The Color dialog will appear (Figure 7.9). Select desired colour by clicking on a colour box (the selected colour box will be highlighted). Other colours can be specified by clicking on the **Define Custom Colors** button.

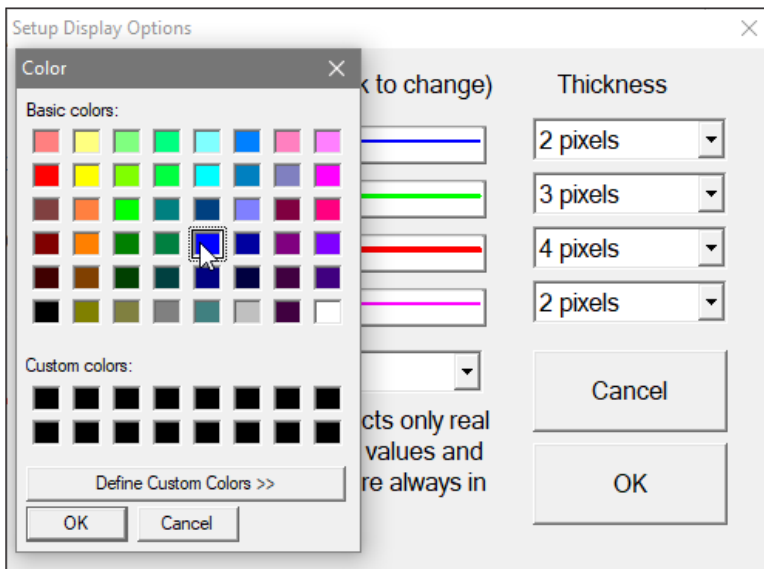


Figure 7.9: Selecting color of profile

The selected color for the EM61-MK2 channel (component/dipole mode/separation) will be used to plot corresponding profile line and moving bar. Click on the button **OK** or press **ENTER** key (if highlighted) to accept the highlighted colour. The Color dialog will disappear and the colour of the appropriate channel button will be updated. To cancel colour selection click on the **Cancel** button or press **Esc** key.

### Thickness

Specify thickness of a profile for an EM61-MK2 channel by using one of eight drop-down boxes labeled Thickness. Thickness of a profile curve is specified in pixels. Available settings are: 1, 2, 3, or 4 pixels. Clicking on the down arrow next to the text box (labeled by number of pixels) opens a drop-down box showing available selection (see Figure 7.10). Select thickness by clicking on the desired selection. If keyboard is used activate text box by pressing **TAB** key (till the box is highlighted) and then by using **Up** or **Down** arrow keys select one of available items.

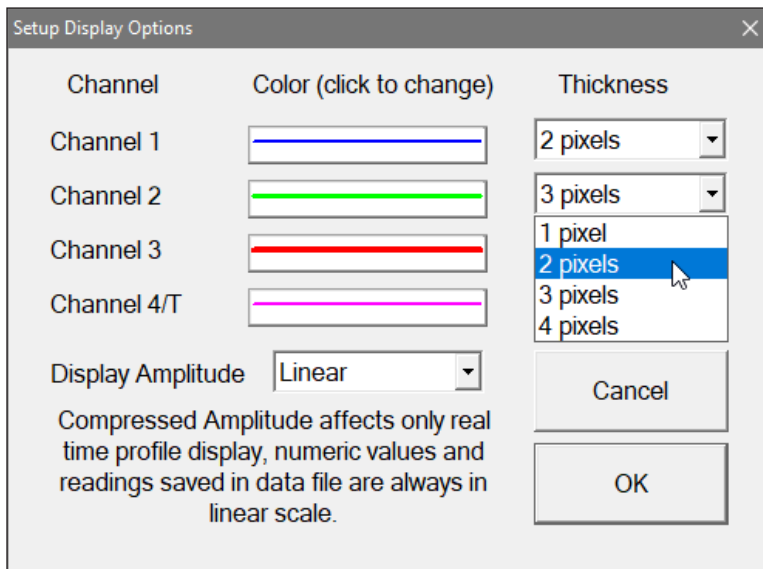


Figure 7.10: Selecting Thickness of Profile Line

### Display Amplitude

Amplitude Scale parameter can be selected as **Compressed** scale or **Linear** scale (Figure 7.11). Compressed scale is presented as a signed square root of the amplitude. The scale parameter applies to moving bars display as well as to curve display in profile mode. The compressed amplitude allows you to display

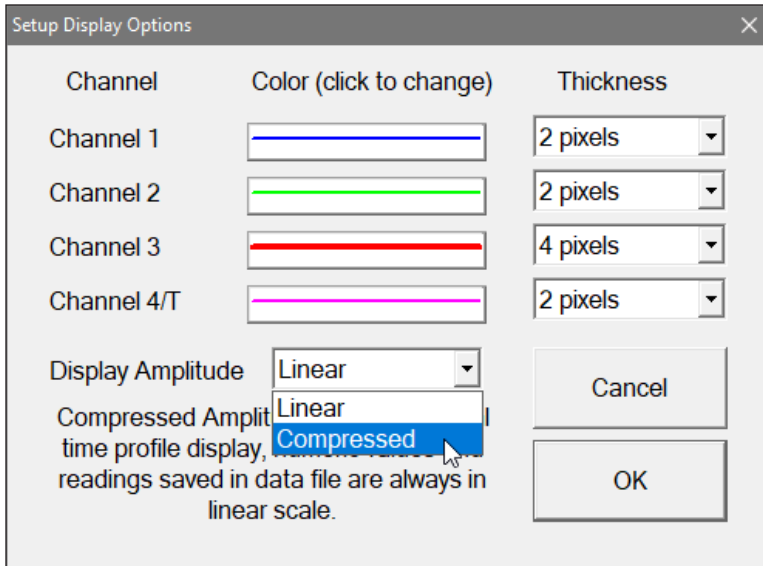


Figure 7.11: Selecting Type of the Displayed Amplitude

the high dynamic range of the EM61-MK2 data in a legible way and it is recommended for average type of survey.

**Please note, that readings displayed in numeric form are always given in mV (linear scale) regardless of the Scale (compressed or linear) 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 (linear) form.**

After all the parameters in the Profile Display Options window are updated click on 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 Profile Display Options.

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

# Logging

# 8

After the **Logging** button (in Main Screen) is clicked, or tapped, or executed by the keyboard, the program enters logging session and starts to read data from the connected EM61-MK2 and GPS receiver. Logging session contains three modes: Monitoring, Stand By and Log. Further each of these modes can use Mapping or Profile mode of the display. Since the Navigation mode is a special case of Mapping mode (display of EM61-MK2 stations or GPS positions without colored response amplitude scale of displayed dots) the term Mapping mode will be used further to describe Mapping and Navigation modes. If the GPS Input is disabled then only the Profile mode is available.

Program starts Logging session always in Monitoring mode and in Mapping display mode if GPS Input is enabled (Figure 8.1). In this mode EM61-MK2 and GPS readings can be quickly examined. Stand By mode is similar to Monitoring mode, however different options are available. Recording of EM61-MK2 and GPS data is allowed only in Logging mode, which is accessible from Stand By mode. In general, after the data file is created in the Monitoring mode, two modes Stand By and Logging are toggled by **Go** (Start) and **Pause** keys. In Stand By mode instrument outputs can be monitored and some survey parameters can be changed, and Logging mode is used only to record data.

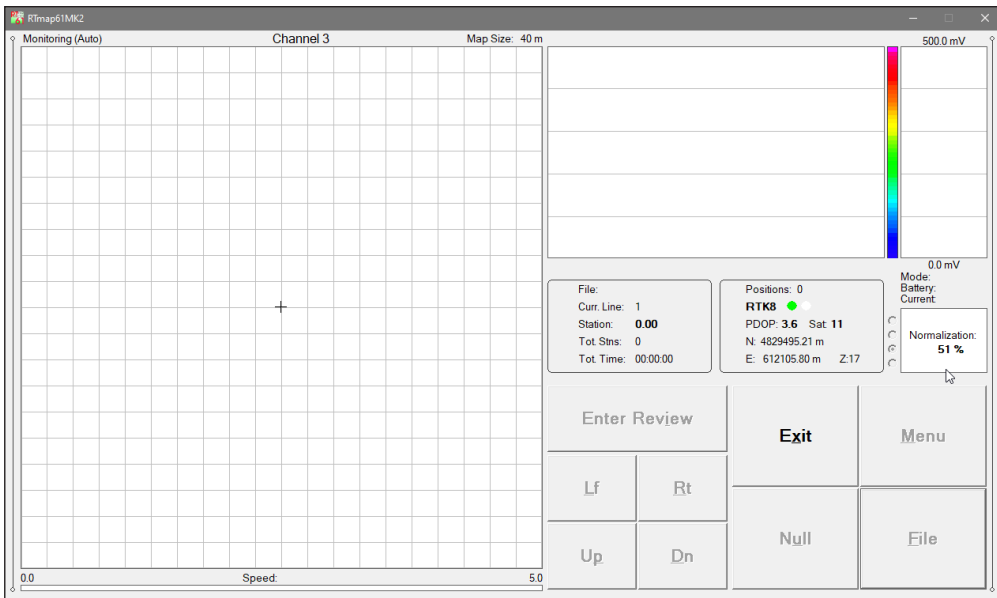


Figure 8.1: The RTmap61MK2 Monitoring screen in Mapping mode during initial Normalization

It is assumed that all settings, especially assignment of serial ports, are correctly specified and instrument is turned ON prior to using this option. In case the instrument is OFF or it is not connected to the field computer the message shown in Figure 8.2 will appear. This message will not appear if option EM61-MK2 in System Setup dialog is Disabled. Check program settings (System Setup), connection, or turn the instrument ON and select the Logging option again.

Assuming that instruments work properly the program will initialize connection with EM61-MK2 and a screen in Monitoring mode will be displayed.

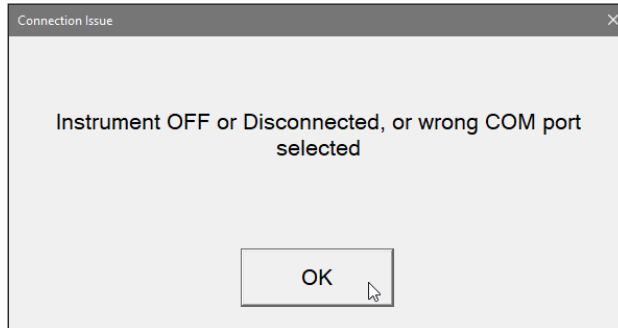


Figure 8.2: No Connection message

## 8.1 Logging Screen Layout in Monitoring Mode

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The RTmap61MK2 Monitor mode allows initial inspection of the range of the instrument readings at the particular site, monitoring the instrument performance, gain setting, monitoring number of available GPS satellites, GPS differential corrections, PDOP parameter status, and GPS coordinates (geodetic or UTM). Speed bar located at the bottom of the screen shows current instrument speed (over the ground) which is calculated from GPS data.

The EM61-MK2 readings in Monitoring and Stand By modes are updated approximately 10 times per second during monitoring session. GPS positions are updated at a rate specified in GPS receiver, usually 1 second interval.

If GPS receiver streams data faster than at 1 Hz the RTmap61MK2 program will process and update display at 1 Hz in real time. However all GPS positions will be written to the data file and will be used later to position data in data processing program. Despite the fact that program will handle more than 1 Hz GPS update it is strongly recommended that GPS receiver is set to 1 Hz update, faster data stream may affect program performance especially when high rate of EM61-MK2 is used. The data processing program RTM61MK2 interpolates EM61-MK2 position similarly to real time GPS interpolation.

## Mapping Mode

When the GPS Input is Enabled in GPS Port Setup menu then the program displays the screen in Navigation mode by default. The RTmap61MK2 Logging screen in Monitoring mode and Mapping display mode is shown below (Figure 8.3).

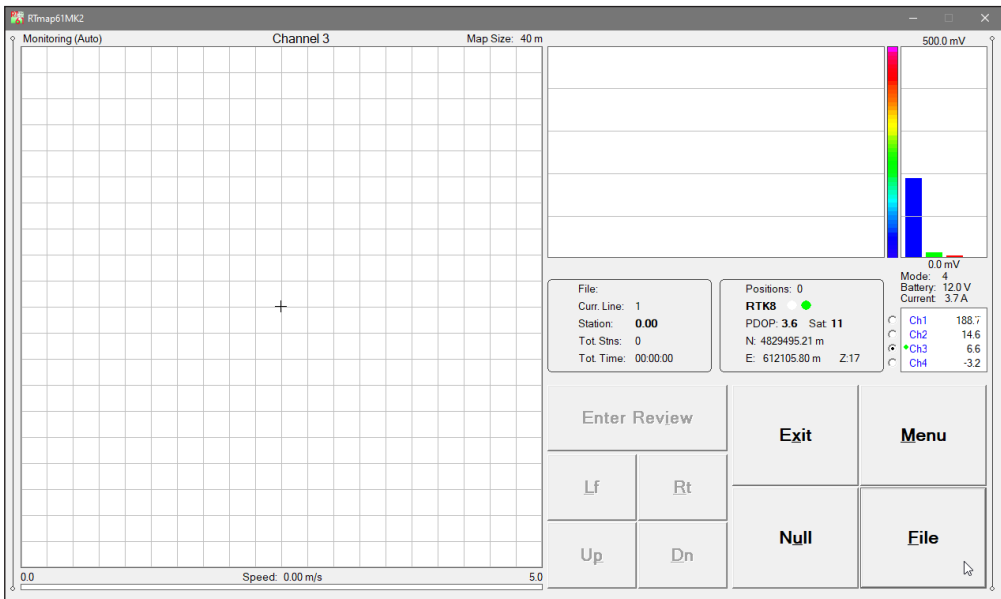


Figure 8.3: Logging screen in Monitoring (Mapping) mode

The left portion of the screen is occupied by the square plot area, a map, which presents current location of the system (based on GPS antenna position) in graphic form. This plot area will display all recorded positions during data recording. The side of the square corresponds to map size which is displayed at the top line of the screen, above the plot area. The size can be given in meters or feet depending on Units selection in the Map Options Setup dialog. Figure 8.3 shows map area that represents square 40 x 40 m. A cross mark indicating current position of the GPS antenna (or indicating position of the instrument if GPS offsets are zero) is always placed in the center of the map when logging session starts. After the operator will start moving the cross mark will move accordingly, however traces will not be plotted. Points indicating GPS stations are plotted only in Log mode when EM61-MK2 and GPS data are recorded in data file. The North points to the top of the screen.

A window displaying profiles (drawn only during data logging) is located on the right side of the map and left of graphic moving bars. There are two sections (text boxes) between map and numeric display window, below profile window. The left box displays parameters associated with data file, and the right one is associated with GPS parameters.

The Monitoring screen will display GPS related information in five lines in the right most text box below the speed bar.

The first parameter labeled Positions: indicates number of recorded positions in the data file. This number is increment only during data logging.

The second line displays label indicating actual corrections of GPS signal. 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. Other labels can be displayed: **RTK3** (Real Time Kinematic) when Quality Parameter is 3, and **RTK4**, **RTK5** (and so on for higher numbers associated with Quality parameter, for example 8 indicates WAAS correction in some receivers) for Quality parameters equal 4, 5 and above. On the right side of **DGPS**, **AGPS**, or **RTK** label two small circles are displayed. A colour of these circles should alternate between white and green with the frequency of GPS update rate (usually 1 second intervals), Figures 8.3 and 8.4. When GPS Warning Mask conditions are not met then circles will be displayed in red and white colours. If the circle is displayed in one colour for long periods of time it means that the GPS system is not working or that it is not connected to the field computer.

The next label **PDOP** with a value varying between 0 and 99.9 represents an index called Position Dilution of Precision (PDOP). The PDOP is given when NMEA data messages GGA/GSA, GGK or POS were selected. If only message GGA is available, then index HDOP (labeled **HDOP**) will be displayed, and when LLK message was selected parameter GDOP (labeled **GDOP**) is displayed. The LLQ message will provide precision of positioning in meters and it is labeled by **X**. Refer to section 6 (Set Port for GPS), Appendix A, and to GPS manuals for more information about GPS parameters.

The label **Sat** and following number shows number of currently tracked satellites.

Coordinates are displayed in two bottom lines. Coordinates are always given in GPS native datum WGS1984 and they can be represented as geodetic (Latitude (N) and Longitude (W), values are given in degrees, minutes, and seconds with four decimal places), or UTM coordinates with units specified in the System Setup dialog.

The remaining portion of the monitoring screen display available options and parameters associated with the EM61-MK2 output. The EM61-MK2 output is represented by a small grid windows that includes four moving vertical bars. The first (left) bar represents Channel 1, the second Channel 2, the third Channel 3, and the last (right) bar represents Channel 4 (or T) readings. Range of readings displayed in this grid can be adjusted (option Scale Readings), grid window with moving bars is labeled at the top and bottom (same range is applied for profile window that is not labeled). The scale for graphic bars

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 grey line. This type of graphic presentation allows the operator for very easy and quick monitoring the response of the connected instrument.

Readings for all channels are shown in numeric form in a window located below the grid with moving bars area. Data for Channels are labeled **1**, **2**, **3**, and **4** or **T** correspondingly. A small green dot at one of channel labels (as well as checked radio button) indicates the EM61-MK2 channel selected for colour scale in Mapping mode (option Colour Channel in Map Options dialog, see chapter 7). Units of readings are not labeled, they are given in mV. Fiducial marker is represented by label **M**. Label **M** is displayed only when the marker is actually pressed by the operator.

Three additional instrument parameters are shown above the numeric display window. These are: current instrument mode (Mode 4 or D), instrument battery in Volts and TX current in Amperers.

Several other parameters are shown on the right side of map plot area. Label **Monitor** indicates Monitoring mode. Labels **Stand By** and **Logging** will be displayed for Stand By and Log modes respectively. Labels in two left text boxes File (data file name), **Curr. Line** (line name), **Station** (current station) and corresponding parameters are not used in Monitoring mode.

Seven command buttons labeled Panning (or Map Navigation if Review button is pressed) can be used to shift displayed map in four directions, as well as Zoom In (**Zm+**), Zoom Out (**Zm-**), and displaying all data points (**FitAll**). These buttons are not enabled in Monitoring mode.

Four command buttons (on the right side of the grid containing moving bars) provide access to options available in Monitoring mode. These options are described below in the section 8.2.

## Navigation Mode

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The RTmap61MK2 Monitoring screen in Navigation mode is almost identical to the described above Mapping mode. Main difference is that when no colour imaging is specified in the Map Display Options dialog the RTmap61MK2 screen in Navigation mode will not show colour bar for readings, and there will be no indication provided by radio buttons (left to numeric window) in numeric display window, and there is no label indicating active channel in the center above the map window. Positions of recorded readings will be indicated by dots or monochromatic swath bar during Logging mode.

All other parameters and functions are same as described above in the Mapping Mode section (see Figure 8.4).

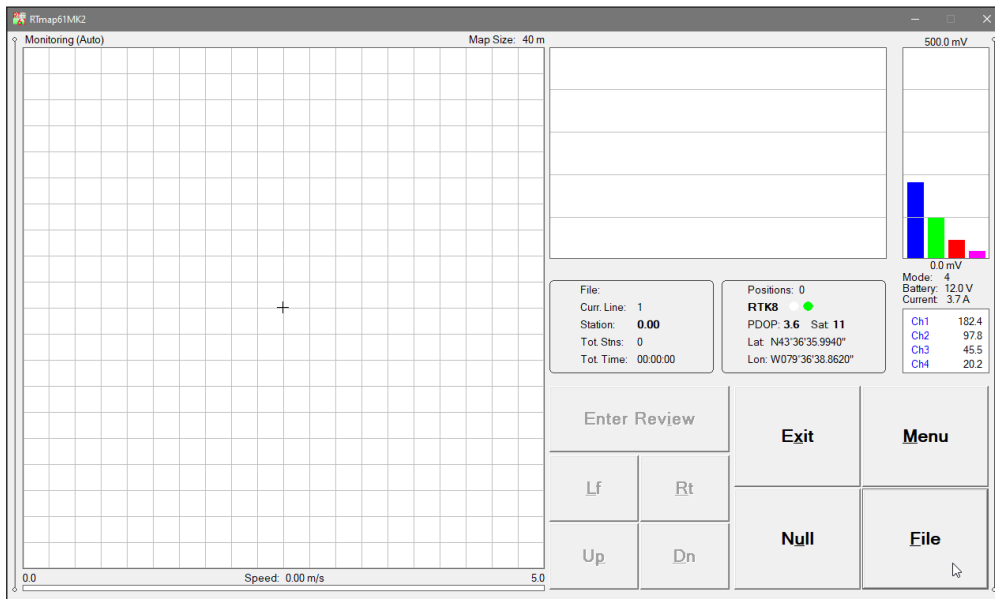


Figure 8.4: Logging screen in Monitoring (Navigation) mode

## Profile Mode

When the GPS Input is Disabled in GPS Port Setup dialog then the program displays the screen in Profile mode. The same mode is displayed when GPS was Enabled and the operator used Toggle option to display program in Profile mode. The RTmap61MK2 Logging screen in Monitoring mode and Profile display mode is shown below (Figure 8.5).

The logging screen is essentially the same as described in Mapping Mode profile (section above). The main difference is that the map is not displayed and profile plot area occupies most of the display. This area will contain profile curves for each recorded and selected (in Profile Options window) EM61-MK2 channels in graphic form. Scale is labeled at the top and bottom of the moving graphic bars window. Two text boxes are located on the left, below the profile view window. Four command buttons are placed along the display bottom and panning and the Review buttons are not shown.

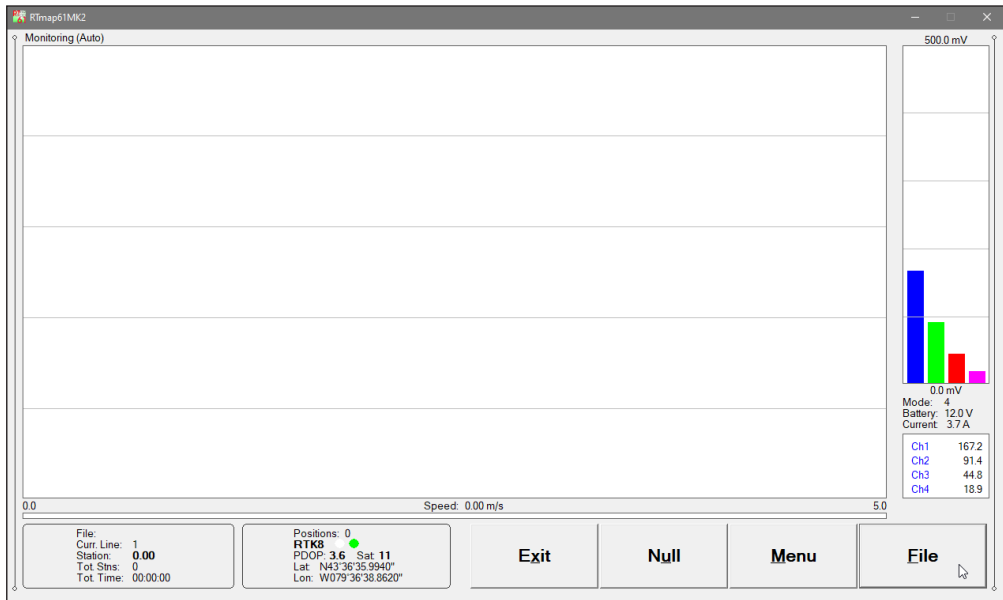


Figure 8.5: Logging screen in Monitoring (Profile) mode

## 8.2 Options Available in Monitoring Mode

Several options are available while the Logging window is in the Monitoring mode. Four frequently used options can be accessed directly from command buttons and others can be used from pop up menu activated by the button **Menu** (displayed in Figure 8.6). There are also four buttons associated with panning the map (Lf - shift Left, Rt - shift Right, etc.) and one button labeled Review that sets the program in Review mode. Command buttons can be used by clicking on the desired button, or from the keyboard by pressing one of the shortcut keys (underlined characters on button labels) or by navigating using **<TAB>** key (sets button as a default button - default button is highlighted) and pressing **<ENTER>** key.

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 **u** will start Nulling procedure. While menu is displayed options can be selected by tapping on the appropriate item, or from the keyboard by pressing the shortcut keys or by navigating using **<Up>** and **<Down>** arrow keys and executing by **<ENTER>**.

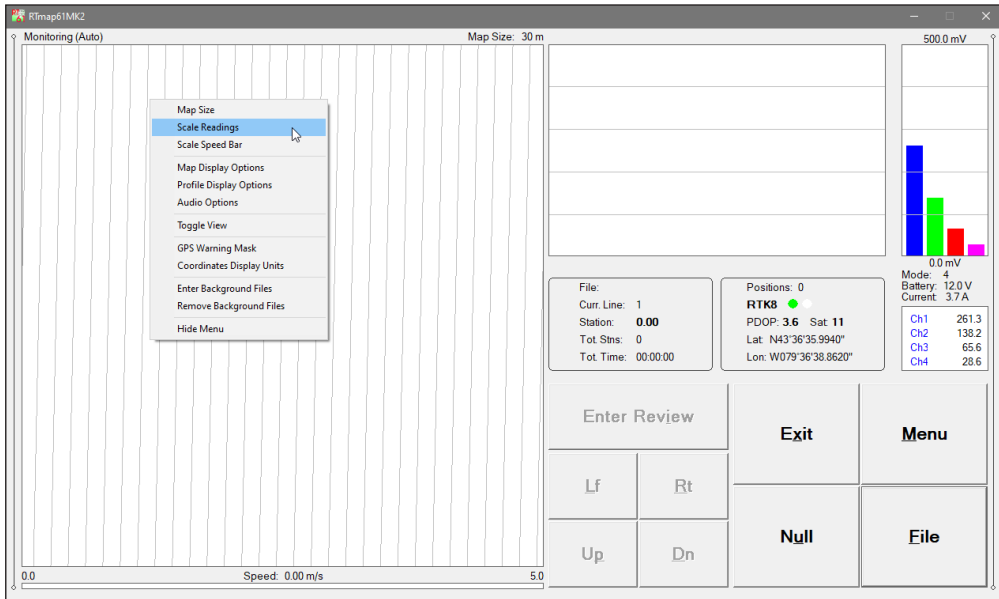


Figure 8.6: Logging screen in Monitoring mode with displayed pop up menu

**File** (create new and append to existing data file)

The RTmap61MK2 data file can be created in any folder. 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 underscore followed by sequential three digits number (001, 002 and so on). (If all 1000 names during one hour are used specify any other name). The extension name of RTmap61MK2 data file is T61. The Create Data File dialog is presented in Figure 8.7.

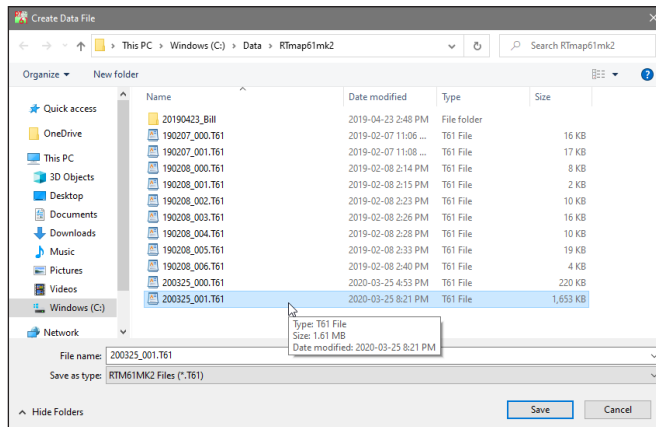


Figure 8.7: Create Data File dialog

The file name can be specified in the Create Data File dialog using the Windows standard interface procedure.

The RTmap61MK2 data files can be appended (data files created with Version 2.00 or later) and after message informing about number of GPS positions already collected in the file (Figure 8.8) the previous data set will be plotted on the map (Figure 8.9). All data collected will be appended to the existing data set. The program run in Profile mode will not display the last survey line profile since the program assumes that a new survey line is to be surveyed (see New Line option). Maximum number of all positions in one data file cannot exceed 28,800 GPS positions and number of EM61-MK2 readings is unlimited.

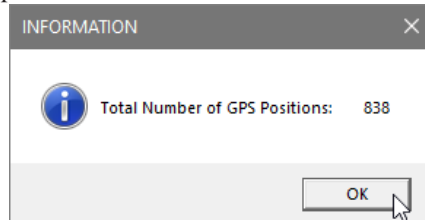


Figure 8.8: Number of GPS positions in the selected data file

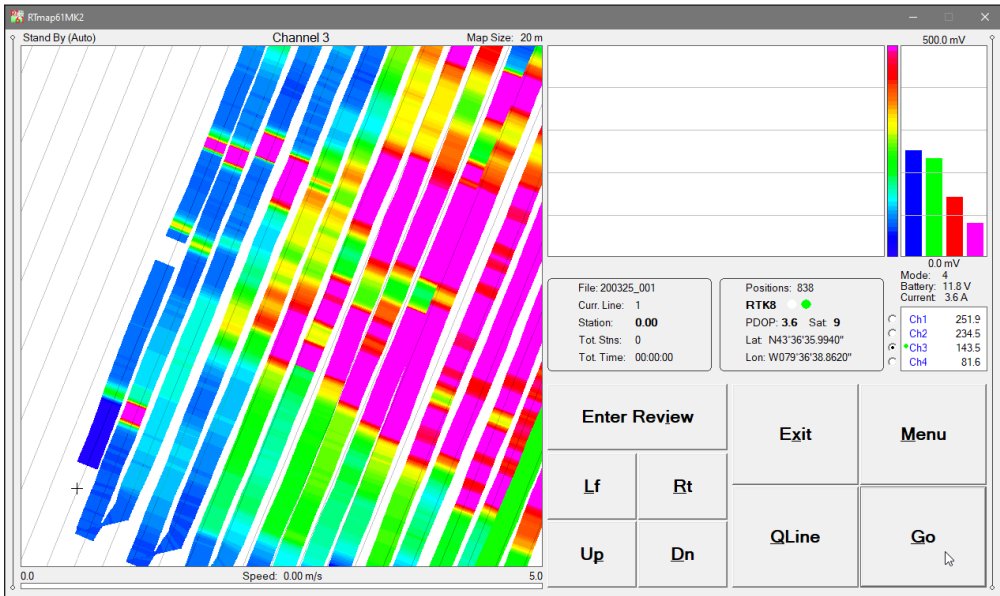


Figure 8.9: Logging display after existing file is selected for append

Each data file in the field computer created by RTmap61MK2 has an extension name T61 (unless it is GXY file created when EM61-MK2 was Disabled in the System Setup window). All T61 data files are created in the RTmap61MK2

binary format. They can be processed and exported to XYZ file format using the RTM61MK2 program. These files can be also exported to ASCII format, or to Geonics DAT61MK2 (M61) format and processed in the Geonics program DAT61MK2.

When a data file is created the program will switch to Stand By mode automatically (see section 8.3).

### **Null** (Nulling)

To perform null of the instrument tap on the command button labeled **Null** or use keyboard shortcut by pressing key **U** (or **u**) key. At this moment the program takes 50 readings and calculates offsets for each channel of the connected EM61-MK2, Figure 8.10.

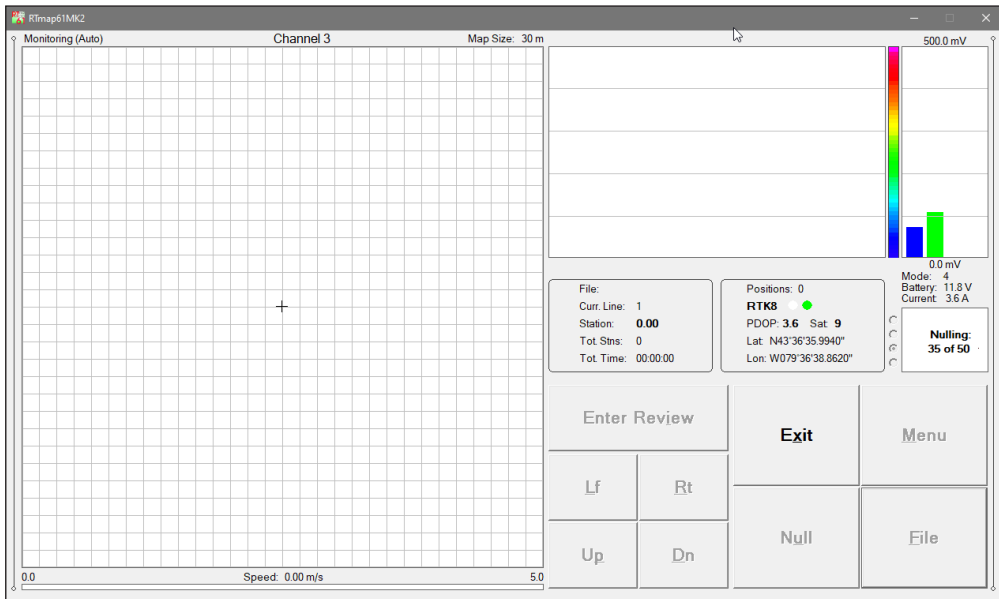


Figure 8.10: Monitoring screen during nulling

Calculated offsets are 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 EM61-MK2 readings are needed, exit the RTmap61MK2 program and run it again. The EM61-MK2 instrument does not have to be turned OFF.

## Exit

The program immediately returns to Main Screen.

## Menu

The program will display pop up menu (Figure 8.6 above). Options available in menu are described below. These options can be executed directly from the keyboard (without displaying menu) by pressing a shortcut key.

### Map Size (Adjust scale of map)

This option is available by clicking on (or selecting by arrow keys) the pop up menu item labeled **Map Size** or directly from keyboard by using shortcut key S. The Map Scale dialog will appear on the screen, Figure 8.11.

This dialog allows the operator to enter new scale for the map displayed by the plot area, map grid interval, and cursor band.

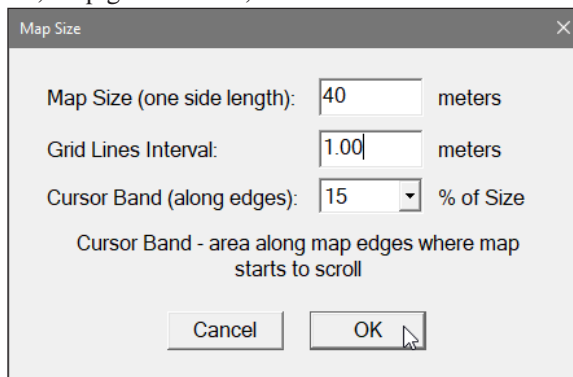


Figure 8.11: Map Scale dialog

Map scale value is entered either in meters or feet according to selected units in Logger Setup dialog and it represents side of the square map. Only positive integer values ranging between 1 and 99999 are allowed by the program.

The second parameter in the Map Size dialog is Grid Interval. These are grey grid lines in Mapping (and Navigation) mode which may be helpful in estimation of distance on the map displayed in Mapping mode. If Parallel Lines (with optional tilt angle) was selected in the Map Display Options dialog then the label for this option will be Line Interval and the entered value will be applied to distance between parallel lines (regardless of specified tilt angle). Setting Grid Interval to zero will not plot any grid lines on the screen.

The third parameter in the dialog is named Cursor Band. This parameter describes an inner band around the map perimeter that is always displayed. In other words, when cursor approaches and enters band area the map is scrolled. The band width is described by percentage of Map Scale. Six selections are available in the combo box labeled Cursor Band: ranging from 10% to 40%.

After parameters are specified click on the button **OK** or press **ENTER** key to accept new values and the map will be redrawn at a specified scale. To ignore an entry and return to Monitor mode click the button **Cancel** ( or X) or press **Esc** key, and the dialog window will disappear.

This option is available also in Stand By mode.

The map size and grid/line interval can be also set in the Map Display Options dialog by clicking on the corresponding item in the pop up menu.

### Scale Readings

This option is available by clicking on (selecting by arrow keys) the pop up menu item labeled **Readings Scale** or directly from keyboard by using shortcut key **R**. The Readings Scale dialog will appear on the screen, Figure 8.12.

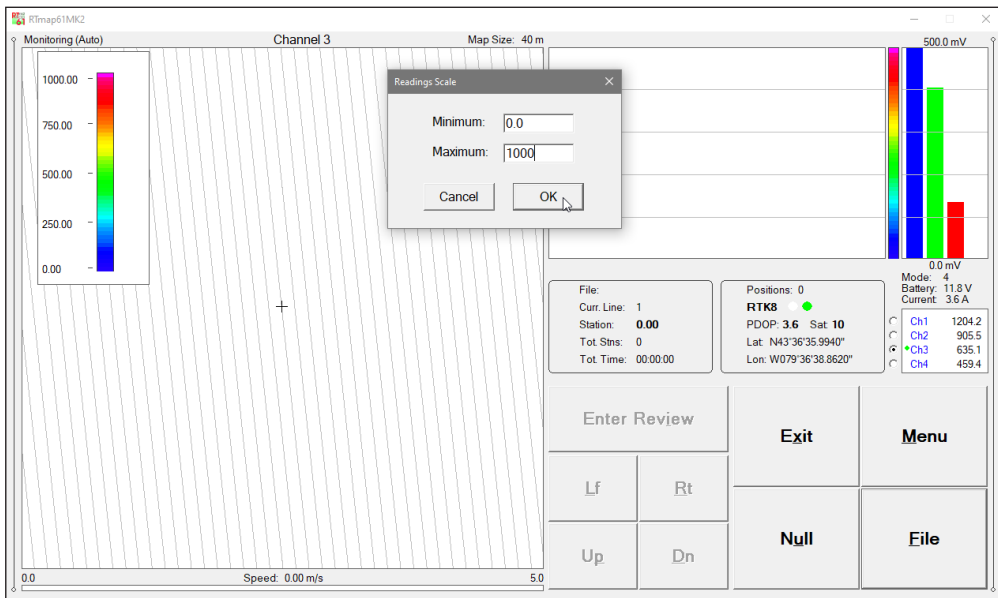


Figure 8.12: Reading Scale dialog with associated color bar

Two edit boxes labeled **Minimum** and **Maximum** allow you to set the amplitude range. Minimum and maximum values are specified for a pseudo-grid image in Mapping mode for the selected EM61-MK2 channel, the plot range of all EM61-MK2 channels in the window containing four moving bars as well as for the profile plot display. Therefore range of displayed data is the same for the Mapping mode, the profile display area and for the grid area with vertical bars. However only profile moving bars window is labeled at its top and bottom (Figure 8.12). In case where minimum or maximum values are wrong, the program will assume minimum scale (0 to 10).

A colour bar representing colour distribution for mapping mode is provided on the left side of the screen. The colour bar is updated whenever Minimum or Maximum Response values are changed.

After the file is specified click on the button **OK** or press **ENTER** key to accept new values or cancel selection and by clicking on the **Cancel (X)** button.

### Scale Speed Bar

This option is available by clicking on (selecting by arrow keys) the pop up menu item labeled **Scale Speed Bar** or directly from keyboard by using shortcut key **B**. The Speed Bar Scale dialog will appear on the screen, Figure 8.13.

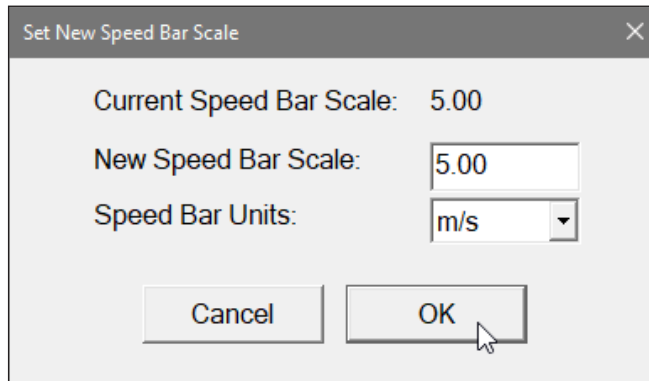


Figure 8.13: Set New Speed Bar Scale dialog

The minimum value for the Speed Bar is preset to 0, therefore this scale requires only entry for the maximum speed. The entered scale applies only to graphic representation of the speed (graphic bar), speed in numeric form is always displayed above the bar, even if the real value exceeded maximum specified for the speed bar. Speed units can be selected in the combo box labeled Speed Bar Units.

After the maximum value for the speed bar is specified tap the button **OK** or press **ENTER** key to accept new values and the display will be redrawn. To cancel selection tap the **Cancel (X)** button or press **Esc** key.

### Map Display Options (Mapping and Navigation modes)

The Map Display Options dialog (Figure 8.14) is identical to a dialog described in detail in Chapter 7. If the program is in the Mapping or Navigation mode, please refer to section 7.1 of the manual.

This option can be accessed from pop up menu or directly by the keyboard by pressing **D** key.

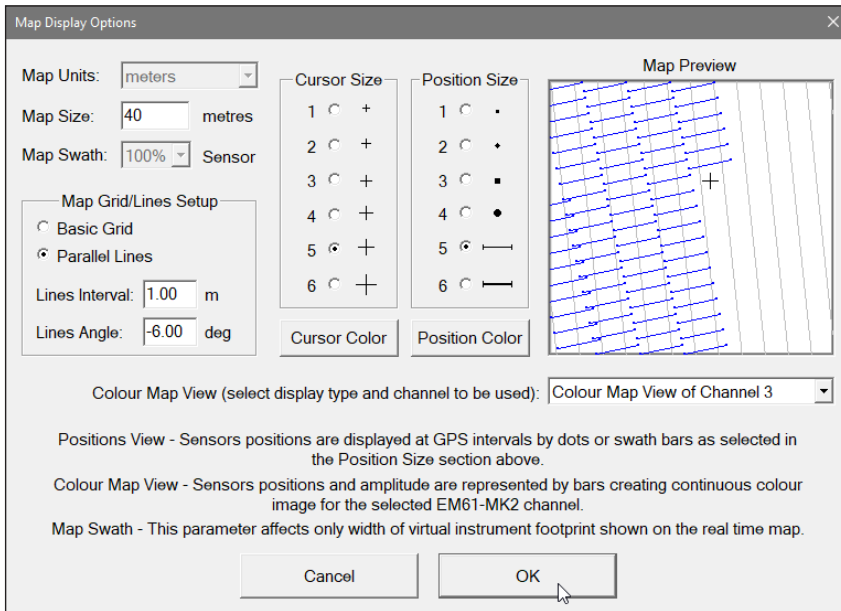


Figure 8.14: Map Display Options dialog

### Display Options (Profile display options)

The Setup Display Options dialog is described in detail in Chapter 7. This dialog allows you to specify color and thickness of profiles (same colours apply to moving bars), and to select Amplitude type: Linear or Compressed. The dialog is presented in Figure 8.15.

To select any option click on the corresponding drop-down list box or check box, or use TAB key to scroll to the option and then use mouse or keyboard to select parameter.

After all the parameters in the Display Setup dialog are updated click on the button **OK** or press **ENTER** key (assuming it is highlighted) to accept the displayed settings. The dialog will disappear and the program will return to the Monitoring mode window. Updated settings will be written to the configuration file and they will be given as default parameters in the subsequent program executions.

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

### Audio Options

This dialog allows to enable and disable three audio functions. Two of these options can be specified in the System Setup dialog (see chapter 4), and the one

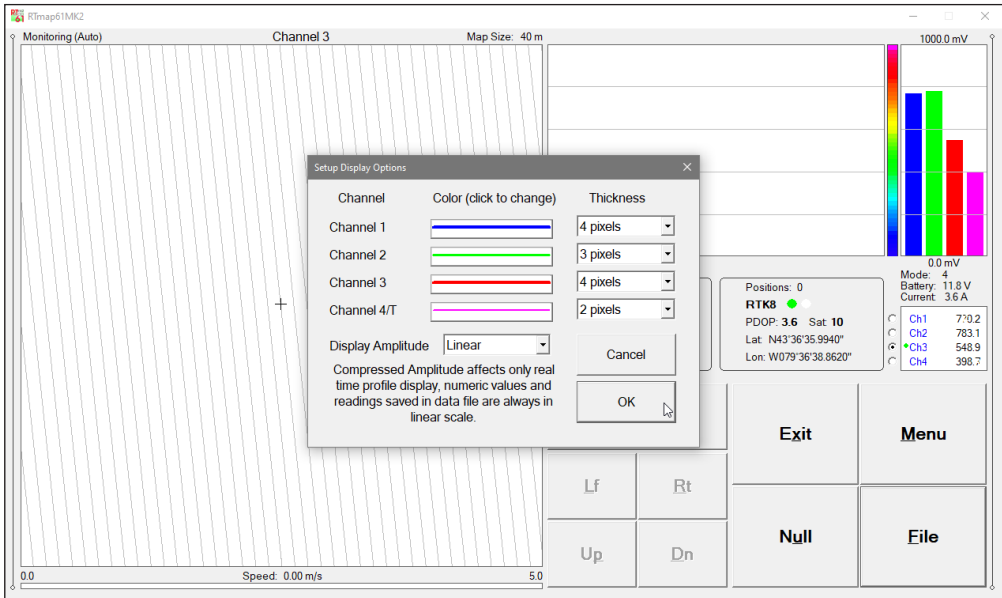


Figure 8.15: Setup Display Options dialog

associated with GPS Warning Mask can be set in GPS Port Setup dialog (see chapter 6). The Audio Options dialog is presented below in Figure 8.16. Parameters in Audio Options dialog are described below.

### Audio Tiks During Data Collection

The program will provide tik sound during data recording (in the Logging mode only). The tik sounds with frequency of approximately 3 Hz. This audio feature may be helpful as an additional confirmation that the button Go has been pressed (or tapped) and data is being collected

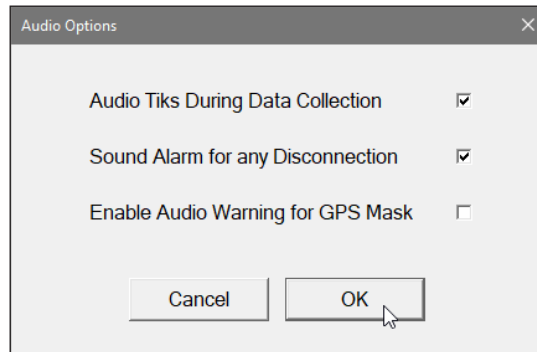


Figure 8.16: Audio Options dialog

and saved in data file. This audio function can be enabled or disabled by check button located at the label naming this option.

### **Sound Alarm for any Disconnection**

The program will sound loud ring when a disconnection in any serial port is detected by the program, or in case any EM61-MK2 console or GPS receiver will stop streaming data for any reason. The audio alarm function does not depend on the visual alarm that is always enabled regardless of audio alarm setting. The audio alarm function can be enabled or disabled by check button at the Sound Alarm for any Disconnection label as shown in Figure 8.16.

### **Enable Audio Warning for GPS Mask**

When this option is enabled then in addition to visual warning (alternating red and white circles) an audio warning will sound (it is more gentle "bell" sound than loud audio alarm ring associated with disconnection of any sensor).

### **Toggle View** (toggle between Mapping and Profile modes)

Selecting this item from pop up menu or simply pressing the key **T** will switch Monitoring or Stand By screens between Profile and Mapping (or Navigation) modes. Changing the display from Profile to Mapping mode (when data were collected) may take few seconds (depending on number of positions displayed and map scale). The program will display message **WAIT** till all positions are plotted in current map area and it will beep at the end of this process.

### **GPS Warning Mask**

This option is available by clicking on (selecting by arrow keys) the pop up menu item labeled **GPS Warning Mask** or directly from keyboard by using shortcut key **W**. The GPS Warning Mask Scale dialog will appear on the screen. This dialog allows to set or change GPS Warning Mask parameters during logging session. The same parameters can be set in GPS Port Setup dialog (see chapter 6). The GPS Warning Mask dialog is presented below in Figure 8.17. Parameters in GPS Warning Mask are described below.

### **Warning**

Clicking 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 by navigating with Tab key and then by using Up or Down arrow keys select one of the available items: Enabled and Disabled. This option allows you to Enable/Disable a GPS Warning Mask that contains three parameters: Quality Indicator (degree of differential corrections), Dilution Parameter (PDOP or other label depending on the selected NMEA message), and number of available satellites.

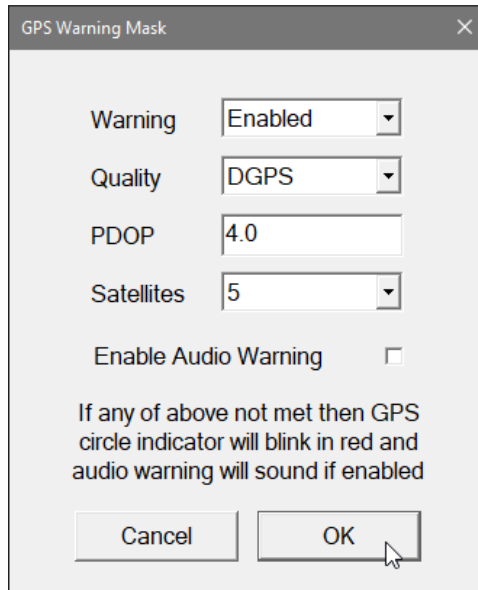


Figure 8.17: GPS Warning Mask dialog

When Enabled is chosen GPS two circle indicator will be alternating in green and white if conditions for specified parameters setting will be met. When any of the parameters is below set values then GPS indicators will alternate in red and white colours. In case Warning parameter is disabled then GPS indicator will be displayed in green and white colours (Figure 8.15) regardless of GPS signal quality. All GPS data is logged, GPS Warning Mask affects only display.

### Quality

This parameter describes Quality Indicator (degree of differential corrections). Clicking 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 by navigating with Tab key and then by using Up or Down arrow keys select one of the available items: AGPS (Raw), DGPS, RTK3, RTK4, RTK5, and so on.

If Quality Indicator received from GPS receiver will be worse than specified then GPS indicator will alternate in red and white colours.

### PDOP

This parameter can be labeled PDOP, HDOP, DOPG, DOP depending on the selected NMEA message. It can be also named Quality m (accuracy in meters) if LLQ was selected, or it is not available (labeled N/A) when messages GLL or any RTS (including pseudo-GGA) are used.

Activate text box by Clicking or using TAB key and then enter the chosen acceptable maximum value of Dilution parameter.

If PDOP (or other similar parameter) is larger than specified value then GPS indicator will alternate in red and white colours.

### Satellites

Clicking 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 by navigating with Tab key and then by using Up or Down arrow keys select one of the available items: 3 to 12.

If number of available satellites will be smaller than specified then GPS indicator will alternate in red and white colours.

After all the parameters in the GPS Warning Mask dialog are updated click on the button **OK** or press **ENTER** key to accept the displayed settings. Updated settings will be written to the initial file and they will be given as default parameters in the subsequent GPS Warning Mask and GPS Port Setup dialogs.

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

### Coordinates Display Units

The Set Coordinates Display Units dialog will be displayed, Figure 8.18. There are four items after the combo box labeled Coordinates unit will be expanded:

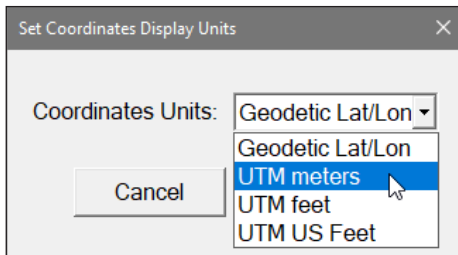


Figure 8.18: Set Coordinates Display Units

Geodetic Lat/Lon (coordinates in Degrees, Minutes, Seconds), UTM meters, UTM feet (International Feet), and UTM US Feet (US Survey Feet). Select one of items and coordinates of the GPS antenna will be displayed in the GPS section (bottom of the logging screen) in selected units.

Select the OK button to accept selection or the Cancel button to exit dialog.

## Enter Background File

The Load Background File dialog is shown in Figure 8.19. The program will display contents of entered files in the background of the map. Two types of

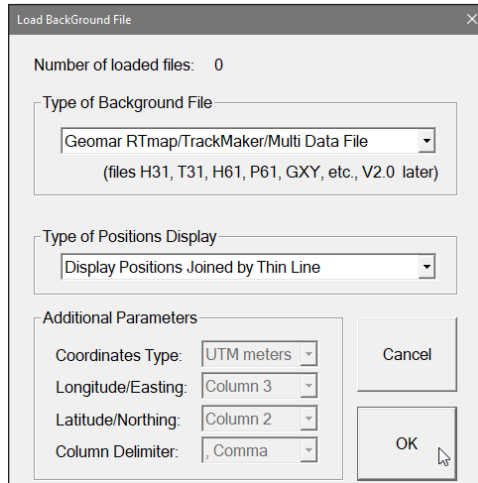


Figure 8.19: Load Background File dialog

files can be entered: any data file created with Geomar programs (RTmap, TrackMaker, or Multi - all V2.00 or later) or user prepared column delimited text file (TXT format) containing coordinates representing site boundary, or any other feature, Figure 8.20. If Geomar data file is entered its content will be displayed as traces of collected survey lines. This option can be used to follow

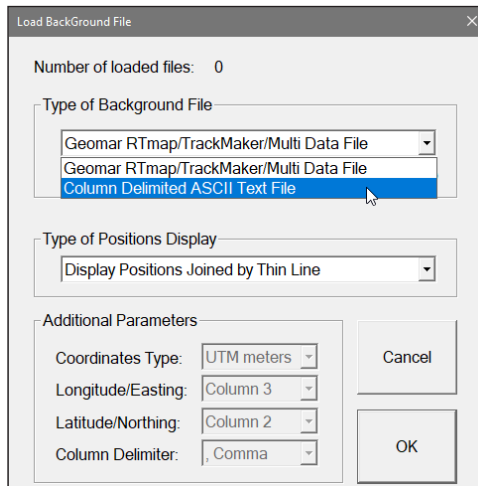


Figure 8.20: Load Background File dialog

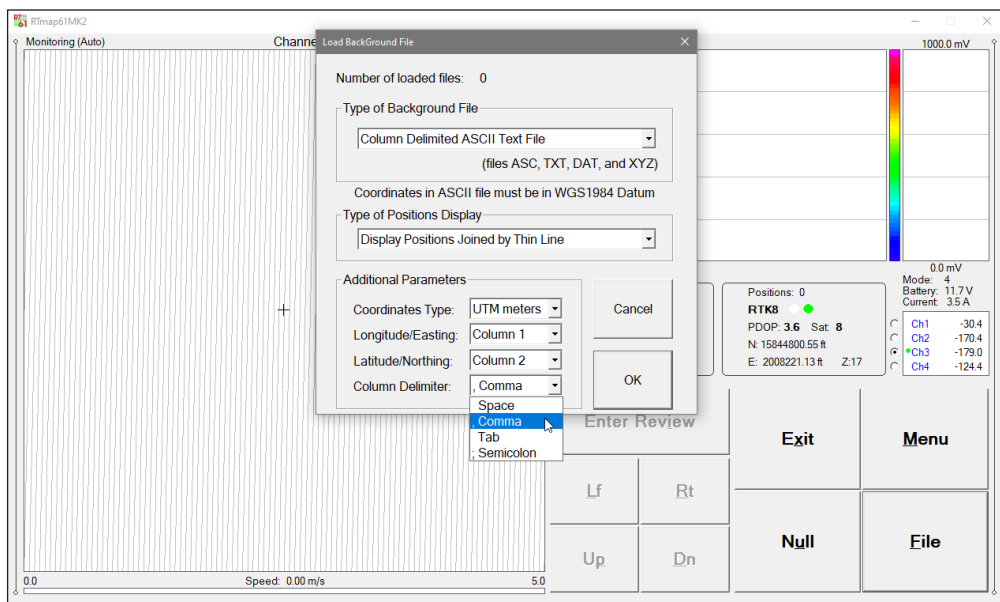


Figure 8.21: Selecting Column Delimiter in Column Delimited File to be loaded.

measurements with another instrument, to display already performed coverage, or to repeat part of the survey. User prepared Column Delimited ASCII Text File can be used to display a site outline, delineated area of special interest to be surveyed with finer line spacing etc. The latter file must contain coordinates in WGS 1984 datum. Geomar data files are in WGS 1984 datum by default. Up to 10 files (mixture of either type) can be entered and displayed.

Type of Positions Display describes how positions are displayed, they can be plotted as separate points, or lines joined by thin, medium, or thick lines depending on the selection in the corresponding combo box. Lines can have breaks if a tag "Break" (lower or upper case) is inserted in the file. Sample of Column Delimited file is shown in Appendix A.

When a Column Delimited file is selected a section labeled Additional Parameters is activated as shown in Figure 8.21. Parameters describing file structure must be specified, these are: Coordinates Type (Geodetic, UTM meters, feet, or US Survey Fee), column numbers for Longitude and Latitude or Easting and Northing, and finally Column Delimiter (Space, Comma, Tab, or Semicolon). For practical simplicity, if UTM coordinates are used it is assumed that the operator is located within the same UTM zone.

Type of the file and all parameters must be specified prior to selecting file name, therefore it is necessary to know structure of background files that are to be loaded. After the OK button is clicked on or tapped an Open File dialog will appear, Figure 8.22.

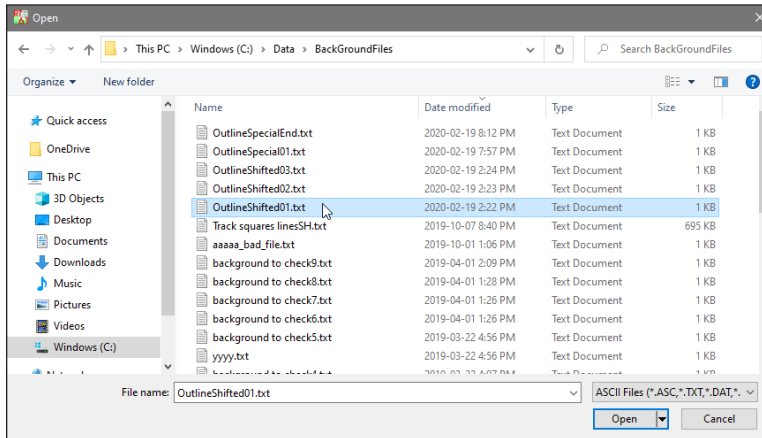


Figure 8.22: Selecting Background File

After file is opened in above dialog program will draw it immediately in the map window and another file can be entered if needed.

The RTmap61MK2 screen with two background files (both Column Delimited type) is shown in Figure 8.23.

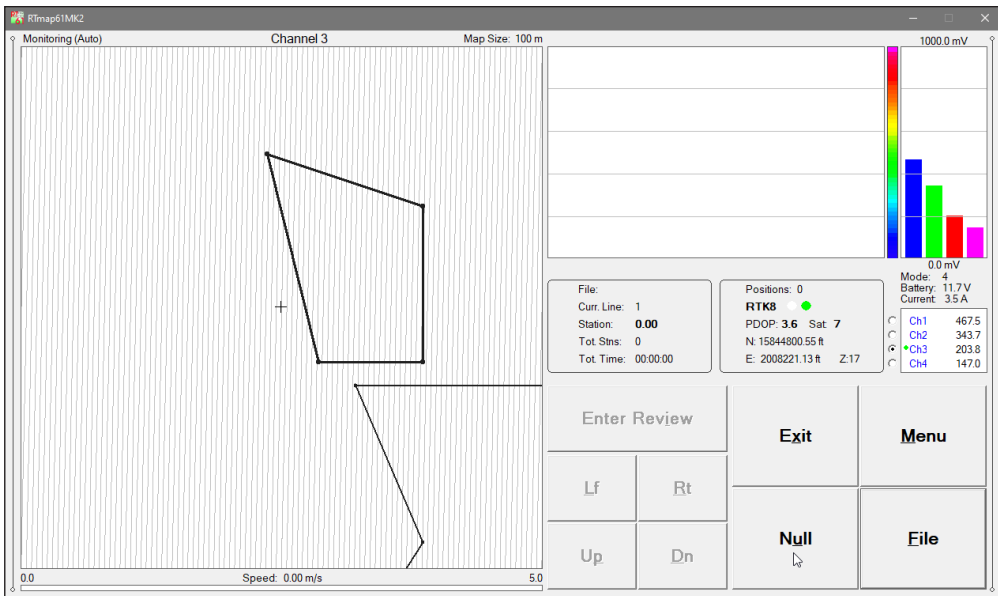


Figure 8.23: Two background files displayed in RTmap61MK2 Monitoring mode

Please note that background files are displayed using real coordinates. Program registers its position as soon as the first GPS position is detected (it is cross cursor displayed in the center of the map). It is the reason that background files cannot be entered prior to the first GPS position obtained by the program. Therefore, loaded background files can be displayed only if operator is in the same area and map size covers coordinates in data file or Column Delimited file. If the entered file is not displayed then it may be visible after changing map to larger size.

### Remove Background Files

After this option is executed the Remove Background Files dialog appears, Figure 8.24. It contains list of loaded background Files. Click on any check box located on the left of corresponding file name and when the OK button is clicked on or tapped the map will be re-drawn and checked files will be removed from the program map. Click on the Select All button and then OK button to remove all entered files at once.

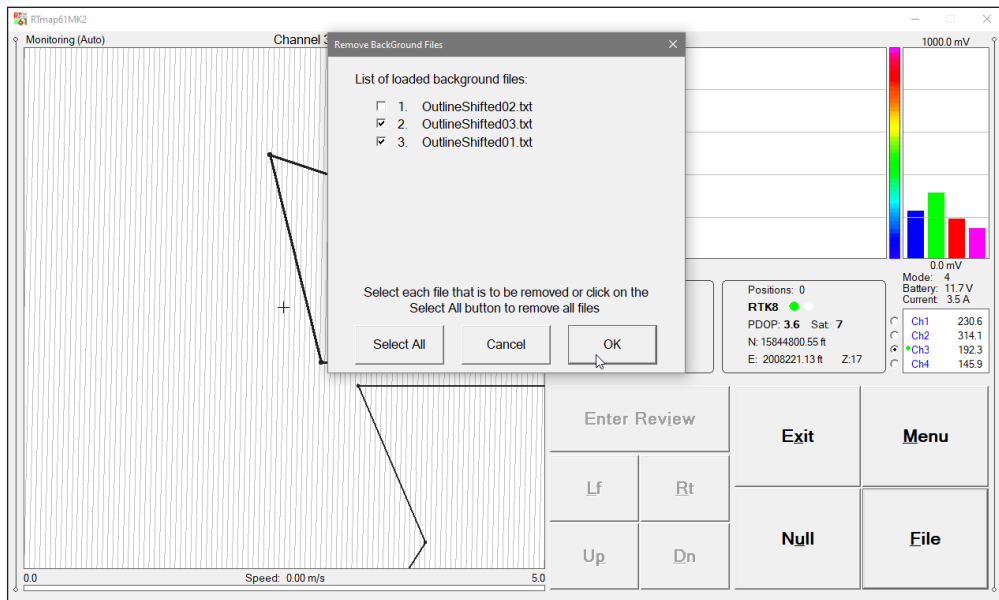


Figure 8.24: Remove Background Files dialog

## 8.3 Stand By Mode

The main difference between the Monitoring and Stand By modes is that from the Stand By mode the program can be directly switched to Log mode to record the data in the data file. The RTmap61MK2 screen in Stand By mode and Mapping mode is shown in Figure 8.25, and Figures 8.26 and 8.27 present Navigation mode (with swath bars and dots). The layout of the screen is almost identical to the layout described in section 8.1. Main differences are: label **Stand By (Auto)**, reminding the operator about current logging mode and survey mode (in this case Auto), different command buttons, contents of two text frame boxes at the bottom of the profile window which display parameters specific to survey settings. The first frame box includes parameters related to file contents: File Name, Current Line Name, Station (current station number), Tot. Stns (total number of stations in file), Tot. Time (total elapsed time of recording). The second frame box described in section 8.1, contains parameters associated with GPS input.

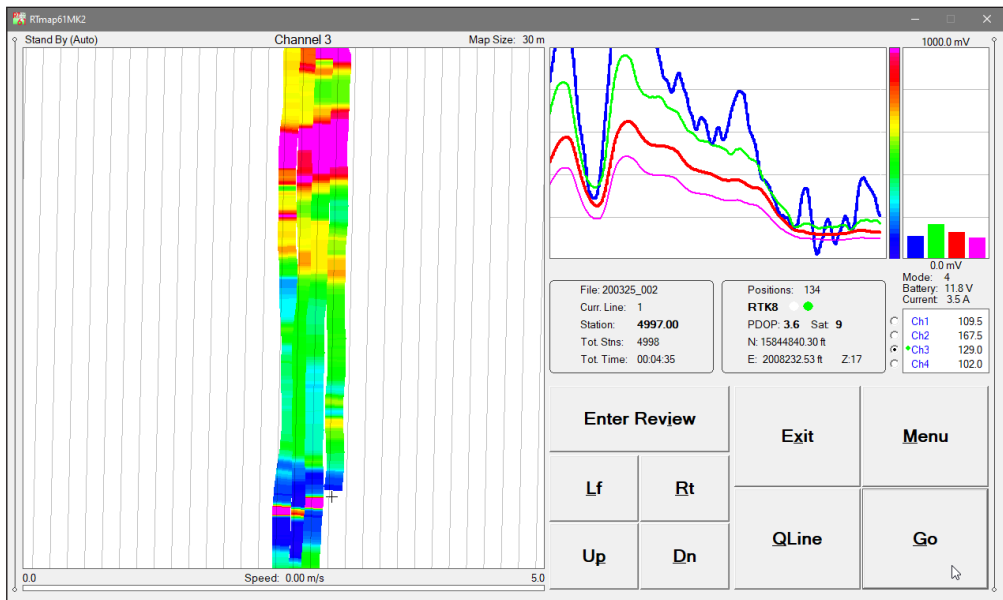


Figure 8.25: RTmap61MK2 in Stand By mode and Mapping display mode

Example shown in Figures 8.25 to 8.27 presents situation where the operator continues to walk in the N-S direction while logging data and then stopped logging data by switching from Log to Stand By mode. In the Stand By mode the cross mark which represents position of the operator (GPS antenna) will move if the operator will change his location, however points corresponding to GPS locations will not be plotted.

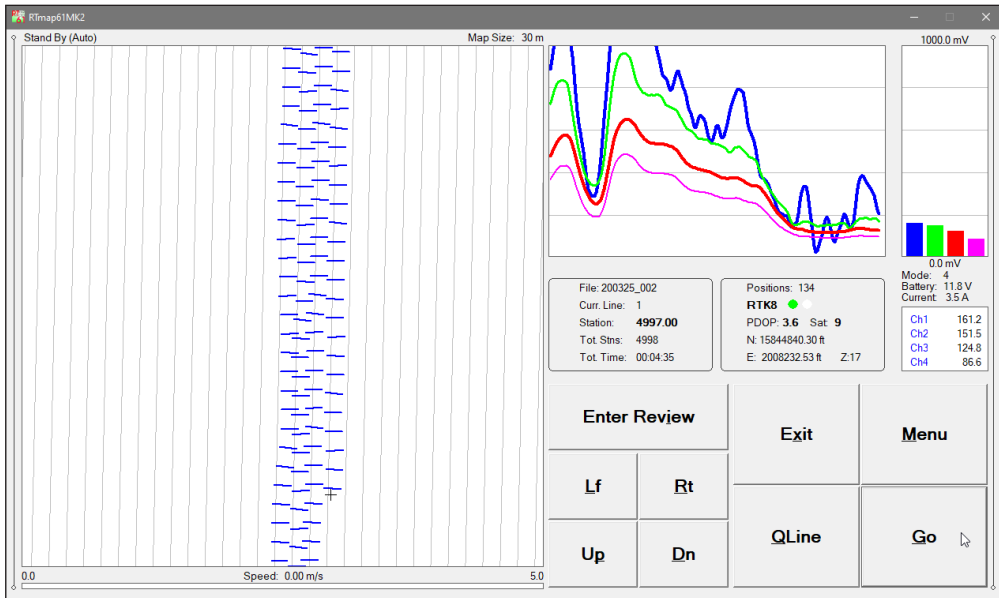


Figure 8.26: RTmap61MK2 in Stand By mode and Navigation display (swath bars)

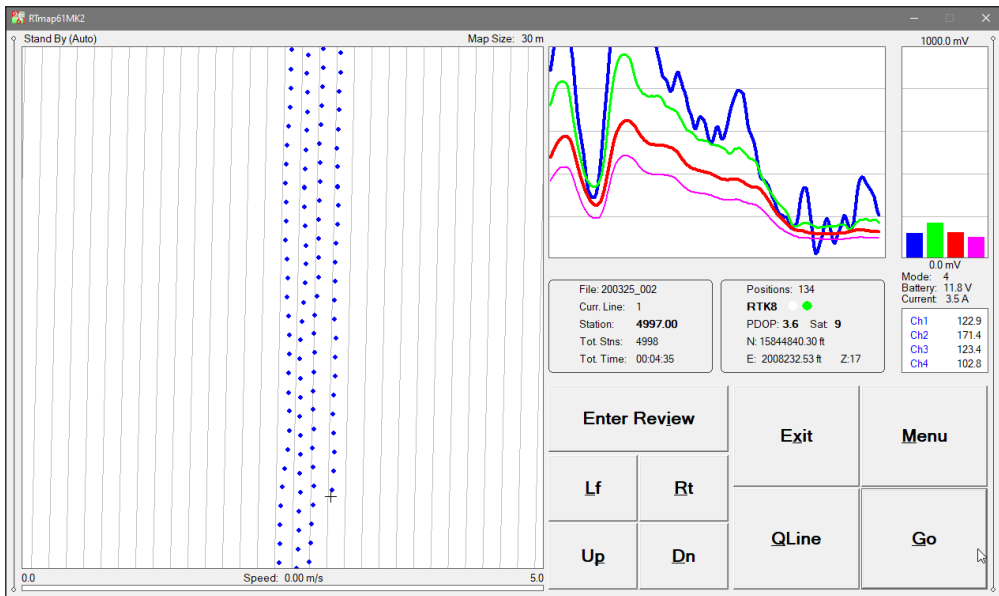


Figure 8.27: RTmap61MK2 in Stand By mode and Navigation display (dots)

In case the program is run in the Profile display mode, data recorded previously in Log mode will be shown as profiles in the plotting area, as shown in Figure 8.28. Similarly to Mapping mode where GPS locations are not plotted on the screen, data plotted in profile form will not be updated in Stand By mode.

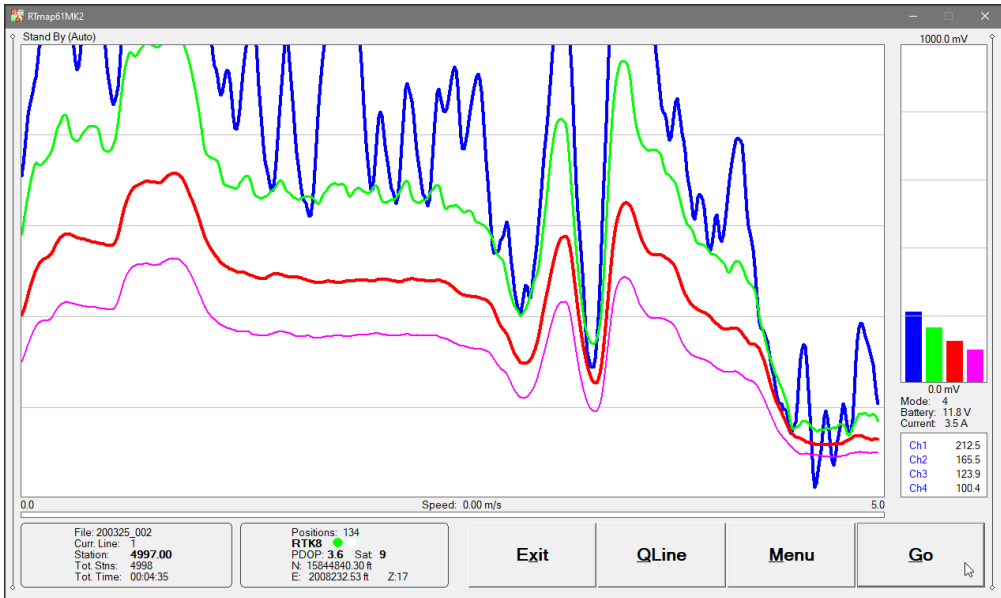


Figure 8.28: RTmap61MK2 in Stand By mode and Profile display mode

The EM61-MK2 data displayed in the window with moving graphic bars and by numeric values will be displayed with the update rate approximately 10 readings per second, however data will not be saved in the log file in Stand By mode. If GPS input was enabled, GPS positions and parameters will be updated with a rate specified in GPS receiver. GPS data are not saved in file in Stand By mode as well.

Four command buttons available in Stand By mode include: **GO** (executed by clicking or tapping, or pressing key **G** or **ENTER** if the button is highlighted) which directs the program to Logging mode and recording EM61-MK2 and GPS data, **QLine** (Quick Line), **Exit**, and **Menu** (which contains more options than pop up menu in Monitoring mode). All command buttons are enlarged as compared to previous program versions to provide easier operation for field computers equipped with touch screen displays. The **Exit** button was moved away from display corner to avoid accidental touch of this button.

Options associated with command buttons are described in detail in Section 8.5 (Field options available in Stand By mode).

## 8.4 Logging Mode

The Logging mode is enabled by clicking or tapping on the **GO** button or pressing the shortcut key **G** (or the **ENTER** key if the button **GO** is highlighted) in Stand By mode. After this button is executed the list of four buttons will be replaced by one large button labeled **Pause**, 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 Stand By mode options) are the same as in Stand By mode and they are described in the preceding section 8.2. The RTmap61MK2 screen in Logging mode and in Mapping display mode is presented in Figure 8.29. The cross mark corresponding to the system location will move while the operator is progressing along the survey line and recorded GPS positions will be plotted as colored image on the screen. At the same time profiles will be plotted in panels located right to the map plot area.

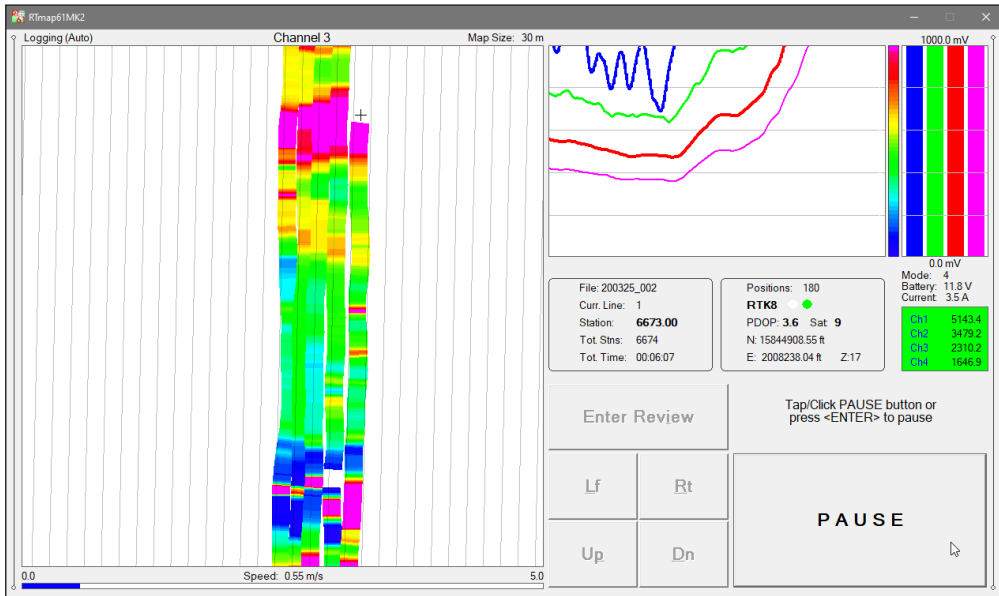


Figure 8.29: RTmap61MK2 in Logging mode and Mapping display mode

The Enter Review button as well as all four panning buttons Left, Right, Up, and Down are not accessible and they are disabled while program is in Logging mode.

If the program's display was toggled in Stand By mode to Profile display mode or if GPS was disabled in GPS Input menu the RTmap61MK2 Profile display mode will be used as shown in Figure 8.28.

Profiles are updated after each reading is written to the data file. The program displays profiles for readings with settings (profile line colour and thickness) selected in the Profile Display Options dialog.

After the screen changes from Stand By mode to Logging mode survey parameters are updated according to the station interval. Similarly, if GPS input was enabled, total number of GPS positions in the data file is increment every time (usually once a second) GPS position is written to the file. Profile plots, amplitude of graphic bars in plot area and readings displayed in numeric form for each instrument are updated after each reading is written to the data file. In addition, background of numeric values window changes to green. The green background serves as a visual indicator that data is recorded, if it is white please check if the Pause button was not accidentally pressed during logging. The audible tik sounds at frequency approximately 3 Hz if Tik Sound option was enabled in the Logger Setup menu. The Map plot is updated with GPS input frequency and Profile display mode is updated at each EM61-MK2 reading.

There is only one option available in the Logging mode - PAUSE logging. After the button labeled **PAUSE** is tapped or a Pause key selected in the Logger Setup dialog is pressed the recording is stopped and the Logging screen returns to the Stand By mode. In the 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, profile plots will not be updated (in Profile mode). The cross mark corresponding to the system location will move according to the operator movement, however sensors positions (or GPS positions in Mapping/Navigation mode) will not be plotted as dots on the screen.

## 8.5 Field Options Available in Stand By Mode

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Several options are available while the Logging window is in the Stand By mode. Four frequently used options can be accessed directly from command buttons (Go, Qline, Exit, and Menu) and others can be used from pop up menu activated by button **Menu** (displayed in Figure 8.30). Command buttons can be used by clicking on the desired button, or from the keyboard by pressing one of the shortcut keys (underlined characters on button labels) or by navigating using **TAB** key (sets button as a default button - default button is highlighted) and pressing **ENTER** key.

Options listed in the menu can be accessed directly (without displaying pop up menu from the **Menu** button) by using keyboard shortcuts (underlined characters in menu items), i.e. pressing key C will display Enter Comment dialog. While the pop up menu is displayed options can be selected by clicking on the appropriate proper option, or from

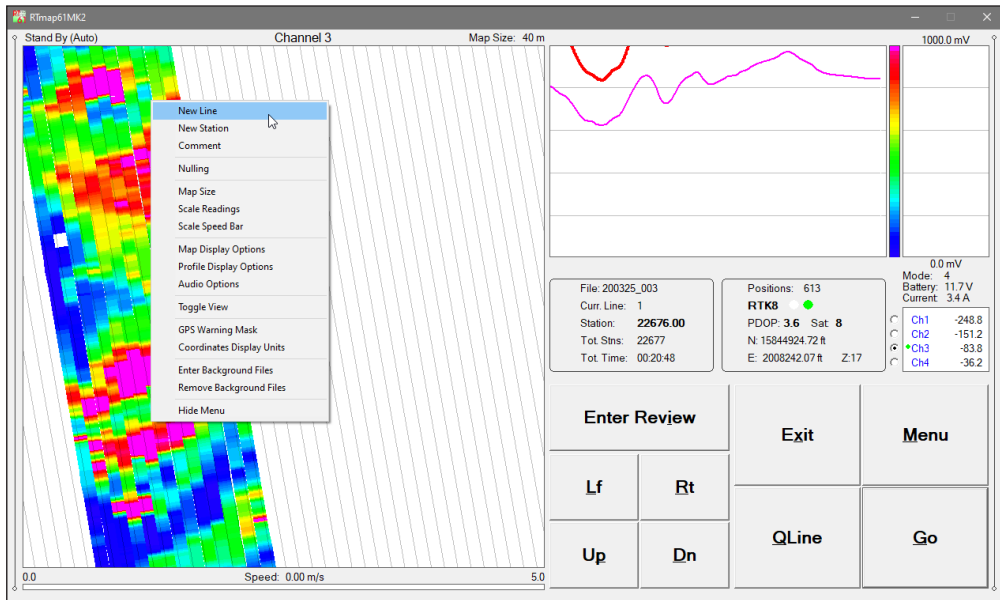


Figure 8.30: RTmap61MK2 in Stand By mode with pop up menu

the keyboard by pressing the shortcut keys or by navigating using **Up** and **Down** arrow keys and then executing by the **ENTER** key.

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

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

### **QLine** (Quick Line change)

Click on the **QLine** button, or while using the keyboard press shortcut key **Q** or if the button is a default button (highlighted) press **ENTER** key. The confirmation message will be displayed, Figure 8.31.

This option allows the operator for fast and convenient change of the survey line, assuming that formerly specified parameters describing survey procedure can be accepted. In case of GPS based survey, this option provides very convenient and fast (two key strokes) procedure of dividing large data sets to several survey lines, without displaying the New Line dialog.

The name of the new line is given by the program based on the former line name and Line Increment (see Survey Setup dialog or the New Line option). Start station and Station Increment of the new survey line is calculated by the program base on the Sequence parameter and former line Start Station and

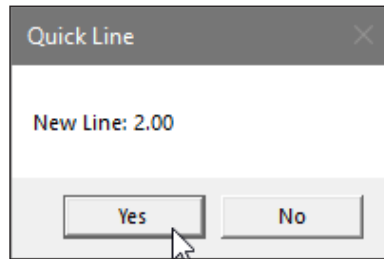


Figure 8.31: Quick Line message

Increment (see Survey Setup dialog or option New Line that follows). To accept proposed Survey Line name click on the **Yes** button or press **ENTER** key. If the button **No** is clicked then the program will continue survey along existing survey line.

### New Line (New Survey Line)

This option is available from pop up menu or from the keyboard by using short-cut key **L**. The New Line dialog is displayed, Figure 8.32. Selecting this option allows the operator to enter a new survey line number (name) and (as opposite to Quick Line described above) to change 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 and the last survey line.

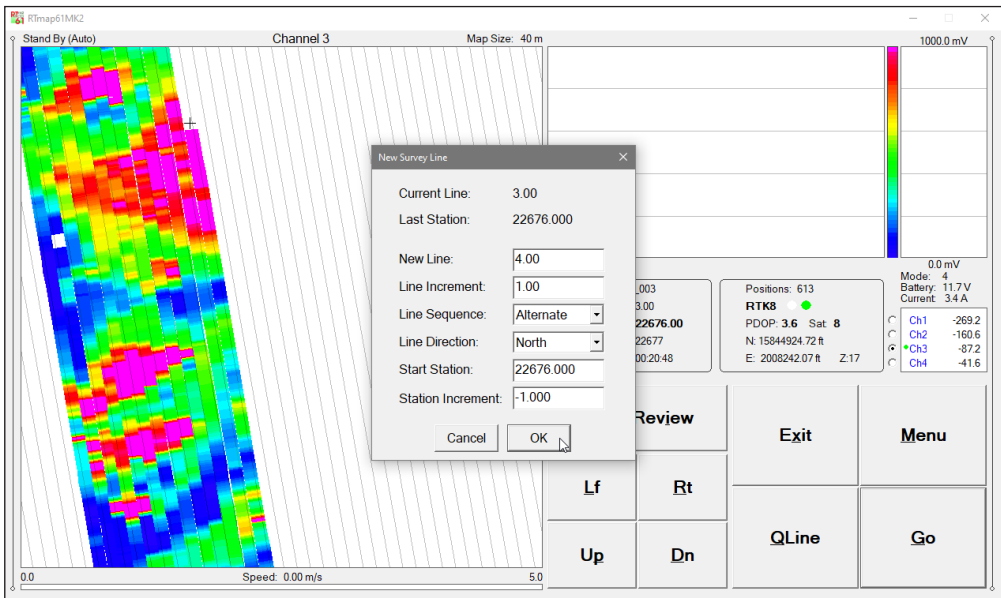


Figure 8.32: The New Survey Line dialog

At the top of the dialog the last survey line name and the last logged station are displayed. Default name for the new line is given based on the Line Increment parameter. The default Start Station, direction of the Station Increment, and Direction are determined based on Sequence selection. All these parameters can be overwritten by the user as described in the Survey Setup dialog description (chapter 3).

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

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

### New Station

The New Station option can be selected from pop up menu or from the keyboard by pressing shortcut key N. Selecting this option allows the operator to enter a new station number (within the same survey line). The New Station dialog is displayed and it is shown in Figure 8.33. New station can be used in situation when an obstruction does not allow for continuation of the survey line. A new station can be entered and survey line can be continued. An alternative

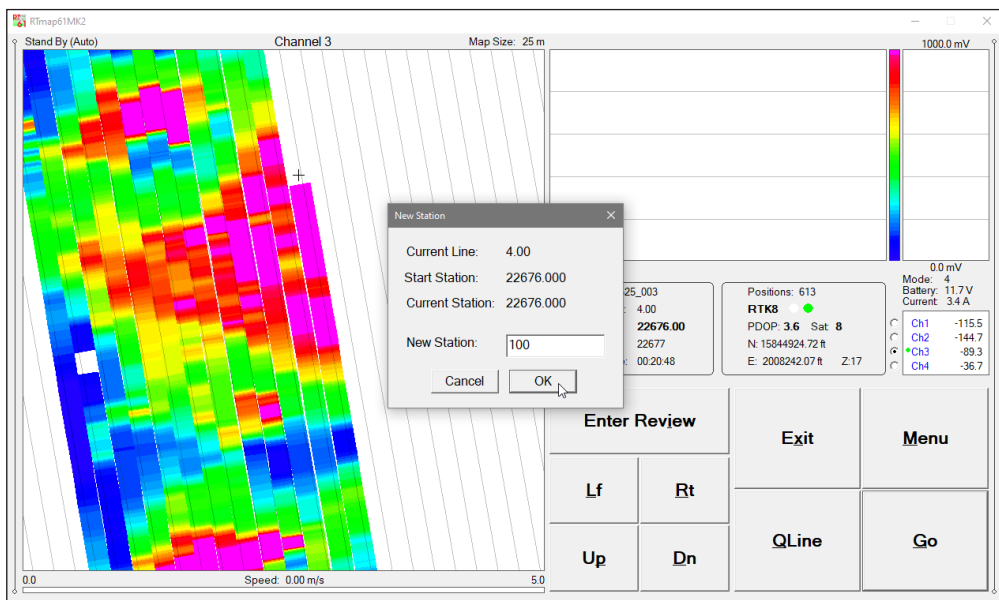


Figure 8.33: New Station dialog

option in this case would be to use a new line with the same name and affix i.e. 11A, 11B, and so on.

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 (**Station:**) value will be updated and after data logging is activated the profile curves (if the program is in Profile mode) will have a small gap (and possible amplitude discontinuity) showing the new station entry.

This option does not provide any visual effect while the program is used in Mapping mode.

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

### Comment

The Comment 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 in Figure 8.34.

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

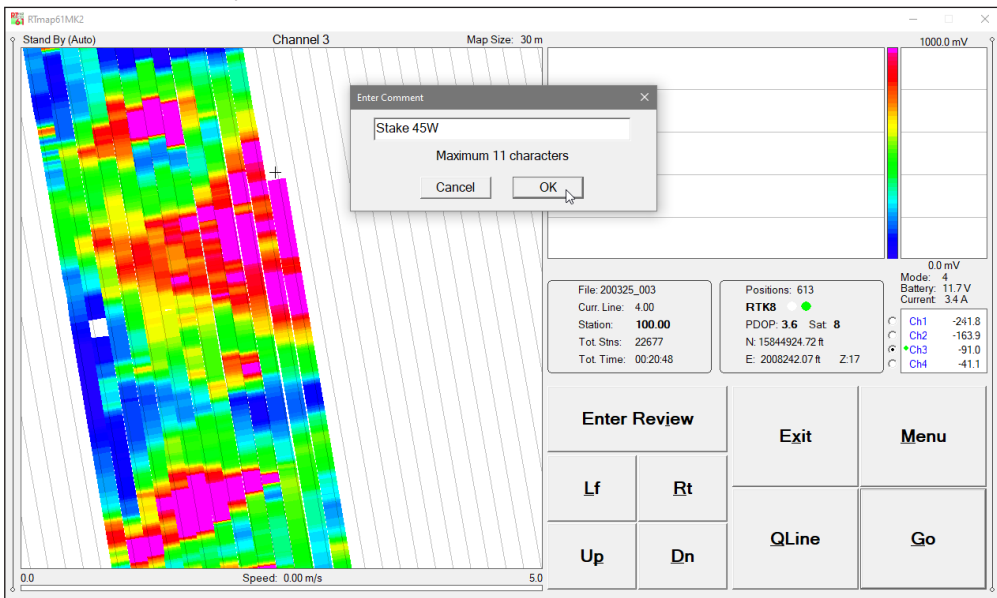
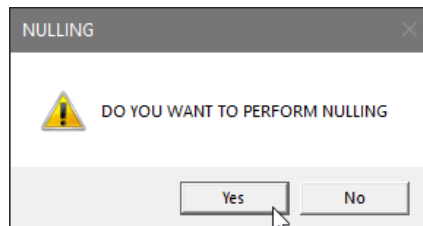


Figure 8.34: Enter Comment dialog

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

## Nulling

The Nulling option can be selected from pop up menu or from the keyboard by pressing shortcut key **U**. After the option is selected a warning message (Figure 8.35) appears to avoid accidental nulling procedure in the middle of data file collection. If the message dialog is confirmed by clicking on the Yes button the computer will take 50 readings (see Figure 8.10) and it will calculate new offsets for each channel of the connected EM61-MK2.



*Figure 8.35: Warning message before Nulling procedure start*

Calculated offsets are 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 EM61-MK2 readings are needed, exit the RTmap61MK2 program and run it again. The EM61-MK2 instrument does not have to be turned OFF.

## Map Scale

This option is available by clicking on (selecting by arrow keys) the pop up menu item labeled **Map Size** or directly from keyboard by using shortcut key **S**. The Map Size dialog will appear on the screen, Figure 8.36.

This dialog allows the operator to enter new scale for the map displayed by the plot area, grid interval and cursor band.

Map scale value is entered in the edit box labeled **Map Size** either in meters or feet according to selected units in System Setup dialog and it represents side of the square map. Only positive integer values ranging between 1 and 99999 are allowed by the program.

The second parameter in the Map Size dialog is **Grid Interval** or **Lines Intervals** depending on the selection (Grid or Guide Lines) in a Map Display Options dialog. These are grey grid lines in the map plot area that may be helpful in estimation of distance on the map displayed in Mapping or Navigation mode. Grid Interval equal zero will result in lack of grid lines.

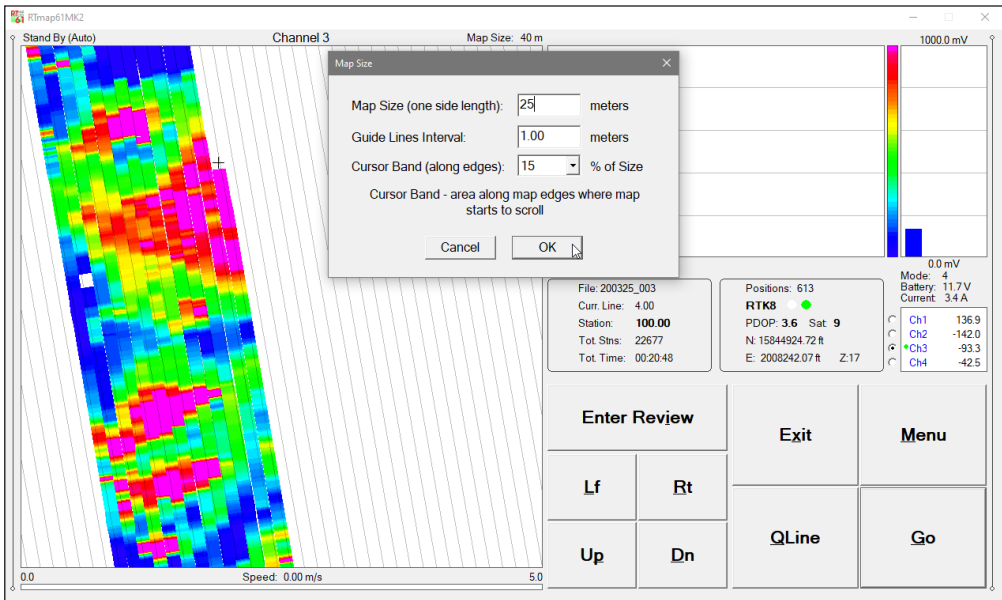


Figure 8.36: Map Size dialog, current RTmap61MK2 map at size of 40 m

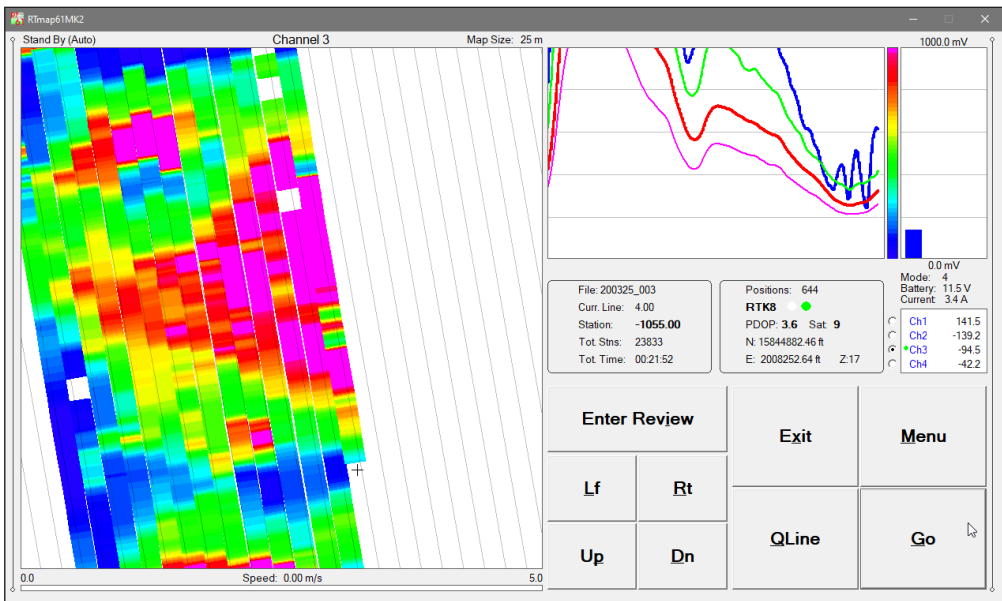


Figure 8.37: RTmap61MK2 in Stand By mode after re-scaling map to 25 m size

The third parameter in the dialog is named **Cursor Band**. This parameter describes a band around map perimeter that is always displayed. In other words, when cursor approaches and enters band area the map is scrolled. The band width is described by percentage of Map Scale. Five selections are available in the combo box labeled **Cursor Band**: 10%, 15%, 20%, 25%, 30%, and 40%. At 40% cursor indicating GPS antenna is mostly in the center area of the map. After parameters in Map Scale dialog are changed click on the button **OK** or press **ENTER** key to accept new values and the screen with a new map scale will be redrawn at a specified scale, see Figure 8.36 (Map Size 40 m) and compare with Figure 8.37 (Map Size 25 m). Re-drawing the map may take several seconds (prompt "Please Wait" is displayed), depending on parameters and number of data points collected in data file.

To ignore an entry and return to Monitor mode click the button **Cancel** ( or X) or press **Esc** key, and the dialog window will disappear.

### **Scale Readings** (Adjust scale for profile, moving bars, and map colour image range)

This option is available by clicking on (selecting by arrow keys) the pop up menu item labeled **Readings Scale** or directly from keyboard by using shortcut key **R**. The Readings Scale dialog will appear on the screen, Figure 8.38.

Two edit boxes labeled **Minimum** and **Maximum** allow you to set the amplitude range. Minimum and maximum values are specified for a pseudo-grid image in Mapping mode for the selected EM61-MK2 channel, the plot range of all EM61-MK2 channels in the window containing four moving bars as well as for the profile plot display. Therefore range of displayed data is the same for the map displayed in Mapping mode, the profile display area and for the grid area with vertical bars. However only moving bars window is labeled at its top and bottom (Figure 8.39).

A colour bar representing colour distribution for mapping mode is provided on the left side of the screen. The colour bar is updated whenever Minimum or Maximum Response values are changed.

After minimum and maximum response values are specified and dialog changes are accepted by clicking on the button **OK** or pressing **ENTER** key the display will be redrawn (see below Figure 8.38 with scale 0 to 1000 mV and compare amplitude map shown in Figure 8.39, where amplitude readings scale is 0 to 1500 mV).

Change of amplitude range is usually required when switching displayed channel on the map.

To cancel selection click on the **Cancel** (X) button or press **Esc** key.

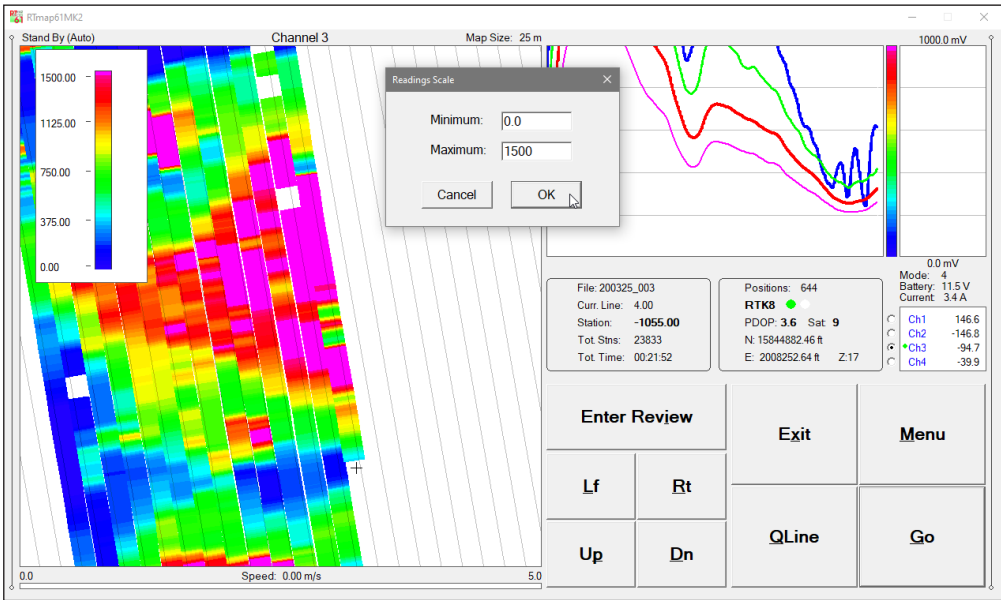


Figure 8.38: Readings Scale dialog, in the background the current EM61-MK2 amplitude range from 0 mV to 1000 mV

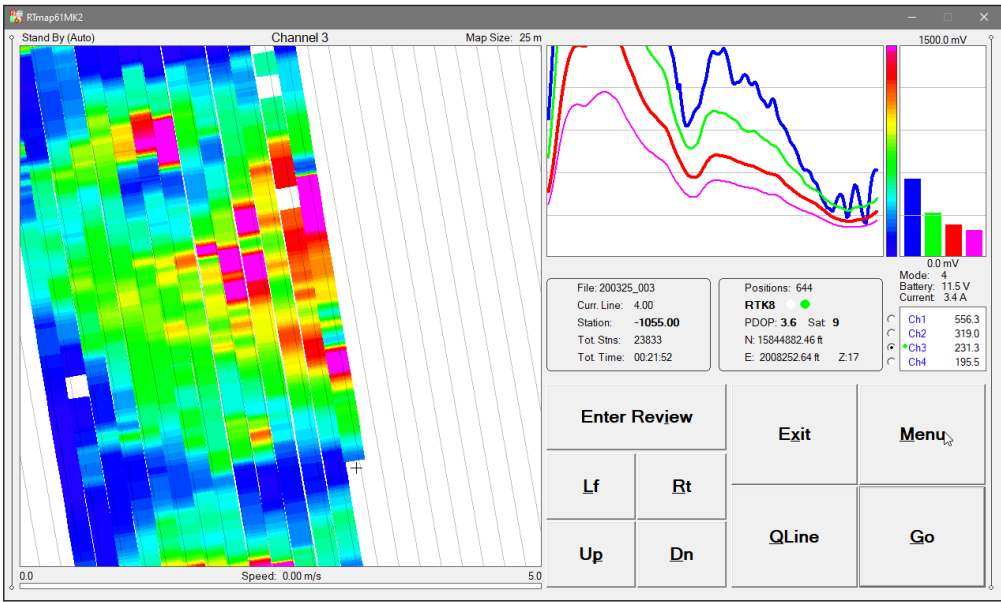


Figure 8.39: RTmap61MK2 Screen in Stand By mode after Readings Scale change to 0 to 1500 mV, compare with Figure 8.38

### Scale Speed Bar (change units and adjust scale for speed bar)

This option is available by clicking on (selecting by arrow keys) the pop up menu item labeled **Scale Speed Bar** or directly from keyboard by using shortcut key **B**. The Speed Bar Scale dialog will appear on the screen, Figure 8.40.

Minimum value for the Speed Bar Scale is preset to 0, therefore this scale requires only one entry for maximum speed. Speed units can be also changed in Set New Speed Bar Scale dialog, which is shown in Figure 8.40.

The entered scale applies only to graphic representation of the speed (graphic bar), speed in numeric form is always displayed above the bar, even if the real value exceeded maximum specified for the speed bar.

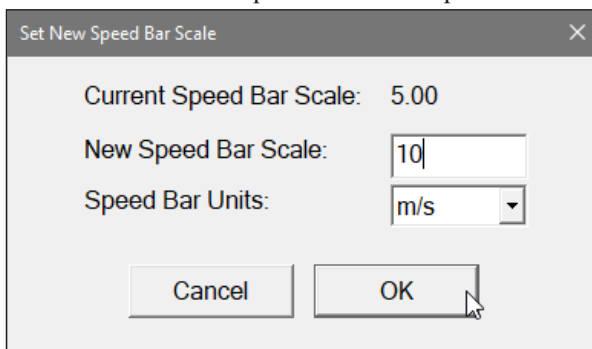


Figure 8.40: Set New Speed Bar Scale dialog

Speed Bar units selection contains: m/s, ft/s, km/h, and mph.

After maximum speed bar value and units are specified click on the button **OK** or press **ENTER** key to accept new parameters.

To ignore an entry and return to Monitor mode click the button **Cancel** ( or X) or press **Esc** key, and the dialog window will disappear.

### Map Display Options (Mapping and Navigation modes)

The Map Display Options dialog is identical to dialog described in detail in Chapter 7 (please refer to section 7.1 of the manual) when measurements are conducted with GPS positioning and the program works in Mapping or Navigation mode.

This option can be accessed from pop up menu or directly by the keyboard by pressing **D** key.

The Map Display Options dialog is shown in Figure 8.41. Figures 8.42, 8.43, and 8.44 below present various setups for Navigation and Mapping modes. Please compare Figures 8.42 (Navigation mode where dots represent EM61-MK2 positions), Figure 8.43 (Navigation mode with swath bar presentation), Figure 8.44 (Mapping mode with colour image of readings amplitude).

When large number of readings was taken a message "Please Wait" may appear for duration of map re-drawing.

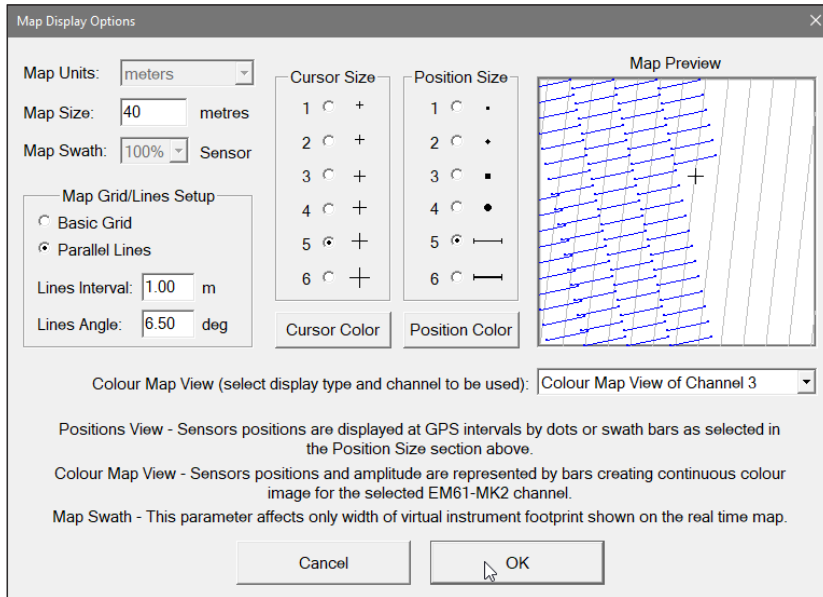


Figure 8.41: Map Display Options dialog

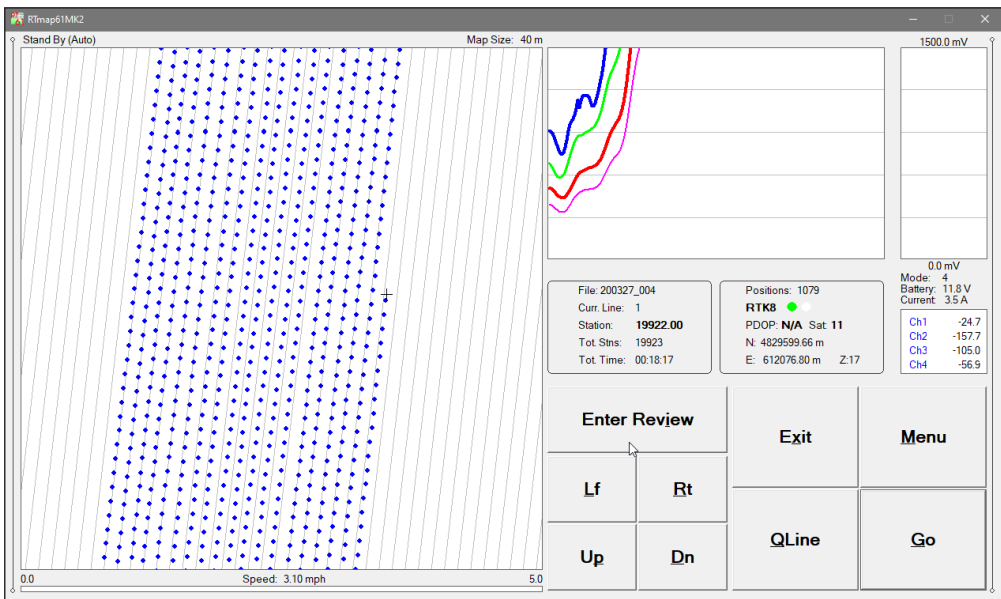


Figure 8.42: RTmap61MK2 Logging Navigation mode with dots representing sensor positions

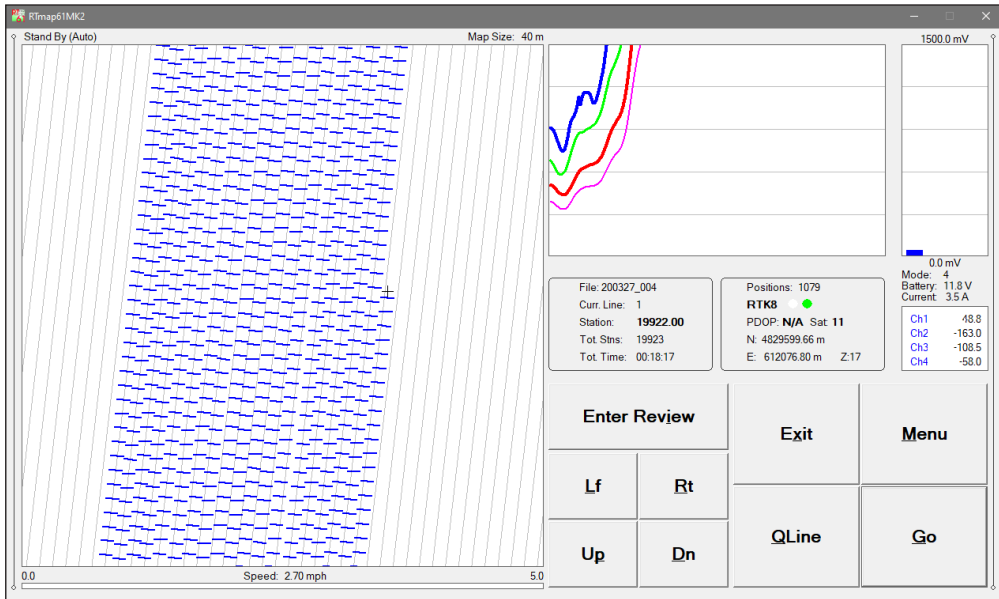


Figure 8.43: RTmap61MK2 Logging Navigation mode with swath bars representing EM61-MK2 sensor positions at GPS update rate

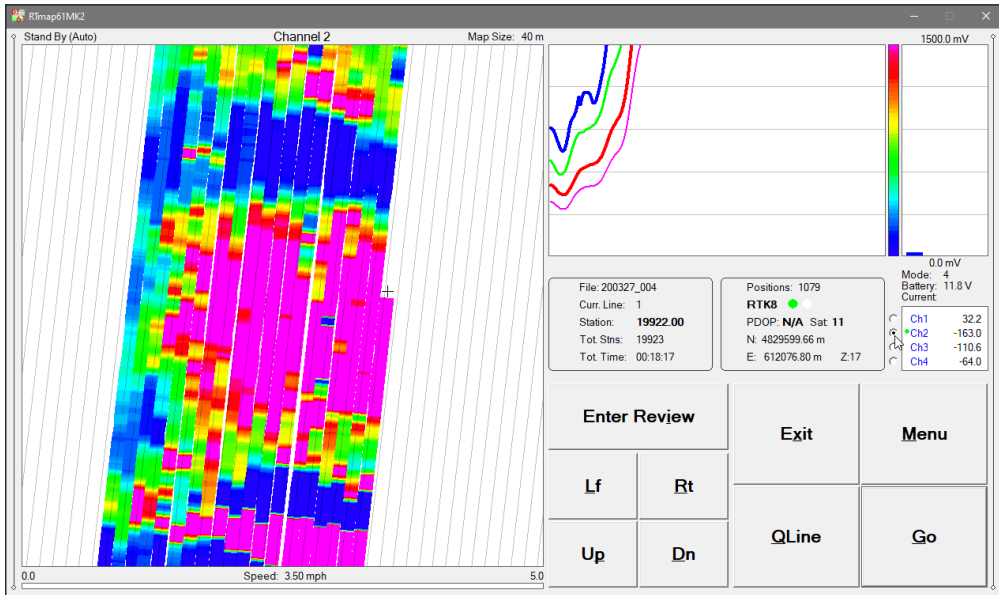


Figure 8.44: RTmap61MK2 Logging screen in Mapping mode with colour image for Channel 2 (positions plotted at the EM61-MK2 update rate)

## Profile Display Options

The Setup Display Options dialog is described in detail in Chapter 7. This dialog allows you to specify color and thickness of profiles (same colours apply to moving bars), and to select grid lines for specific component in profiles window. The dialog is presented in Figure 8.45.

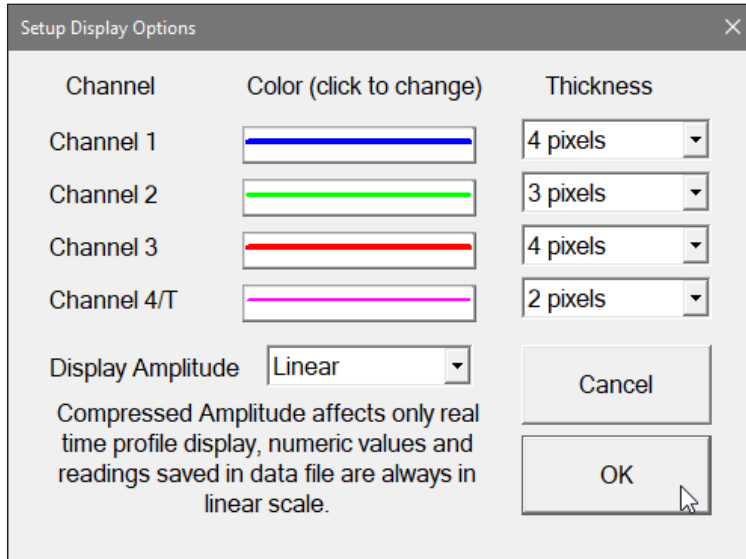


Figure 8.45: Profile Display Options dialog

To select any option click on the corresponding drop down list box or check box, or use TAB key to scroll to the option and then use mouse or keyboard to select parameter.

After all the parameters in the Display Setup dialog are updated click on the button **OK** or press **ENTER** key (assuming it is highlighted) to accept the displayed settings. The dialog will disappear and the program will return to the Monitoring mode window. Updated settings will be written to the initial file and they will be given as default parameters in the subsequent program executions. To return to original settings (state before this dialog was selected) click on the button labeled **Cancel** (or X button) or press **Esc** key. All parameters will be reset to initial settings and the dialog window will disappear.

## Audio Options

This dialog allows to enable and disable three audio functions. Two of these options can be specified in the System Setup dialog (see chapter 3), and the one associated with GPS Warning Mask can be set in GPS Port Setup dialog (see chapter 5). The Audio Options dialog is presented below in Figure 8.46. Parameters in Audio Options dialog are described below.

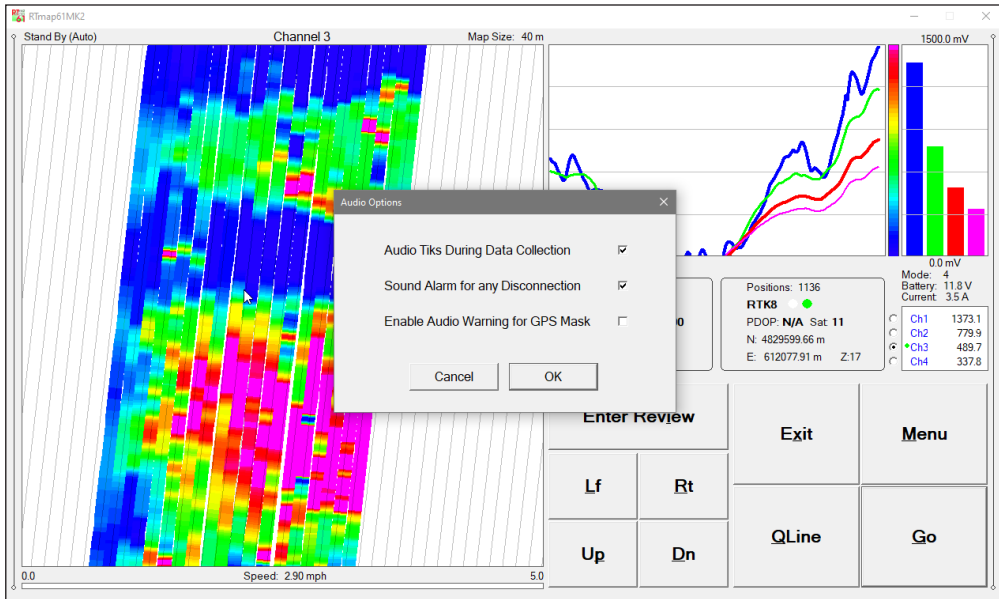


Figure 8.46: Audio Options dialog

### Audio Ticks During Data Collection

The program will provide tik sound during data recording (in the Logging mode only). The tik sounds with frequency of approximately 3 Hz. This audio feature may be helpful as an additional confirmation that the button Go has been pressed (or tapped) and data is being collected and saved in data file. This audio function can be enabled or disabled by check button located at the label naming this option.

### Sound Alarm for any Disconnection

The program will sound loud ring when a disconnection in any serial port is detected by the program, or in case any EM61-MK2 console or GPS receiver will stop streaming data for any reason. The audio alarm function does not depend on the visual alarm that is always enabled regardless of audio alarm setting. The audio alarm function can be enabled or disabled by check button at the Sound Alarm for any Disconnection label as shown in Figures 8.55 and 8.56.

### Enable Audio Warning for GPS Mask

When this option is enabled then in addition to visual warning (alternating red and white circles) an audio warning will sound (it is more gentle "bell" sound than loud audio alarm ring associated with disconnection of any sensor).

## Toggle View (toggle between Mapping and Profile modes)

Selecting this item from pop up menu or simply pressing the key **T** will switch Monitoring or Stand By screens between Profile and Mapping (or Navigation) modes. Changing the display from Profile to Mapping mode (when data were collected) may take few seconds (depending on number of positions displayed and map scale). The program will display message **WAIT** till all positions are plotted in current map area and it will beep at the end of this process.

## GPS Warning Mask

This option is available by clicking on (selecting by arrow keys) the pop up menu item labeled **GPS Warning Mask** or directly from keyboard by using shortcut key **W**. The GPS Warning Mask Scale dialog will appear on the screen. This dialog allows to set or change GPS Warning Mask parameters during logging session. The same parameters can be set in GPS Port Setup dialog (see chapter 6). The GPS Warning Mask dialog is presented below in Figure 8.47. Parameters in GPS Warning Mask are described below.

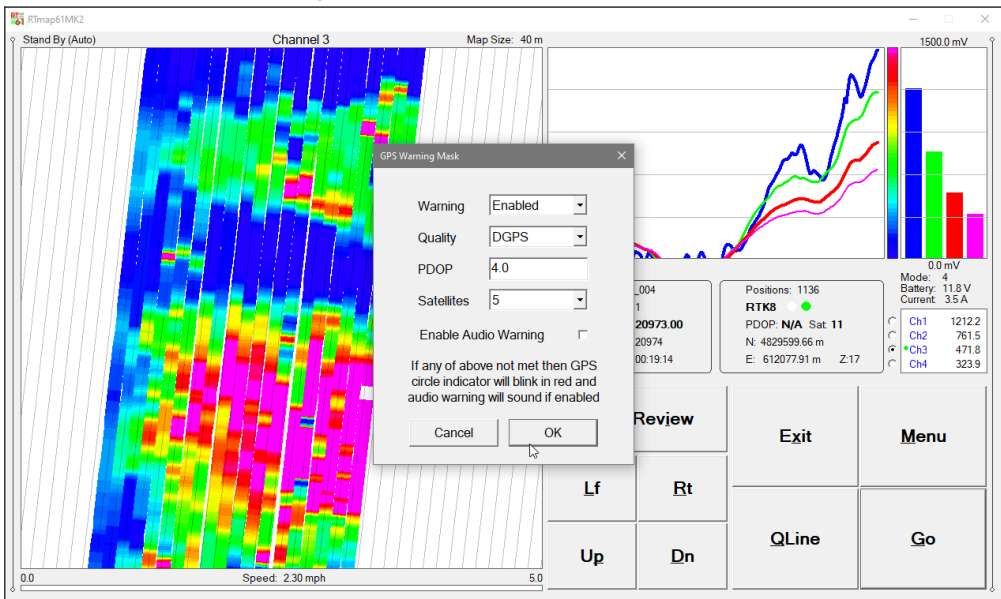


Figure 8.47: GPS Warning Mask dialog

## Warning

Clicking 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 by navigating with Tab key and then by using Up or Down arrow keys select one of the available items: Enabled and Disabled.

This option allows you to Enable/Disable a GPS Warning Mask that contains three parameters: Quality Indicator (degree of differential corrections), Dilution Parameter (PDOP or other label depending on the selected NMEA message), and number of available satellites.

When Enabled is chosen GPS two circle indicator will be alternating in green and white if conditions for specified parameters setting will be met. When any of the parameters is below set values then GPS indicators will alternate in red and white colours (see Figure 8.48). In case Warning parameter is disabled then GPS indicator will be displayed in green and white colours (see Figure 8.47) regardless of GPS signal quality.

All GPS data is logged, GPS Warning Mask affects only display.

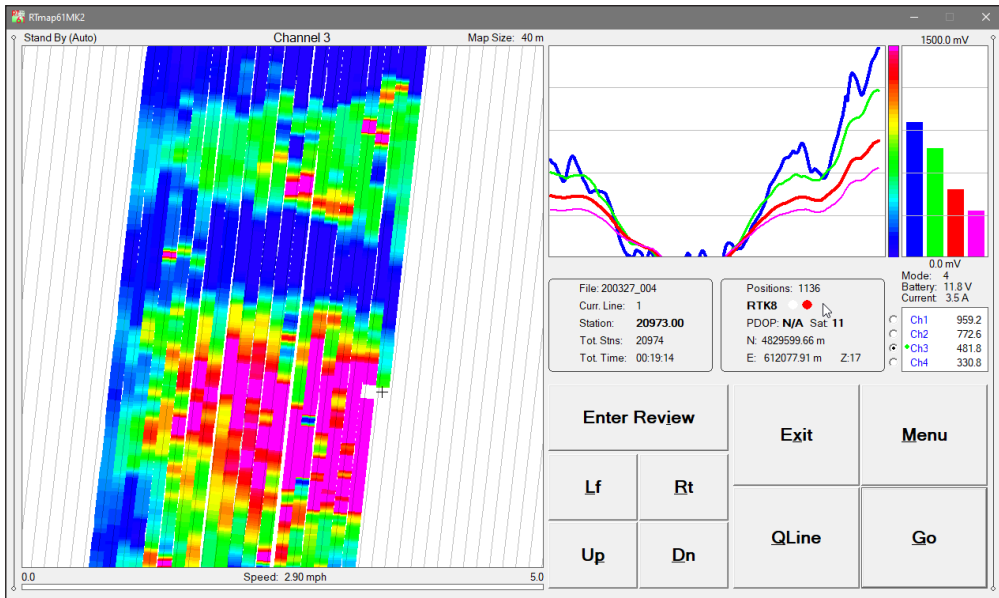


Figure 8.48: RTmap61MK2 screen with GPS Warning indication

## Quality

This parameter describes Quality Indicator (degree of differential corrections). Clicking 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 by navigating with Tab key and then by using Up or Down arrow keys select one of the available items: AGPS (Raw), DGPS, RTK3, RTK4, RTK5, and so on.

If Quality Indicator received from GPS receiver will be worse than specified then GPS indicator will alternate in red and white colours.

### **PDOP**

This parameter can be labeled PDOP, HDOP, DOPG, DOP depending on the selected NMEA message. It can be also named Quality m (accuracy in meters) if LLQ was selected, or it is not available (labeled N/A) when messages GLL, pseudo-GGA or Trimble RTS are used.

Activate text box by Clicking or using TAB key and then enter the chosen acceptable maximum value of Dilution parameter.

If PDOP (or other similar parameter) is larger than specified value then GPS indicator will alternate in red and white colours.

### **Satellites**

Clicking 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 by navigating with Tab key and then by using Up or Down arrow keys select one of the available items: 3 to 12.

If number of available satellites will be smaller than specified then GPS indicator will alternate in red and white colours.

After all the parameters in the GPS Warning Mask dialog are updated click on the button **OK** or press **ENTER** key to accept the displayed settings. Updated settings will be written to the initial file and they will be given as default parameters in the subsequent GPS Warning Mask and GPS Port Setup dialogs.

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

**GPS Warning Mask settings affect only display information. All GPS positions are written to data file in original form regardless of specified values in GPS Warning Mask dialog.**

### **Coordinates Display Units**

The Set Coordinates Display Units dialog will be displayed, Figure 8.49. There are four items after the combo box labeled Coordinates unit will be expanded: Geodetic Lat/Lon (coordinates in Degrees, Minutes, Seconds), UTM meters, UTM feet (International Feet), and UTM US Feet (US Survey Feet). Select one of items and coordinates of the GPS antenna will be displayed in the GPS section (bottom of the logging screen) in selected units. Please compare Figure 8.48 (Coordinates in UTM meters) and Figure 8.49 (Geodetic Coordinates in degrees).

Select the OK button to accept selection or the Cancel button to exit dialog.

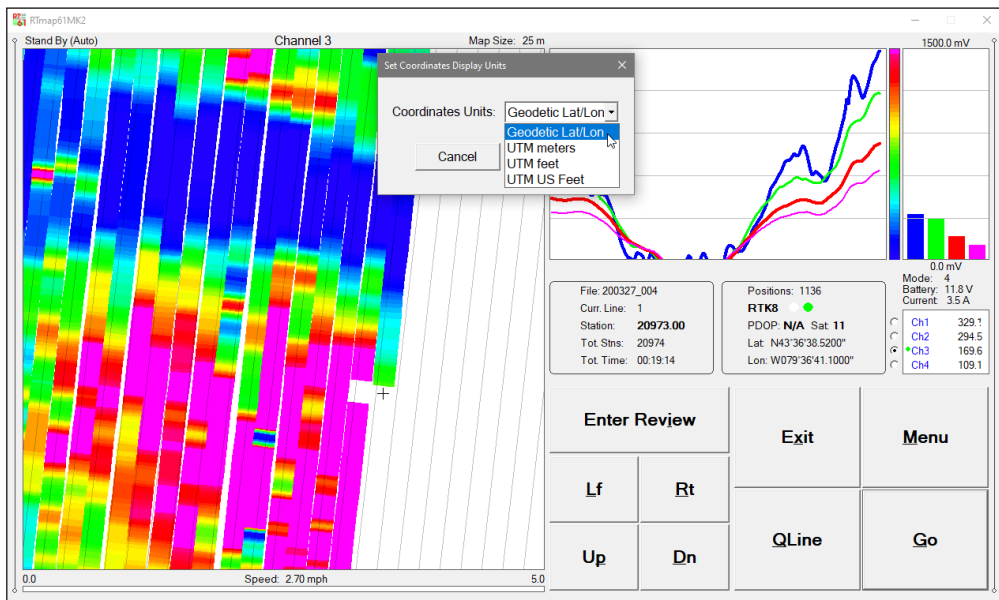


Figure 8.49: RTmap61MK2 Set Coordinates Display Units dialog

### Enter Background File

The Load Background File dialog is shown in Figure 8.50. This option is also described in section 8.2, in this section examples with background files and collected data will be shown. The program will display contents of entered files in the background of the map. Two types of files can be entered: any data file

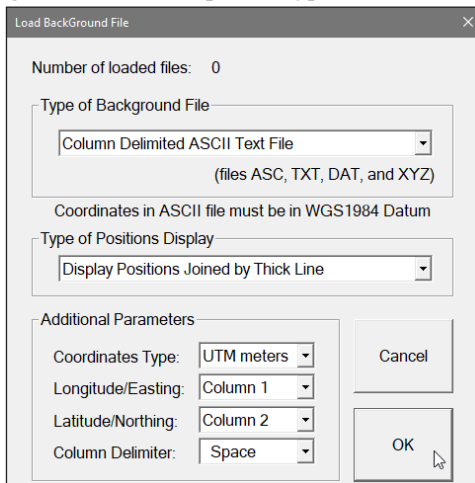


Figure 8.50: Load Background File dialog

created with Geomar programs (RTmap, TrackMaker, or Multi - all V2.00 or later) or user prepared column delimited text file (TXT format) containing coordinates representing site boundary, or any other feature. If Geomar data file is entered its content will be displayed as traces of collected survey lines. This option can be used to follow measurements with another instrument, to display already performed coverage, or to repeat part of the survey. User prepared Column Delimited ASCII Text File can be used to display a site outline, delineated area of special interest to be surveyed with finer line spacing etc. The latter file must contain coordinates in WGS 1984 datum. Geomar data files are in WGS 1984 datum by default. Up to 10 files (mixture of either type) can be entered and displayed.

Type of Positions Display describes how positions are displayed, they can be plotted as separate points, or lines joined by thin, medium, or thick lines depending on the selection in the corresponding combo box. Lines can have breaks if a tag "Break" (lower or upper case) is inserted in the file. Sample of Column Delimited file is show in Appendix A.

When a Column Delimited file is selected a section labeled Additional Parameters is activated. Parameters describing file structure must be specified, these are: Coordinates Type (Geodetic, UTM meters, feet, or US Survey Fee), column numbers for Longitude and Latitude or Easting and Northing, and finally Column Delimiter (Space, Comma, Tab, or Semicolon). For practical simplicity, if UTM coordinates are used it is assumed that the operator is located within the same UTM zone.

Type of the file and all parameters must be specified prior to selecting file name, therefore it is necessary to know structure of background files that are to be loaded. After the OK button is clicked on or tapped an Open File dialog will appear, Figure 8.51.

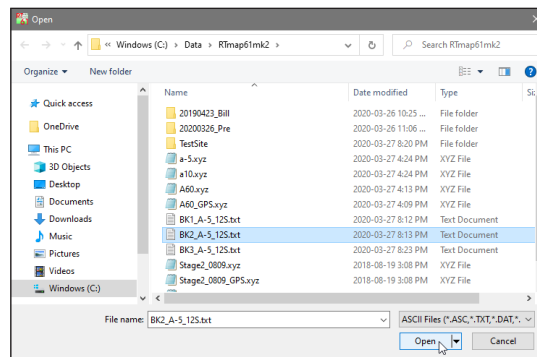


Figure 8.51: Selection of Background File

After file is opened in above dialog program will draw it immediately in the map window and another file can be entered if needed.

The RTmap61MK2 screen with two loaded background files (both Column Delimited type) and start of actual data logging is shown in Figure 8.52.

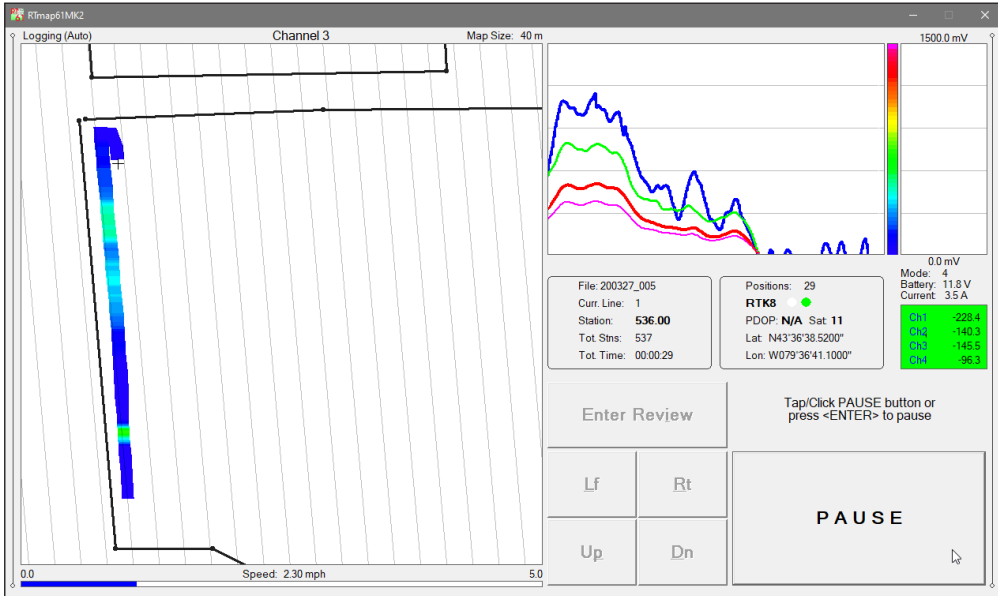


Figure 8.52: RTmap61MK2 with two background files after logging is started

As long as there are less than 10 background files loaded into the program next file can be entered or removed at any time during logging data. Example of loading new file is shown in Figures 8.53 and 8.54 (it is same logging session at later stage as shown in Figure 8.52). When Enter Background File option is executed, the dialog that appear indicates number of already loaded files (Figure 8.53). After all parameters are specified and file is selected in Open File dialog the program displays newly entered background file on the map as shown in Figure 8.54.

Please note that background files are displayed using real coordinates. Program registers its position as soon as the first GPS position is detected (it is cross cursor displayed in the center of the map). It is the reason that background files cannot be entered prior to the first GPS position obtained by the program. Therefore, loaded background files can be displayed only if operator is in the same area and map size covers coordinates listed in data file or Column Delimited file. If the entered file is not displayed then it may be visible after changing map to larger size.

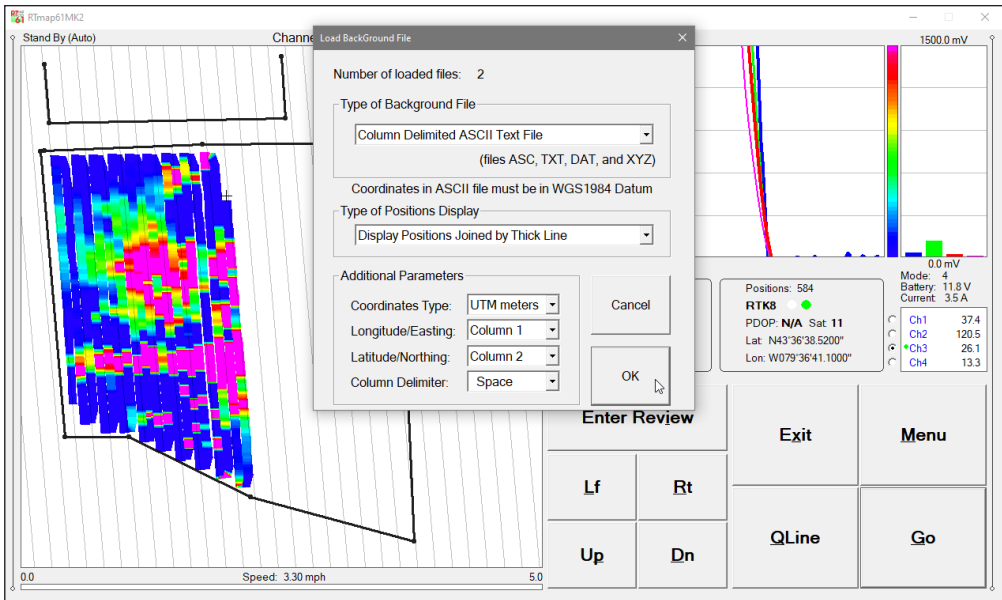


Figure 8.53: RTmap61MK2, loading third background file

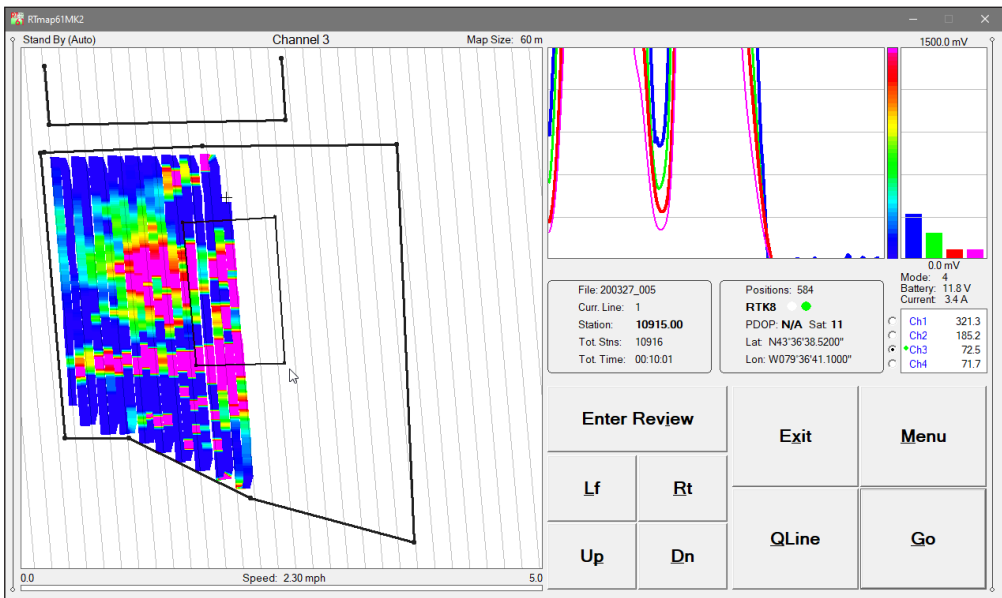


Figure 8.54: Three background files displayed on the map, compare with Figure 8.53

## Remove Background Files

After this option is executed the Remove Background Files dialog appears, Figure 8.55. In this example the dialog contains list of three loaded background

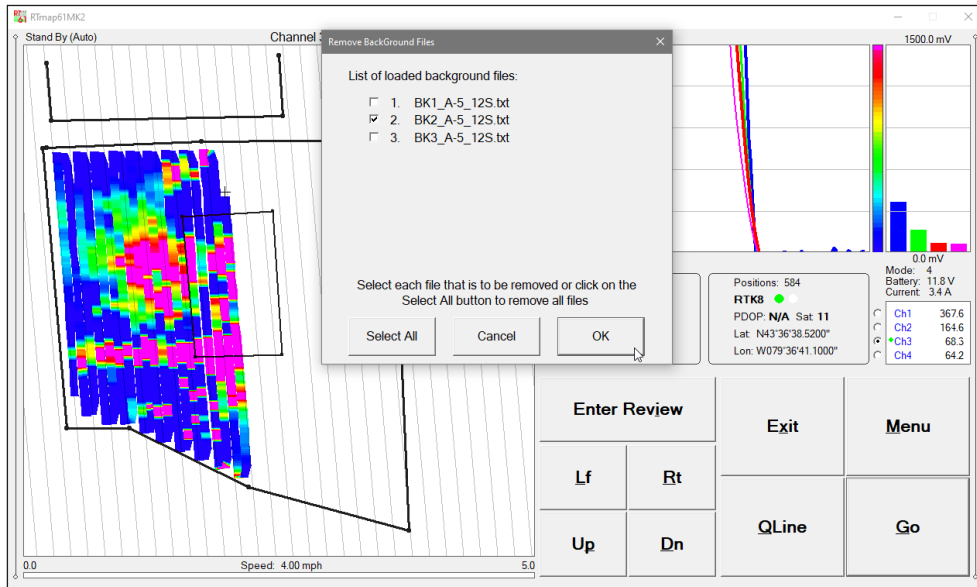


Figure 8.55: Remove Background Files dialog

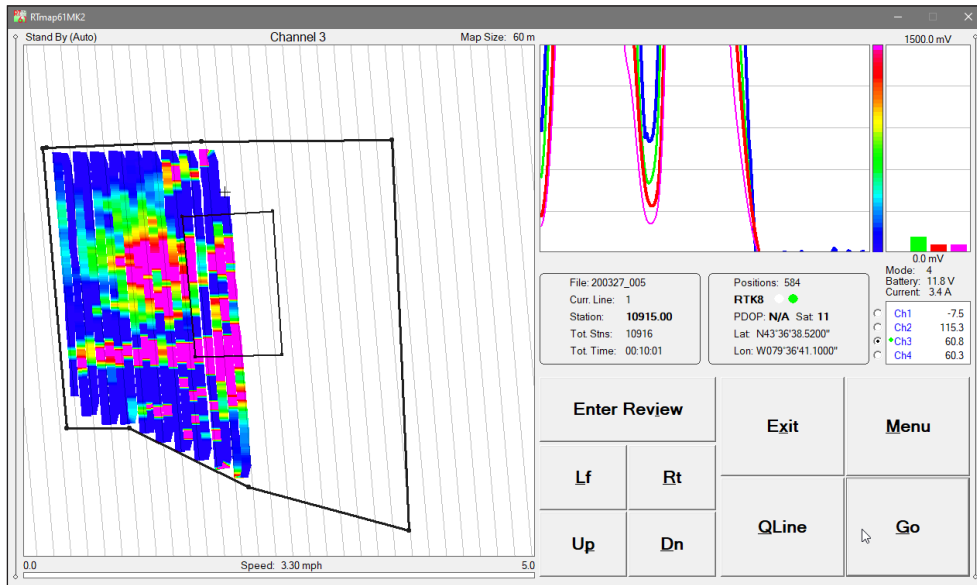


Figure 8.56: RTmap61MK2 map with one removed file, compare with Figure 8.55

files. Click on any check box located on the left of corresponding file name (in this example only one second file is to be removed) and when the OK button is clicked on or tapped the map will be re-drawn and checked files will be removed from the program map. Result is shown in Figure 8.56 where map does not contain outline located above main survey area.

Click on the Select All button and then OK button to remove all entered files at once.

### Exit (exit data logging)

During data collection (in Stand By mode) a confirmation message dialog will be displayed (there is no such message if **Exit** is performed in Monitoring mode) before program exits logging window, Figure 8.57.

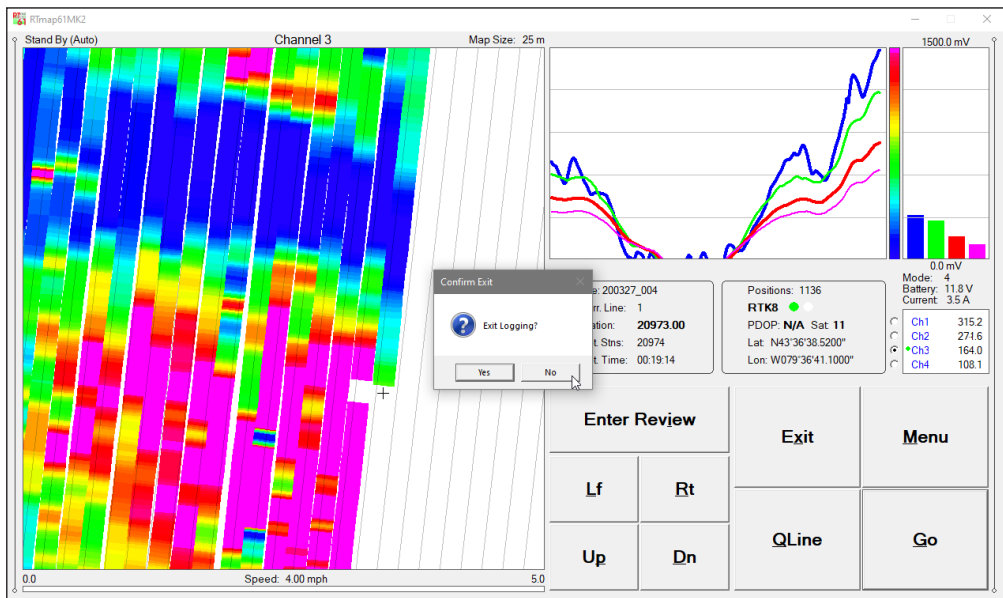


Figure 8.57: RTmap61MK2 - Exit Logging session confirmation message

After above message is confirmed (click on the **Yes** button) the program stops logging, closes data file and returns to Main Screen. If the button **No** is tapped the program returns to logging mode and data collection can be continued.

### Map Navigation (seven command buttons below speed bar) and Review

Seven above command buttons are displayed below the label Panning and the button labeled **Enter Review** (Figure 8.58). Four panning buttons **Lf** (Left), **Rt** (Right), **Up**, and **Dn** (Down) are enabled and available at any time in the Stand By mode, without executing Review mode. They can be used to shift

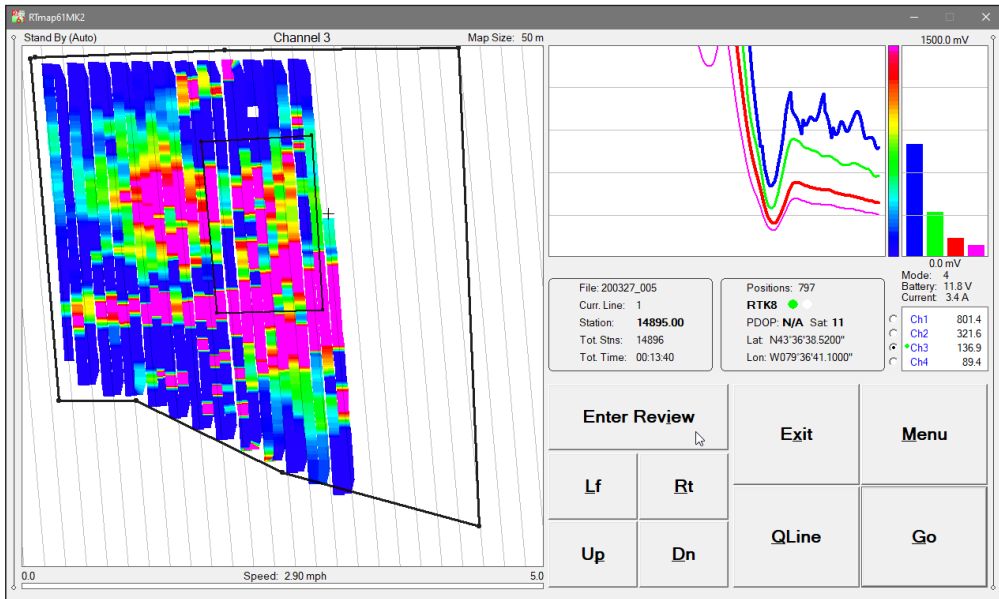


Figure 8.58: RTmap61MK2 - Panning buttons available in Stand By mode

colour image in any direction, as long as current position (cursor position) is located within the map.

Three remaining buttons **Zm+**, **Zm-**, and **FitAll** are enabled as soon as the button **Enter Review** is clicked or tapped on. At this moment the displayed map is not updated (cursor indicating current position is disabled), label Panning is replaced by label Navigation, and button **Enter Review** is replaced by the button **Exit Review** (Figure 8.59). When Review is active top row of buttons is used to pan the displayed map while second row of buttons can be used to change scale of the map.

Description of panning and navigation buttons is given below and various zooming and panning action is show in Figures 8.60 and 8.61. Please compare Figures 8.58, 8.59, 8.60, and 8.61 that represent the same data set at various scales.

#### **Lf, Rt, Up, Dn** (panning functions: Left, Right, Up, and Down)

Panning functions move screen in four directions. The procedure can be accomplished by clicking or tapping on corresponding command buttons or by pressing cursor keys or **P**, **D**, **L**, and **R** keys correspondingly. The step of pan (percentage of the screen being moved) can be specified in the Map Scale dialog, the program default is 20%.

#### **Zm+, Zm-, FitAll** (zoom functions: Zoom In, Zoom Out, and Fit All)

These options can be used by clicking on corresponding command buttons or from keyboard by pressing keys **+**, **-**, or **F**. The step of zoom

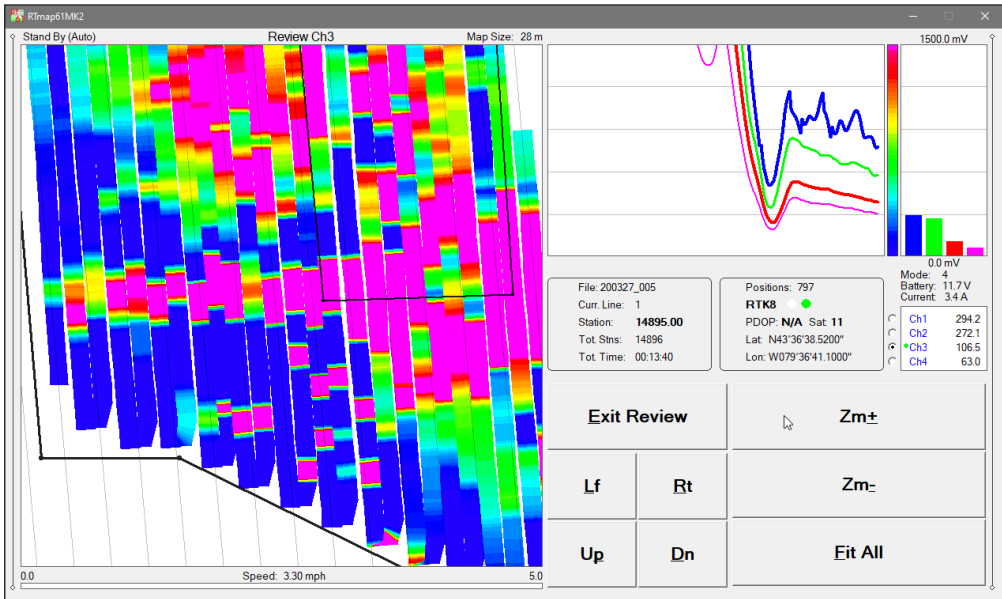


Figure 8.59: RTmap61MK2 - Navigation buttons available in Review mode

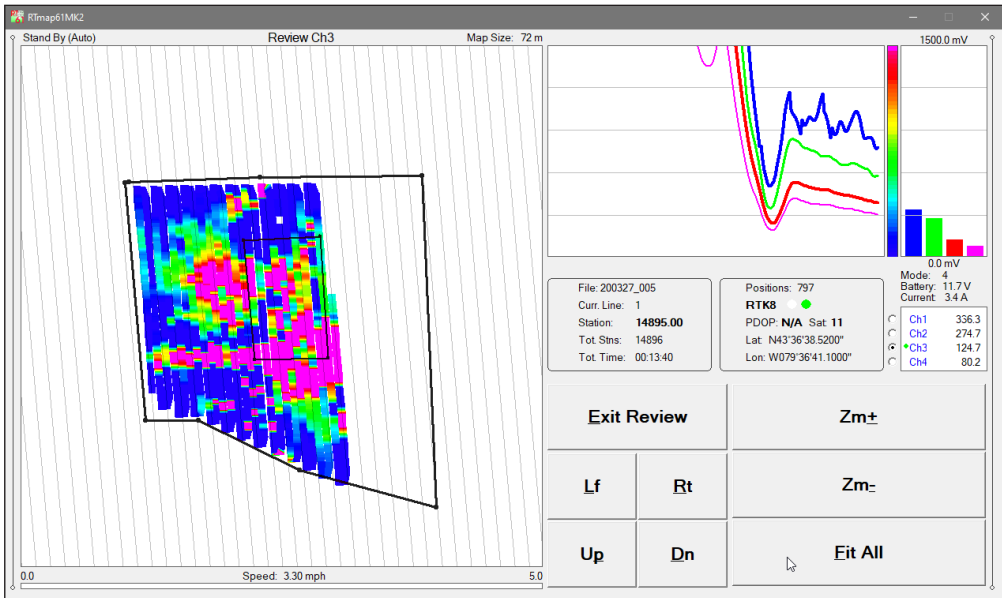


Figure 8.60: Executing the Fit All option in Review mode

(percentage of the current map scale) is the same as a Band Cursor in Map Scale dialog.

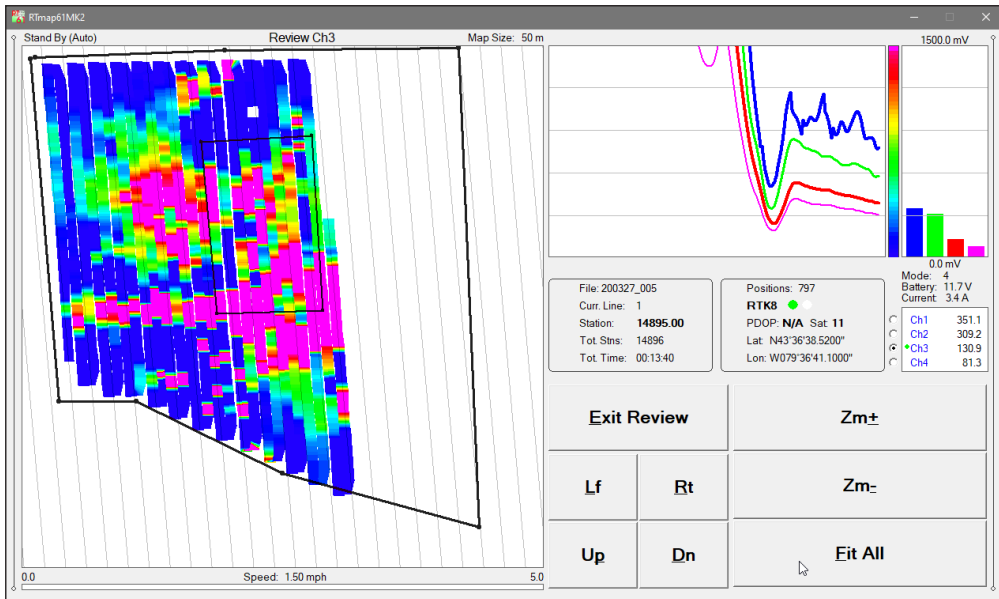


Figure 8.61: A map after multiple Zoom+ and Pan actions

To exit Review mode and return to Stand By mode tap or click on the button **Exit Review**. The label **Navigate** will be replaced by label **Panning**, zooming buttons will be disabled, map will return to the former size (scale), and cursor (cross) indicating current position of the system will appear.

## 8.6 No Connection Message

A message **No Connection** may appear during any RTmap61MK2 logging mode (Monitoring, Stand By, or Log modes). The message **Lost Connection, trying** (Figure 8.62) is displayed in the numeric values window and replaces displayed values. The message is highlighted by red to alert operator, and audio alarm sounds if enabled.

This message indicates lack of communication between the EM61-MK2 console and the field computer. In most cases the message **Lost Connection** is caused by disconnected connector in the instrument cable, turning the instrument OFF, or low battery in the EM61-MK2. The program tries to re-establish communication while the message is displayed. After correcting the source of a problem the program automatically connects to the EM61-MK2, checks performance, and then the program returns to normal operation.

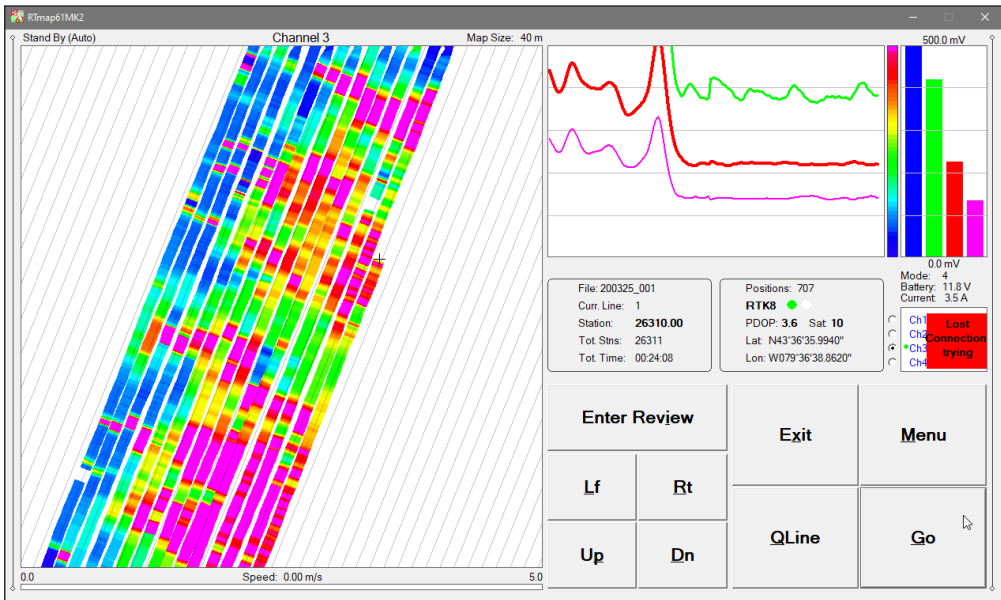


Figure 8.62: Message No Connection for the EM61-MK2 unit

When the source of the problem cannot be corrected please return program to Stand By mode (if in Log mode) and then use the **Exit** button (few clicks on the button may be required, pressing keyboard key **X** provides faster response in this case), the program will properly close open data file (if Logging session is not in Stand By) and the program will exit logging session. If data is monitored or logged (in Monitoring, Stand By, or Logging modes) a message **Lost Connection** may appear in the centre of the screen when connection with the EM61-MK2 is lost permanently.

## 8.7 No Connection for GPS Receiver

The alert that indicates lack of communication between the GPS receiver and the field computer is shown as red highlight of all GPS parameters displayed in the RT-map61MK2 screen (Figure 8.63). In most cases this message is caused by disconnected connector in the cable, turning the GPS receiver OFF, or low battery in the receiver. The program tries to re-establish communication while the message is displayed. After correcting the source of a problem the program automatically connects to the GPS receiver, checks performance, and then the program returns to normal operation.

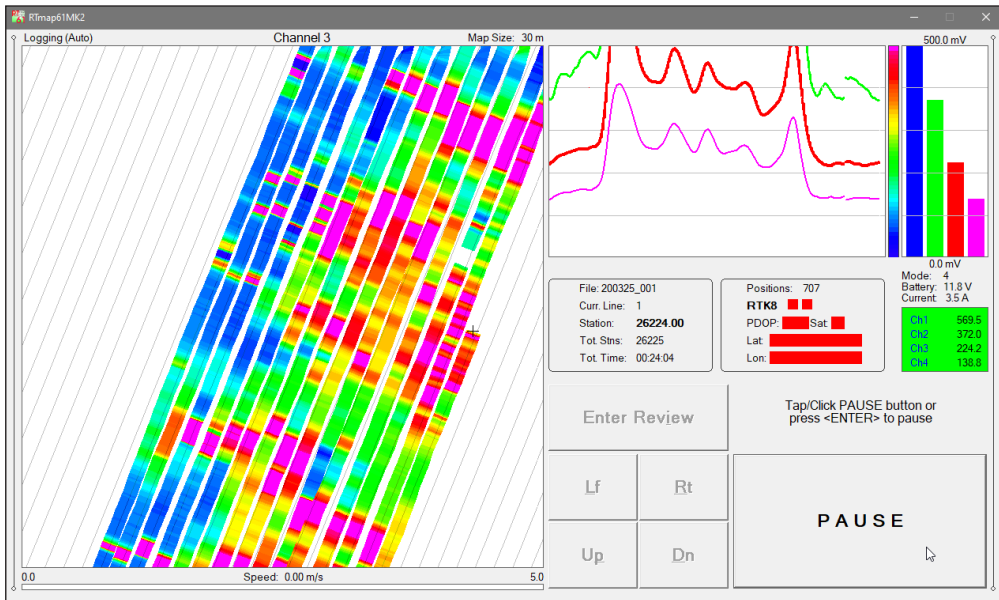


Figure 8.50: The RTmap61MK2 screen indicating lack of connection between GPS receiver and the computer

When the source of the problem cannot be corrected please return program to Stand By mode (if in Log mode) and then use the **Exit** button (few clicks on the button may be required, pressing keyboard key **X** provides faster response in this case), the program will properly close open data file (if Logging session is not in Stand By) and the program will exit logging session.

# RTmap61MK2 Data File



## A.1 Description of RTmap61MK2 Data File Format (T61)

Each record created by the RTmap61MK2 program contains 27 characters, including line feed at the end of each record.

**Header of the file contains 9 records starting with characters R, H, G, G, G, and then four records starting with 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	25	26	27	
R	T	M	M	K	2			W	2	1	5	Survey Type	UT	IT	IM	ST						DD				10	
H																											10
G																											10
G																											10
G																											10
O																											10
O																											10
O																											10
O																											10

- RTM61M - identification of program file, if rTM61M (lower case r) is present later in the file, it indicates start of appended file header
- W201 - version number (V2.15)
- Survey Type - GPS (if GPS Input Enabled) or GRD (grid)
- UT - unit type (0 = meters, 1 = ft, 2 = US Survey ft)
- IT - sensor size  
(0 = 1 x 1 m, 1 = 1 x 0.5 m, 2 = 0.5 x 0.5 m)
- IM - not used in this version (0 = Auto mode)
- ST - instrument type (=0 fixed, not used)
- DD - display decimation factor (not used)
- File Name - file name, maximum 8 characters

- Time - this field depends on EM61-MK2 survey mode  
Auto Mode - Time Increment in seconds
- TG - File tag (space=original, 1=Saved As / edited)
- GPS X Offset - Offset of GPS antenna in X direction
- GPS Y Offset - Offset of GPS antenna in Y direction
- GP - type of GPS NMEA message  
(0 = GGA/GSA, 1= GGA, 2 = POS, 3 = LLK,  
4=LLQ, 5=GLL, 6 = GGK, 7 = Leica TPS)
- GS - GPS state (0=disabled, 1=Enabled, >1 indicates  
averaging number for GXY files)
- GR - GPS update rate (= 0, fixed, not used)
- O - nulling value for corresponding channel
- 10 - Line Feed character

**Header at the start of survey line (contains four records starting with L, B, A, and Z)**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
<b>L</b>	Line Name - 8 characters																								<b>10</b>		
<b>B</b>	Start Station (Format F11.2)																								<b>10</b>		
<b>A</b>	Dir							Increment (Format F11.3)												<b>10</b>							
<b>Z</b>	D	D	M	M	Y	Y	Y	Y		H	H	:	M	M	:	S	S	.	h	h							<b>10</b>

- Line Name - Line Name, maximum 8 characters
- Start Station - Start Station for the Line, format F11.2
- Time - Time when Line was created in milliseconds
- 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 - Time when Line was created, format HH:MM:SS.hh
- 10 - Line Feed character

**Timer Reset**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
*	Computer Time (Format HH:MM:SS.hh)												Time Stamp in ms (10 digits)												<b>10</b>	

Indicates reset time of the program timer. This record links timer in milliseconds and computer time (local time) in format HH:MM:SS.hh. This record is written to the file each time after the program switches from the Stand By to Log mode. In case when data are taken continuously the timer is automatically reset every hour.

## 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	25	26	27
<b>I</b>	Gn	1h	1l	2h	2l	3h	3l	4h	4l	5h	5l	6	7h	7l	8	Time Stamp in ms (10 digits)										<b>10</b>

- I** - indicator (one ASCII character). Number of the ASCII character represents type of reading (standard or Hand Held sensor and Mode 4 or D), and presence of fiducial marker.
  
- 84** - Standard, Mode 4, channels 1, 2, 3, 4
- 68** - Standard, Mode D, channels 1, 2, 3, T
- 69** - Hand Held, Mode 4, channels 1, 2, 3, 4
- 70** - Hand Held, Mode D, channels 1, 2, 3, T
- 77** - Standard, Mode 4, channels 1, 2, 3, 4 Marker
- 78** - Standard, Mode D, channels 1, 2, 3, T Marker
- 80** - Hand Held, Mode 4, channels 1, 2, 3, 4 Marker
- 81** - Hand Held, Mode D, channels 1, 2, 3, T Marker
  
- Gn** - one character parameter (Hex format), contains Gain, see table of ranges at the end of this section.
  
- 1h** - higher byte of the 2's complement Hex number of Channel 1
- 1l** - lower byte of Channel 1
  
- 2h** - higher byte of the 2's complement Hex number of Channel 2
- 2l** - lower byte of Channel 2
  
- 3h** - higher byte of the 2's complement Hex number of Channel 3
- 3l** - lower byte of Channel 3
  
- 4h** - higher byte of the 2's complement Hex number of Channel 4
- 4l** - lower byte of Channel 4
  
- 5h** - higher byte of the 2's complement Hex number of TX averaged current
- 5l** - lower byte of TX averaged current
  
- 6** - fraction of averaged current (5h 5l), Hex number
  
- 7h** - higher byte of the 2's complement Hex number of TX current
- 7l** - lower byte of TX current
  
- 8** - instrument battery voltage, Hex number
  
- Time** - time stamp of the reading in milliseconds, this is time elapsed from the start (creation) of the current data. The time in milliseconds can be linked with the computer local time by using Times in lines B and Z of Line Header.
  
- 10** - Line Feed character

### Comment

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
<b>C</b>	Comment (maximum 11 characters)																Time Stamp in ms (10 digits)					<b>10</b>				

### New Station

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
<b>S</b>	New Station (Format 11.2)																Time Stamp in ms (10 digits)					<b>10</b>				

### Internal Readings

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
{	<b>a</b>	Internal Position of an Element (Format 14.3)																Time Stamp in ms (10 digits)					<b>10</b>			

These records (curly brackets) are used only internally during data collection to speed up map re-drawing in real time.

### Records starting with X

Several informative records, for example X\$STARTED indicates start of Logging mode, X\$PAUSED indicates Pause (activated by Pause key stroke), etc.

### GPS Data Message Records

Each GPS record (NMEA Message) is broken in to several 25 characters strings and placed in the RTmap61MK2 data file which contains 27 characters records, including one character indicator and line feed at the end of each record. The GPS sequence starts at the line which contains the character @ as the first character, then records that contain a continuation of the same message start with the character #. The GPS sequence ends with a line starting with the character !. The last line contains sequential number of GPS recorded position and a logger time stamp for the given GPS reading. A sample of the GGA (one of GPS messages) written in RTmap61MK2 format is given below.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
@	\$	G	P	G	G	A	,	h	h	m	m	s	s	.	s	s	,	d	d	m	m	.	m	m	m	<b>10</b>
#	m	m	,	s	,	d	d	d	m	m	.	m	m	m	m	,	s	,	n	,	q	q	,	p	<b>10</b>	
#	p	.	p	,	s	a	a	a	a	a	.	a	a	,	u	,	±	x	x	x	x	.	x	,	M	<b>10</b>
#	,	s	s	s	,	a	a	a	*	c	c	CR	LF											<b>10</b>		
!	0	0	4	3	5											Time Stamp in ms (10 digits)					<b>10</b>					

The GPS sequence may contain 4 to 7 records. The components of the GGA message may differ in length, however they are placed in the same number of columns. Refer to Appendix B (section B.2) for the definition of each component of the GGA data message. Other available GPS messages in NMEA format, GSA, POS, LLK, LLQ, GLL, and GGK, are recorded similarly. The structure of these NMEA sentences is given in section B.2 of Appendix B.

If the Checksum in NMEA message is invalid then starting character @ is replaced by ?, and # is replaced by " (ASCII character code 34). The starting character of Time Stamp record ! remains the same.

## A.2 Conversion Factors

---

EM61M 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  
 DATA (1 to 4) - instrument output for each channel as recorded in logger  
 RANGE - range is controlled by the EM61-MK2, it can be 1, 10, or 100

**EM61-MK2** - **Mode 4** (One Sensor 1 x 0.5 m or 1 x 1 m)  
 Channel 1= $(DATA1 \times 4.8333 \times 2)/RANGE$   
 Channel 2= $(DATA2 \times 4.8333 \times 2)/RANGE$   
 Channel 3= $(DATA3 \times 4.8333 \times 2)/RANGE$   
 Channel 4= $(DATA4 \times 4.8333 \times 2)/RANGE$

**EM61-MK2** - **Mode D** (Two Sensors 1 x 0.5 m or 1 x 1 m, Top and Bottom coils)  
 Channel 1= $(DATA1 \times 4.8333 \times 2)/RANGE$   
 Channel 2= $(DATA2 \times 4.8333 \times 2)/RANGE$   
 Channel 3= $(DATA3 \times 4.8333 \times 2)/RANGE$   
 Channel T= $(DATA4 \times 4.8333 \times 4)/RANGE$   
 if coil is 1 x 0.5 m Channel T is further multiplied by a factor 1.117.

Further each channel is normalized by current following formula:

**EM61-MK2** Channel = Channel x 3000/Current  
 where, current is a value represented by **5h**, **5l**, and **6** in reading record of RTmap61MK2 data file (see section A.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 RTmap61MK2 Data File

The RTmap61MK2 data file records are written in binary format, therefore characters may have a different shape when displayed or printed, depending on particular video or printer settings.

```
RTMMK2 W216GPS0000 1
H200327 001 0.100 0
G 0.00 0.00 010
G 612054.330 17
G 4829572.296
O 694.05
O 342.40
O 185.74
O 79.72
LO
B 0.00
AS 1.000
Z24022006 22:51:08
O 694.05 0.00
O 342.40 0.00
O 185.74 0.00
O 79.72 0.00
*22:51:08.000 321892745
@$PGSA,A,3,,23,25,20,16,
#14,,06,01,,,02.2,01.2,01.
#8*09
! 321894566
DyQñB. .î ‡^ <0 321894763
DyQCOA
© ‡ ‡0 321894964
DyRAST
:î ‡Y f0 321895165
DySif0 Đî ‡^ 0 321895366
@$PGGA,055055.00,4336.593
#76,N,07936.65029,W,2,7,1,
#139.98,M,-35,M,5,119*54
! 321895487
@$PGSA,A,3,,23,25,20,16,
#14,,06,01,,,02.2,01.2,01.
#8*09
! 321895544
DyRø, ç/ ‡X †0 321895567
DyRfp
)ä ‡a Š0 321895768
DyR6 / ^0 321895969
Xä
DySoæ
=b ‡0 321896170
DySy p/ ^ Š0 321896371
@$PGGA,055056.00,4336.593
#90,N,07936.65024,W,2,7,1,
#139.97,M,-35,M,6,119*52
! 321896486
@$PGSA,A,3,,23,25,20,16,
#14,,06,01,,,02.2,01.2,01.
#8*09
! 321896543
DyRd! ./ ^ 0 321896572
DyQ1X. Đ0 ^ Š0 321896773
DyQ"2Y
& ‡ 0 321896974
DyRq3@
o - Š0 321897175
DySA6ø ‡ ä ^ <0 321897376
.....
```

## A.4 Format of GXY Data File

---

The RTmap61MK2 data file with extension GXY contains GPS records. The structure of this file is identical to the standard RTmap61MK2 (T61) file. The difference is that it does not contain any EM61-MK2 records. This file is created by RTmap61MK2 when the EM61-MK2 option is Disabled in the System Setup menu. In this case the program acts as a GPS logging program.

It should be noted that any RTmap61MK2 data file, as well as GXY and data files created by other Geomar data acquisition programs (RTmap31, NAV31, NAV61MK2, ML61MK2xpn, etc.) can be used as an GXY file in the data processing programs RT-M61MK2. The extension name GXY indicates that the file does not contain electromagnetic data.

## A.5 Background File Format

---

The RTmap61MK2 program can display user prepared column delimited ASCII (text) format. It is assumed file contains columns of coordinates (columns order needs to be reflected in the program dialog) and use one of 4 column delimiter: Space, Comma, Tab, or Semicolon. Any row started with backslash "\" is recognized as comment and a row started by word "Break" (upper or lower case) is treated as a tag to break the continuity of line (assuming line connecting coordinates is selected in the dialog).

Sample #1 of background file format:

```
/UTM meters, Easting Col#1, Northing Col#2, delimiter comma  
612228.933,4829559.632  
612168.933,4829524.632  
612148.933,4829504.632  
612108.933,4829489.602  
612108.933,4829479.602  
break  
612149.933,4829459.602  
612168.933,4829449.602  
612228.933,4829417.602
```

Sample #2 of background file format:

```
/UTM meters, Easting Col#2, Northing Col#1, delimiter Space  
4829530 612080  
4829530 612020  
4829580 612020  
4829580 612075
```

---

# RTmap61MK2 and GPS Input

# B

---

## B.1 Using the RTmap61MK2 with a GPS System

---

The RTmap61MK2 program accepts input from GPS systems that stream NMEA-0183 compatible data through their output port. The program can use the following NMEA messages: pair GGA and GSA, GGA, POS, GLL, LLK, LLQ, and GGK. In addition to GPS NMEA statements RTmap61MK2 provides also interface to Leica Robotics Total Station TPS1100 and TPS1200 for areas where GPS signal is not accessible. To use Leica Robotics device select option "Leica TPS" in NMEA Data of the GPS Port Setup menu. The program writes entire message (that was selected in GPS Input menu) to the RTmap61MK2 data file. If the pair GGA/GSA is selected, both GGA and GSA messages are written to the RTmap61MK2 data file. The GSA message is used to display index PDOP (Position Dilution of Precision) on the logger screen and to determine quality of GPS position while processing data in the program RTM61MK2.

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 messages (GGA, POS, GLL, LLK, LLQ, GGK, or GGA and GSA) that are actually used by RTmap61MK2.** 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 data. Normally, the RTmap61MK2 running in Allegro CX logger uses less than 100 ms to process and record GPS data from the two NMEA messages, GGA and GSA.

If the particular GPS receiver is capable of sending data more than once a second, limit its output frequency to a maximum 1 Hz. At higher frequency of GPS data the program will be occupied by GPS activity and may not record all required EM61-M K2data. The RTmap61MK2 can record up to 15 EM61-MK2 readings and one GPS position per second with older units, and all 18 EM61-MK2 readings with units equipped with new Eprom. Data processing program TrackMaker61MK2 will interpolate EM61-MK2 stations between neighbouring GPS positions based on recorded time stamp.

To achieve higher speed of data acquisition it is also recommended to use single NMEA message (i.e. POS, LLK, GGK, or just GGA). In addition, if it is possible set faster Baud Rate for GPS, i.e. 19200 or 38400 instead of default value of 9600.

If the pair GGA/GSA is selected, only message GGA is necessary to position EM61-MK2 data. If message GSA is not available in a particular system, the RTmap61MK2 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. In this case it is better to select the message GGA which will provide display of index HDOP (Horizontal Position Dilution of Precision).

The RTmap61MK2 displays several parameters related to GPS status. A label **DGPS** (Differential Global Positioning System) in the program indicates that GPS readings are differentially corrected in real time. Label **AGPS** (Autonomous Global Positioning System) indicates lack of differential correction. There are more labels **RTK3**, **RTK4**, and **RTK5** (up to 10 - it indicates Quality parameter) and they correspond to GPS Quality Indicator 3, 4, and so on. Correction AGPS corresponds to Quality Indicator 1, and DGPS represents Quality Indicator 2. Corrections described by RTK3 and above correspond to Quality Indicator 3, 4, and so on (they have often different names for different brands of GPS receivers). See next section B.2 and GPS receiver documentation for detailed description and availability of this parameter.

On the right side of labels **DGPS**, **AGPS**, or **RTK** two small circles are displayed. These circles should alternate between green and white with the frequency of GPS update rate (usually 1 second intervals). If circle are still for a long period of time it means that the GPS system is not working or that it is not connected to the field computer. The number of recorded GPS positions are displayed on the right side of small green/white circles. This number is updated only in logging mode, when the data are recorded (in Stand By mode or during Monitoring alternating circles, updated GPS positions, index 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 open sky is less than 3, and most accuracies given for many GPS systems are given for this norm. The index called HDOP is related only to horizontal position fix. It is used when message GGA was selected. If a message GGL was selected the index PDOP nor HDOP are not available.

Refer to GPS documentation and literature for more information related to error sources of GPS positioning.

## B.2 Description of Selected NMEA 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:

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

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

## POS Data Message

---

The POS message contains the GPS position information and PDOP value. The POS message is given in the following form:

**\$PASHR,POS,n,qq,hhmmss:ss,ddmm.mmmmm,s,dddmm.mmmmm,s,saaaa.aa,seeeee,ttt,ggg,svvv,pp,hh,vv,tt,vvv\*cc<CR><LF>**

Definition of POS message components:

<b>n</b>	Quality indicator, 0 = no differentially corrected position, 1 = differentially corrected position
<b>qq</b>	Number of satellites used in position computation
<b>hhmmss:ss</b>	UTC time in hours, minutes, seconds of the GPS position
<b>ddmm.mmmmm</b>	Latitude in degrees, minutes, and decimal minutes
<b>s</b>	s=N or s=S, for North and South latitude
<b>dddmm.mmmmm</b>	Longitude in degrees, minutes, and decimal minutes
<b>s</b>	s=E or s=W, for East and West longitude
<b>saaaa.aa</b>	sensor computed altitude
<b>seeeee</b>	reserved

<b>ttt</b>	True track/true course over ground in degree
<b>ggg</b>	Speed over ground (knots)
<b>svvv</b>	Vertical velocity (decimeters per second)
<b>pp</b>	PDOP - position dilution of precision (00 to 99)
<b>hh</b>	HDOP - horizontal dilution of precision (00 to 99)
<b>vv</b>	VDOP - vertical dilution of precision (00 to 99)
<b>tt</b>	TDOP - time dilution of precision (00 to 99)
<b>vvvv</b>	firmware version ID
<b>*cc</b>	Checksum
<b>&lt;CR&gt;&lt;LF&gt;</b>	Carriage return and Line feed

## LLK Data Message

---

The LLK (Leica Local Position and GDOP) message provides position in local coordinates in meters and GDOP value. The LLK message is given in the following form:

**\$GPKLLK,hhmmss.ss,ddmmyy,xxxx.xxxx,M,xxxx.xxxx,M,x,x,xx.xx,xxxx.xxxx,M,  
\*cc<CR><LF>**

Definition of LLK message components:

<b>hhmmss.ss</b>	UTC time in hours, minutes, seconds of the GPS position
<b>ddmmyy</b>	UTC date (day, month, year)
<b>xxxx.xxxx</b>	Grid Easting, meters
<b>M</b>	Meters (fixed text "M")
<b>xxxx.xxxx</b>	Grid Northing, meters
<b>M</b>	Meters (fixed text "M")
<b>x</b>	Quality indicator, 0 = not valid, 1 = GPS Nav Fix (no differentially corrected position), 2 = DGPS Fix (differentially corrected position), 3 = RTK Fix
<b>x</b>	Number of satellites used in computation,
<b>xx.xx</b>	GDOP
<b>xxxx.xxxx</b>	Height, meters
<b>M</b>	Meters (fixed text "M")
<b>*cc</b>	Checksum
<b>&lt;CR&gt;&lt;LF&gt;</b>	Carriage return and Line feed

## LLQ Data Message

---

The LLQ (Leica Local Position and Quality) message provides position in local coordinates in meters and position quality in meters. The LLQ message is given in the following form:

**\$GPLLQ,hhmmss.ss,ddmmyy,xxxx.xxxx,M,xxxx.xxxx,M,x,x,xx.xx,xxxx.xxxx,M,\*cc<CR><LF>**

Definition of LLQ message components:

<b>hhmmss.ss</b>	UTC time in hours, minutes, seconds of the GPS position
<b>ddmmyy</b>	UTC date (day, month, year)
<b>xxxx.xxxx</b>	Grid Easting, meters
<b>M</b>	Meters (fixed text “M”)
<b>xxxx.xxxx</b>	Grid Northing, meters
<b>M</b>	Meters (fixed text “M”)
<b>x</b>	Quality indicator, 0 = not valid, 1 = GPS Nav Fix (no differentially corrected position), 2 = DGPS Fix (differentially corrected position), 3 = RTK Fix
<b>x</b>	Number of satellites used in computation,
<b>xx.xx</b>	Position quality, meters
<b>xxxx.xxxx</b>	Height, meters
<b>M</b>	Meters (fixed text “M”)
<b>*cc</b>	Checksum
<b>&lt;CR&gt;&lt;LF&gt;</b>	Carriage return and Line feed

## GLL Data Message

---

The GLL message takes the following form:

**\$GPGLL,ddmm.mmmmm,s,dddmm.mmmmm,s,hhmmss.ss,s\*cc<CR><LF>**

Definition of GLL message component:

**dddmm.mmmmm** Latitude in degrees, minutes, and decimal minutes  
**s** s=N or s=S, for North and South latitude

<b>dddmm.mmmmm</b>	Longitude in degrees, minutes, and decimal minutes
<b>s</b>	s=E or s=W, for East and West longitude
<b>hhmmss.ss</b>	UTC time in hours, minutes, seconds of the GPS position
<b>s</b>	Status, A = valid, V = invalid
<b>*cc</b>	Checksum
<b>&lt;CR&gt;&lt;LF&gt;</b>	Carriage return and Line feed

## GGK Data Message

---

The GGK message contains the GPS position, Time, Date, Position Type, and DOP information. The GGK shown below is not a standard NMEA data message and it is used in several Trimble GPS receivers. If this message is used as a standard NMEA statement by a given GPS receiver it starts with \$GPGGK and contains GDOP instead of DOP.

TrackMaker software automatically recognizes which type of GGK message is used.

The Trimble proprietary type of GGK message takes the following form:

**\$PTNL,GGK,hhmmss.ss,ddmmyy,ddmm.mmmmmmmmm,s,dddmm.mmmmmmmmm,s,n,qq,p,p,EHT-aa.aaa,M\*cc<CR><LF>**

Definition of GGK message component:

<b>hhmmss.ss</b>	UTC time in hours, minutes, seconds of the GPS position
<b>ddmmyy</b>	Date
<b>ddmm.mmmmmmmmm</b>	Latitude in degrees, minutes, and decimal minutes
<b>s</b>	s=N or s=S, for North and South latitude
<b>dddmm.mmmmmmmmm</b>	Longitude in degrees, minutes, and decimal minutes
<b>s</b>	s=E or s=W, for East and West longitude
<b>n</b>	GPS Quality indicator, 0 = fix not valid or not available, 1 = Autonomous GPS fix, no differentially corrected position, 2 = differential, floating carrier phase integer based solution (FLOAT), 3 = differential, fixed carrier phase integer-based solution (FIXED), 4 = differential, code phase only solution (DGPS)
<b>qq</b>	Number of satellites used in fix
<b>p.p</b>	DOP of fix

EHT-aa.aaa	Ellipsoidal height of fix
M	unit of measure for ellipsoidal height in meters
*cc	Checksum
<CR><LF>	Carriage return and Line feed

## B.3 Configuring Trimble GPS Pathfinder ProXRS System

---

The data output in the Trimble Pathfinder ProXRS receiver can be configured in Asset Surveyor software in Trimble field computer (TSC1, TDC1, or TDC2). The Asset Surveyor Operation Manual provides details of the NMEA output format.

While running Asset Surveyor software select NMEA/TSIP output options from the Communication options menu. In the NMEA/TSIP output options form for Output select **NMEA**. After the NMEA option is selected Asset Surveyor extends the NMEA/TSIP form. Select Baud Rate: **9600** and Output interval: **1s** (or larger if required). Below these parameters a list of available NMEA-0183 messages will be displayed. Enable only required messages: GGA and GSA, or only GGA.

After you save the contents of the NMEA/TSIP output options form with the Output parameter set to **NMEA**, the Pathfinder GPS receiver begins to stream selected NMEA-0183 messages at the specified Output interval.