

Multi61 MK2

Version 1.43

data processing program for
an array of EM61-MK2s and GPS

User's Manual

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Introduction

1

The Geomar ML61MK2 Data Logging System consists of a data logging program ML61MK2 (or ML61MK2A) and associated PC computer program Multi61MK2. The program ML61MK2 is designed for the Pro4000 field computer, the ML61MK2A is prepared to handle the different size screen of the Allegro field computer. If necessary any of these programs can be used with any other IBM compatible computer running an MS DOS operating system and equipped with the necessary number of serial ports. The only disadvantage of using a standard laptop computer will be the small size of the display which is limited for the Pro4000 or Allegro field computers. The Allegro version of the program, the ML61MK2A is more suitable for standard laptop screens. The program Multi61MK2 is used to process data files recorded under the control of program ML61MK2 or ML61MK2A

1.1 About the Multi61MK2

The program Multi61MK2 is a Windows based program for IBM PC compatible computers operating under Windows 95/98/XP/NT(V4.0) and Windows 2000. The program Multi61MK2 is designed to process data collected by a field computer under the control of programs ML61MK2 or ML61MK2A. The program can be used to transfer data from the field computer to PC, to position EM61-MK2 sensors, to convert data to Geonics DAT61MK2 (MK2) format, to convert ASCII text file format, position field comments and generate position file for stand-alone GPS positions (GXY), and to correct created XYZ files for a delay (lag) caused by the system time constant.

Main function of this program is to position each EM61-MK2 sensor based on the recorded GPS position, the configuration of the system, and several user specified filters. The Multi61MK2 also allows you to correct the collected GPS positions with post-processed GPS files and with standalone GPS files (when GPS receiver cannot be connected to ML61MK2 logger). Optionally GPS quality parameters can be written to the output file. The program can process six different NMEA GPS messages recorded by data acquisition software NAV61MK2: a pair GGA/GSA, GGA, POS, LLK, LLQ, GLL, and GSK. In addition program handles interface of Leica Robotics Total Station TPS1100.

In case of grid based surveys (without GPS positioning) the program will layout the survey grid based on survey setup parameters and the system geometry. Alternatively, the grid based data files can be exported to Geonics DAT61MK2 (M61) format and data can be processed using the Geonics program DAT61MK2. The later appears to be a better way mainly due to the better editing capabilities of grid based data in Geonics DAT61MK2.

The Multi61MK2 uses data files in ML61MK2 format which have extension name N61. These are binary files with a record length of 22 bytes terminated by Line Feed character. These files should not be edited using standard text editors. The program can also process files with extension GXY. The GXY file contains standalone GPS positions if the ML61MK2 program was used to collect GPS data only. These files are also binary (records are 22 bytes long and terminated by Line Feed character) and care should be taken if they are viewed with text editors. Files GXY generated by any other Geomar data acquisition program i.e. ML61, NAV61MK2, NAV31, etc. are fully compatible and they can be processed by Multi61MK2.

One sample ML61MK2 data file, 052410a.N61, and one external (postprocessed) GPS file ext.txt are included on the program disk. They allow the user to become familiar with running the Multi61MK2 program.

1.2 Contents of Multi61MK2 Distribution Disk

Program Multi61MK2 is supplied on one CD disk. Disk contains following files and directories:

- SETUPML61** - setup program for Multi61MK2
- Documentation** - directory containing all ML61MK2 and Multi61MK2 related manuals in PDF format.
- ML61Disks** - directory containing two subdirectories (Disk1 and Disk2) for users that require floppy disks to run SetupML61
- ML61MK2(A)** - Pro4000 or Allegro version of data acquisition program

The program can be also supplied on floppy disks if requested.

1.3 Multi61MK2 Software Installation

Multi61MK2 uses a setup program to load files onto your computer. The following section describes the installation process. To install Multi61MK2: Insert the Multi61MK2 CD disk (or floppy diskette #1) into computer CD (or floppy) 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).

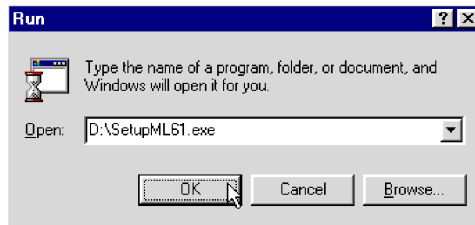


Figure 1.1: Run Dialog window

Browse for the file SETUPML61.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).

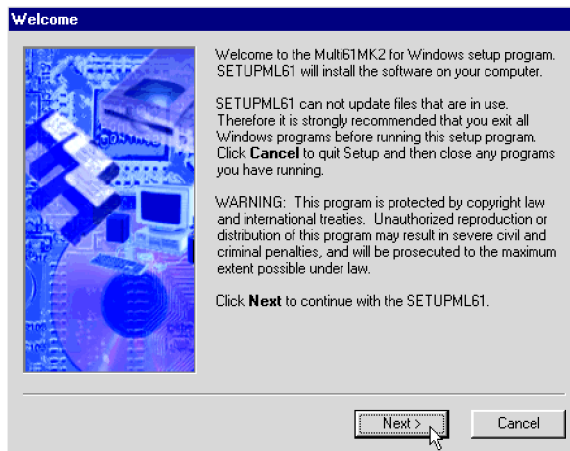


Figure 1.2: Welcome window

Read the text and click the **Next** button. The Serial Number window will be displayed (Figure 1.3).

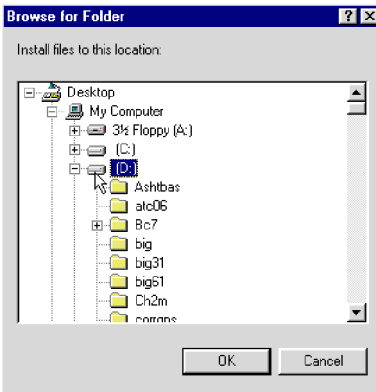


Figure 1.5: *Select Installation Directory window*

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 1.6).

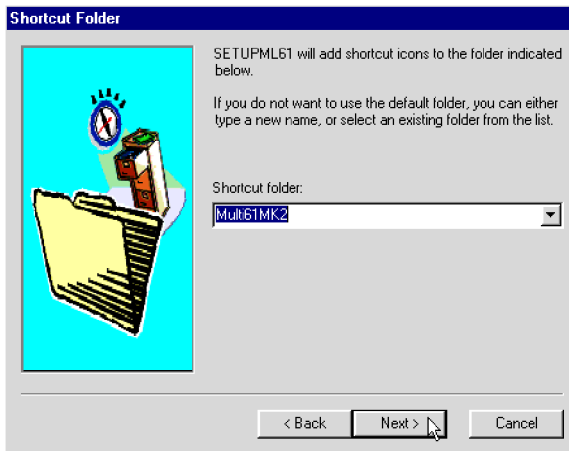


Figure 1.6: *Select Shortcut Folder window*

The setup program will create a Multi61MK2 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 the Ready to Install window will follow (Figure 1.7).

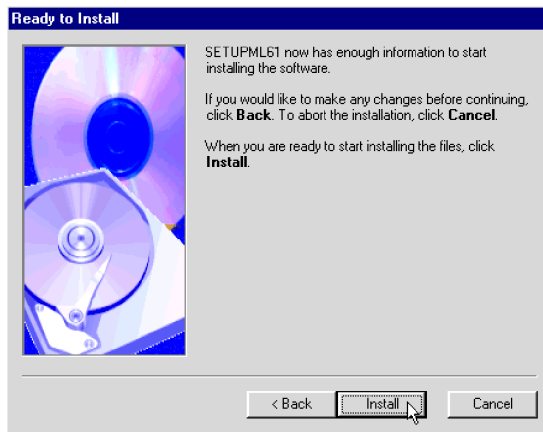


Figure 1.7: Ready to Install window

In case you would like to make any changes before the installation, click **Back**. To abort installation click **Cancel**. If you are ready to start installation, click **Finish**. The installation progress bar will appear (Figure 1.8).



Figure 1.8: Installing Files

The Installing Files window with a progress bar displays the percentage of the installation completed. When finished, the following window will appear (Figure 1.9).

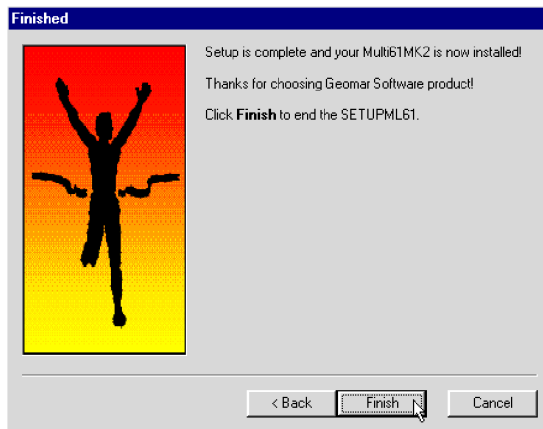


Figure 1.9: Finished window

Click **Finish** to end installation. SETUPML61 creates a Multi61MK2 program group and places **Multi61MK2** and **Uninstall** icons into it. The setup program creates also a **Multi61MK2** menu item in the Program menu accessible by clicking **Start**. A reminder to restart the system will be displayed at the end of the SETUPML61 program.

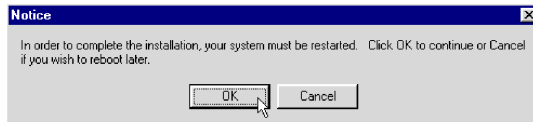


Figure 1.10: Restart Notice message

The destination directory that was chosen earlier contains program files and sample data files.

1.4 Program Overview

Start the Multi61MK2 by double clicking the Multi61MK2 icon in the **Start | Programs** menu, in Windows Explorer, or on the desktop if a shortcut was created. At the start, Multi61MK2 displays the following screen (Figure 1.11):

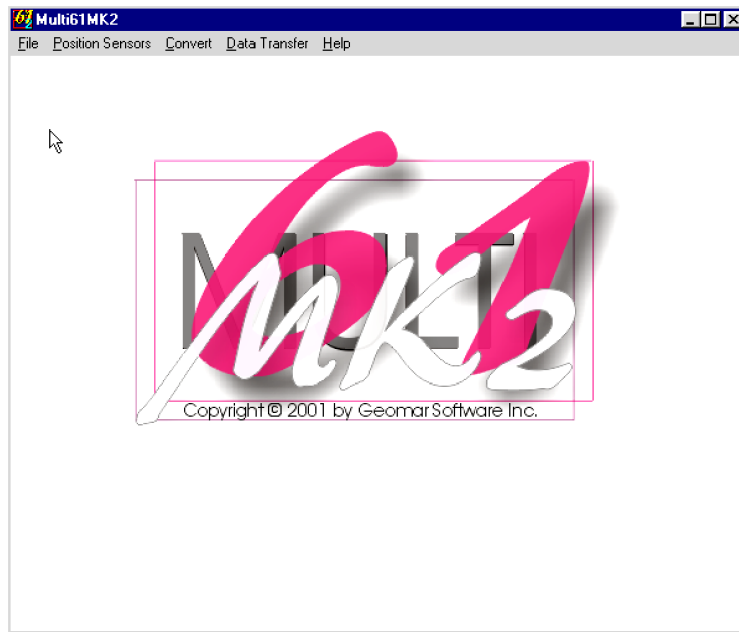


Figure 1.11: Multi61MK2 Main Screen

The Multi61MK2 is a menu driven program. A short description of the possible menu options is given below.

File Menu

The File Menu is shown in Figure 1.12. Functions accessible from this menu allow you to display information about selected data file, to display two dimensional layout of selected XYZ file, and exit the program

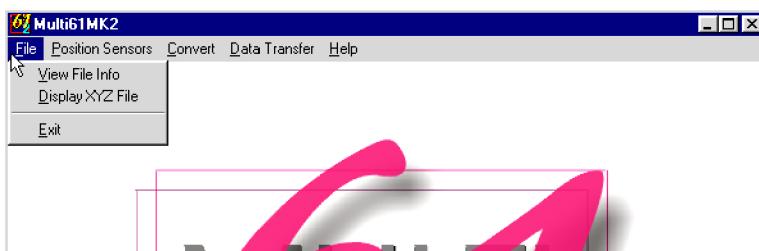


Figure 1.12: Multi61MK2 File menu

Position Sensors Menu

The Position Sensors menu represents the main function of the program: positioning each of the EM61-MK2 array sensor based on the system geometry and GPS

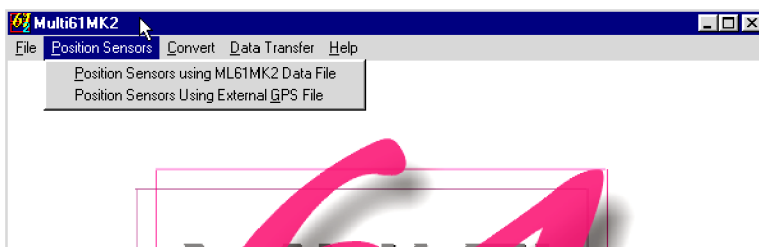


Figure 1.13: Multi61MK2 Position Sensors menu

positioning. The first item of the menu, Position Sensors using ML61MK2 Data File allows you to position sensors based on Real Time GPS data embedded in ML61MK2 file. The second item, Position Sensors using External GPS File is used to replace Real Time GPS data by positions from the postprocessed GPS data file. The later requires that the GPS data is collected in the field computer running ML61MK2 program as well as in the GPS receiver logger. GPS data can be processed by the GPS manufacturer

software and then exported as an ASCII file. This option is especially useful in the following cases:

- when Real Time differentially corrected positioning is not available,
- accuracy of positioning may be further improved by processing data using special GPS software,
- if special or unique coordinate system provided by GPS software is required and it is not available in other employed data processing or mapping software.

Convert Menu

The Convert menu has four functions available. The menu is shown in Figure 1.14.

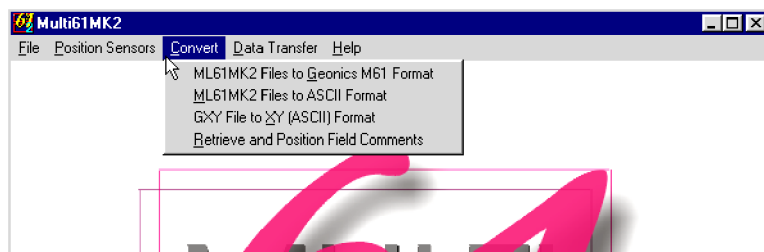


Figure 1.14: Multi61MK2 Convert menu

The first item, ML61MK2 Files to Geonics M61 Format allows you to convert ML61MK2 files to files that can be loaded and processed by the Geonics DAT61MK2 program.

The second item, ML61MK2 Files to ASCII Format allows you to convert data files to ASCII text format. This file can be simply used to examine data in text mode, or it can be easily converted to other formats if required.

In case when the ML61MK2 program was used to acquire standalone GPS positions (without EM data) the data files have extension name GXY. The third item, GXY File to XY (ASCII) Format can be used to convert binary data file to simple text file with three columns: Easting (Longitude), Northing (Latitude), and Time Stamp of the record. These files can be used in other applications.

The fourth item of the Convert menu, Retrieve and Position Field Comments allows you to filter out and position field comments entered by the operator during the survey.

Data Transfer Menu

This menu has only one item: Download Logger Files. Downloading is performed with the cooperation of the field computer program (option Dump Files). The menu is shown in Figure 1.15.

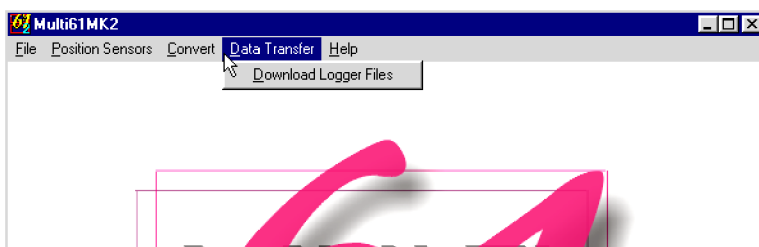


Figure 1.15: Multi61MK2 Data Transfer menu

Alternatively, data files can be transferred from the field computer by the Juniper System program Lynx which is available with Pro4000 and Allegro loggers.

Help Menu

About is the only available option in this menu. It displays name and version of the program. On line help function is not available in this version of the Multi61MK2.

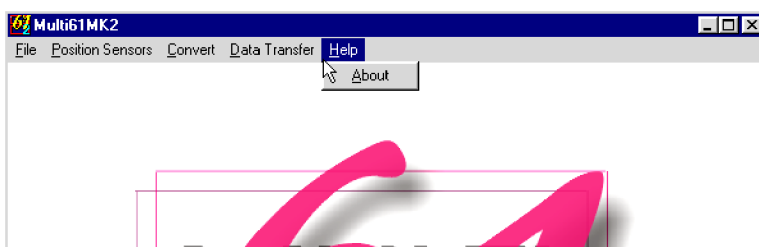


Figure 1.16: Multi61MK2 Help menu

A detailed description of the function of each menu item is provided in relevant sections of the manual.

Data Transfer

2

This chapter describes the transfer of data files from Pro4000 or Allegro field computers to PC computer using the Data Transfer option of program Multi61MK2. This option requires that the logger program ML61MK2 is version 1.10 or later, and Multi61MK2 program is version 1.05 or later. If an earlier version of the program ML61MK2 is in use in the field computer, upload the newer version of the program (it will not damage any data files) or use other utility, i.e. Lynx, to transfer data files.

Data files can be also downloaded by alternative utilities i.e. ProShell in Pro4000 or FileScout in Allegro Field PC and Windows based Lynx (see Appendix C).

2.1 Download Files Procedure

To start downloading files from the field computer, select the **Data Transfer | Download Logger Files** item in the program menu (Figure 2.1).



Figure 2.1: Data Transfer menu

After you click the Download Logger Files item, the Download ML61MK2 Files window will appear (Figure 2.2).

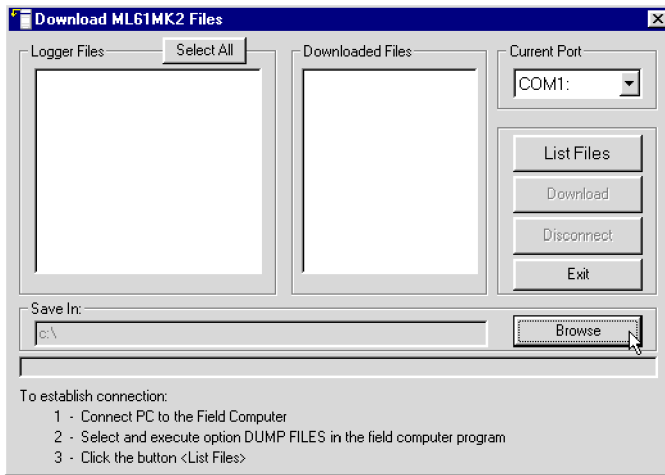


Figure 2.2: Download ML61MK2 Files window

The Download ML61MK2 Files window has two list boxes. The first from the left, labeled **Logger Files** will contain, after the **List Files** button is clicked, a list of data files located in the field computer and available to download. File names, with their size in bytes will be displayed as well. The second list box, labeled **Downloaded Files**, will list downloaded data files in the ML61MK2 format. If a file name already exists on the computer hard disk, an underscore followed by a letter will be added to the base name. (i.e. file name ABC.N61 would be changed to ABC_1.N61, ABC_2.N61, and so on.)

To select the directory where transferred files will be placed click the **Browse** button. The Select Directory for ML61MK2 Files window will be displayed (Figure 2.3).

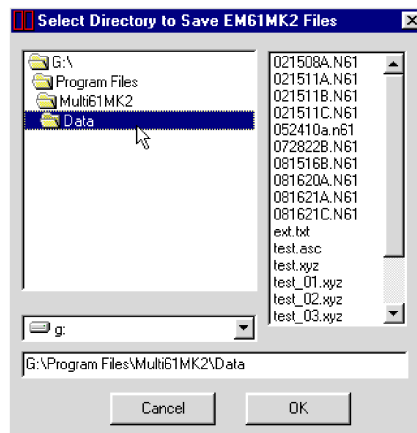


Figure 2.3: Select Directory to Save ML61MK2 Files window

After the directory is selected, it will be displayed in the text box labelled **Save In** at bottom part of the Download ML61MK2 Files window. The selected directory will be saved and it will be used as the default directory during subsequent Multi61MK2 executions. If this directory is removed the C:\ directory will be used instead.

Change of the port assignment can be done by clicking the Down arrow button in the field labeled Current Port. The pull down list box will be displayed (Figure 3.4). Select required COM port number.

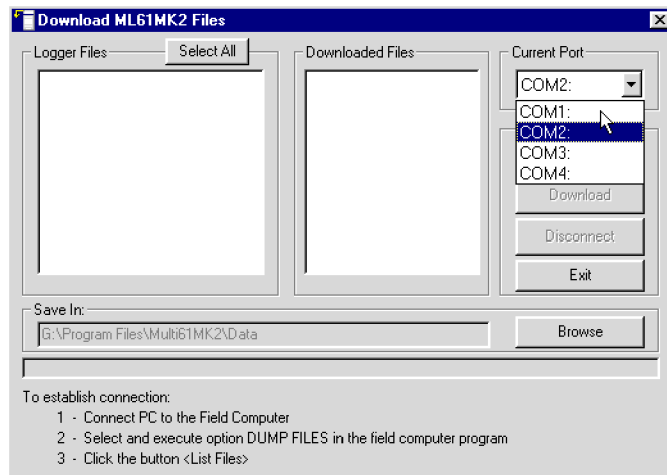


Figure 2.4: Select serial port number

Selecting Baud Rate can be done by clicking the Down arrow button in the field labeled Baud Rate. The pull down list box will be displayed. Select Auto setting or specify one of the given Baud Rates.

The **Auto** setting will cause the program to establish and test the highest possible speed for data transmission for particular computer and logger. This setting is adequate for most computers. However if the program will prompt that one or more bytes were lost during transmission click on the **Disconnect** button, select a lower Baud Rate, and then repeat downloading.

To start downloading the data files, connect the field computer (Pro4000 or Allegro) and PC computer with the serial cable.

Run the ML61MK2 program in the logger. In the Main menu of the program select **Dump Files** option, and press <ENTER>. The logger screen will display the message "Waiting for PC" (shown in Figure 2.5) for up to 1 minute (if time elapses repeat the procedure). On the computer side click the **List Files** button in the Download



Figure 2.5: Pro4000 screen

ML61MK2 Files window. At that time both programs (ML61MK2 and Multi61MK2) will establish and test the communication at the highest possible speed of data transfer. After several seconds the Logger Files list box will be updated with the names and sizes of data files available for download (Figure 2.6). At the same time, the **Download** and **Disconnect** buttons will be activated, and the **List Files** button will be deactivated.

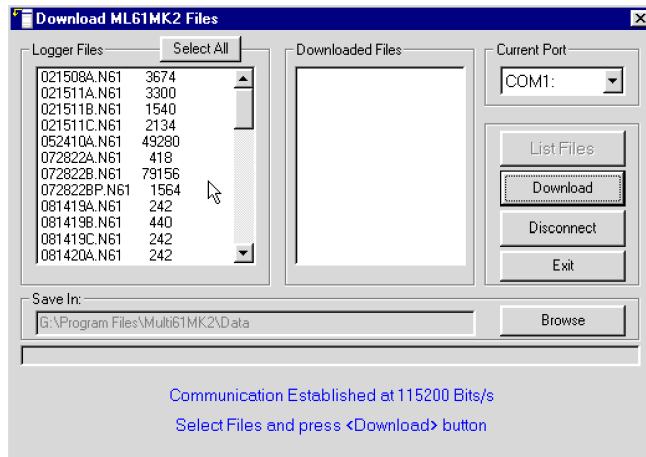


Figure 2.6: List of files available in the field computer for transfer listed in Download ...window

Select the files to be downloaded from the logger by clicking on individual file names in the list box (Figure 2.7) or click the **Select All** button to select all available files. When all files are selected the **Select All** button will change to the **Unselect All** button.

When file selection is complete click the **Download** button. The name of each transferred file is displayed at the bottom of the window as it transfers and a progress bar indicates the percentage completed (Figure 2.8).

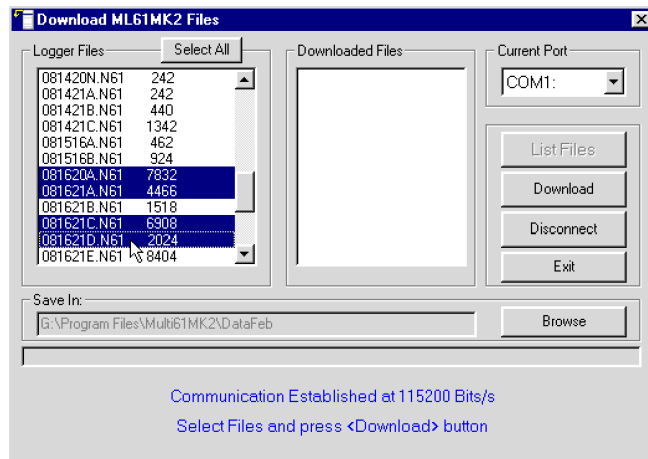


Figure 2.7: Selecting files to download

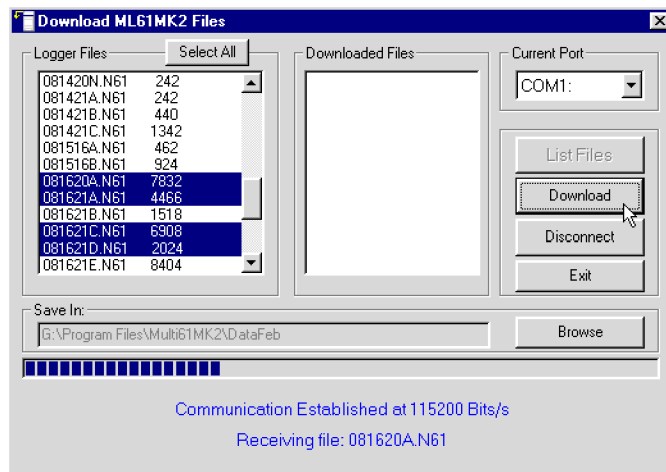


Figure 2.8: Download window during data transmission

At the same time the logger screen displays transmitted file name and percentage of completed uploading (Figure 2.9). The transfer procedure can be stopped at any time by pressing <Esc> key on the logger keypad.



Figure 2.9: Pro4000 screen during data transfer

Transferred files will be displayed in the right list box labeled Downloaded Files (Figure 2.10). These files (with extension name N61) can be loaded and processed further in the program.

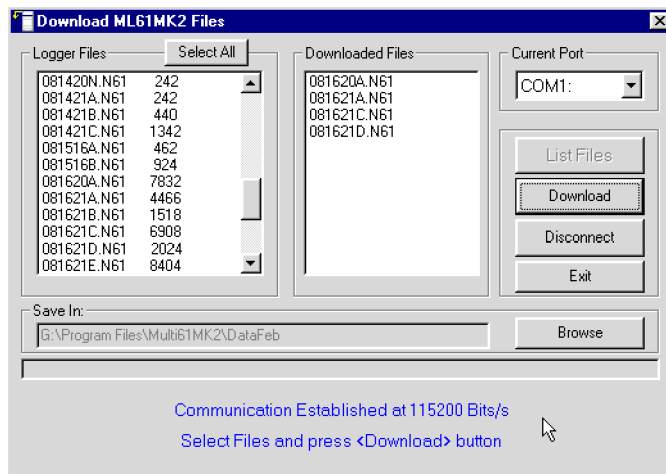


Figure 2.10: Download ML61MK2 Files window after downloading selected files is completed

Click the **Disconnect** button to cancel communication with logger. The Download ML61MK2 Files window will remain on the screen and next data transfer session (i.e. from another logger) can be performed. Clicking the **Exit** button will stop Data Transfer function and the Download ML61MK2 Files window will disappear.

Positioning of sensors is the main function of the Multi61MK2. Location of each EM61-MK2 sensor is calculated based on the recorded GPS position, the array geometry (number of EM61-MK2 units, size of EM61-MK2 sensor, location of GPS antenna, and separations between sensors), and instant heading of the system.

There are three methods of positioning sensors in Multi61MK2: Position Sensors using ML61MK2 Data File, using External GPS File, and by Merging Standalone GPS file. The first method allows you to position sensors based on Real Time GPS data embedded in ML61MK2 file while in the second technique Real Time GPS data are replaced by GPS positions from the postprocessed GPS data file. The second method requires that the GPS data is collected in the field computer running ML61MK2 program as well as in the GPS receiver logger. This option is especially useful in following cases:

- when real time differential data correction is not available,
- accuracy of positioning may be further improved by processing data using special GPS software,
- if a special or unique coordinate system provided by GPS software is required and it is not available in other employed data processing or mapping software.

The third method uses GPS data which were collected only in a separate GPS logger. This procedure should be avoided as the least accurate. In case it is employed GPS Input should be set to Disable in GPS Port Setup menu (data acquisition program).

Description of functions involved in positioning sensors is preceded by a short description of the array geometry. For more detailed description of EM61-MK2 array setup and survey procedure see Chapter 2 of ML61MK2 manual.

3.1 The EM61-MK2 Array Geometry

The instrument array may consists from one to five instruments. Instruments are numbered from the left while facing the direction of the array movement, see Figure 3.1. This procedure of naming (numbering) is very important since positioning of specific sensors based on one GPS is based on this assumption.

The main result of the described method of numbering EM61-MK2 instruments in the array is that the system can not change its orientation. The instrument furthest to the left

(#1) must remain in this position (related to direction of moving) during collection of data to one data file.

The EM61-MK2 array geometry (Figure 3.1) is described by following parameters:
number of EM61-MK2 units
sensor size
separation between sensors
location of GPS antenna (for surveys positioned with GPS) or leading EM61-MK2 (for surveys conducted without GPS).

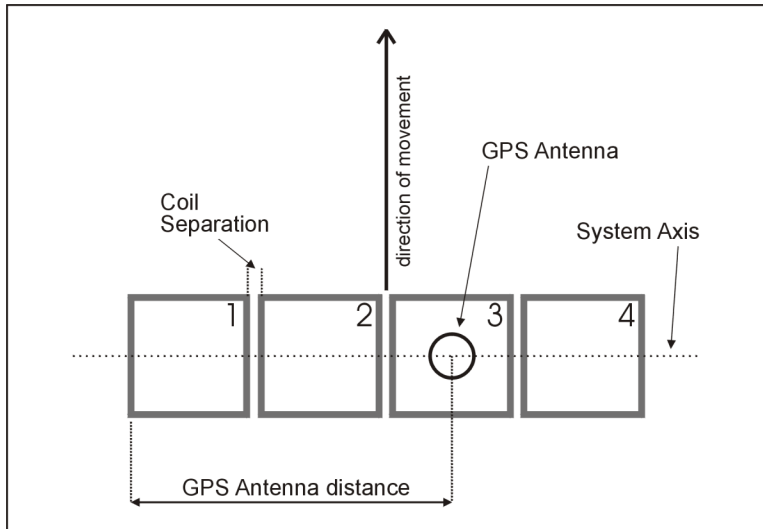


Figure 3.1: Array geometry with GPS antenna location

The ML61MK2 is designed to work with an array of up to five EM61-MK2s systems (however it will work with one unit as well).

Sensor Size

Program assumes that all EM61-MK2 sensors used in array are of the same size. The following sensor size can be selected in the program: 1.0 x 1.0 m, 1.0 x 0.5 m, 0.5 x 1.0 m, 0.5 x 0.5 m, and Hand Held. Attention should be paid when choosing antenna 1.0 x 0.5 m. These sensor can be used in two configurations 1.0 x 0.5 and 0.5 x 1.0 m as shown in Figure 3.2. The first dimension represents the side of the antenna oriented along the array axis, or perpendicular to the movement direction. If Hand Held sensor is used then layout of the array is specified only by sensor separation (distance between centres of neighbouring coils), and GPS antenna location which is measured from the center of the left most sensor.

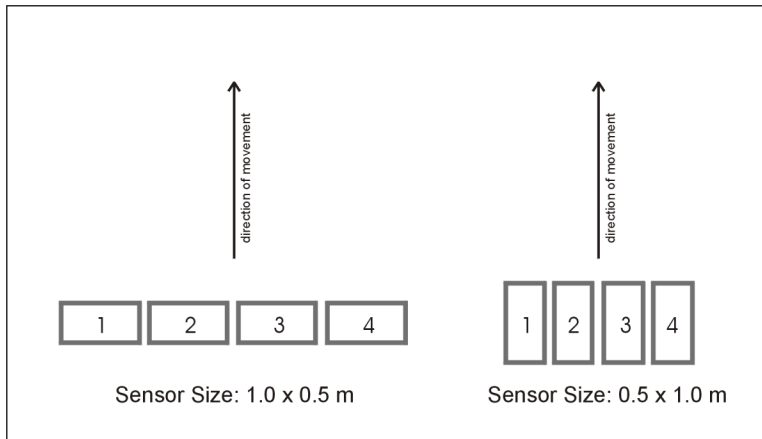


Figure 3.2: Two types of 1.0 x 0.5 m sensors layouts

Separation Between Sensors

The data acquisition program, ML61MK2, assumes that separation between all sensors is the same (to provide more simplicity during the field operation). However, if this value varies between sensors for any reason, the separation between each pair of sensors can be specified separately during data processing in the program Multi61MK2. Sensor Separation can be entered in feet or meters, depending on the Unit setting in Logger Setup menu. This parameter is taken to account during calculation positions of sensors for surveys conducted with GPS positioning, as well as for surveys carried out along grid. If Hand Held sensors are employed, the separation between antennas is measured between centers of coils.

Location of GPS Antenna

The location of GPS antenna is represented by the distance which is measured between the center of GPS antenna and the left edge of an array (left side of the EM61-MK2#1 sensor), while facing direction of the movement, see Figure 3.1. It is assumed that GPS antenna is located on the center axis of the system array. The GPS Antenna distance can be given in meters or feet depending on the unit selection in the Logger Setup menu. GPS antenna can be placed anywhere along the center axis of the instrument array. However to achieve higher accuracy for the calculated positions of each coil the GPS antenna must be placed as close to the center of the system as possible, and preferably in the center of the EM61-MK2 sensor.

3.2 Positioning Sensors Using ML61MK2 Data File

The Position Sensors Using ML61MK2 Data File option allows you to position sensors based on Real Time GPS data which were recorded in ML61MK2 data file during the survey. Select **Position Sensors | Position Sensors Using ML61MK2 Data Files** from the main program menu, as shown in Figure 3.3.

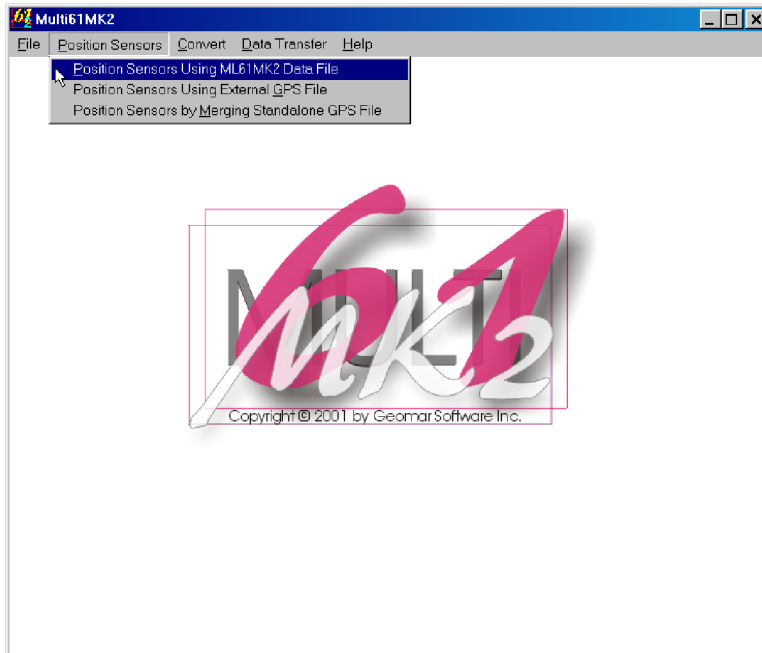


Figure 3.3: Position Sensors menu

After the selected menu item is clicked the Position Sensors Using ML61MK2 Data File window will be displayed in the centre of the screen, Figure 3.4.

Parameters in Positioning Sensors Using ML61MK2 File window

Several parameters which affect the contents and format of the created output (XYZ) file must be specified. These are the ML61MK2, and XYZ file names, parameters describing contents of the created file and parameters related to GPS data.

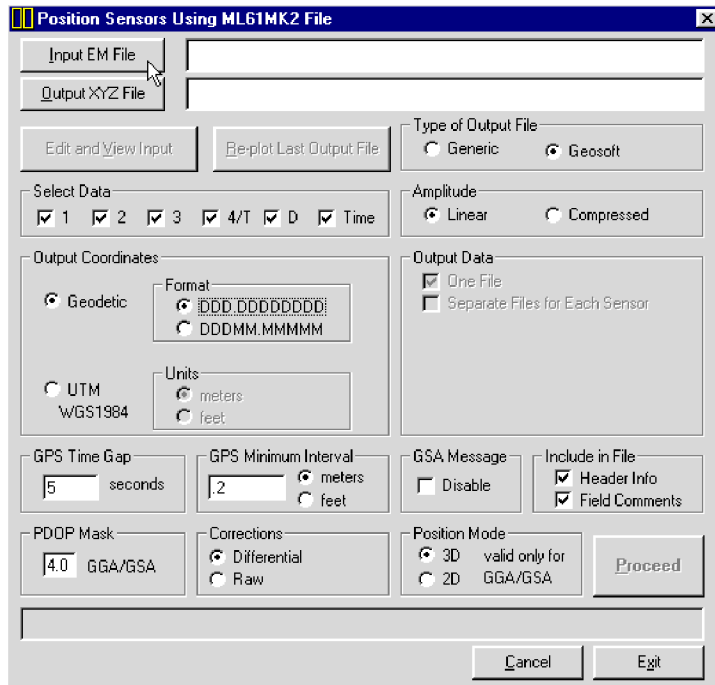


Figure 3.4: Position Sensors Using ML61MK2 File window

Input EM File

Click on **Input EM File** button. The Select ML61MK2 Input File window is displayed (Figure 3.5).

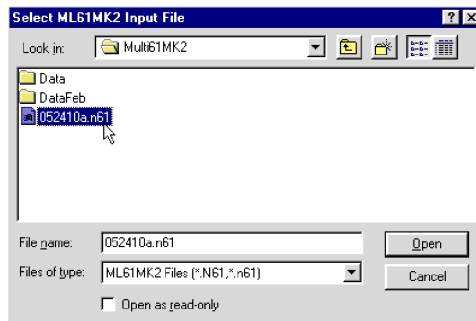


Figure 3.5: Select ML61MK2 File window

The window lists files with extension name N61. Select a file name and click the **Open** button. The Select ML61MK2 File window will close, progress bar will

indicate loading of the file, and at the end the ML61MK2 File Info window will appear (Figure 3.6).

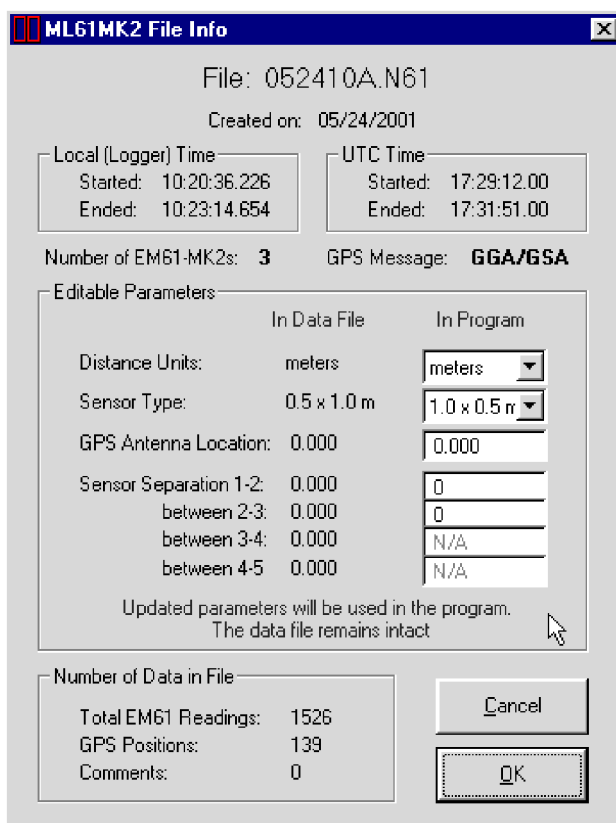


Figure 3.6: ML61MK2 File Info window

The ML61MK2 File Info window displays the most important parameters of the entered data file. At the top of the window the original file name (as entered in the field), date of file, and start and end times in local time (field computer clock) and UTC time (GPS time in NMEA messages), number of EM61-MK2 units used in the array, and type of used GPS NMEA message are displayed. Total number of EM61-MK2 readings (from all instruments), number of GPS positions recorded, and number of comments entered in the field are displayed at the bottom of the window.

The center of the window displays parameters that the user can edit. These are Distance Units, Sensor Type, GPS Antenna Location, and Sensor Separations. If all parameters were correctly specified in the field then clicking on **OK** button

will accept these entries. In case some of the parameters require modification they can be entered in appropriate text boxes located under label In Program. Distance Units and Sensor Type can be selected from combo list boxes, while GPS Antenna Location and Sensor Separations must be entered in appropriate text boxes. It should be noted that while the field data acquisition program allows for only one Sensor Separation for all pairs of sensors, in this window Separation for each pair of sensors can be specified. Example of ML61MK2 File Info window with modified parameters is shown in Figure 3.7.

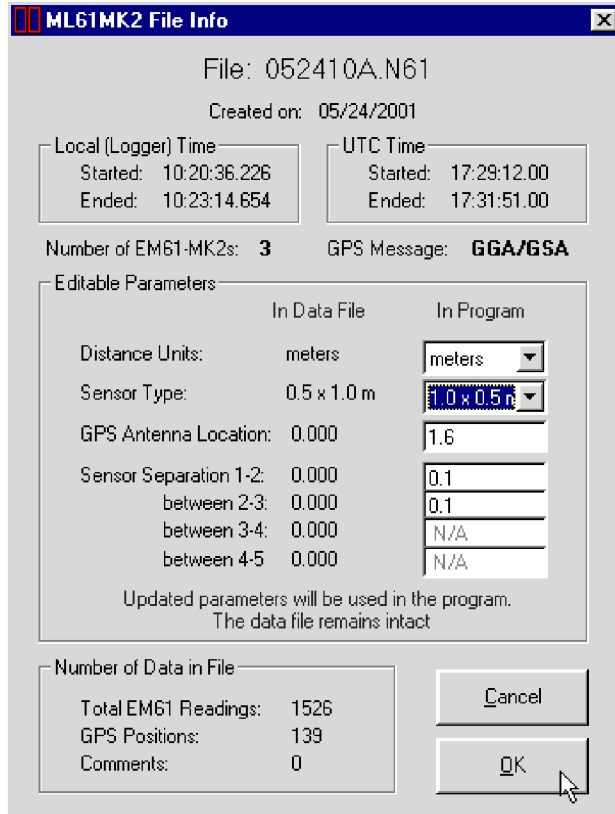


Figure 3.7: Modified parameters in ML61MK2 File Info window

Any updates in this window are valid only for duration of the program. The data file will remain the same.

Clicking on the **OK** button will accept any changes in editable parameters, while clicking on the **Cancel** button will cause the program to use original parameters, listed in fields under label In Data File.

After the buttons **OK** or **Cancel** are clicked and ML61MK2 File Info window is closed, the button **Edit and View File** in the Position Sensors Using ML61MK2 File window (Figure 3.4) is activated. If data file info has to be examined or any editable parameters require change, clicking on this button will display ML61MK2 File Info window again.

Output File

Click on the **Output XYZ File** button. The Select Output File window is displayed (Figure 3.8).

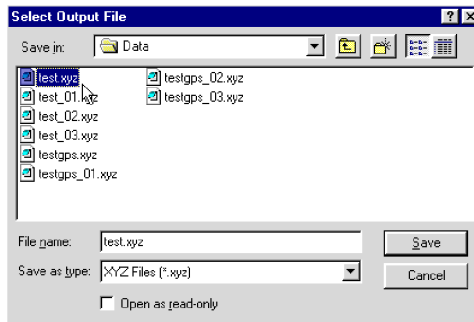


Figure 3.8: Select Output File window

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 **Output XYZ File** button in the Position Sensors Using ML61MK2 File window.

When both, Input and Output files are specified the **Proceed** button in the Position Sensors Using ML61MK2 File becomes active (Figure 3.9).

Select Data

To select a channel click on the check box next to the channel number or name. Data is always placed in the created XYZ file in the following order: X coordinate, Y coordinate, and all marked channels listed from left to right of Select Data section. The optional parameter Time (time stamp for each reading) will be placed always in the last column of the file. If parameter Header Info in Include in File section is checked a line listing all parameters in the file will be placed as a header for each created XYZ file.

If selected, channel D will be written to the file only when instruments were used in EM61-MK2 mode **D** (top and bottom coils as a sensor). Channel labeled **4/T** corresponds to channel T if EM61-MK2 mode **D** was used, and to channel 4 if the instrument mode **4** was employed.

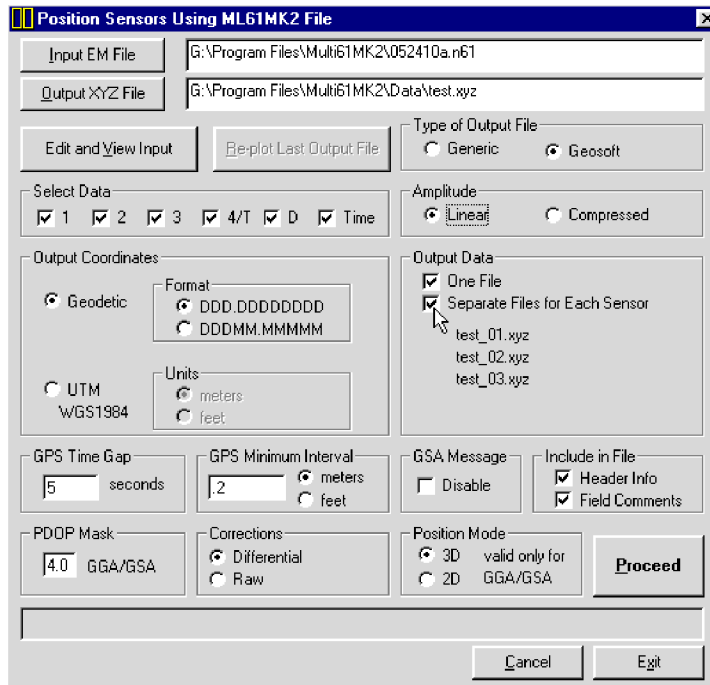


Figure 3.9: Position Sensors Using ML61MK2 File window

Type of Output File

Check the option appropriate for the contouring software used. The Generic option will create a three or more column file without any text strings. This file can be used as an input file for many contouring packages (including Surfer). Geosoft format will cause the program to write LINE # at the beginning of each survey line.

Amplitude

Readings can be written in the output file in Linear (original) scale, or Compressed, as the signed square root of each value. Check the appropriate radio button in the Amplitude section of the Position Sensors Using ML61MK2 File window.

Output Data

Multi61MK2 can generate one file containing data from all EM61-MK2 in the array, or separate file for each instrument. Check appropriate boxes labeled One File and Separate File for Each Sensor in the Output Data section. If data are written to separate file for each instrument the program creates name for

the file by adding underscore and number of the instrument to the base output file name (i.e. ABC_01.XYZ, ABC_02.XYZ and so on), see Figure 3.9. In One File option data are written sequentially, first coordinates and readings for the instrument #1 are generated, then full set of data for instrument #2 follows, and so on.

Include in File

This section contains two check boxes labeled **Header Info** and **Field Comments**. When Header Info box is checked the file will contain a header listing type of coordinates and names of channels contained in each column of created XYZ file. Checking box labeled Field Comments will cause the program to write text of all field comment (entered by the operator during the survey) in to the created file.

Output 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. To select coordinates click **Geodetic** or **UTM** radio buttons (Figure 3.9).

Geodetic coordinates, Latitude and Longitude are given in degrees. They can be written in two formats DD.DDDDDDDD or DDMM.MMMMM (native format found in NMEA GPS messages). To select which format click the appropriate radio button in Format section located at the radio button labeled Geodetic. This section is active only when radio button Geodetic is selected (Figure 3.9).

UTM coordinates can be generated in meters or feet. To select units for UTM coordinates click one of the radio buttons located in the Units section located at the UTM radio button (Figure 3.9). These radio buttons are active only when radio button labeled UTM is selected.

GPS Time Gap

Differentially corrected GPS data often has gaps, due to differences in the constellation of satellites visible to two (fixed and moving receivers), lack of beacon signal, surveying near trees, buildings, and other elevated obstructions. These gaps are filled by Multi61MK2 with the assumption that the GPS receiver speed is essentially constant and that it moves along a straight line during the gaps.

The **GPS Time Gap** parameter specifies the maximum time during which the EM61-MK2 data for each instrument in the array will be linearly interpolated between two GPS positions. Enter this parameter (in seconds) in the edit box labeled **seconds** in the GPS Time Gap section (Figure 3.9). In most cases a value 2 to 3 times larger than the GPS data acquisition frequency is adequate, however the user has to determine this value based on the survey specific conditions and requirements. To ignore effect of this parameter enter a large number of seconds (i.e. 300 or more) as GPS Time Gap parameter.

GPS Minimum Interval

The **GPS Minimum Interval** parameter specifies the minimal distance between two GPS stations that will be used in interpolation. If this distance is smaller than the specified GPS Minimum Interval, then all EM61-MK2 readings located between these two stations will be ignored. This parameter is useful in cases when the operator stops for a moment and data are collected in one point. Limited accuracy of GPS positioning will create randomly distributed positions in area adjacent to the stationary location of the system. If Multi61MK2 will calculate positions of sensors in the array, positions of all outer sensors will have quite large variations associated with apparent change of direction of the survey line caused by randomly close spaced GPS positions. In most cases a value 2 or 3 times smaller than average distance between two GPS stations is adequate, however the user has to determine right value for this parameter which will depend on survey conditions and first of all accuracy of the employed GPS receiver. To ignore the effect of this parameter and to use all stations during creating XYZ file (i.e. during testing when GPS antenna is stationary) set this parameter to zero.

Enter the GPS Minimum Interval in the edit box and check one of the two radio buttons labeled **meters** and **feet** (indicating distance unit) in the GPS Minimum Interval section (Figure 3.9).

GSA Message

This parameter is used to disable GSA message. This is to be used only if the operator has specified in the data acquisition program (ML61MK2) that the GPS Message will be pair GGA/GSA and for any reason message GSA was not recorded. In such case the Multi61MK2 will search for GPS quality information contained in not recorded GSA statement and it would conclude that GPS readings are invalid. Disabling GSA message in this situation causes that the program will use only information available from GGA message.

The GSA message should be also disabled while using data files created by early version of ML61MK2 (earlier than 1.02) which did not record GSA statement.

PDOP Mask

The PDOP Mask is used to filter quality of GPS positions. The index called PDOP (Position Dilution of Precision) measures the strength of satellite coverage for a given area. PDOP is affected by the number of satellites visible and their relative positions in the sky. The smaller the number of PDOP the stronger the satellite coverage is. When there are more than 5 satellites widely spaced visible, the PDOP is 4 or less. However, when there are less satellites visible, or they are unevenly spaced in the sky, PDOP values can be 6 or higher. In most cases, the PDOP in open sky is less than 3, and most accuracies given for many GPS systems are given for this norm. The index called GDOP covers time accuracy in addition, while the index HDOP is related only to horizontal position fix (it is used when message GGA was selected). Refer to GPS documentation and literature for more information related to error sources of GPS positioning.

The section PDOP Mask may differ depending on GPS NMEA message used. It is related to PDOP parameter if GGA/GSA, POS, or GPK was employed during the survey, to HDOP if GGA was used, to GDOP if LLK was used during the survey, and it is invalid if GLL or LLQ message was used.

Enter the PDOP (HDOP or GDOP) value in the edit box in the PDOP Mask section, Figure 3.9. All positions (as well as EM61-MK2 readings) associated with GPS data of higher than specified value of this index will be ignored.

Corrections

Check the radio button labeled **Differential** if differentially corrected position data is to be used during the creation of XYZ file. When radio button labeled **Raw** is checked, both differentially corrected and raw GPS data are used to calculate positions of all EM61-MK2s stations.

Position Mode

This option is valid only if the pair GGA/GSA messages were used during data collection. If radio button labeled 3D is checked then GPS data in mode 3D are used, while when radio button 2D is checked then program uses 2D as well as 3D mode of GPS data.

It should be noted that if any NMEA message indicates that GPS position (fix) is invalid this data is ignored by the Multi61MK2.

Creating XYZ files with positioned sensors

When all parameter are set and input and output file names are specified, the **Proceed** button is activated in the Position Sensors Using ML61MK2 File window. After you click the **Proceed** button, the program begins to read the input file, calculates all EM61-MK2 stations positions based on the recorded GPS readings, instant heading, and other specified parameters, and writes results to the XYZ output file (or files depending on the Output Data setting). A progress bar at the bottom of the screen shows the percentage read (Figure 3.10).

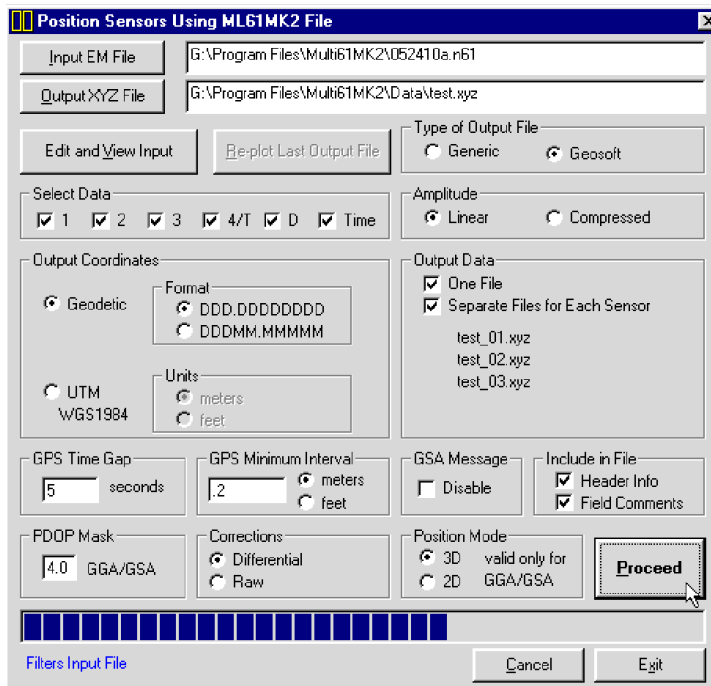


Figure 3.10: Position Sensors Using ML61MK2 File window during creating XYZ file

The speed of this operation depends on the size of the input file. After the output XYZ file is created a two dimensional layout of the survey is displayed (Figure 3.11).

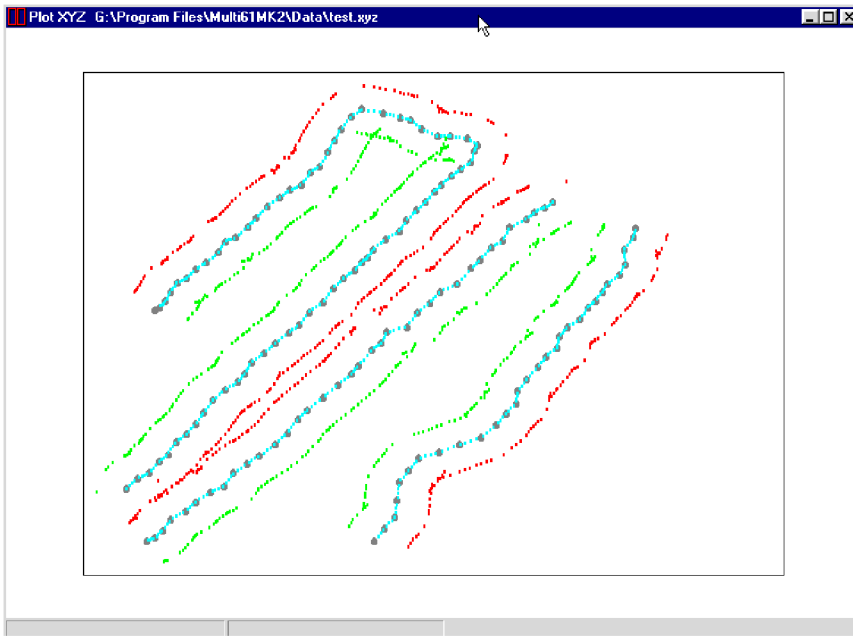


Figure 3.11: Two dimensional layout of stations taken with 3 EM61-MK2 unit array. The GPS antenna was located at 1.5 m (in the center of the second sensor).

The image displayed in the Plot XYZ window shows the spatial layout of stations to scale, based on the station coordinates as written to the created file. The display has fixed colours. GPS positions are marked by larger grey dots. Positions of the first EM61-MK2 (sensor #1) are plotted by red dots, then cyan dots correspond to sensor #2s, green dots to sensor #3, magenta dots to sensor #4, and blue dots denote positions of sensor #5. This plot window can be closed by clicking on **Close** button (located in the top right corner of the window).

After the Plot XYZ window is closed a button **Replot Last Output File** becomes active and the layout of data can be examined again. However, at this time original GPS positions will not be displayed and all instruments will be represented by the same colour on the screen. Files created by this portion of the program can be also viewed at any time using the **File | View XYZ File** menu.

After the file is created and its layout is examined it is possible (if required) to recreate XYZ file with changed array geometry parameters. To do this, click **Edit and View Input** button, the GPS File Info window will appear again. After changes are done, click the **Proceed** button to repeat procedure of creating XYZ file. See example in Figure 3.12 where GPS Antenna Location was changed as compared to case shown in Figure 3.11.

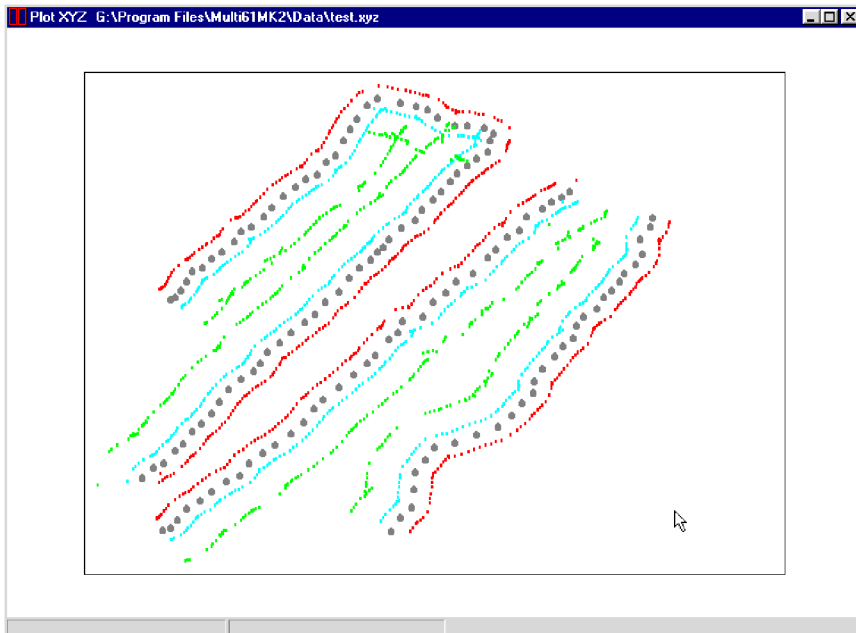


Figure 3.12: Two dimensional layout of stations taken with 3 EM61-MK2 unit array. The GPS antenna was located at 1.1 m (between sensors 1 and 2).

If the input file does not contain sufficient GPS information, or parameters are not correctly selected, the program will display a warning message (Figure 3.13), and the program will pause operation till the **OK** button is clicked in the warning window.

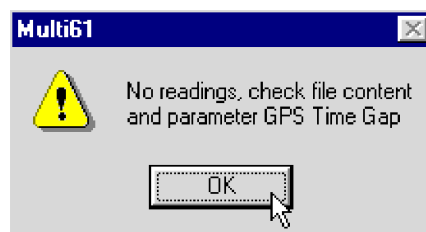


Figure 3.13: Warning window

The above message may indicate lack of GPS data in the file, however in most cases it reflects lack of GSA messages when GGA/GSA was selected in the data acquisition program (check Disable GSA Message), raw positions only when Differential button is checked, too small value specified in GPS Time Gap section, etc..

3.3 Positioning Sensors Using External GPS File

The Position Sensors Using External GPS File item of the Position Sensors menu allows you to position sensors based on separately logged GPS positions which were postprocessed by a GPS software and then exported to ASCII format file. It is assumed that GPS positions were concurrently recorded by ML61MK2 program during the survey. Select **Position Sensors | Position Sensors Using External GPS File** from the main program menu, as shown in Figure 3.14.

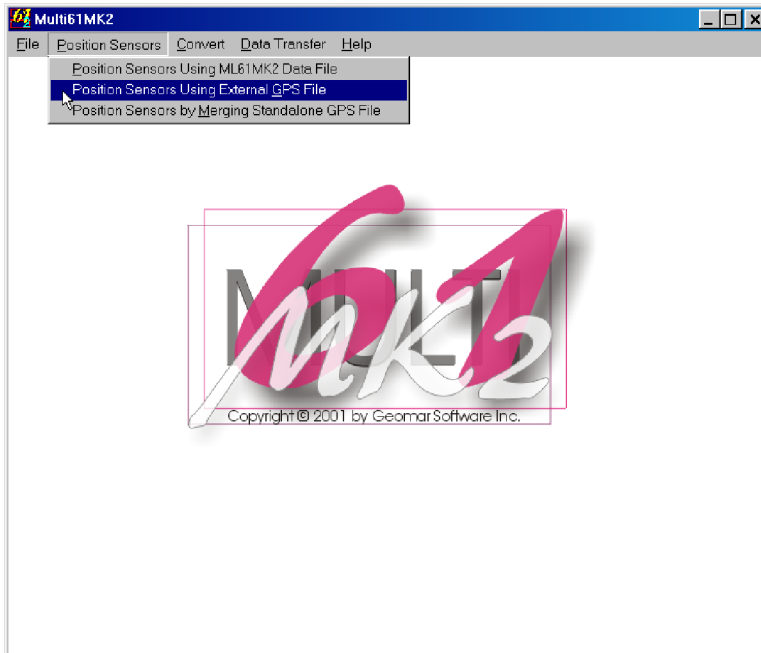


Figure 3.14: Position Sensors menu

After the selected menu item is clicked the Position Sensors Using External GPS File window will be displayed in the centre of the screen, Figure 3.15.

Parameters in Positioning Sensors Using External GPS File window

Several parameters which affect the contents and format of the created output (XYZ) file must be specified. These are the ML61MK2, GPS, and XYZ file names, parameters describing contents of the created file and parameters related to GPS data.

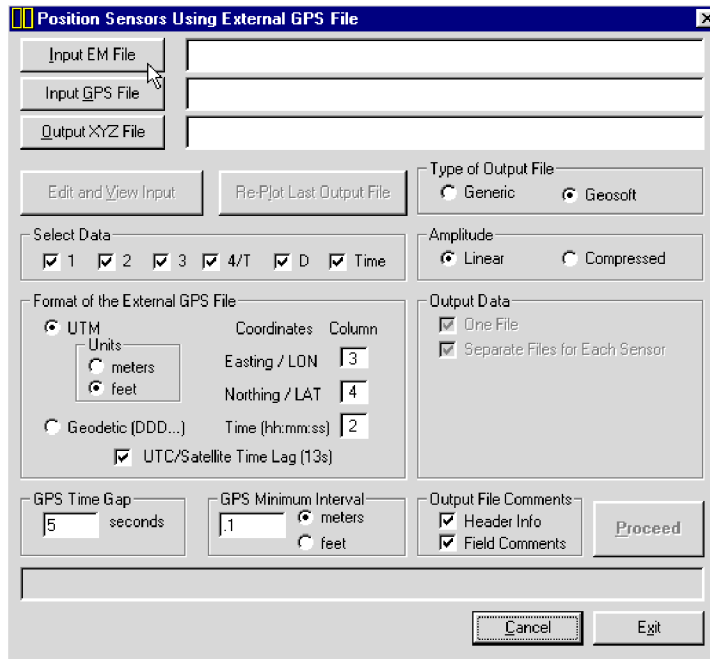


Figure 3.15: Position Sensors Using External GPS File window

Input EM File

Click on **Input EM File** button. The Select ML61MK2 Input File window is displayed (Figure 3.16).

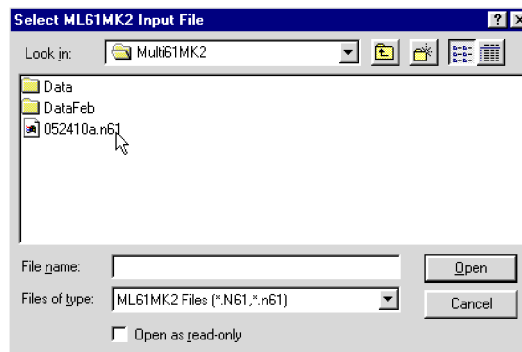


Figure 3.16: Select ML61MK2 File window

The window lists files with extension name N61. Select a file name and click the **Open** button. The Select ML61MK2 File window will close, progress bar will

indicate loading of the file, and at the end the ML61MK2 File Info window will appear (Figure 3.17).

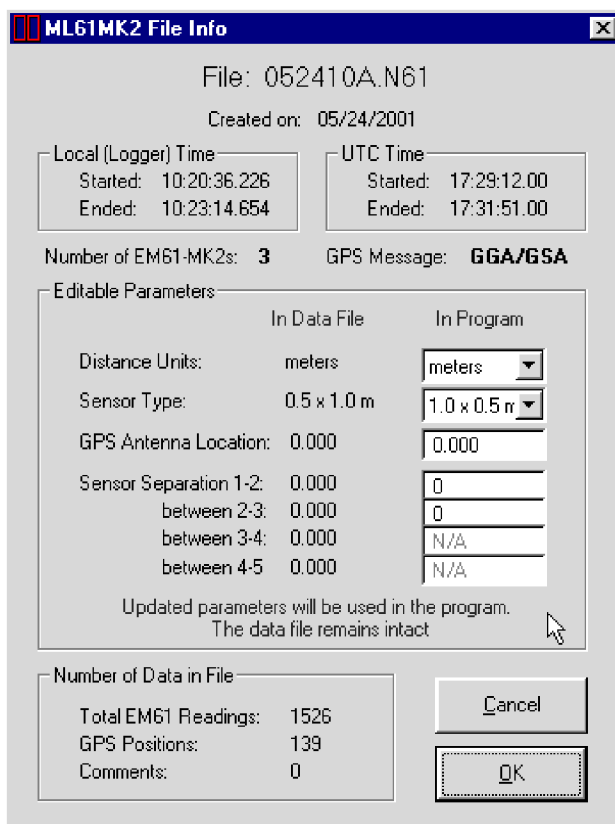


Figure 3.17: ML61MK2 File Info window

The ML61MK2 File Info window displays the most important parameters of the entered data file. At the top of the window the original file name (as entered in the field), date of file, and start and end times in local time (field computer clock) and UTC time (GPS time in NMEA messages), number of EM61-MK2 units used in the array, and type of used GPS NMEA message are displayed. Total number of EM61-MK2 readings (from all instruments), number of GPS positions recorded, and number of comments entered in the field are displayed at the bottom of the window.

The center of the window displays parameters that the user can edit. These are Distance Units, Sensor Type, GPS Antenna Location, and Sensor Separations. If all parameters were correctly specified in the field then clicking on **OK** button

will accept these entries. In case some of the parameters require modification they can be entered in appropriate text boxes located under label In Program. Distance Units and Sensor Type can be selected from combo list boxes, while GPS Antenna Location and Sensor Separations must be entered in appropriate text boxes. It should be noted that while the field data acquisition program allows for only one Sensor Separation for all pairs of sensors, in this window Separation for each pair of sensors can be specified. Example of ML61MK2 File Info window with modified parameters is shown in Figure 3.18.

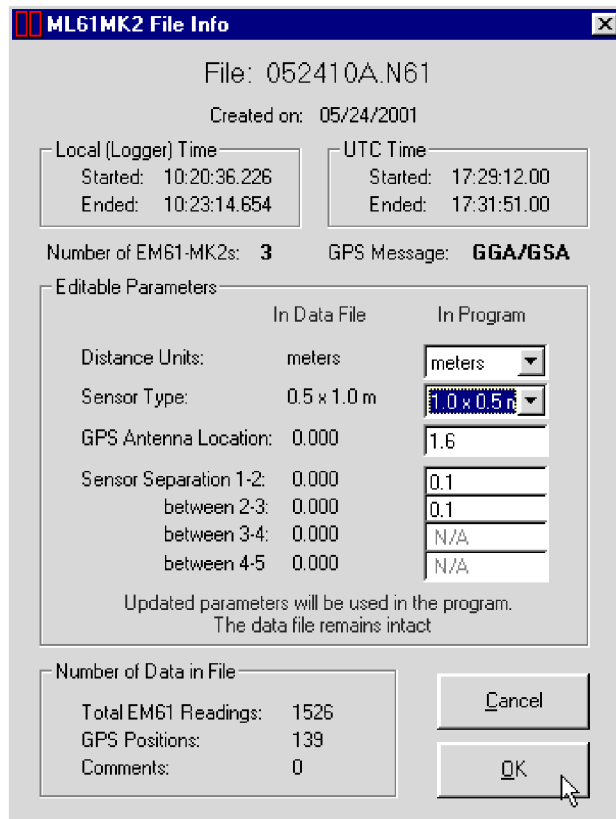


Figure 3.18: Modified parameters in ML61MK2 File Info window

Any updates in this window are valid only for duration of the program. The data file will remain the same.

Clicking on the **OK** button will accept any changes in editable parameters, while clicking on the **Cancel** button will cause the program to use original parameters, listed in fields under label In Data File.

After the buttons **OK** or **Cancel** are clicked and ML61MK2 File Info window is closed, the button **Edit and View File** in the Position Sensors Using External GPS File window (Figure 3.15) is activated. If data file info has to be examined or any editable parameters require change, clicking on this button will display ML61MK2 File Info window again.

Input GPS File

Click on the **Input GPS File** button. The Select External GPS ASCII File window is displayed (Figure 3.19).

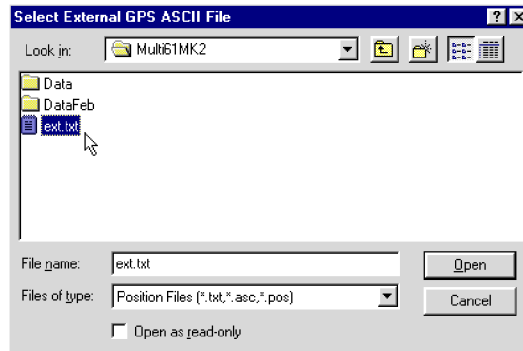


Figure 3.19: Select External GPS File window

Select a file name and click the **Open** button. The Select External GPS ASCII File window will close and the selected file name will be displayed beside the **Input GPS File** button in the Position Sensors Using External GPS File window.

Output File

Click on the **Output XYZ File** button. The Select Output File window is displayed (Figure 3.20).

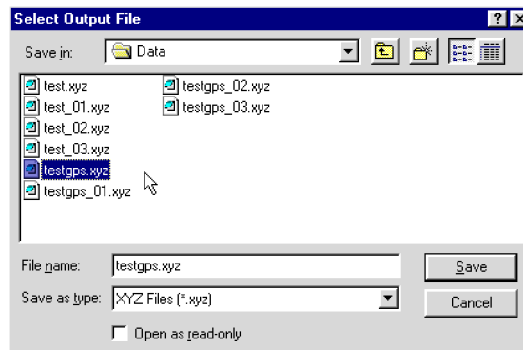


Figure 3.20: Select Output File window

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 **Output XYZ File** button in the Position Sensors Using External GPS File window.

When all three, Input EM61MK2, Input GPS and Output files are specified the **Proceed** button in the Position Sensors Using External GPS File becomes active (Figure 3.21).

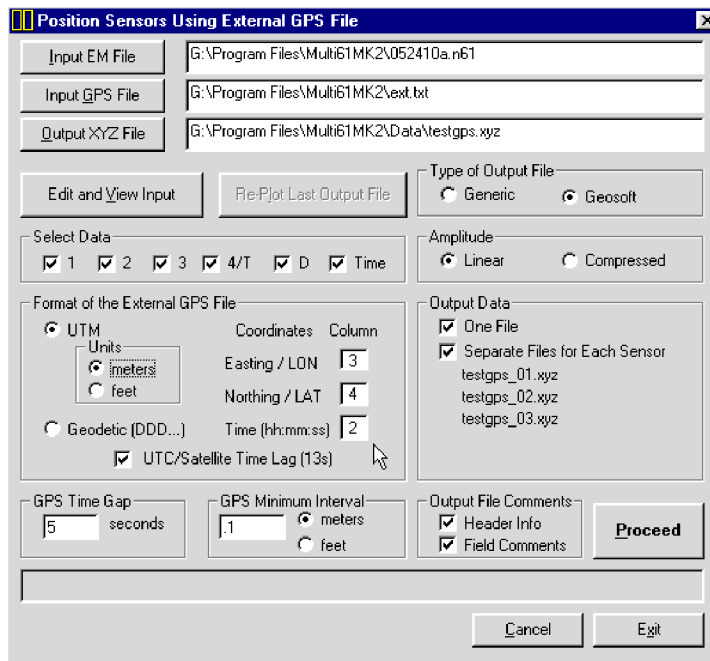


Figure 3.21: Position Sensors Using External GPS File window

Select Data

To select a channel click on the check box next to the channel number or name. Data is always placed in the created XYZ file in the following order: X coordinate, Y coordinate, and all marked channels listed from left to right of Select Data section. The optional parameter Time (time stamp for each reading) will be placed always in the last column of the file. If parameter Header Info in Include in File section is checked a line listing all parameters in the file will be placed as a header for each created XYZ file.

If selected, channel D will be written to the file only when instruments were used in EM61-MK2 mode **D** (top and bottom coils as a sensor). Channel labeled **4/T** corresponds to channel T if EM61-MK2 mode **D** was used, and to channel 4 if the instrument mode **4** was employed.

Type of Output File

Check the option appropriate for the contouring software used. The Generic option will create a three or more column file without any text strings. This file can be used as an input file for many contouring packages (including Surfer). Geosoft format will cause the program to write a message **LINE #** at the beginning of each survey line.

Amplitude

Readings can be written in the output file in Linear (original) scale, or Compressed, as the signed square root of each value. Check the appropriate radio button in the Amplitude section of the Position Sensors Using External GPS File window.

Output Data

Multi61MK2 can generate one file containing data from all EM61-MK2 in the array, or separate file for each instrument. Check appropriate boxes labeled One File and Separate File for Each Sensor in the Output Data section . If data are written to separate file for each instrument the program creates name for the file by adding underscore and number of the instrument to the base output file name (i.e. ABC_01.XYZ, ABC_02.XYZ and so on), see Figure 3.21. In One File option data are written sequentially, first coordinates and readings for the instrument #1 are generated, then full set of data for instrument #2 follows, and so on.

Include in File

This section contains two check boxes labeled **Header Info** and **Field Comments**. When Header Info box is checked the file will contain a header listing type of coordinates and names of channels contained in each column of created XYZ file. Checking box labeled Field Comments will cause the program to write text of all field comment (entered by the operator during the survey) in to the created file.

GPS Time Gap

Differentially corrected GPS data often has gaps, due to differences in the constellation of satellites visible to two (fixed and moving receivers), lack of

beacon signal, surveying near trees, buildings, and other elevated obstructions. These gaps are filled by Multi61MK2 with the assumption that the GPS receiver speed is essentially constant and that it moves along a straight line during the gaps.

The **GPS Time Gap** parameter specifies the maximum time during which the EM61-MK2 data for each instrument in the array will be linearly interpolated between two GPS positions. Enter this parameter (in seconds) in the edit box labeled **seconds** in the GPS Time Gap section (Figure 3.21). In most cases a value 2 to 3 times larger than the GPS data acquisition frequency is adequate, however the user has to determine this value based on the survey specific conditions and requirements. To ignore effect of this parameter enter a large number of seconds (i.e. 300 or more) as GPS Time Gap parameter.

GPS Minimum Interval

The **GPS Minimum Interval** parameter specifies the minimal distance between two GPS stations that will be used in interpolation. If this distance is smaller than the specified GPS Minimum Interval, then all EM61-MK2 readings located between these two stations will be ignored. This parameter is useful in cases when the operator stops for a moment and data are collected in one point. Limited accuracy of GPS positioning will create randomly distributed positions in area adjacent to the stationary location of the system. If Multi61MK2 will calculate positions of sensors in the array, positions of all outer sensors will have quite large variations associated with apparent change of direction of the survey line caused by randomly close spaced GPS positions. In most cases a value 2 or 3 times smaller than average distance between two GPS stations is adequate, however the user has to determine right value for this parameter which will depend on survey conditions and first of all accuracy of the employed GPS receiver. To ignore the effect of this parameter and to use all stations during creating XYZ file (i.e. during testing when GPS antenna is stationary) set this parameter to zero.

Enter the GPS Minimum Interval in the edit box and check one of the two radio buttons labeled **meters** and **feet** (indicating distance unit) in the GPS Minimum Interval section (Figure 3.9).

Format of the External GPS File

This section describes contents of the External GPS File. It is assumed that the file is in ASCII (text) format, and columns are delimited by comma or space. Parameters that have to be specified include: type of coordinates (UTM or

Geodetic), identifying numbers of columns corresponding to each coordinate and time, and indicating time of GPS data (UTC or satellite time). These parameters are necessary for Multi61MK2 to correctly calculate positions of each sensor.

Post-processed GPS files in ASCII (text) format include UTM or Geodetic (Latitude/Longitude) coordinates. To select coordinates click **Geodetic** or **UTM** radio buttons (Figure 3.21). Geodetic coordinates, Latitude and Longitude are given in degrees. The program assumes format DDD.DDDDDDDD. Format DDMM.MMMMM (native format found in NMEA GPS messages) is not supported by this option of Multi61MK2. UTM coordinates can be generated in meters or feet. To select units for UTM coordinates click one of the radio buttons located in the Units section located at the UTM radio button (Figure 3.21). These radio buttons are active only when the radio button labeled UTM is selected.

Specify columns where each coordinate and time in text boxes labeled **Column**. Valid format of the time is hh:mm:ss.

Check box labeled UTC/Satellite Time Lag (13s) has to be checked if your GPS software is using Satellite Time to time stamp positions. NMEA messages, and therefore ML61MK2 data file contain UTC time as a time of GPS reading. In most cases, if GPS logger is used to save data Satellite Time is used. Please refer to your GPS software manual. Currently difference between UTC and Satellite clocks is 13 seconds.

Creating XYZ files with positioned sensors

When all parameter are set and input and output file names are specified, the **Proceed** button is activated in the Position Sensors Using External GPS File window. After you click the **Proceed** button, the program begins to read input files, replaces GPS positions by positions given in GPS file, calculates all EM61-MK2 stations positions based on the recorded GPS readings, instant heading, and other specified parameters, and writes results to the XYZ output file (or files depending on the Output Data setting). A progress bar at the bottom of the screen shows the percentage read (Figure 3.22).

The speed of this operation depends on the size of input files. After the output XYZ file is created a two dimensional layout of the survey is displayed (Figure 3.23).

The image displayed in the Plot XYZ window shows the spatial layout of stations to scale, based on the station coordinates as written to the created file. The display has

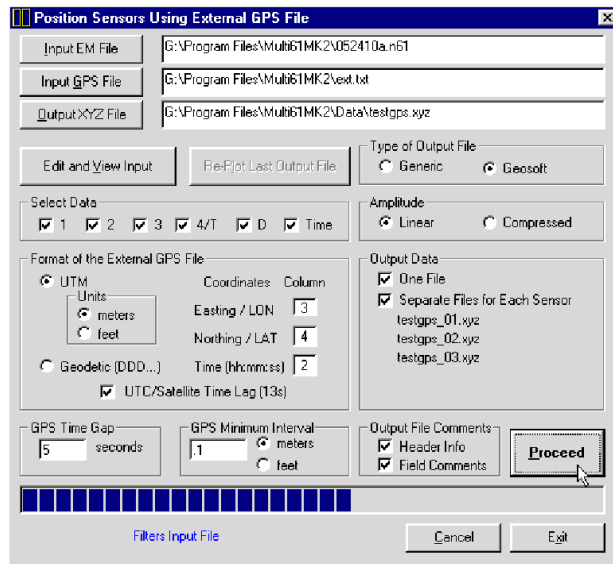


Figure 3.22: Position Sensors Using External GPS File window during creating XYZ file

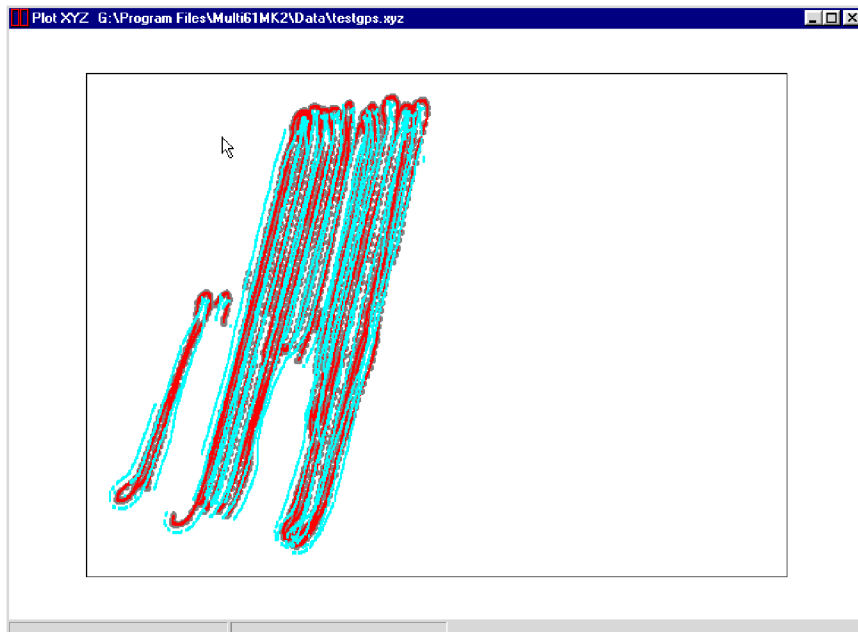


Figure 3.23: Two dimensional layout of stations taken with 2 EM61-MK2 unit array. The GPS antenna was located at 0.5 m (in the center of the first sensor).

fixed colours. GPS positions are marked by larger grey dots. Positions of the first EM61-MK2 (sensor #1) are plotted by red dots, then cyan dots correspond to sensor #2s, green dots to sensor #3, magenta dots to sensor #4, and blue dots denote positions of sensor #5. This plot window can be closed by clicking on **Close** button (located in the top right corner of the window).

After the Plot XYZ window is closed a button **Replot Last Output File** becomes active and the layout of data can be examined again. However, at this time original GPS positions will not be displayed and all instruments will be represented by the same colour on the screen. Files created by this portion of the program can be also viewed at any time using the **File | View XYZ File** menu.

After the file is created and its layout is examined it is possible (if required) to recreate XYZ file with changed array geometry parameters. To do this, click **Edit and View Input** button, the GPS File Info window will appear again. After changes are done, click the **Proceed** button to repeat procedure of creating XYZ file.

3.4 Positioning Sensors by Merging Standalone GPS File

The Position Sensors by Merging Standalone GPS File item of the Position Sensors menu allows you to position sensors when GPS receiver is not connected to the logger running ML61MK2 program. This option of the program lets you combine two data sets (EM61-MK2s and GPS) into one XYZ file as long as you can synchronize the ML61MK2 logger clock with the GPS satellite time or determine the difference between these two clocks. In most cases the difference between clocks (Time Shift) can be determined with higher accuracy than the logger and satellite clocks can be synchronized. It is advised that this type of procedure is used only in cases when all attempts of collecting GPS data by the ML61MK2 program failed. While using this method ML61MK2 files should be relatively small, no more than 0.5 worth of data, and what is the most important **GPS Input** option in the logging device has to be set to **Disabled** in GPS Port Setup menu. This method can be used with virtually any GPS system that possesses log data capabilities, however it requires processing positioning data using GPS software and exporting a GPS file to ASCII format that contains a minimum positioning data (Easting/Northing or Lat/Lon) as well as GPS satellite time data in 24 hour clock format. Select **Position Sensors | Position Sensors by Merging Standalone GPS File** from the main program menu, as shown in Figure 3.24.

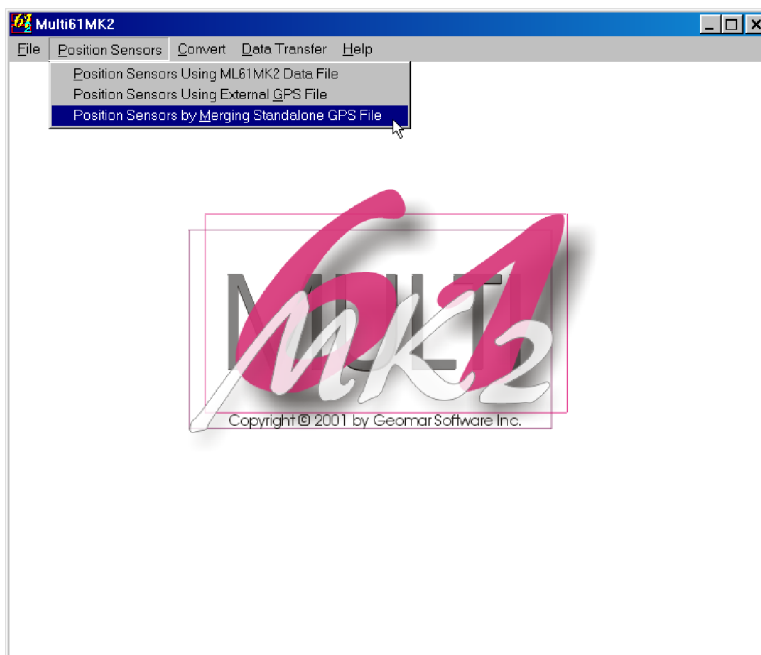


Figure 3.24: Position Sensors menu

After the selected menu item is clicked the Position Sensors by Merging Standalone GPS File window will be displayed in the centre of the screen, Figure 3.25.

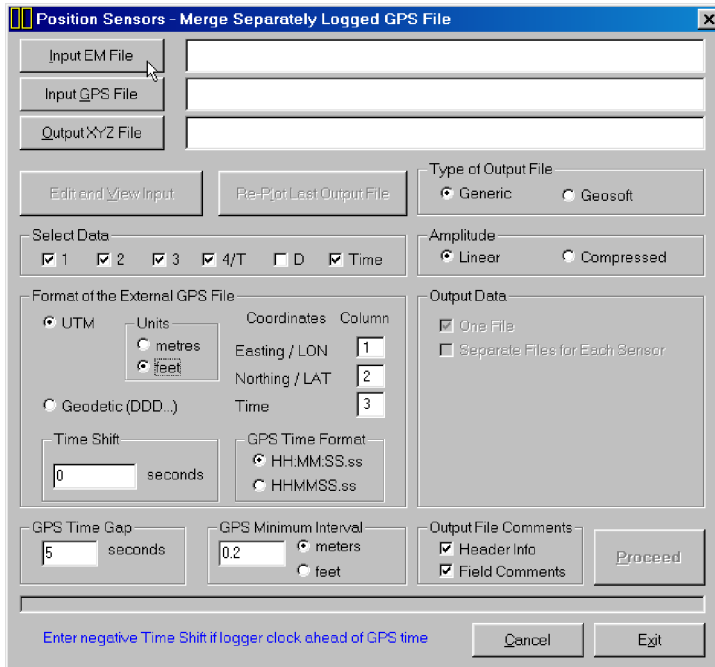


Figure 3.25: Position Sensors by Merging Standalone GPS File window

Parameters in Positioning Sensors by Merging Standalone GPS File window

Several parameters which affect the contents and format of the created output (XYZ) file must be specified. These are the ML61MK2, and XYZ file names, parameters describing contents of the created file and parameters related to GPS file.

Input EM File

Click on **Input EM File** button. The Select ML61MK2 Input File window is displayed (Figure 3.26).

The window lists files with extension name N61. Select a file name and click the **Open** button. The Select ML61MK2 File window will close, progress bar will indicate loading of the file, and at the end the ML61MK2 File Info window will appear (Figure 3.27).

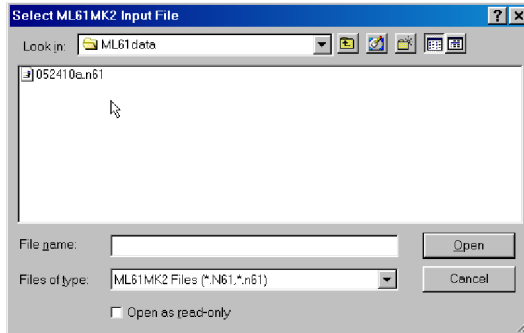


Figure 3.26: Select ML61MK2 File window

The ML61MK2 File Info window displays the most important parameters of the entered data file. At the top of the window the original file name (as entered in the field), date of file, and start and end times in local time (field computer clock) and UTC time (GPS time in NMEA messages), number of EM61-MK2 units used in the array, and type of used GPS NMEA message are displayed. Total number of EM61-MK2 readings (from all instruments), number of GPS

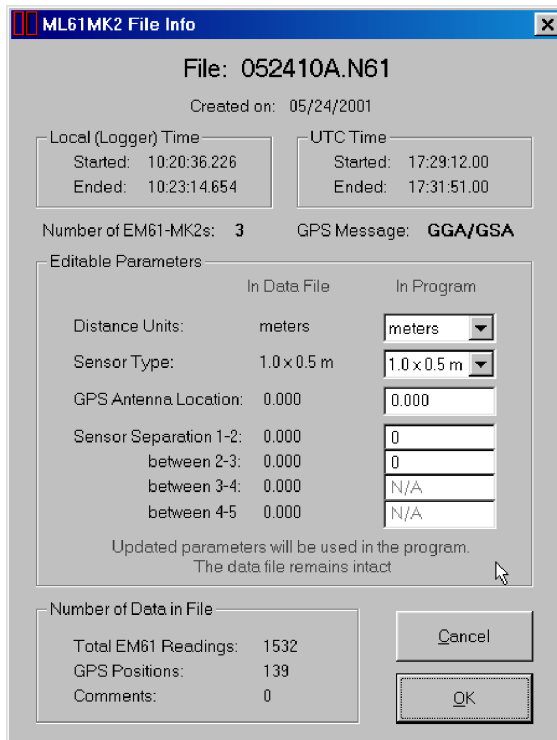


Figure 3.27: ML61MK2 File Info window

positions recorded, and number of comments entered in the field are displayed at the bottom of the window.

The center of the window displays parameters that the user can edit. These are Distance Units, Sensor Type, GPS Antenna Location, and Sensor Separations. If all parameters were correctly specified in the field then clicking on **OK** button will accept these entries. In case some of the parameters require modification they can be entered in appropriate text boxes located under label **In Program**. Distance Units and Sensor Type can be selected from combo list boxes, while GPS Antenna Location and Sensor Separations must be entered in appropriate text boxes. It should be noted that while the field data acquisition program allows for only one Sensor Separation for all pairs of sensors, in this window Separation for each pair of sensors can be specified. Example of ML61MK2 File Info window with modified parameters is shown in Figure 3.28.

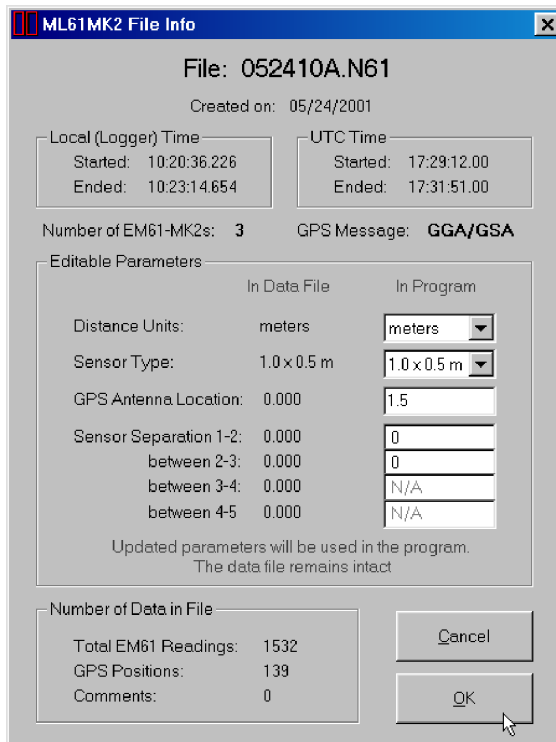


Figure 3.28: Modified parameters in ML61MK2 File Info window

Any updates in this window are valid only for duration of the program. The data file will remain the same.

Clicking on the **OK** button will accept any changes in editable parameters, while clicking on the **Cancel** button will cause the program to use original parameters, listed in fields under label In Data File.

After the buttons **OK** or **Cancel** are clicked and ML61MK2 File Info window is closed, the button **Edit and View File** in the Position Sensors Using External GPS File window (Figure 3.25) is activated. If data file info has to be examined or any editable parameters require change, clicking on this button will display ML61MK2 File Info window again.

Input GPS File

Click on the **Input GPS File** button. The Select External GPS ASCII File window is displayed (Figure 3.29).

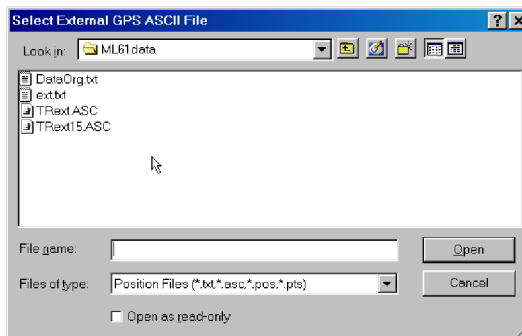


Figure 3.29: Select Input GPS File window

Select a file name and click the **Open** button. The Select External GPS ASCII File window will close and the selected file name will be displayed beside the **Input GPS File** button in the Position Sensors by Merging Standalone GPS File window.

Output File

Click on the **Output XYZ File** button. The Select Output File window is displayed (Figure 3.30).

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 **Output XYZ File** button in the Position Sensors Using External GPS File window.

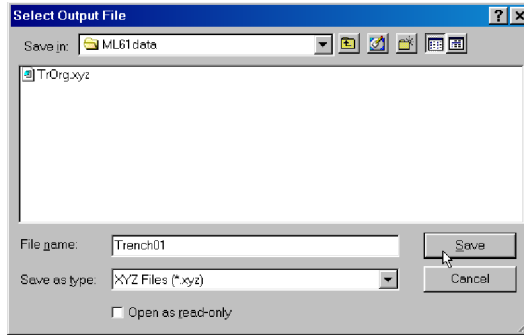


Figure 3.30: Select Output XYZ File window

When all three, Input EM61MK2, Input GPS and Output files are specified the **Proceed** button in the Position Sensors by Merging Standalone GPS File becomes active (Figure 3.31).

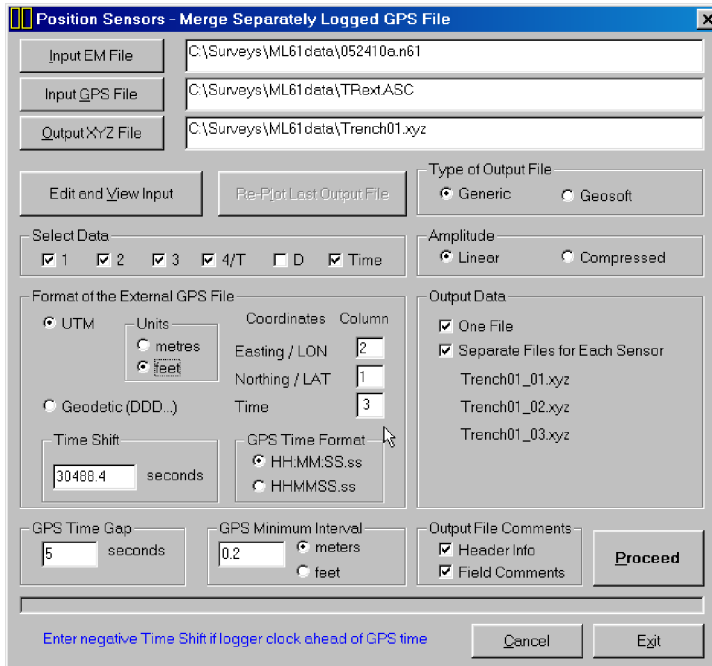


Figure 3.31: Position Sensors by Merging Standalone GPS File window

Select Data

To select a channel click on the check box next to the channel number or name. Data is always placed in the created XYZ file in the following order: X

coordinate, Y coordinate, and all marked channels listed from left to right of Select Data section. The optional parameter Time (time stamp for each reading) will be placed always in the last column of the file. If parameter Header Info in Include in File section is checked a line listing all parameters in the file will be placed as a header for each created XYZ file.

If selected, channel D will be written to the file only when instruments were used in EM61-MK2 mode D (top and bottom coils as a sensor). Channel labeled 4/T corresponds to channel T if EM61-MK2 mode D was used, and to channel 4 if the instrument mode 4 was employed.

Type of Output File

Check the option appropriate for the contouring software used. The Generic option will create a three or more column file without any text strings. This file can be used as an input file for many contouring packages (including Surfer). Geosoft format will cause the program to write a message LINE # at the beginning of each survey line.

Amplitude

Readings can be written in the output file in Linear (original) scale, or Compressed, as the signed square root of each value. Check the appropriate radio button in the Amplitude section of the Position Sensors by Merging Standalone GPS File window.

Output Data

Multi61MK2 can generate one file containing data from all EM61-MK2 in the array, or separate file for each instrument. Check appropriate boxes labeled One File and Separate File for Each Sensor in the Output Data section . If data are written to separate file for each instrument the program creates name for the file by adding underscore and number of the instrument to the base output file name (i.e. ABC_01.XYZ, ABC_02.XYZ and so on), see Figure 3.21. In One File option data are written sequentially, first coordinates and readings for the instrument #1 are generated, then full set of data for instrument #2 follows, and so on.

Output File Comments

This section contains two check boxes labeled **Header Info** and **Field Comments**. When Header Info box is checked the file will contain a header listing type of coordinates and names of channels contained in each column of created XYZ file. Checking box labeled Field Comments will cause the program

to write text of all field comment (entered by the operator during the survey) in to the created file.

GPS Time Gap

Differentially corrected GPS data often has gaps, due to differences in the constellation of satellites visible to two (fixed and moving receivers), lack of beacon signal, surveying near trees, buildings, and other elevated obstructions. These gaps are filled by Multi61MK2 with the assumption that the GPS receiver speed is essentially constant and that it moves along a straight line during the gaps.

The **GPS Time Gap** parameter specifies the maximum time during which the EM61-MK2 data for each instrument in the array will be linearly interpolated between two GPS positions. Enter this parameter (in seconds) in the edit box labeled **seconds** in the GPS Time Gap section (Figure 3.31). In most cases a value 2 to 3 times larger than the GPS data acquisition frequency is adequate, however the user has to determine this value based on the survey specific conditions and requirements. To ignore effect of this parameter enter a large number of seconds (i.e. 300 or more) as GPS Time Gap parameter.

GPS Minimum Interval

The **GPS Minimum Interval** parameter specifies the minimal distance between two GPS stations that will be used in interpolation. If this distance is smaller than the specified GPS Minimum Interval, then all EM61-MK2 readings located between these two stations will be ignored. This parameter is useful in cases when the operator stops for a moment and data are collected in one point. Limited accuracy of GPS positioning will create randomly distributed positions in area adjacent to the stationary location of the system. If Multi61MK2 will calculate positions of sensors in the array, positions of all outer sensors will have quite large variations associated with apparent change of direction of the survey line caused by randomly close spaced GPS positions. In most cases a value 2 or 3 times smaller than average distance between two GPS stations is adequate, however the user has to determine right value for this parameter which will depend on survey conditions and first of all accuracy of the employed GPS receiver. To ignore the effect of this parameter and to use all stations during creating XYZ file (i.e. during testing when GPS antenna is stationary) set this parameter to zero.

Enter the GPS Minimum Interval in the edit box and check one of the two radio buttons labeled **meters** and **feet** (indicating distance unit) in the GPS Minimum Interval section (Figure 3.31).

Format of the External (Standalone) GPS File

This section describes contents of the External GPS File. It is assumed that the file is in ASCII (text) format, and columns are delimited by comma or space. Parameters that have to be specified include: type of coordinates (UTM or Geodetic), identifying numbers of columns corresponding to each coordinate and time, and indicating time of GPS data (UTC or satellite time). These parameters are necessary for Multi61MK2 to correctly calculate positions of each sensor.

Post-processed GPS files in ASCII (text) format include UTM or Geodetic (Latitude/Longitude) coordinates. To select coordinates click **Geodetic** or **UTM** radio buttons (Figure 3.31). Geodetic coordinates, Latitude and Longitude are given in degrees. The program assumes format DDD.DDDDDDDDD. Format DDMM.MMMMM (native format found in NMEA GPS messages) is not supported by this option of Multi61MK2. UTM coordinates can be generated in meters or feet. To select units for UTM coordinates click one of the radio buttons located in the Units section located at the UTM radio button (Figure 3.31). These radio buttons are active only when the radio button labeled UTM is selected.

Specify columns where each coordinate and time in text boxes labeled **Column**.

To select GPS Time Format (24 hours clock) click **HH:MM:SS.ss** or **HHMMSS.ss** radio buttons (Figure 3.31).

The **Time Shift** can be specified in the edit box labeled **Time Shift**. The Time Shift is needed when the EM61-MK2 logger and GPS system clocks are not synchronized prior to the survey. An appropriate correction (in seconds) can be entered in the edit box labeled **Time Shift**. In most cases, it is much easier to determine the time difference between the clocks in these two devices than to synchronize the two clocks at the outset.

During calculations the Time Shift is applied to the recorded EM61-MK2 logger time. Therefore, if the logger time is ahead of the GPS time, enter a negative value; if the EM61-MK2 logger time is behind the GPS time, enter a positive value.

Creating XYZ files with positioned sensors

When all parameter are set and input and output file names are specified, the **Proceed** button is activated in the Position Sensors by Merging Standalone GPS File window. After you click the **Proceed** button, the program begins to read input files, calculates all EM61-MK2 stations positions based on readings recorded by GPS logger, entered Time Shift, instant heading, and other specified parameters, and writes results to the XYZ output file (or files depending on the Output Data setting). A progress bar at the bottom of the screen shows the percentage read (Figure 3.32).

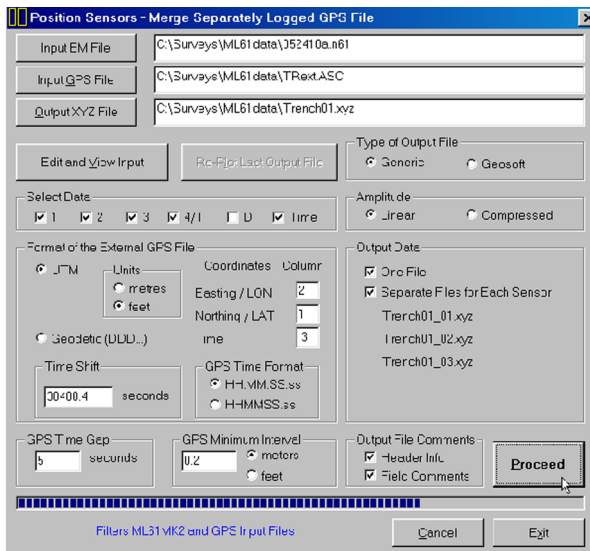


Figure 3.32: Position Sensors by Merging Standalone GPS File window during creating XYZ file

The speed of this operation depends on the size of input files. After the output XYZ file is created a two dimensional layout of the survey is displayed (Figure 3.33).

The image displayed in the Plot XYZ window shows the spatial layout of stations to scale, based on the station coordinates as written to the created file. The display has fixed colours. GPS positions are marked by larger grey dots. Positions of the first EM61-MK2 (sensor #1) are plotted by red dots, then cyan dots correspond to sensor #2s, green dots to sensor #3, magenta dots to sensor #4, and blue dots denote positions of sensor #5. This plot window can be closed by clicking on **Close** button (located in the top right corner of the window).

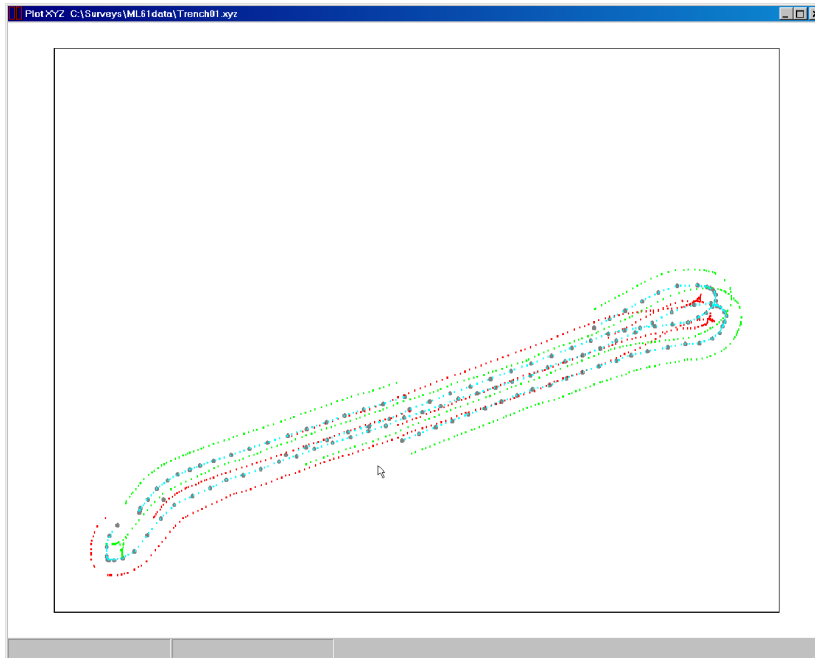


Figure 3.33: Two dimensional layout of stations displayed after XYZ file is created (layout for array of 3 EM61-MK2 units)

After the Plot XYZ window is closed a button **Replot Last Output File** becomes active and the layout of data can be examined again. However, at this time original GPS positions will not be displayed and all instruments will be represented by the same colour on the screen. Files created by this portion of the program can be also viewed at any time using the **File | View XYZ File** menu.

After the file is created and its layout is examined it is possible (if required) to recreate XYZ file with changed array geometry parameters. To do this, click **Edit and View Input** button, the GPS File Info window will appear again. After changes are done, click the **Proceed** button to repeat procedure of creating XYZ file.

Convert Files

4

Convert menu of Multi61MK2 program allows you to convert the ML61MK2 binary file to other formats. There are four items associated with the Convert menu (Figure 4.1):

- convert ML61MK2 file to Geonics DAT61MK2 (.M61) format,
- convert ML61MK2 file to general format ASCII file,
- convert GXY file to ASCII file containing positions,
- retrieve and position field comments from ML61MK2.
- correct system time constant delay in XYZ files.

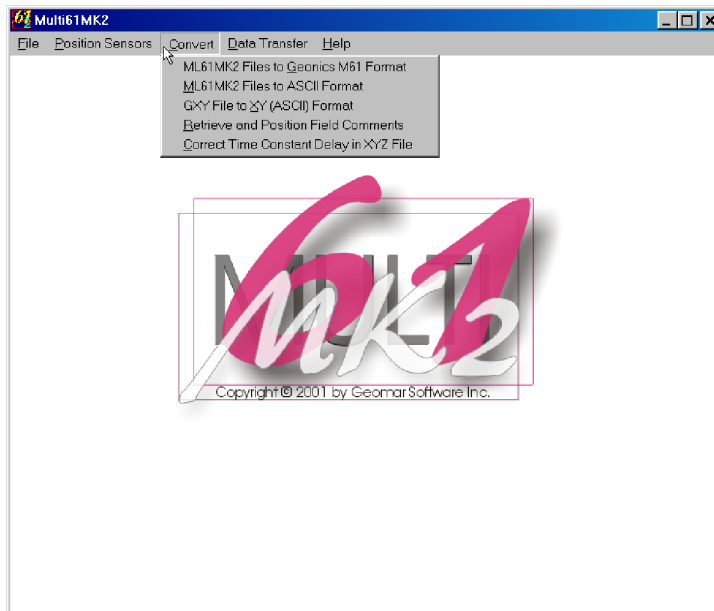


Figure 4.1: Convert menu

Files converted to Geonics DAT61MK2 format can be further processed by the Geonics DAT61MK2 program, while files converted to general ASCII format can be easily reformatted and used by other software. When converting GXY files (containing only GPS positions and field comments) the program generates simple XY type of file (coordinates in two columns with optional time of the record). While retrieving comments from ML61MK2 file, the program retrieves text of the comment and their position based on neighbouring GPS records.

Examples of file formats created by Multi61MK2 are given in Appendix B of this manual.

4.1 Convert ML61MK2 Files to Geonics DAT61MK2 (M61) Format

The Convert ML61MK2 to Geonics M61 Format option allows you to convert ML61MK2 files to Geonics DAT61MK2 format. Select **Convert | ML61MK2 to Geonics M61 Format** from the main program menu, as shown in Figure 4.1.

After the selected menu item is clicked the Convert ML61MK2 Files (N61) to Geonics M61 Format window will be displayed in the centre of the screen, Figure 4.2.

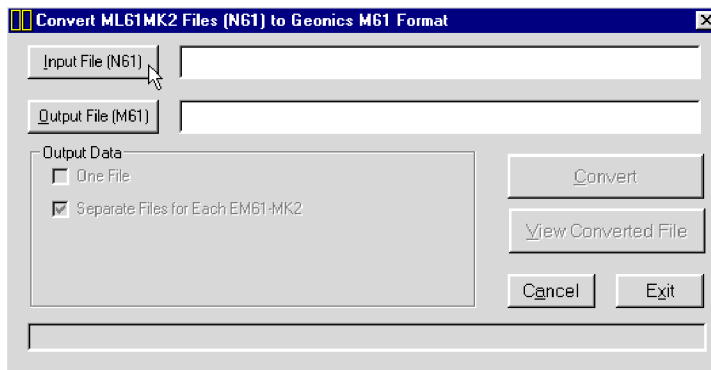


Figure 4.2: Convert ML61MK2 File to Geonics M61 Format window

Parameters in Convert ML61MK2 File to Geonics M61 Format window

Several parameters which affect the contents and format of the created output (XYZ) file must be specified. These are the ML61MK2, and M61 file names, and Output Data as a one, or separate files for each EM61-MK2.

Input File (N61)

Click on **Input File (N61)** button. The Select ML61MK2 Input File window is displayed (Figure 4.3).

The window lists files with extension name N61. Select a file name and click the **Open** button. The Select ML61MK2 File window will close and the selected file name will be displayed beside the **Input File (N61)** button in the Convert ML61MK2 File (N61) to Geonics M61 Format window.

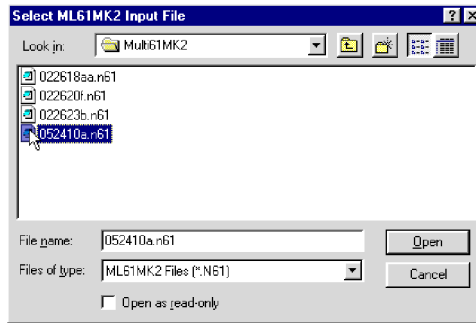


Figure 4.3: Select ML61MK2 Input File window

Output File (M61)

Click on the **Output File (M61)** button. The Select Output File window is displayed (Figure 4.4).

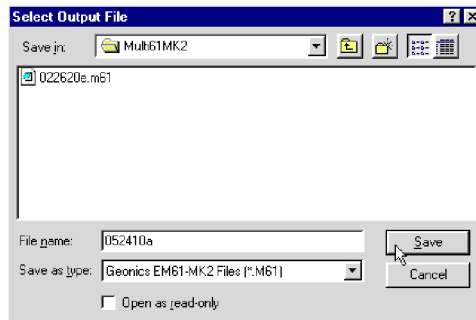


Figure 4.4: Select Output File window

Select a file name and click the **Save** button. The Select Output File window will close and the selected file name will be displayed beside the **Output File (M61)** button in the Convert ML61MK2 to Geonics M61 Format window.

When both, Input and Output files are specified the **Convert** button in the Convert ML61MK2 to Geonics M61 Format window becomes active.

Output Data

Multi61MK2 can generate one file containing data from all EM61-MK2 in the array, and/or separate file for each instrument. Check appropriate boxes labeled One File and Separate File for Each Sensor in the Output Data section . If data are written to separate files for each instrument the program creates a name for

the file by adding an underscore and number of the instrument to the base output file name (i.e. ABC_01.XYZ, ABC_02.XYZ and so on), see Figure 4.5.

Converting ML61MK2 file to Geonics DAT61MK2 (M61) format

When all parameters are set and input and output file names are specified, the **Convert** button is activated in the Convert ML61MK2 File to Geonics M61 Format window. After you click the **Convert** button, the program begins to read the input file, converts data to DAT61MK2 format and writes results to the output file (or files depending on the Output Data setting). A progress bar at the bottom of the screen shows the percentage read (Figure 4.5).

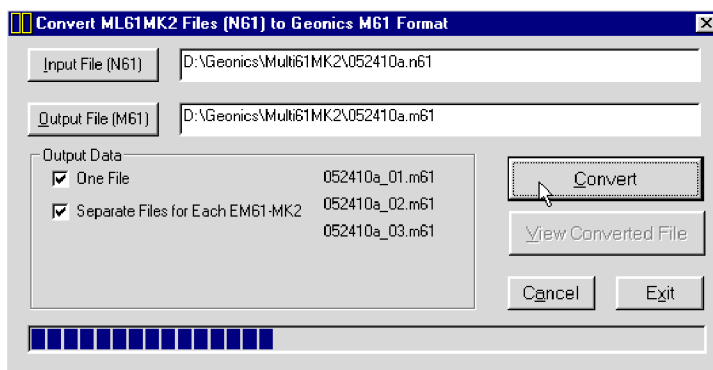


Figure 4.5: Convert ML61MK2 Files (N61) to Geonics Format window during data processing

The speed of this operation depends on the size of the input file. After the output (M61) file (or files) is created the **View Converted File** button becomes active. Clicking on this button will display first 63 Kbytes of the created file.

The created file can be loaded to the Geonics DAT61MK2 program. It should be noted that the file and files created for separate sensors contain original GPS positions.

Clicking **Cancel** button will clear text boxes at **Input File (N61)** and **Output File (M61)** buttons. Click on **Exit** button to close the Convert ML61MK2 Files (N61) to Geonics M61 Format window.

An example of data file in Geonics DAT61MK2 (M61) format is given in Appendix B.

4.2 Convert ML61MK2 Files to ASCII Format

The Convert ML61MK2 to ASCII Format option allows you to convert ML61MK2 binary files to ASCII format, which can be viewed with any text editor and then easily converted to the other format. Select **Convert | ML61MK2 to ASCII Format** from the main program menu, as shown in Figure 4.1.

After the selected menu item is clicked the Convert ML61MK2 Files to ASCII Format window will be displayed in the centre of the screen, Figure 4.6.

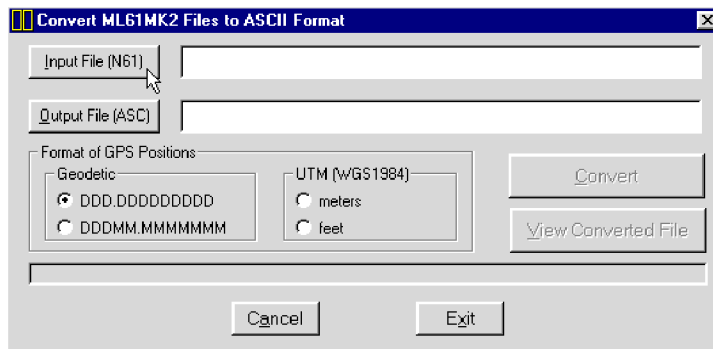


Figure 4.6: Convert ML61MK2 Files to ASCII Format window

Parameters in Convert ML61MK2 Files to ASCII Format window

Several parameters which affect the contents and format of the created output (ASC) file must be specified. These are the ML61MK2, and ASCII file names, and Format of GPS Positions.

Input File (N61)

Click on **Input File (N61)** button. The Select ML61MK2 Input File window is displayed (Figure 4.7).

The window lists files with extension name N61. Select a file name and click the **Open** button. The Select ML61MK2 File window will close and the selected file name will be displayed beside the **Input File (N61)** button in the Convert ML61MK2 File (N61) to ASCII Format window.

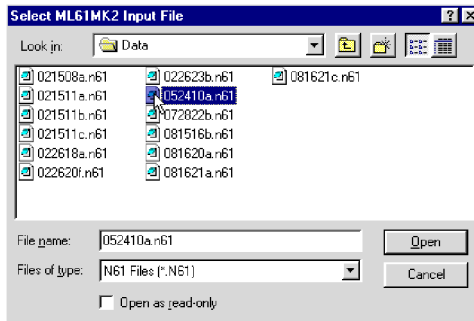


Figure 4.7: Select ML61MK2 Input File window

Output File (ASC)

Click on the **Output File (ASC)** button. The Select Output File window is displayed (Figure 4.8).

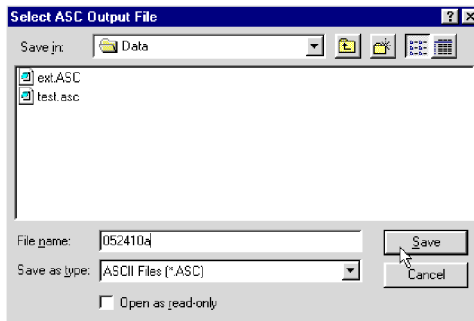


Figure 4.8: Select ASC Output File window

Select a file name and click the **Save** button. The Select ASC Output File window will close and the selected file name will be displayed beside the **Output File (ASC)** button in the Convert ML61MK2 Files to ASCII Format window.

When both, Input and Output files are specified the **Convert** button in the Convert ML61MK2 to ASCII Format window becomes active.

Format of GPS Positions

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. To select coordinates click the appropriate radio buttons in the sections labeled **Geodetic** or **UTM** (Figure 4.6).

Geodetic coordinates, Latitude and Longitude are given in degrees. They can be written in two formats DD.DDDDDDDD or DDMM.MMMMM (native format found in NMEA GPS messages). To select which format click the appropriate radio button in the section labeled **Geodetic** (Figure 4.6).

UTM coordinates can be generated in meters or feet. To select units for UTM coordinates click one of the radio buttons located in the Units section located at the UTM radio button (Figure 4.6).

Converting ML61MK2 file to ASCII format

When all parameter are set and input and output file names are specified, the **Convert** button is activated in the Convert ML61MK2 File to ASCII Format window. After you click the **Convert** button, the program begins to read the input file, converts data to DAT61MK2 format and writes results to the output file. A progress bar at the bottom of the screen shows the percentage read (Figure 4.9).

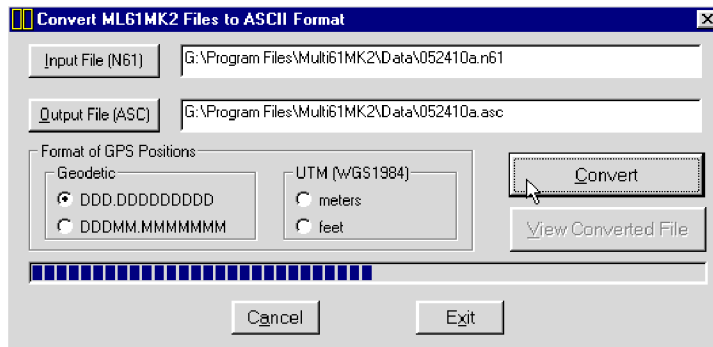


Figure 4.9: Convert ML61MK2 Files to ASCII Format window during data processing

The speed of this operation depends on the size of the input file. After the output file is created the **View Converted File** button becomes active. Clicking on this button will display first 63 Kbytes of the created file.

The created file contains EM61-MK2 readings, GPS positions, and entire information related to instruments and survey settings. Example of the output file in ASCII format is given in Appendix B.

Clicking **Cancel** button will clear text boxes at **Input File (N61)** and **Output File (ASC)** buttons. Click on **Exit** button to close the Convert ML61MK2 Files to ASCII Format window.

4.3 Convert GXY Files to XY (ASCII) Format

Files GXY are created by the ML61MK2 when only GPS data are collected (number of EM61-MK2s is set to 0). This type of file contains GPS positions and optionally field comments. The Convert GXY File to XY (ASCII) Format option allows you to convert GXY binary file to simple XY type of file (coordinates are placed in two columns with an optional time of the record in the third column). This format can be viewed with any text editor and it can be easily converted to other formats.

It should be noted that GXY files created with any other Geomar data acquisition programs (i.e. ML61, NAV61MK2, NAV31, NAV38, etc.) can be converted to ASCII format using this option of Multi61MK2.

Select **Convert | GXY Files to XY (ASCII) Format** from the main program menu, as shown in Figure 4.1. After the selected menu item is clicked the Convert GXY File to XY Format window will be displayed in the centre of the screen, Figure 4.10.

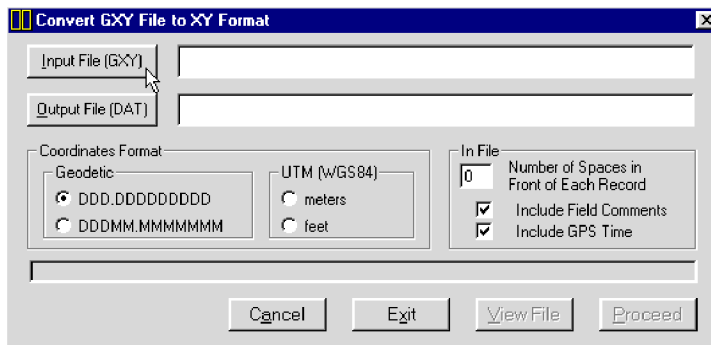


Figure 4.10: Convert GXY Files to XY Format window

Parameters in Convert GXY to XY Format window

Several parameters which affect the contents and format of the created output (ASC) file must be specified. These are the input and output names, Coordinates Format, and contents of the output file.

Input File (GXY)

Click on **Input File (GXY)** button. The Select GXY Input File window is displayed (Figure 4.11).

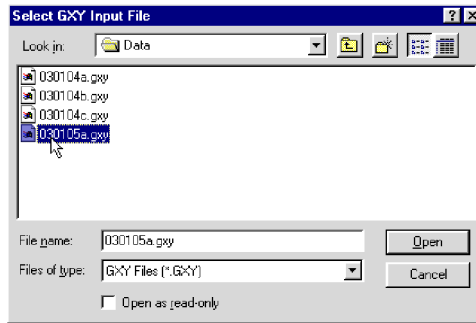


Figure 4.11: Select GXY Input File window

The window lists files with extension name GXY. Select a file name and click the **Open** button. The Select GXY File window will close and the selected file name will be displayed beside the **Input File (GXY)** button in the Convert GXY File to XY Format window.

Output File (DAT)

Click on the **Output File (DAT)** button. The Select Output File window is displayed (Figure 4.12).

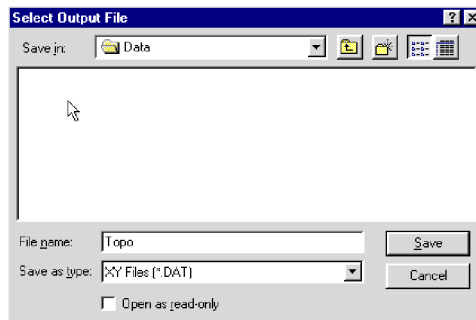


Figure 4.12: Select Output File window

Select a file name and click the **Save** button. The Select Output File window will close and the selected file name will be displayed beside the **Output File (DAT)** button in the Convert GXY File to XY Format window.

When both, Input and Output files are specified the **Proceed** button in the Convert GXY File to XY Format window becomes active.

Coordinates Format

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. To select coordinates click appropriate radio buttons in sections labeled **Geodetic** or **UTM** (Figure 4.10 or 4.13).

Geodetic coordinates, Latitude and Longitude are given in degrees. They can be written in two formats DD.DDDDDDDD or DDMM.MMMMM (native format found in NMEA GPS messages). To select which format click the appropriate radio button in section labeled **Geodetic** (Figure 4.10).

UTM coordinates can be generated in meters or feet. To select units for UTM coordinates click one of the radio buttons located in the Units section located at the UTM radio button (Figure 4.10).

In File

This section affects the output file format and contents. It contains one text box labeled **Number of Spaces in Front of Each Record** and two check boxes labeled **Include Field Comments** and **Include GPS Time**.

Number entered in the text box will specify number of spaces in front of each record. This option may be useful while using created files as control files in mapping software. To ignore this option enter zero.

Checking box labeled Include Field Comments will cause the program to write text of all field comment (entered by the operator during the survey) in to the created file.

When Include GPS Time box is checked the program will write a third column containing time of GPS position.

Converting GXY file to XY (ASCII) format

When all parameter are set and input and output file names are specified, the **Proceed** button is activated in the Convert GXY to XY Format window. After you click the **Proceed** button, the program begins to read the input file, converts data to ASCII format and writes results to the output file. A progress bar at the bottom of the screen shows the percentage read (Figure 4.13).

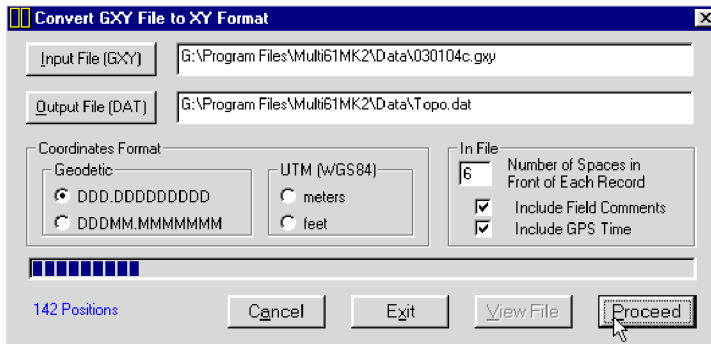


Figure 4.13: Convert GXY Files to XY Format window during data processing

The speed of this operation depends on the size of the input file. After the output file is created the **View File** button becomes active. Clicking on this button will display first 63 Kbytes of the created file.

The created file contains GPS positions as recorded in the field. Example of the output file in ASCII format is given in Appendix B.

Clicking **Cancel** button will clear text boxes at **Input File (GXY)** and **Output File (DAT)** buttons. Click on **Exit** button to close the Convert GXY Files to XY Format window.

4.4 Retrieve and Position Field Comments

The Retrieve and Position Field Comments option allows you to convert retrieve field comments from ML61MK2 binary files. At the same time the program assigns GPS positions to indicate where these comments were entered by the operator. The position can be assigned either as a GPS position preceding or position following the comment entry. The resulting output file consists of coordinates and corresponding text of the comment. Select **Convert | Retrieve and Position Field Comments** from the main program menu, as shown in Figure 4.1.

After the selected menu item is clicked the Position Comments Recorded in ML61MK2 File window will be displayed in the centre of the screen, Figure 4.14.

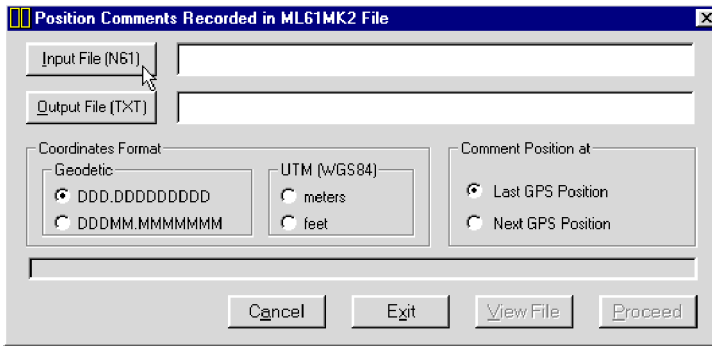


Figure 4.14: Position Comments Recorded in ML61MK2 File window

Parameters in Position Comments Recorded in ML61MK2 File window

Several parameters which affect the contents and format of the created output (ASC) file must be specified. These are the input ML61MK2 file and output file names, coordinates format, and indicating type of position of the comment - using a preceding or following GPS reading.

Input File (.N61)

Click on **Input File (.N61)** button. The Select ML61MK2 Input File window is displayed (Figure 4.15).

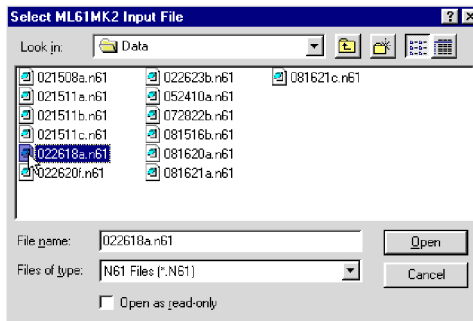


Figure 4.15: Select ML61MK2 Input File window

The window lists files with extension name N61. Select a file name and click the **Open** button. The Select ML61MK2 Input File window will close and the selected file name will be displayed beside the **Input File (.N61)** button in the Position Comments Recorded in ML61MK2 File window.

Output File (TXT)

Click on the **Output File (TXT)** button. The Select Output File window is displayed (Figure 4.16).

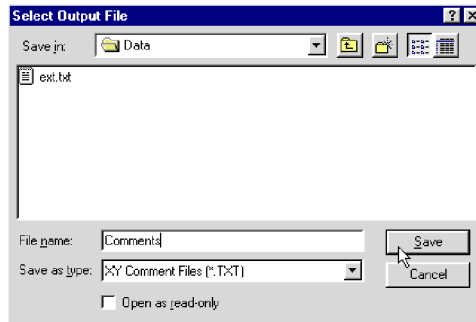


Figure 4.16: Select Output File window

Select a file name and click the **Save** button. The Select Output File window will close and the selected file name will be displayed beside the **Output File (TXT)** button in the Position Comments Recorded in ML61MK2 File window.

When both, Input and Output files are specified the **Proceed** button in the Position Comments Recorded in ML61MK2 File window becomes active.

Coordinates Format

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. To select coordinates click the appropriate radio buttons in sections labeled **Geodetic** or **UTM** (Figure 4.14).

Geodetic coordinates, Latitude and Longitude are given in degrees. They can be written in two formats DD.DDDDDDDD or DDMM.MMMMM (native format found in NMEA GPS messages). To select which format click the appropriate radio button in section labeled **Geodetic** (Figure 4.14).

UTM coordinates can be generated in meters or feet. To select units for UTM coordinates click one of the radio buttons located in the Units section located at the **UTM** radio button (Figure 4.14).

Comment Position at

This section specifies how GPS positions are assigned to the comment. There are two choices: Comment can be assigned to the last position that was recorded by the ML61MK2 program, or to the position that follows comment entry. In most cases any choice is right since comments are usually taken while collecting data (including GPS positions) and during comment entry operator stops recording for a moment. However the option **Last GPS Position** appears to be more natural since after the comment entry the operator may stop taking readings and later continue survey from other location.

To select comment position option click one of the radio buttons labeled **Last GPS Position** and **Next GPS Position** located in the Comment Position at section of the window (Figure 4.17).

Positioning Comments Recorded in ML61MK2 File

When all parameter are set and input and output file names are specified, the **Proceed** button is activated in the Position Comments Recorded in ML61MK2 File window. After you click the **Proceed** button, the program begins to read the input file, converts data to ASCII format and writes results to the output file. A progress bar at the bottom of the screen shows the percentage read (Figure 4.17).

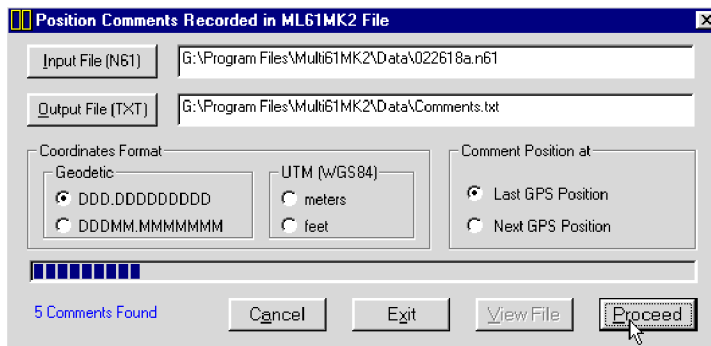


Figure 4.17: Position Comments Recorded in ML61MK2 File during data processing

The speed of the operation depends on the size of the input file. After the output file is created the **View File** button becomes active. Clicking on this button will display first 63 Kbytes of the created file.

The created file contains GPS positions in the first two columns followed by the text of comment as recorded in the field. Example of the output file containing comments is given in Appendix B.

Clicking **Cancel** button will clear text boxes at **Input File (N61)** and **Output File (TXT)** buttons. Click on **Exit** button to close the Position Comments Recorded in ML61MK2 File window.

4.5 Correct Time Constant Delay in XYZ File

This option allows for the system time constant delay correction. The procedure acts on two dimensional, GPS positioned data.

While the EM61-MK2 time constant is known the time constant of the combined EM61-MK2 and GPS receiver system is a function of these two devices. The easiest 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. Another 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.

Since the image of two dimensional data can be displayed in a mapping system (after gridding) the procedure can be time consuming, however it only needs to be done once for a given GPS receiver and EM61-MK2 array.

In order to apply the correction the generated XYZ file must have time stamps. In the event input file does not have time stamp at each reading the program will display a warning message.

The correction acts on any XYZ type of file so care should be taken that data is not corrected twice.

To access this option select **Convert | Correct Time Constant Delay in XYZ File** in the menu (Figure 4.1). The Correct Time Constant Delay window will appear on the screen (Figure 4.18).

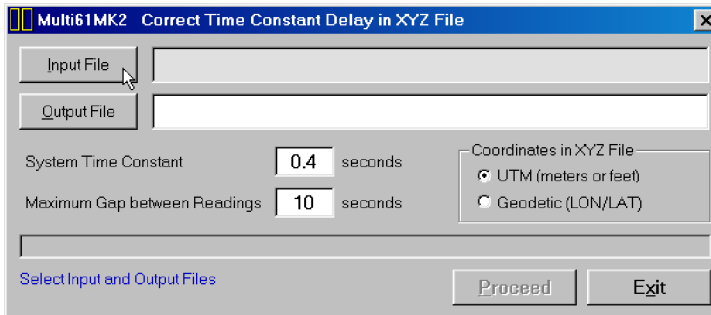


Figure 4.18: Correct Time Constant Delay in XYZ File window

Parameters in Correct Time Constant Delay Window

Several parameters which affect the contents of the created output (XYZ) file must be specified. These are the Input and Output XYZ file names, System Time Constant, Maximum Gap between Readings, and type of coordinates in the input XYZ file.

Input File

Click on **Input File** button. The Select Input XYZ File window is displayed (Figure 8.19).

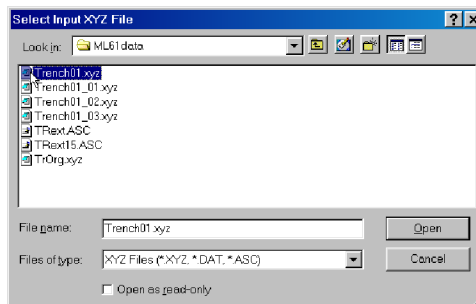


Figure 4.19: Select Input XYZ File window

The window lists files with extension names XYZ, DAT, and ASC. Select a file name and click the **Open** button. The Select Input XYZ File window will close and the selected file name will appear next to the **Input File** button in the Correct Time Constant Delay window.

Output File

Click on the **Output File** button. The Select XYZ File window is displayed (Figure 4.20).

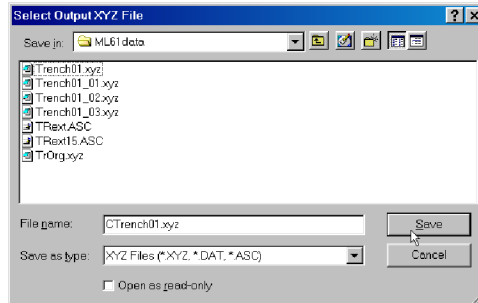


Figure 4.20: Select Output XYZ File window

As a default the Input File name with prefix C is given. Accept the default, enter, or select a file name and click the **Save** button. The Select Output XYZ File window will close and the selected file name will be displayed beside the **Output File** button in the Correct Time Constant Delay window.

When Input and Output files are specified the **Proceed** button in the Correct Time Constant Delay window becomes active (Figure 4.21).

System Time Constant

Time delay 0.5 seconds is given as a default. This value can be changed (0 to 2 seconds), however the user should experiment before choosing a final value.

Maximum Gap Between Readings

This parameter specifies the maximum time during which the EM61-MK2 data will be treated as continuous data set. If the gap between two stations is larger than specified maximum gap the station that follows the gap will be assumed the first station of a new line.

Enter this parameter (in seconds) in the edit box labeled Maximum Gap between Readings. In most cases a value 2 to 3 times larger than the GPS acquisition frequency is adequate.

Coordinates in XYZ File

Specify type of coordinates in the input file. The output file will be written with the same type of coordinates.

Creating XYZ File With Time Delay Corrections

When all parameter are set and input and output file names are specified, the **Proceed** button is activated in the Correct Time Constant Delay window. After you click the **Proceed** button, the program begins to read and analyse the input file. A label Analyzing File is displayed at the bottom of the window. The program then calculates corrections for each station based on the instant velocity of the system at each station. A progress bar at the bottom of the screen shows the percentage read (Figure 4.21).

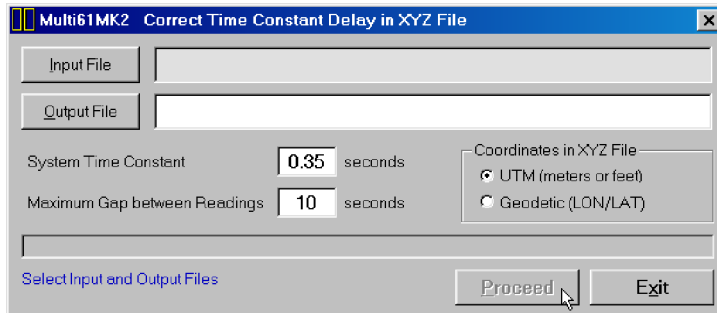


Figure 4.21: Correct Time Constant Delay in the XYZ File window during data processing

If the input file does not contain time stamp information, the program will display a warning message and the program will pause operation till the **OK** button is clicked in the warning window.

File Menu

5

File menu of Multi61MK2 program is shown in Figure 5.1. There are three items associated with the File menu:

- View File Info (displays contents of ML61MK2 data file),
- Display XYZ File (displays layout of stations in XYZ file),
- Exit (terminates Multi61MK2 program).

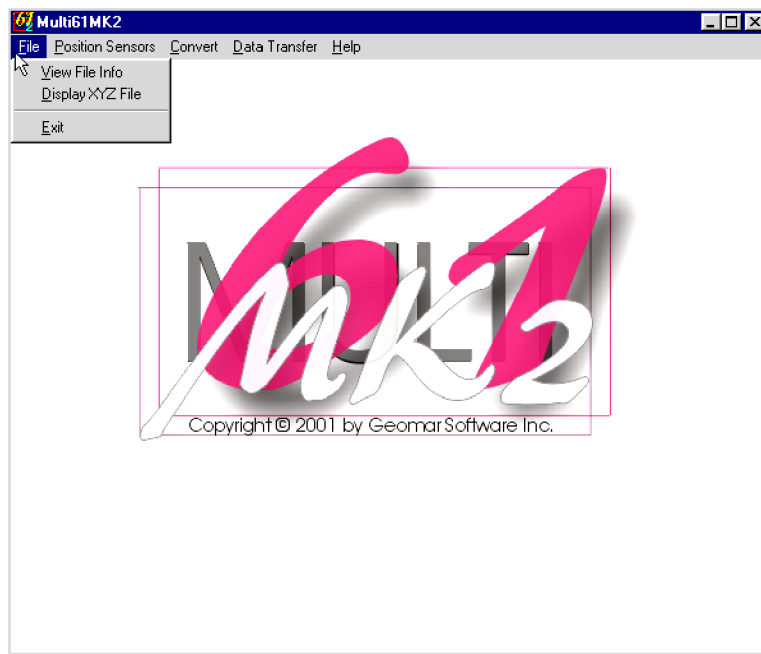


Figure 5.1: Multi61MK2 File menu

5.1 View File Info

The View File Info option allows you to display information describing parameters, type and amount of data in binary data file in ML61MK2 format. Select **File | View File Info** from the main program menu, as shown in Figure 5.1.

After the selected menu item is clicked the Select ML61MK2 Input File window will be displayed in the centre of the screen, Figure 5.2.

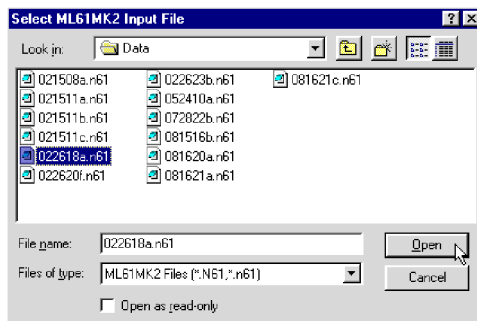


Figure 5.2: Select ML61MK2 Input File window

The window lists files with extension name N61. Select a file name and click the **Open** button. The Select ML61MK2 File window will close and the progress bar will appear in the center of program's main window indicating percentage of loaded file (Figure 5.3).

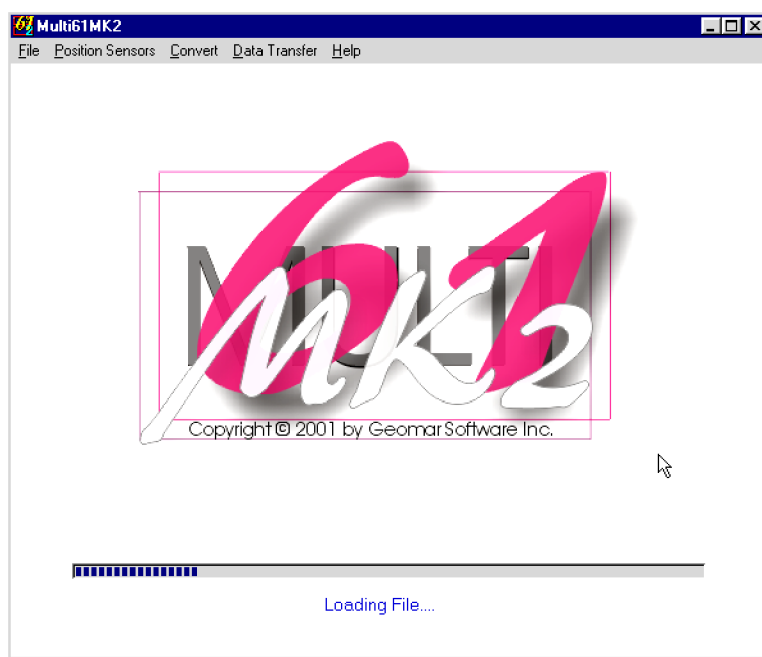


Figure 5.3: Progress bar indicating loading ML61MK2 file

When the selected file is loaded a ML61MK2 File Info window will appear (Figure 5.4).

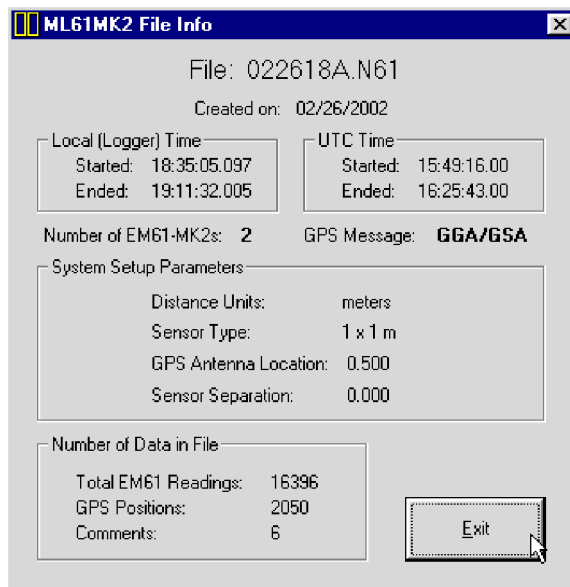


Figure 5.4: ML61MK2 File Info window

The ML61MK2 File Info window displays the most important parameters of the selected data file. At the top of the window the original file name (as entered in the field), date of file, and start and end times in local time (field computer clock) and UTC time (GPS time in NMEA messages), number of EM61-MK2 units used in the array, and type of employed GPS NMEA message are displayed.

The center of the window displays parameters describing geometry of the array. These are Distance Units, Sensor Type, GPS Antenna Location, and Sensor Separations.

Total number of EM61-MK2 readings (from all instruments), number of GPS positions recorded, and number of comments entered in the field are displayed at the bottom of the window.

Click on the **Exit** button to close the ML61MK2 File Info window.

5.2 Display XYZ File

The Display XYZ File option allows you to display two dimensional layout of stations in a selected XYZ file. Select **File | Display XYZ File** from the main program menu, as shown in Figure 5.1. The Select XYZ to Open window will appear (Figure 5.5).

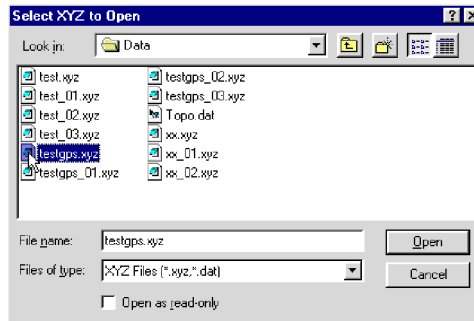


Figure 5.5: Select XYZ to Open window

The window lists files with extension name XYZ. Select a file name and click the **Open** button. The Select XYZ to Open window will close, the file will be loaded and two dimensional image will be displayed (Figure 5.6).

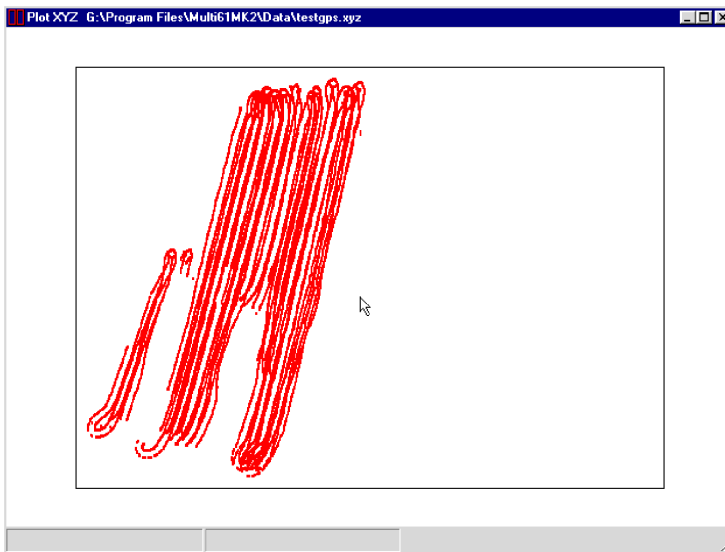


Figure 5.6: Two dimensional layout of stations in XYZ File

The image displayed in the Plot XYZ window shows the spatial layout of stations to scale, based on the station coordinates as written in the selected XYZ file.

- IM - instrument mode
(0 = Auto, 1 = Wheel, and 2 = Manual)
- File Name - file name, maximum 8 characters
- Time Increment - time increment (Auto Mode) in seconds
- GPS Antenna - location of GPS antenna in m or ft
- Sensor Separation - separation between sensors in array in m or ft
- EM - number of EM61-MK2 instruments (1 to 5)
- LD - leading EM61-MK2 (1 to 5)
- GP - type of GPS NMEA message
(0 = GGA/GSA, 1= GGA, 2 = POS, 3 = LLK, 4=LLQ, 5=GLL, 6=GGK, 7=RTS Leica)
- MN - Main EM61 (1 to 5)
- CO - coordinates (0 = Lat/Lon, 1 = UTM)
- EM61#1 Offset - offset for indicated EM61-MK2 channel in mV
- 10 - Line Feed character

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

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
L	Line Name - 8 characters																				10
B	Start Station (Format F11.2)												Time in milliseconds						10		
A	Dir							Increment (Format F11.2)										10			
Z	M	M	D	D	Y	Y	Y	Y			H	H	:	M	M	:	S	S			10

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

Reading

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

I - indicator (one ASCII character). Number of the ASCII character represents number of the EM61-MK2, type of reading (standard or Hand Held sensor and Mode 4 or D), and presence of fiducial marker (in Auto and Wheel modes).

- 84** - Standard, Mode 4, channels 1, 2, 3, 4
- 68** - Standard, Mode D, channels 1, 2, 3, T
- 69** - Hand Held, Mode 4, channels 1, 2, 3, 4
- 70** - Hand Held, Mode D, channels 1, 2, 3, T
- 77** - Standard, Mode 4, channels 1, 2, 3, 4 Marker
- 78** - Standard, Mode D, channels 1, 2, 3, T Marker
- 80** - Hand Held, Mode 4, channels 1, 2, 3, 4 Marker
- 81** - Hand Held, Mode D, channels 1, 2, 3, T Marker

Above ASCII numbers are valid for EM61-MK2 #1. Following constants are added to each of these numbers to indicate other instruments in the array:

EM61-MK2 #1	0
EM61-MK2 #2	+32
EM61-MK2 #3	+128
EM61-MK2 #4	+160
EM61-MK2 #5	-64

Gn - one character parameter (Hex format), contains Gain, see table of ranges at the end of this section.

- 1h - higher byte of the 2's complement Hex number of Channel 1
- 1l - lower byte of Channel 1
- 2h - higher byte of the 2's complement Hex number of Channel 2
- 2l - lower byte of Channel 2
- 3h - higher byte of the 2's complement Hex number of Channel 3
- 3l - lower byte of Channel 3
- 4h - higher byte of the 2's complement Hex number of Channel 4
- 4l - lower byte of Channel 4
- 5h - higher byte of the 2's complement Hex number of TX current
- 5l - lower byte of TX current
- 6 - fraction of current (5h 5l), Hex number

Time - time stamp of the reading in milliseconds, this is time elapsed from the start (creation) of the current data. The time in milliseconds can be linked with the computer local time by using Times in lines B and Z of Line Header.

10 - Line Feed character

Other Records

Timer Reset

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

Indicates reset time of the timer. This record links timer in milliseconds and computer time (local time) in format HH:MM:SS.hh (introduced in ML61MK2 V1.20).

Comment

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
C	Comment (maximum 11 characters)												Time Stamp in milliseconds							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
S	New Station (Format 11.2)												Time Stamp in milliseconds							10	

GPS Data Message Records

Each GPS record (GGA or other type of message) is broken in to several 20 characters strings and placed in the ML61 data file which contains 22 characters records, including one character indicator and line feed at the end of each record. The GPS sequence starts at the line which contains the character @ as the first character, then records that contain a continuation of the same message start with the character #. The GPS sequence ends with a line starting with the character !. The last line contains a logger time stamp for the given GPS reading. A sample of the GPS message GGA written in ML61MK2 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	
@	\$	G	P	G	G	A	,	h	h	m	m	s	s	.	s	s	,	d	d	m	10	
#	m	.	m	m	m	m	m	,	s	,	d	d	d	m	m	.	m	m	m	m	10	
#	m	,	s	,	n	,	q	q	,	p	p	.	p	,	s	a	a	a	a	a	10	
#	.	a	a	,	u	,	+	x	x	x	x	.	x	,	M	,	s	s	s	,	10	
#	a	a	a	*	c	c	CR	LF													10	
!																					Time Stamp in milliseconds	10

The GPS sequence may contain 4 to 7 records. The components of the GGA message may differ in length, however they are placed in the same number of columns. Other available GPS messages in NMEA format are recorded similarly. The structure of all used NMEA sentences is given in ML61MK2 manual (Appendix B).

A.2 Conversion Factors

EM61-MK2 has four channels. Channels 1, 2, and 3 are common for Mode 4 and Mode D. Channel 4 in Mode D is named Channel T (it corresponds to Top coil).

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

- Channel 1 to 4 - converted data
- DATA1 (to 4) - instrument output for each channel as recorded in logger
- RANGE - range is controlled by the EM61-MK2, it can be 1, 10, 100

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

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

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

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

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

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

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

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

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

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

if coil is 1 x 0.5 m Channel T is further multiplied by a factor 1.117.

Hand Held Unit - Mode 4 (One Sensor)

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

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

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

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

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

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

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

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

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

Further each channel is normalized by current following formula:

Standard Unit Channel = Channel x 3000/Current

Hand Held Unit Channel = Channel x 1800/Current

where, current is a value represented by **5h**, **5l**, and **6** in reading record of ML61MK2 data file (see section A.1)

Table of Ranges Determined by the EM61-MK2 Microprocessor

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

A.3 Example of ML61 Data File

The ML61MK2 data file records are written in binary (ML61MK2) format, therefore characters may have a different shape when displayed or printed, depending on particular video or printer settings.

```
ML61MK2 V105GPS000
H 072822B 0.200
G 1.500 0.000 41010
O 238.61
O 121.36
O 69.11
O 25.58
O 236.30
O 120.38
O 68.26
O 25.40
O 236.28
O 120.41
O 68.49
O 25.43
O 0.00
O 0.00
O 0.00
O 0.00
L11
B 0.00 00039397
AW 1.000
Z07282001 22:50:21
E.-%û 7)JD00155485
@$PGGA,025847.00,433
#6.59374,N,07936.6498
#3,W,2.6,2,135.50,M,-
#35,M,5,119*55
! 00155503
@$PGSA,A,3,31,28,27,
#01,,,,,13,03,03.6,
#02.0,03.0*0B
! 00155503
e. !%
-^A00155675
+.%nn]400155730
s. !%3 *^Q00155785
E. !%â L)JG00155841
e. !%n ^+^I00155896
+.%V 8+J]500155951
s. !%$2 !s^L00156006
E. +%?JB00156090
e. +%| E8^F00156145
+.%o L-]700156201
s.-%d 7-^000156256
E.-%eJC00156336
e. +%N I=-^A00156391
+.%o Us] )00156446
s.-%û a!^A00156501
@$PGGA,025848.00,433
#6.59374,N,07936.6498
#5,W,2.6,2,135.60,M,-
#35,M,6,119*5C
! 00156502
@$PGSA,A,3,31,28,27,
#01,,,,,13,03,03.6,
#02.0,03.0*0B
! 00156502
E. +%# 12J800156681
e. !%fd^400156736
```

A.4 Format of GXY Data File

The ML61MK2 data files with extension GXY contain GPS records. The structure of this file is identical to N61 file. The difference is that it does not contain EM61-MK2 records. This file is created by ML61MK2 when number of EM61s in an array is set to zero, and the program acts as a GPS logging program.

File Formats

B

B.1 Description of Geonics DAT61MK2 (M61) File Format

A DAT61MK2 (with extension name M61) 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.

File Header starts and ends by a double line separators and it contains three lines, as shown below:

```
===== EM61MK2 FILE HEADER =====  
EM61MK2 V1.00 GPS U I M  
FileName TimeI  
Channel 1 Channel 2 Channel 3 Channel 4  
=====
```

First line contains following parameters:

- | | | |
|-------------|---|---|
| EM61MK2 | - | identification of program file |
| V120 | - | version number (V1.20) |
| Survey Type | - | GPS (if GPS Input Enabled) or GRD (grid) |
| U | - | unit type (0 = meters, 1 = feet) |
| I | - | instrument type
(0 = sensor 1x0.5m, 1 = 1x1m, 2 = 0.5x0.5m,
3 = HH61) |
| M | - | instrument mode (0 = Auto, 1 = Wheel, and
2 = Manual) |

Second Line contains file name and time increment if Auto Mode was used:

- | | | |
|----------------|---|--|
| File Name | - | file name, maximum 8 characters |
| Time Increment | - | time increment (if Auto Mode was used) in
seconds |

The last line of file header contains offsets for each channel that were used during data acquisition:

Offsets - four values for channel 1, 2, 3, and 4 respectively.

Line Header contains four lines, each line starts with identifier **id** as shown below:

```
L LineName FileName GPS U I M  
B Start  
A D StationIncrement  
Z Date Time
```

The first line of Line Header starts with L and contains:

Line Name - line name, maximum 8 characters
File Name - file name, maximum 8 characters (original file for this line)
Survey Type - GPS (if GPS Input Enabled) or GRD (grid)
U - unit type (0 = meters, 1 = feet)
I - instrument type
(0 = sensor 1x0.5m, 1 = 1x1m, 2 = 0.5x0.5m, 3 = HH61)
M - instrument mode (0 = Auto, 1 = Wheel, and 2 = Manual)

Second line starts with B and contains Start Station for the Line, format F11.2

The third line starts with A and contains:

Dir - Direction of the Line (E, W, N, or S)
Station Inc. - Station Increment, format F11.3

The fourth line starts with Z and includes:

Date - Date when Line was created, format MM-DD-YYYY
Time - Time when Line was created, format HH:MM:SS

Each reading starts with indicator **id** specifying type of the data. The indicator is followed by six columns: Station, Channel 1, Channel 2, Channel 3, Channel 4 or T, and Time Stamp.

id	-	indicator T, D, E, F, M, N, P, or Q. Each record representing reading starts with one of the following character, which indicates type of reading:	
T	-	Standard, Mode 4,	channels 1, 2, 3, 4
D	-	Standard, Mode D,	channels 1, 2, 3, T
E	-	Hand Held, Mode 4,	channels 1, 2, 3, 4
F	-	Hand Held, Mode D,	channels 1, 2, 3, T
M	-	Standard, Mode 4,	channels 1, 2, 3, 4 +Marker
N	-	Standard, Mode D,	channels 1, 2, 3, T +Marker
P	-	Hand Held, Mode 4,	channels 1, 2, 3, 4 +Marker
Q	-	Hand Held, Mode D,	channels 1, 2, 3, T +Marker

Reading containing GPS data starts with character @. This character is followed by eight columns separated by commas.

Column 1	-	UTC time in hours, minutes, seconds of the GPS position
Column 2	-	Latitude (ddmm.mmmmm) in degrees, minutes, and decimal minutes
Column 3	-	N or for North and South latitude
Column 4	-	Longitude (dddmm.mmmmm) in degrees, minutes, and decimal minutes
Column 5	-	N or for North and South longitude
Column 6	-	Quality indicator, 0 = no position, 1 = raw, 2 = differentially corrected position
Column 7	-	Number of satellites used in position computation
Column 8	-	Field computer time

For more informations regarding GPS parameters refer to Appendix B of the ML61MK2 manual.

Example of DAT61MK2 File

```
=====EM61MK2 FILE HEADER=====
EM61MK2 V1.20 GPS 0 2 0
022623A_1 0.250
-1087.69 -707.90 -378.35 -168.02
=====
L 102 022623A GPS 0 2 0
B 332.00 0
AW 1.000
Z 02/26/2002 23:59:03
@,051101.00,4336.59257,N,07936.65004,W,2,8,2,23:59:04.378
E 332.00 102.65 112.36 81.00 71.76 23:59:04.566
E 333.00 112.24 107.84 71.14 67.23 23:59:04.870
E 334.00 135.44 114.72 80.37 70.85 23:59:05.171
@,051102.00,4336.59257,N,07936.65005,W,2,8,2,23:59:05.378
E 335.00 138.67 102.66 85.52 63.74 23:59:05.504
E 336.00 127.49 120.12 84.50 71.75 23:59:05.955
E 337.00 110.63 133.76 100.53 71.45 23:59:06.245
@,051103.00,4336.59257,N,07936.65008,W,2,8,2,23:59:06.370
E 338.00 115.39 128.53 75.45 76.12 23:59:06.561
E 339.00 120.10 102.35 99.17 65.99 23:59:06.812
E 340.00 113.46 138.90 93.98 70.52 23:59:07.113
E 341.00 114.28 130.08 81.69 66.59 23:59:07.415
@,051104.00,4336.59255,N,07936.65006,W,2,8,2,23:59:07.419
E 342.00 116.97 136.68 75.19 72.02 23:59:07.704
E 343.00 123.37 103.47 87.65 74.59 23:59:08.007
E 344.00 103.80 106.45 75.66 82.90 23:59:08.313
@,051105.00,4336.59250,N,07936.65008,W,2,8,2,23:59:08.379
E 345.00 133.68 113.31 89.55 63.24 23:59:08.613
E 346.00 122.31 108.70 79.38 92.57 23:59:08.874
E 347.00 123.32 103.15 84.96 77.44 23:59:09.164
@,051106.00,4336.59248,N,07936.65009,W,2,8,2,23:59:09.378
E 348.00 111.04 112.19 72.24 59.90 23:59:09.563
E 349.00 152.32 107.07 84.50 68.20 23:59:09.855
E 350.00 128.25 116.60 84.48 77.73 23:59:10.154
@,051107.00,4336.59250,N,07936.65000,W,2,8,2,23:59:10.377
E 351.00 123.58 108.23 79.79 60.93 23:59:10.554
E 352.00 112.02 117.47 87.28 56.54 23:59:10.805
E 353.00 127.77 90.24 84.32 66.51 23:59:11.202
@,051108.00,4336.59250,N,07936.65001,W,2,8,2,23:59:11.379
E 354.00 118.30 94.10 75.16 82.39 23:59:11.560
E 355.00 143.09 93.08 97.17 74.82 23:59:11.862
E 356.00 124.63 118.26 79.18 64.83 23:59:12.152
@,051109.00,4336.59251,N,07936.65002,W,2,8,2,23:59:12.380
E 357.00 134.12 120.75 65.24 64.21 23:59:12.551
```

B.2 Description of ML61MK2 File in ASCII Format

The ML61MK2 data file converted to ASCII format is similar to file in DAT61MK2 however it contains additional information related to multiple instruments which is not supported by DAT61MK2 format. The format of the file is self explanatory.

The file starts with a header block, which starts with the line **ML61MK2 File Header** and it ends with line **End of file header**. The file header includes: ML61MK2 version number, type of positioning, distance units, sensor type, survey mode, name of data file (as entered during the survey), number of EM61-MK2s in array, GPS Antenna location, GPS NMEA message type, sensor separation, and offsets for all instruments.

The file contains at least one survey line (even if survey lines are not used with GPS positioning). Each survey line starts with a Line Header Block. The Line Header Block contains four lines describing: survey line name, start station, station increment, date (MM/DD/YYYY) and time (HH:MM:SS) of line creation.

Lines containing readings start with digits 1, 2, 3, 4, or 5. These lines are identical to the records described in former section B.1 (Geonics DAT61MK2 format) with one exception. Each line starts with a number identifying number of the instrument in the array. It is followed by one of the reading indicators: T, D, E, F, M, N, P, and Q. These reading indicators are described in section B.1 of this Appendix. Reading identifier is followed by six columns: station number, Channel 1, Channel 2, Channel 3, Channel 4 (or T), and local time stamp (format HH:MM:SS.ttt).

Line that starts with C corresponds to field comment, and line that starts with S indicates entry of New Station.

GPS data consists of one or two lines starting with GP and GQ. Line containing GP is always present and it contains position, while line starting with GQ corresponds to quality of GPS reading.

Line that starts with GP contains position, UTC time, and local time. If Geodetic Coordinates were selected the position is indicated by Latitude and Longitude. In case when UTM coordinates were selected the position is described by UTM Zone number, Easting and Northing (see example of the file below). The second line that starts with GQ describes quality of GPS position and its contents depends on the NMEA message used during the survey. In the example of the file GQ statement is given for NMEA message pair GGA/GSA and contains: Position Quality, status of differential corrections, and index PDOP. For other NMEA messages contents of line starting with GQ may differ.

Example of ML61MK2 file in ASCII format

```
ML61MK2 File Header Version V1.20
Positioning: GPS           Distance units: meters
Sensor Type: 1 x 1 m      Survey Mode   : Auto
Data File   : 022620F.N61
# of EM61s  : 3
GPS Antenna: 0.500       GPS Message  : GGA/GSA
Sensor Sep.: 0.000
Offsets:
  EM61 #1 Ch1:    0.00 Ch2:    0.00 Ch3:    0.00 Ch4:    0.00
  EM61 #2 Ch1:    0.00 Ch2:    0.00 Ch3:    0.00 Ch4:    0.00
  EM61 #3 Ch1:    0.00 Ch2:    0.00 Ch3:    0.00 Ch4:    0.00
End of file header
```

```
Survey Line      : 105
Start Station    : 53.00
Station Increment: -1.000
Date: 02/26/2002 Time: 20:50:40
1E 49.000 1186.01 725.21 407.06 179.19 20:50:46.643
2E 49.000 1179.08 721.86 410.87 181.08 20:50:46.699
3E 49.000 1174.10 727.52 417.99 183.41 20:50:46.752
GP,17, 612102.277,W, 4829483.020,N, 18:05:05.00 20:50:46.758
GQ Position: 3D Differential PDOP: 01.8 20:50:46.758
1E 48.000 1169.10 723.72 410.59 179.52 20:50:46.904
2E 48.000 1167.72 714.18 406.70 173.62 20:50:46.960
3E 48.000 1162.92 713.93 405.96 166.12 20:50:47.014
1E 47.000 1163.17 710.31 405.51 152.71 20:50:47.111
2E 47.000 1159.52 707.55 405.44 151.41 20:50:47.165
3E 47.000 1153.98 703.79 399.81 152.64 20:50:47.222
1E 46.000 1159.86 713.74 398.40 152.88 20:50:47.304
2E 46.000 1157.48 716.17 397.36 158.24 20:50:47.359
3E 46.000 1151.67 711.71 395.67 145.67 20:50:47.414
1E 45.000 1148.37 710.80 397.76 141.29 20:50:47.500
2E 45.000 1144.35 706.15 394.17 147.77 20:50:47.555
3E 45.000 1143.18 706.38 391.82 149.31 20:50:47.610
1E 44.000 1149.54 719.32 392.64 148.11 20:50:47.707
2E 44.000 1155.26 720.80 391.63 150.00 20:50:47.762
GP,17, 612102.346,W, 4829482.965,N, 18:05:06.00 20:50:47.769
GQ Position: 3D Differential PDOP: 01.8 20:50:47.769
3E 44.000 1141.38 717.13 397.79 156.93 20:50:47.899
1E 43.000 1146.27 718.18 393.71 159.07 20:50:47.953
2E 43.000 1148.93 720.21 393.00 159.36 20:50:48.009
3E 43.000 1142.12 723.92 392.88 154.86 20:50:48.063
1E 42.000 1137.52 723.57 392.97 152.56 20:50:48.144
2E 42.000 1143.68 721.66 393.97 156.19 20:50:48.199
3E 42.000 1157.11 711.56 397.16 155.35 20:50:48.255
1E 41.000 1172.90 712.36 391.82 156.22 20:50:48.351
2E 41.000 1182.34 713.96 393.14 154.45 20:50:48.406
3E 41.000 1174.96 713.32 395.05 156.63 20:50:48.461
```

1E	40.000	1161.41	723.24	397.72	159.41	20:50:48.543
2E	40.000	1159.63	730.28	395.83	159.22	20:50:48.597
3E	40.000	1159.20	733.04	391.76	160.12	20:50:48.653
1E	39.000	1150.46	726.41	388.24	164.33	20:50:48.750
GP,17, 612102.331,W, 4829483.002,N, 18:05:07.00 20:50:48.758						
GQ Position: 3D Differential PDOP: 01.8 20:50:48.758						
Survey Line : 106						
Start Station : -9.00						
Station Increment: 1.000						
Date: 02/26/2002 Time: 20:52:06						
1E	-9.000	1148.49	740.68	414.94	173.29	20:52:08.589
2E	-9.000	1159.29	737.89	417.21	177.55	20:52:08.644
3E	-9.000	1162.81	732.77	409.63	178.50	20:52:08.699
GP,17, 612101.741,W, 4829482.085,N, 18:06:27.00 20:52:08.703						
GQ Position: 3D Differential PDOP: 02.1 20:52:08.703						
1E	-8.000	1171.84	752.50	407.79	175.67	20:52:08.879
2E	-8.000	1171.28	755.01	403.45	175.48	20:52:08.933
3E	-8.000	1173.09	752.11	396.08	178.97	20:52:08.989
1E	-7.000	1168.36	751.74	394.37	181.08	20:52:09.068
2E	-7.000	1171.83	749.00	400.36	178.50	20:52:09.125
3E	-7.000	1170.04	748.79	404.10	168.02	20:52:09.178
1E	-6.000	1155.42	752.25	408.13	168.22	20:52:09.274
2E	-6.000	1146.44	747.00	405.38	172.95	20:52:09.329
3E	-6.000	1147.97	746.93	405.42	175.82	20:52:09.385
3E	-6.000	1175.00	744.31	405.01	177.89	20:52:09.578
1E	-5.000	1168.20	729.01	410.05	178.38	20:52:09.674
2E	-5.000	1168.58	719.00	405.72	178.83	20:52:09.728

B.3 ML61MK2 GXY File in ASCII Format

The GXY type of file while converted to ASCII format with extension name DAT consists of coordinates in UTM or Geodetic format. While in UTM format Easting coordinate is located in the first column and Northing in the second column. If Geodetic format was selected then Longitude is written in the first column and Latitude in the second column. Optionally the file may include GPS UTC time and text of field comments.

Example of GXY file in ASCII format (UTM coordinates)

```
612102.229 4829484.278 01:59:17.00
612102.255 4829484.352 01:59:18.00
612102.241 4829484.389 01:59:19.00
612102.349 4829484.391 01:59:20.00
612102.268 4829484.408 01:59:21.00
Comment: "Stake#1"
612102.578 4829484.339 01:59:32.00
612102.564 4829484.376 01:59:33.00
612102.578 4829484.339 01:59:34.00
612102.579 4829484.284 01:59:35.00
612102.718 4829484.045 01:59:36.00
Comment: "WE corner"
612102.730 4829484.101 01:59:53.00
612102.784 4829484.121 01:59:54.00
612102.853 4829483.992 01:59:55.00
612102.813 4829483.973 01:59:56.00
```

Example of GXY file in ASCII format (Geodetic coordinates)

```
-79.610841500 43.609900500 01:59:17.00
-79.610841167 43.609901167 01:59:18.00
-79.610841333 43.609901500 01:59:19.00
-79.610840000 43.609901500 01:59:20.00
-79.610841000 43.609901667 01:59:21.00
Comment: "Stake#1"
-79.610837167 43.609901000 01:59:32.00
-79.610837333 43.609901333 01:59:33.00
-79.610837167 43.609901000 01:59:34.00
-79.610837167 43.609900500 01:59:35.00
-79.610835500 43.609898333 01:59:36.00
Comment: "WE corner"
-79.610835333 43.609898833 01:59:53.00
```

B.4 Retrieved and Positioned Field Comments

File containing retrieved and positioned comments starts with a header indicating name of the original ML61MK2 data file. This is followed by coordinates and text of comment enclosed in double quotes. Coordinates can be written in UTM or Geodetic format. Column one includes Easting or Longitude, and second column contains Northing or Latitude. The optional, fourth column of the file includes local time.

Example of file containing positioned comments (Geodetic coordinates)

```
Comments in Data File : 022618A.L61
-79.610851833    43.609890333  "Stake#1"      18:37:50.934
-79.610850500    43.609890167  "Stake#2"      18:39:12.182
-79.610833500    43.609879500  "Stake#3"      18:39:38.834
-79.610833500    43.609879500  "Stake#4"      18:39:49.976
-79.610833500    43.609879500  "Stake#5"      18:39:57.637
-79.610835167    43.609885833  "Stak#10"     18:57:22.838
```

File Transfer Using Lynx



Programs ProShell and Lynx

Two programs, ProLink and Lynx, are supplied with the Pro4000 system and can be used to transfer files between the Pro4000 and a desktop Windows based computer.

The program ProLink is factory installed in the Pro4000 ROM (drive A:). When ProShell is run (type PS to run ProShell in Pro4000) ProLink is automatically initiated.

Lynx runs on computers equipped with Windows 95 or higher. To install Lynx, insert the Pro4000 Setup disk (Utility disk #1) into drive A: on your computer and run the Setup program. The Lynx icon will appear on your desktop after installation is complete. When Lynx is started two Windows Explorer type screens will be displayed. The top screen, labeled Local, displays the contents of the PC. The bottom screen, labeled Remote, displays the contents of the Pro4000 assuming a connection is established. Several file management functions can be performed using Lynx, including File Transfer, renaming folders, creating new folders or sub-folders, and deleting files.

Establishing Communication

To transfer data to and from a base computer, attach the cable (null modem serial communication cable) between the Pro4000 and the computer COM ports. Run ProShell on the Pro4000 (type command PS to run ProShell) and Lynx on the PC computer.

Correct communication ports must be selected on both computers. To set up the serial port on the PC, from Lynx select the **Transfer/Select COM Port** menu option. To set up the communication port on the Pro4000, press <F5>(Xfer) from main screen of ProShell, and then press <F1> to toggle between ports COM1 and COM2.

Juniper Systems recommends that the Pro4000 is in auto baud rate detection mode (the default setting). In this mode, the Pro4000 tries to establish communication at 115K baud, and in case communication fails at this rate, it automatically steps down to the next slowest rate until communication is established.

To start communication click on the **Connect** button (the green circulating arrows in the centre tool bar) or select the Transfer/Connect to Remote menu option from Lynx. When connection is established the contents of the Pro4000 Field Computer will be displayed in the Lynx bottom Remote view screen.

Transferring Files to the Pro4000 from the PC

Select the folder in the Remote view screen. Transferred files will be saved in this folder.

In the Local view screen select files to be transferred to the Pro4000.

Click the Down arrow button or select Transfer/Send to Remote from the main menu. File transfer starts immediately. In cases where the selected file exists in the logger the program will prompt for permission to overwrite.

Transferring Files from the Pro4000 to the PC

Select the folder in the Local view screen. Transferred files will be saved in this folder.

In the Remote view screen select files to be transferred to the PC.

Click the Up arrow button or select Transfer/Receive from Remote from the main menu. File transfer starts immediately. If selected files exist in the selected folder in the PC the program will prompt for permission to overwrite.

Disconnecting

When the transferring session is finished click the Disconnect button before disconnecting the serial cable. Otherwise, the Esc key must be pressed on the logger to return the Pro4000 to normal function.

Please refer to Pro4000 Field Computer User's Manual (Section 5) for more detailed description of ProShell and Lynx functions.