

OPERATING INSTRUCTIONS

EM38pro DATA LOGGING SYSTEM
FOR FIELD COMPUTER Pro4000

EM38pro

Version 1.02

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1. Introduction

The Geonics EM38pro Data Logging System (DL4000/38) consists of a field computer Pro4000, data logging program EM38pro, and associated cable to connect the Polycorder to the Geonics EM38RT instrument. The program EM38pro is designed for the Pro4000 field computer, although, if necessary it can be used with any other IBM compatible computer running a MS DOS operating system and equipped with serial port. (i.e. Allegro Field PC.) The only disadvantage of using a standard laptop computer, will be small size of the display which is limited for the Pro4000. This documentation describes the use of the EM38pro program used with the Pro4000 field computer, and the Geonics EM38RT.

The program EM38pro records data together with a time stamp at each station. Data files created with this program can be used to position a survey according to locations recorded separately by a Global Positioning System (GPS).

The EM38pro will also accept NMEA-0183 compatible data from a GPS receiver directly connected to a Pro4000 field computer. GPS data which are embedded in the EM38pro data file can be processed later in the Geonics DAT38W program. The connected GPS must be able to stream NMEA-0183 compatible messages. The EM38pro uses two NMEA messages GGA and GSA. While message GGA is mandatory, the GSA string is used only to provide information related to the GPS signal quality.

Program EM38pro acquires and records survey data from the EM38RT system, under the control of the operator. It also records various field information such as survey line number (line name), starting station, increment, comments, etc. Readings can be displayed in text or graphic mode. Readings are displayed in real time in mS/m or ppt. In addition, the program allows you to monitor the instrument output while data are not recorded. The EM38pro also continuously monitors the EM38 measured component (Conductivity or Inphase), dipole mode (Vertical or Horizontal), instrument scale (100 or 1000), and state of fiducial marker without leaving the program.

The program allows the user to set the EM38pro into a specific instrument mode of operation: AUTO, Wheel, or Manual modes. In AUTO mode readings can be automatically recorded in desired time intervals. In Wheel mode readings are triggered by a counter installed at the wheel assembly, and in MANUAL mode readings are triggered manually by the operator. In AUTO and Wheel modes the program can record one combination of the EM38 component (Conductivity or Inphase) and dipole mode (Vertical or Horizontal) per station. In Manual mode any combination of components and dipole modes can be taken at each station, and data can be averaged at up to 99 samples per reading.

Survey setup parameters are saved in a file, therefore they can be automatically used during subsequent data collection sessions. In addition, ten preset survey setups are provided. These setups are user selectable, they can be edited and saved for future use.

In addition to logging EM38pro data, the EM38pro provides data file management tasks. The program allows you to upload data files to a PC running the DAT38W program. It also has options allowing viewing and deleting data files. Data files are always saved to the programs current directory. Data file names, which can be set by the program based on the computer clock or they are user specified, have extension names R38.

Over 350,000 readings can be collected in the field computer Pro4000 with the standard memory of 8 Mb. The maximum speed of data collection is approximately 10 readings per second in text mode, and 9 readings per second in graphic display mode. In graphic display mode, the profile containing the last 84 (or 140 in Allegro) data readings for each channel is displayed.

2. Program Requirements

To successfully use this software, you will need :

Computer

Field computer Pro4000 or Allegro

or alternatively:

- IBM PC and compatibles,
- Minimum 640 Kbytes of available memory,
- DOS 3.1 or higher,
- Floppy drive or other mean to transfer files,
- CGA graphics capability,
- One Serial Port
- optionally, Two Serial Ports if directly connected GPS system is to be used.

Geonics EM61MK2

The EM38RT instrument with associated cables.

2.1 Contents of EM38pro disk

The program EM38pro is stored on one 3.5" floppy disk. All necessary initial files (with extension names .INI) are created in your computer after the program is run for the first time. Check that the file EM38pro.EXE is included on the floppy disk.

3. Installing EM38pro

While using the Pro4000, Allegro, or other field computer which is not equipped with a floppy drive disk, the EM38pro.EXE file should be transferred from a PC computer using software and serial cable provided by manufacturer.

On other computers the EM38pro program can be installed by copying the EM38pro.EXE file to a directory on your hard disk. This can be performed by using Windows Explorer or at DOS prompt (described below). It is assumed that A: indicates floppy drive, and C: indicates hard disk drive.

A directory (i.e. EM38) can be created with the command MD from DOS.

C:\MD EM38

In order to access directory EM38, type:

C:\CD EM38

Once in EM38 directory the EM38pro.EXE file can be copied from the distribution disk.

C:\EM38\COPY A:EM38pro.EXE

After you run the program for the first time it will create permanent initial files EM38pro.INI, SURVEY0.INI, SURVEY1.INI, etc. which contain some of the program settings. If the above files do not exist on the default drive they will be created with default parameters during the first execution of the program.

The EM38pro data files with extension name R61 will be created in the program current directory.

4. Running EM38pro Program

The EM38pro is a menu-driven program designed to be simple to use.

Most of the menus contains (from the top):

- name of the menu,
- informative window (instrument type, file name, etc.),
- list of options and parameters,
- list of available commands.

Menu selections are made using the **Up/Down** arrow keys. The selected option is highlighted and can be executed by pressing **<ENTER>** key.

Left and **Right** arrow keys are used to edit selected parameter. When editing **Up** or **Down** arrow keys can be used to exit current parameter.

The carriage return key is described as **<ENTER>**, **<CR>**, or symbol. Where permitted by the program, the **<Esc>** key is used to quit the current menu and return to the former one.

In general, settings for most menus can be saved by the function key **F1**. The function key **F2** is used to cancel editing and to return to former settings.

While using the Pro4000 field computer the program can be started from the ProShell utility program by selecting its name. Otherwise, the program is started from a copy on the working disk, by entering the name EM38pro in response to the DOS prompt, i.e.:

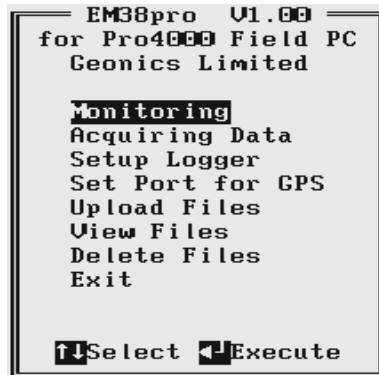
C:\EM38\EM38pro <CR>

While using the Pro4000 ProShell DOS utility or FileScout DOS File Manager in Allegro Field PC, the computer system will prompt for parameters. Since there is no parameters required press simply **<ENTER>** key.

After name EM38pro is entered, the menu, presented in the next section and afterwards called MAIN MENU, is displayed.

5. Main Menu

The Main Menu appears always as the first menu after the program is started. It contains the name of the program, its version number, and list of available options. The EM38pro Main Menu is displayed below.



These options are selected by using the **Down** and **Up** arrow keys. Use **<ENTER>** to execute the highlighted item. Short description for each of the options follows.

5.1 Short description of Main menu options

Monitoring

This option allows to monitor the EM38 instrument output.

Acquiring Data

Executing this option leads to the Data Acquiring Menu which allows to set up survey options and logging parameters.

Setup Logger

Menu that is associated with this option is used to set the date and time of the computer, audio click, serial port number, type of pause key, and type of display (text or graphic).

Set Port for GPS

This menu allows to disable and enable GPS data acquisition. This menu is also used to set the serial port number used for GPS input, and to specify necessary serial port communication settings.

Upload Files

This option allows to upload recorded data files to a PC computer running DAT38W program.

View Files

The program will display list of available data files that can be reviewed.

Delete Files

This option allows to delete permanently not needed data files from the field computer disk.

Exit

Selecting this option will terminate the program execution.

6. Monitoring

The Monitoring menu allows initial inspection of the range of the instrument readings at the particular site, monitoring the instrument performance, and quick inspection of the instrument settings.

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



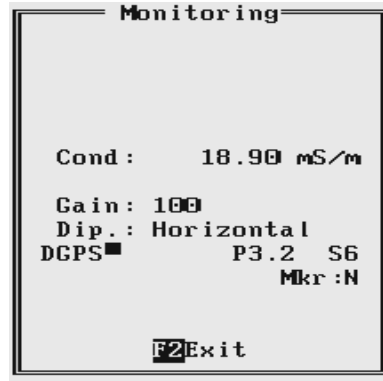
Check the connection or turn the instrument ON and select the Monitoring option again.

Assuming that the instrument works properly the program will display Monitoring menu and will start displaying instrument readings. At this stage the layout of the Monitoring menu is as follows:



The EM38 readings are updated approximately 10 times per second during monitoring session. If **Quad-phase** was selected on the instrument panel values of conductivity in mS/m are displayed, and when **Inphase** was selected values of the measured Inphase component in ppt will be given. The dipole mode, instrument scale, and state of fiducial marker are continuously updated.

When GPS was Disabled in the Set Port for GPS menu a message GPS Disabled will be displayed. If the GPS port is Enabled and a working GPS system is connected to the field computer the Monitoring screen will display a few more parameters, as presented below.



In the above Figure one line of the display is dedicated to show the GPS status. A label **DGPS** (Differential Global Positioning System) indicates that GPS readings are differentially corrected in real time, while label **AGPS** (Autonomous Global Positioning System) indicates lack of differential correction. On the right side of **DGPS** or **AGPS** label small square is displayed. This square should move down and up with the frequency of GPS update rate (usually 1 second intervals). If the square is not moving for long periods of time it means that the GPS system is not working or that it is not connected to the field computer. The next label **P** with a value varying between 0 and 99.9 represents an index called Position Dilution of Precision (**PDOP**). The last label **S** and following number shows number of currently tracked satellites. Refer to section 9 (Set Port for GPS), Appendix A, and to GPS manuals for more information about GPS parameters.

To exit the Monitoring option press the function key **F2**.

7. Logger Setup Menu

This option allows you to set several parameters in the logger. The Logger Set Up menu is presented below.



Description of Parameters:

Date

This option allows you to change the date in the field computer clock. When the option is highlighted pressing the **ENTER**, or **Left** or **Right** arrow keys, enables editor that allows the operator to change day, month and year.



The new date is accepted (and set in the computer) after the function key **F1** is pressed. Use **Down** or **Up** arrow key to exit the editor and cancel any changes.

Time

This option allows you to change time of the day in the field computer clock. When this option is highlighted pressing the **ENTER**, or **Left** or **Right** arrow keys, enables editor that allows the operator to change hour, minute, and second.



The modified time is accepted (and set in the computer clock) after the function key **F1** is pressed.

Use **Down** or **Up** arrow key to exit the editor and cancel any changes.

Units

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

COM Port

The number of serial port that is assigned to the EM38RT. Available selections: COM1 and COM 2. The program default is COM1. Communication parameters for the selected serial port are set by the program, since the EM38RT operates only at Baud Rate (9600), Parity (N), Data Bits (8), and Bit Stop (1).

This port must be different than the port specified in the Set Port for GPS menu (see next), otherwise a message will be displayed and ports will have to be reassigned.

The serial port selected here is also used for uploading data files to the PC.

Audio

Two selections are available: **Yes** or **No**. The audible click will be generated at each reading when this option is enabled.

Pause key

Three selections are available: **Any key**, **Alt+F1**, and **Ctrl+F5**. This feature is used to pause data recording during logging session. Default setting **Any key** can be changed to one of the two key combinations for field conditions where a logger key can be accidentally pushed causing unwanted stop of data logging.

Display

This parameter specifies the display type during data collection. Two types of display can be selected: Text mode or Graphic mode.

In the text mode conductivity and Inphase data are displayed in digital form. This mode is recommended for instrument AUTO mode when the highest possible frequency of data collection is used. The same applies to Wheel mode since the data triggering can be accelerated at any given moment (while passing a curb, downhill, etc.).

The graphic mode allows to display profiles for any selected reading (combination of component and dipole mode) in real time as well as simultaneous display of readings in digital form for all measured data. When the Display Graphic is selected, four additional parameters are activated (see menu below).



Parameter **Cond V** (conductivity in vertical dipole mode), **Cond H** (conductivity in horizontal dipole mode), and similarly for Inphase component **Inph V** and **Inph H** allow you to enable (Yes) or disable (No) display of each type of reading separately.

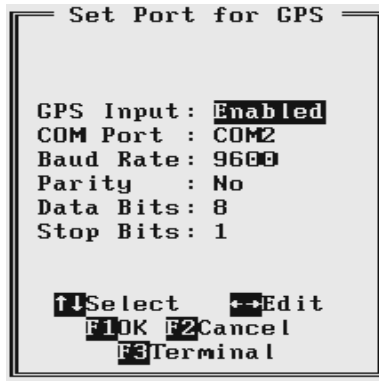
Regardless of which combinations are chosen, data for all types of readings will be displayed in digital form below profile display.

After all the parameters in the Logger Setup menu are updated press the function key **F1** to accept the displayed settings. The program will return to the Main menu.

To return to the original settings (state before this option was selected) press the function key **F2**. All parameters will be reset to the initial settings and the program will return to the Main menu.

8. Set Port for GPS Menu

After the Set Port for GPS option is selected in the Main Menu the Set Port for GPS menu appears on the screen. This menu allows you to enable and disable the GPS input, specify serial communication parameters matching GPS receiver settings, and to monitor the GPS output in terminal mode (key F3). The menu is presented below.



GPS Input

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

The GPS Input can be Enabled even if there is no GPS system connected to the Pro4000. In such case data file will contain proper sequence of EM38 readings without any GPS input.

COM Port

The number of serial port that is assigned to the GPS input. Available selections: COM1 and COM 2. The program default is COM2. Communication parameters for the selected serial port can be determined in options described below.

This port must be different than the port specified in the Logger Set Up menu (for EM38), otherwise a message will be displayed and ports will have to be reassigned.

Baud Rate

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

Parity

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

Data Bits

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

Stop Bits

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

After all the parameters in the Logger Setup menu are updated press the function key **F1** to accept the displayed settings. The program will return to the Main menu.

To return to the original settings (state before this option was selected) press the function key **F2**. All parameters will be reset to the initial settings and the program will return to the Main menu.

To activate terminal mode which allows you to monitor GPS receiver output press the function key **F3**. The monitoring mode will work regardless of the GPS Input being Enabled or Disabled. This option is described in the following section.

8.1 Monitoring GPS Receiver Output

After the function key F3 is pressed in Set Port for GPS menu the program will display the screen in terminal mode. In this mode the screen is divided into three parts. The top portion of the screen, labeled Receive GPS Data, displays the GPS receiver output. The middle portion labeled NMEA Command is used to enter NMEA commands to be sent to the GPS receiver, and at the bottom, the screen menu with available options is displayed. This screen is shown below.

```
Receive GPS Data
$GPGGA,031006.00,4336.
$GPGSA,A,3,,,20,11,,28
$GPGGA,031007.00,4336.
$GPGSA,A,3,,,20,11,,28
$GPGGA,031008.00,4336.
$GPGSA,A,3,,,20,11,,28
-----
NMEA Command
-----
F1Stop F2Send F3Exit
```

As soon as the EM38pro screen is in terminal mode and the GPS is streaming data, the first 20 characters of each message will appear in the top portion of the display. The display is updated with the frequency the GPS receiver outputs data. This allows you to recognize the GPS update rate and type of messages being sent by the connected GPS. In cases where the GPS data is not received by the logger a message NO DATA and current time will appear in the top window of the display, as shown below.

```
Receive GPS Data
NO DATA 23:14:28
NO DATA 23:14:34
NO DATA 23:14:40
NO DATA 23:14:46
-----
NMEA Command
-----
F1Stop F2Send F3Exit
```

The message NO DATA is normally updated with a rate of 6 seconds. This may indicate the following: serial port number not correctly specified in Set Port for GPS menu, GPS receiver not sending any data, and not working or not connected GPS receiver. If the message is updated more often than 6 seconds (i.e. every 1 or 2 seconds) or the display does not show legible characters, it is possible that the GPS is working correctly and is connected to the proper serial port, however communication parameters are not specified correctly. In most cases the Baud Rate or Parity must be adjusted.

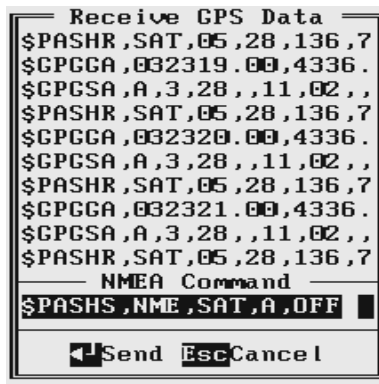
The NO DATA message may also appear if the GPS data are received correctly, but the GPS receiver was set to send data with a time interval longer than 6 seconds. In this case the NO DATA message will be displayed in between GPS messages. This indicates that the GPS is working correctly, however the operator should consider adjustment of the GPS receiver output update rate. Most high resolution geophysical surveys require positioning update of 1 or 2 seconds, and a 5 seconds interval can be used only when the survey is carried out at an even pace and along relatively straight survey lines.

The monitoring display can be stopped any time by pressing the function key **F1** (labeled **Stop**). At that time scrolling of the GPS output will be stopped, and the function key **F1** will be labeled **Go**. The next pressing of this key will activate receiving and display of GPS data.

8.2 Sending NMEA Messages to GPS Receiver

The function key F2 allows you to send a NMEA command to the GPS receiver. It is preferable if the GPS receiver parameters are set using the GPS manufacturer software or controller (GPS logger or panel keys). However, **when the operator is familiar with NMEA protocol and structure of commands for a given GPS system**, this function can be very convenient and useful when the update rate and enabling or disabling messages in the data stream is required.

After the function key **F2** is pressed the portion of the screen labeled NMEA Command is activated and the beginning of the standard NMEA command, **\$PASHS**, is displayed. After the entire NMEA command is typed in, press the key **<ENTER>** to send the command to the GPS receiver. Pressing the **<Esc>** key will cancel the command and deactivate the NMEA Command window. An example of a command that will remove the NMEA message **SAT** is given in the below figure (it is assumed that the GPS receiver output serial port is A).

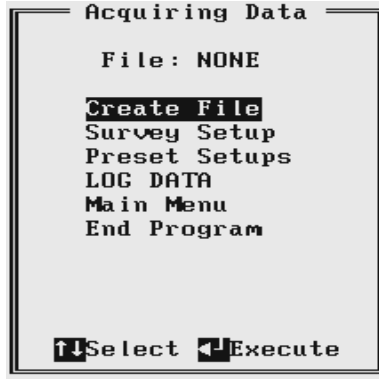


After this command is received by the GPS receiver, the confirmation message will be sent by the receiver (\$PASHR, ACK*3D) and data stream will not contain the message SAT (\$PASHR, SAT,.... in the above figure).

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

9. Acquiring Data Menu and Logging

After the Acquiring Data option is selected in the Main Menu the Acquiring Data menu appears on the screen. This menu is presented below.



At the top of the screen the current name of the data file is displayed. If data file is not created its name is displayed as NONE. The menu contains several options listed below.

Create File

This option creates data file.

Survey Setup

The Survey Setup menu will be displayed. Instrument mode and survey settings can be specified in this menu.

Preset Setups

List of 10 predesigned survey setups will be displayed. Each survey setup can be edited and saved by the user for later use.

LOG DATA

This option is used for actual monitoring and logging EM38 data.

Main Menu

The program returns to the EM38pro Main Menu.

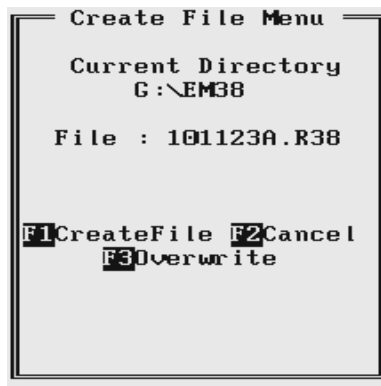
End Program

Executing this option will end the program.

9.1 Create File Menu

The Create File option can be executed before or after the Survey Setup parameters are specified.

The log file is created in the current directory (containing the EM38pro program). The name of the file is given by the field computer clock and it consists of month (2 digits), day (2 digits), hour (2 digits), and one alphabetic character A, B, C, etc. (If all letters during one hour are used use the Overwrite option). The Create File menu is presented below.



The file can be created by pressing the function key **F1**, this option can be skipped by pressing the function key **F2**, or by pressing key **F3** the file name can be overwritten. After key **F3** is pressed the Create File menu will be displayed as follows.



Each data file in the field computer (raw data file) has an extension name R38 and it is created in the programs current directory. The R38 files are created in the instrument binary format. They can be viewed using the Main menu option “View Files”. These files can be also converted to ASCII format and processed in the Geonics program DAT38W and DAT38 (for DOS).

9.2 Survey Setup Menu

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



To select any option use the **Down** and **Up** keys. To start the editing of any setting press **Left** or **Right** key. Some parameters that have only a few possible options (e.g. EM38 Mode) can be simply toggled by **Left** or **Right** keys.

Description of the Survey Setup menu options and parameters.

EM38 Mode

Set the EM38 mode of operation by pressing **Left** or **Right** arrow keys. Available modes are: Auto, Wheel, and Manual. These modes of operation are described below.

Auto Mode

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

In Auto Mode only one component (conductivity or Inphase) and one dipole mode (Vertical or Horizontal) can be selected.

Please note that when Auto mode is selected, parameter Wheel Inc. or Samp/Rdg are not available, see figure above. At the same time the Stn Incr (station increment) has only two options: Positive or Negative.

Wheel Mode

This mode is available only if the system is equipped with adapted (i.e. EM61) wheels.

Readings will be triggered automatically by a counter attached to the wheel.

In Wheel Mode only one component (conductivity or Inphase) and one dipole mode (Vertical or Horizontal) can be selected.

Please note that when Wheel mode is selected the option Reading/s or Samp/Rdg are not available, see figure below. At the same time the station increment (Stn Incr) has only two options: Positive or Negative.



Manual Mode

Readings will be taken only while the manual trigger (switch on the instrument consol or a handle) is pressed.

In Manual Mode any combination of components (conductivity and Inphase) and dipole modes (Vertical and Horizontal) can be selected.

Please note that when Manual mode is selected options Wheel Inc. and Reading/s are not available. In this mode any value can be entered for the station increment (Stn Incr) parameter.



Readings/s

When this option is highlighted the editor is activated and you can enter desired value. The editor accepts only numerical values.

This parameter describes number of readings per second that will be taken. Any number larger than zero can be entered, however the EM38 maximum frequency of data output is 10 readings per second.

At high frequencies (above 5 readings per second) obtained frequency may slightly differ from the specified rate, however speed of data collection will be consistent for a given field computer. The real speed of data collection (in Auto mode) depends on the field computer used and display type. In general, displaying data in the text mode allows for faster data collection and while using fast computers the difference between specified and obtained frequency is very small.

This parameter is displayed only when the Auto Mode was selected.

Use **Down** or **Up** arrow key to leave editor.

Wheel Inc.

When this option is highlighted the editor is activated and you can enter desired value. The editor accepts only numerical values.

In case the EM61 or EM61-MK2 wheel assembly is adopted to EM38 system a wheel increment is approximately 20 cm (or 0.64 feet). If the Hand Held EM61-MK2 wheels are used then two wheel increments 0.1 and 0.2 m are available. Check the wheel increment setting on the antenna assembly.

This option is displayed only when the Wheel mode was selected.

Use **Down** or **Up** arrow key to leave editor.

Samp/Rdg (Samples per Reading)

When this option is highlighted the editor is activated and you can enter desired value. The editor accepts only numerical positive values.

This parameter describes number of readings that will be taken after the trigger switch is pressed. At the end of sampling time the logger will beep and an average value will be written in to the file and plotted on the screen. During the sampling period interval data are measured at approximately 10 readings per second. For example by specifying 10 samples, 1 second will be used at each station. The maximal sampling is 99 readings which corresponds to approximately 10 seconds at each station.

This option could be used to improve quality of data in areas of high industrial noise, especially if the ground conductivity is relatively low (small response signal).

In cases when multiple sampling is not required (good signal to noise ratio) enter the value **0** or **1** and 1 reading per station will be taken.

This parameter is displayed only when the Manual Mode was selected.

Use **Down** or **Up** arrow key to leave editor.

Component

When this option is highlighted press **Left** or **Right** to toggle between two or three available settings: Conductivity, Inphase, and Both.

When Manual mode was selected three settings are available: Conductivity, Inphase, and Both.

If Auto or Wheel mode was selected two available dipole modes are: Conductivity or Inphase.

Use **Down** or **Up** arrow key to leave editor.

Dipole (instrument dipole mode)

When this option is highlighted press **Left** or **Right** to toggle between two or three available settings: Vertical, Horizontal, and Both.

When Manual mode was selected three settings are available: Vertical, Horizontal, and Both. If Auto or Wheel mode was selected two available dipole modes are: Vertical or Horizontal.

Use **Down** or **Up** arrow key to leave editor.

Surv Line (survey line name)

When this option is highlighted press **Left** or **Right** arrow key to activate editor and then enter desired value. Use **Down** or **Up** arrow key to leave editor.

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

Line Incr. (survey line name)

When this option is highlighted press **Left** or **Right** arrow key to activate editor and then enter desired value.

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

Use **Down** or **Up** arrow key to leave editor.

Sequence

When this option is highlighted press **Left** or **Right** to toggle between two available settings: Alternate and One Way.

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

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

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

Direction

When this option is highlighted press **Left** or **Right** to toggle between four available settings: East, West, South, and North.

This parameter indicates the heading of the survey line.

Use **Down** or **Up** arrow key to leave editor.

Start Stn (start station of a survey line)

When this option is highlighted press **Left** or **Right** arrow key to activate editor and then enter desired value.

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

Use **Down** or **Up** arrow key to leave editor.

Stn Incr (station increment)

When this option is highlighted press **Left** or **Right** arrow key to activate editor.

In case the EM38 Manual mode was selected enter desired value for the station increment. If Auto or Wheel modes were selected then, the **Left** and **Right** arrow keys will toggle between two available options: Positive and Negative.

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

In Auto mode the increment is assumed +1 (Positive) or -1 (Negative), while in Wheel mode it will be Positive or Negative value of the specified Wheel Increment.

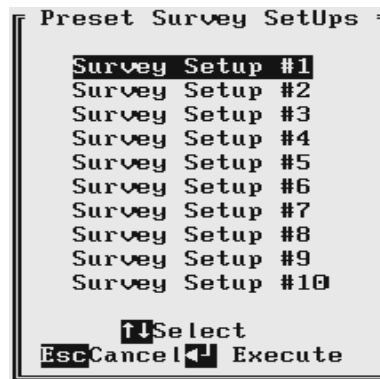
Use **Down** or **Up** arrow key to leave editor.

After all the parameters in the Survey Setup menu are updated press the function key **F1** to accept the displayed settings. The program will return to the Acquiring Data menu. Updated settings will be written to the initial file and they will be given as default parameters in the subsequent Survey Setup menu display.

To return to original settings (state before this option was selected) press the function key **F2**. All parameters will be reset to initial settings and the program will return to the Acquiring Data menu.

9.3 Survey Setups

The Preset Survey Setups menu, presented below, contains list of ten predesigned Survey Setup. Each Survey Setup can be configured and saved by the user for subsequent use. As a default surveys 1 to 4 are assigned for various settings of survey conducted in EM38 Auto mode, and surveys 5 to 10 contain various settings for EM38 Manual mode.



To select any survey set up number use **Down** and **Up** keys, and to start editing particular Survey Setup menu press **<ENTER>**. Press **<Esc>** key. to return to the Acquiring Data menu.

After a Survey Setup number (e.g. Survey Set Up #2) is selected the following screen will appear:



The survey parameters are updated in the exactly same way as in the Survey Setup menu (see section 9.2).

After all parameters are specified three options represented by function keys **F1**, **F2**, and **F3** are available :

F1 (OK)

The display returns to Acquiring Data menu. The selection will become the current Survey Setup parameters, however settings will not be saved as a Survey Setup # for subsequent use.

F2 (Cancel)

The display returns to Acquiring Data menu. The selection is cancelled and it will not be saved.

F3 (Save)

The selection is saved as a particular Survey Setup number. The display does not return to Acquiring Data menu, nor it becomes the current Survey Setup. In order to use the edited parameters as a current Survey Setup use function key **F1**.

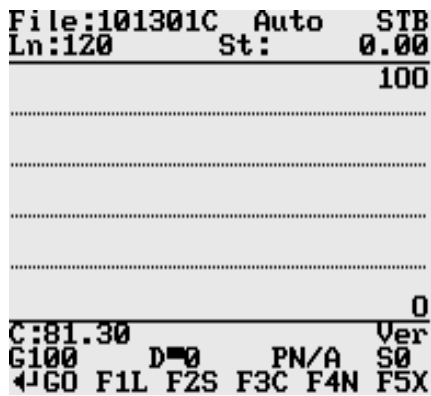
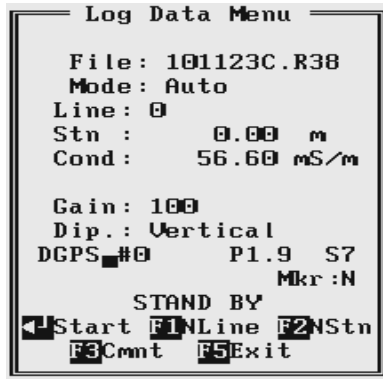
9.4 LOG DATA Menu

After the Acquiring Data menu option LOG DATA is highlighted press **<ENTER>** key. It is assumed that the instrument is turned ON prior to using this option. In case instrument is OFF or the instrument console is not connected to the field computer the message shown below will appear.



Check the connection or turn the instrument ON and select the LOG DATA option again.

Assuming that the instrument works properly and the LOG DATA is selected in Acquiring Data the program will display Log Data screen. The layout of the Log Data screen depends on the type of the display selected in the Logger Set Up menu. The Log Data menus have two display modes, the text mode (on the left) and the graphic mode (on the right) are presented below.

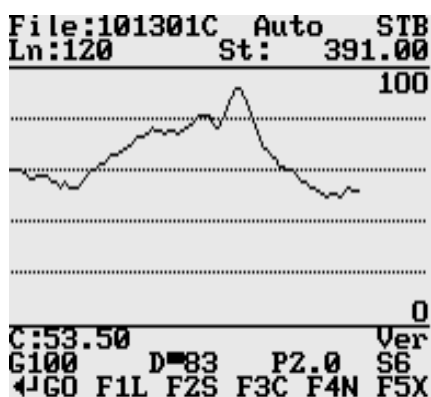
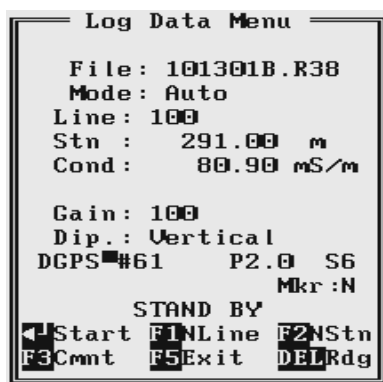


Regardless of the display type the Log Data menus have two operating modes: Stand By and Logging. In the Stand By mode the EM38 data and the instrument settings are monitored with the update rate of approximately 10 times per second. In this mode the operator can monitor the instrument output (without recording the data), the component, instrument dipole mode, instrument scale, GPS parameters (if Enabled), as well as change the operation to the Logging mode, and access several field options. In the Logging mode when the EM38 data is recorded in the data file, field options can not be accessed.

When the Log Data menu is displayed for the first time it appears always in the Stand By mode.

Stand By Mode

The Log Data menus have two display modes, the text mode (on the left) and the graphic mode (on the right) are presented below.

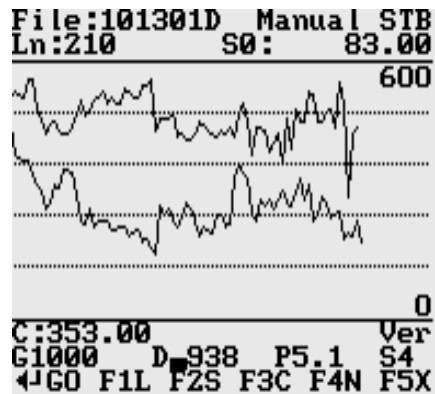
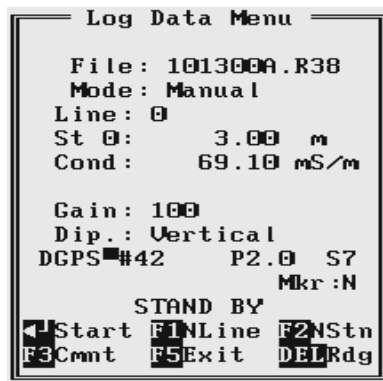


The main portion of the screen in graphic mode is occupied by the plot area. Readings in the plot area can be displayed in the user specified scale. The amplitude scale is divided by four or five dotted grid lines. In cases where the amplitude scale starts with a negative value, then the grid line corresponding to zero is always plotted as a solid line.

Readings for conductivity or Inphase are shown in digital form in the central portion of the screen in the text mode, and below plot area in the graphic mode. In graphic mode due to small screen of Pro4000 readings are labeled C for conductivity and I for Inphase. Units (mS/m and ppt) are not displayed in the graphic mode.

Both modes show the log file name and optional GPS parameters. Name of the Log Data menu mode is displayed in the text mode, and it is shown as an abbreviation in the top right corner of the screen in graphic mode, STB for Stand By mode, and LOG for logging mode. The instrument component setting, the instrument gain (G in graphic mode), and dipole mode (labeled Ver or Hor in graphic mode) are updated continuously in both modes. When the fiducial marker is pressed a label M will appear on the screen in graphic mode, and Y will be displayed at label Mkr in the text mode..

Current survey line name and station number is displayed at the top of the screen. In the Stand By mode the station number will not change. Stations in the EM38pro program are incremented by 1 or station increment value after each reading is written to the data file. If more than one readings are taken at the same station, available only in Manual mode, station is incremented after necessary number of readings is taken. In the latter case number of readings taken at the given station is displayed in the field following label S (and in front of current station), as shown in Figure below..

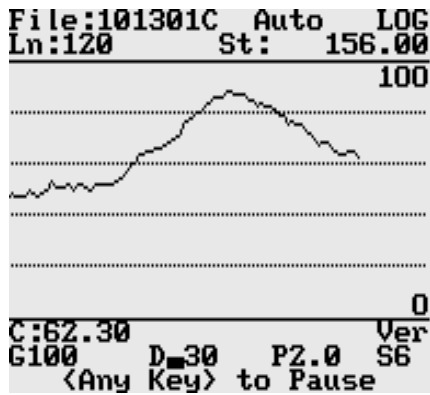


Similarly, the stations with the GPS readings (assuming that the GPS is connected to the logger) remain the same in the Stand By mode. Number of GPS positions is incremented by 1 after each GPS reading is written to the data file. In the text mode number of GPS positions follows label **DGPS** (or **AGPS** positions are not differentially corrected), the corresponding label in graphic mode is **D** (or **A**). Small square moving up and down in Stand By mode indicates that the GPS system is monitored and it is working. Two other GPS parameters: PDOP (represented by label **P**) and Number of Tracked Satellites (label **S**) are updated continuously in Stand By mode.

Several available field options are listed at the bottom of the Stand By mode screen. They will be described in the following section 9.5.

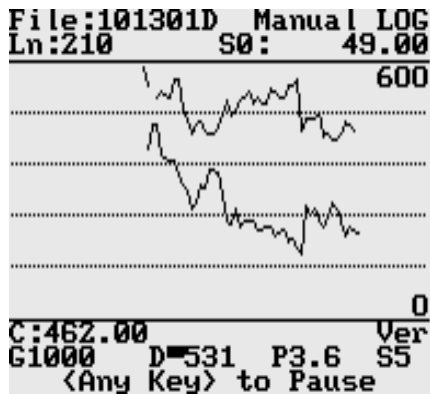
Logging Mode

The Logging mode is enabled by pressing the **<ENTER>** key, which corresponds to label **Start** in the Text Display, and **GO** in the Graphic display mode. After this key is pressed the bottom portion of the screen will change and data will be logged in the mode corresponding to the selected EM38 mode in the Survey Setup menu. Log Data screens in logging mode in the text (on the left) and graphic (on the right) display modes (for EM38 Auto mode) are presented below.



After the screen changes to Logging mode current station (Stn in Text and St in Graphic display mode) is updated according to the station interval. Similarly, if GPS Input was enabled, total number of GPS positions in the data file is incremented every time (usually once a second) GPS position is written to the file. If the Graphic display mode is enabled profiles (or profile) curves are updated after each reading is written to the data file. The program displays profiles for readings that were selected in the Logger Setup Menu and at the same time they correspond to selection in Survey Setup menu (component and dipole mode). If the latter condition is not met readings will be saved in the file and displayed in digital form, however corresponding profile will not appear on the screen. The audible click sounds at each reading if Sound option was enabled in the Setup Logger menu.

Log Data screens in logging mode in the text (on the left) and graphic (on the right) display modes (for EM38 Manual mode with 2 readings per station) are presented below.



There is only one option available in the Logging mode - pause logging. After a Pause key (any key, Alt+F1, or Ctrl+F5) selected in Logger Setup menu is pressed the recording is stopped and the Log Data menu returns to the Stand By mode. The EM38 data will be displayed with the update rate approximately 10 readings per second, however data will not be saved in the log file, audible click will stop if Sound option was enabled, and if graphic mode is used, profile curves will not be updated.

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

9.5 Field Options

Several field options are available while the Log Data screen is in the Stand By mode. These options are listed at the bottom of the screen.

<ENTER>

This option is labeled **Start** in the Text display mode, and **GO** in the Graphic display mode. The Log Data screen changes from Stand By to Logging.

F1 (New Line)

This option is labeled **NLine** in the Text display mode, and **L** in the Graphic display mode. The New Line menu is displayed, which is the same for Text and Graphic display modes.

Selecting this option allows the operator to enter a new survey line number (name) and associated information (Direction, Start Station, and Station Increment). The new line number and associated parameters will be prompted by the program based on parameters specified in the Survey Setup menu.

```
----- New Line Menu -----
Last Line : 0
Last Stn  : 280.00

Surv Line : 1 ██████████
Line Incr : 1.0
Sequence  : Alternate
Direction : West
Start Stn : 280.00
Stn Incr  : Negative
↑ Accept  Esc Cancel

F1 OK   F2 Cancel Menu
```

At the top of the screen the last survey line name and the last station are displayed. Default name for the new line is given based on the Line Increment parameter. The default Start Station, direction of the Station Increment, and Direction are determined based on Sequence selection. All these parameters can be overwritten by the user as described in the Survey Setup menu description (section 9.2).

After selection is updated, it can be accepted by pressing the function key **F1**. The display returns to the Log Data screen with new settings for the new survey line.

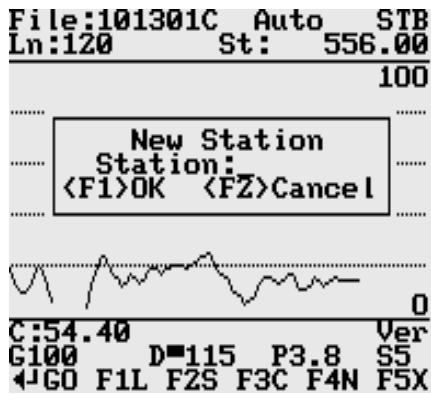
Pressing key **F2** or **<Esc>** will disregard any New Line menu changes and the program will return to the Log Data screen and measurements can be continued.

F2 (New Station)

This option is labeled **NStn** in the Text display mode, and **S** in the Graphic display mode. The New Station menus in two display modes, in the text mode (on the left) and in the graphic mode (on the right) are given below.

Selecting this option allows the operator to enter a new station number. In the Text mode Start Station and Current Stations are displayed at the top of the screen. In the Graphic mode only the Current Station is displayed. The New Station can be entered in the similar way as editing parameters in Survey Setup menu, and in the provided message box in the Graphic display mode.

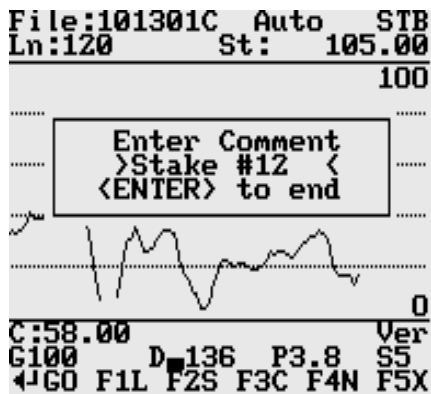
After the New Station is entered, it can be accepted by pressing the function key **F1**. The display return to the Log Data screen with new station..



Pressing key **F2** or **<Esc>** will disregard new entry and the program will return to the Log Data screen and measurements can be continued.

F3 (Comment)

This option is labeled **Cmnt** in the Text display mode, and **C** in the Graphic display mode. Menus containing Enter Comment box in the text mode (on the left) and in the graphic mode (on the right) are given below.

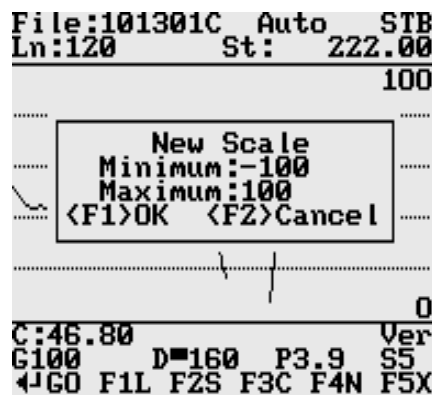


Selecting this option allows the operator to enter a comment at any point of the survey. A maximum of 11 characters can be entered as a comment. Text of the comment is saved in the file with a corresponding time stamp.

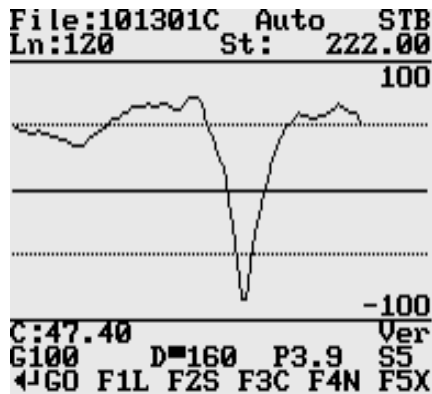
The user must exit the comment mode by pressing **<ENTER>** key.

F4 (New Scale) *only graphic display*

This option is available only in the Graphic display mode and it is labeled **N**. The Log Data screen with the entry box for New Scale parameters is given below.

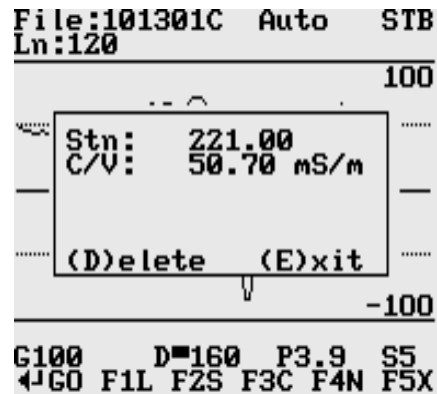


Selecting this option allows the operator to enter new scale parameters for the amplitude display. After minimum and maximum values are specified, the function key **F1** (OK) will accept new values and the display will be redrawn (see below). When the key **F2** (Cancel) is pressed the new entry is cancelled.



(delete reading)

This option is labeled **Rdg** in both display modes. The Delete Reading box that appears on the screen, in the text mode (on the left) and in the graphic mode (on the right) is shown below.



This function allows operator to delete previously recorded reading(s). The reading (station) to be deleted is displayed on the screen. The data will only be deleted when the key **D** is pressed. The program will then display the next previous station, and allow it to be deleted in a similar fashion. If there is no further data available, the program will provide related information.

To exit delete reading mode press key **E**.

F5 (exit LOG DATA mode)

This option is labeled **Exit** in the text display mode, and **X** in the graphic display mode. After key **F5** is pressed a confirmation prompt **Exit Logging Y(es)/N(o)** will appear on the screen as shown below.

When the key **Y** is pressed the data file is closed and the program returns to the Acquiring Data menu. In order to continue survey a new data file must be created.

If the key **N** is pressed the program returns to current logging mode.

```

Log Data Menu
File: 101123C.R38
Mode: Auto
Line: 1
Stn : 80.00 m
Cond: 55.10 mS/m

Gain: 100
Dip.: Vertical
DGPS #84 P2.3 S6

Exit Logging
(Y)es (N)o

```

```

File:101301C Auto STB
Ln:120 St: 375.00
400
C:419.00 Ver
G1000 D=189 P3.9 S5
Exit Logging (Y)es/(N)o

```

M or V (memory check, no prompt on the screen)

This label corresponding to this option is not shown on the screen. After key **M** or **V** is pressed a small window that shows the amount of available memory for data is displayed. The amount of available memory is given in Kbytes and in number of EM38 readings (one EM38 record is 22 bytes long). If GPS data is taken concurrently, one GPS record is equal to 5 or 6 EM38 readings (110 or 132 bytes).

```

Log Data Menu
File: 101300A.R38
Mode: Manual
Line: 0
St 1: 6.00 m
Cond: 16.50 mS/m

Gain: 100
Dip.: Horizontal

Available Memory
428595 Kb
19481615 Rdgs

```

```

File:101301C Auto STB
Ln:120 St: 391.00
100
^
Available Memory
428136 Kb
19460763 Rdgs
0
C:52.90 Ver
G100 D=83 P2.0 S6
←G0 F1L F2S F3C F4N F5X

```

Available memory is also checked automatically during data collection. In cases where the amount of available memory in the logger is less than 10 Kbytes, the program will stop, data file will close, and a proper message will be displayed.

10. Data Transfer (Upload Files)

This chapter describes the transfer of data files from a field computer Pro4000 to PC computer using **Download EM38pro Files** option of the DAT38W program. Data files can be downloaded by alternative utilities (e.g. ProShell, Lynx, or FileScout in Allegro Field PC) and then these files can be converted to DAT38 format using option **Convert | EM38pro Files** in the DAT38W menu.

10.1 Data File Formats

Data files in the field computer are formatted in proprietary EM38pro format. The EM38pro data is saved in one data file with the extension name R38.

Files in the logger format are converted to the DAT38 format during the downloading of data. These new files have same base name with an added extension name G38. Files in the DAT38 format can be loaded and processed by the DAT38W program.

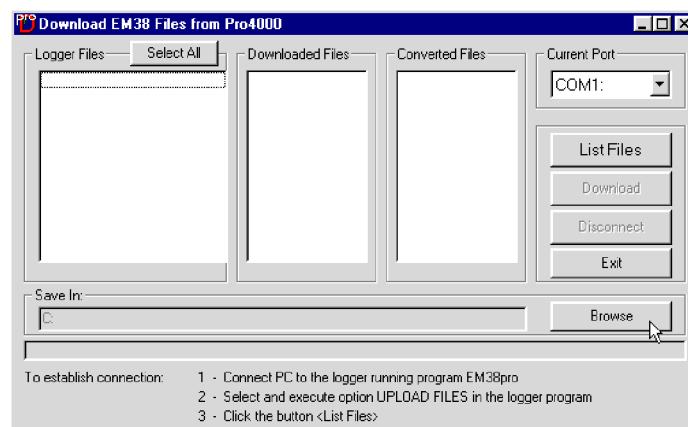
While only the DAT38 format is used in data processing, it is strongly advised that data in the raw (EM38pro) format be saved as well. In the case of any hardware malfunction, i.e. a damaged instrument cable, only the file in logger format may indicate the source of the problem. Additionally, raw data files also contain useful information about the instrument settings used during field work. Files in the EM38pro format can be converted to the DAT38 format at any time using the Convert EM38pro Files option of the DAT38W menu.

Description and sample of the EM38 files in the EM38pro format, as well as an example of a file converted to the DAT38 format are placed in Appendix A of DAT38W manual.

10.2 Upload Files Procedure

To start downloading files from the field computer, select the **Data Transfer** item in the program menu and then click on **Download EM38pro Files** from the menu item

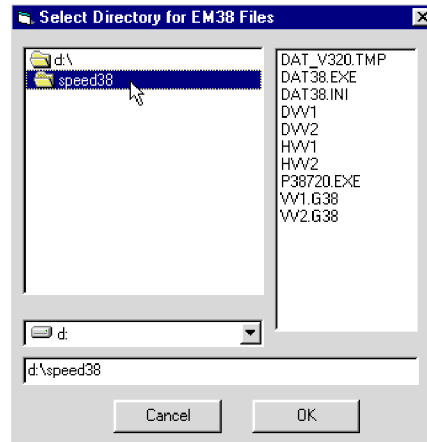
After you click the **Download EM38pro Files** item, the Download EM38 Files from Pro4000 window will appear.



The Download window has three 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,

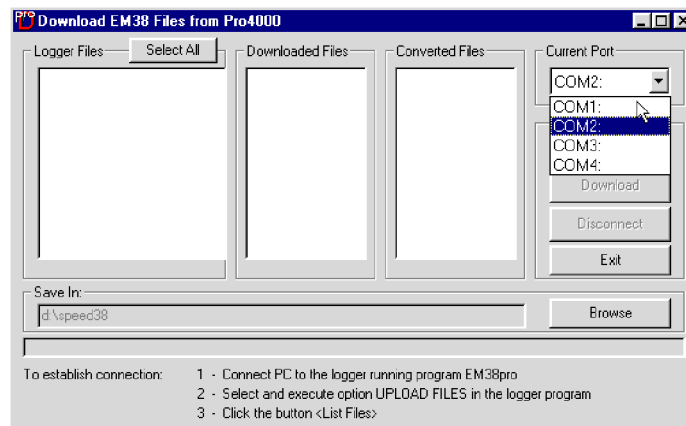
labeled Downloaded Files, will list downloaded data files in the EM38pro format, and the third, Converted Files, will list files converted to DAT38 format. If a file name already exists on the computer hard disk, an underscore followed by a letter will be added to the base name. (ie. file name ABC.R38 would be changed to ABC_1.R38, ABC_2.R38, and so on.)

To select the directory where transferred files will be placed click the **Browse** button. The Select Directory for EM38 Files window will be displayed (Figure below).



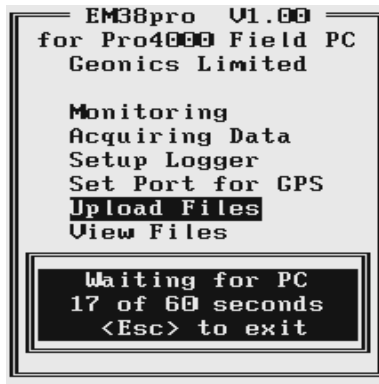
After the directory is selected, it will be displayed in the text box labelled **Save In** at bottom part of the Download EM38pro Files from Pro4000 window. The selected directory will be saved and it will be used as the default directory during subsequent DAT38W executions. If this directory is removed 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, as shown in Figure below. Select required COM port number.

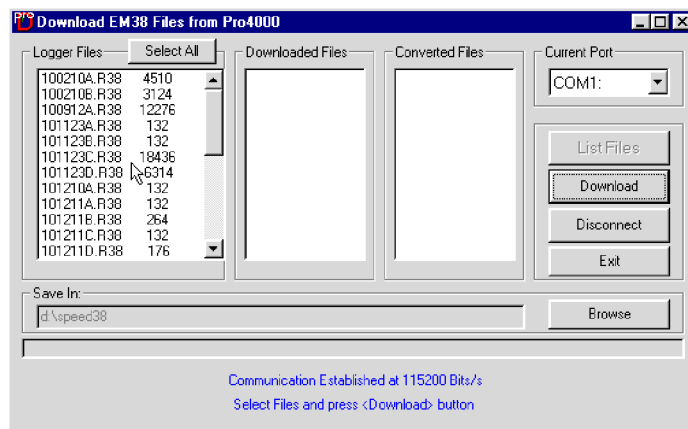


To start downloading the data files, connect the field computer (Pro4000) and PC computer with the serial cable.

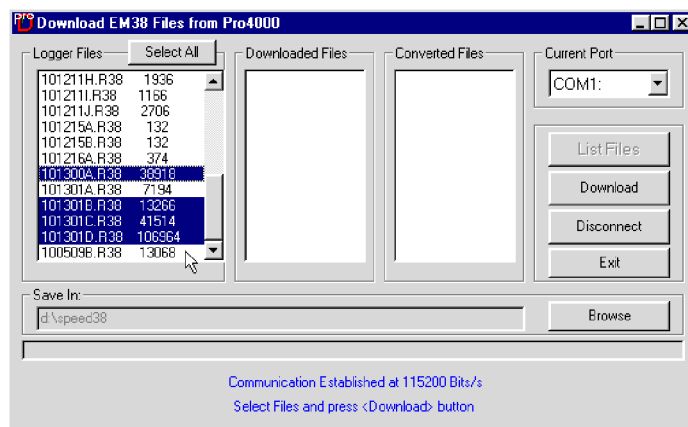
Run the EM38pro program in the logger. In the Main menu of the program select **Upload Files** option, and press <ENTER>. The logger screen will display the message “**Waiting for PC**” (shown in Figure below) for up to 1 minute (if time elapses repeat the procedure). On the computer click the **List Files** button in the Download EM38pro Files from Pro4000 window. At that time both programs (EM38pro and DAT38W) will establish and test the communication at the highest



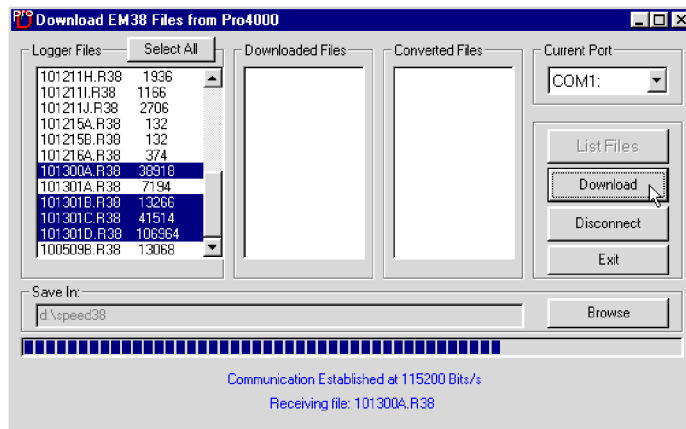
possible speed of data transfer. After several seconds the Logger Files list box will be updated with the names and sizes of data files available for download (see Figure below). At the same time, the **Download** and **Disconnect** buttons will be activated, and the **List Files** button will be deactivated.



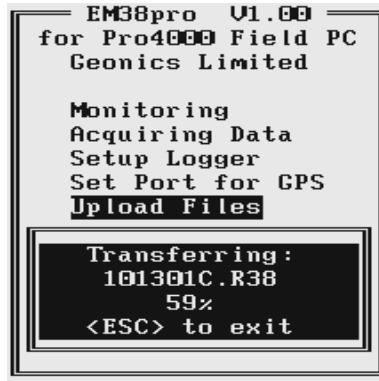
Select the files to be downloaded from the logger by clicking on individual file names in the list box (Figure below) or click the **Select All** button to select all available files. When all files are selected the **Select All** button will change to the **Unselect All** button.



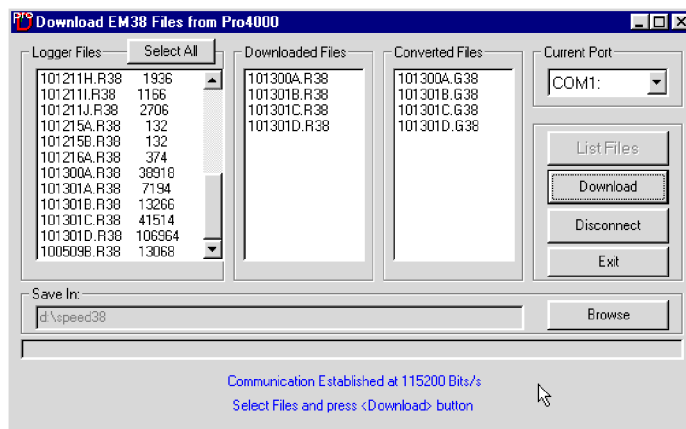
When file selection is complete click the **Download** button. The name of each transferred file is displayed at the bottom of the window as it transfers and a progress bar indicates the percentage completed, as shown in the following Figure.



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



Transferred files (in EM38pro format) will be displayed in the centre list box. After the transfer of all selected files is complete, files in the EM38pro format are automatically converted to the DAT38 format (with extension name G38). Converted files will be displayed in the Converted Files list box (see Figure below). Converted files (with extension name G38) can be loaded and processed further in the program.



Click the **Disconnect** button to cancel communication with logger. The Download EM38 Files from Pro4000 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 EM38 Files from Pro4000 window will disappear.

11. View Files

This option allows to view recorded data files. After the View Files option is selected in the Main Menu the View Files menu with a list of data files and their size appears on the screen. This menu is presented below.



Name	Size
100912A.R38	12276
101123A.R38	132
101123B.R38	132
101123C.R38	18436
101123D.R38	6314
101211A.R38	132
101211B.R38	264
101211C.R38	132
101211D.R38	176
101211E.R38	3982
101211F.R38	3234

F1 Select F2 View F3 Exit

Select the file by using **Down** and **Up** arrow keys. When the desired file is highlighted press function key **F1** to view contents of this file. Pressing key **F2** will return the program to the EM38pro Main menu.

After key **F1** is pressed the View File menu with readings taken at the first station of the first survey line in the file is displayed, as shown below.



View File Menu

File: 100912A.R38
Mode: Auto
Line: 57
Stn : 5.00 m
Cond/V: 41.30 mS/m

Dir:E Mkr:N

F1 NextStn F2 PrevStn
F3 NextL F4 PrevL F5 Exit

At the top of the screen name of the data file and the EM38 mode are displayed. Then the Line Name, Station, and readings with the instrument dipole mode (V for Vertical or H for Horizontal) are shown. The survey line direction (Dir) and the fiducial marker (Mkr) presence **Y**(es) or **N**(o) are displayed as well. If the file contains comments, the text will be displayed between neighbouring stations.

The **Right** arrow key is used to show next station (NextStn) and the **Left** arrow key will move display to previous station (PrevStn) readings. Survey lines can be changed by pressing **Down** and **Up** arrow keys. The **Down** arrow key will switch the display to the first station of the next survey line (NextL), and the **Up** arrow key will show the first station readings of the previous survey line (PrevL). If the last or first station of a survey line will be reached, or the last survey line in the file will be encountered, the program will provide appropriate information.

12. Delete Files

This option allows you to delete data files from the field computer memory. After the Delete Files option is selected in the Main Menu the Delete Files menu with a list of data files and their size appears on the screen. This menu is presented below.



Name	Size
101211A.R38	132
101211B.R38	264
101211C.R38	132
101211D.R38	176
101211E.R38	3982
101211F.R38	3234
101211G.R38	1320
101211H.R38	1936
101211I.R38	1166
101211J.R38	2706
101215A.R38	132

F1 Select F2 Delete F3 Exit

Select the file by using **Down** and **Up** arrow keys. When the file to be deleted is highlighted press function key **F1** to delete the file. Pressing key **F2** will return the program to the EM38pro Main Menu.

After key **F1** is pressed a confirmation prompt appears on the screen, as shown below.



Name	Size
101211A.R38	132
101211B.R38	264
101211C.R38	132
101211D.R38	176
101211E.R38	3982
101211F.R38	3234

1
1
1
1
1
1

Delete file
101211D.R38
(Y)es (N)o

F1 Select F2 Delete F3 Exit

If key **Y** will be pressed the file will be permanently deleted from the field computer memory. When key **N** is pressed the confirmation prompt disappears and display shows the list of available data files.

Exit the Delete Files menu by pressing the function key **F2**. The program will return to the EM38pro Main Menu.

13. End Program

To end the program highlight the Exit option in the Main Menu and press the **<ENTER>** key. The program will stop, and it will return to the DOS prompt.

Appendix A

A.1 Using the EM38pro with a GPS System

The EM38pro program accepts input from GPS systems that stream NMEA-0183 compatible data through their output port. The program uses two NMEA messages: GGA and GSA. The entire GGA message is written to the EM38pro data file, while the GSA message is used only to display PDOP index on the logger screen.

The GPS system means (control device, receiver panel, or manufacturer software) must be used to set GPS receiver communication parameters, to specify frequency of GPS output, and number and type of NMEA messages sent by the GPS system output port. Any GPS system can send various NMEA messages. **It is important to select only two messages (GGA and GSA) that are actually used by EM38pro.** The program will accept any GPS string sent by the GPS receiver, however it uses time to process GPS data that is not being used. Therefore, selecting a larger number of NMEA messages for GPS output will result in slower data acquisition of EM38pro. Normally, the EM38pro running in Pro4000 logger uses less than 100 ms to process and record GPS data from two NMEA messages, GGA and GSA.

Only message GGA is necessary to position EM38 data. If message GSA is not available in a particular system, the EM38pro will function and record position data based on GGA message. Lack of GSA message will result in PDOP index displayed as Not Available (N/A) on the logger display.

The EM38pro dedicates one line of the display to show GPS status. A label **DGPS** (Differential Global Positioning System) in text mode or **D** in graphic mode indicates that GPS readings are differentially corrected in real time. Label **AGPS** (Autonomous Global Positioning System) or **A** in graphic mode indicates lack of differential correction. On the right side of **DGPS** or **AGPS** (**D** or **A** in graphic mode) a label small square is displayed. This square should move down and up with the frequency of GPS update rate (usually 1 second intervals). If the square is not moving for longer period of time it means that GPS system is not working or that it is not connected to the field computer. Number of recorded GPS positions are displayed on the right side of the small square. This number is updated only in the logging mode, when the data are recorded. (In Stand By mode or during Monitoring only the moving square, and updated values of PDOP and number of tracked satellites, indicate presence of GPS input).

Two more GPS parameters are displayed on the logger screen. These are index PDOP shown by label **P** and number of tracked satellites represented by label **S**. The index called PDOP (Position Dilution of Precision) measures the strength of satellite coverage for a given area. PDOP is affected by the number of satellites visible and their relative positions in the sky. The smaller the number of PDOP the stronger the satellite coverage is. When there are more than 5 satellites widely spaced visible, the PDOP is 4 or less. However, when there are less satellites visible, or they are unevenly spaced in the sky, PDOP values can be 6 or higher. In most cases, the PDOP in an open sky is less than 3, and most accuracies given for many GPS systems are given for this norm. Refer to GPS documentation and literature for more information related to error sources of GPS positioning.

A.2 Description of GGA and GSA Data Messages

GGA Data Message

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

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

Definition of GGA message component:

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

GSA Data Message

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

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

Definition of GSA message components:

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

Appendix B

B.1 Description of Data File in EM38pro Format

Each record contains 22 characters, including line feed at the end of each record.

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

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
E	M	3	8	S				V	1	0	0	Survey Type	UT	ID	IM	IC					10	
H																						10

- EM38S - identification of program file
- V100 - version number (V1.00)
- Survey Type - GPS (if GPS Input Enabled) or GRD (grid)
- UT - unit type (0 = meters, 1 = feet)
- ID - EM38 Dipole Mode
(0 = Vertical, 1 = Horizontal, 2 = Both)
- IM - EM38 survey mode
(0 = Auto, 1 = Wheel, and 2 = Manual)
- IC - EM38 component
(0 = Both, 1 = Inphase, and 2 = Conductivity)
- File Name - file name, maximum 8 characters
- Time/Wheel/Samples - this field depends on EM38 survey mode
 - Auto Mode - Time Increment in seconds
 - Wheel Mode - Wheel Increment (user units, see IT)
 - Manual Mode - Samples/Reading
- 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																						10
B																						10
A	Dir																					10
Z	D	D	M	M	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 (ms) - Time when Line was created in ms from start of the file
- Dir - Direction of the Line (E, W, N, or S)
- Station Inc. - Station Increment, format F11.3
- Date - Date when Line was created, format DD-MM-YYYY
- Time - Real Time when Line was created, format HH:MM:SS
- 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	Reading					not used					Time Stamp in ms (8 digits)					10				

- I - indicator T, 2, 3, or 4
- T** - First reading at the station (default for Auto mode)
- 2** - second reading at station (possible only in Manual mode)
- 3** - third reading at station (possible only in Manual mode)
- 4** - fourth reading at station (possible only in Manual mode)
- Gn - information byte, one character parameter, the ASCII number of this character indicates following:

Bit	Decimal	Value and Meaning	
7	128	1	<i>not used</i>
6	64	Marker	= 1 <i>trigger pressed</i> = 0 <i>otherwise</i>
5	32	Mode	= 1 <i>Vertical</i> = 0 <i>Horizontal</i>
4	16	Gain	= 1 <i>Gain=8</i> = 0 <i>Gain=1</i>
3	8	0	<i>not used</i>
2	4	Component	= 1 <i>Conductivity</i> = 0 <i>Inphase</i>
1	2	Range 2	
0	1	Range 1	

Range 2 and Range 1 represent sensitivity (gain) as follows

Sensitivity	Range 1	Range 2	Multiplication Factors	
1000	1	1	Conductivity	-1/Gain
			Inphase	-0.0288/Gain
100	0	1	Conductivity	-0.1/Gain
			Inphase	-0.00288/Gain

Multiply Reading by above factors to obtain result in mS/m or ppt.

- Reading - five character field containing instrument output includes sign (+ or -) and four digits
- Time - time stamp of the reading in milliseconds, this is time elapsed from the start (creation) of the current data. The time in milliseconds can be linked with the computer local time by using Times in lines B and Z of Line Header.
- 10 - Line Feed character

Comment

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

Deleted Records

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
X	Gn	Reading										Time Stamp in ms					10				
X	Comment (maximum 11 characters)												Time Stamp in ms					10			

GPS Data Message Records

Each GPS record (GGA Message) is broken in to several 20 characters strings and placed in the EM38pro 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 character @ as the first character, then records that contain continuation of the same message start with character #. The GPS sequence ends with a line starting with the character !. The last line contains logger time stamp in milliseconds for given GPS reading. A sample of the GPS message written in EM38pro 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	,	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		
!															H	H	M	M	S	S	h	h	10

The GPS sequence may contain 5 or 6 records. Component of the GGA message may differ in length, however they are placed in the same number of columns. Refer to Appendix A (section A.2) for definition of each component of GGA data message.

B.2 Example of Data File in EM38pro Format

The EM38pro data file records are written in binary format, therefore the file may have different shape when displayed or printed, depending on particular video or printer settings.

```
EM38S   V100GPS0002
H 101301B   0.200
L100
B       0.00 00000009
AE      1.000
Z10132001 01:17:53.61
T¥-0806   00005823
T¥-0805   00006019
T¥-0808   00006219
T¥-0804   00006419
@$GPGGA,052507.00,433
#6.59312,N,07936.6516
#9,W,2,6,1,139.16,M,-
#35,M,4,118*5C
!       00006596
T¥-0807   00006665
T¥-0812   00006865
T¥-0805   00007064
T¥-0797   00007264
T¥-0808   00007464
@$GPGGA,052508.00,433
#6.59315,N,07936.6516
#9,W,2,6,1,139.17,M,-
#35,M,5,118*54
!       00007596
T¥-0804   00007724
T¥-0788   00007924
T¥-0791   00008123
T¥-0795   00008322
T¥-0808   00008520
@$GPGGA,052509.00,433
#6.59311,N,07936.6516
#1,W,2,6,1,139.18,M,-
#35,M,4,118*57
!       00008604
T¥-0810   00008725
T¥-0805   00008925
T¥-0792   00009124
T¥-0799   00009324
T¥-0805   00009525
@$GPGGA,052510.00,433
#6.59308,N,07936.6516
#3,W,2,6,1,139.32,M,-
#35,M,5,118*5C
!       00009596
T¥-0812   00009724
T¥-0806   00009918
T¥-0820   00010118
T¥-0816   00010317
T¥-0815   00010517
@$GPGGA,052511.00,433
#6.59312,N,07936.6516
#4,W,2,6,1,139.37,M,-
#35,M,4,118*55
!       00010596
T¥-0808   00010725
```

Appendix C

C.1 Short Overview of Programs Lynx and ProShell

Two programs, ProShell (includes 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.

C.2 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.

C.3 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.

C.4 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.

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.