

COMPUTER PROGRAM MANUAL
(SURVEY DATA REDUCTION MANUAL)

DAT38MK2

Version 1.34

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Geonics Limited

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

E-mail: geonics@geonics.com

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1. Introduction

Survey data reduction program DAT38MK2 for Geonics EM38-MK2 ground conductivity meter data operates under Windows 98/XP, and Windows 2000. DAT38MK2 supports EM38-MK2 data files which include Global Positioning System (GPS) data recorded directly in the Allegro CX logger operating under the control of program EM38MK2 for Windows CE.

1.1 About DAT38MK2

The program DAT38MK2 is designed to process data collected in the field computer Allegro CX using data acquisition program EM38MK2, program EM38MK2win for Mesa3, or data acquired directly in the computer through the RS232 interface (program EM38MK2xp). The program can be used to display, edit, print and plot data files. Data can be plotted on the computer screen and on any printer supported by Windows. There is also an option to create files that can be used as input for the GEOSOFT or SURFER contouring packages, or any other contour software, if three or more columns are required, then the [X, Y, data1, data2, data3, ...] format is suitable.

This Windows based version of DAT38MK2 provides an easy interface and information on the screen. The amount of readings are limited only by the capacity of a computer hard drive. It supports any printer or plotter that is supported by Windows.

EM38-MK2 readings are arranged in profile lines. Every profile line can consist of unlimited number of segments. Each profile line can contain up to eight separate curves: two for the Inphase and Quadrature (Conductivity) components, for each of the Vertical and Horizontal dipole modes, and an additional two for the different instrument coil separations (the latter not available for EM38-MK2-1 instrument version). Note that the Quadrature component is generally referred to as Conductivity in this manual.

One sample data file, TEST.M38 is included on the program disk. It allows the user to become familiar with running the DAT38MK2 program.

1.2 Contents of DAT38MK2 Distribution Disk

Program DAT38MK2 is supplied on one CD disk. Disk contains following files and directories:

- SETUP38M.EXE - setup program for DAT38MK2.
- Documentation - directory containing manuals available in PDF format
- EM38MK2.EXE - data acquisition program for the field computer Allegro CX

1.3 DAT38MK2 Software Installation

DAT38MK2 uses setup program to load files on your computer. The following section describes the installation process.

To install DAT38MK2 insert the DAT38MK2 CD disk into computer CD disk drive. Exit all Windows applications before installing the program.

From the Windows File Manager, select **Run** from the **File** menu. The Run dialog box opens (Figure 1.1).

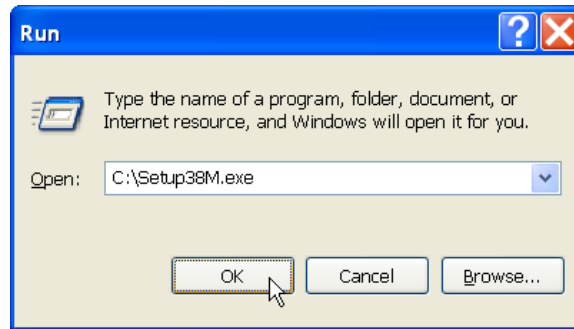


Figure 1.1 Run Dialog window

Browse for the file SETUP38M.EXE in the directory of the diskette. Click **OK** to launch the Setup program. Once the Setup determines your computer configuration the Welcome window opens (Figure 1.2).

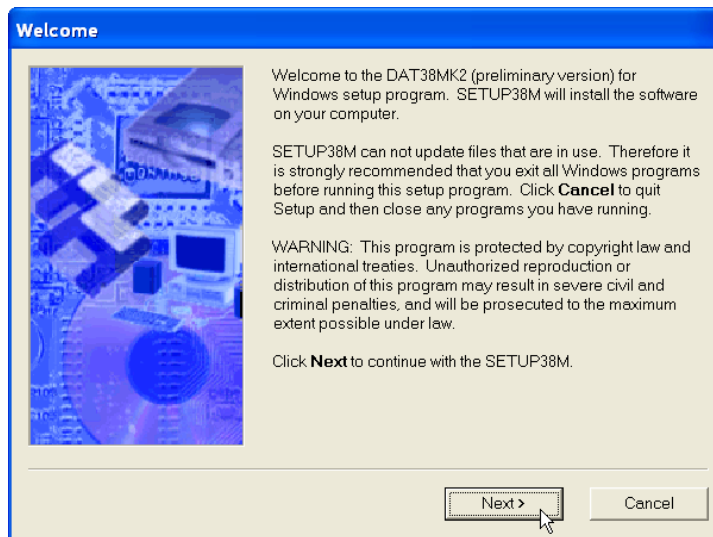


Figure 1.2 Welcome window

Read the text and click the **Next** button and the Installation Directory window opens (Figure 1.3).

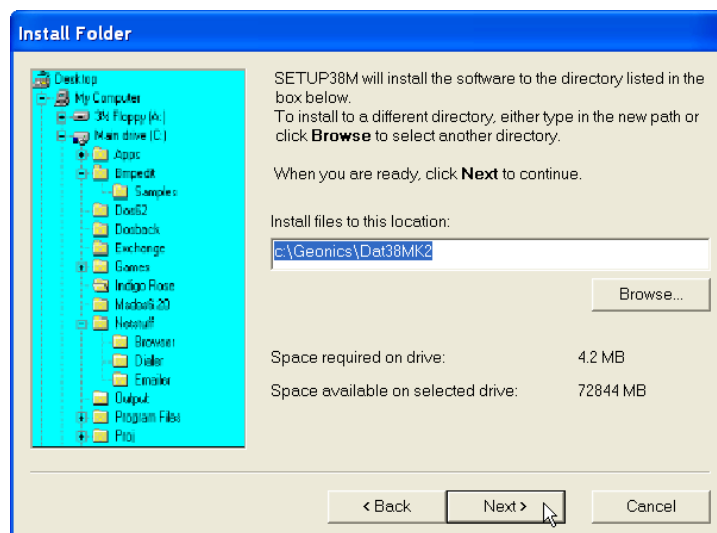


Figure 1.3 Installation Directory window

Some of program versions may support a Serial Number for the setup, in this case the Serial Number window would be displayed prior to the Installation Directory window.

The default directory is c:\Geonics\DAT38MK2. Click the **Next** button to install the program to this directory. If you wish to install DAT38MK2 to another directory, click the **Browse** button and the Select Installation Directory window will open (Figure 1.4).

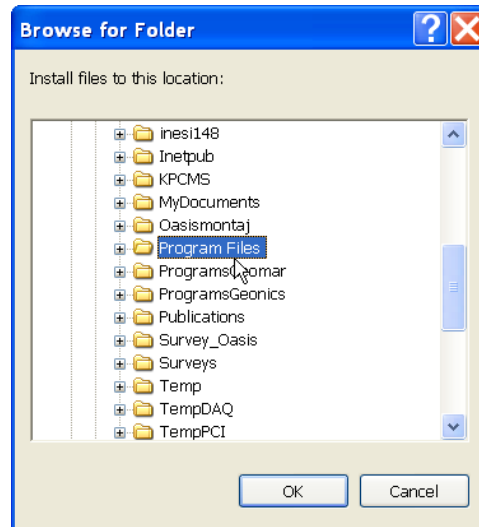


Figure 1.4 Select Installation Directory window

Select a target directory and click **OK**. The Select Installation Directory window closes, and the Installation Directory window opens with the selected directory listed. Click the **Next** button. The Select Short cut Folder window opens (Figure 1.5).

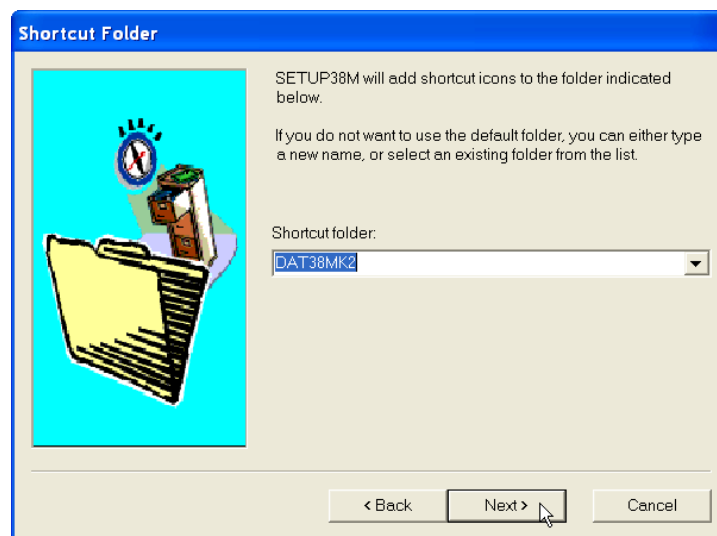


Figure 1.5 Select Shortcut Folder window

Select a target directory and click **OK**. The Select Installation Directory window closes, and the Installation Directory window opens with the selected directory listed. Click the **Next** button. The Select Shortcut Folder window opens (Figure 1.6).

The setup program will create a DAT38MK2 menu item in the Program menu accessible by clicking **Start**. If you do not want to use the proposed folder, you can either enter a new name, or select an existing folder from the list. Click **Next** and Ready to Install window will follow.

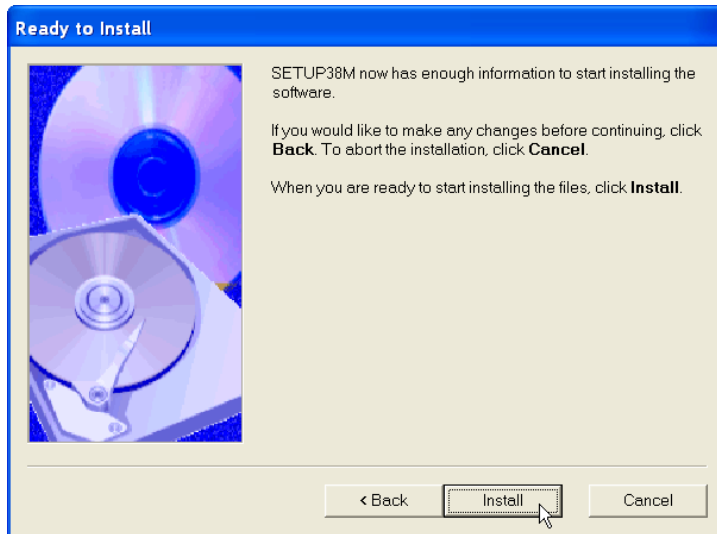


Figure 1.6 Ready to Install window

In case you would like to make any changes before installation, click **Back**. To abort installation click **Cancel**. If you are ready to start installation, click **Finish**. The installation progress bar will appear (Figure 1.7).

The Installing Files window with a progress bar displays the percentage of the installation completed.

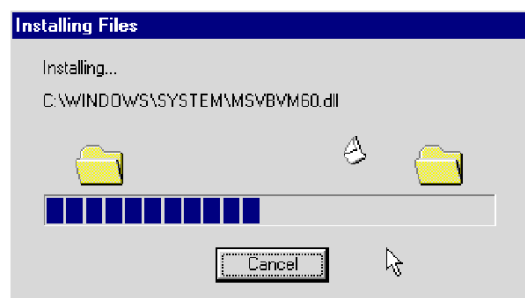


Figure 1.7 Installing Files progress bar

When finished, the End of Installation window will appear (Figure 1.9).

Click **Finish** to end installation. SETUP38M creates a DAT38MK2 program group and places

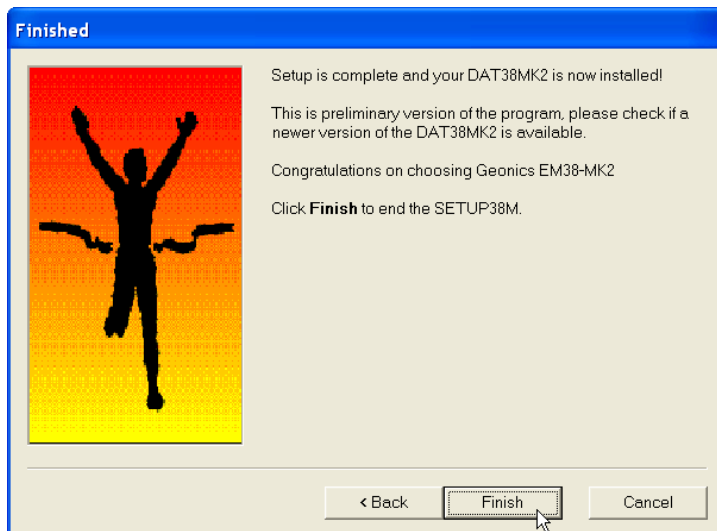


Figure 1.9 Finished window

DAT38MK2 and **Uninstall** icons into it. The setup program creates also a **DAT38MK2** menu item in the Program menu accessible by clicking **Start**. A reminder to restart the system may be displayed on some systems at the end of the Setup38M program.

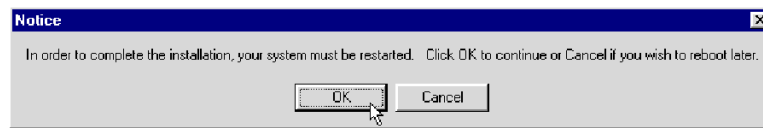


Figure 1.10 Restart Notice window

The destination directory that was chosen earlier contains other program files, sample files, and the subdirectory Allegro CX that includes data acquisition program for Allegro CX.

1.4 Data File Transfer

Data files are saved in the Allegro CX with extension N38. Transfer of files to desktop PC can be performed with MS ActiveSync or by PC memory card. Data files with extension N38 are binary raw data files. These files have to be converted to DAT38MK2 format with extension M38 (option “Convert” in DAT38MK2). Files in M38 format can be loaded and processed in the DAT38MK2.

Please do not open binary N38 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, please retain raw binary files till the end of the project. If any problem will arise binary files in N38 format contain all necessary information that allows to trace potential problem.

1.5 Program Overview

Start the DAT38MK2 by double clicking the DAT38MK2 icon in the **Start|Programs** menu, in Windows Explorer, or on the desktop if a shortcut was created. At the start, DAT38MK2 occupies the entire screen (Figure 1.11):

The DAT38MK2 defaults to a maximized screen and clicking the minimize button allows access to other applications behind DAT38MK2. At this point, the user can:

- convert raw binary data files (N38) to DAT38MK2 format M38,
- load data DAT38MK2 profile files (.M38 files) and display in form of stacked profiles,
- display the DAT38MK2 program version,
- exit the program.

After DAT38MK2 profile file (M38) is loaded the program menu expands and several more options become available. Twenty separate data files can be loaded and displayed concurrently by the present version of the program. The DAT38MK2 with displayed profile window has following shape (Figure 1.12). At this stage, the user can:

- save, or save as files after editing,
- print profiles on any Windows supported printer,
- manage survey lines: specify selection of survey lines that will be displayed, rename and delete survey lines,

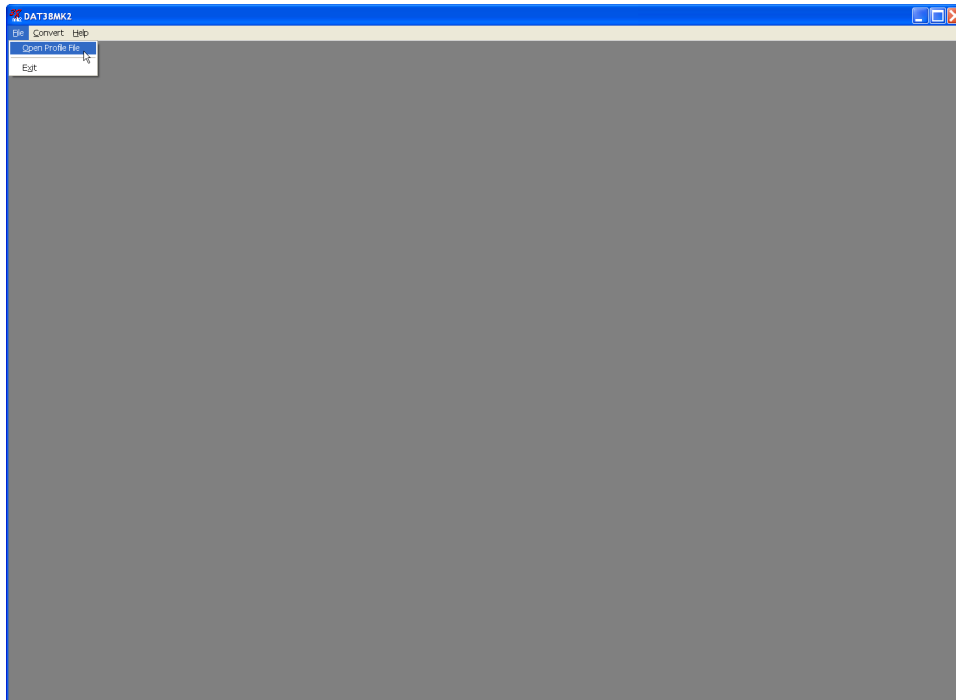


Figure 1.11 DAT38MK2 Initial screen

- display profiles with selected parameters (component, dipole mode, and coil separation),

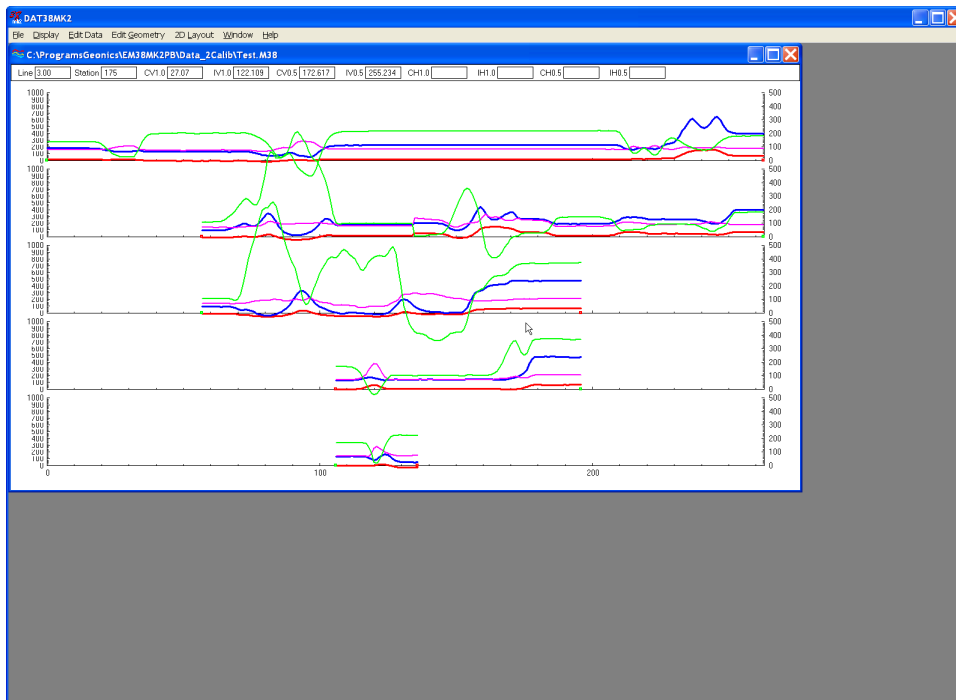


Figure 1.12 DAT38MK2 screen after profile file is loaded

- specify range of values and axes tics, separately for stations, Conductivity, and Inphase,
- display grid lines, separately for each component,
- change colours and thickness of lines for each component/dipole mode/coil separation combination,
- shift selected data set Up or Down in user specified steps, selection applies to survey lines

- as well as to any combination of component, dipole mode, and coil separation,
- edit survey geometry: set line limits, shift survey lines left or right, and position markers and line ends,
 - export data set to XYZ file based on grid positioned data (based on survey line names as one coordinate and station numbers as another coordinate),
 - export data set to XYZ file based on embedded GPS positions.

A stacked profile display can be enlarged to occupy the entire screen by clicking the maximize button as shown in Figure 1.13.

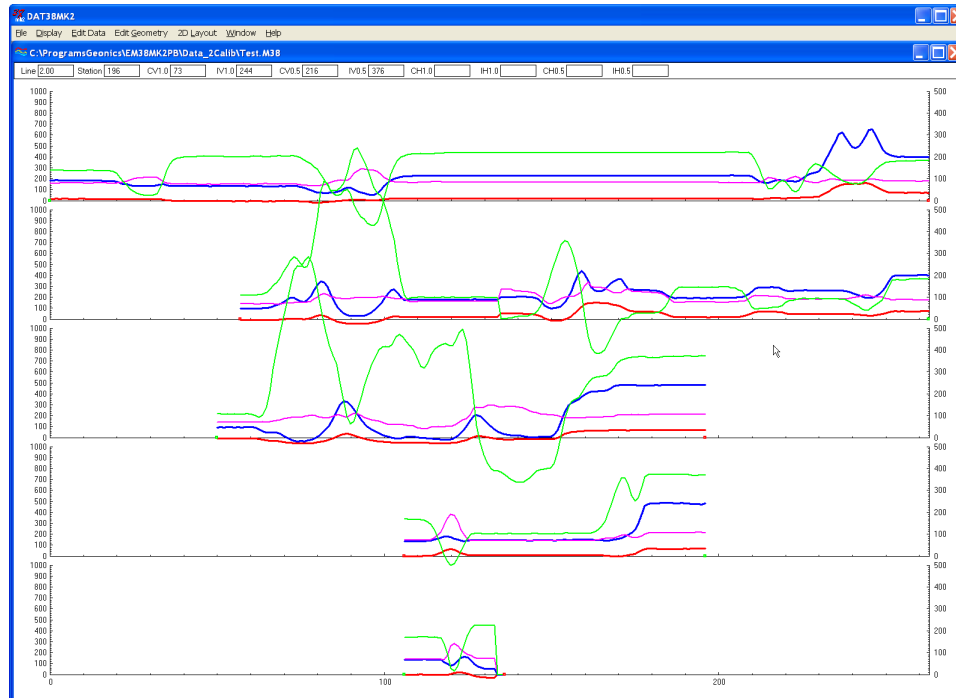


Figure 1.13 DAT38MK2 screen with maximized profile window

2. Quick Start

This chapter is intended for users who wish to quickly start downloading and editing an EM38-MK2 survey with the files necessary to collect field data. Detailed information about all functions and capabilities of the program is given in later sections. It is assumed that the field computer Allegro CX was loaded with files necessary to collect field data.

2.1 Transfer Raw Data Files and Convert File Format

The data acquisition program EM38MK2, operating in the field computer, saves readings in a raw (binary) files format which are given the extension name N38. Transfer of raw files from the Allegro CX field computer to desktop PC can be performed with MS ActiveSync or by PC memory card. The latter method provides faster and much more convenient transfer of data files. The default data folder in the Allegro CX is named DATA38MK2. This folder is created in the Allegro after the data acquisition program is run for the first time and data files in raw (binary) format are placed in this folder.

DAT38MK2 uses the ASCII format of data files. These files are given the extension name M38. When the binary (raw) data file is transferred from the field computer it must be converted to DAT38MK2 (M38) format. An option called **Convert** allows you to convert the raw data files (N38) to ASCII files (M38).

This function is also useful if the data acquisition program, EM38MK2xp, is used on a laptop field computer. In this case transfer of raw data files is not applicable and data files saved in N38 format can be rewritten to M38 using the Convert option. These M38 files can be loaded to the DAT38MK2 program in the same computer.

To convert N38 files select **Convert** in the program menu and then select the **Convert Raw (N38) Files to Profile (M38) Files** item. The Convert EM38-MK2 Allegro Files to M38 Format window will appear (Figure 2.1).

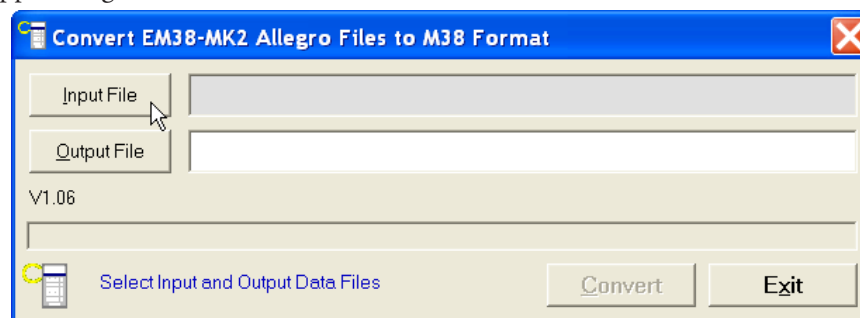


Figure 2.1 Convert EM38-MK2 Allegro Files to M38 Format window

Select the file to be converted by clicking on the **Input File** button. An open file window will appear with list of available N38 files. In a similar way click on the **Output File** button and specify the output file name with extension M38. After both files are displayed in the corresponding text windows the button **Convert** will be activated. When the **Convert** button is clicked the selected N38 file is converted to M38 format. This file can be subsequently loaded to the program as a “Profile” file.

The above procedure can be repeated for any number of remaining raw data files to be converted.

2.2 Displaying Data as Profiles

Loading and Displaying Data Files

To display data, select **File | Open Profile File** in the DAT38MK2 program menu. The **Open EM38-MK2 File** window will be displayed (Figure 2.2).

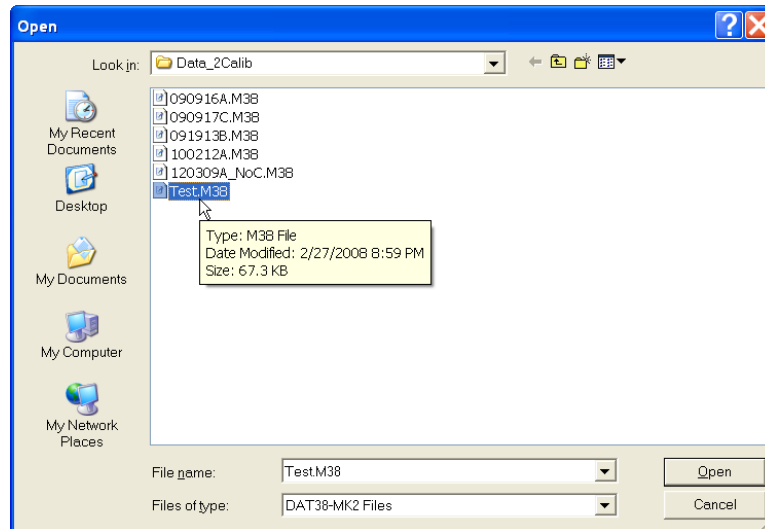


Figure 2.2 Open EM38-MK2 File window

Select a directory and file name and then click on **Open** (you can also simply double click the left mouse button or press **Alt_O** on the keyboard). The **Open EM38-MK2 File** window displays available files with the extension name M38.

After the file is loaded, data is displayed in the stacked profile format shown in Figure 2.3. Survey lines are organized in panels, which contain recorded data. In general, each survey line belongs to a separate panel, although, in the case where two or more survey lines have the same line name and same instrument mode, they will be placed in the same panel. In order to display these lines in separate panels the line names must be changed. A sequence of small windows located below the program menu displays current Line Name, Station, and values of all readings at survey line and station pointed by mouse cursor.

Each panel will include one or more data types (channels, each channel is combination of component, dipole mode, and coil separation) as specified in the Select Data Type window. This window can be access from the main menu by selecting **Display|Select Data Type**. See Select Data Type section below.

This description of the EM38-MK2 data types is used through the entire program in several windows. Each data type (channel) is described by an abbreviation:

CV1.0m	-	Conductivity,	Vertical Dipole mode,	Coil Separation 1.0 m
CV0.5m	-	Conductivity,	Vertical Dipole mode,	Coil Separation 0.5 m
CH1.0m	-	Conductivity,	Horizontal Dipole mode,	Coil Separation 1.0 m
CH0.5m	-	Conductivity,	Horizontal Dipole mode,	Coil Separation 0.5 m
IV1.0m	-	Inphase,	Vertical Dipole mode,	Coil Separation 1.0 m
IV0.5m	-	Inphase,,	Vertical Dipole mode,	Coil Separation 0.5 m
IH1.0m	-	Inphase,	Horizontal Dipole mode,	Coil Separation 1.0 m
IH0.5m	-	Inphase,	Horizontal Dipole mode,	Coil Separation 0.5 m

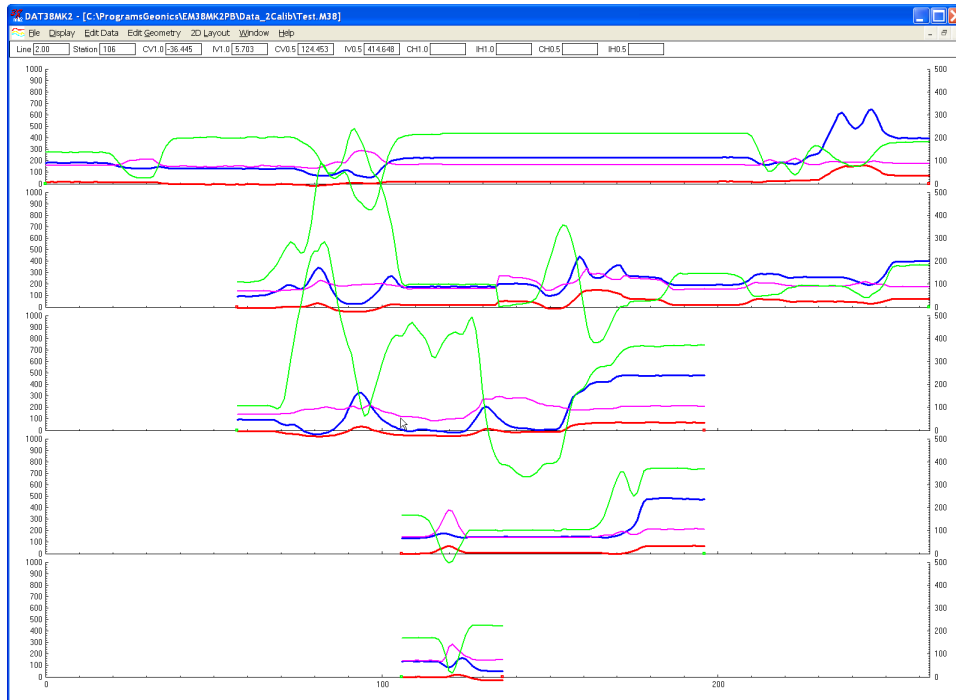


Figure 2.3 DAT38MK2 screen with stacked profiles

By default all channels are displayed for all survey lines. The left vertical axis relates to the EM38-MK2 apparent conductivity (Quad-phase component) and it is labeled in millisiemens per meter (mS/m), while right axis corresponds to the EM38-MK2 Inphase response and it is labeled in parts per thousands of Primary Field (ppt).

Selecting Survey Lines

When a data file is loaded, all survey lines are profiled. To display a selection of available survey lines select **Display>Select Lines** in the program menu. The Select Survey Lines window is shown in Figure 2.4.

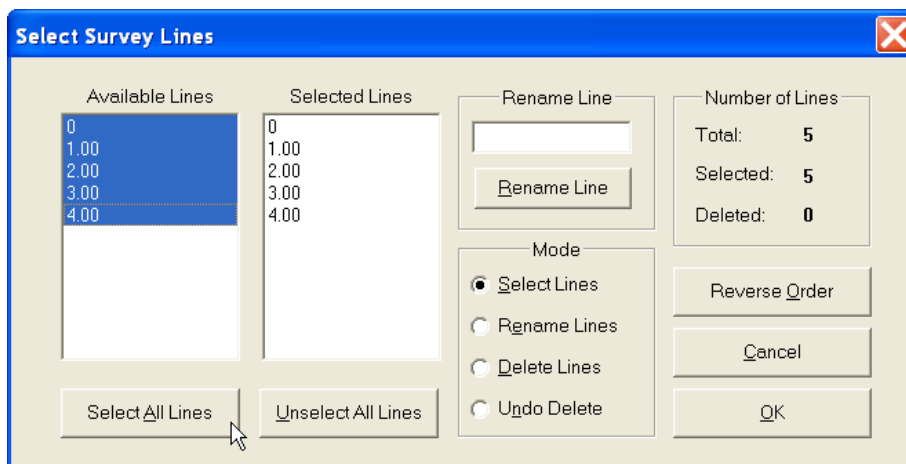


Figure 2.4 Select Survey Lines window

Select and deselect lines to be displayed, by clicking on the line names in list boxes labeled **Available Lines** and **Selected Lines**. Buttons **Select All** and **Unselect All** are also available. All highlighted line names will be profiled on the screen after clicking on the **OK** button.

Deleting and Renaming Survey Lines

The most common initial task in data processing is deleting and renaming survey lines. Both tasks can be accomplished in the **Select Lines** window (Figure 2.4).

To delete a survey line from the loaded set of data, click on the radio button labeled **Delete Lines** located in the section labeled Mode. When the radio button is checked, click on the appropriate line name in the Available Lines list box. The letter **D** will be displayed next to the line name. These lines will not be displayed nor written to the output file during **Save** or **Save As** tasks.

Survey lines also can be renamed in the Select Lines window. Click on the radio button labeled **Rename Lines** and then click on the line name in the Available Lines list box. The highlighted line name will appear in the edit box located in the Rename Line section. Edit the name in the Edit Box and click the **Rename Line** button. The updated name will now be displayed in both line names list boxes.

Please refer to section 3 (Data Display) for a detailed description of the Select Survey Lines window.

Please note that Deleted and Renamed lines will be valid as long as the program is running. In order to save changes permanently use “Save As” or “Save” option to create a new data file which can be used later by the program. It is recommended that you use “Save As” and keep the original data in an unedited form.

Selecting Data Types to Display

To select the type of data to be displayed select the **Display|Select Data Type** from the program top menu. The Select Data Type window will appear as shown in Figure 2.5.

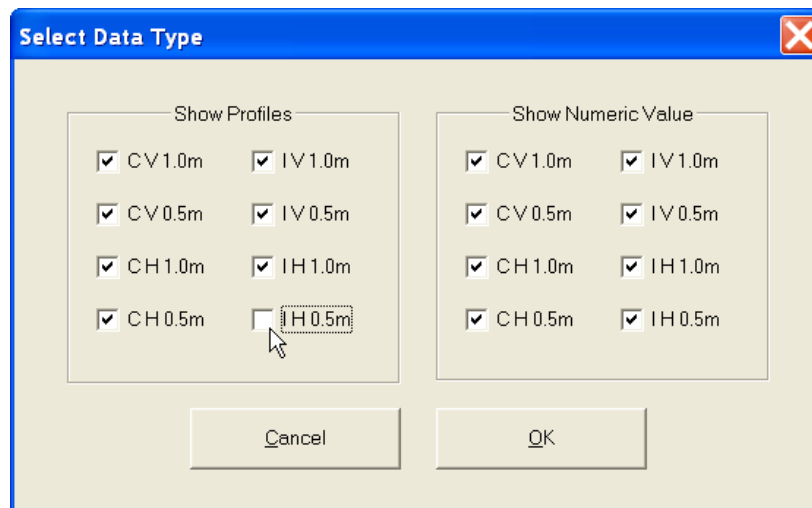


Figure 2.5 Select Data Type window

The Select Data Types window contains check boxes for each type of EM38-MK2 data (sometimes named channel). Each Type is described by an abbreviation:

CV1.0m	-	Conductivity,	Vertical Dipole mode,	Coil Separation 1.0 m
CV0.5m	-	Conductivity,	Vertical Dipole mode,	Coil Separation 0.5 m
CH1.0m	-	Conductivity,	Horizontal Dipole mode,	Coil Separation 1.0 m
CH0.5m	-	Conductivity,	Horizontal Dipole mode,	Coil Separation 0.5 m

IV1.0m	-	Inphase,	Vertical Dipole mode,	Coil Separation 1.0 m
IV0.5m	-	Inphase,,	Vertical Dipole mode,	Coil Separation 0.5 m
IH1.0m	-	Inphase,	H orizontal Dipole mode,	Coil Separation 1.0 m
IH0.5m	-	Inphase,	H orizontal Dipole mode,	Coil Separation 0.5 m

The Select Data Type window is divided into two sections, Show Profiles and Show Numeric Values. The profile section lets you select channels to be displayed as profiles. Data Types selected in the Show Numeric Values section of the **Select Data Type** window (Figure 2.5) will be displayed in display boxes located under the menu bar.

Changing Display Parameters

To adjust the range of displayed parameters select **Display|Set Display Parameters** in the program menu. The **Set Display Parameters** window is shown in Figure 2.6.

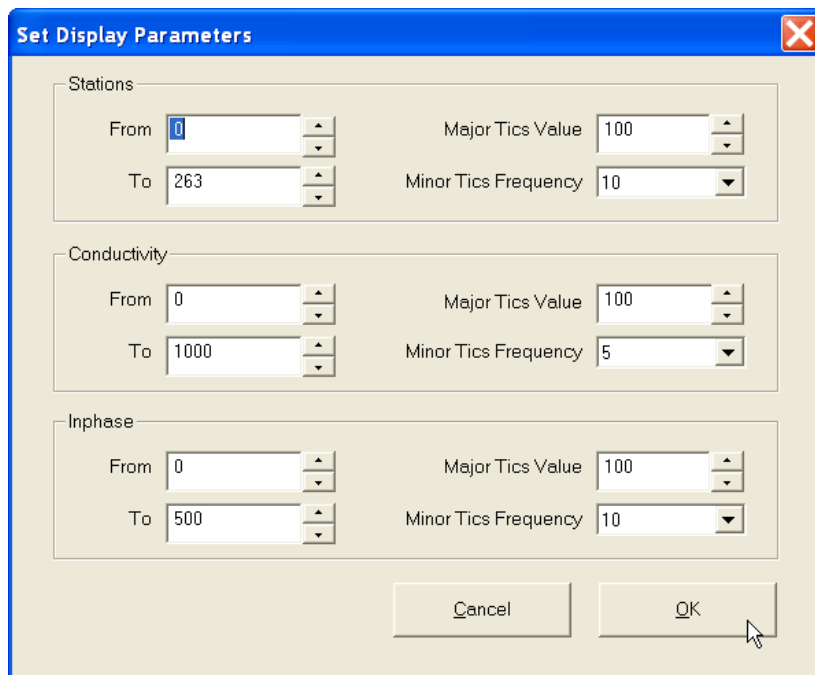


Figure 2.6 Set Display Parameters window

This option allows a range to be set for the length of the line (stations displayed), and the EM38-MK2 conductivity and Inphase amplitudes. The major axis tick intervals as well as minor tics frequency are also controlled through this window. (Labels and optional grid lines are plotted at the major ticks only.)

2.3 Editing Survey Geometry

The Edit Geometry option allows adjustment of the profile geometry, including the repositioning of both the start and end stations of each line, shift survey lines, as well as any station marked with the fiducial switch. To display the Edit Geometry menu select **Edit Geometry** in the main menu at the top of the screen (Figure 2.7).

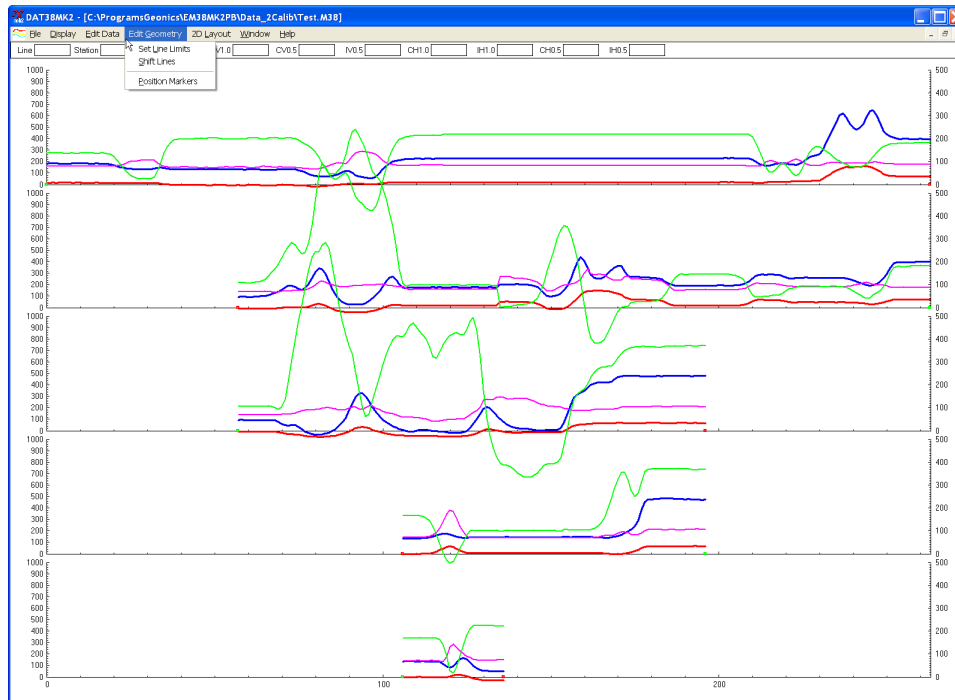


Figure 2.7 Edit Geometry menu

The Edit Geometry menu contains three items:

Set Line Limits changes the position of the start and end stations of any selected group of survey lines;

Shift Survey Lines can be used to move any selected group of survey lines in either a positive or negative direction along the profile axis;

Position Markers is an efficient tool for aligning fiducial markers and the start and end points of survey lines.

Survey Conducted without Fiducial Markers

A survey that was done without using the fiducial markers will generally not require any editing of data positions. Corrections of common field errors, such as an incorrect start station or line direction, can be made using the **Set Line Limits** or **Shift Survey Lines** option in the Edit Geometry menu shown in Figure 2.7.

Please note that ends of survey lines can also be easily adjusted by the Position Markers tool even if during the survey fiducial markers were not used. The Start and End stations of each survey line can be edited in the same way as stations tagged by fiducial markers.

Survey Conducted with Fiducial Markers

If data was recorded with fiducial markers, the following two step procedure is recommended:

Adjust the ends of the survey lines using either the **Adjust Survey Line** or **Set Line Limits** options, or by using Position Markers option (see the note above), and then position fiducial markers using the **Position Markers** option.

2.4 Creating XYZ Files

To display the 2D Layout menu select **2D Layout** in the main menu at the top of the screen. The menu contains two options: Create Grid Based XYZ File and Create GPS Based XYZ File.

The first option, **Create Grid Based XYZ File** lets you generate files with N-S and W-E configuration of survey lines, when readings are collected along grid that it is layout before the survey. Therefore, it is strongly recommended that data files be organized so that each file contains parallel lines surveyed in one direction, either W-E or S-N. The program assumes that stations along survey lines correspond to one of coordinates (X or Y) and line names indicate another coordinate (X or Y). If line names do not correspond to an appropriate coordinate they can be easily changed by the **Rename** function in the **Select Survey Lines** window. Position of stations (line end points, fiducial markers) along survey lines should be organized using the **Edit Geometry** function prior to creating XYZ file.

The second 2D Layout menu item, **Create GPS Based XYZ File** can be used only when EM38-MK2 data is collected together with GPS positioning data. In this method the GPS receiver is connected to the Allegro CX (or other field computer logging EM38-MK2 readings) serial port and GPS data is collected in the EM38-MK2 data file.

Create Grid Based XYZ File

After you select the **2D Layout|Create Grid Based XYZ File** from the profile menu the Create Grid Based XYZ File window is displayed (Figure 2.8).

Create Grid Based XYZ File

Select Survey Lines Orientation

West - East
 North - South

Shift Option

Apply Shift
see description at the bottom of dialog

Component

Both
 Conductivity
 Inphase

Dipole Mode

Vertical
 Horizontal

Coil Separation

Both
 1.0 m
 0.5 m

File Format

Geosoft
 Surfer
 Generic

Column Delimiter

Fixed
 Comma
 Space
 Tab

Options

File Header
 Time Stamp
 Date

Output File **Create XYZ** **Exit**

[Set Parameters, then Select Output File](#)

Shift (of 0.25m) is applied to 0.5 m coils assuming that it is in front of the center of 1.0 m coil, in this case two XYZ files are created (name_10 and name_05).
Above applies only to EM38-MK2 data.

Figure 2.8 Create Grid Based XYZ File window

Several parameters which affect the contents and format of the created XYZ file must be specified. Specifically, these are the Orientation of Survey Lines, the EM38-MK2 Data Type and other parameters to be written to the file, format of the output file, and the output file name. For each parameter there is only one option for each layout which you select by clicking the appropriate radio or check box button.

Orientation of Survey Lines

The W-E orientation corresponds to a layout where lines are parallel and oriented in the X direction (assuming that the North or Y coordinate points to the top, and that the East or X coordinate points to the right edge of a page). The S-N orientation corresponds to the perpendicular layout, with survey lines oriented in the Y direction.

If W-E orientation is selected, it is assumed that the line name gives the Y (S-N) coordinate and stations are aligned along the X (W-E) axis. If survey lines are parallel and oriented in W-E direction, but line names do not correspond to the Y coordinate, then rename the lines in the Select Lines window. It should be noted that if the line name starts with a number and ends with a letter, e.g. 10N, only the number will be recognized as a Y coordinate.

Apply Shift

Center of measurement for coil separation 0.5 m is shifted 0.25 m from the center of the 1.0 m separation when instrument is oriented in the direction of surveying. Assuming that stations are related to the physical center of the EM38-MK2 (matching center of 1.0 m separation) and the instrument is oriented in one direction (in the direction of the movement) during the entire survey (recommended practice) the program can calculate offset of 0.5 m coil separation automatically if the check box labeled **Apply Shift** is checked in the Options section. In this case two XYZ files will be created, one for 1.0 m separation (with suffix _10) and another for 0.5 m separation (with suffix _05).

This options does not apply to EM38-MK2-1 data files.

Please note that this option can be used only when orientation of the instrument was kept in direction of surveying during the entire data set collection.

Select Data Type (Component, Dipole Mode, Separation)

To select the EM38-MK2 data type (component, dipole mode, and coil separation) to be written in the output file click the corresponding radio button in sections labeled **Component**, **Dipole Mode**, and **Separations** (Figures 2.8). Only one dipole mode of the EM38-MK2 data can be written to created XYZ file. Data is always placed in the created XYZ file in the following order: X coordinate, Y coordinate, Conductivity 1 m, Inphase 1 m, Conductivity 0.5 m, Inphase 0.5 m for selected dipole mode. The parameter Time (time stamp for each reading) will be placed in the last column of the file if **Time Stamp** is selected in the section labeled **Options**.

File Format

Indicate the appropriate option for the contouring software to be used. The Generic option will create a multicolumn file without any text strings. This file can be used as an input file for many contouring packages (including Geosoft and Surfer). When Geosoft is selected then file extension name XYZ will be given as a default, and extension names DAT and ASC will be given respectively for Surfer and Generic selections respectively.

Column Delimiter

Select column delimiter that is required by your application. The option Fixed corresponds to fixed field for each column with space or spaces between columns. This format is suitable

for most applications and a file created with this selection provides the easiest option if file is to be viewed using any standard text editor.

Options

There are three items listed: File Header, Time Stamp, and Date. File Header occupies one line at the top of file and contains description of each column included in the file. Time Stamp and Date will be written in two columns (or one if any of two selected) that follow instrument readings.

Output File

When the **Output File** button is clicked, a Select XYZ File Name window is displayed. The EM38-MK2 file name with an extension corresponding to the selected output file format (xyz, dat, or asc) is given as a default. After the Output File is specified the **Create XYZ** button is activated.

When you click on the **Create XYZ File** button a progress bar, located at the left bottom corner of the window, will indicate the percentage of the created file that has been completed.

Create GPS Based XYZ File

Data can be positioned directly to an XYZ file format by selecting the **2D Layout|Create GPS Based XYZ File** menu option. The Create XYZ File Based on GPS Positions window is displayed (Figure 2.9).

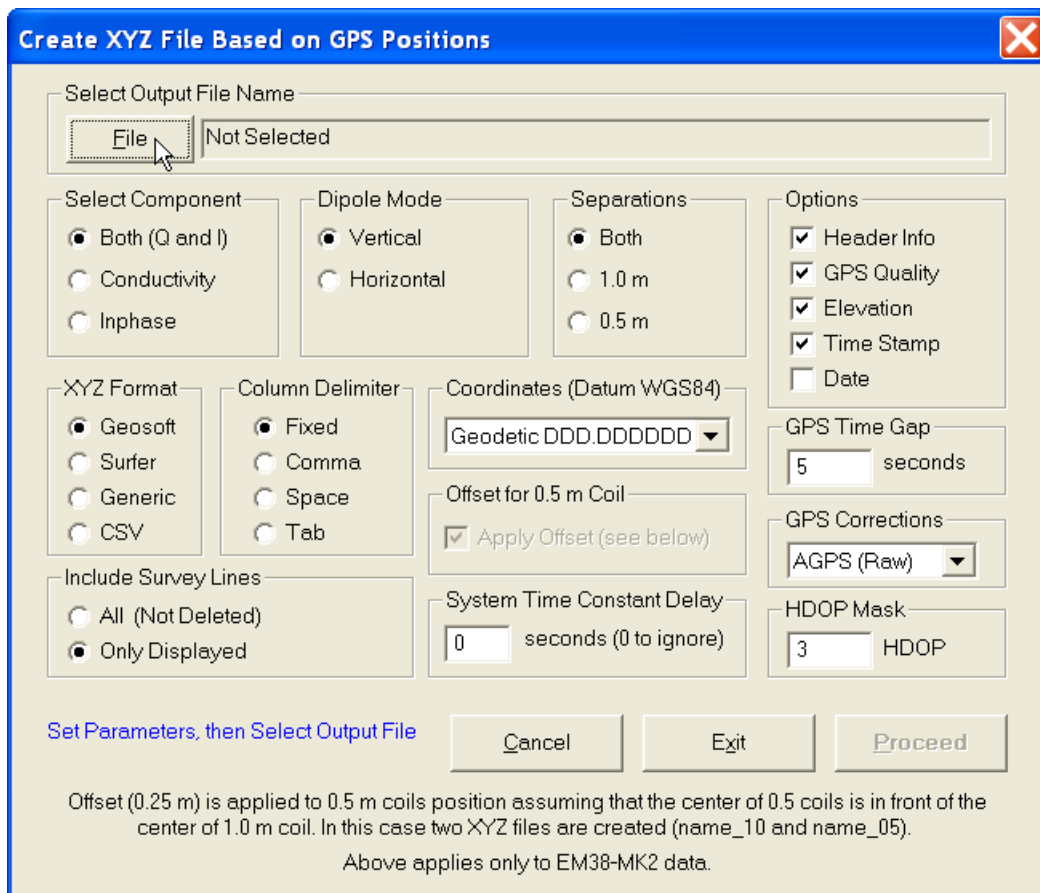


Figure 2.9 Create XYZ File Based on GPS Positions window

Before creating the XYZ file the following parameters must to be specified:

Output File

Click on the **File** button. The Select XYZ File window is displayed. Select a file name and click the **Save** button. The Select XYZ File window will close and the selected file name will be displayed beside the **File** button in the GPS Positioning window.

When Input and Output files are specified the **Proceed** button in the Create XYZ File Based on GPS Positions becomes active.

Select Data Type (Component, Dipole Mode, Separation)

To select the EM38-MK2 data type (component, dipole mode, and coil separation) to be written in the output file click the corresponding radio button in sections labeled **Select Component**, **Dipole Mode**, and **Separations**.

Only one dipole mode of the EM38-MK2 data can be written to created XYZ file. Data is always placed in the created XYZ file in the following order: X coordinate, Y coordinate, Conductivity 1 m, Inphase 1 m, Conductivity 0.5 m, Inphase 0.5 m for selected dipole mode. Obviously if one Component or Separation will be selected then less parameters will be written in the file, however order will be the same.

Options

There are five items listed: File Header, GPS Quality, Elevation, Time Stamp, and Date. File Header occupies two lines at the beginning of file, the first line contains Datum description and the second line contains labels with description of each column included in the file. GPS Quality, Elevation, Time Stamp and Date will be written in columns (in the order as listed in this dialog) that follow instrument readings. The GPS Quality contains parameters in three columns: Quality (degree of differential corrections), number of satellites, and HDOP parameter.

XYZ Format

Indicate the appropriate option for the contouring software to be used. The Generic option will create a multicolumn file without any text strings. This file can be used as an input file for many contouring packages (including Geosoft and Surfer). A comment indicating column contents and used coordinates will be written at the beginning of file if Header More detailed description is given in the XYZ File Format section.

Column Delimiter

Select column delimiter that is required by your application. The option Fixed corresponds to fixed field for each column with space or spaces between columns. This format is suitable for most applications and a file created with this selection provides the easiest option if file is to be viewed using any standard text editor.

Coordinates

Positions can be written in the output file as geodetic (geographical) coordinates (Latitude/Longitude) or they can be converted to UTM coordinates. The program uses the WGS1984 datum.

Geodetic coordinates are given in degrees, while UTM coordinates can be generated in meters, feet or US Survey feet.

GPS Time Gap

The **GPS Time Gap** parameter specifies the maximum time during which the EM38-MK2 data will be linearly interpolated between two GPS positions. Enter this parameter (in seconds) in the edit box labelled GPS Time Gap. In most cases a value 2 to 3 times larger than the GPS acquisition frequency is adequate.

GPS Corrections

Select item in combo box placed in a section labeled **GPS Corrections** to write selected or higher degree of GPS differential corrections.

HDOP Mask

Specify value of HDOP parameter the section labeled **HDOP Mask**. Readings associated with GPS positions that have HDOP values higher than specified will not be written to the file.

Offset for 0.5 m Coil Separation

Center of measurement for coil separation 0.5 m is shifted 0.25 m from the center of the 1.0 m separation. Assuming that stations are related to the physical center of the EM38-MK2 (matching center of 1.0 m separation) and the instrument is oriented in one direction (in the direction of the movement) during entire survey (recommended practice) the program can calculate offset of 0.5 m coil separation automatically if the check box labeled **Apply Shift** is checked in the Options section. In this case two XYZ files will be created, one for 1.0 m separation (with suffix _10) and another for 0.5 m separation (with suffix _05).

This options does not apply to EM38-MK2-1 data files.

When you click on the **Proceed** button a progress bar, will appear above command buttons and it will indicate the percentage of the created file that has been completed.

3. Displaying Data

The DAT38MK2 requires that files have to be displayed in the form of stacked profiles prior to any editing, reorganizing survey lines, or creating grid or GPS based XYZ data file for a mapping systems. Files containing EM38-MK2 readings and displayed in the program as profiles have the extension name M38. These files are described in this section. Conversion of binary raw (N38) format to M38 format is described in section 2.1. The Mesa3/Allegro CX raw data files (with extension N38) and DAT38MK2 file (M38) formats are described in Appendix A.

Coil Separations 1.0 and 0.5 m is available only when data was collected using the EM38-MK2 instrument (it supports two separation of sensor coils 1.0 m and 0.5 m), while instrument EM38-MK2-1 is equipped with one set of coils with 1.0 m separation. Data files collected with both versions of the instrument are recognized automatically by the DAT38MK2 program.

3.1 Loading Profile Files

Loading Data File

The DAT38MK2, when started, has a very simple menu. Only Loading and Convert functions are available before data files are loaded and displayed. To load EM38-MK2 data file in M38 format select **File|Open Profile File** in the menu (Figure 3.1).

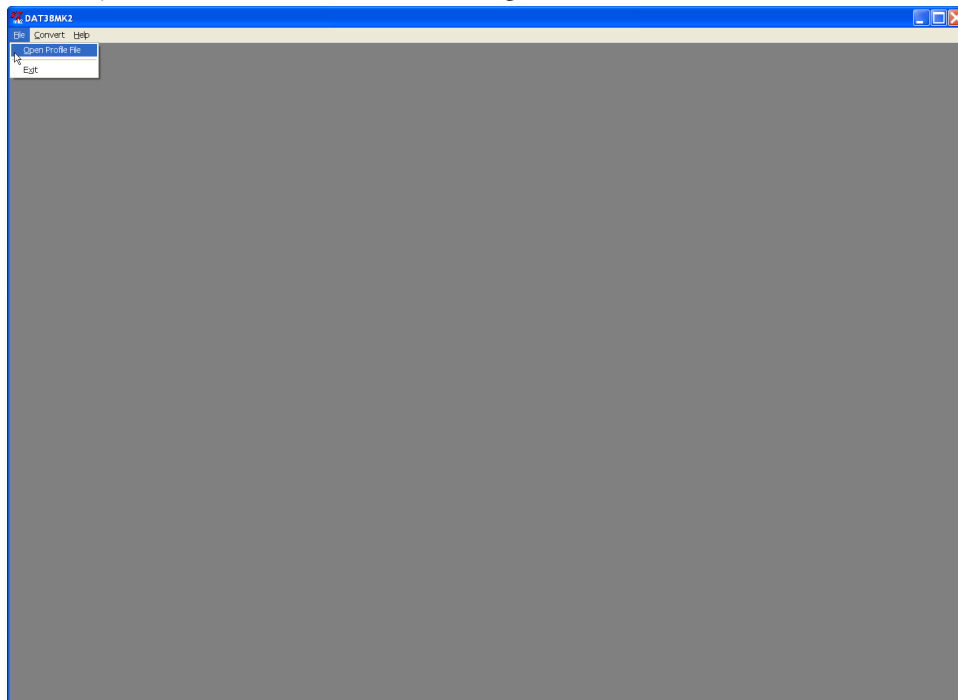


Figure 3.1 DAT38MK2 File menu before any data file is loaded

The **Open Profile File** window will be displayed (Figure 3.2). Select the directory and file name and then click the **Open** button (or double click the left mouse button, or press **Alt_O** on the keyboard). Data files in DAT38MK2 format have the extension name M38. When a larger data file in DAT38MK2 format is loaded to the program a progress bar may show the percentage of file loaded.

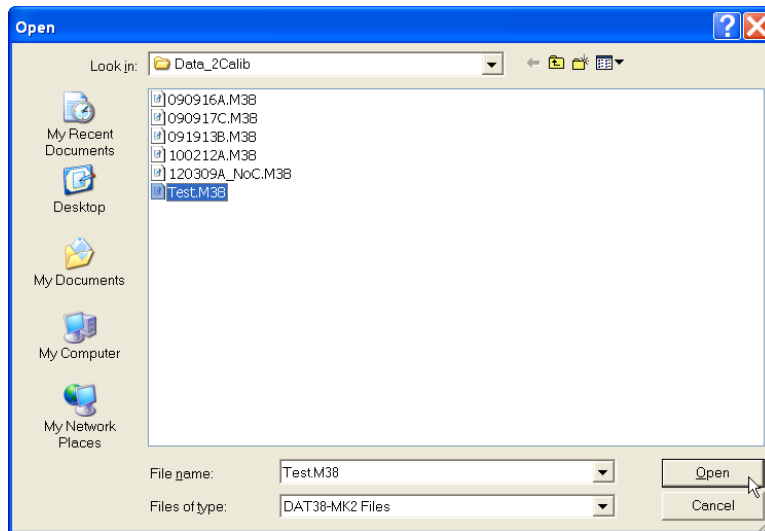


Figure 3.2 Open EM38-MK2 File window

After a DAT38MK2 profile file is loaded, data is displayed in a stacked profile format as shown in Figure 3.3. Survey lines are organized in panels, which contain the recorded readings. In general, each survey line surveyed in one instrument mode appears in a separate panel. In the case where two or more survey lines have the same line name, however, they will be placed in the same panel. In order to display these lines in separate panels the line names must be changed (see section 3.3).

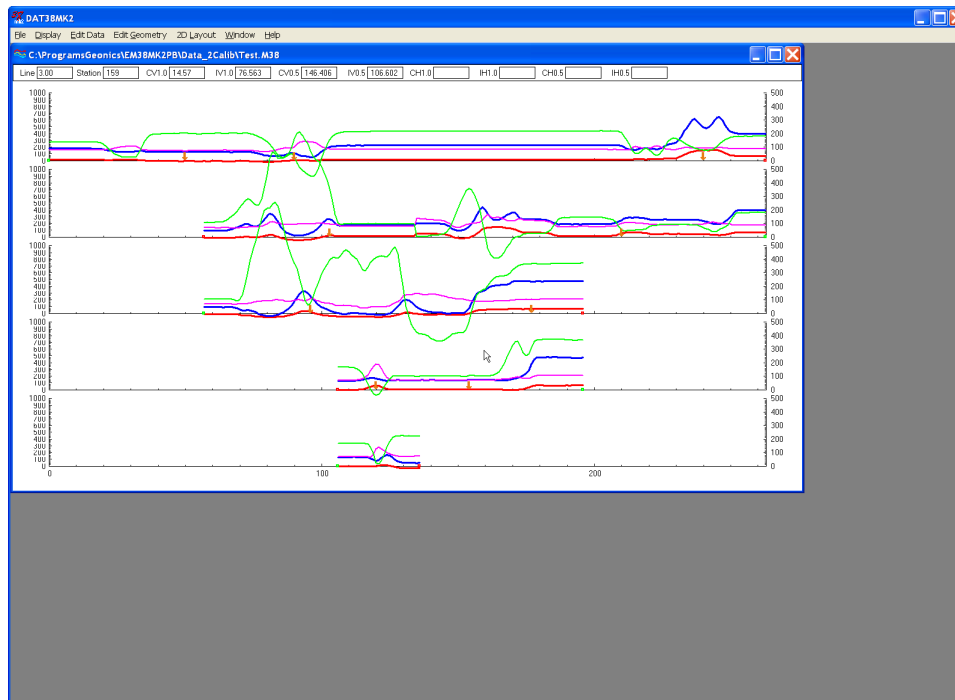


Figure 3.3 DAT38MK2 screen with stacked profiles

In each panel the data type selected for display (see section 3.4 below) are profiled. In the default settings, all data types (both components, both dipole modes, and both coil separations) are profiled. Therefore each panel may contain up to 8 profiles for each survey line, but usually it contains 4 profiles for vertical or horizontal dipole mode. The left vertical axis corresponds to EM38-MK2 Quad-phase component (conductivity) in milliSiemens/m (mS/m), while the right axis is assigned to EM38-MK2 Inphase component in parts per thousands (ppt) of Primary Field.

Loading Additional Data Files to Separate Windows

To display another data set (can be exactly same data file) in a separate window select **File|Open Profile File** in the menu (Figure 3.4). The Open EM38-MK2 File window will be displayed (Figure 3.2). Select directory and file name and then click the **Open** button (or double click the left mouse button, or press **Alt_O** on the keyboard).

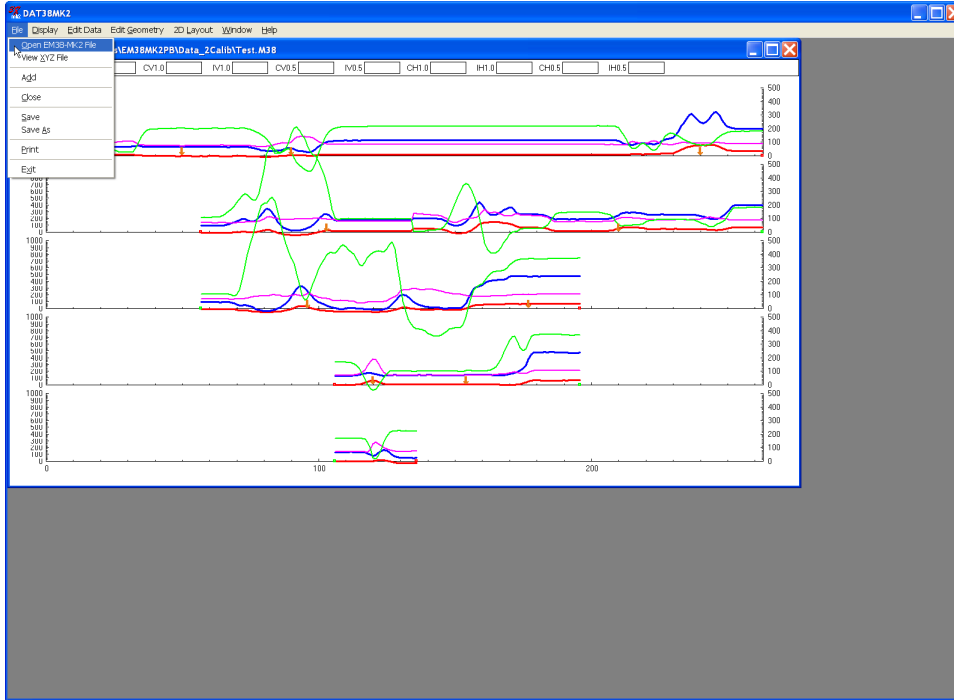


Figure 3.4 DAT38MK2 File menu after data files are loaded

After the new profile file is loaded, data is displayed in a stacked profile format in a new window, as shown in Figure 3.5. Up to 20 document windows can be displayed by the present version of the

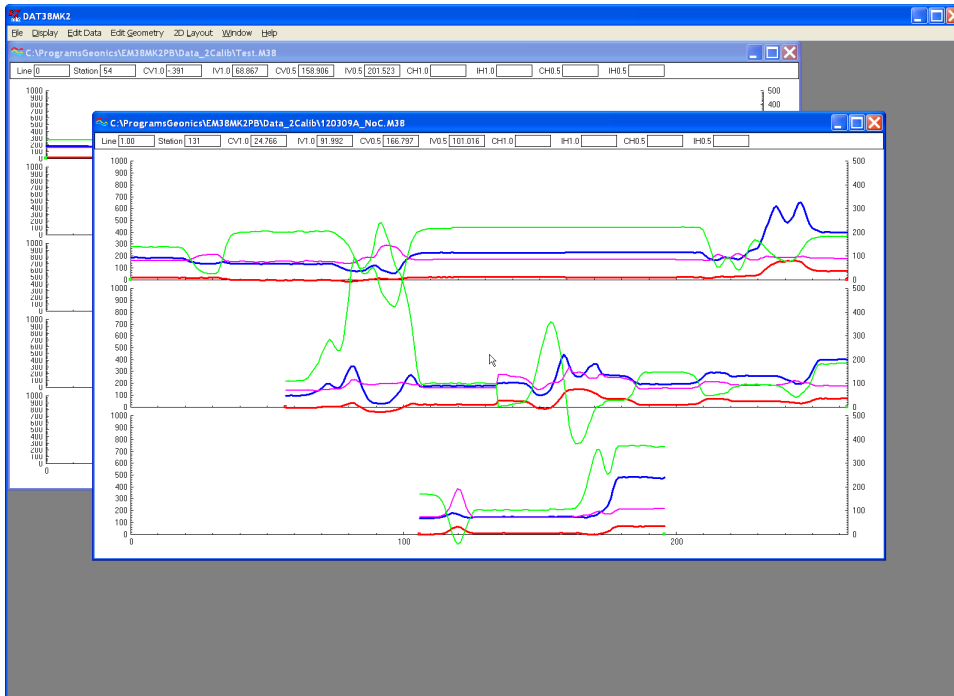


Figure 3.5 DAT38MK2 screen with stacked profiles in two separate windows

program at the same time. This includes multiple entry of the same file name, so the same data set can be displayed in separate windows. Windows can be resized or tiled (vertically or horizontally) using the Window menu. The menu displayed at the top of the screen is always associated with the active window.

Adding Data to the Existing Window

To insert data to the existing window select **File|Add Profile File** in the menu (Figure 3.4). The Open EM38-MK2 File window will be displayed (Figure 3.2). Select directory and file name and then click the **Open** button (or double click the left mouse button, or press **Alt_O** on the keyboard).

After the new profile file is loaded, data is appended to the existing data set and displayed in a stacked profile format in the same window (Figure 3.6). Any number of files (limited only by the capacity of the computer memory) can be loaded to one window.

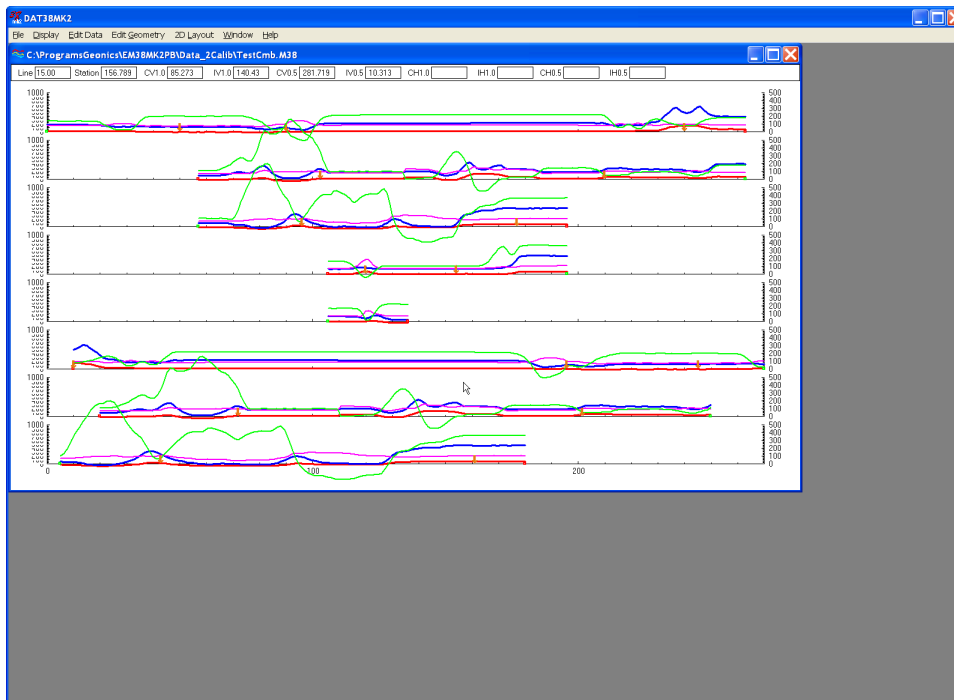


Figure 3.6 DAT38-MK2 screen with content of two files in one window

Data loaded to one window can be saved only as a single file. After several files are loaded to one window it is worthwhile saving the data set (using function **Save As**) as a separate data file in order to preserve the content of the original data files.

3.2 Closing Profile Window and Saving Data

Closing Active Window

To close any active window select **File|Close** in the menu (Figure 3.7). This procedure can also be performed by clicking the close button of the active window.

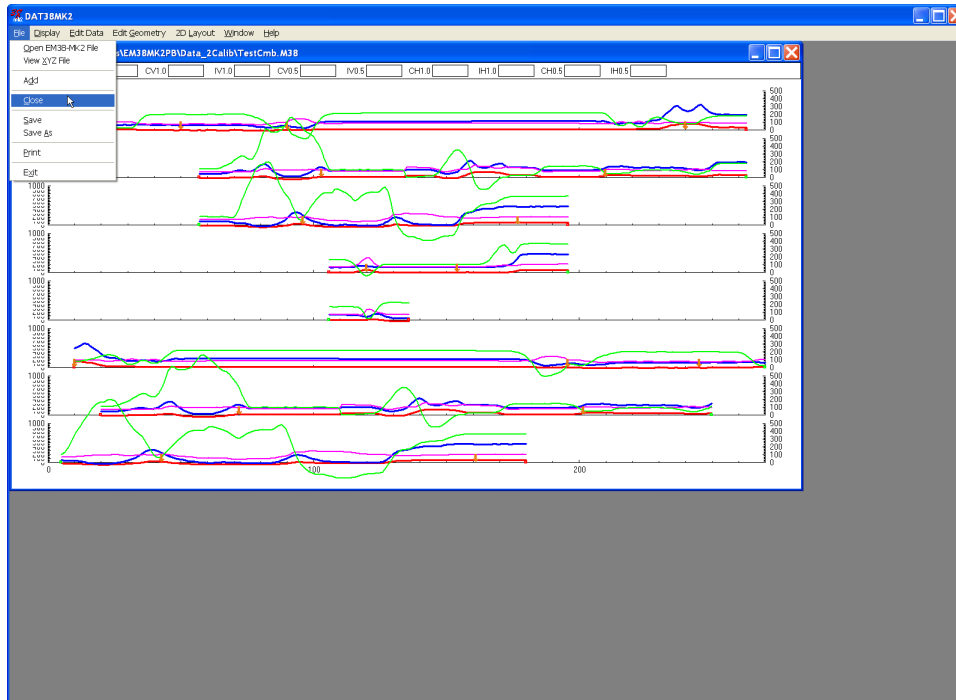


Figure 3.7 DAT38MK2 File menu

If any data processing was performed on the loaded data set and items not saved using **Save** nor **Save As** functions (see below), a Save Changes window will appear as shown in Figure 3.8.

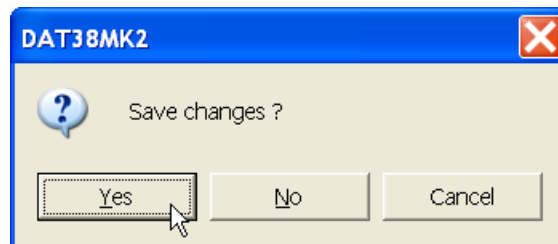


Figure 3.8 Save Changes window

Save Data

To save data to the currently opened file select **File|Save** in the menu (Figure 3.7) or click the left mouse button on the toolbar button. If several files are open, the caption displayed at the top of the active window will be used as the file name.

It is recommended that you use the option Save As, to maintain the original data in an unedited form.

Save Data to Specified File (Save As)

To save data to a different file select **File|Save As** from the top menu (Figure 3.7). The Save As window will be displayed (Figure 3.9). Select a directory, specify a file name and then click the **Save** button (or double click the left mouse button, or press **Alt_S** on the keyboard). Data files containing EM38-MK2 readings will have the extension name M38.

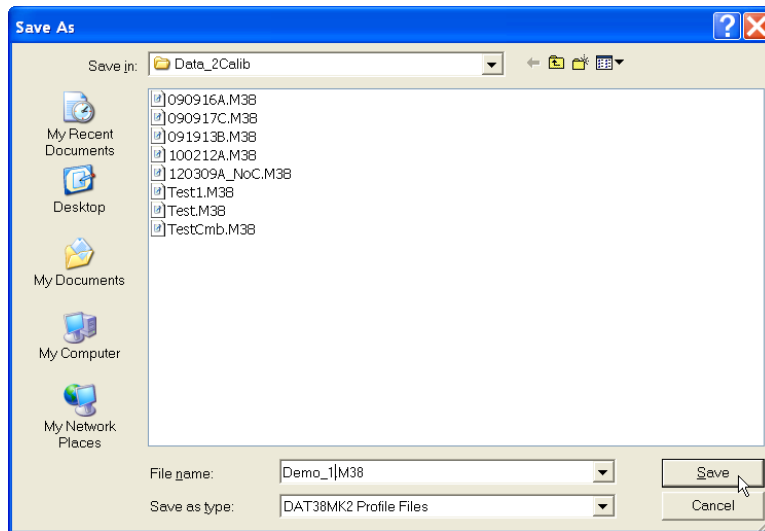


Figure 3.9 Save As window

3.3 Select, Delete and Rename Survey Lines

Selecting Survey Lines

When a data file is loaded, all survey lines contained in the file are displayed. To display a selection of survey lines select **Display>Select Lines** from the top menu (Figure 3.10).

The Select Lines window is shown in Figure 3.11. In the top right section the number of available

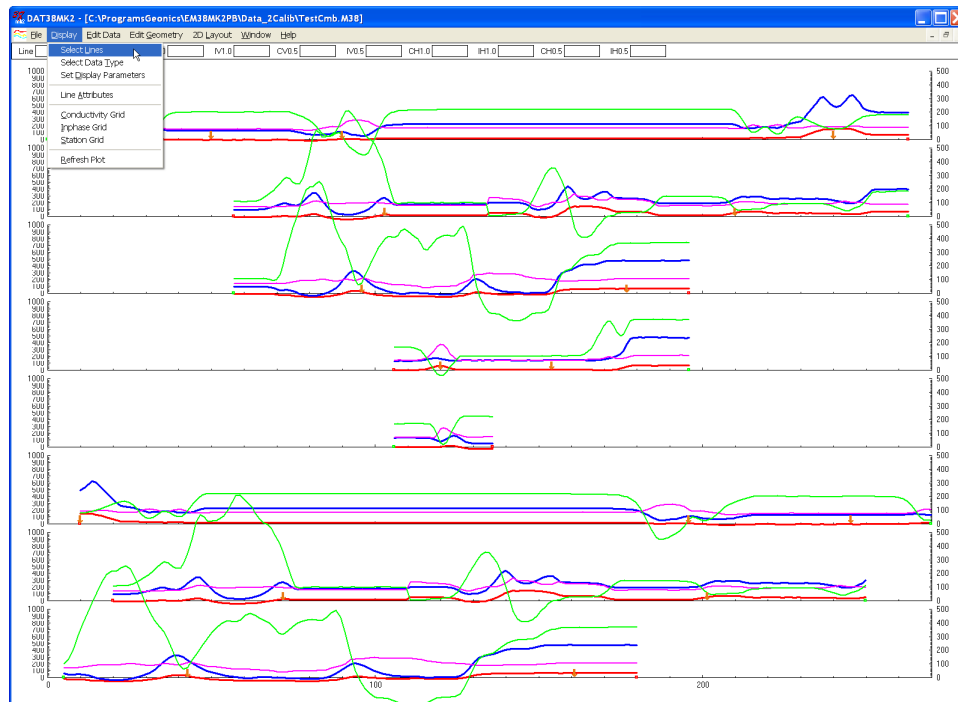


Figure 3.10 DAT38MK2 Display window

survey lines (Total), the number of currently selected lines (Selected.), and the number of deleted lines (Deleted) are displayed.

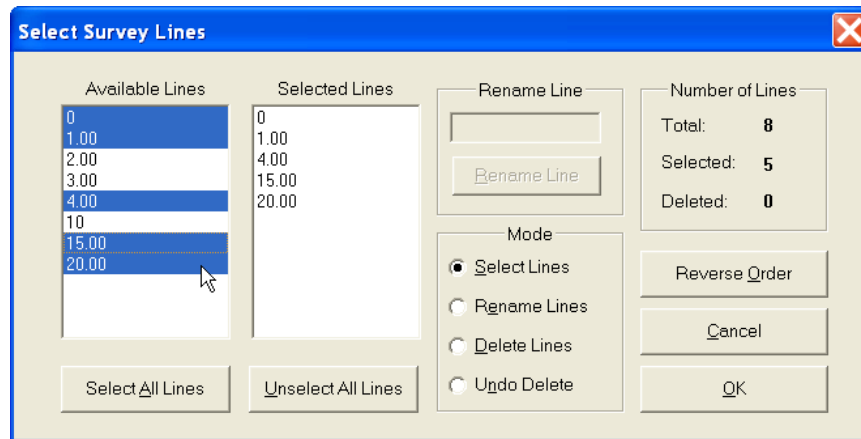


Figure 3.11 Select Lines window

The left list box, labeled Available Lines, displays all available lines. The right list box, labeled Selected Lines, shows the lines selected for display. When saving data (**Save** or **Save As** options), data will be saved in the order shown in the Select Lines window.

Select (and deselect) lines to be displayed by clicking the line names in the corresponding list box. **Select All Lines/Unselect All Lines** functions are also available. Clicking on the **Reverse Order** button will change sequence of all previously selected survey lines (from top to bottom of the display). All highlighted line names will be displayed on the screen after clicking the **OK** button. Figure 3.12 is an example of a screen with three selected lines. (The corresponding Select Lines window is shown in Figure 3.11.)

The selection of lines has no effect on the execution of **Save**, **Save As**, **Create Grid Based XYZ**

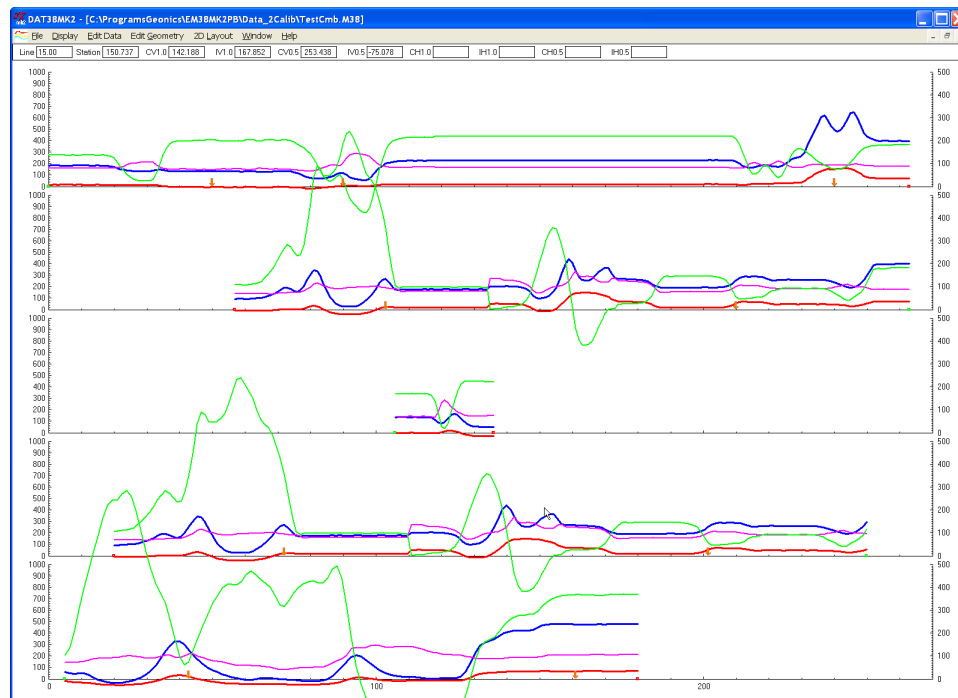


Figure 3.12 DAT38MK2 screen with selected survey lines

File, **Create GPS Based XYZ File** options. Select Lines only affects the current display. Therefore, one or two survey lines can be displayed and examined in detail and then saved with all other (not deleted) survey lines to a new file.

Deleting Survey Lines

You can also delete and rename lines with the **Select Lines** window while using Delete and Rename mode (Figure 3.11).

To delete a survey line from the loaded set, first click the **Delete** radio button in the section labeled Mode. When the radio button is checked click the appropriate line name in the list box labeled **Available Lines**. The letter **D** will be displayed next to the line name in the Available Lines list (Figure 3.13). These lines will not be displayed nor written to the output file during **Save**, **Save As**, **Create XYZ File** tasks.

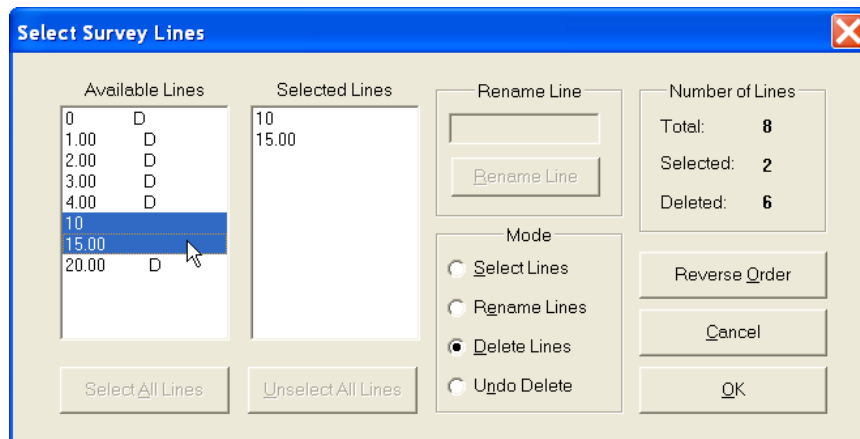


Figure 3.13 Select Lines window during Delete Line procedure

Lines can be undeleted as well. To undo previously deleted lines (as long as program is running), first click the **Undo Delete** radio button. When this radio button is marked in the Mode section click the appropriate line name (with letter D next to its name) in the list box. The letter **D** will disappear and the survey line can be displayed, edited, and saved.

Renaming Survey Lines

You can rename survey lines in the Select Lines window as well. Click on the radio button labeled **Rename Lines** in the Mode section and then click on the appropriate line name in the Available Lines list box. The highlighted line name will appear in the Rename Line edit box (Figure 3.14). Edit the name and click the **Rename Line** button. The updated name will now be displayed in the Available Lines list.

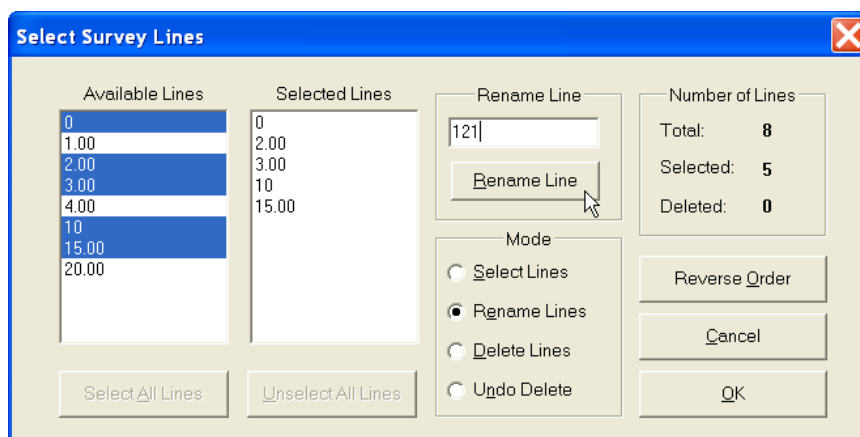


Figure 3.14 Select Lines window during Rename Line procedure

Deleted and Renamed lines will be valid as long as the program is running. In order to save changes permanently, use the Save As option to create a new data file which can be used later by the program. It is recommended that you use the option Save As in order to maintain the original data in an unedited form.

3.4 Select Data Type

To select the type of data to be displayed select the **Display|Select Data Type** from the top menu (Figure 3.10). The Select Data Type window will appear as shown in Figure 3.15.

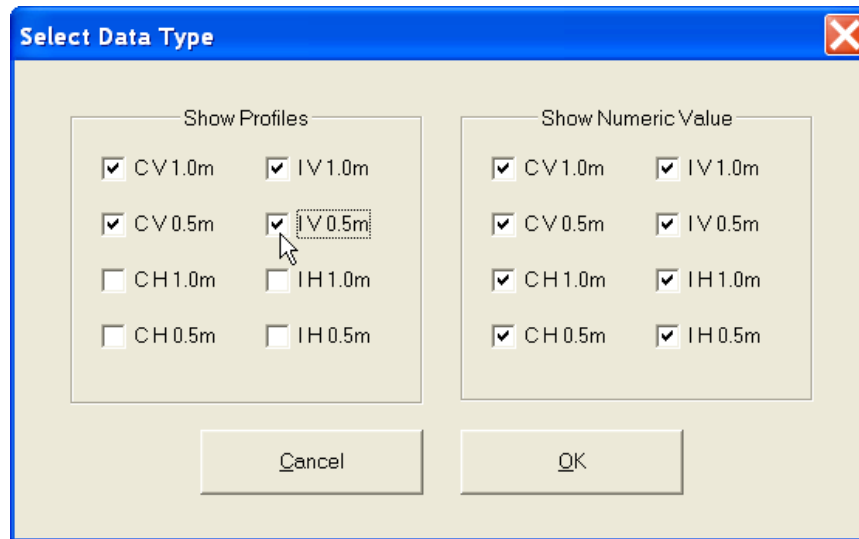


Figure 3.15 Select Data Type window

The Select Data Types window contains check boxes for each type of EM38-MK2 data. Each Type is described by an abbreviation:

CV1.0m	- Conductivity,	Vertical Dipole mode,	Coil Separation 1.0 m
CV0.5m	- Conductivity,	Vertical Dipole mode,	Coil Separation 0.5 m
CH1.0m	- Conductivity,	Horizontal Dipole mode,	Coil Separation 1.0 m
CH0.5m	- Conductivity,	Horizontal Dipole mode,	Coil Separation 0.5 m
IV1.0m	- Inphase,	Vertical Dipole mode,	Coil Separation 1.0 m
IV0.5m	- Inphase,,	Vertical Dipole mode,	Coil Separation 0.5 m
IH1.0m	- Inphase,	Horizontal Dipole mode,	Coil Separation 1.0 m
IH0.5m	- Inphase,	Horizontal Dipole mode,	Coil Separation 0.5 m

The Select Data Type window is divided into two sections, Show Profiles and Show Numeric Values. The profile section lets you select channels to be displayed as profiles. To select a data type click on the check box next to the data type name in the Show Profiles section. Data Types selected in the Show Numeric Values section of the **Select Data Type** window (Figure 3.15) will be displayed in display boxes located under the menu bar. To select a data type click on the check box next to the data type name.

After all parameters are selected click the **OK** button located at the bottom of the window. Clicking the **Cancel** button will cancel the selection and the display will not change.

3.5 Set Display Parameters

To open the Set Display Parameters window (Figure 3.16) select **Display|Set Display Parameters** from the top menu (Figure 3.10).

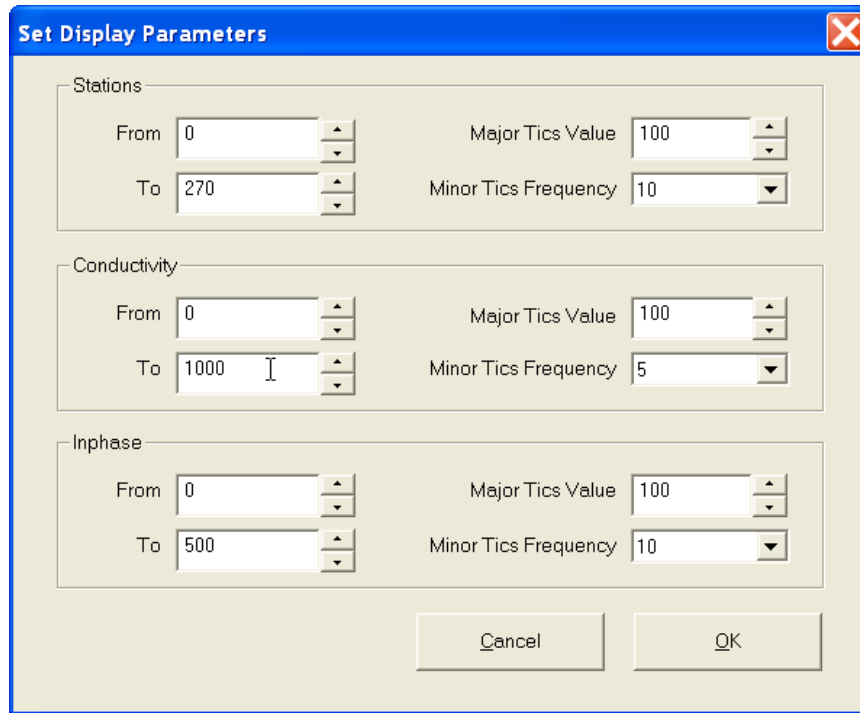


Figure 3.16 Set Display Parameters window

This option allows a range to be set for the length of the line (stations displayed), and the EM38-MK2 conductivity and Inphase amplitudes. The major axis tick intervals as well as minor tics frequency are also controlled through this window. (Labels and optional grid lines are plotted at the major ticks only.) The conductivity axis is located at the left side of the profile display, while right axis corresponds to Inphase readings. After all parameters are set, press the **OK** button and the profile display will be updated.

3.6 Line Attributes

To change the colour and/or thickness of the profile lines of each channel (component/dipole mode/coil separation) select **Display|Line Attribute** from the top menu (Figure 3.10). The **Select Line Attributes** window is shown in Figure 3.17.

Each profile line is of a different type, given by the data type name indicating instrument component, dipole mode, and coil separation (see section 3.4 above). The line types are displayed in the column of radio buttons located at the left edge of the window. Samples of the lines are placed in a box labeled Preview. To change colour or thickness of the profile, click the appropriate radio button to select profile type, then click the desired colour bar in the Select Colour box and thickness in the Select Thickness box. Samples of lines are updated in real time in the box labeled Preview.

After all attributes are set, click the **OK** button and the profile display will be updated. Line attributes are written to the DAT38MK2 initial file and during future executions of the program these attributes will be used as default settings.

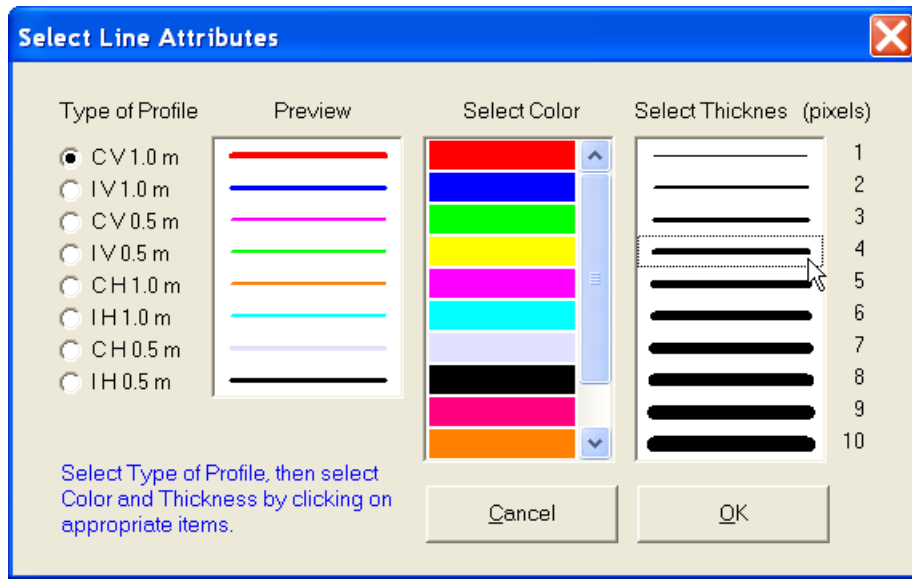


Figure 3.17 Select Line Attributes window

3.7 Grid Lines

To obtain horizontal and/or vertical lines at major ticks along the axes, select **Display|Conductivity Grid**, **Display|Station Grid**, or **Display|Inphase Grid** from the display menu (Figure 3.10). The screen with grid lines is shown in Figure 3.18.

Grid lines are plotted across each panel at corresponding major ticks as light grey lines. These options

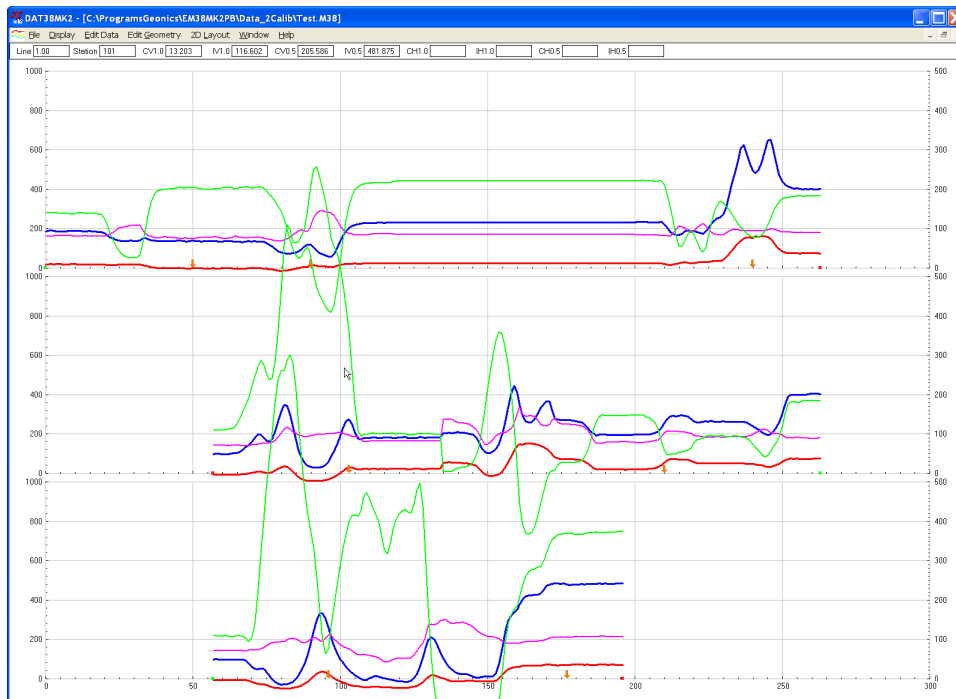


Figure 3.18 DAT38MK2 screen with stacked profiles display while grid lines for conductivity and stations are enabled

can be useful in examining the alignment of anomalies which are distributed across more than one survey line, as well as for comparing anomaly amplitudes.

4. Edit Data

To display the Edit Data menu select **Edit Data** from the main menu at the top of the screen (Figure 4.1). The Edit Data menu in the present version of the program contains one item Shift Data Set.

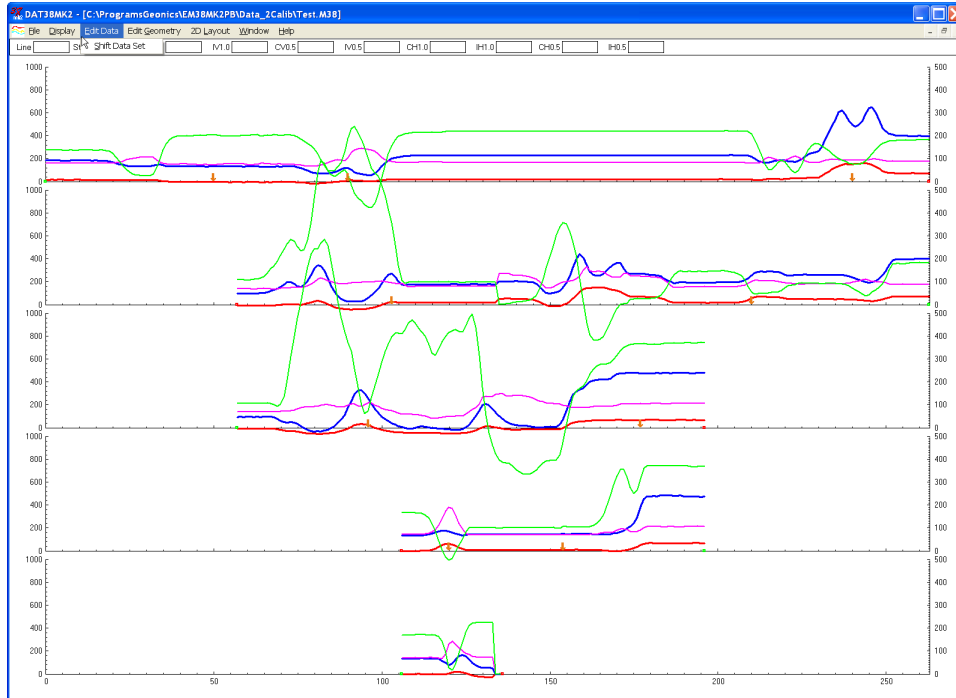


Figure 4.1 DAT38MK2 Edit Data menu

4.1 Shift Data Set

To display the **Shift Data Set** window select **Edit Data|Shift Data Set** from the main menu (Figure 4.1). The window that will appear is shown in Figure 4.2.

The shifting of data function - to increase or decrease the values of all readings on a survey line by

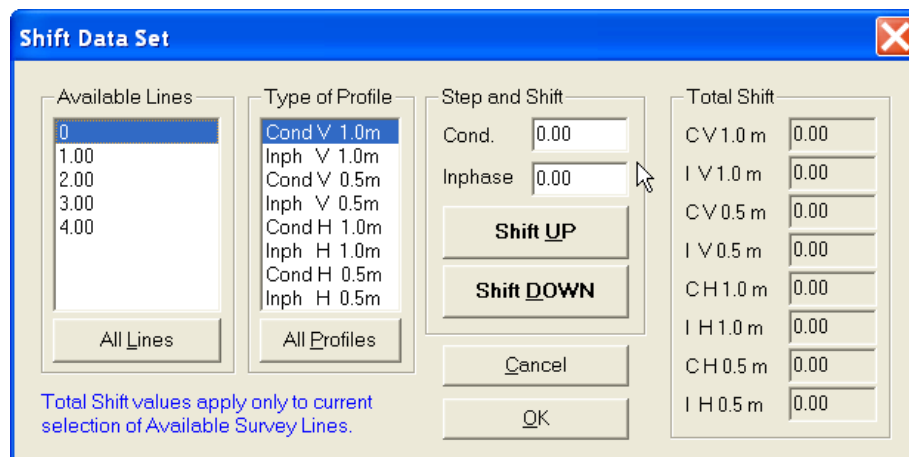


Figure 4.2 Shift Data Set window

a constant amount - can be applied to any number of selected survey lines and to any selected data types of profiles. Survey lines can be selected by clicking on Line Names in the box labeled **Available Lines**, while data types can be chosen by clicking on data types listed in the box labeled **Type of Profile**. Selected survey lines and data types will be highlighted, see Figures 4.2 and 4.3.

To select all lines and data types click on the **All Lines** button and on the **All Profiles** button to

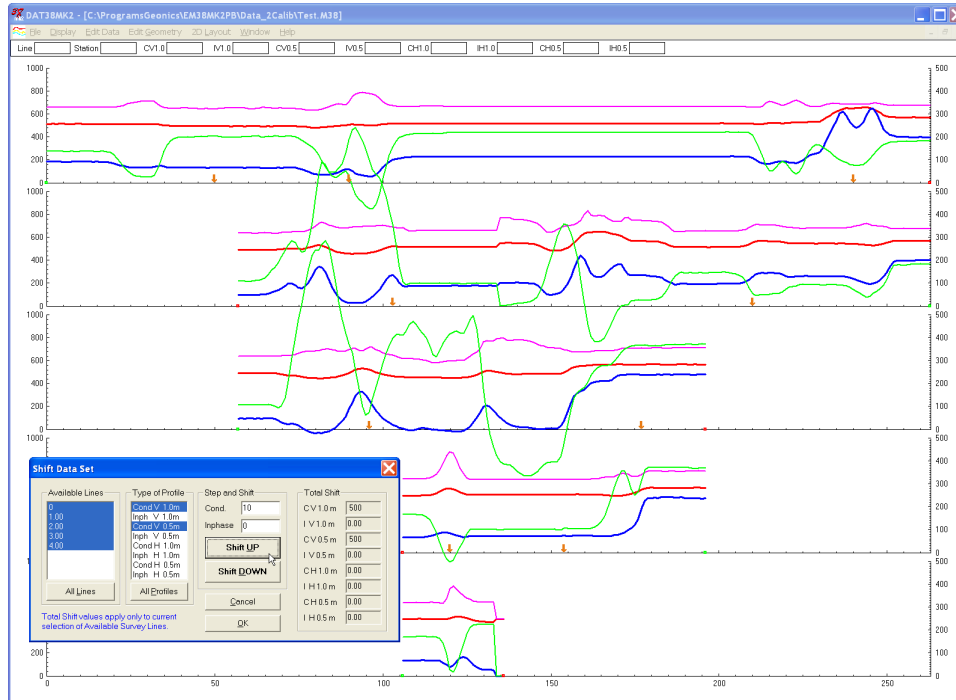


Figure 4.3 DAT38MK2 during Shift Data operation

shift data for all survey lines and types listed in the Available Lines and Type of Profile list boxes.

Data is shifted in increments specified in two edit boxes labeled Cond (for Conductivity) and Inphase in the section labeled **Step and Shift**. The increments (steps) for Conductivity and Inphase can be set from the keyboard (after positioning the cursor in the edit box). Increment 0 causes no shift for the data of given component.

To shift data for the selected survey lines click on the **Shift UP** or **Shift DOWN** button. The total shift will be shown in the display box labeled **Total Shift** and the graphic display (profile view) will be updated in real time. The Shift Data Set window can be moved to a section of the screen where it will be the least obstructive (Figure 4.3). The screen with the shifted readings is shown in Figure 4.3, please compare to Figure 4.1.

To close the Shift Data Set window click on **OK** or the close window button. This will temporarily save any changes in the data set.

5. Edit Survey Geometry

The Edit Geometry option allows adjustment of the profile geometry, including the repositioning of both the start and end stations of each line, as well as any station marked with the fiducial switch. To display the Edit Geometry menu select **Edit Geometry** in the main menu at the top of the screen (Figure 5.1).

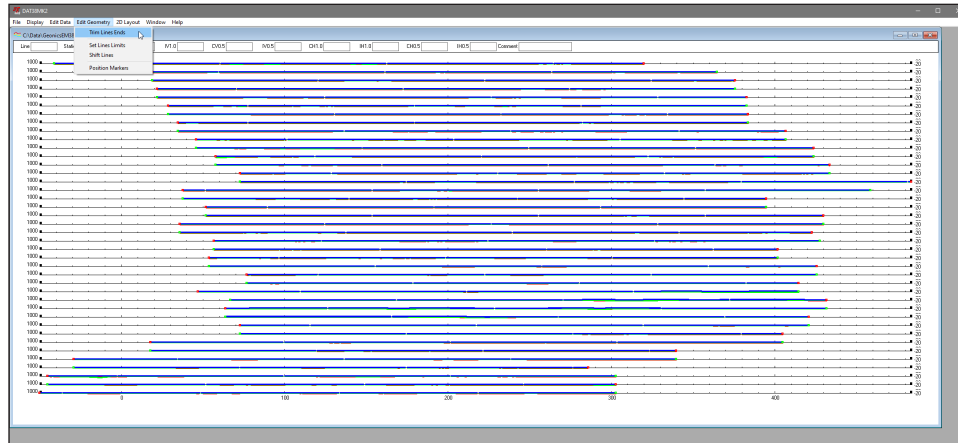


Figure 5.1 DAT38MK2 Edit Geometry menu

The Edit Geometry menu contains four items:

Trim Lines Ends changes the position of the start and end stations of any selected group of survey lines, stations outside of specified range are discarded and station increment remains unchanged;

Set Line Limits changes the position of the start and end stations of any selected group of survey lines, all stations remain within the line and station increment is adjusted (squeezed or expanded) according to a new range;

Shift Survey Lines can be used to move any selected group of survey lines in either a positive or negative direction along the profile axis, all stations remain in the line and station increment is not changed;

Position Markers is an efficient tool for aligning fiducial markers and the start and end points of survey lines.

5.1 Trim Line Ends

To display the **Trim Lines Ends** dialog select **Edit Geometry|Trim Lines Ends** in the menu (Figure 5.1). The Trim Lines Ends dialog is shown in Figure 5.2.

You can set lines ends (positions of the start and end stations) for any number of selected survey lines at one time. To select lines, use the list box labeled Select Line(s). Lines can be selected one by one by clicking on each line name in the list box or if all are to be limited to the same range the button **Select All** can be used.

In the Selected Line(s) Limits section the minimum (Left) and maximum (Right) end stations values for the set of selected lines are shown. (Left corresponds to the minimum station positions on the left side of the screen, while Right corresponds to the maximum positions on the right side for the selected survey lines.) You can specify new Left and Right line ends in the two edit boxes labeled

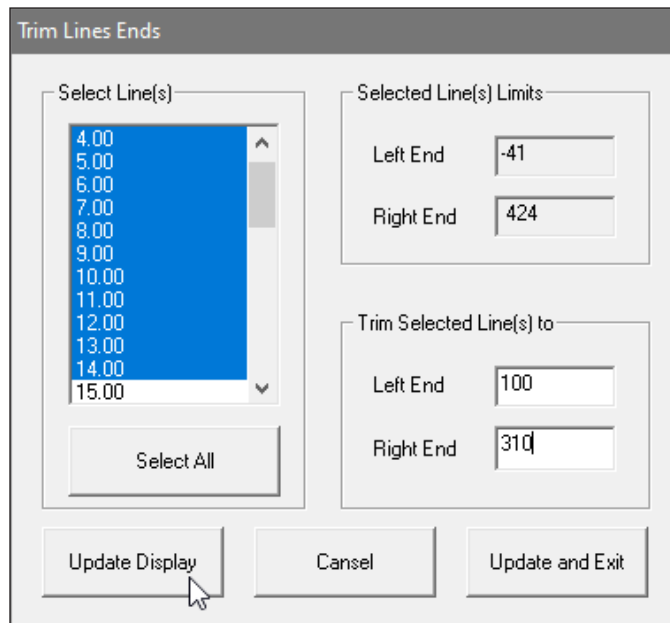


Figure 5.2 Trim Lines Ends dialog

Trim Selected Line(s) to. Stations located outside of the specified range (limited by both Left and Right Ends stations) will be discarded.

After you click the **Update Display** button, the specified adjustments are completed. The graphic display will be updated in real time. The procedure can be repeated for any additional sets of survey lines and settings. The Update Display updates is temporary for the display, to save all changes in the current program session the **Update and Exit** button must be used. In order to save updated lines ends permanently in the data file an option Save or Save As (menu item File) must be used.

An example is shown in Figures 5.3 , 5.4, and 5.5 where an adjustment for the last set of lines (bottom section of profiles) is performed. Selection of lines that are to be trimmed to new ends (120 and 275) is presented in Figure 5.3 (display before the **Update Display** is pressed) while Figure 5.4



Figure 5.3 Profile display before the last set of lines adjustment

shows the screen right after this button has been clicked and all stations outside of the select range are discarded.

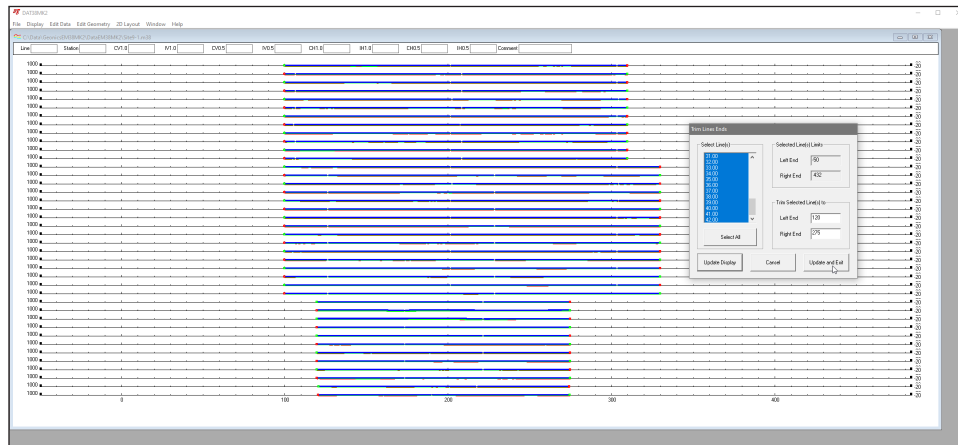


Figure 5.4 Profile display after the Update Display button action

After the **Update and Exit** button is pressed the program removes the Trim Lines Ends dialog and the profile display with trimmed survey lines is shown in Figure 5.5

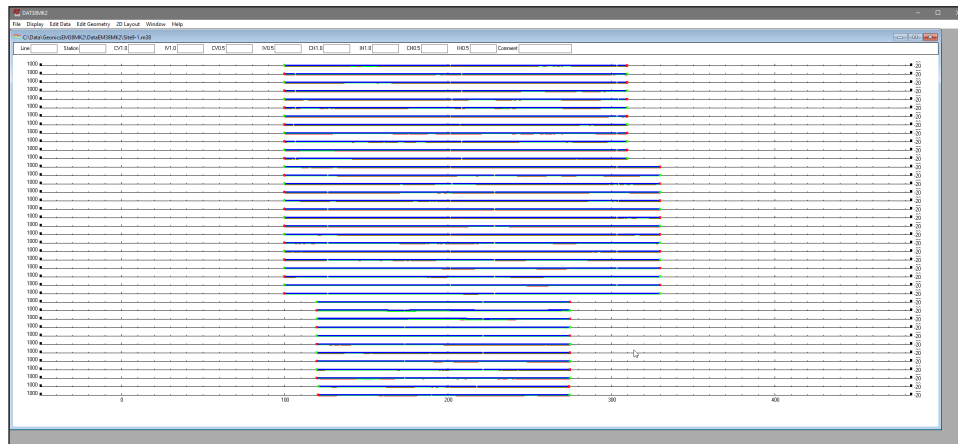


Figure 5.5 DAT38MK2 profile display after survey lines trimming (compare with Figure 5.3)

If any change is not satisfactory, click the **Cancel** button to close the Trim Lines Ends dialog and return all lines to their original length. Clicking the **Update and Exit** button will close the dialog and apply performed changes. As it was mentioned above this action is temporary till the program session end, in order to save new geometry of trimmed survey lines permanently in data file the data set must be Saved or Saved As in the File program menu (Figure 5.6).

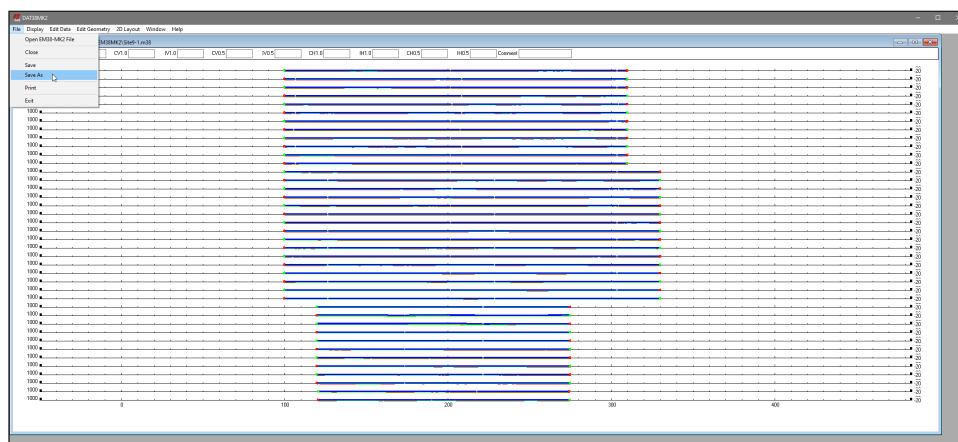


Figure 5.6 Saving data file after trimming procedure

5.2 Set Line Limits

To display the **Set Line Limits** window select **Edit Geometry|Set Line Limits** in the menu (Figure 5.1). The Set Line Limits window is shown in Figure 5.7.

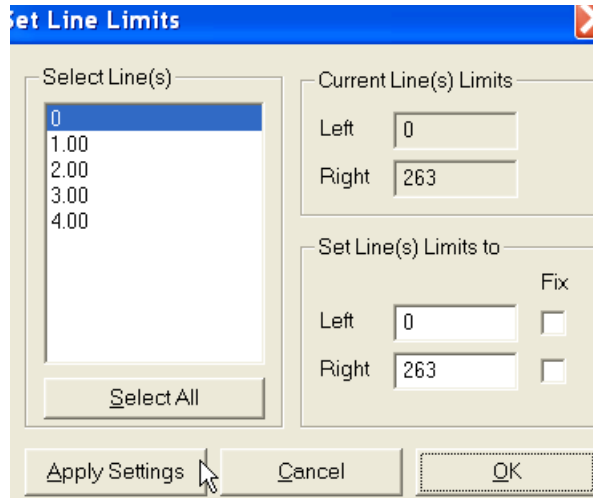


Figure 5.7 Set Line Limits window

You can set line limits (positions of the start and end stations) for any number of selected survey lines at one time. To select lines, use the list box labeled **Select Line(s)**. In the **Current Line Limits** display box, the minimum (**Left**) and maximum (**Right**) positions of stations are shown. (**Left** corresponds to the minimum station positions on the left side of the screen, while **Right** corresponds to the maximum positions on the right side for the selected survey lines.) You can specify new **Left** and **Right** positions can be specified in the two edit boxes labeled **Set Line Limits to**.

If both edit boxes are not checked (Figure 5.7), both ends of the selected survey lines will be repositioned to the specified values. In this case, the station intervals will be adjusted accordingly. If only one edit box is checked (Figure 5.8), the active station will be repositioned to the specified location, while the non-active station (checked) will remain unchanged.

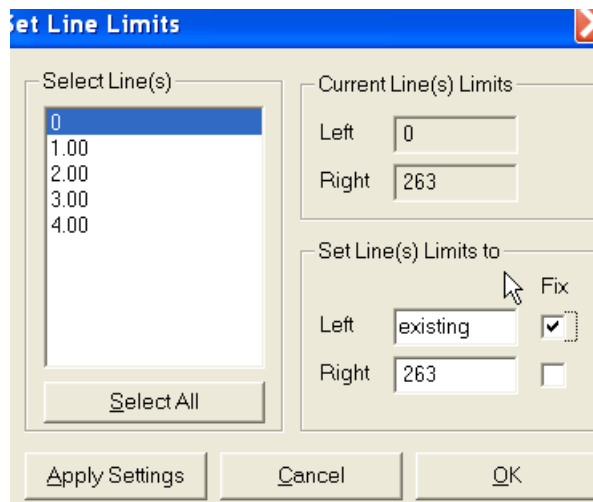


Figure 5.8 Set Line Limits window with one edit box checked (end station fixed)

After you click the **Apply Setting** button, the specified adjustments are completed. The graphic display will be updated in real time. The procedure can be repeated for any additional sets of survey lines and settings.

An example is shown in Figures 5.9 and 5.10 where three first lines are to be set to new positions of left and right end stations of lines, and after clicking on the **Apply Settings** button these stations are repositioned (Figure 5.10). This action is temporary, in order to save new geometry of adjusted survey lines the **OK** button must be clicked and then data set must be saved.

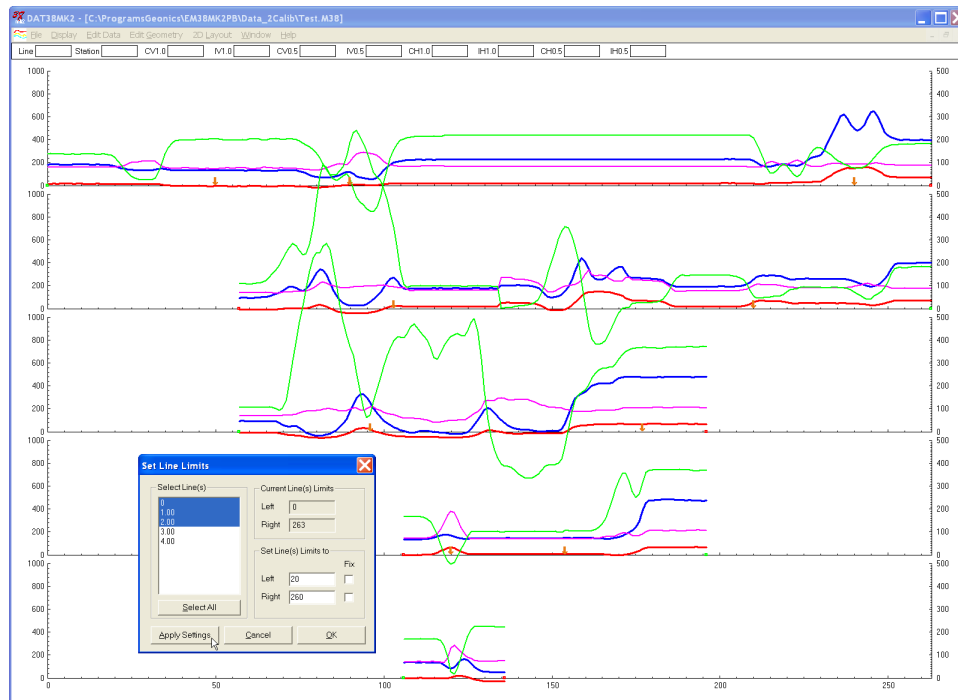


Figure 5.9 DAT38MK2 profile display before Set Line Limits adjustment

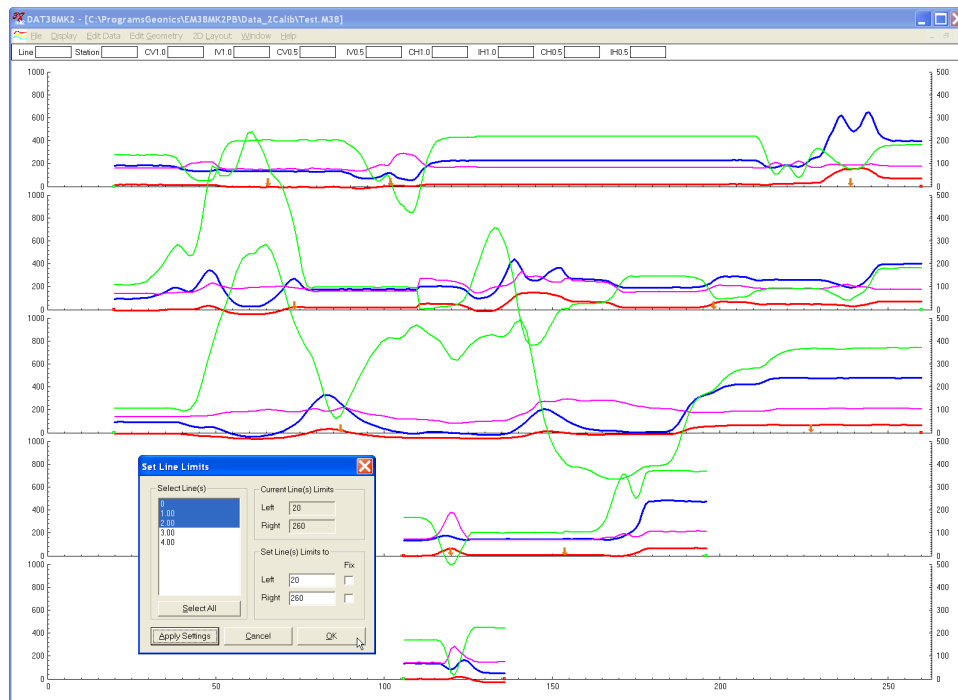


Figure 5.10 DAT38MK2 profile display after action in Set Line Limits has been applied

If any change is not satisfactory, click the **Cancel** button to close the Set Line Limits window and return all stations to their original positions. Clicking the **OK** button will close the Set Line Limits window and apply the changes.

5.3 Shift Survey Lines

To display the **Shift Survey Lines** window select **Edit Geometry|Shift Survey Lines** from the main menu (Figure 5.1). The window is shown in Figure 5.11.

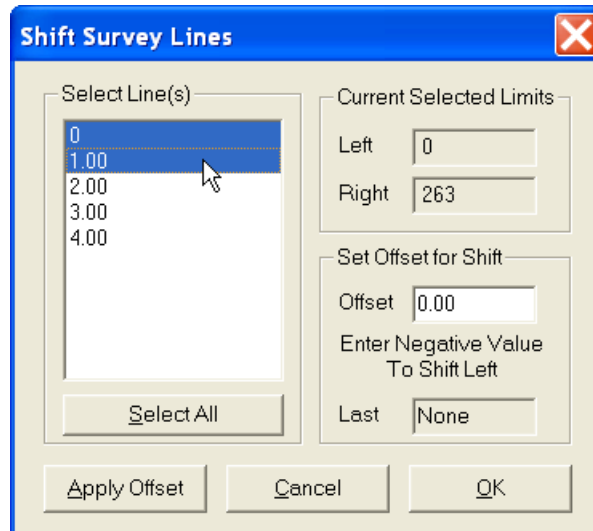


Figure 5.11 Shift Survey Lines window

This option lets you shift any number of selected survey lines, left or right, along the profile axis. The survey lines can be selected from the list box labeled **Select Line(s)**. The information on current positions of the end points of the current line is shown in the display box labeled **Current Position**. The shift increment (step) can be entered in the edit box labeled **Set Offset for Shift**. If the step is positive, the selected lines will be shifted to the right, with the station numbers increasing accordingly. A negative step will shift survey lines to the left, with station numbers decreasing accordingly. The lengths of the survey lines will not change.

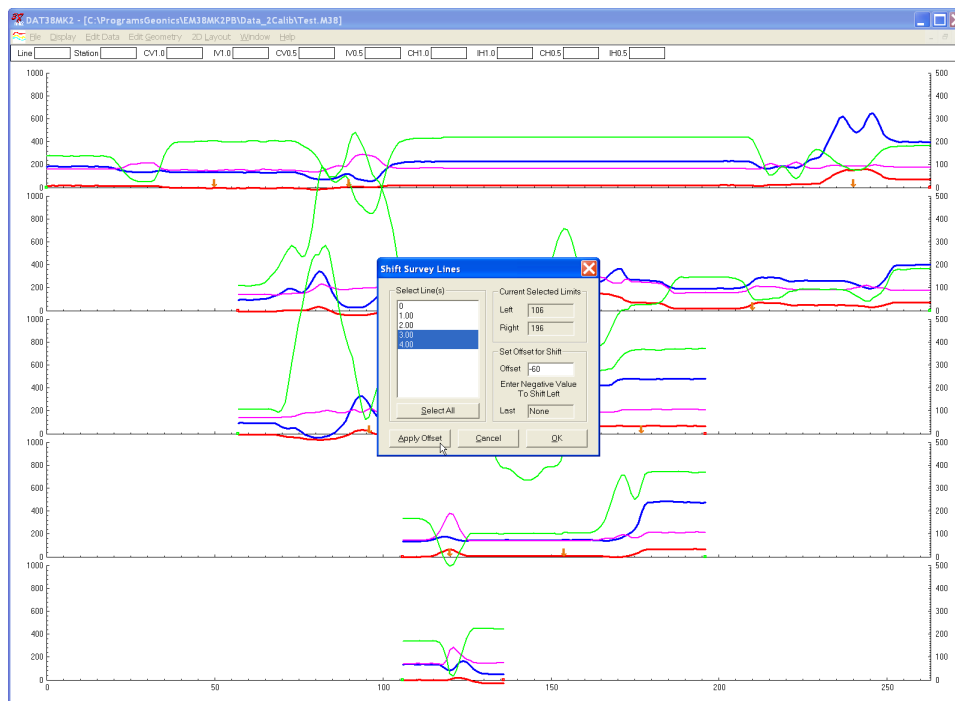


Figure 5.12 DAT38MK2 profile display before Shift of survey lines is applied

After the step is entered, click on the **Apply Offset** button to shift the selected lines. The graphic display will be adjusted in real time. An example is shown in Figures 5.12 and 5.13 where lines 3 and 4 are shifted 60 stations to the left, entered shift is -60 (Figure 5.12).

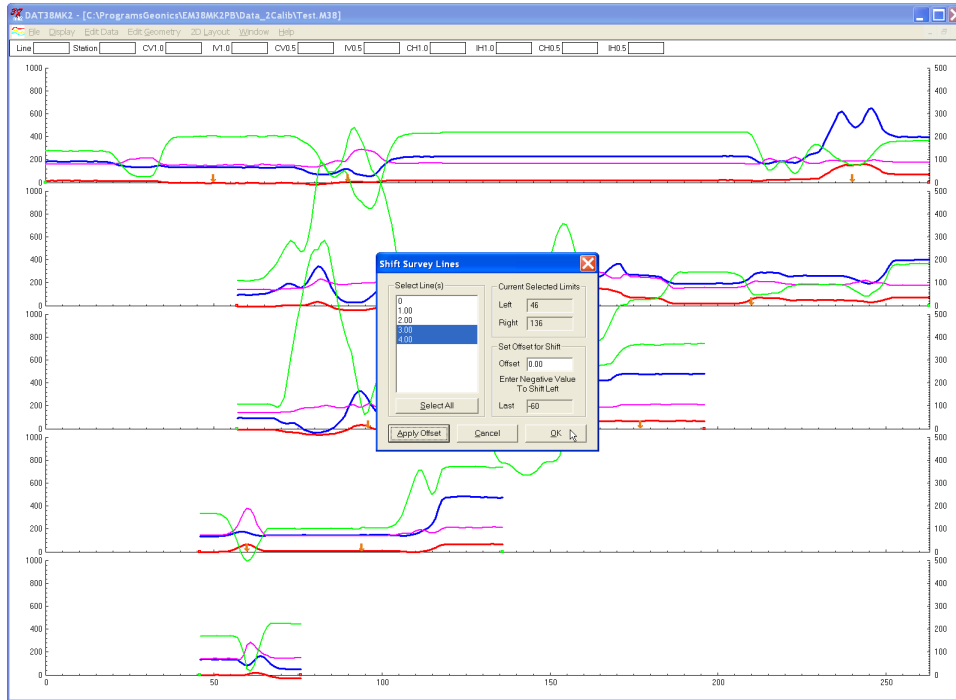


Figure 5.13 DAT38MK2 profile display after Shift of -60 stations has been applied to survey lines 3 and 4

To end this operation, click on **OK**: the Shift Survey Lines window will close, and all changes will be applied.

If any change is not satisfactory, click the **Cancel** button to close the Shift Survey Lines window and return all stations to their original positions.

5.4 Position Markers

To display the **Position Markers** window select **Edit Geometry|Position Markers** from the main menu (Figure 5.1). The Position Markers window is shown in Figure 5.14.



Figure 5.14 Position Marker window

This option allows you to reposition fiducial points that were marked by pressing fiducial marker while logging. You can adjust a selected survey marker, and also change start and end stations.

The Position Marker window is simple and small in order to allow a maximum view for the profiles. An un-labeled edit box is provided for entry of the position to where the marker or the start/end station will be moved. The position can be entered using either the keyboard.

If the **Info** button is clicked a window with related help information will be displayed.

To close the window click the Exit button located at the bottom of the window.

Repositioning A Selected Marker

In the edit box, enter a position to which the marker (or line end) is to be moved. Position the mouse cursor on (or near) the marker or end to be moved and click. The marker will be repositioned to the station entered in the edit box and all points between the adjacent markers will be adjusted accordingly. If markers on several survey lines are to be adjusted, the fastest way will be to enter the station in the edit box and then click on all appropriate markers before entering a new station in the Position Markers window.

Figures 5.15 and 5.16 show an example of positioning of markers that were moved from various stations to station 100 in the first three survey lines from the top of the display. The DAT38MK2 profile plot is shown in Figure 5.15 where value 100 is entered in Position Markers window.

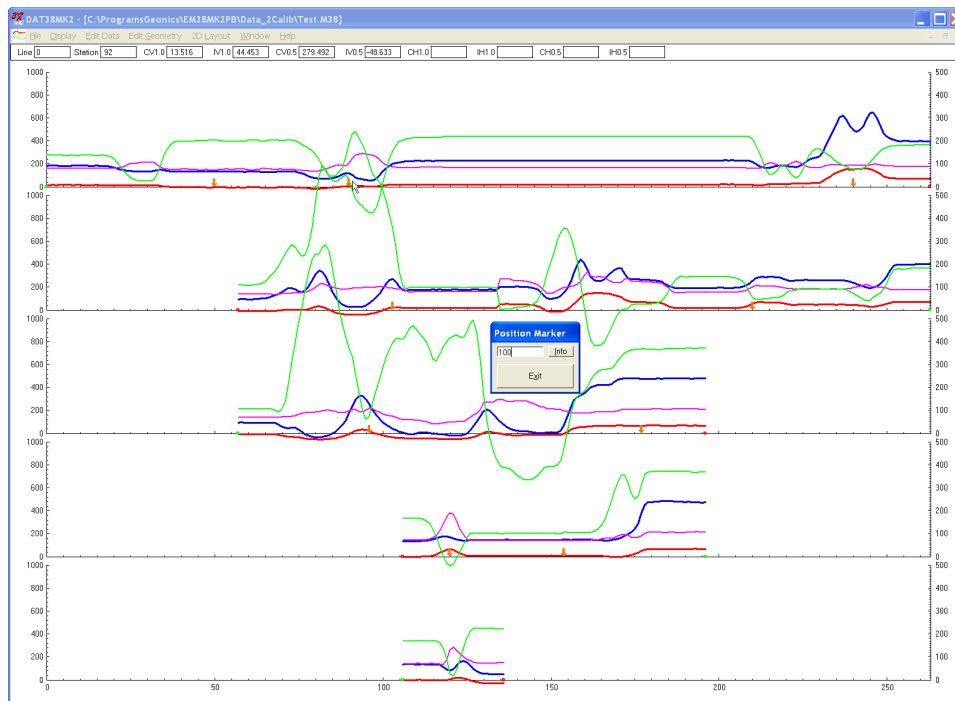


Figure 5.15 DAT38MK2 profile plot before adjustment of markers

Figure 5.16 shows profile plot after three markers (located in vicinity of station 100) have been clicked in three survey lines (sequence of top three lines). Three markers at station 100 are perfectly aligned in corresponding survey lines (compare with Figure 5.15).

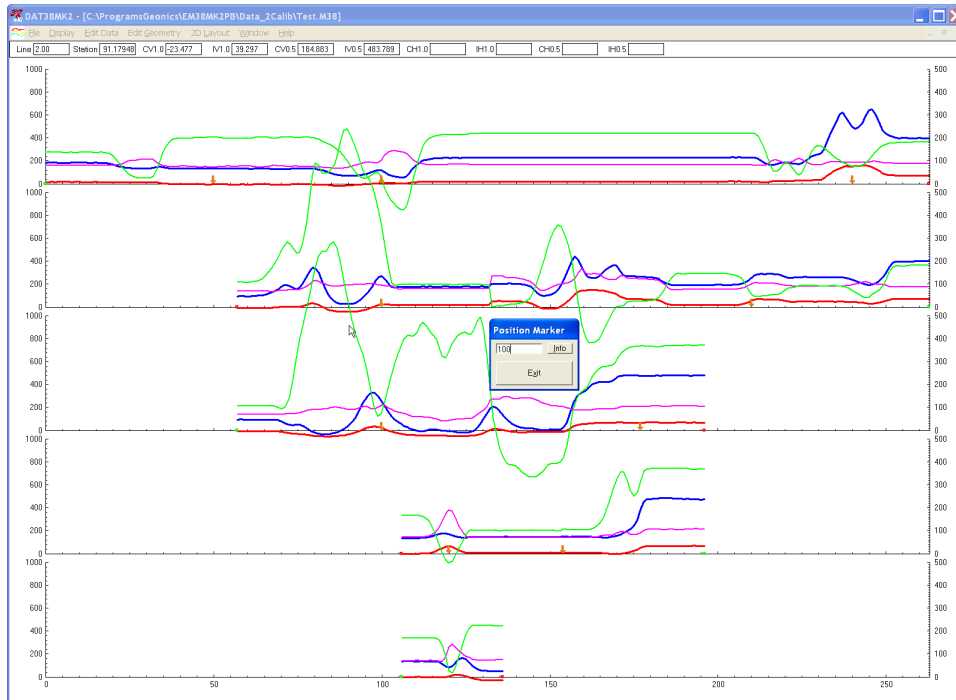


Figure 5.16 DAT38MK2 profile plot after positions of three markers have been adjusted

Start and final stations of survey lines act as markers when the Position Markers function is used. An example is shown in Figure 5.17 where start station of the third line (from the top of the display) was moved to station 20, please compare with Figure 5.16.

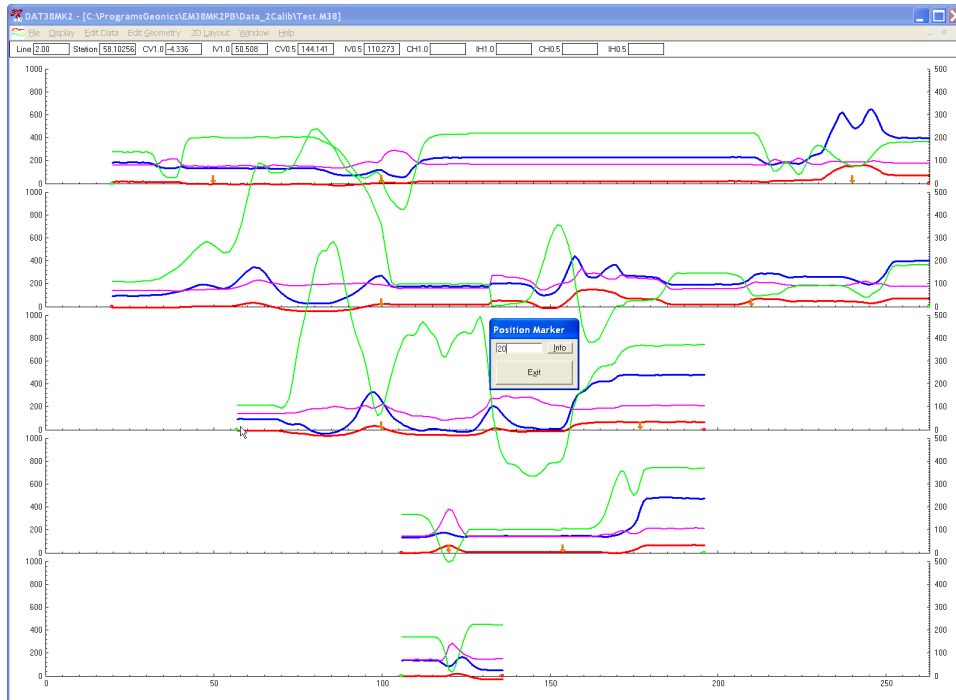


Figure 5.17 Repositioning start station

Please note that the marker must not be moved past neighboring marker (or end of survey line). If the specified station is beyond this range a warning message will be displayed (Figure 5.18). In the event that a marker must be repositioned beyond the range of a neighboring marker, either reposition or delete the adjacent marker first.

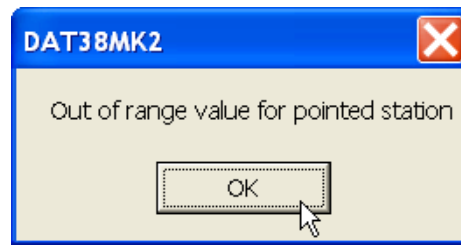


Figure 5.18 Warning message

6. 2D Layout (Create XYZ File)

The **2D Layout** option lets you create a two dimensional (XYZ type) file which can be used as an input file for various contouring systems. The created ASCII file contains three or more columns: X, Y, Z1, Z2 etc. (where Z1 corresponds to e.g. conductivity in mS/m, depending on the Create XYZ File settings). All data must be entered in the **Load Profile File** or **Add** menus prior to running this option.

To display the 2D Layout menu select **2D Layout** in the main menu at the top of the screen (Figure 6.1). The menu contains two options: Create Grid Based XYZ File and Create GPS Based XYZ File.

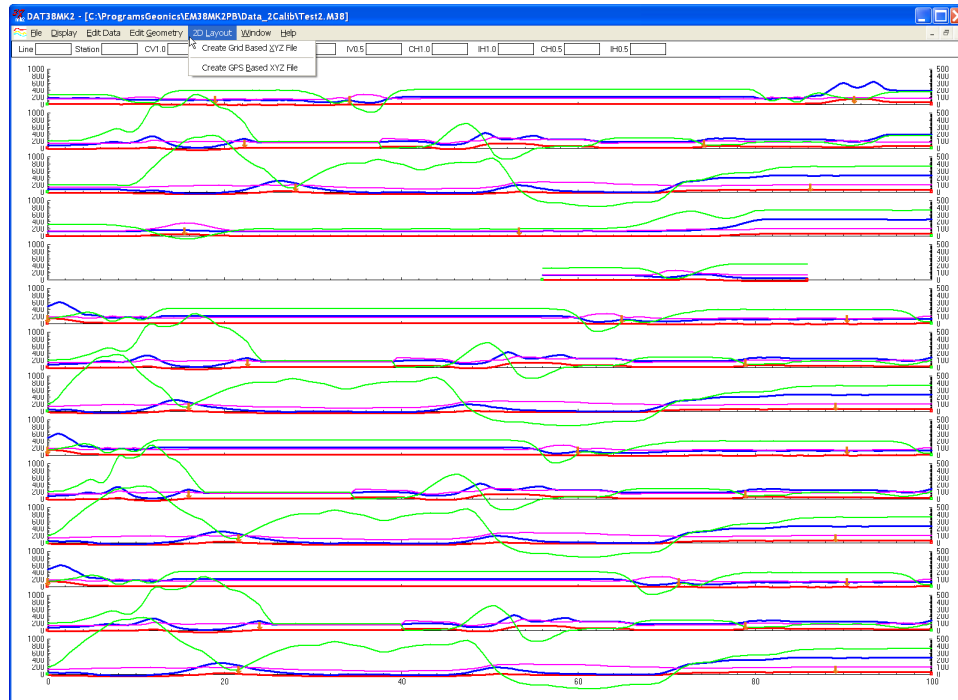


Figure 6.1 DAT38MK2 2D Layout menu

The first option, **Create Grid Based XYZ File** lets you generate files with N-S and W-E configuration of survey lines, when readings are collected along grids that are layed out before the survey. Therefore, it is strongly recommended that data files be organized so that each file contains parallel lines surveyed in one direction, either W-E or S-N. The program assumes that stations along survey lines correspond to one of coordinates (X or Y) and line names indicate another coordinate (X or Y). If line names do not correspond to an appropriate coordinate they can be easily changed by the **Rename** function in the **Select Survey Lines** window. Position of stations (line end points, fiducial markers) along survey lines should be organized using the **Edit Geometry** function prior to creating XYZ file.

The second 2D Layout menu item, **Create GPS Based XYZ File** can be used only when EM38-MK2 data is collected together with GPS positioning data. In this method the GPS receiver is connected to the Allegro CX (or other field computer logging EM38-MK2 readings) serial port and GPS data is collected in the EM38-MK2 data file. This method can be used with virtually any GPS receiver that can stream a **GGA** message (standard NMEA-0183 data string). The program is using GPS positions as received from employed GPS receiver, therefore differentially corrected positions (DGSP or any RTK system) provide better accuracy. When Create GPS Based XYZ File option is used, the DAT38MK2 positions EM38-MK2 readings based on simultaneously recorded GPS data and time stamps associated with EM38-MK2 and GPS records. A GPS positioned survey does not require the use of the survey lines feature, however it is strongly

recommended that while conducting project with a GPS, the survey is organized along parallel, or semi parallel lines if possible. Also, entry of line numbers may be helpful to locate specific area in case a portion of survey is to be repeated. At the same time a data set organized in survey lines can be displayed as stacked profiles, even if profiles are not perfectly organized it is easier to note some features on several lines instead of viewing one very long line.

6.1 Create Grid Based XYZ File

After you select the **2D Layout|Create Grid Based XYZ File** from the profile menu the Create Grid Based XYZ File window is displayed (Figure 6.2).

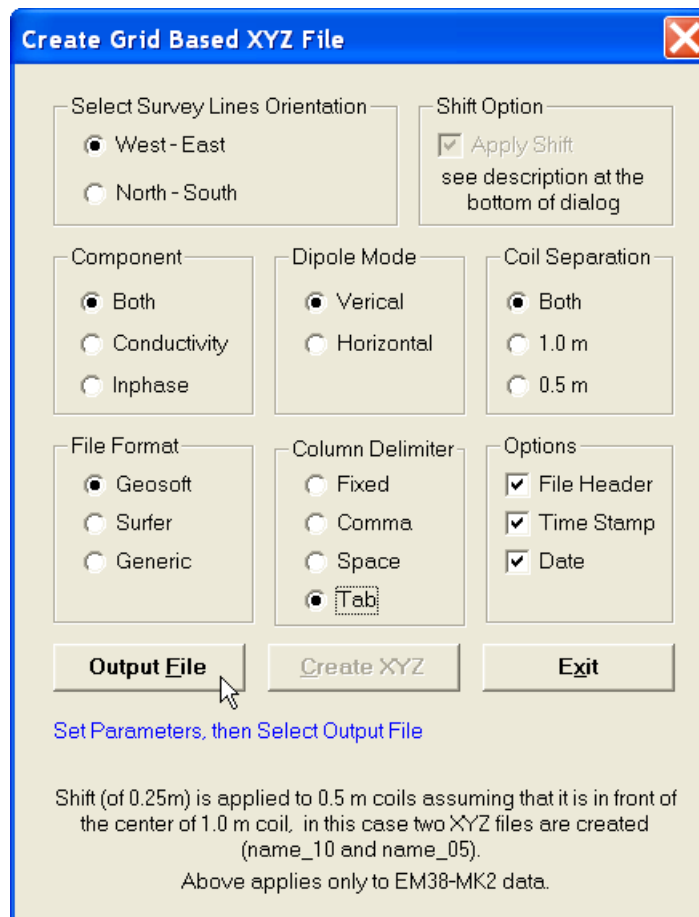


Figure 6.2 Create Grid Based XYZ File window

Several parameters which affect the contents and format of the created XYZ file must be specified. Specifically, these are the Orientation of Survey Lines, the EM38-MK2 Data Type and other parameters to be written to the file, format of the output file, and the output file name. For each parameter there is only one option for each layout which you select by clicking the appropriate radio or check box button.

Orientation of Survey Lines

Choose Regular **W-E** or **S-N** orientation of survey lines. The W-E orientation corresponds to a layout where lines are parallel and oriented in the X direction (assuming that the North or Y coordinate points to the top, and that the East or X coordinate points to the right

edge of a page). The S-N orientation corresponds to the perpendicular layout, with survey lines oriented in the Y direction.

If W-E orientation is selected, it is assumed that the line name gives the Y (S-N) coordinate and stations are aligned along the X (W-E) axis. If survey lines are parallel and oriented in W-E direction, but line names do not correspond to the Y coordinate, then rename the lines in the Select Lines window. It should be noted that if the line name starts with a number and ends with a letter, e.g. 10N, only the number will be recognized as a Y coordinate.

If the S-N orientation is selected, the line name corresponds to the X (W-E) coordinate and stations are aligned along the Y (S-N) axis. Again, if survey lines are parallel and oriented in S-N direction, but line names do not correspond to the X coordinate, then rename the lines in the Select Lines window. It should be noted that if the line name starts with a number and ends with a letter, e.g. 10A, only the number will be recognized as an X coordinate.

Please note that the program does not recognize letters as an indication of positive or negative coordinates. Stations and line names should be clearly named with negative sign (for example -10) if they correspond to negative side of X or Y coordinate.

Apply Shift

Center of measurement for coil separation 0.5 m is shifted 0.25 m from the center of the 1.0 m separation when instrument is oriented in the direction of surveying. Assuming that stations are related to the physical center of the EM38-MK2 (matching center of 1.0 m separation) and the instrument is oriented in one direction (in the direction of the movement) during the entire survey (recommended practice) the program can calculate offset of 0.5 m coil separation automatically if the check box labeled **Apply Shift** is checked in the Options section. In this case two XYZ files will be created, one for 1.0 m separation (with suffix _10) and another for 0.5 m separation (with suffix _05).

This options does not apply to EM38-MK2-1 data files.

Please note that this option can be used only when orientation of the instrument was kept in direction of surveying during the entire data set collection.

Select Data Type (Component, Dipole Mode, Separation)

To select the EM38-MK2 data type (component, dipole mode, and coil separation) to be written in the output file click the corresponding radio button in sections labeled **Component**, **Dipole Mode**, and **Separations** (Figures 6.2).

Only one dipole mode of the EM38-MK2 data can be written to a created XYZ file. Data is always placed in the created XYZ file in the following order: X coordinate, Y coordinate, Conductivity 1 m, Inphase 1 m, Conductivity 0.5 m, Inphase 0.5 m for selected dipole mode. Obviously, if one Component or Separation will be selected then less parameters will be written in the file, however the order will be the same. The parameter Time (time stamp for each reading) will be placed in the last column of the file if **Time Stamp** is selected in the section labeled **Options**. A comment line listing all parameters in the file is placed as a header for each created XYZ file.

Format

Indicate the appropriate option for the contouring software to be used. The Generic option will create a multi column file without any text strings. This file can be used as an input file for many contouring packages (including Geosoft and Surfer). When Geosoft is selected then file extension name XYZ will be given as a default, and extension names DAT and XYZ will be given respectively for Surfer and Generic selections respectively. Surfer and

Generic are basically same formats with different file extension names. Format CSV is fixed, it contains sequential reading number in the first columns, then time in seconds elapsed from UTC midnight, coordinates, elevation (if selected), and selected instrument readings.

Column Delimiter

Select column delimiter that is required by your application. The option Fixed corresponds to fixed field for each column with space or spaces between columns. This format is suitable for most applications and a file created with this selection provides the easiest option if file is to be viewed using any standard text editor. Remaining column delimiters are Comma, Space (single), and Tab.

Output File

When the **Output File** button is clicked, a Select XYZ File Name window is displayed. The EM38-MK2 file name with an extension corresponding to the selected output file format (xyz, dat, or asc) is given as a default (Figure 6.3).

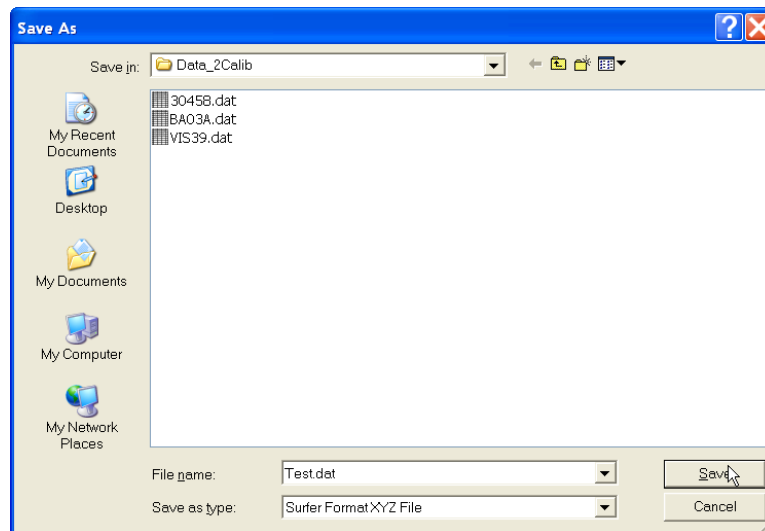


Figure 6.3 Select XYZ File Name window

Accept the default or specify a new file name and click the **Save** button. If the specified file exists on the hard disk a warning message will be displayed.

The Select XYZ File Name window will close and the selected file name will be displayed at the bottom of the Create Grid Based XYZ File window. At the same time the **Create XYZ** button is activated (Figure 6.4).

When all parameters are properly set the output XYZ file can be created. After you click on the **Create XYZ File** button a progress bar, located at the bottom of the window, will indicate the percentage of the created file that has been completed (Figure 6.5). After the file is created a label indicating selected file name will change and it will display that operation is completed.

Files created by this portion of the program can be viewed at any time using the **File|View XYZ File** menu. The displayed image will show the spatial layout of lines and stations to scale, based on the station coordinates written to the created file (Figure 6.6).

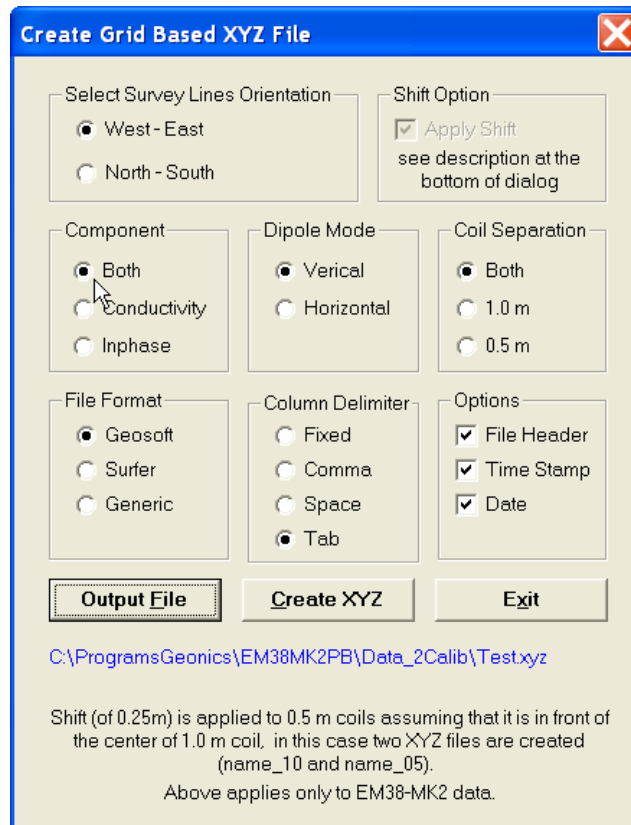


Figure 6.4 Create Grid Based XYZ File window after Output File is specified

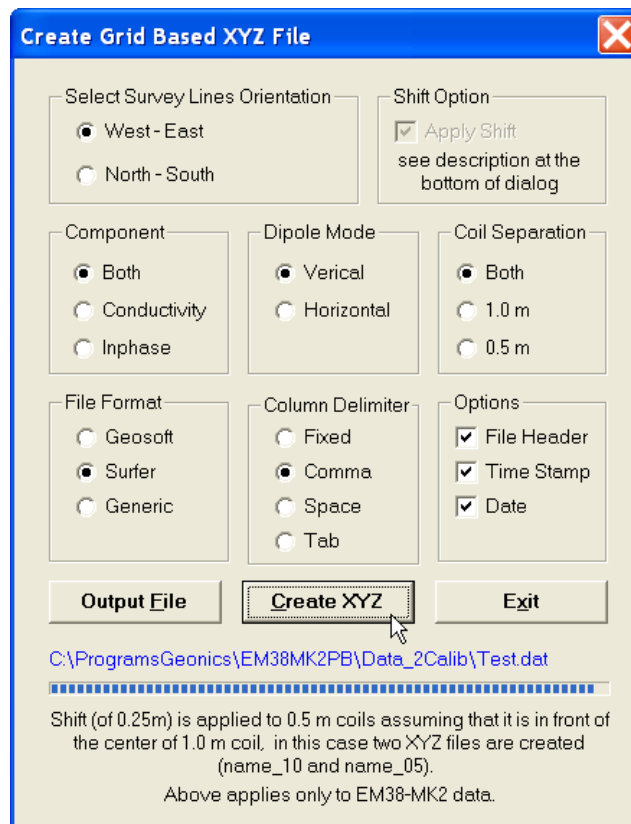


Figure 6.5 Create Grid Based XYZ File window during creating output file

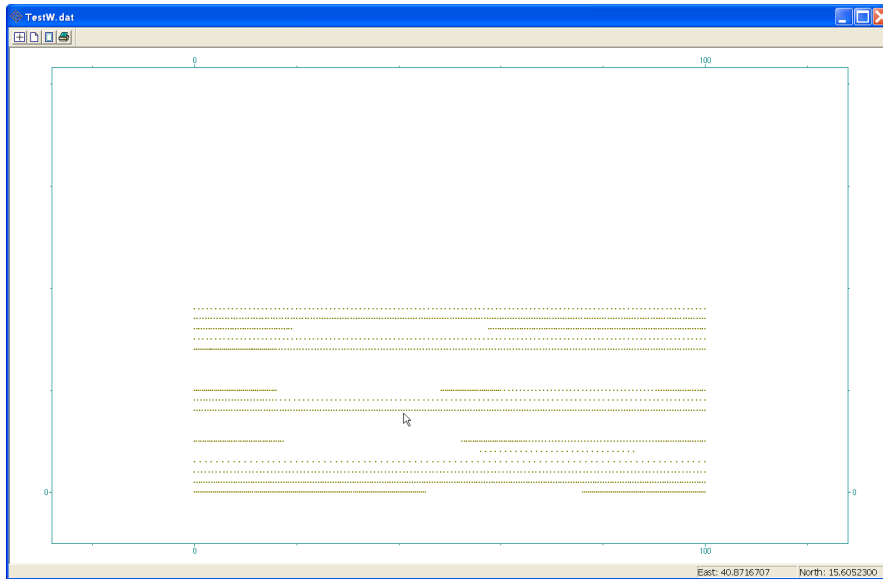


Figure 6.6 Layout of stations after an XYZ file is created

6.2 Create GPS Based XYZ File

This option of the DAT38MK2 program can be used when the GPS receiver is connected to the EM38-MK2 logger serial port and GPS data is recorder in the EM38MK2 data file. The EM38-MK2 data can be positioned directly to an XYZ file format by selecting the **2D Layout|Create GPS Based XYZ File** menu option. The Create XYZ File Based on GPS Positions window is displayed (Figure 6.7).

Offset (0.25 m) is applied to 0.5 m coils position assuming that the center of 0.5 coils is in front of the center of 1.0 m coil. In this case two XYZ files are created (name_10 and name_05).
Above applies only to EM38-MK2 data.

Figure 6.7 Create XYZ File Based on GPS Positions window

Before creating the XYZ file several parameters must be specified. These are XYZ file name, the format of coordinates in the output file, and several parameters associated with GPS signal.

File (Output File)

Click on the **File** button. The Select XYZ File window is displayed (Figure 6.8).

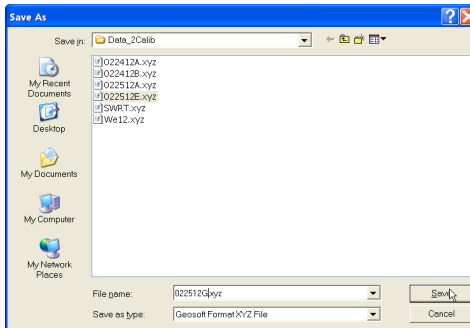


Figure 6.8 Select XYZ File window

The XYZ file name extension default will be determined by the selected output file format (xyz, dat, or asc) in XYZ File Format section. The XYZ File Format option must be selected before clicking on the **File** button.

Specify or select a file name and click the **Save** button. The Select XYZ File window will close and the selected file name will be displayed beside the **File** button in the Create XYZ File Based on GPS Positions window.

When Output Files is specified the **Proceed** button in the Create XYZ File Based on GPS Positions becomes active and name of selected file is displayed in the window associated with the **File** button (Figure 6.9).

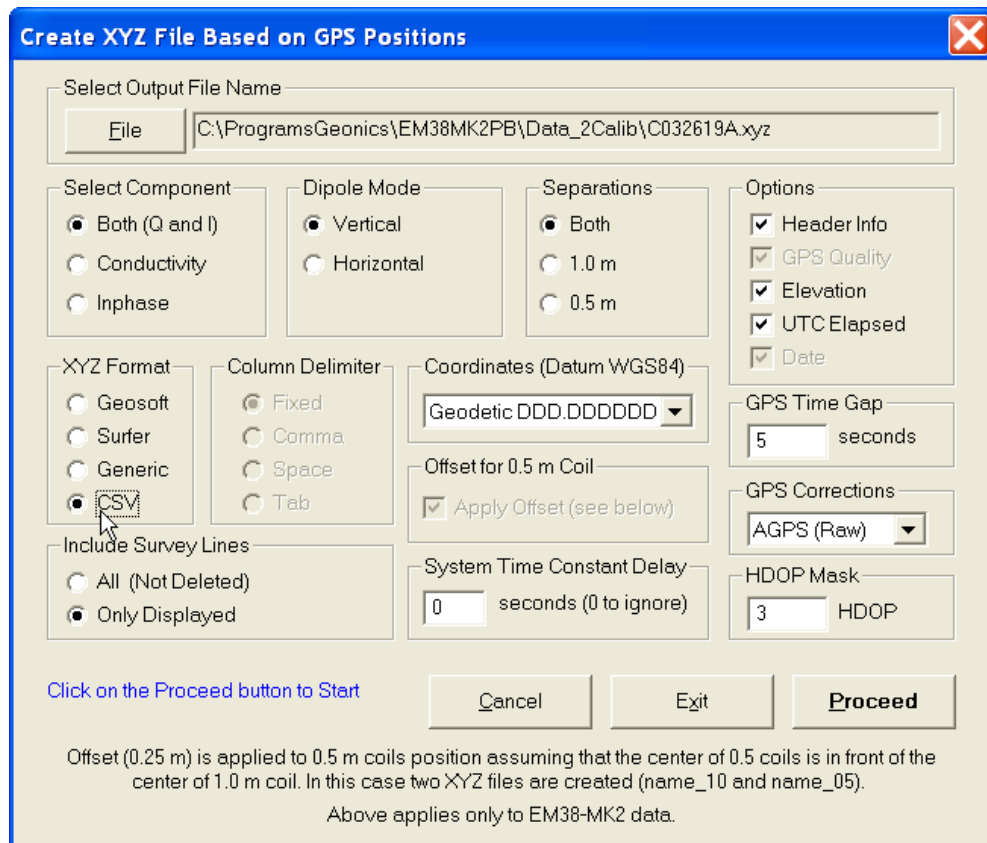


Figure 6.9 Create XYZ File Based on GPS Positions window after Output File name is specified

Select Data Type (Component, Dipole Mode, Separation)

To select the EM38-MK2 data type (component, dipole mode, and coil separation) to be written in the output file click the corresponding radio button in sections labeled **Select Component, Dipole Mode, and Separations** (Figures 6.7).

Only one dipole mode of the EM38-MK2 data can be written to created XYZ file. Data is always placed in the created XYZ file in the following order: X coordinate, Y coordinate, Conductivity 1 m, Inphase 1 m, Conductivity 0.5 m, Inphase 0.5 m for selected dipole mode. Obviously if only one Component or Separation is selected, then less parameters will be written in the file, however the order will be the same.

Options

A two line comment indicating selected datum and column contents will be written at the beginning of file if Header Description is selected in the Options section.

Remaining parameters GPS Quality (includes three parameters in separate columns: degree of differential corrections, number of satellites, and HDOP parameter), Elevation, Time Stamp (UTC Elapsed in case if CSV file format is selected), and Date will be placed in the last columns of the file assuming that they are selected in the **Options** section. These optional parameters are placed in the order indicated in Options section.

XYZ File Format

Indicate the appropriate option for the contouring software to be used. The Generic option will create a multi column file without any text strings. This file can be used as an input file for many contouring packages (including Geosoft and Surfer). The CSV option will create comma delimited file. This parameter will also determine a default file extension name during specifying XYZ file name. The program will prompt extension file names XYZ, DAT, ASC, or CSV for formats Geosoft, Surfer, Generic, and CSV respectively.

Coordinates

Positions can be written in the output file as geodetic (geographical) coordinates (Latitude/Longitude) or they can be converted to UTM coordinates. The program uses the WGS1984 datum.

Geodetic coordinates are given in degrees. They can be written in format DD.DDDDDDDDD. UTM coordinates can be generated in meters, feet or US Survey feet. To select Geodetic or UTM (and units) coordinates click one of the item listed in the combo box labeled Coordinates (Datum WGS 1984), see Figure 6.10.

Column Delimiter

Select column delimiter that is required by your application. The option Fixed corresponds to fixed field for each column with space or spaces between columns. This format is suitable for most applications and a file created with this selection provides the easiest option if file is to be viewed using any standard text editor. Remaining column delimiters are Comma, Space (single), and Tab.

GPS Time Gap

The **GPS Time Gap** parameter specifies the maximum time during which the EM38-MK2 data will be linearly interpolated between two GPS positions. Enter this parameter (in seconds) in the edit box labelled GPS Time Gap. In most cases a value 2 to 3 times larger than the GPS acquisition frequency is adequate

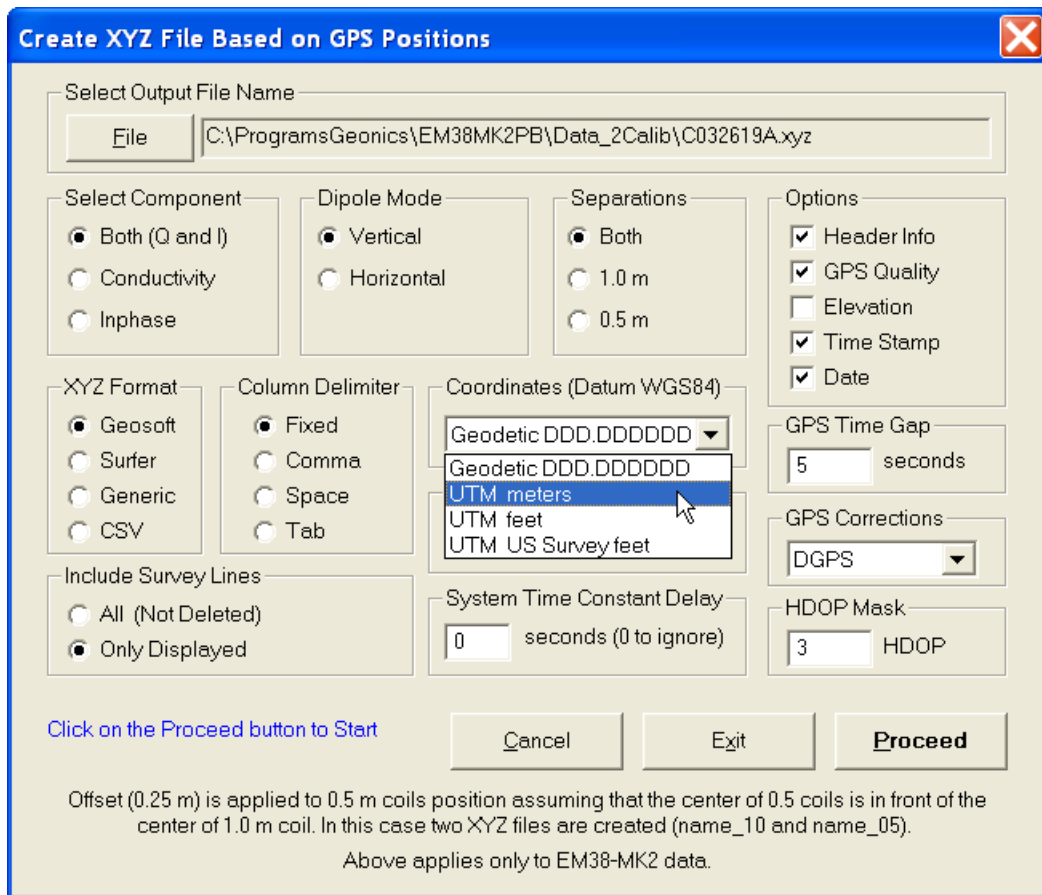


Figure 6.10 Selecting Coordinates in Create XYZ File Based on GPS GPS Positions window

GPS Corrections

Select item in combo box placed in a section labeled **GPS Corrections** to write selected or higher degree of GPS differential corrections. Selection includes: 1 AGPS (Raw), 2 Differential (DGPS), 3 RTK (RTK-3), 4 RTK (RTK-4), 5 RTK (RTK-5), and 6 Higher (>5), see Figure 6.11. The latter option covers future RTK options as well as WAAS option that is indicated by Quality Indicator 9. The specified parameter indicates the lowest acceptable degree of corrections. For example, if Raw is selected then all GPS positions will be accepted by the program (obviously with the exception of NO FIX that has Quality Indicator = 0), and if DGPS is selected then all positions with Quality Indicator = 1 (Raw) will be ignored by the program filter and DGPS and higher degree of corrections will be accepted.

HDOP Mask

Specify value of HDOP parameter the section labeled **HDOP Mask**. Readings associated with GPS positions that have HDOP values higher than specified will not be written to the file.

Offset for 0.5 m Coil Separation

Center of measurement for coil separation 0.5 m is shifted 0.25 m from the center of the 1.0 m separation. Assuming that stations are related to the physical center of the EM38-MK2 (matching center of 1.0 m separation) and the instrument is oriented in one direction (in the direction of the movement) during entire survey (recommended practice) the program

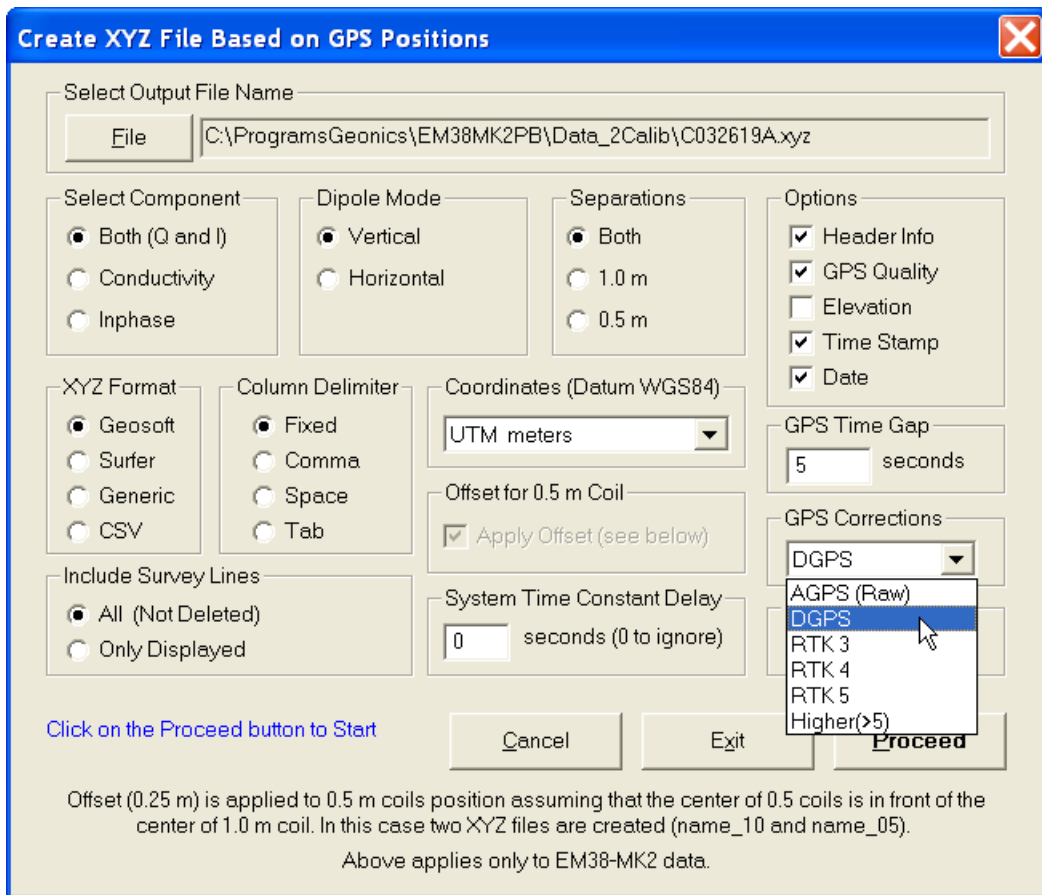


Figure 6.11 Selecting GPS Corrections in Create XYZ File Based on GPS GPS Positions window

can calculate offset of 0.5 m coil separation automatically if the check box labeled **Apply Shift** is checked in the Options section. In this case two XYZ files will be created, one for 1.0 m separation (with suffix _10) and another for 0.5 m separation (with suffix _05).

This options does not apply to EM38-MK2-1 data files.

System Time Constant Delay (System Latency)

This option allows for the system time constant delay correction. While the EM38-MK2 time constant is known the time constant of the combined EM38-MK2 and GPS receiver system is a function of these two devices. The best method to determine the time delay is to survey a few lines (in two directions) with varying speeds over the same small metallic target. When displaying the image the anomaly associated with the sample target may be slightly displaced or extended in size on neighboring lines. After the correct time constant for the system is determined the anomaly should be at the same location for each survey line. The alternative, possibly easier method to determine the time constant of the system is to survey a known buried pipe. After the proper time constant delay correction is applied the linear anomaly associated with the pipe should be free of any “hearing bone” effect.

Since the image of two dimensional data can be displayed in a mapping system (after grid-ing) the procedure can be time consuming, however it only needs to be done once for a given GPS receiver and EM38-MK2.

In order to apply the correction the generated XYZ file must have Time Stamp option

selected in the Options section.

Time Delay must be entered in seconds, default is 0.

Include Survey Lines

This option contains two items, choose by clicking on the appropriate radio button. When the **All** is selected then all (not deleted) survey lines in the loaded data set will be included in the created XYZ file. If the **Only Displayed** radio button is marked then survey lines that are actually displayed in stacked profile active window will be placed in the XYZ file.

After all parameters are specified and you click on the **Proceed** button a progress bar, will appear above command buttons and it will indicate the percentage of the created file that has been completed (Figure 6.12).

After the XYZ file is created, you can view the two dimensional layout at any time using the **File|View**

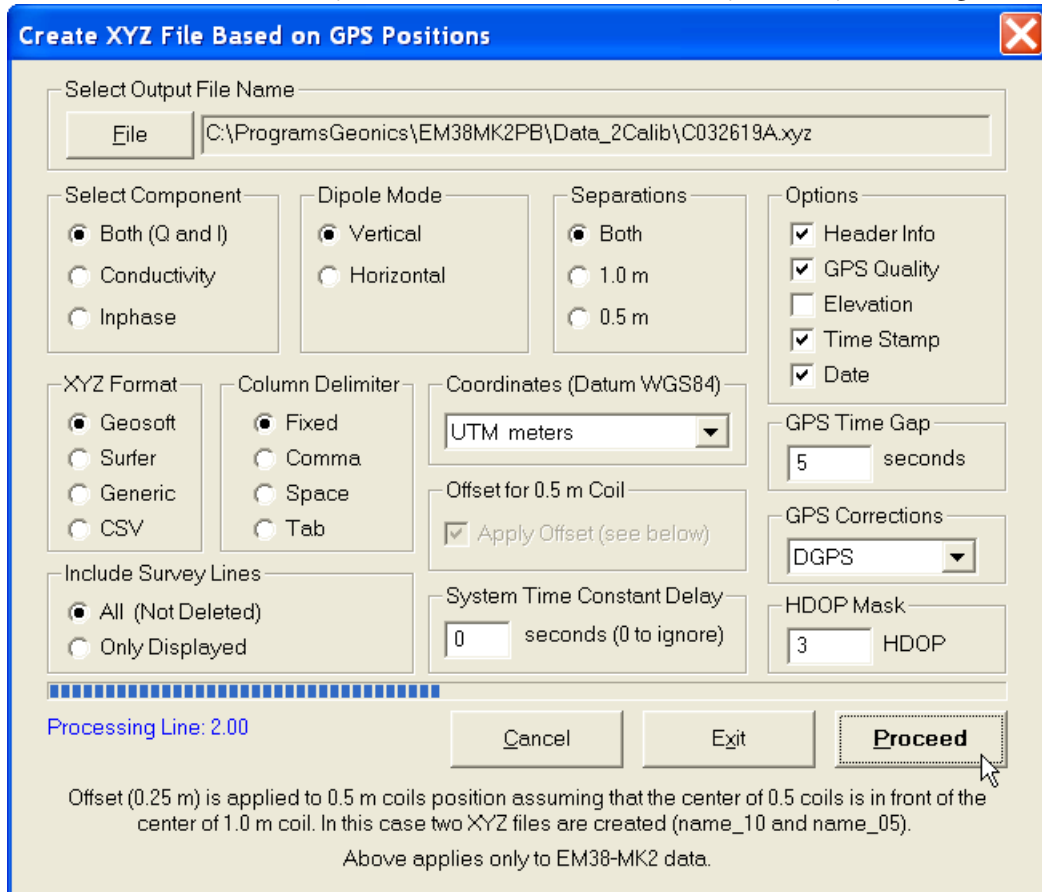


Figure 6.12 Create XYZ File Based on GPS Positions window during creating output file

XYZ File menu item.

Appendix A

A.1 Description of File in DAT38MK2 (M38) Format

A DAT38MK2 (with extension name M38) ASCII data file is comprised of one file header, one or more line header, one or more station records after each line header and GPS info (if GPS was used during data acquisition). The file starts with a file header. In the body of file there are line headers and station records. Line header, station record and GPS info can be distinguished by a type of **id** which is the first character in each record.

The DAT38MK2 file header contains name of the instrument: EM38-MK2, the program version number, and original name of file, as shown below:

EM38-MK2 V1.15 031008B

The row started with L specifies beginning of the survey line, it is followed by the line name, and line parameters (three characters e.g. BV100):

- 1st component (B-both, fixed),
- 2nd dipole mode (B-both, V-vertical, H-horizontal),
- 3rd not used (=1),
- 4th not used (=0),
- 5th user unit (as entered in during acquisition) (=0 meters, =1 feet).

The next field specifies line direction W, E, N, or S. At the end of this row two parameters indicate mode of data acquisition A-Auto Mode and it is followed by time increment in seconds, N-Manual Mode is followed by 0). Remaining fields correspond to the file original name, and date and time of survey line creation. The sample line header is shown below.

L 1.00 BV100 N A0.048 031008B 10/03/2008 08:59:25

The rows containing data start with the four character sequence (e.g. SV10), meaning of these characters is as follows:

- 1st S - reading and station,
R - reading, it appears only when more than one reading was taken at one station,
N - start of new segment of the line,
C - comment, the text of comment follows this field.
- 2nd V - reading with Vertical dipole mode,
H - reading with Horizontal dipole mode.
- 3rd 0 - no fiducial marker,
1 - fiducial marker pressed at this station (only in Auto Mode),
- 4th 1 - EM38-MK2 reading,
0 - EM38-MK2-1 reading.

Above 4 character field is followed by station number [user units], Conductivity 1m, Inphase 1 m, Conductivity 0.5 m, Inphase 0.5 m, Temperature 1 m, Temperature 0.5 m, and Time Stamp. All columns are separated by comma. Conductivity 1m represents conductivity taken for 1 m coil separation. If EM38-MK2 is used then fields for 0.5 m coil separations are filled by zeros.

Example of a line containing EM38-MK2 reading is given below:

sv01, 1.000, 117.678, -95.008, 338.521, 0.323, 17.568, 9.176,08:59:26.707

File may also contain lines started with with C that contain field comment (maximum 15 characters).

Reading containing GPS data starts with character \$. This character is followed by a standard NMEA GPS messages. For more informations regarding GPS parameters refer to Appendix A of the EM38MK2 manual.

The DAT38MK2 data file can be easily edited using any text editor, however care should be taken on preserving proper placement of all parameters.

A.2 Example of Data File in DAT38MK2 (M38) Format

```
EM38-MK2 V1.15 031008B
L 1.00 BV100 N A0.048 031008B 10/03/2008 08:59:25
$GPGSA,A,3,30,29,24,,02,,13,12,10,05,04,,02.5,01.4,02.1*0E,
SV01, 0.000, 117.444, -94.735, 339.107, 0.200, 17.568, 19.176,08:59:26.689
SV01, 1.000, 117.678, -95.008, 338.521, 0.323, 17.568, 19.176,08:59:26.707
SV01, 2.000, 116.233, -95.360, 338.560, 1.230, 17.568, 19.176,08:59:26.732
SV01, 3.000, 116.467, -94.969, 338.365, 1.200, 17.568, 19.176,08:59:26.825
SV01, 4.000, 106.350, -104.930, 328.482, 0.000, 17.568, 19.176,08:59:32.216
SV01, 5.000, 105.920, -104.774, 327.896, 0.000, 17.568, 19.176,08:59:32.375
SV01, 6.000, 105.647, -104.305, 328.365, 0.000, 17.568, 19.176,08:59:32.397
SV01, 7.000, 108.459, -104.344, 329.107, 0.000, 17.568, 19.176,08:59:32.425
SV01, 8.000, 105.334, -104.618, 328.951, 0.000, 17.568, 19.176,08:59:32.437
SV01, 9.000, 105.647, -104.930, 327.857, 0.000, 17.568, 19.176,08:59:32.457
$GPGGA,154424.00,4336.59278,N,07936.64471,W,2,9,1,139.74,M,-35,M,5,119*50,
08:59:32.477
SV01, 10.000, 108.147, -104.540, 328.600, 0.000, 17.568, 19.176,08:59:32.478
SV01, 11.000, 105.686, -105.243, 328.717, 0.000, 17.568, 19.176,08:59:32.509
SV01, 12.000, 105.491, -105.321, 327.740, 0.000, 17.568, 19.176,08:59:32.553
$GPGSA,A,3,30,29,24,,02,,13,12,10,05,04,,02.5,01.4,02.1*0E,
08:59:32.553
SV01, 13.000, 107.405, -104.618, 328.092, 0.000, 17.568, 19.176,08:59:32.609
SV01, 14.000, 106.741, -105.165, 328.209, 0.000, 17.568, 19.176,08:59:32.629
SV01, 15.000, 104.670, -105.516, 327.271, 0.000, 17.568, 19.176,08:59:32.703
SV01, 16.000, 105.491, -105.086, 327.779, 0.000, 17.568, 19.176,08:59:32.728
SV01, 17.000, 108.108, -104.813, 327.935, 0.000, 17.568, 19.176,08:59:32.756
SV01, 18.000, 106.858, -105.047, 328.053, 0.000, 17.568, 19.176,08:59:32.826
SV01, 19.000, 103.459, -105.516, 327.975, 0.000, 17.568, 19.176,08:59:32.858
SV01, 20.000, 103.381, -105.516, 327.428, 0.000, 17.568, 19.176,08:59:32.908
SV01, 21.000, 105.139, -105.594, 327.350, 0.000, 17.568, 19.176,08:59:32.959
SV01, 22.000, 106.155, -105.165, 327.428, 0.000, 17.568, 19.176,08:59:33.018
SV01, 23.000, 106.545, -105.165, 328.248, 0.000, 17.568, 19.176,08:59:33.061
SV01, 24.000, 104.983, -105.360, 327.896, 0.000, 17.568, 19.176,08:59:33.143
```

Appendix B

B.1 Description of Data File in EM38MK2 (N38) Format

Each record contains 26 characters, including line feed at the end of each record.

Header of the file (contains two records starting with characters E and H)

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
E	M	3	8	M	K	2		V	1	0	0	Survey Type	UT	ID	IM	IC	CS								10
H																									10

- EM38MK2 - identification of program file
- V100 - version number (1.00)
- Survey Type - GPS (if GPS Input Enabled) or GRD (grid)
- UT - unit type (0 = meters, 1 = feet)
- ID - EM38-MK2 Dipole Mode
(0 = Vertical, 1 = Horizontal, 2- Both)
- IM - EM38MK2 survey mode
(0 =Auto, 2 =Manual)
- IC - not used (0 - fixed)
- CS - instrument type (1 = EM38-MK2-1, 2 = EM38-MK2-2)
- File Name - file name, maximum 8 characters
- Time/Samples - this field depends on EM38MK2 survey mode
 - Auto Mode - Time Increment in seconds
 - Manual Mode - Samples/Reading
- 10 - Line Feed character

Header at the start of survey line (four records starting with L, B, A, 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
L																									10
B																									10
A	Dir																								10
Z	D	D	M	M	Y	Y	Y	Y		H	H	:	M	M	:	S	S								10
O	1																								10
O	2																								10
O	3																								10
O	4																								10
O	5																								10
O	6																								10

- Line Name - Line Name, maximum 8 characters
- Start Station - Start Station for the Line, format F11.2
- Dir - Direction of the Line (E, W, N, or S)

- Station Inc. - Station Increment, format F11.3
- Date - Date when Line was created, format DD-MM-YYYY
- Time - Real Time when Line was created, format HH:MM:SS
- O1 - Calibration factor - conductivity 1.0 m coils (current and former)
- O2 - Calibration factor - conductivity 0.5 m coils (current and former)
- O3 - Calibration factor - Inphase 1.0 m, V mode (current and former)
- O4 - Calibration factor - Inphase 0.5 m, V mode (current and former)
- O5 - Calibration factor - Inphase 1.0 m, H mode (current and former)
- O6 - Calibration factor - Inphase 0.5 m, H mode (current and former)
- 10 - Line Feed character

Timer Relation

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

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

Reading

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
I	Gn	1h	1l	2h	2l	3h	3l	4h	4l	5h	5l	6h	6l		Time Stamp in ms (10 digits)										10

- I - indicator T, t, or 2
 - T - first reading at the EM38-MK2-2 station (default for Auto mode)
 - t - first reading at the EM38-MK2-1 station (default for Auto mode)
 - 2 - second reading at station (possible only in Manual mode)
- Gn - information byte, one character parameter, the ASCII number of this character indicates following:

Bit	Decimal	Value and Meaning	
7	128	0	<i>not used</i>
6	64	0	<i>not used</i>
5	32	0	<i>not used</i>
4	16	Ext. Marker = 1	<i>used</i>
		= 0	<i>otherwise</i>
3	8	Soft Marker = 1	<i>used</i>
		= 0	<i>otherwise</i>
2	4	Dipole Mode = 1	<i>Vertical</i>
		= 0	<i>Horizontal</i>
1	2	Marker = 1	<i>no marker</i>
		= 0	<i>trigger pressed</i>
0	1	0	<i>not used</i>

- 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 Channel 5
- 5l - lower byte of Channel 5
- 6h - higher byte of the 2's complement Hex number of Channel 6
- 6l - lower byte of Channel 6
- Time Stamp - time in ms from the Windows start (resets every 49.7 days).
The time in milliseconds can be linked with the computer local time by using Times in line started by * (see Timer Relation).
- 10 - Line Feed character

Channel Information

- Channel 1 - Conductivity for coil separation 0.5 m
- Channel 2 - Inphase for coil separation 0.5 m
- Channel 3 - Conductivity for coil separation 1.0 m
- Channel 4 - Inphase for coil separation 1.0 m
- Channel 5 - Temperature for coil separation 0.5 m
- Channel 6 - Temperature for coil separation 1.0 m

Multiply Channels 1 to 4 according to following formulas to obtain Conductivity or Inphase readings in mS/m or ppt.
(In EM38-MK2-1 data only channels 3, 4, and 6 are valid).

$$\text{Reading (Conductivity)} = (\text{Channel} \times 5 / 1024 - 160) \times 8 \quad (\text{channel 1 or 3})$$

$$\text{Reading (Inphase 1.0 m)} = (\text{Channel} \times 5 / 1024 - 160) \times 8 \times 0.028819 \quad (\text{channel 4})$$

$$\text{Reading (Inphase 0.5 m)} = (\text{Channel} \times 5 / 1024 - 160) \times 8 \times 0.00720475 \quad (\text{channel 2})$$

Multiply Channels 5 and 6 according to the expression given below obtain Temperature readings in degrees.

$$\text{Temperature (for 1.0 or 5.0 m)} = \text{Channel} \times 100 / 13107 - 50$$

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
C	Comment (maximum 11 characters)												Time Stamp in ms (10 digits)										10			

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
S	New Station (Format 11.2)												Time Stamp in ms (10 digits)										10			

Calibration

When Calibration is performed during data logging then record for each component/coil separation/dipole mode contains two factors. First value corresponds to the current calibration and the second, following value shows former calibration factor. Calibration values is always recorded as a block of six record, each record represents values for different component/coil separation and in case of Inphase dipole mode settings.

Calibration values placed in Line Header do not contain second, former values till calibration is performed during data logging, in this case they are set to zero.

○	1	Calibration for Q/P 1.0 m (F10.3)	Former Cal. for Q/P 1.0 m (F10.3)	10
○	2	Calibration for Q/P 0.5 m (F10.3)	Former Cal. for Q/P 0.5 m (F10.3)	10
○	3	Calibration for I/P V 1.0 m (F10.3)	Former Cal. for I/P V 1.0 m (F10.3)	10
○	4	Calibration for I/P V 0.5 m (F10.3)	Former Cal. for I/P V 0.5 m (F10.3)	10
○	5	Calibration for I/P H 1.0 m (F10.3)	Former Cal. for I/P H 1.0 m (F10.3)	10
○	6	Calibration for I/P H 0.5 m (F10.3)	Former Cal. for I/P H 0.5 m (F10.3)	10

- O1 - Calibration factor - conductivity 1.0 m coils (current and former)
- O2 - Calibration factor - conductivity 0.5 m coils (current and former)
- O3 - Calibration factor - Inphase 1.0 m, V mode (current and former)
- O4 - Calibration factor - Inphase 0.5 m, V mode (current and former)
- O5 - Calibration factor - Inphase 1.0 m, H mode (current and former)
- O6 - Calibration factor - Inphase 0.5 m, H mode (current and former)
- 10 - Line Feed character

GPS Data Message Records

Each GPS record (GGA Message) is broken in to several 24 characters strings and placed in the EM38MK2 data file which contains 26 characters long records, including one character indicator and line feed at the end of each record. The GPS sequence starts at the line which contains character @ as the first character, then records that contain continuation of the same message start with character #. The GPS sequence ends with a line starting with the character !. The last line contains logger time stamp in milliseconds for given GPS reading. A sample of the GPS message written in EM38MK2 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	
@	\$	G	P	G	G	A	,	h	h	m	m	s	s	.	s	s	,	d	d	m	m	.	m	m	10	
#	m	m	m	,	s	,	d	d	d	m	m	.	m	m	m	m	m	,	s	,	n	,	q	q	10	
#	,	p	p	.	p	,	s	a	a	a	a	a	.	a	a	,	u	,	±	x	x	x	x	.	10	
#	x	,	M	,	s	s	s	,	a	a	a	*	c	c	CR	LF									10	
!																									Time Stamp in milliseconds	10

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

B.2 Example of Data File in EM38MK2 (N38) Format

The EM38MK2 data file records are written in binary format, therefore the file may have different shape when displayed or printed, depending on particular video or printer settings.

```
EM38MK2 W115GPS00002
H 090916A 0.100
L0
B 0.00
AS 1.000
Z09092007 16:49:17
01 112.765 0.000
02 23.365 0.000
03 5.127 0.000
04 2.259 0.000
05 15.823 0.000
06 16.235 0.000
*16:49:17.000 40102085
T '@AEÿÿf£ÛÛ 40165321
T ...
¿AÿÿvfvÛÛ 40165416
@$GPGGA,223956.00,4336.59
#316,N,07936.65071,W,2,4,
#3,134.93,M,-35,M,4,118*5
#C
! 40165402
T †vÁ}ÿÿ~áÛÛ 40165511
@$GPGSA,A,3,,,,,28,,17,1
#1,08,,,09.3,02.7,08.8*09
#
! 40165484
T "ãAàÿÿ.....ÛÛ 40165606
T %ÛÁ ÿÿ «ÛÛ 40165700
T ×(àÿÿWÛÛ 40165795
T ÷ÛñÿÿZ£ÛÛ 40165890
T †/A1ÿÿ,1ÛÛ 40165985
T †!¿ÿÿ~4ÛÛ 40166080
T ^%A1ÿÿ,'ÛÛ 40166175
T "Aeÿÿ3IÛÛ 40166270
T $ Aóÿÿ...<ÛÛ 40166365
T - áóÿÿ ÛÛ 40166460
@$GPGGA,223957.00,4336.59
#315,N,07936.65071,W,2,4,
#3,135.10,M,-35,M,4,118*5
#4
! 40166401
@$GPGSA,A,3,,,,,28,,17,1
#1,08,,,09.3,02.7,08.8*09
#
! 40166498
T $1/2E'ÿÿ...,ÛÛ 40166555
T ...e34Eÿÿ,tÛÛ 40166650
T †,34fÿÿ ^ÛÛ 40166745
T †ÿAáÿÿya ÛÛ 40166839
T '2A~ÿÿ,TÛÛ 40166934
T ®ZY^ÿÿYüÛÛ 40167124
T †
AZÿÿ3AÛÛ 40167219
T †p¿ìÿÿfÛÛ 40167314
T †¿¿ÿÿ~2ÛÛ 40167409
@$GPGGA,223958.00,4336.59
#312,N,07936.65069,W,2,4,
#3,135.25,M,-35,M,5,118*5
#2
! 40167401
.....
```

