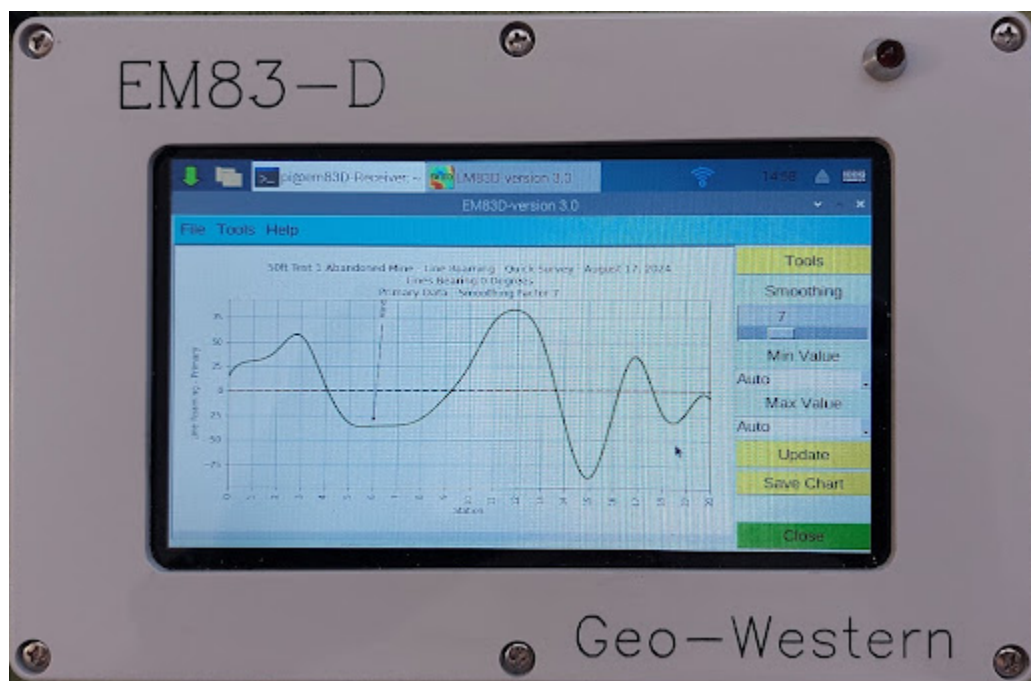


# EM83D Operation Manual



Version 2.0

August 2024

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## **Introduction**

Congratulations on your purchase of the EM83D by Geo-Western. The EM83D is an electromagnetic pulse-type detector capable of determining variations in ground conductivity. Pulse-type electromagnetic systems are widely used to identify a variety of subterranean formations which exhibit changes in conductivity.

Your EM83D unit allows you to create new surveys, log millivolt responses, capture GPS coordinates, identify geologic landmarks, produce .PNG format image contours and line plot maps of survey data, and export both datasets and charts for use in external reports or viewing. A touchscreen provides the user interface.

When connected to a WiFi network, you can access the exported maps and dataset spreadsheets securely as well over an SFTP connection using readily available software.

Please take a moment to familiarize yourself with the contents of this manual. A copy of this manual can be accessed on your EM83D unit by opening the EM83D application and clicking Help>Operations Manual for easy access while in the field.

## What's In The Box

Your EM8D unit ships in a sturdy storage case and includes:

1. EM83D Pulse-Type Detector Unit
2. Transmitter Coil
3. Transmitter Staff
4. Receiver Coil
5. Receiver Staff
6. 5 Foot Receiver Cable
7. Set Of Transmitter Cables (50', 100', 200')
8. Lithium Polymer Power Bank
9. 5.5mm x 2.5mm x 3' Battery Power Cable
10. 110V AC to DC Charger
11. GPS Module
12. External Keyboard/Mouse Combination

## Charging Your Battery Pack



**Note:** Use only the supplied Power Bank to power your EM8D.

Your EM83D unit is shipped partially charged and should be fully charged before use. To charge the Power Bank, simply plug in the Battery Charger connector to the charging port on the battery and insert into a 110V AC outlet.

The high capacity Power Bank may take up to 8 hours to fully charge. See Battery Instruction Manual for further details and warnings.

## Starting Up Your New EM83D



**Important** See the section “Shutting Down Your New EM83D” before disconnecting Power Cable after starting your EM83D.

Remove the EM83D, the 5.5mm x 2.5mm Battery Power Cable, and the Power Bank from the Storage Case.

Follow the instructions included with the power bank to power on the device and set the output voltage to 12 volts.

A minimum of 12 volts is required for the proper Transmitter output voltage. The recommended voltage range is between 12.0V and 16.0V.

Connect one end of the 5.5mm x 2.5mm Battery Power Cable to the EM83D unit and the other end to the appropriate Power Bank connector. Press and release the Power Button on the side of the Power Bank once to ensure the Power Bank is on.

The EM83D unit will boot up automatically and the EM83D software will launch.

## Shutting Down Your New EM83D



**Important:** It is critical that the EM8D unit be properly shut down before disconnecting the Power Cable. Failure to do so may cause permanent data loss. Ensure the red Power Indicate lamp on the top of the EM8D is OFF before disconnecting the power cable.

The easiest way to properly shut down your EM83D is through the EM83D software File Menu.

On the EM83D Software Menu, click File- → Shutdown System.

A message box appears asking you to confirm you wish to power off the system. Click Yes to continue or No to cancel.

Upon clicking Yes, the system will begin to power down and the screen will go dark.

Before disconnecting the Power Cable, ensure that the red LED Power Indicator on the top of the EM83D is OFF. Failure to wait until the LED Power Indicator is OFF may result in permanent data loss.

If the system is not powered off correctly, the next reboot will perform a check of the system and may take slightly longer to boot up (usually less than a minute). This check attempts to recover from an improper shutdown, but cannot recover lost data.

## Launching The EM83D Software

The EM83D Software automatically launches at system startup. However to relaunch the software manually, click on the System Menu in the top left corner of the screen, or via the software icon on the Desktop.

Choose the EM83D software item from the menu to relaunch the software.

The software will now launch and the Main Survey Screen will be displayed.

## Survey Types

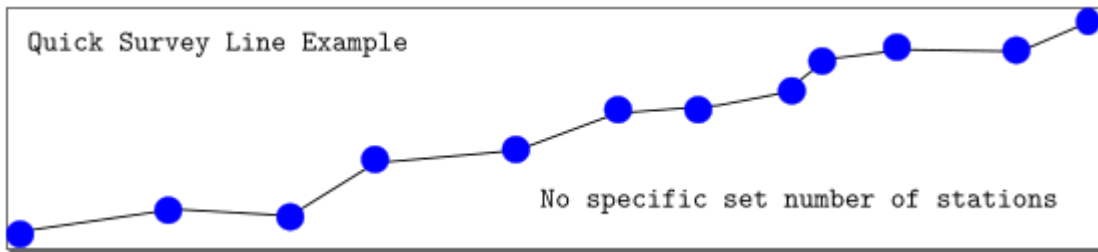
The EM83D allows for multiple survey types. Choosing the appropriate survey based on the needs of the project is important.

### Quick Survey

The Quick Survey is designed as a fast way to get started collecting data. It does not use a predefined number of stations and all data is collected on a single data line. GPS data captured will reference the Receiver location only. Coil separation and direction of travel



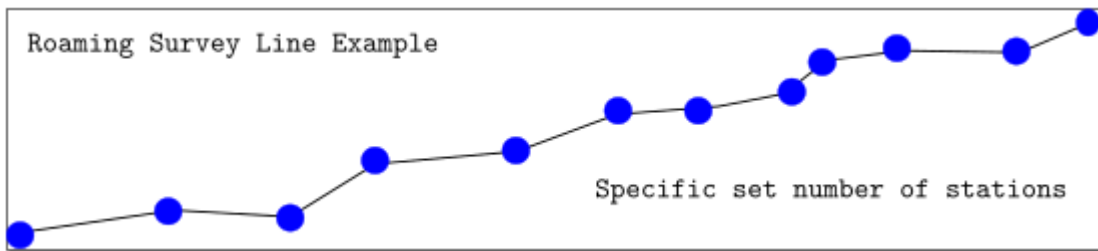
is not recorded.



Starting off with a Quick Survey may help identify the target area for additional surveys using one of the other Manual Survey types. If the general area is known and the user simply wishes to identify where a specific Roaming, Grid or Depth survey may need to be conducted, the Quick Survey is a good place to start. Data from a Quick Survey is plotted as a standard line plot only along the data points.

## Roaming Survey

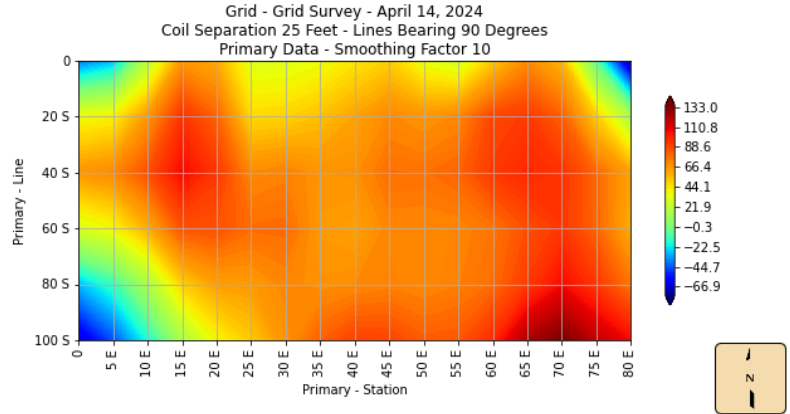
Like the Quick Survey, a Roaming survey collects data along a predetermined line. However, the Roaming Survey accounts for coil separation, line bearing, and uses a predefined number of stations for which to collect data.



Roaming Surveys are useful to narrow down a broad field of exploration to a set range of stations for further targeting. Typically Roaming Surveys are conducted along a measured line of predetermined length with consistent separation between data collection points. This allows the user to target a specified area with a single line. Data from a Roaming Survey is plotted as a standard line plot only along the data points.

## Grid Survey

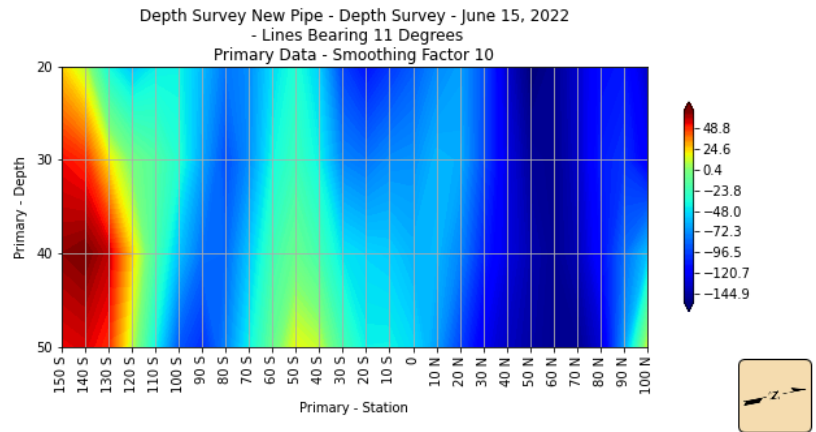
A grid survey is used to collect data on a predetermined area with a specific number of lines and station data points per line. Grid surveys are often used to map out a larger area with predetermined distances between lines and station data points.



In this example, six lines ranging from Line 0 to Line 100 S (South) and stations ranging from Station 0 to Station 80 E (East) was conducted. Data was collected along each Line traveling in an eastbound direction.

## Depth Survey

A Depth Survey (or depth pseudosection) is a survey type that allows the user to identify depth of a target along a predetermined line with regular depth of penetration intervals.



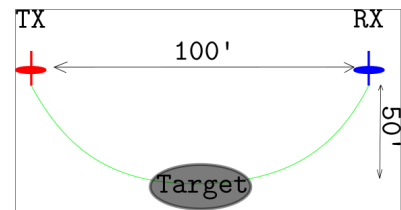
In this example, data was collected along a single survey line at depths of 20', 30', 40' and 50' from Stations 150 S to 100 N.

## Transmitter And Receiver Coil Separation



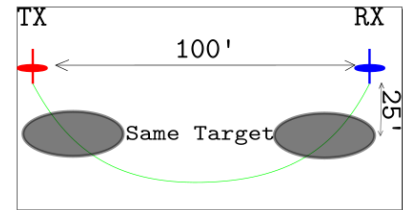
**Important!** A minimum distance of 20 feet should be observed whenever transmitting to avoid overloading the internal circuit. Distances under 20 feet of separation may produce inaccurate results.

The coil separation between the transmitter and receiver determines the maximum depth of penetration while collecting data.

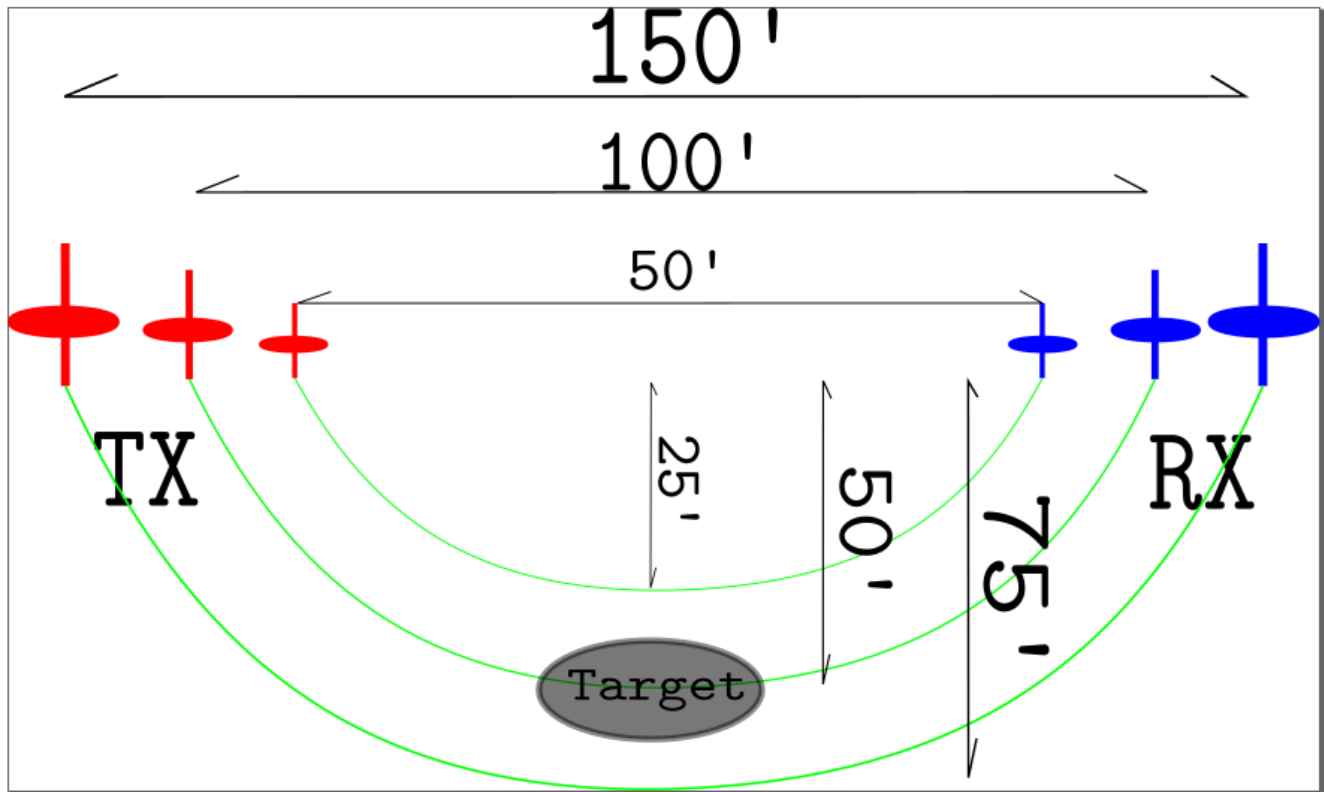


The transmitter signal passes through the earth via a roughly sinusoidal curve. Targets along this path of travel are picked up by the receiver.

When the signal passes through the target at a shallow depth of penetration, the resulting data will display the target twice as it passes through the field on the transmitter side and again on the receiver side. This will show as a double peak on a line plot. Therefore it is important to verify acquired targets with a subsequent Depth Profile Survey.



Sample Depth Survey target depth identification:



In this example, three passes were completed over the same line with coil separations of 50', 100' and 150' resulting in depth layer readings of 25', 50' and 75' respectively. The target appears most defined at the 50' depth.

# File Menu

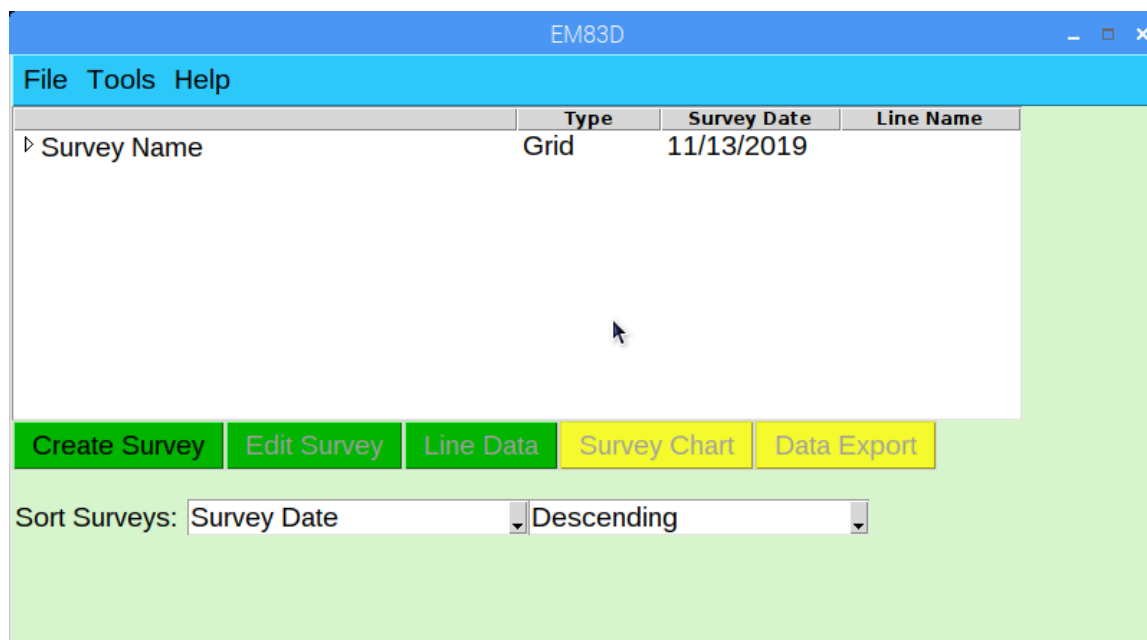
## Surveys

The EM83D Software was designed to allow ease of use in the field, while still providing all the tools you'll need to perform an effective survey. The different screens available in this section of the manual are located by clicking on the appropriate file menu items.

### Main Survey Screen

By default, the Main Survey Screen is displayed upon launching the software. This screen will display a list of surveys, the survey type, date, and names of included lines in the survey (for grid-type surveys).

Survey types may be either a standard Grid layout, or a Roaming. See the section on Creating Your First Survey of this manual for differences between these two survey type options.

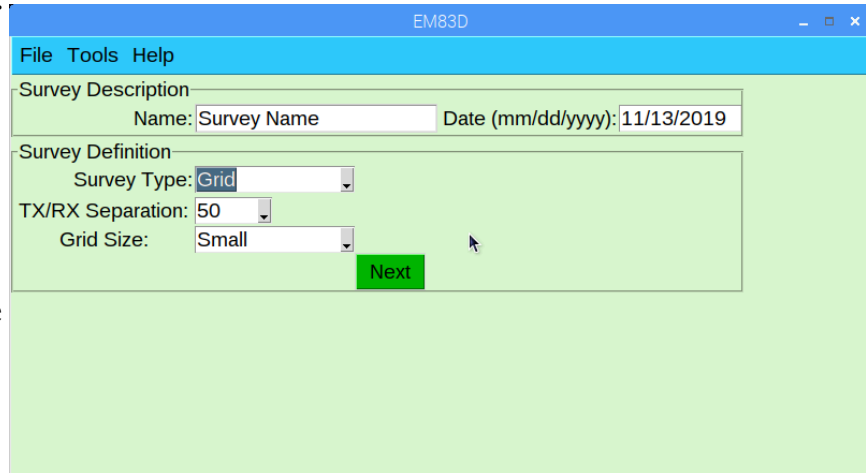


The list of surveys are automatically sorted by Survey Date in Descending order. To change the order in which the list of surveys is displayed, simply choose between "Survey Date" or "Survey Name" in the Sort Surveys field, then choose either "Ascending" or "Descending" order.

## Creating A Grid Survey

Creating a grid survey is easy. From the Main Survey Screen, click on the Create Survey button. The first screen of the survey setup is displayed.

In the Name field, replace the “Survey Name” text with the name you would like to use for this survey.



In the Date field, type the survey date in mm/dd/yyyy format.

Choose the “Grid” survey type.



**A few words on Survey Types: Grid surveys are typically used to map out a large area on a predefined grid of evenly spaced parallel lines and evenly spaced station data points. This survey type works well for detailed analysis of a given target area. Grid surveys can be performed with a transmitter and mobile receiver pair moving across the grid lines and stations, using a fixed separation with the transmitter trailing behind the receiver along a predefined path. This survey type yields better depth analysis based on the TX/RX separation distance. Roaming surveys allow for one-operator use by fixing the transmitter at a stationary location and moving the receiver over an area at random intervals. This process helps perform a quick analysis of a suspected target area and is usually followed up with a more detailed Grid survey.**

Choose a Transmitter/Receiver (TX/RX) separation distance for the survey you wish to perform. This is usually a fixed cable length used for a survey grid. An optional “0” distance for the TX/RX Separation is also available and is automatically selected for Roaming survey types. This “0” separation distance causes the system to use the GPS coordinates of the Receiver as the data point instead of the ½ distance of the TX/RX separation location as the data point. Selecting a “0” separation requires the use of the GPS data for determining location of a data point. Keep in mind that GPS location data can vary significantly and should not be the sole indicator for data gathering, but rather a

general area reference. More fixed positioning such as flagging or marking areas of interest is recommended when performing “0” separation surveys.

Choose a Grid Size for the survey you would like to create. The options of Small, Medium, Large, or Very Large will change the selectors in subsequent survey setup screens. Below are the limits of surveys that can be created depending on the selected Grid Size:

Small:

- Maximum 51 lines centered over Zero
- Maximum 51 stations centered over Zero

Medium:

- Maximum 101 lines centered over Zero
- Maximum 101 stations centered over Zero

Large:

- Maximum 501 lines centered over Zero
- Maximum 501 stations centered over Zero

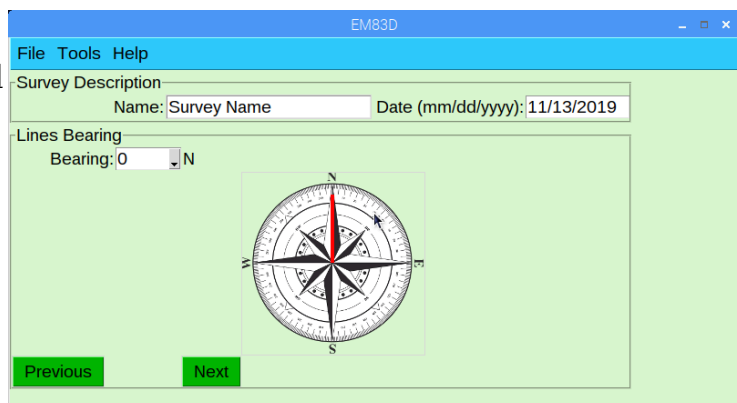
Very Large:

- Maximum 1001 lines centered over Zero
- Maximum 1001 stations centered over Zero

The most common selection is a Small Grid Size survey, as this provides the best option for a reasonably manageable data set.

Click Next to continue building your survey.

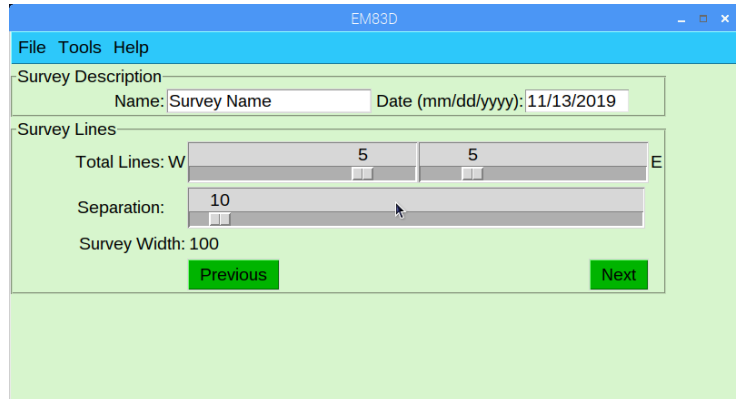
The following screen allows for the compass direction of the lines for a Grid type survey. The Lines Bearing is fixed and cannot be altered after a survey is created, so special care should be taken to ensure its accuracy before creating the survey.



Use the stylus to move the red compass direction indicator to the direction in which the lines will be created. Begin by touching somewhere on the white compass area then move in a circular motion until the proper bearing is displayed in the Bearing drop down menu. The Bearing drop down menu can also be used to choose the compass degrees as well.

Click Next once the Lines Bearing is correctly selected to display the Survey Lines setup screen.

Use the Total Lines sliders to move left or right to select the number of lines on either side of your “Zero” grid center. For example, in the selection above 5 lines will be created West of Zero and 5 lines will be created East of zero, for a total of 11 lines (including the Zero line).

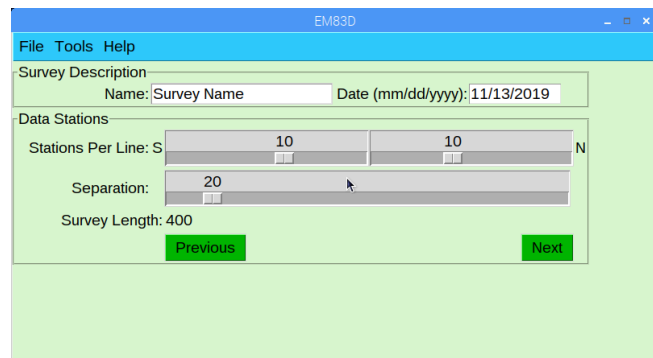


Use the Separation slider to change the distance between parallel lines on the survey.

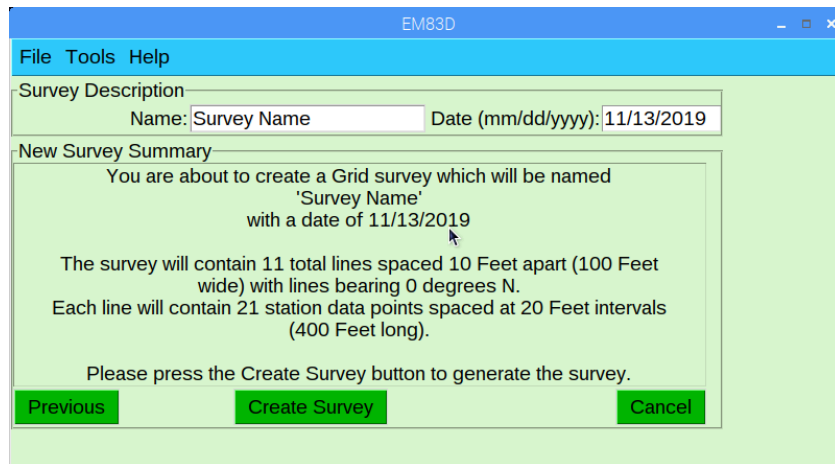
The Survey Width indicates the distance (in feet or meters, depending on User Preferences) of the total survey. In this example, 11 lines spaced 10 feet apart would produce a survey with a total width of 100 feet.

Click Next to continue to the Data Stations setup screen.

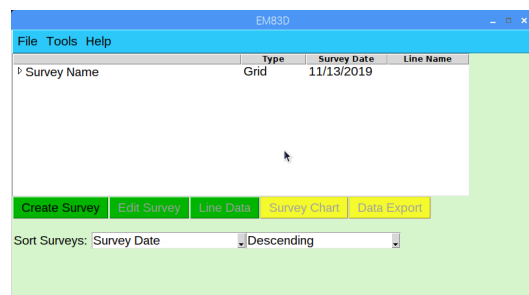
As before with the Lines Setup, use the sliders to select the number of stations on either side of “Zero” and choose the appropriate Station Separation for your grid survey. In this example, 10 stations either side of zero for a total of 21 stations (including zero), spaced 20 feet apart would produce a survey length of 400 feet.



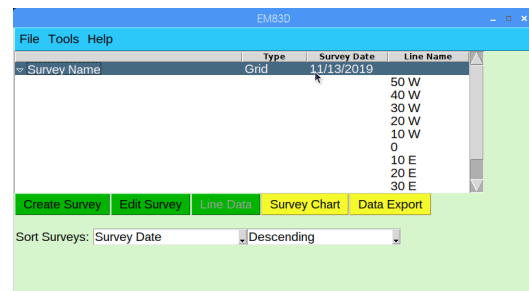
Click Next to continue to the New Survey Summary screen and finalize your new survey.



Click the Create Survey button and the survey will be created. You will then be returned to the Main Survey Screen where your new survey is now available.



Click on the survey to display the lines created in the survey.



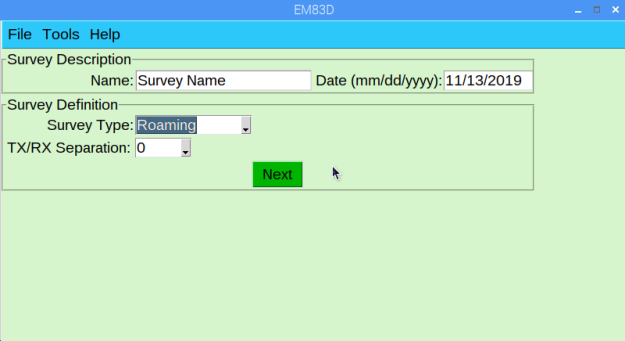
Your Grid Survey is now completed. Access the station data by choosing a Line and clicking the Line Data button.



## Creating A Roaming Survey

Many of the steps of creating a Roaming survey are the same as creating a Grid survey. Click the Create Survey button to begin.

Provide a name and date for your Survey and choose the Roaming option from the Survey Type.



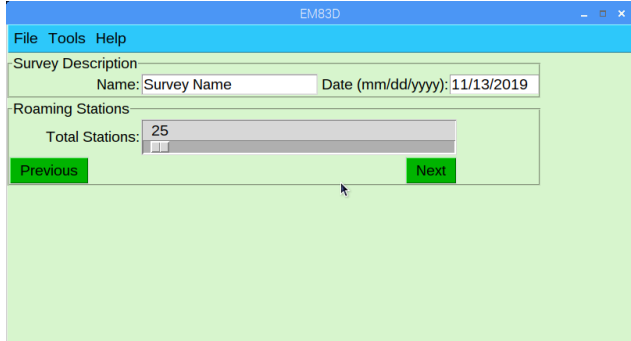
The screenshot shows the EM83D software interface. The title bar reads 'EM83D'. The menu bar includes 'File', 'Tools', and 'Help'. The 'Survey Description' section contains a 'Name' field with 'Survey Name' and a 'Date (mm/dd/yyyy)' field with '11/13/2019'. The 'Survey Definition' section contains a 'Survey Type' dropdown menu set to 'Roaming' and a 'TX/RX Separation' field set to '0'. A green 'Next' button is located at the bottom right of the 'Survey Definition' section.

Notice that the TX/RX separation field defaults to "0". This should remain "0", as the data point for a Roaming type survey is directly below the Receiver unit.

Click Next to continue to select the total number of Roaming data point stations

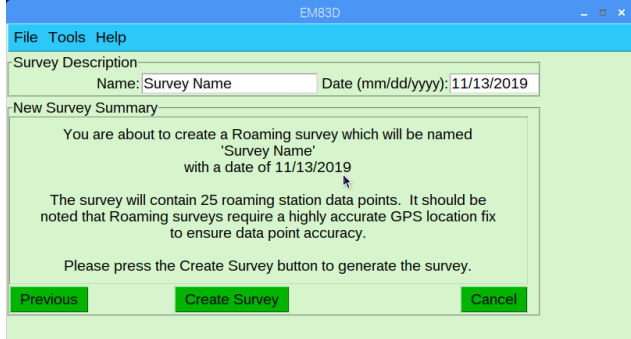
Use the Total Stations slider to move left or right to choose the total number of data point stations to create for the Roaming survey.

Click Next to proceed to the New Survey Summary screen and finalize your survey.



The screenshot shows the EM83D software interface. The title bar reads 'EM83D'. The menu bar includes 'File', 'Tools', and 'Help'. The 'Survey Description' section contains a 'Name' field with 'Survey Name' and a 'Date (mm/dd/yyyy)' field with '11/13/2019'. The 'Roaming Stations' section contains a 'Total Stations' slider set to '25'. Green 'Previous' and 'Next' buttons are located at the bottom left and right of the 'Roaming Stations' section, respectively.

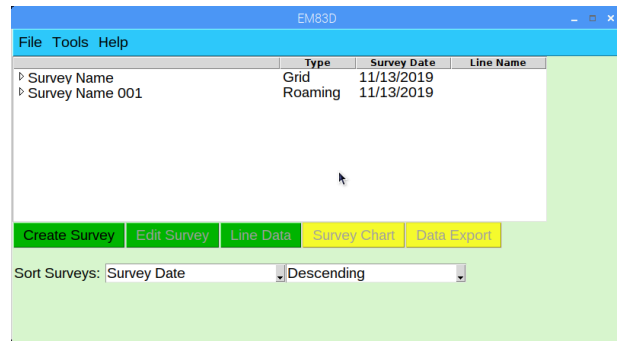
Observe the number of stations on the survey and note the GPS location fix requirement data.



The screenshot shows the EM83D software interface. The title bar reads 'EM83D'. The menu bar includes 'File', 'Tools', and 'Help'. The 'Survey Description' section contains a 'Name' field with 'Survey Name' and a 'Date (mm/dd/yyyy)' field with '11/13/2019'. The 'New Survey Summary' section contains the following text: 'You are about to create a Roaming survey which will be named "Survey Name" with a date of 11/13/2019. The survey will contain 25 roaming station data points. It should be noted that Roaming surveys require a highly accurate GPS location fix to ensure data point accuracy. Please press the Create Survey button to generate the survey.' Green 'Previous', 'Create Survey', and 'Cancel' buttons are located at the bottom of the 'New Survey Summary' section.

Click Create Survey and the survey will be created and the Main Survey Screen will appear.

The previously created Grid Survey and new Roaming survey now appear. Notice that the Roaming Survey is appended with a numeric string. This occurs if the name selected already exists in the system. As with the Grid Survey, click on the Roaming Survey name to display the single “Line”. Choose that Line and click Line Data to display Station Data.



### Creating a Quick Survey

A Quick Survey is the simplest survey to create. On the Main Survey Screen click Quick Survey. A prompt informs the user that a Quick Roaming survey will be created with specific characteristics. Click ‘Yes’ to create the Quick Survey.

The user will be prompted to confirm if the survey will use a fixed transmitter location. (See section on Fixed Transmitters).

After confirming the fixed transmitter location prompt, the user is directed immediately to the Line Data screen to begin the survey.

### Creating a Depth Survey

A Depth Survey can be created to get a pseudosection depth profile of an identified target along a particular line.

To create a Depth Survey, on the Main Survey Screen click Manual Survey and then choose Depth from the Survey Type options and any other pertinent options; then click Next.

As with the Grid Survey, select the direction of travel for the survey by moving the red indicator line around the area of the compass to choose the bearing of the line. Once the bearing is selected, click Next. (Note, the bearing cannot be changed once the survey is

completed.)

In the Depth Profile section, choose the Starting Depth by moving the slider bar to the appropriate value.

Then choose the number of depth layers to be used for the profile. For example, if the user wishes to read at depths of 20', 30', 40', and 50', select 4 Depth Layers.

Set the Layer Separation to the appropriate value. In the previous example, the user would choose 10 to indicate a distance of 10 feet between each layer.

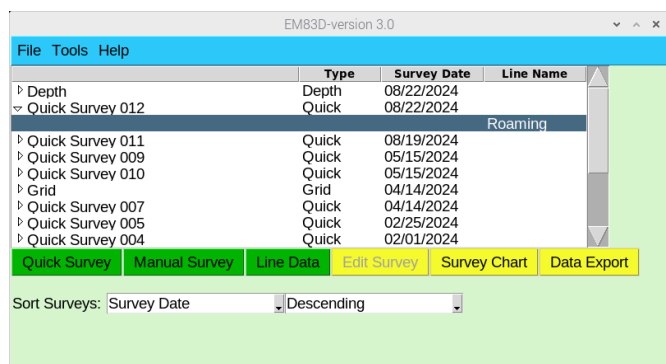
Click Next to continue to the Station setup screen.

As with the Grid Survey setup, choose the number of stations on either side of the Zero station for which data is to be collected. Then select the Station Separation distance.

Click Next to advance to the Confirmation screen.

Note that for a Depth Survey, the information indicates that 1 line will be created 1 feet apart (0 feet wide) with lines bearing in the direction selected. This is normal and indicates that only 1 line will be created with multiple depths along that line.

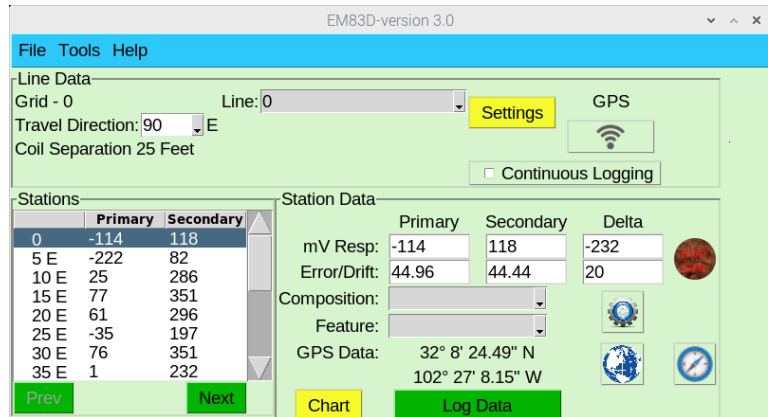
Click the Create Survey button to finalize the survey and return to the Main Survey screen.



## Line Data Screen

To access the Line Data (or collect data for a survey line), expand the Survey on the Main Survey Screen to view the lines contained in that survey. Click on the line for which data is to be viewed or collected and click the Line Data button.

The Line Data screen displays data collected for an existing survey. If data has not yet been collected, the Stations table and Station Data information will be blank and the user can begin data collection.



## Line Data Section



- Contains the Survey Name and Line number currently viewed (Grid - 0)
- The Line dropdown menu allows the user to switch between different lines in the survey.
- The Travel Direction (90 degrees East) can be switched to allow the user to change the travel direction for collecting data by 180 degrees from that which was established during the survey creation.
- The Coil Separation indicator shows the current coil separation that should be used for collecting data based on the information provided during the survey creation.
- Continuous Logging checkbox allows for continuous logging and is not normally used. This checkbox allows the system to read data continuously and is only recommended for Quick Survey types.
- The GPS indicator shows the current GPS fix status:
  - Gray: No Fix

- Yellow: Fix, but with poor accuracy
- Green: Fix with good accuracy
- Blue: Fix with excellent accuracy
- Clicking on the GPS icon will attempt to display the current GPS location
- The Settings button allows the user to access the calibration, read, and override settings for the line.

### Stations Table

	Primary	Secondary
0	-114	118
5 E	-222	82
10 E	25	286
15 E	77	351
20 E	61	296
25 E	-35	197
30 E	76	351
35 E	1	232

Prev Next

Stations for the survey are displayed along with their corresponding Primary and Secondary data values. The scroll bar on the right allows the user to scroll through station information.

The Previous/Next buttons allow for navigation between selected survey station data. Upon selecting a station by using the Previous/Next buttons or tapping on a specific station in the table will populate the Station Data section with relevant information collected for that station.

## Station Data Section

	Primary	Secondary	Delta
mV Resp:	-114	118	-232
Error/Drift:	44.96	44.44	20
Composition:	<input type="text"/>		
Feature:	<input type="text"/>		
GPS Data:	32° 8' 24.49" N 102° 27' 8.15" W		

The Station Data section displays all data logged for the selected station. The mV response for the Primary and Secondary reading and their corresponding Delta value. Data error (standard deviation) and Drift values are also displayed to help identify potential noisy readings.

The **COMPOSITION** and **FEATURE** drop down lists allow the user to select from a list of surface observed anomalies or structures to help aid in identification of landmarks.

**GPS DATA** displays the recorded GPS location for the reading

The **LOG DATA** button allows the user to read data for the selected station (also accessed by the trigger button on the receiver staff).

The **CHART** button displays a line chart for the data collected on the line.

The **GEAR** icon displays the frequency, transmitter power, receiver gain and delay/offset values for both the Primary and Secondary readings.

The **GLOBE** icon displays the GPS location information for the station.

The **COMPASS** icon displays the direction and distance from the current location to the data point location for the station.

The **MATERIAL** icon to the right of the Delta field indicates possible presence of a given material one of the following:

- Very good conductor
- Moderate conductor
- Poor conductor
- Smelted iron
- Iron ore
- Magnetite
- Cavity
- Unidentifiable



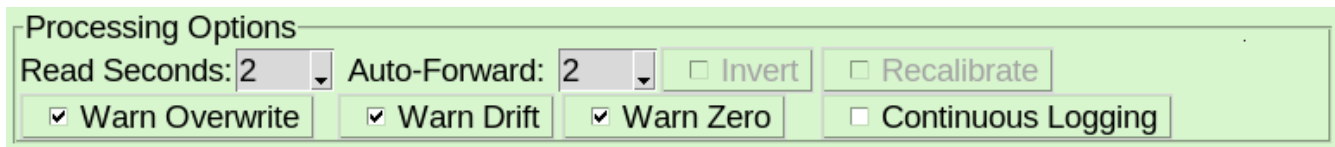
**Note that these indicator icons are suggestions for what may be present based on the data collected. Further geophysical analysis is required to verify the presence of the material identified.**

### Line Data Settings

The Setting screen displays information applicable to the current line. Information applied in the Processing Options section determines the transmission read time, the auto-forward delay, and warning options throughout the survey. Gain and Power Controls set the receiver gain and transmitter power output. Instrument Zero and Offsets are calculated during the Zero Instrument phase before collecting data and

determines the delay and zero offset values which are applied to collected data. The Test Instrument section serves to test the instrument settings after zeroing the instrument.

### Processing Options



Processing Options

Read Seconds: 2 Auto-Forward: 2  Invert  Recalibrate

Warn Overwrite  Warn Drift  Warn Zero  Continuous Logging

- Read Seconds: This setting determines the read time while collecting data for each station. The recommended value is 2 seconds. Increasing read time can help improve results in noisy environments.
- Auto-Forward: The Auto-Forward setting indicates the number of seconds the information is displayed in the Station Data field before forwarding to the next available station in the Stations table.
- Invert: This checkbox allows the option to invert data by reversing the polarity of the value received. For example, positive values that would indicate a conductor may be inverted to negative values. This is not normally changed during a standard survey.
- Recalibrate: This checkbox allows the system to recalibrate the secondary delay while zeroing the instrument. Recalibrating the secondary delay is necessary to account for changes in the background substrate between surveys and maximize performance of the material identification.
- Warn Overwrite: When attempting to read data on a station that already has existing data, a warning box is displayed. Switch this feature off by unchecking this box.
- Warn Drift: At the onset of each data reading, a drift comparison is done to determine changes in background noise that may alter the results of the data received. Unchecking this box will silence the Drift Warning error message.
- Warn Zero: When zeroing the instrument, values for the primary and secondary response are compared to verify they are within the acceptable range. If they fall outside of the acceptable range, a warning error is generated and the instrument cannot be zeroed. Uncheck this box to force the system to accept whatever zero values are read during the Zero Instrument process.
- Continuous Logging: This is available for future enhancements and should not be



used at this time.

### Gain/Power Controls



Gain/Power Controls

Auto    RX Gain:     Target:     TX Power:

- Auto: When checked the RX Gain and TX Power settings are determined by the system during the Zero Instrument process. Unchecking this option allows the user to manually set the Receiver Gain and Transmitter Power levels.
- RX Gain: This value can be changed from 0 (lowest gain) to 255 (highest gain) applied to the output amplifier for the receiver circuit.
- Target: The Target dropdown menu sets the target receiver peak response in millivolts. Normal values are between 500 and 1000 mV and are used to set the target of the automatic receiver gain and transmitter power output during the Zero Instrument process.
- TX Power: The transmitter power can be changed to either High, Medium or Low power and is set automatically using the Auto function, or can be set manually by unchecking the Auto function.

### Instrument Zero/Offsets

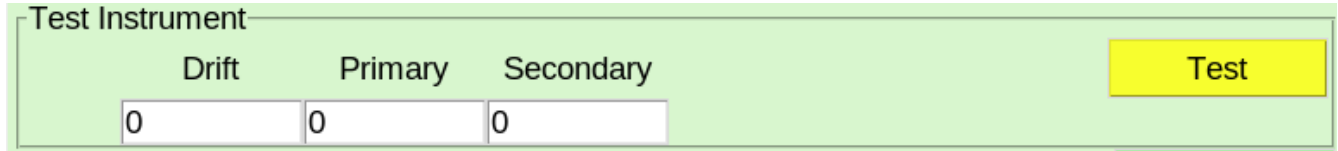


Zero	Pri. Offset	Sec. Offset	Clear Zero
<input type="text" value="1"/>	<input type="text" value="476"/>	<input type="text" value="500"/>	<input type="button" value="Clear Zero"/>

- Zero value: This is the value read by the receiver with no transmitter pulsing and is used to compare drift during the initial reading of each Station Data.
- Primary Offset: This millivolt value should be a negative number equal to one half of the Target Gain/Power Control option value. It is the midpoint reading on the response curve of the receiver input.
- Secondary Offset: This millivolt value should be a value ranging from +100 to -100 mV. Values closer to zero are normally expected and indicate a good reading.
- The above 3 fields will change to either Green (low deviation) to yellow (moderate deviation) or red (high deviation). Low noise areas may produce yellow or red results which may impact the data collected.
- Clear Zero Button: (shown here) This button can be used to clear an unacceptable zero value and try again. Before the Instrument Zero process, a yellow “Zero”

button is present here that can be used to zero the instrument before beginning a survey. Note: The Zero Instrument process is also automatic when the user clicks on the Log Data button on the Line Data screen at the beginning of each survey.

### Test Instrument



The screenshot shows a light green rectangular interface titled "Test Instrument". It contains three input fields labeled "Drift", "Primary", and "Secondary", each with the number "0" entered. To the right of these fields is a yellow button labeled "Test".

Click the Test button to read data after the Zero Instrument process has completed. Values returned for the Drift, Primary, and Secondary responses should be close to zero; though these may vary with coil separation and general background noise up to 10 to 20 millivolts.

### Fixed Transmitter Location



The screenshot shows a light green rectangular interface titled "Fixed Transmitter Location". It features a yellow button labeled "Log Transmitter Location" and a Wi-Fi icon to its right.

Used for surveys where a fixed transmitter was selected upon creation of the survey. Click the Log Transmitter Location button with the EM83D unit near the actual transmitter location to log the GPS location of the transmitter.



**Note: Before clicking this button the GPS module must be connected and have a valid fix location.**

### Open Saved Charts

Charts created can be saved in the system and then copied to a standard USB drive for offline use. When a chart is saved, it is saved in the Documents folder in a subfolder titled with the name of the survey.

The Open Saved Charts option on the File Menu will open a file browser that displays subfolders located in the /home/pi/Documents directory.

Double click on the appropriate subfolder for the survey containing the chart you wish to view.

Select the png image file you wish to open and click the OPEN button.

To close the opened chart, click the “X” in the upper right corner of the image window.

## Open Data Exports

Data can also be exported in CSV format. When a data set is exported, it is saved in the Documents directory in a subfolder bearing the name of the survey.

The Open Data Exports option on the file menu will open a file browser that displays the subfolders option on the File Menu will open a file browser that displays the subfolders in the /home/pi/Documents directory.

Double click on the appropriate subfolder for the survey containing the data you wish to view.

Select the CSV file you wish to open and press the OPEN button. The system will launch LibreOffice and display a Text Import option menu.

Ensure that only the “COMMA” option is selected in the SEPARATOR options and click OK.

The data will be displayed in a spreadsheet. To close the spreadsheet, simply click on the “X” in the upper right hand corner of the spreadsheet window.

## Exit Application

To close the application only (not power down the system), choose the File -> Exit Application option.

Note: The application can be opened again by double clicking on the desktop icon, or by choosing the EM8D icon from the EM83D menu in the green dropdown arrow menu in the upper left corner of the screen.

## Reboot System

To reboot the system, click on the File->Reboot System option. Answer YES to the confirmation box and wait for the system to power down and restart.



**Important: DO NOT unplug the power cable from the EM83D nor the battery during a reboot. Doing so may result in data loss.**

## Shutdown System

To shutdown the system, click on the File->Shutdown System option. Answer YES to the confirmation box and wait for the red light on the faceplate of the EM83D to stop blinking. It should take about 5 to 10 seconds for the unit to completely power down.

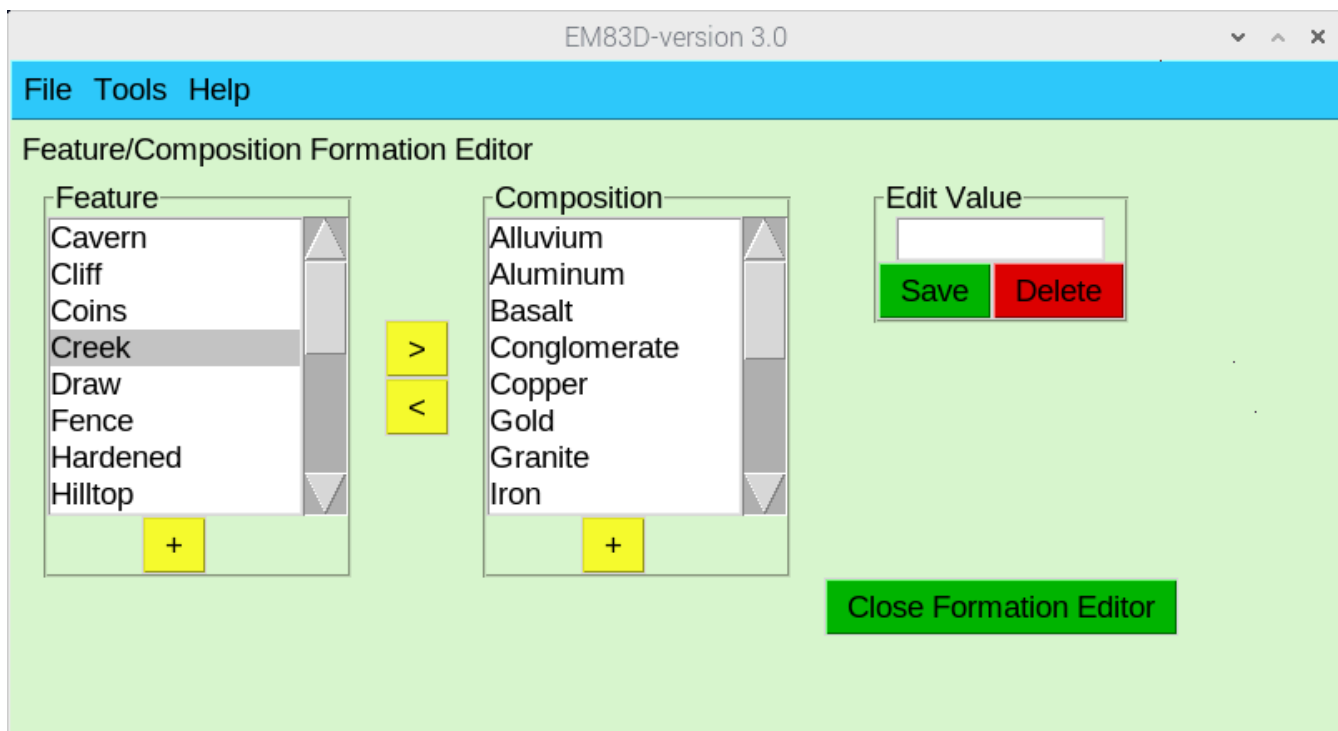


**Important: DO NOT remove the power cable until the unit completely powers down and the red light has stopped blinking for 2 to 3 seconds. Failure to do so may result in data loss.**

## Tools Menu

### Formation Editor

The Formations Editor screen is accessed via the Tools->Formations Editor menu. This



tool allows the user to add, update, or delete features and compositions that are available on the corresponding Line Data menus.

## Adding a Feature/Composition

1. To add a new Feature or Composition, click on the yellow PLUS icon below the appropriate section.
2. Type the new value in the EDIT VALUE field and press SAVE

## Editing a Feature/Composition

1. Select the Feature or Composition to edit by clicking on its value
2. The value will now appear in the EDIT VALUE field
3. Change the value as needed and press SAVE

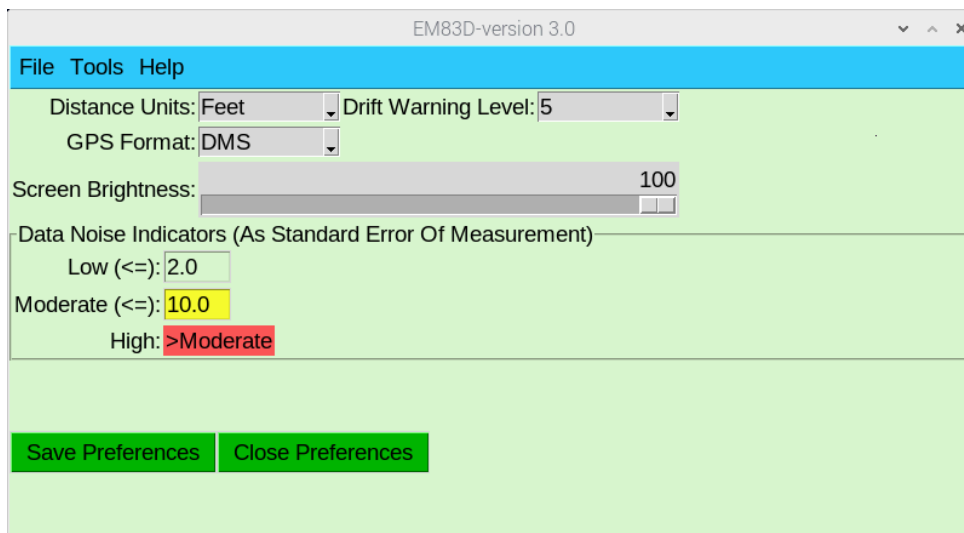
## Deleting a Feature/Composition

1. Select the feature or composition by clicking the item in the corresponding table
2. The value will now appear in the EDIT VALUE field
3. Click the DELETE button
4. Confirm the deletion by pressing YES

## Transferring Items Between Compositions and Features

1. Select the feature or composition by clicking the item in the corresponding table
2. Click on the arrow between the Feature/Composition tables to move the item to the other category table

## User Preferences



User Preferences can be accessed via the Tools->User Preferences menu option. In this screen, users can change the Distance units between Feet and Meters, change the Drift Warning Level (default 5), the GPS data format, and set the Screen Brightness.

Data Noise indicators are measured as standard errors of measurement and can be set in ascending order. By default the Low noise indicator is set at 2 and the Moderate indicator is set at 10. Any value over 10 registers as a High Noise environment. Colors of the Primary and Secondary mV fields read on the Line Data screen will change color to indicate noise level detected based on the values entered on the User Preference screen.

To save changes, click the Save Preferences button.



**Note: Lower Screen Brightness values will increase battery life during operation significantly.**

## GPS

The screenshot shows a software window titled "EM83D-version 3.1" with a menu bar containing "File", "Tools", and "Help". The main content area is titled "GPS" and displays the following information:

My Location:	31° 54'XX.XX"N	102° 20'YY.YY"W	3D Fix - 7 Satellites
GPS Error +/-:	205.0 Feet	329.0 Feet	Found WAAS 138
Altitude:	2882.3 Feet		
Local Time:	2024-08:25 07:54:35 CDT		

Below the data is a "Destination" section with two rows of input fields:

Target Location:		
Bearing/Distance:		

At the bottom of the screen are two buttons: "Reset GPS" and "Close".

The GPS Screen allows for viewing of the current GPS location along with error margins, altitude and reported local time. The display to the right of the location information

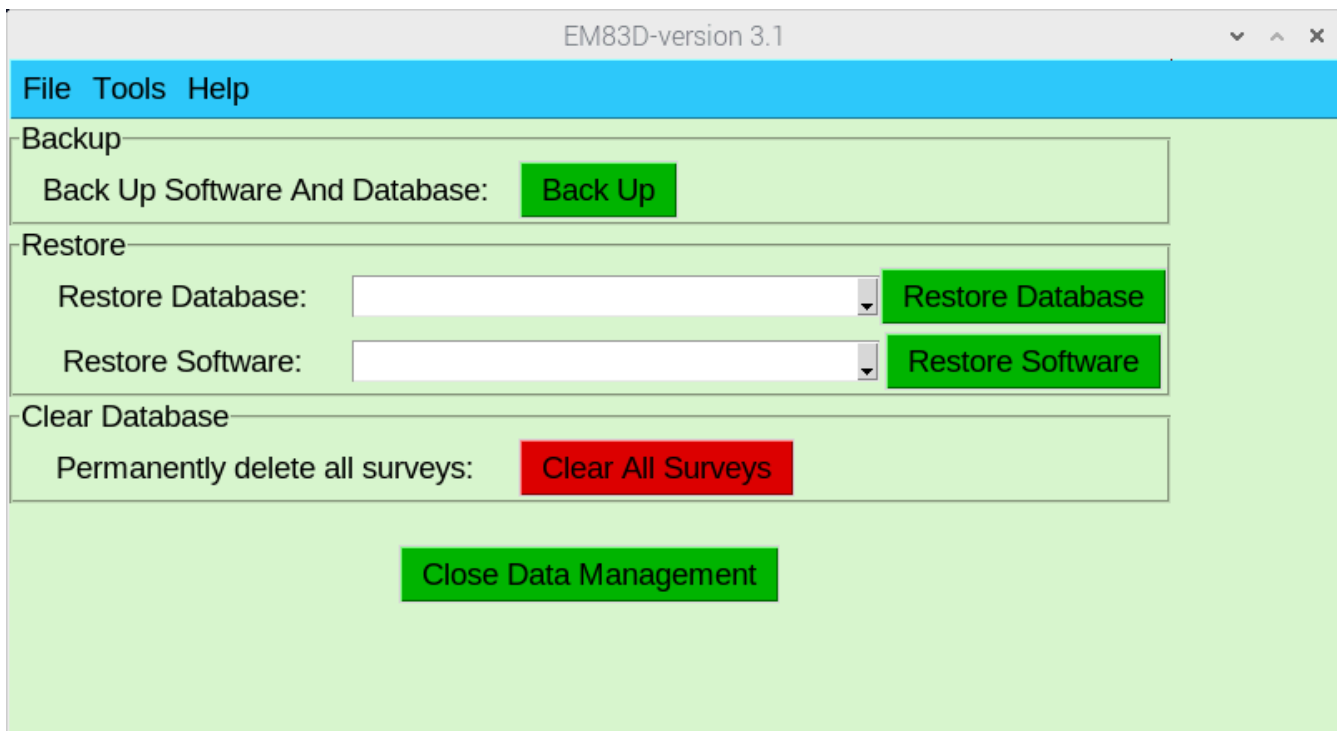
provides the detail of the number of satellite fixes acquired and supplemental navigation WAAS systems.

The Destination section is entered by clicking on the COMPASS icon for a given station in the Line Data screen for which a GPS location has been recorded.

If the GPS system should stop functioning, or the GPS puck is connected after the unit is powered up, click the RESET GPS button to reset the connection.

Once a GPS signal is acquired, the system time will be updated to reflect the current reported GPS time.

## Data Management

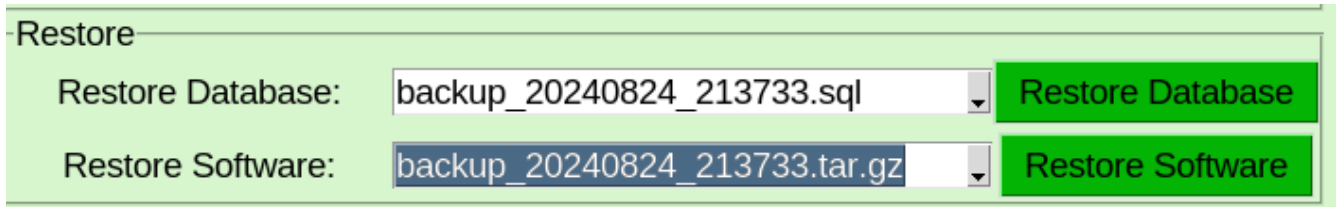


The Data Management screen is accessible via the Tools->Data Management menu. Backups of both the Database and installed Software are performed by clicking the Backup button. Data backups are saved in the /home/pi/Backups folder and should not be deleted.

If data restoration becomes necessary, the user should restore both the database and

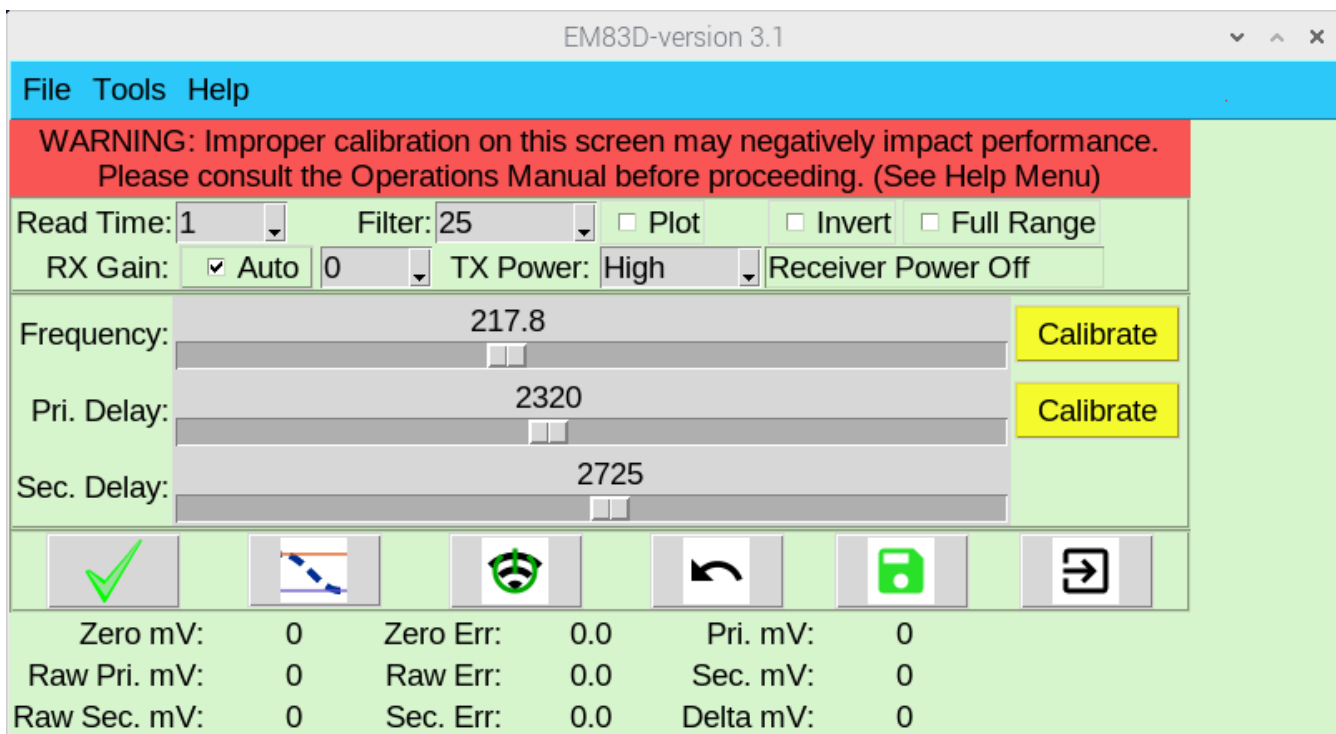
corresponding software from the same backup period.

For example, to restore the backup completed on August 24, 2024 at 9:37:33, the user should select BOTH the Database from the RESTORE DATABASE dropdown menu and the Software from the RESTORE SOFTWARE sections. Restore the Database first, then the Software, then reboot the system for the changes to take effect. After selecting the appropriate filename, click the RESTORE button for each package.



The CLEAR ALL SURVEYS button can be used to PERMANENTLY DELETE all surveys contained in the system. It is recommended that the user first complete a full BACKUP before deleting all surveys in the system.

## System Calibration







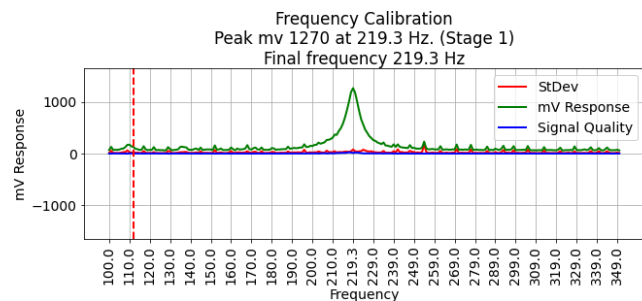
**IMPORTANT: System Calibration is performed at the factory and should not need to be adjusted by the user. The information provided in this section is technical in detail and users should contact Geo-Western support prior to performing a system calibration.**

The SYSTEM CALIBRATION screen is accessible from the Tools->System Calibration menu. The preferences below control the parameters for the calibration:

- Read Time: Data collection read time in seconds for each calibration step (default is 2 seconds)
- Filter: Filtered values used for data collection. For example, the default 25 corresponds to collecting the top 25% of recorded samples and averaging that data to produce a corresponding reading.
- Plot checkbox: Chooses whether to plot the Frequency calibration, the Delay Calibration (Pri and Sec) as well as a sample reading taken using the GREEN CHECKMARK button.
- Invert checkbox: Inverts data collection during the Primary and Secondary delay calibration for wired systems. This should be checked during the Delay Calibration
- Full Range: Scans the full range of frequencies to find the peak frequency. Normally the scan is limited to -15Hz to +15Hz of the currently selected Frequency value
- RX Gain AUTO: Attempts to automatically select the Receiver Gain for the calibration steps. Leave the AUTO checkbox selected to attempt an automatic detection, or uncheck the checkbox and select the gain from 0 to 255 in the dropdown menu
- TX Power: Selects the output power for the calibration as either LOW, MEDIUM, or HIGH.

## Frequency Calibration

To perform a Frequency Calibration, click the CALIBRATE button to the right of the Frequency slider. The preferences are applied and a sweep of the frequency range will occur. The peak frequency is detected. If a



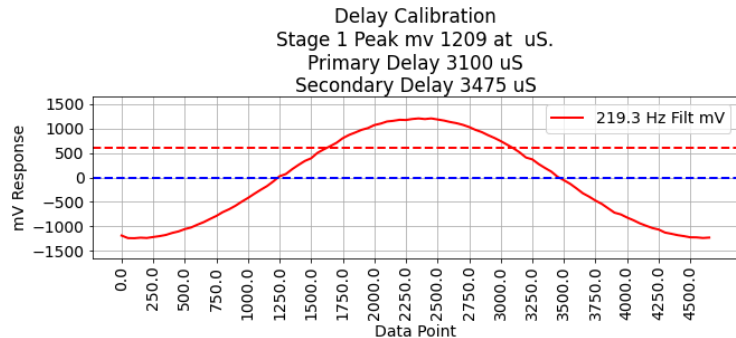
plot is selected, the plot is displayed showing the selected frequency for calibration:

## Delay Calibration

Data is collected at two points along the received signal curve, once at the Primary Delay microseconds and once at the Secondary Delay microseconds. These data produce the Primary and Secondary mV responses while collecting data.

The Primary Delay point should be halfway between the peak of the curve and Zero while the Secondary Delay point should be at the first Zero point following the Primary

Delay. These values are crucial for accurate data collection and material identification. A well-balanced Delay curve as shown here with the 0.0 data point being near the trough of the curve and the peak at the midpoint of the data points indicates a good frequency calibration and properly tuned system.



After completing the calibration, click the Save Calibration button on the prompt to save the settings.

## Read Calibration Sample Data

Click the GREEN checkmark button on the Actions menu to read data collected after calibration has been completed. Collected data is displayed in the data details at the bottom of the screen.



## Read Peak Signal Data

Click the charted Peak Signal button on the Actions menu to read the peak signals of the receiver signal. Note: These values should be well-balanced between positive and negative values (Max Val, Min Val) indicating a properly



performing system. For a properly selected RX Gain and TX Power, the received values should not exceed 1500 mv for the Max mV and not less than -1500 for the Min mV. A variation of up to 50 mV between the absolute value of these two values is acceptable

## Restore Factory Calibration


To restore the Factory Calibration values, click the UNDO button on the Actions menu. Confirm the restoration of the factory values by clicking YES on the confirmation box.



## Save Calibration Values

After performing both a Frequency and Delay calibration, click the GREEN save button to save your values.




 **Note:** *If the values are not saved, the system will revert to the previously saved values upon restarting the software, or the user may choose to restore the factory calibration, if performance is not as anticipated.*

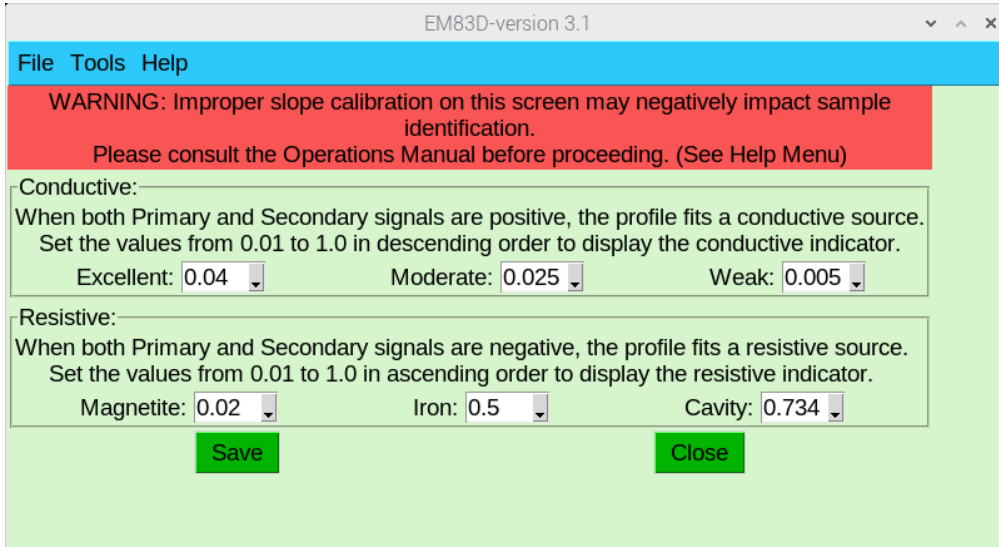
## Exit Calibration Screen

Click the Exit Button to exit the Calibration Screen.



 **Note:** *Any changes to calibration values that have not been saved will not be available once the software is restarted.*

# Sample Calibration



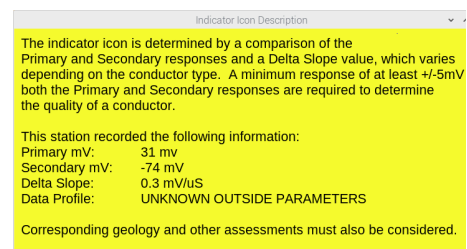
The Sample Calibration screen is accessible from the Menu->Tools icon. The data on this screen is used to display the Material Identification icon on the Line Data screen. Sample Calibration is separated into two sections: Conductive targets and Resistive targets.


The values are set at the factory and can be reset by the user as needed to enhance material identification accuracy, but should be in the range of the values listed above.

The values are a calculation derived from the slope of the curve as  $(\text{Pri mV} - \text{Sec mV}) / (\text{Pri Delay } \mu\text{S} - \text{Sec Delay } \mu\text{S})$ . To determine the proper values for your machine and recalibrate these settings, collect data on a survey by placing a target sample on the receiver coil with a transmitter/receiver coil separation of 50'. Read three to five samples of a given target and press the Material Icon displayed.

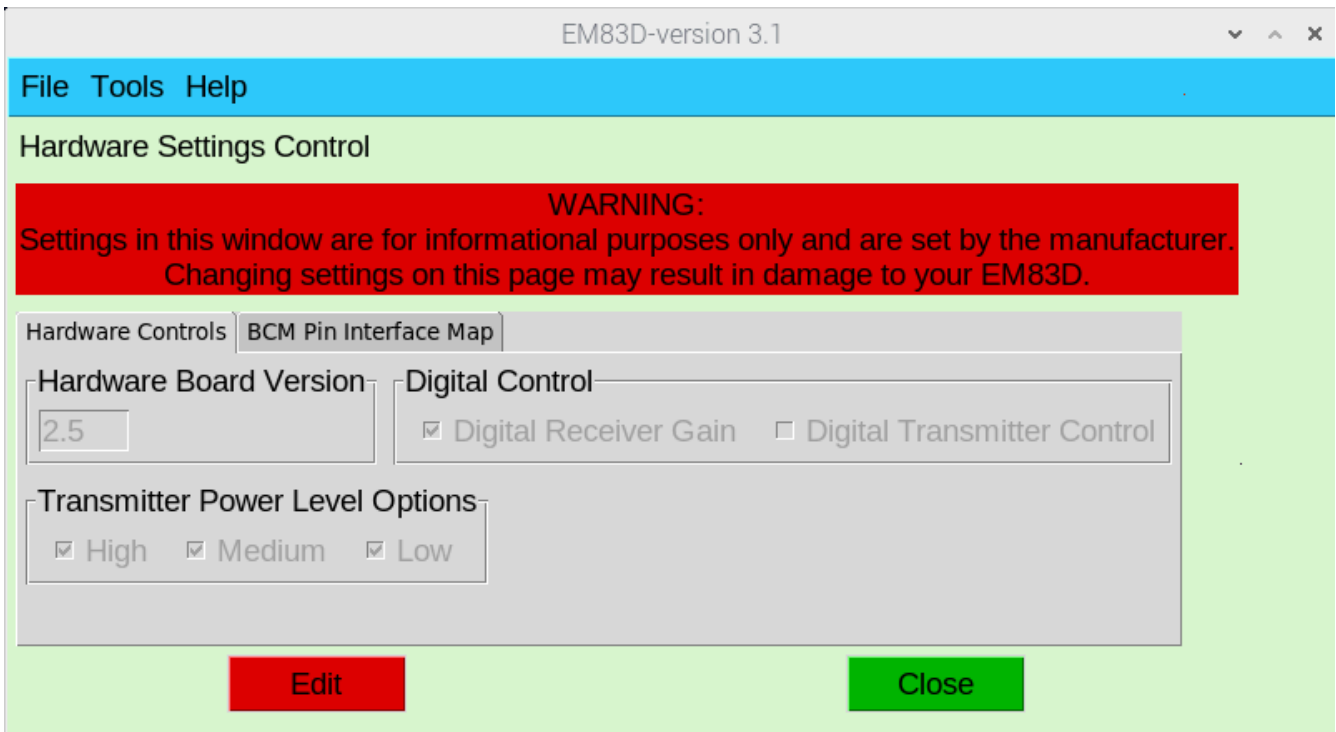
Average the Delta Slope mV/ $\mu$ S values for the readings and log these into the appropriate sample type.

Clicking on the Material Icon displayed on the Line Data screen shows the following information for that data point:



 **Note: Material Icons are for informational purposes only and are estimates based on collected data. Corresponding geology and other assessments should be considered to determine actual target type.**

# Hardware Settings



***Important: The Hardware Settings Control screen is set by the manufacturer and should not be changed unless explicitly advised by the manufacturer to do so.***

## Help

### Operations Manual

An electronic copy of this Operations Manual can be displayed by clicking on the Help->Operations Manual menu

To close the Operations Manual, click on the X in the upper right hand corner of the document.

### Local IP Address

When connected to a 2.4GHz WiFi system, the current IP address of your device can be located by clicking on the Help->Local IP Address button. This may be useful when setting up a connection via SFTP to the device to download images or data exported from the system.

## **Check For Updates**

The software on your EM83D can be updated when a new version is released to add enhancements to your system. To perform an update, ensure that you are connected to the internet and click on the Menu->Help->Check For Update menu bar item.

If an update is available, you will be prompted to update your software. During the update process a backup of your current database and software is automatically saved to your system.

Allow the update to complete the process and you will be prompted to reboot your system for the changes to take effect.

In the event you experience an issue with a software update, please contact Geo-Western for support.

## **About**

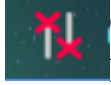
The About screen on the Menu->Help->About menu displays the model number, serial number, current software version and current database version for your system. You may be asked for this information when contacting Geo-Western support.

## Appendix 1: Starting A New Quick Survey

1. Connect the GPS module
2. Connect the Transmitter cable to the EM83D Transmitter input
3. Connect the Transmitter cable to the Transmitter coil
4. Connect the Receiver cable to the EM83D Receiver input
5. Connect the Receiver cable to the Receiver coil
6. Turn on the Power Supply and select the appropriate 12V battery output
7. Connect the Power Supply to the battery and the EM83D unit
8. Wait for the software to load
9. On the Main Survey Screen, click Quick Survey to create the survey
10. Click YES on the Create Quick Survey confirmation box
11. Click YES or NO on the Fixed Transmitter Location confirmation box
12. When the Line Data screen loads, click the Log Data button (or depress the Receiver staff trigger switch)
  - a. The Log Data button will launch the Zero Instrument function before reading the first station.
13. Move to the next data station
14. Click the Log Data button (or depress the Receiver staff trigger switch)
15. Continue steps 13 and 14 until all data for the survey has been collected
16. Press the Chart button on the Line Data screen to display a line chart of the collected data.

## Appendix 2: Peripheral Devices

### Connecting To A Wifi Network



Connection to a Wifi network is easy. Just click on the Network connection icon located in the top right corner of the Desktop, choose “Turn On WiFi”, if necessary, and choose the 2.4GHz WiFi network to which you wish to connect then type in the password for the network and click OK

When the connection is established, the Network connection icon will display the wireless connection icon:



### Connecting The External Wireless Keyboard/Mouse

To connect the external wireless keyboard/mouse, locate the dongle and plug it into one of the two available USB ports. Insert batteries into the wireless keyboard and power it on. Connection should occur automatically.

If connection does not occur automatically, check the keyboard batteries and power switch, or use the Solaar software located in the Main Menu under Accessories to scan for and pair the new device.

### Connecting the GPS Receiver



**Note: Before powering on the unit, connect the GPS Receiver to ensure it is recognized by the software upon powering on the EM83D. If connecting the GPS Receiver after the EM83D has been powered on, you will need to access the Tools->GPS menu on EM83D software and press the RESET GPS button after connecting the receiver.**

Remove the included GPS Receiver module and plug the USB into an available USB port. The GPS Receiver will be activated automatically. The red indicator light on the GPS Receiver will remain solid red for a period of time while satellites are located and then will flash once every second after a location fix has been attained.



## Appendix 3: Retrieving Data From Your EM83D

### Using An SFTP Client

Users may choose to access their device using an SFTP client like FileZilla. Create a connection by following the software instructions for your preferred client and connect to the Local IP Address (found in the Menu->Help->Local IP Address).

Connection Type: SFTP over Port 22

User Name: pi

Password: em83D

To avoid unintentional damage to your system, limit access to the /home/pi/Documents folder. All exported survey data and survey charts are saved in subfolders in this directory.

### Using a USB Thumb Drive

Plug in a USB thumb drive into any available USB port and use the file explorer to copy files from the /home/pi/Documents directory to the thumb drive for offline access.

To avoid unintentional damage to your system, limit access to the /home/pi/Documents folder. All exported survey data and survey charts are saved in subfolders in this directory.

## Appendix 4: Technical Support

For support or assistance, please contact Geo-Western:

Telephone +1 (801) 566-8479

Website: <https://geo-western.com>

Email: [sales@geo-western.com](mailto:sales@geo-western.com)

Be prepared to provide the product serial number, model number, and a detailed description of the issue.