Profiler Manual

MN37-230 Rev D

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Before returning any equipment to GSSI, a Return Material Authorization (RMA) number must be obtained. Please call the GSSI Customer Service Manager who will assign an RMA number. Be sure to have the serial number of the unit available

FCC Class B Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment or residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the introduction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

Shielded cables must be used with this unit to ensure compliance with the Class B FCC limits.

Canadian Emissions Requirements

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numerique de la classe A est conforme a la norme NMB-003 du Canada.

Declaration of CE Conformance

The Profiler EMP-400 has been certified to meet the requirements of the following European standards:

EN61326:1997, A1:1998, A2:2001

Table of Contents

Chapter 1: Introduction

This manual is provided as an operational reference tool. It is highly recommended that the User read the entire manual regardless of your level of experience with electromagnetic induction instruments. Appendix C is a summary of the basic steps in conducting an EM survey. For additional information on EM theory and applications please review the list of references, which can be found in Appendix E.

Unpacking Your System

Thank you for purchasing a GSSI Profiler™ EMP-400 electromagnetic induction (EM) instrument, hereinafter referred to as the Profiler. A packing list was included with your shipment which identifies all of the items that are in your order. If you find that an item is missing or damaged during shipment, please call or fax your sales representative immediately so that GSSI can take steps to correct the problem.

Your EMP-400 system (Standard Configuration) includes the following items:

1 – EMP-400 Transit case (large). This includes:

1 – Profiler EMP-400 digital electromagnetic induction instrument
1 – Low carry handle and mounting clamps
1 – Hip height padded shoulder carrying strap and mounting straps
1 – EMP-400/Recon-400 PDA mounting bracket and clamp

1 – EMP-400 Transit case (small). This includes:

1 – TDS Recon PDA with integrated Bluetooth service and WAAS GPS module
1 – AC rechargeable power boot module for Recon-400 PDA
1 –120 V AC re-charger for Recon-400 power boot module
(See PDA manual for Input/Output specifications for International AC charger)
1 – Battery charger for EMP-400 Li-Ion battery
1 - AC power cord for AC battery charger power supply
2 – Re-chargeable Li-Ion batteries for EMP-400
1 – PDA stylus pen and lanyard
1 – USB data transfer cable
1 – Spare stylus pen
1 – Package of PDA screen protectors (10 count)
1 – Recon-400 hand strap
1 – User's Manual
1 – User's CD containing the Profiler EMP-400 backup calibration files, Geometrics MagMap2000 software and a *.PDF copy of the User's Manual, the Profiler File Transfer Utility Program and the MagMap 2000 manual
1 – TDS Recon Getting Started Guide
1 – TDS Recon Companion CD
1 – OEM copy of Microsoft® Windows Mobile™ 2003 software for Pocket PC's

General Description

Electromagnetic induction instruments are used for many different types of geologic, engineering and environmental investigations. These include shallow soils mapping, soil-salinity mapping, ground water investigations, the detection and delineation of waste pits and associated subsurface contaminants from acids, salts or volatile organic contaminants (VOC's). They have also been used extensively for the detection of conductive geologic media such as clays and ferrous mineral deposits, as well as the detection of resistive geologic materials such as sand and gravel deposits. In addition, the systems are used for near-surface archaeological investigations, the detection of buried structures such as building foundations, as well as for the detection of buried metallic objects such as drums, tanks, large diameter utilities and other non-descript metallic objects.

The major system components are the Profiler, the Profiler battery pack and the TDS Recon-400 PDA. These are illustrated in Figures 1 through Figure 11.

The Profiler is a portable, digital multi-frequency electromagnetic induction sensor. The User can collect from one (1) to three (3) frequencies simultaneously. The system bandwidth extends from 1 KHz to 16 KHz, in 1 KHz steps. The system's primary data output is the In-Phase and Quadrature components of the mutual coupling field ratio of the transmitted field to the induced field in parts per million (PPM) at all frequencies, and the apparent conductivity (σ_a) at 15 kHz. The magnitude of the In-Phase and Quadrature components of the induced secondary field, as well as the apparent conductivity are stored for each reading along with a time stamp and user supplied survey grid information. GPS data, in the form of a NMEA 0183 GGA string, is also recorded if the internal GPS is enabled or if an external GPS system is connected with the PDA via the PDA RS-232 serial port.

The Profiler sensor electronics are controlled from the PDA via a wireless Bluetooth™ communications interface. The system user interface and data storage are incorporated into the TDS RECON-400 Personal Digital Assistant (PDA) provided with the system. The instrument weighs 10 lbs. (4.535 kg). The system coil configuration is Horizontal Co-Planar (HCP). The inter coil spacing is 4 feet (1.219 meters). Data can be collected in both the vertical (VDM) and horizontal (HDM) dipole modes. The Profiler is powered by a re-chargeable Li-Ion battery pack. The PDA is powered by an AC rechargeable power pack. The PDA is configured with an integrated 22-channel WAAS (Wide Area Augmentation System) GPS.

The Profiler EMP-400

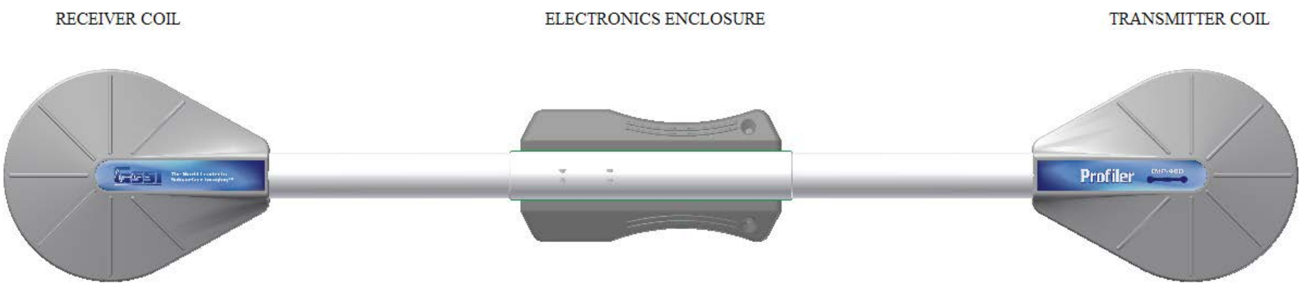


Figure 1: Profiler EMP-400 top view.

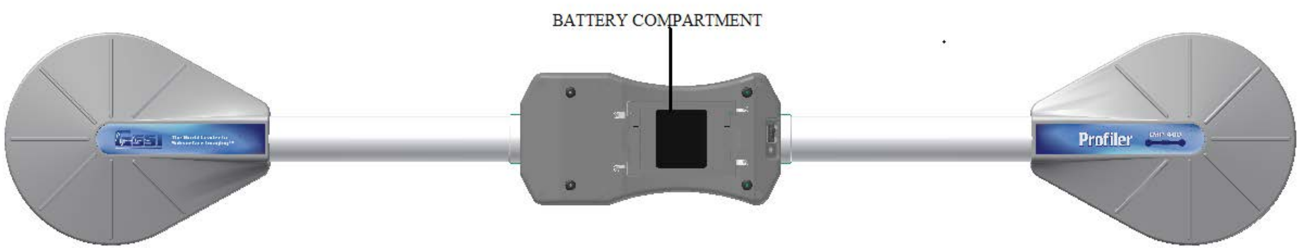


Figure 2: Profiler EMP-400 bottom view.

The Profiler has no external connectors or I/O ports. An expanded view of the Profiler electronics enclosure is illustrated in Figures 3 and 4.

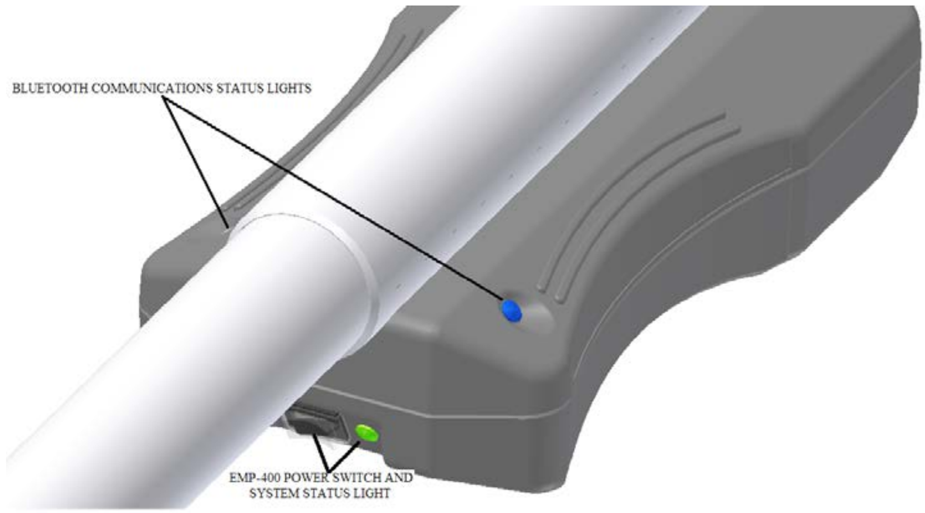


Figure 3: Profiler top view showing the location of the system power switch, Bluetooth communications status and system status lights.

The Profiler is powered by re-chargeable Li-Ion batteries. The batteries are accessible via the removable battery pack located on the bottom of the electronics assembly.

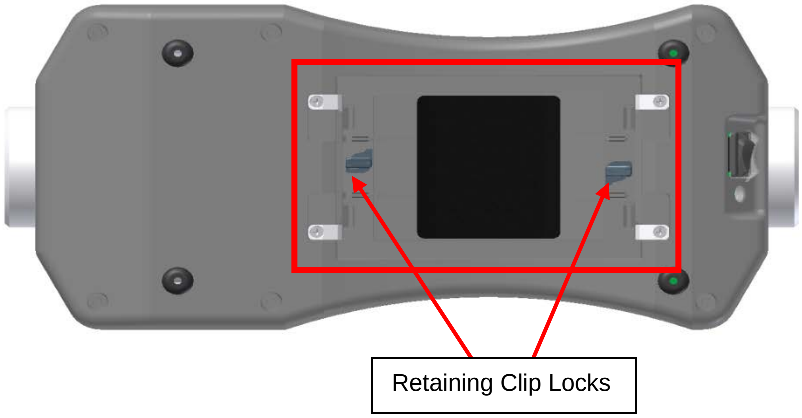


Figure 4: Profiler Electronics Assembly bottom view showing the location of removable battery pack outlined in red.

The Profiler Removable Battery Pack

The battery pack is removed from the unit by gently pulling the removable battery pack retaining springs towards each other i.e., towards the center of the battery pack, until they snap out from beneath the four (4) retaining clips screwed into the bottom of the electronics. The locks on the battery pack retaining clips prevent the clips from accidentally opening when the electronics enclosure base brushes against tall grass, field stubble, or other near-surface objects. Engage the locks by turning the clip locks 90 degrees clockwise. The operator can use the reverse end of the PDA stylus as a tool to turn the locking tabs.

- The removable PDA battery pack accepts the 10.8 VDC Li Ion batteries provided with your system. Operation time of the Li Ion battery on a single charge is ~ 9 - 12 hours of continuous use when operating at one measurement per second at ambient temperature of 59° F to 95° (+15o C to +35o C). Operation time of the Li Ion battery on a single charge is 18 hours when operating at one measurement per second at ambient temperature of 77° F (25o C). Life expectancy is 300 charge/discharge cycles. The discharge temperature limits are -14°F to 122° F (10° C to +50°C). The storage temperature limits are -4°F to 140°F (-20° C to +60° C).
- Fully charged battery status is indicated by five (5) rectangular black squares located on the battery charge gauge on the end of the battery opposite the five (5) battery contact slots.

The Profiler Li Ion batteries should be placed in the Li Ion charger when the battery charge gauge reaches one square. The time required to recharge a battery is three and a quarter hours for a fully discharged battery.

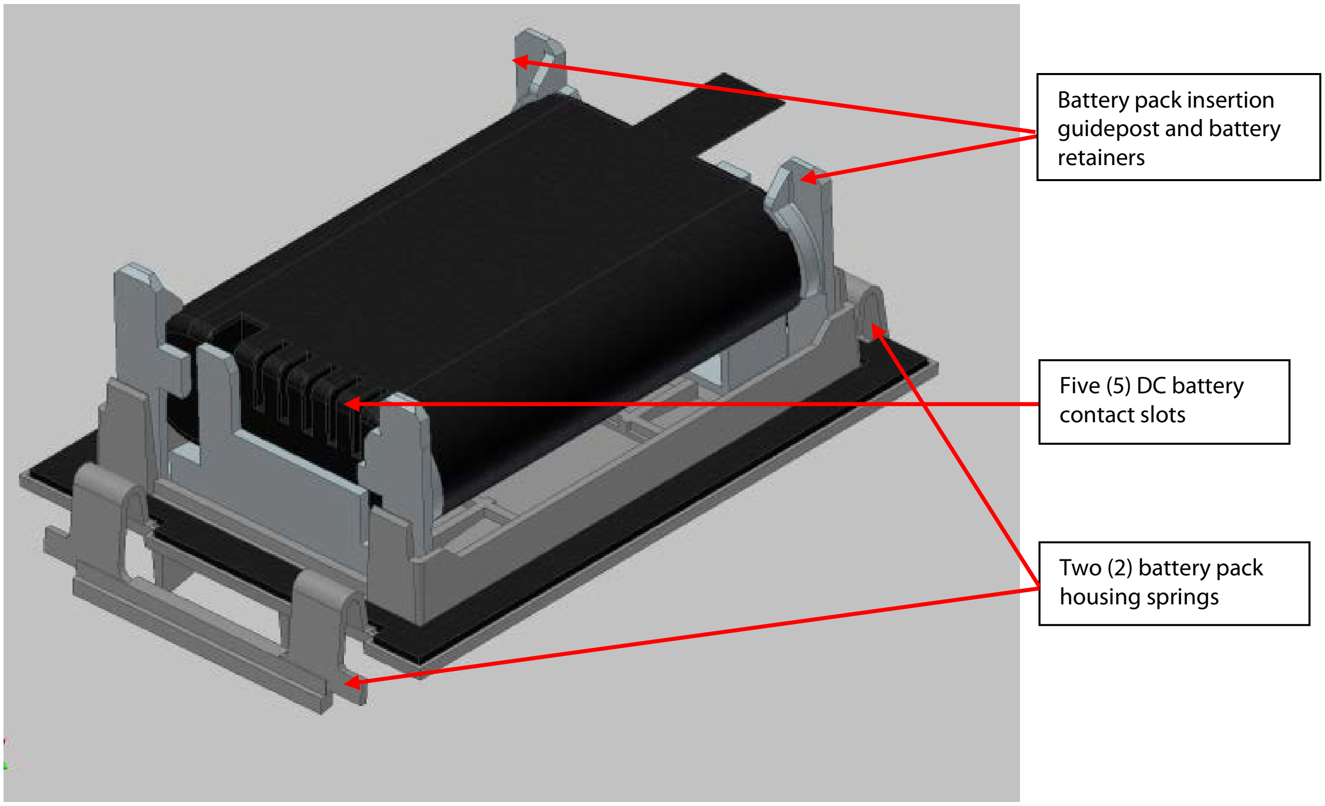


Figure 5: Re-chargeable Li-Ion battery pack and removable battery pack housing.

Installing the EMP-400 Batteries

1 The Li Ion battery is inserted into the Profiler battery pack by inserting the battery and gently pinching the battery pack housing springs back until the battery snaps into place.

2 The battery pack is then inverted and then inserted into the electronics enclosure. The User should gently squeeze the battery pack retaining clips and then insert the battery pack into the Profiler electronics assembly using the insertion guideposts.

3 The battery must be installed into the removable battery pack correctly. The five (5) DC contact slots on the Li Ion should align with the DC battery terminals located on the electronics assembly board inside the removable battery pack enclosure. The battery should be inserted so that the five (5) battery contact slots are facing UP.

4 Press gently on the top of the battery pack until the retaining springs click into place. Be certain the clip locks have been rotated counter-clockwise (unlocked) before pressing on the retaining springs. The pack can be removed by gently pinching the battery pack housing springs until the springs un-snap from beneath the four white battery pack housing clips.

5 The system can now be turned ON by pressing the power button located at the front of the electronics assembly. The **Green** power LED should illuminate. This indicates that the system is receiving power from the battery pack and that the voltage level of the batteries is sufficient to operate the system.

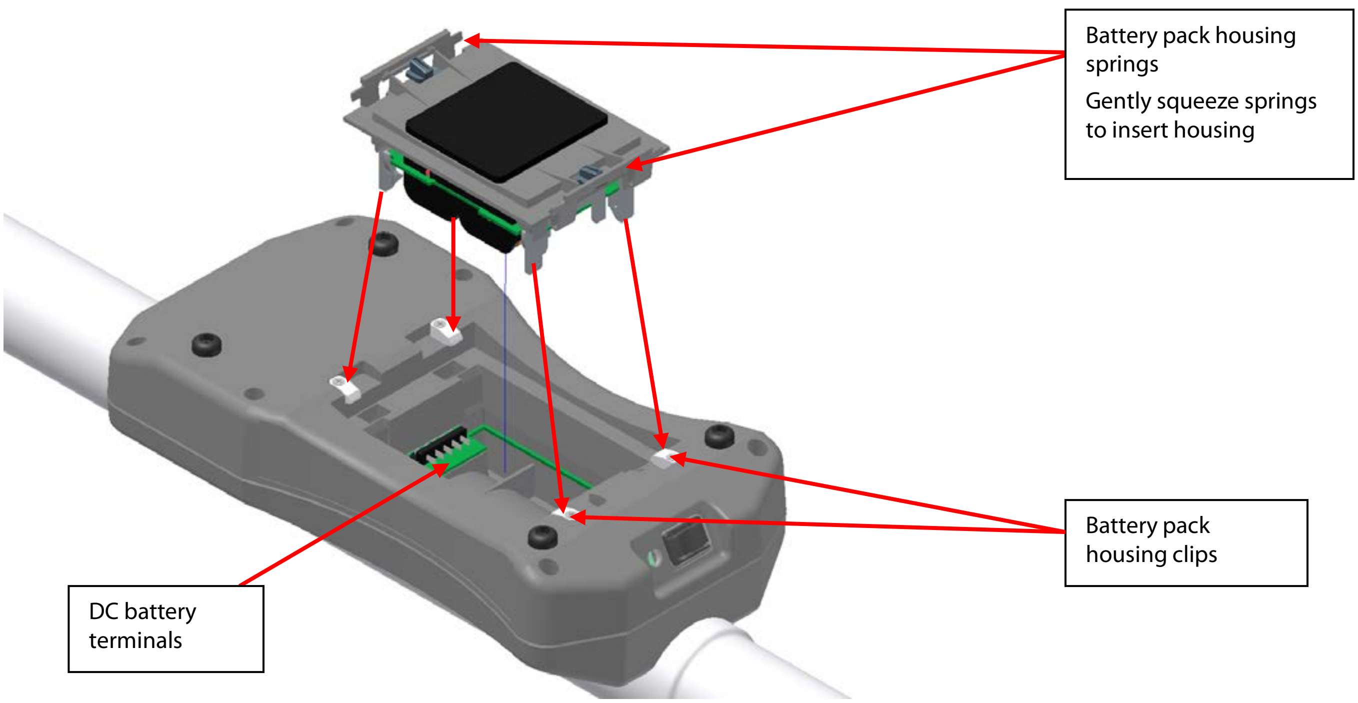


Figure 6: Inserting the removable battery pack into the EMP-400 electronics.

TDS Recon-400 PDA

The Tripod Data Systems (TDS) Recon-400 is a portable, field rugged PDA. It is the platform for the Graphic User Interface and data storage of the Profiler.

Caution: GSSI assumes no responsibility for Profiler interface operating difficulties if the User installs any additional third-party software in the Profiler PDA or reconfigures the PDA Bluetooth™ connection for operation with any other devices.

Specifications

- The Recon-400 incorporates an Intel PXA255 X Scale CPU running at 400 MHz.
- It is configured with 64 MB high-speed SDRAM and 256 MB of non-volatile storage.
- The system display is a 240 X 320 pixel (1/4 VGA) color TFT display with LED front light.
- It is configured with integrated Bluetooth® communications and a 22-channel WAAS GPS receiver.
- Available Profiler PDA user storage memory is 248 MB. The system is capable of storing 500,000 readings in both continuous mode and discrete mode.
- The PDA weighs 17 ounces (.481 kg) and has an operating temperature range of -22°F to – 140°F (-30°C to +60° C). Storage temperature limits are -40 to 158° F (-40 to +70° C). Battery life is 500 charge/discharge cycles (typical) if battery is stored at least partially charged at 32°F – 95°F (0° to +35° C).
- The system meets MIL-STD-810F standards for humidity, water (accidental immersion), drop, vibration, humidity, and altitude. It has an IP67 rating and is impervious to water and dust.
- A rechargeable 3800 mAH NiMH DC power boot module.
- Input/Output and power ports include a D-shell RS-232 serial port, a USB data port, and AC charging connector for the AC power boot module.
- The Operating System software is Windows™ Mobile 6.0 (or higher).

Figure 7: TDS RECON-400 keypad layout.

TDS Recon-400 PDA Connectors

The TDS Recon-400 has three (3) primary connectors: One (1) AC battery charger connector, One (1) D-Shell RS-232 serial port connector and one (1) USB data port.

Figure 8: TDS RECON-400 connectors.

TDS Recon-400 PDA Power and Batteries

The Recon-400 Windows operating system has on board power management and a battery gas gauge. The User should place the PDA on charger upon unpacking the instrument. The Windows operating system is stored in non-volatile memory. GSSI recommends placing the PDA on the charger for several hours after every survey or when the PDA battery gas gauge reads 25% or less.

- PDA battery level information is accessible by selecting the Windows Start tray icon and selecting the Settings option.
- Select the START > Settings > System tab and select the Clocks & Alarms icon to access the clock settings for the PDA. Set the appropriate time for your location and the appropriate date prior to collecting data with the system.
- The On Battery Power device shutdown parameters been turned OFF at the factory to prevent inadvertent shutdown of the system and display and to prevent interruptions of Bluetooth communications during a survey. **The User should not modify these settings.**
- The On Battery Power device shut down and On External Power device shut down parameters for the Screen Power and Backlight Brightness have been set at the factory to prevent inadvertent shutdown of the system, and display and interruptions of Bluetooth communications during a survey. **The User should not modify these settings.**
- The Sounds and Notification parameters have been set at the factory. The User should not modify these settings.
- When using the AC rechargeable power boot module, under normal operating conditions, the Recon-400 should operate for up to 4.5 - 5 hours. When using the WAAS GPS system, operating time drops to ~2.5 - 3 hours.
- Operating the PDA with less than 25% battery power may result in intermittent loss of Bluetooth communication and potential loss of data. GSSI recommends that the PDA power boot module be recharged when the power level reaches 25%.

Caution: Under no conditions should the user modify the PDA Screen parameters. The window orientation is set at the factory to Portrait by default. Changing the window orientation could lead to unpredictable operating display results when running the Profiler interface. **GSSI assumes no responsibility for Profiler interface operating problems if the display orientation is changed by the user**.

Caution: The PDA should not be placed on the charger for longer than a 12 hour period. Charging the PDA Power Boot Module for longer than 12 hours repeatedly may damage the power boot module.

TDS Recon-400 Power Boot Module and AA Power Boot Module

The Recon-400 is supplied with the rechargeable power boot module installed. The power module can be removed from the PDA by turning the module locking tabs to the unlocked position. The Recon PDA is supplied with a screen stylus that has a screwdriver tool opposite the stylus end. This tool is used to lock and unlock the power boot modules and the protective cap for the WAAS GPS card. The modules can be secured by returning the locking tabs to the locked position. The location of the locking tabs is illustrated in Figure 10.

The AA power boot module accepts two (2) AA batteries. Under normal operating conditions and with the appropriate batteries, the AA power boot module will operate for approximately 2-3 hours. When using the WAAS GPS, the PDA operating time drops to .5 hours.

Figure 9: PDA AA power boot module (front).

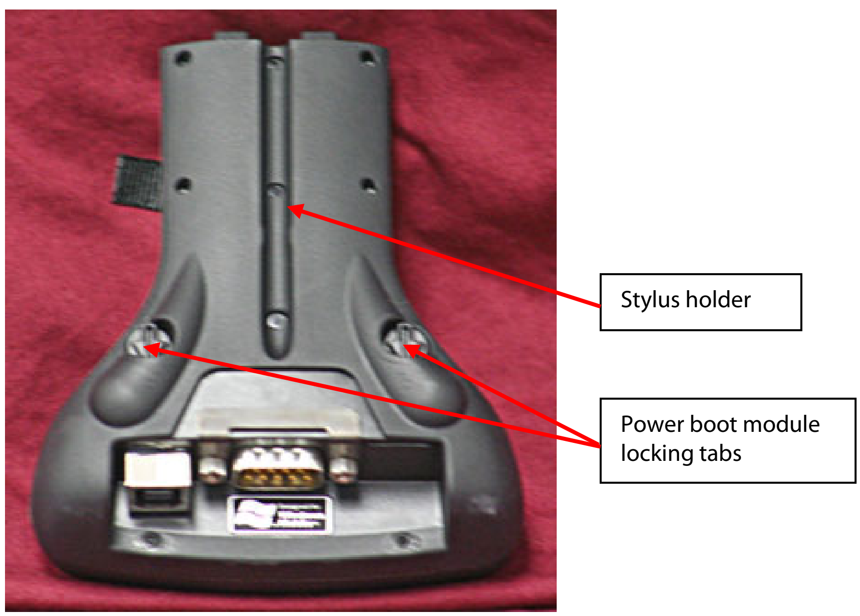


Figure 10: PDA AA power boot module (back).

PDA Mount and Low Carry Handle

PDA Mount

Your Profiler is supplied with a shoulder strap for hip height deployment and a low carry handle for near-surface deployment. The system is supplied with two (2) Velcro cinch straps that are secured to the Profiler body tube by adjusting the strap tension. The straps have attached plastic clips, allowing the User to clip the Profiler carrying strap to the cinch straps. The Velcro cinch straps and the shoulder-carrying strap are adjustable. The Profiler shoulder strap should be adjusted so that the instrument is approximately 1 meter from the ground surface.

The PDA mount attaches to the main tube of the EMP-400 with a screw-clamp. The PDA is designed to slip into the black plastic bracket on the PDA mount. If inserted properly, the PDA should click into place. The orientation of the PDA can be adjusted for easy viewing by the operator. The PDA mount incorporates a lockable ball joint and armature adjustment that allows the user to adjust the pitch and the angle of the PDA screen. When the desired pitch and angle adjustment has been made, use the ball joint locking lever to lock the PDA into position by moving the lever from the horizontal to vertical position. *Do **not** force the ball joint armature without unlocking the ball joint. This will damage the ball joint.*

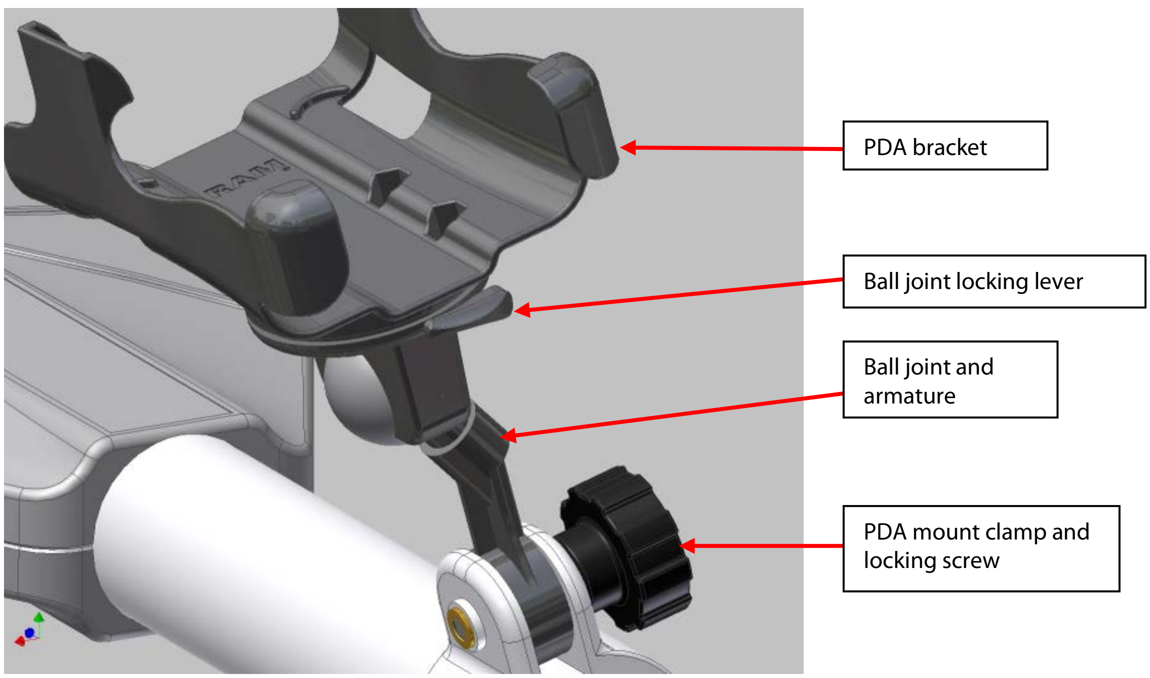


Figure 11: PDA Adjustable mounting bracket and clamp.

Note: GSSI does not recommend using PDA mount when the low carry handle is used. The PDA display will not be visible to the User.

Figure 12 illustrates the PDA mount with the PDA inserted and the shoulder carry strap attached to the Profiler body tube. The PDA mount clamp should be attached to the instrument so that the clamp butts up against the tube section to which the electronics enclosure is attached. This position provides better balance to the instrument when using the shoulder strap.

Figure 12: Profiler with the PDA mount and PDA installed.

Low Carry Handle

The Profiler handle allows the User to carry the instrument in closer proximity to the ground surface. The Profiler In-Phase response will improve the closer it is to the ground surface. The low carry handle is attached to the tube with the two screw-clamps provided with the handle. The low carry handle, clamps and clamp screws are illustrated Figure 13.

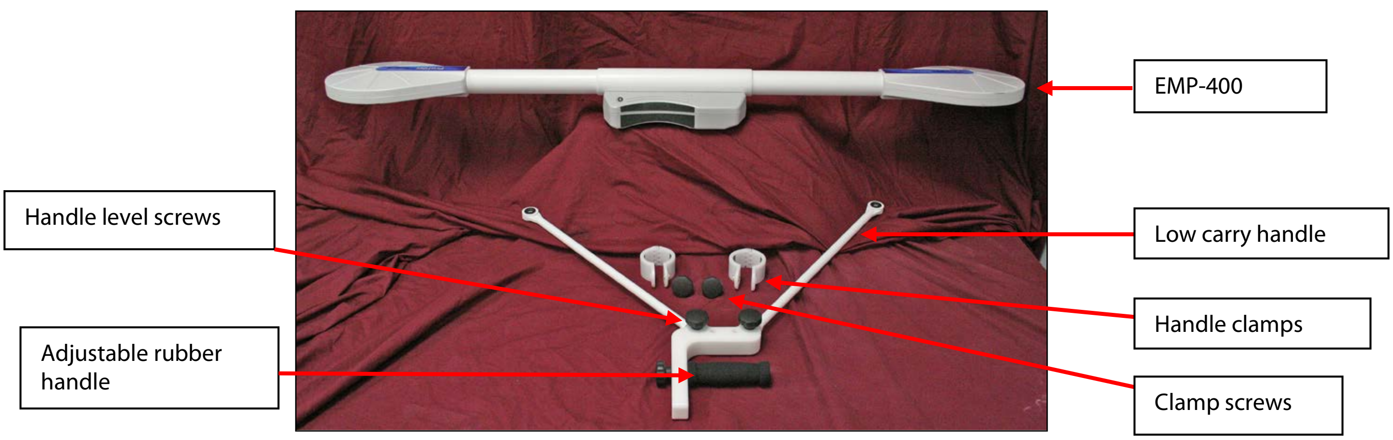


Figure 13: Profiler, low carry handle and two (2) screw clamps.

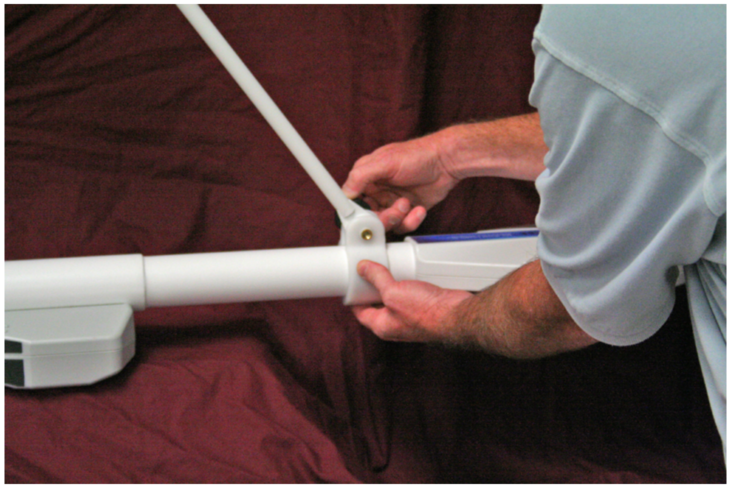


Figure 14: Attaching clamps for low carry handle.

Attaching and Adjusting Low Carry Handle

1 Position the clamp and the handle as shown in Figure 14 and insert the clamp screw through the blind side of the handle clamp, i.e., the side of the clamp opposite the threaded brass insert, and through the rubber bushings at the bottom of the carry handle.

2 Slowly screw the threaded clamp screw through the clamp and handle until the screw is tight.

3 Repeat this process with the other handle clamp.

- The height of the handle can be adjusted by loosening the handle clamps and sliding them towards (lower) or away (higher) from the EMP-400 coils.
- The User can also adjust the handle height by removing the rubber handle screw and repositioning the rubber handle in one of the three (3) pre-drilled holes in the carry handle.
- The level of the instrument can be adjusted by loosening the two handle level screws beneath the handle and adjusting the handle until the handle and EMP-400 are level. The handle level can be checked by placing the Profiler on a flat surface and the handle screws adjusted as necessary.
- The recommended deployment height when using the low carry handle is 8 – 10 inches (20 to 25 cm) from the ground surface.

Note: To obtain reasonable apparent conductivity (σ_a) values GSSI recommends that the Profiler be deployed with the low carry handle and operated at a transmit frequency of 15 kHz. This is discussed in detail in Chapter 2.

Remote RF Key Fob

The EMP-400 is supplied with a remote RF key fob for remote Start/Stop of Profiler during data acquisition and for placing fiducial marks in data files collected in the Continuous mode.

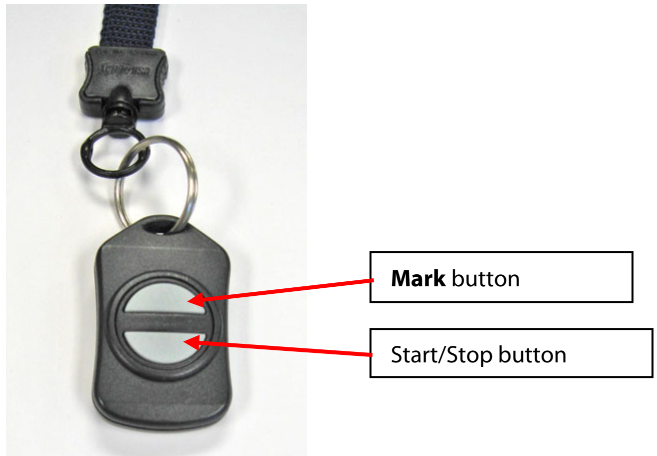


Figure 15: RF Key fob.

Chapter 2: Profiler Data Collection Setup

System Startup

GSSI strongly urges the User to review the system setup procedures in Chapter 2 carefully and use them as a step-by-step guide when configuring the system.

Prior to starting system setup and data acquisition, insert a fully charged Profiler Li-ION battery into the removable battery pack (see Section 1.4: Profiler Removable Battery Pack).

1. Turn ON the Profiler. The **Green** power status light next to the Profiler power switch will illuminate. The **Blue** Bluetooth communication status lights will also illuminate.

2. Turn ON the PDA by pressing the PDA Power ON/OFF button.

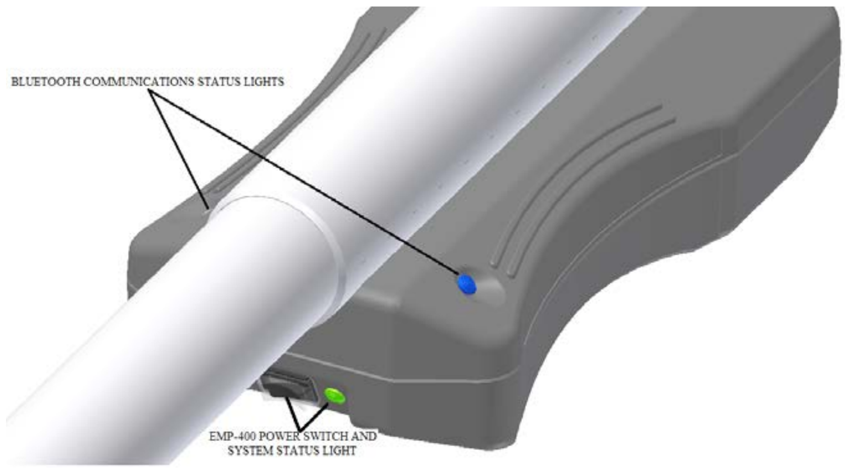


Figure 16: Profiler power switch and power LED location.

Figure 17: PDA power On.

3 After starting the Profiler software program, the RECON-400 will display the PROFILER splash screen.

Figure 18: Profiler Start progress bar.

4 Beneath the splash screen a **Blue** progress bar will appear. When initialization is complete, the progress bar and splash screen will disappear and the Main menu will be displayed.

Setting Up the Profiler

When communication is established between the Profiler and the PDA, the PDA will display the Main menu. At the bottom of the screen, the PDA battery charge status, the speaker status (On/Off) and the current system time are displayed.

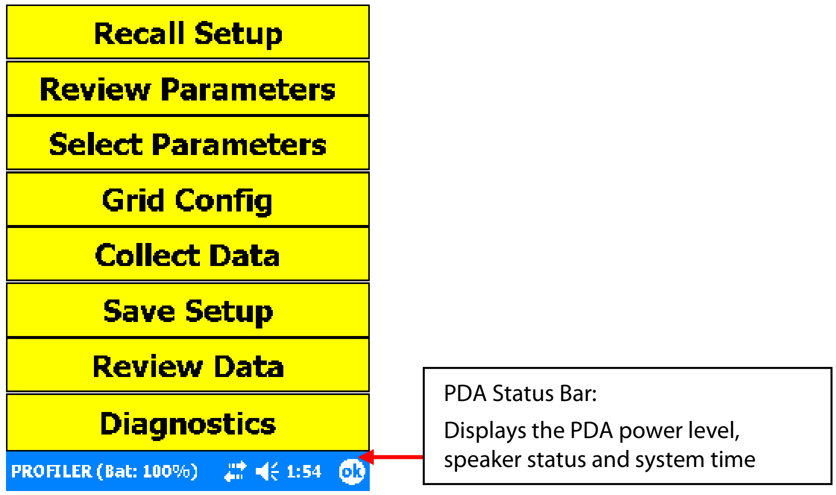


Figure 19: Profiler Main menu.

Recall Setup

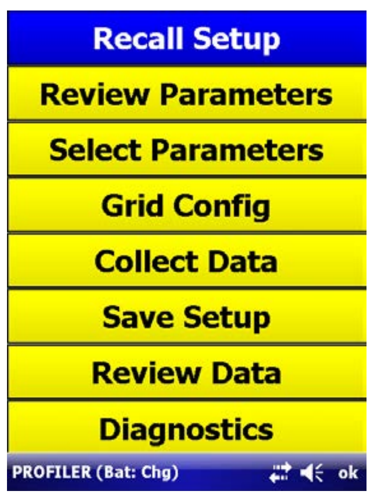


Figure 20: Recall Setup.

1 If the User has stored a previously saved setup it can be recalled by selecting **Recall Setup** and then selecting the desired setup number. Thirty (30) User-defined setups can be stored in the PDA memory. Once system setup is complete, the User can store the setup for future use by selecting Save Setup from the Main menu and select a setup number.

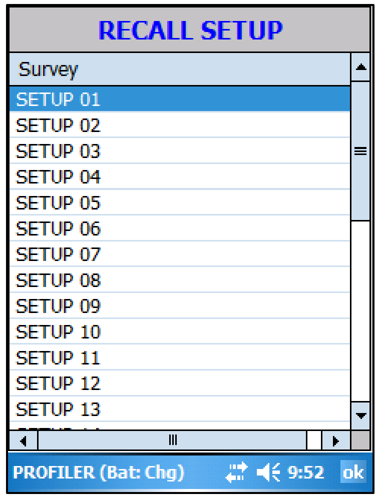


Figure 21: Recall Setup menu.

2 To recall a setup the User should select Recall Setup from the Main menu and select the desired setup number.

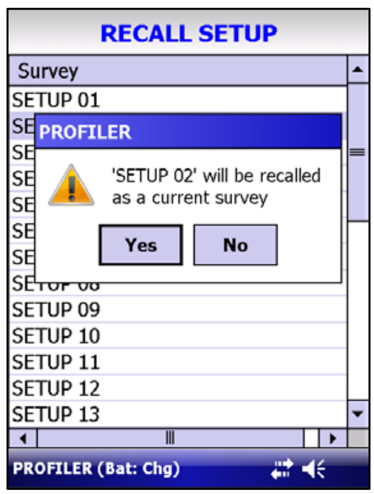


Figure 22: Recall Setup courtesy check.

3 The system will prompt the User with a courtesy check above. The User should select YES.

Note: The GPS setup and the system calibration parameters are **NOT** saved in a Saved setup. If the User is using a GPS, a GPS test must be conducted with the Internal or External GPS to assess the GPS signal condition and GPS validity. If the operator is using an external GPS system, it should be connected to the PDA serial communications port at this time. The User must also perform a system calibration prior to data collection.

Review Parameters

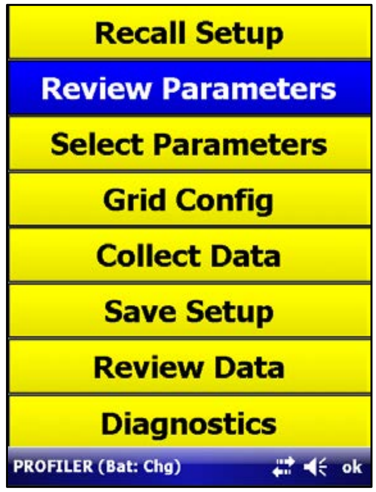


Figure 23: Recall Setup menu.

Project Info Menu

Prior to starting the survey, the User may record project information for permanent record. Site data often includes a Project name which may consist of a site location or job number. In addition, the identity of the operator, the date and time when the data was collected and the units (English or Metric) are all useful information to archive. This information may be entered into the PDA by selecting Review Parameters.

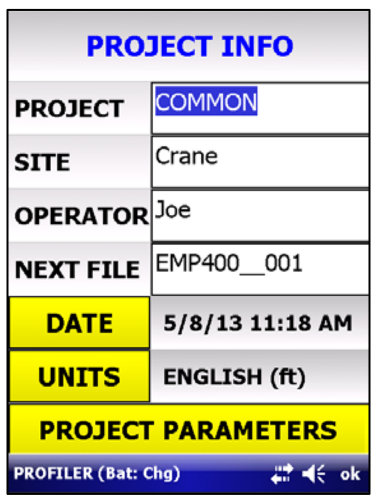


Figure 24: Project Info.

PROJECT

This field can contain alphanumeric information about the survey being conducted. This information will be used to create a Project folder in the \Profiler\DATA directory on the PDA into which all the data files will be written. This field can contain a maximum of 21 characters. The default Project folder is COMMON.prj.

SITE

The User can enter information on the job site or location. This field can contain a maximum of 21 characters.

OPERATOR

The User can enter information on the system operator. This field can contain a maximum of 21 characters.

NEXT FILE

This field contains the ***File Name and Number*** of the ***next*** data file to be collected. The default data file names are written in the form EMP400___001.EMI.

The file name format can be changed by the operator. EMI files are stored as BINARY files in the PDA. They are converted to ASCII text files upon data transfer from the PDA.

Note: The number field of the default file names will continue to increment until manually reset or changed by the User. The file number field ***does not*** automatically reset when the PDA is turned off, or data is transferred from the PDA by the user.

DATE

This field displays the date and time. This field is ***not*** updated automatically. Prior to beginning data collection, the User must select the Date field. This will update the date and time the current system time set on the PDA.

UNITS

This field displays the linear units that will be used in the Grid Config. menu for the grid limit values as well as the reading\station increment and the transect spacing. This field will toggle between English and Metric units. When the desired system of units has been entered, tap **OK** to return to the Review Parameters menu.

Note: The User should select a system of units at the beginning of a survey. The User ***should not change units*** during the course of the survey, as the conversion from one set of unit to the other will result in floating point errors in the distance conversion.

PROJECT PARAMETERS Menu

To access the Project Parameters, the User should select **Project Parameters**.

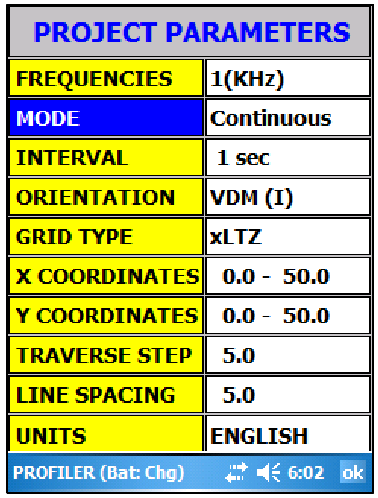


Figure 25: Project Parameters menu.

The Project Parameters screen displays ***all*** of the User selectable data acquisition parameters and Grid Configuration parameters.

The Project Parameters menu can be accessed directly from this menu by selecting any of the Parameter fields; Frequency, Mode, Interval, or Orientation. This allows the user to quickly change any acquisition parameters if survey requirements change.

The Grid Configuration menu can be accessed directly from this menu by selecting the Grid Type, X Coordinates, Y Coordinates, Traverse Step or Line Spacing.

System Diagnostics Parameters

Diagnostics Menu

The User should check the parameters in the Diagnostics menu to ensure that the system is properly configured by selecting Main > Diagnostics.

- GUI (page 22)
- Firmware (page 22)
- Upgrade Firmware (page 22)
- System Calibrations (page 22)
- Display Preferences (page 23)
- System Setup (page 28)

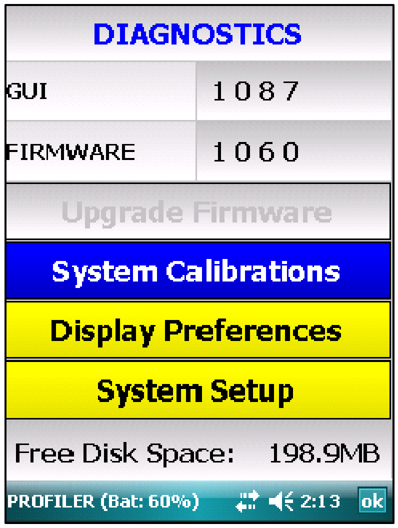


Figure 26: System Diagnostics menu.

GUI

The field displays the Graphic User Interface (GUI) version installed on the PDA. This field is for information purposes only and cannot be changed or accessed by the User.

FIRMWARE

This field contains information on the Firmware version number installed on your Profiler. This field is for information purposes only and cannot be changed or accessed by the User.

UPGRADE

This function can only be accessed with a GSSI supplied installation update file.

SYSTEM CALIBRATIONS

Slection of this field opens the Systems Calibrations menu where the User must perform several required calibration functions prior to data collection.

System Display Parameters

Display Preferences Menu

The User should select Display Preferences to set the display paramters for the PDA.

- Screen Colors (page 23)
- Data Display Colors (page 24)
- Data Display Limits Setup (page 25)
- Positioning Dsiplay (page 25)
- Map Smoothing (page 27)
- Data Smoothing (page 27)

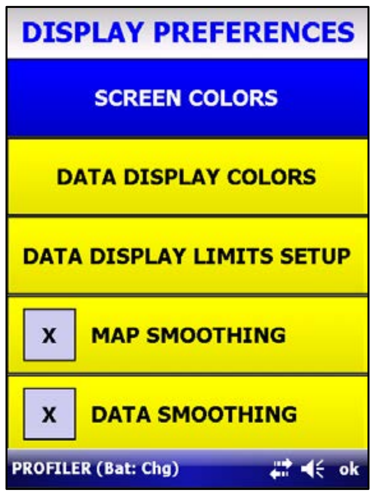


Figure 27: Display Preferences menu.

SCREEN COLORS

The Screen Colors menu allows the User to customize all of the system setup menus, tool bar labels and background colors. Customization of the system displays is entirely up to the User. In some cases, it may be desirable to change the colors of certain fields to enhance the menu display in high (or low) ambient light conditions. Both the Text and Background color of the Edit Box, Header, Label and function Button may all be customized.

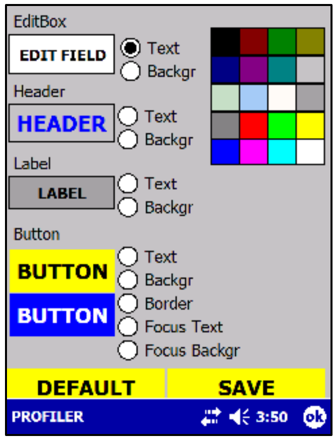


Figure 28: Screen Colors menu.

Background: To change the Background, the User must select Backgr next to the specific field to customize and then select the desired color from the color palette on the left of the display.

Text: To change the color of the Text, the User must select the Text next to the specific field to customize and then select the desired color from the color palette on the left of the display.

Function Button: Customization of the Function button includes the Text, Background, Border, Focus Text and Focus Background. Customization of the Text and Background for the Function buttons are the same as that for the Edit Box, Header and Label.

Function Button Border: The function Button Border (the border around the Function button) Focus Text (active menu selections under the function Button) and Focus Backgr (the background behind the Focus Text) allow the user to further customize the function Buttons as desired.

- GSSI recommends that the User experiment with these functions. Once the desired colors have been chosen, select **Save**.
- At any time the User may return the system to the default color settings by selecting **SET DEFAULTS.**

When the User is satisfied with any changes, select Save, then OK from the PDA Status Bar to return to the Display Preferences menu. Select OK from the PDA Status Bar to return to the Diagnostics menu.

DATA DISPLAY COLORS

The Data Display Colors menu allows the User to select a specific color for the In-Phase, Quadrature, and Conductivity line graph, bar graph and alphanumeric data dislays.

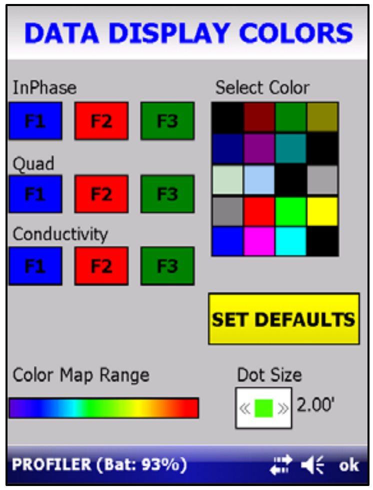


Figure 29: Data Display Colors Setup menu.

To apply a color to a given component, select the Frequency number box (F1, F2, or F3) of the desired component: In-Phase, Quadrature, Conductivity or Susceptibility, and then select the desired color from the color pallet to the right. The selected color will now be applied to the selected frequency(s) and component(s).

Color Map Range

The Color Map range allows the User to select three (3) different rainbow color tables that are used to draw the color map in the Free Way GPS data collection mode. The User can change the color map table by tapping on the color table.

Dot Size

The Dot Size allows the User to adjust the color dot size displayed on the screen in the Free Way GPS collection mode.

When the User is satisfied with the color(s) select Save Colors > OK from the PDA Status Bar to return to the Display Preferences menu.

Note: GSSI recommends that the User avoid selecting light grey or gray as data display colors for the line graph display. These colors will be difficult to see against the white data display background.

DATA DISPLAY LIMITS Menu

This menu allows the User to set the Display Limits for the frequencies selected for data collection. To access the Display Scale menu, select Data Display Limits Setup.

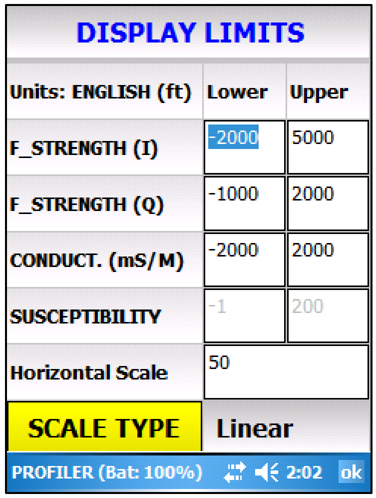


Figure 30: Display Limits menu.

The Display Scale menu allows the User to select the minimum and maximum data values that will be displayed for both graphic and alphanumeric data. The User has the option of selecting a linear or logarithmic display scale.

F_STRENGTH (I): The data values for the In-Phase magnitude in parts per million (ppm).

F_STRENGTH (Q): The data values for the Quadrature magnitude in parts per million (ppm).

CONDUCT. (mS/m): The data values for the Apparent Conductivity (σ_a) are displayed in milli Siemens per meter (mS/m) when data is collected at 15 kHz using the low carry handle.

Susceptibility: No longer implemented.

Horizontal Scale: This will adjust the full-scale width of the PDA Line Graph display. All line graph data is plotted from left to right on the line graph display.

Example: If the horizontal scale is set to 100, the full width of the PDA display will be used to display the entire 100 feet of data. At this scale small features may be compressed and difficult to distinguish. The User can select a smaller scale of 10, 20, or 50 feet and the horizontal scale of the display would then correspond to the specified distance in feet or the reading number (when operated in the continuous mode). The screen will automatically scroll to the left one-half the display width when the plotted line graph data reaches the right hand edge of the data display.

SCALE TYPE: This parameter allows the User to change the data display scale from linear to logarithmic.

Note: It is often useful to collect a test transect across the site after the calibration is performed and the In-Phase zero is set in order to estimate the range of measured values at the site. This allows the User to set the lower and upper data limits so that high positive and negative values for the In-Phase and Quadrature data are not clipped off the top or bottom of the display. If, during the course of collecting the test transect, the User notes that the data has exceed the scale the display, GSSI recommends that the lower and upper limits on the Graphic display be reset or the scale of the Graphic display set to a Logarithmic scale. The values entered for Lower and Upper bounds are for display purposes only. These values do not affect the data values stored in memory during data collection.

Once the desired graphic scale and values for the Lower and Upper bounds are entered, select OK from the PDA Status Bar or PDA keypad to return to the Display Limits menu.

MAP SMOOTHING

The Map Smoothing function acts to smooth the level contours on the contour map display in the Review Data section of the Main menu. To enable this function, tap in the box next to MAP SMOOTHING.

DATA SMOOTHING

The Data Smoothing filter is a 5-point center-weighted triangular filter applied to the data during data collection. The User has the option to enable or disable this function to ensure high quality data.

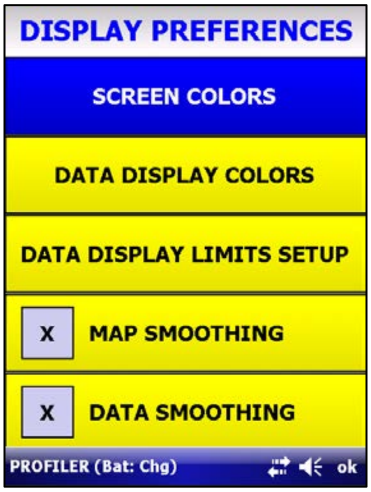


Figure 31: Display Preferences menu. Map Smooth and Data Smoothing Enabled

When the User has made the appropriate selections, select OK to return to the Diagnostics menu.

System Setup Parameters

SYSTEM SETUP Menu

The User should navigate to the System Setup menu. This menu contains all of the User selectable parameters required for system data storage, system beeper, internal or external GPS function settings and GPS test. To access this menu, select System Setup.

- Save Data (page 28)
- Beep (page 28)
- GPS Test (page 29)
- GPS Device (page 30)
- GPS Baud rate (page 30)
- Bluetooth Port (page 31)

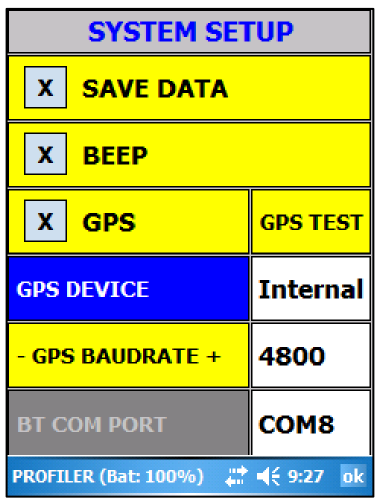


Figure 32: System Setup menu.

SAVE DATA

The Profiler SAVE Data is **ON** by default.

If the User wishes to collect data files for test purposes (e.g., evaluating system response and for setting the data display limits) and does not wish to save the data, the User can turn Save Data OFF by selecting this option. This field will toggle between ON (X) and OFF.

Note: If the User turns the Save Data Off, and the Profiler and PDA are powered down, the system will power on with the Save Data **Off**. The User must turn **On** the Save Data before conducting a survey.

BEEP

The Beep function power on default is ‘On’. It is recommended that the User leave the beep ‘On’ at all times. The beeper serves several useful functions:

- It notifies the user when a data point has been collected.
- In the Continuous mode, the beep serves as a useful pace timer when collecting data.

GPS TEST Menu

If the internal WAAS GPS or an external GPS is to be used to collect GPS data, the User must conduct a GPS Test prior to conducting the survey. Selecting GPS Test will open the GPS Test display.

The only User selectable field on the GPS Test display is the **GPS VALIDITY** setting and the **SYSTEM TIME**.

GPS STATUS: GPS validity is determined by the number of satellites and the **HDOP** (Horizontal Dilution of Precision). The User may select the number of visible satellites as the criteria for determining GPS validity. It is recommended that the number of satellites should be set at ≥ four. The Validity selections available to the user are:

- **Satellites ≥ 4:** If the number of satellites equal to or greater than four, the GPS solution is valid. This is the GSSI recommended setting for both the internal WAAS and external GPS validity.
- **Satellites≥ 3:** If the number of satellites is equal to or greater then 3, the GPS solution is valid.
- **No Conditions:** When no conditions are applied to the Validity the GPS is always valid. ***This setting is not recommended.***

LATITUDE: This field displays the GPS calculated Latitude.

LONGITUDE: This field displays the GPS calculated Longitude.

GPS UTC: GPS Coordinated Universal Time.

 # Satellites: The number of satellites from which the GPS system is currently receiving a signal.

System Time: The UTC (Coordinated Universal Time). This value is equivalent to Greenwich Mean Time (GMT).

Note: After the GPS status has been established and the system returns a VALID GPS condition, the User **MUST** then select SYSTEM TIME by tapping the System Time field on the PDA screen, or highlighting with field with the PDA arrow key and the select Enter (↵). This synchronizes the internal PDA clock with UTC.

Note: The average cold-start time for the WAAS GPS can be up to 5 minutes. In some areas, signal acquisition for the WAAS may be difficult. In some cases WAAS startup times may be longer when the GPS is downloading a new almanac.

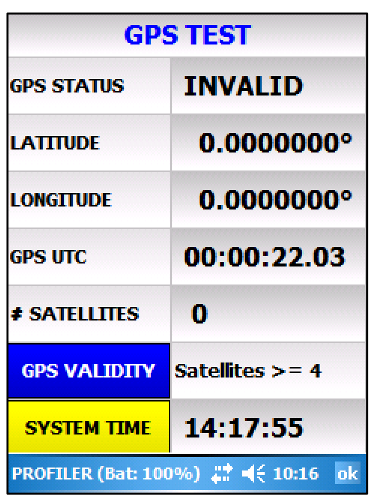


Figure 33: GPS Test menu No Satellites detected. GPS status invalid.

When the GPS has returned a VALID GPS status select OK to return to the system Set Up menu.

GPS DEVICE

The appropriate WAAS communications port for the RECON-400 PDA and Profiler communications have been preset at the factory. The port can be set by the User to one (1) of two (2) states:

- **INTERNAL.** The default setting for the internal WAAS GPS com port.
- **EXTERNAL.** The external GPS port is enabled.

Settings for an External GPS System

The Profiler is designed to accept a NMEA 0183 GGA string (see Appendix A for an example of a GGA string). If the User wishes to configure the PDA with an external GPS, the external GPS COM output must be configured as follows:

- 8 bits
- N (No) parity
- 1 (stop bit)
- BAUD: 4800*
- The data output rate from an external GPS should be set to 1 HZ

***This is the default BAUD setting for the External GPS Com port. The Profiler PDA can be configured for either 4800 or 9600 Baud.

Note: For Users who have the Profiler software installed in a Trimble GeoXT or GeoXH hand held GPS system, the displayed COMM port assignments are different than the standard GSSI Recon PDA. The Bluetooth COMM port may be either COMM 4, COMM 5 or COMM 6 depending upon the firmware installed in the Trimble PDA. The Internal and External GPS device settings operate the same as the standard GSSI Recon PDA.

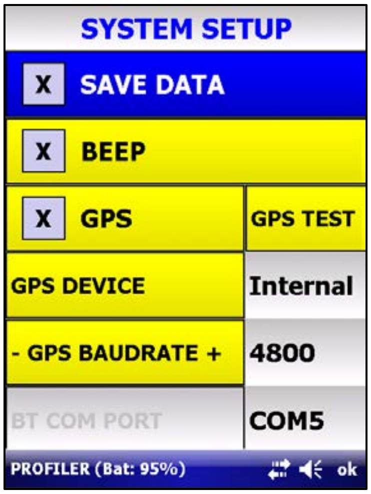


Figure 34: System Setup menu - Trimble GEO XT PDA.

Note: The User **must start** the Trimble GPS controller software on the GeoXT or GeoXH ***prior*** to starting the Profiler User interface. The User should start the GPS controller software and wait until it has aquired satellites and has a valid GPS solution and ***then* start** the Profiler software. The Trimble GPS software will run simultanesouly with the Profiler software.

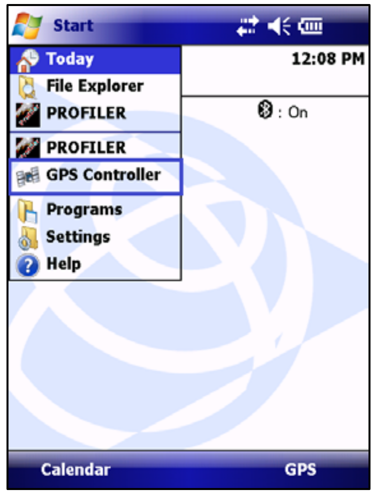


Figure 35: GPS Controller Start. Trimble GeoXH and Geo XT.

The User must configure the GeoXT or GeoXH COMM port outpurt paramters as indicated above. When Using a Trimble GeoXT or GeoXH PDA the GPS system of the Trimble PDA is the INTERNAL system.

Using An External GPS

The User should consult their GPS Manual for instructions on how to configure the output COM port of their GPS system.

The Profiler PDA will only accept an RS-232 null modem serial connection from an external GPS. The external GPS must have a Serial COM port output or a USB to Serial adapter for the output COMM line.

The Profiler is designed to accept a NMEA GGA string (see Appendix A for an example of a GGA string). If the Profiler is to be configured with an external GPS, the GPS system COM output format should be configured as follows:

- 8 bits.
- N (No) parity.
- 1 (stop bit).
- BAUD: 4800/9600.
- The message rate must be set to 1 Hz.
- The message type must be set to GGA.

BT (Bluetooth) COM PORT

The Bluetooth communications port is preset at GSSI and cannot be modified by the user.

System Parameters

The Select Parameters menu contains all of the data acquisition parameters. To access this menu > Select Parameters.

Select Parameters Menu

- Mode (page 32)
- Interval (page 33)
- Freq 1 (page 33)
- Freq 2 (page 33)
- Freq 3 (page 33)
- Orientation (page 34)
- Stacking (page 36)
- Use Zero Level for In-Phase (page 36)

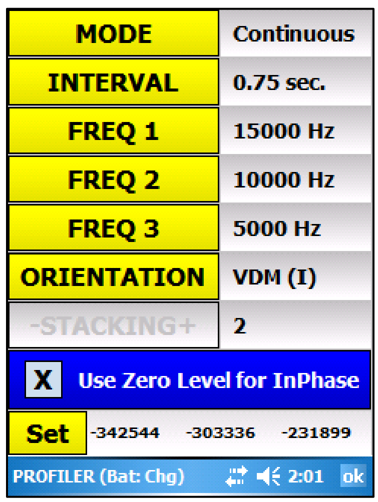


Figure 36: Select Parameters menu.

MODE

This enables Continuous (time) mode for Grid and\or GPS acquistion, Stationary (point-to-point), or Free Way (Continuous mode with GPS only) data collection. Select either Continuous, Free Way or Stationary mode. The selection field will toggle between these three (3) options.

Continuous Mode: This parameter allows the User to collect time based data i.e. a given number of readings per unit of time. When collecting one (1) frequency the maximum data collection rate is 0.25 sec. When collecting two (2) frequencies the maximum data collection rate is 0.5 sec. When collecting three (3) frequencies the maximum data collection rate is .75 sec. In Continuous mode, data collection is initiated by selecting Start Data Collection and then depressing the Enter (↵) key on the RECON PDA keypad, or by depressing the Start button on the RF key fob. The system will beep and the **Blue** communication status lights will blink when a data point has been recorded. The rate at which the Profiler will collect Continuous data is selected in the Interval field.

Stationary Mode: In stationary mode, data collection is initiated by selecting Start Data Collection, then depressing the Enter (↵) key on the PDA keypad, or by depressing the Start button on the RF key fob. The system will beep and the Blue communication status lights will blink when the data has been recorded and a data point will appear on the PDA data display in the data display format selected by the user.

Free Way: The Free Way mode allows the User to collect continuous data with a GPS system and utilize the color map LEVELS display. Data collected in the Free Way Mode does not utilize any survey grid information. Data is stored with only GPS positioning data.

Interval

Interval is the time interval (in seconds or fractions thereof) between successive readings when operating the Profiler in the Continuous mode. If the User is collecting data in the Continuous mode, select the desired time interval. When satisfied with the selection, select OK from the PDA Status Bar to return to the Select Parameters screen.

Figure 37: Continues Mode - Time Interval menu.

FREQ 1

The first transmit frequency.

FREQ 2

The second transmit frequency.

FREQ 3

The third transmit frequency.

The transmit frequencies may be selected in any order.

To Select Frequency

The User can select from one (1) to three (3) frequencies for data collection. At least one (1) frequency must be selected prior to data collection.

Select FREQ 1 from the Select Parameters menu.

Figure 38: Select Transmit Frequencies menu.

After selecting the desired transmit frequencies tap OK on the PDA screen or press OK on the PDA keypad to return to the Select Parameters screen.

- If the User selects more than one (1) transmit frequency for data collection, the user must select the frequencies in numerical order, i.e., FREQ 1 then FREQ 2 and then FREQ 3.
- To un-select multiple transmit frequencies i.e., FREQ 2 and/or FREQ 3, the User must select FREQ 3 first and then tap None on the Select Frequency list and then tap OK on the PDA Status Bar menu or press OK on the PDA keypad This sequence is then repeated with FREQ 2.

(Dipole) ORIENTATION

This parameter writes the orientation of the transmitter and receiver dipoles used during data collection into the Profiler file header. The User may select either the Vertical Dipole Mode (VDM) or the Horizontal Dipole Mode (HDM). The in-line and broadside instrument orientations must also be selected. The perspective of the menu is a is a 'birds-eye' view of an operator holding the Profiler.

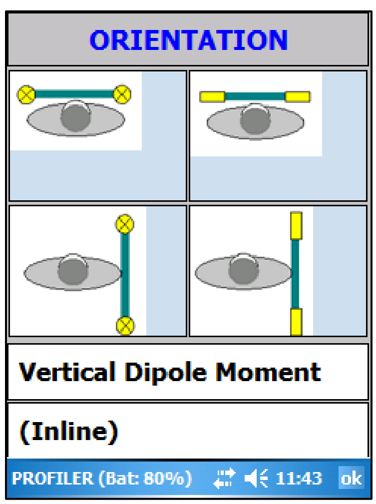


Figure 39: Dipole Orientation menu.

There are four (4) possible dipole orientations:

- On the left of the screen is the Vertical Dipole Mode. The two instrument orientations are VDM broadside (top left) and VDM inline (bottom left).
- On the right of the screen is the Horizontal Dipole Mode. The instrument orientations are HDM broadside (top right) and HDM inline (bottom right).

After selecting the desired instrument orientation, tap OK on the PDA Status Bar to return to the Select Parameters screen.

Profiler Tilt Error Message

The Profiler electronics incorporate a tilt sensor which senses the orientation of the instrument with respect to system horizontal i.e., the Vertical Dipole Mode. This sensor will detect if the instrument is rotated more than 45° from the specified dipole mode.

Note: Data must be collected in the dipole orientation in which the system was calibrated.

- For example, if the User selects the Vertical Dipole Mode in the Orientation menu and then rotates the EMP-400 45°, the PDA will display a Profiler Tilt Error message.
- If the User selects the Horizontal Dipole Mode in the Orientation menu and then rotates the EMP-400 45°, the PDA will display a Profiler Tilt Error message.
- If the instrument is in the Vertical Dipole mode and is rotated 180° e.g., upside down, the system will display a Profiler Tilt Error.
- The tilt sensor does NOT affect the orientation setting selected by the User, or the value for the instrument orientation that is stored in the file header. The User must enter the correct instrument orientation in the Orientation Parameters menu. If the tilt sensor detects an orientation error and the error is not corrected in the Orientation menu, the system will write an error mark (X) into the Tilt column of the Profiler data file and display a Profiler Tilt Error on the data collection screen.

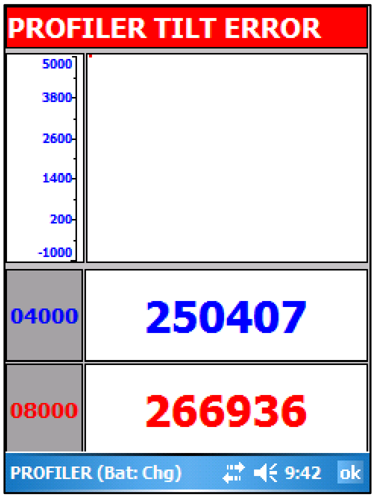


Figure 40: Profiler Tilt error.

STACKING

The Stacking function will operate in both the Continuous and Stationary modes. Stacking is the number of successive readings averaged at each data collection point. Stacking is used to suppress random noise and improve the signal-to-noise ratio of the data. Stacking is useful in areas where random noise, cultural noise or intermittent noise 'spikes' may be effecting the quality of the data.

In the Continuous and FreeWay modes, the stacking values are selected automatically. The Profiler is designed to maximize the number of stacks for a selected data acquisition rate and number of transmit frequencies. The total number of stacks is a function of the number of frequencies and the speed of operation. For example, if the operator is collecting three (3) frequencies at the maximum rate of one (1) reading per second, the Stacking is set to two. If the User is collecting one frequency at one (1) reading per second, the Stacking is automatically set to eight. If the User is collecting one (1) frequency at four reading per second, the Stacking is automatically set to one.

In the Stationary mode the User selected values are one (1) (no stacking) through 64. Select Stacking from the Select Parameters menu. The selection field will increment through the available stacking values.

- Stacking will slow down the data acquisition speed. The decrease in collection speed will be determined by the number of frequencies collected and the number of stacks applied.
- In Stationary mode, the User may increment (increase) the stacking value by tapping the right (+) side of the yellow stacking field. To decrement (decrease) the stacking value, tap the left side (-) of the stacking field.

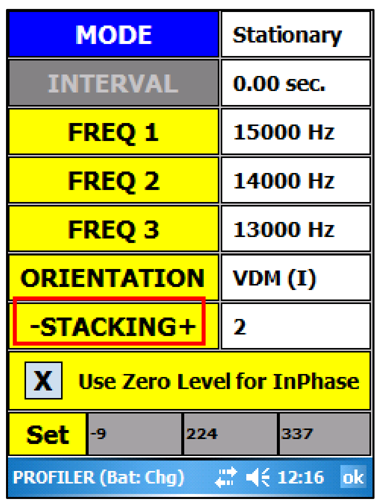


Figure 41: Increase or decrease Stationary mode Stacking.

Once the desired level of stacking is set, tap OK on the PDA Status Bar or PDA keypad to return to the Main menu.

Use Zero Level for In-Phase

The Use Zero level for In-Phase function is not enabled until after the Profiler has been calibrated by the User.

System Calibration

Prior to data collection, the User must calibrate the Profiler for the local site conditions. This calibration compensates for the presence of the operator and the PDA as well as the operating height and local ambient noise conditions. In addition, the system must compensate for the presence of an external GPS system if one is used during data collection. The Field Calibration must be performed first, and then the Operator Calibration. The User should measure the distance from the coils to the ground surface at the height, at which data is to be collected. When collecting data in the Vertical Dipole Moment (VDM), the User should measure the distance from the ground to the horizontal seam in the coil cover(s). When collecting data in the Horizontal Dipole Moment (HDM) the User should mesure from the ground surface to the center of the coil cover (s).

Note: ***Collecting Apparent Conductivity Data***. When the objective of the survey is to collect apparent conductivity (σa) data, the Profiler should be operated with the low carry handle, and at least one (1) of the transmit frequencies must be 15 kHz. The algorithm that converts the Quadrature values to apparent conductivity has been optimized for the 15 kHz transmit frequency for the Profiler coil spacing.

To perform the System Calibrations, select the **System Calibrations**.

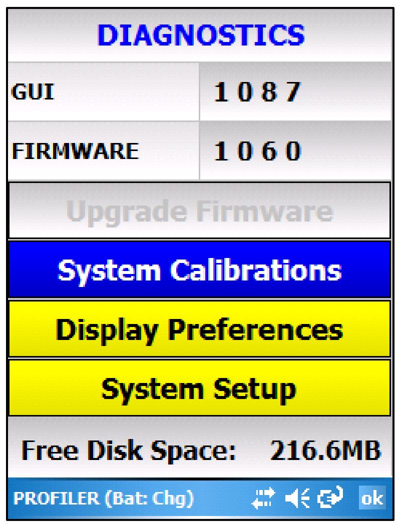


Figure 42: Profiler System Calibrations.

Field Calibration

1. Prior to performing the Field Calibration, the User must select the desired Transmit Frequencies.
2. Place the Profiler unit on the ground.
3. Walk at least 12 feet away from the Profiler with the PDA. The User should not stand between the PDA and the Profiler during the calibration process or Bluetooth communication with the Profiler may be disrupted
4. Select Height, and enter the height at which the Profiler is to be operated.

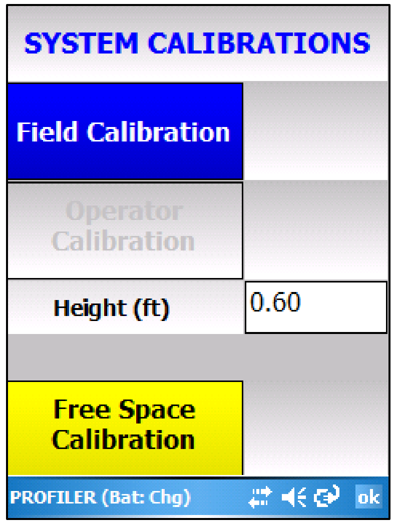


Figure 43: System Calibrations – Field Calibration.

Note: After the User enters the operation height, the system will issue a warning that the In Phase values may be innacurate when operated between 12 and 20 inches (30.5 and 50.8 Centimeters). Due to this calibration issue, the Magnetic Susceptibility output for the current version of the software has been disabled.

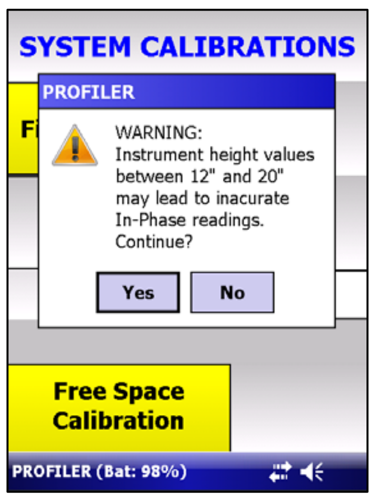


Figure 44: In-Phase Height Calibration Warning.

5 Select Field Calibration and tap the screen or press the Enter (↵) key of the PDA.

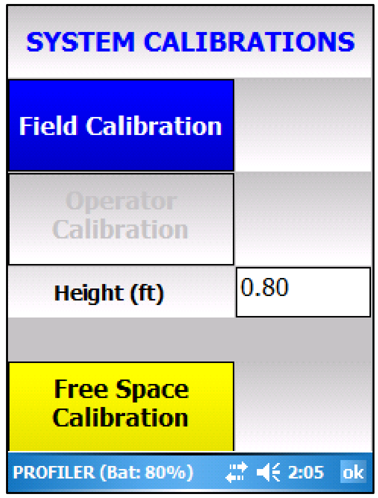


Figure 45: Field Calibration menu.

6 The Profiler will begin to calibrate for the selected Transmit frequencies. When the Field Calibration is complete, the system will prompt the User to pick up the instrument.

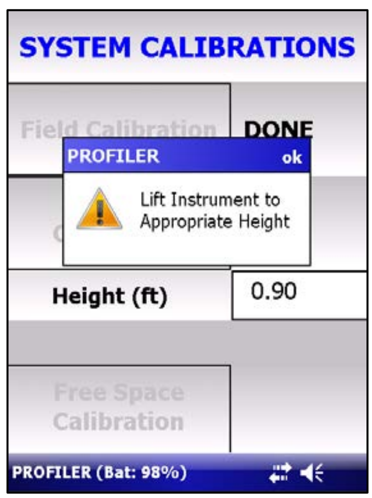


Figure 46: Operator calibration.

Operator Calibration

Note: Prior to conducting the Operator Calibration, the User should remove all large metallic objects from their person. The User should never carry wireless devices e.g. cell phones, personal data assistants, etc, during calibration or system operation. If using an external GPS, the User should carry/wear the GPS system while performing the Operator Calibration. The User should not wear steel toed boots when calibrating or operating the Profiler.

1 Enter the Height (in feet or meters) at which the survey data will be collected.

2 Pick up the Profiler and position it at the height at which data will be collected.

3 Select Operator Calibration.

4 The Profiler will begin to calibrate for the selected Transmit frequencies. When the Operator Calibration is complete, the display will prompt **Done.**

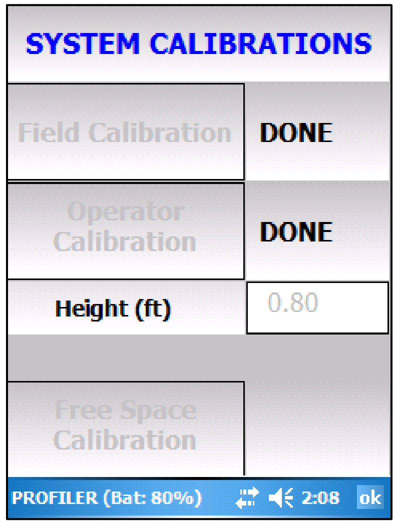


Figure 47: Completed operator calibration.

Note: The Profiler System Calibration only calibrates for the selected transmit frequencies. If the operator changes the Transmit Frequencies after the initial Field and Operator calibration, the User must re-calibrate the system for the new transmit frequencies.

Caution: The User should never perform a Free Space Claibration. This calibration has been performed at GSSI. If the User selects the Free Space Cailbration the system will issue the following warning.

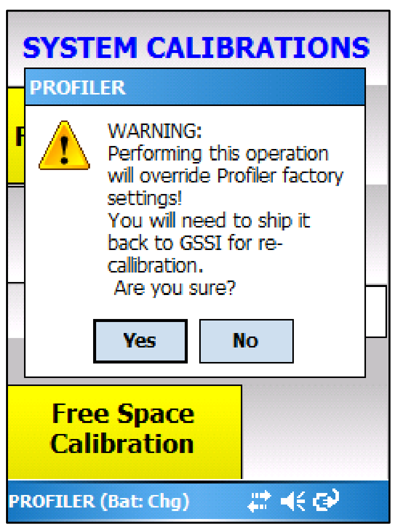


Figure 48: Free Space Calibration Warning.

If this warning should appear, the User should select **No**.

If the User inadvertently selects **Yes**, the Profiler will immediately begin the Free Space Calibration procedure. The User must let this procedure run until completion. If the User attempts to terminate the calibration procedure before it is completed the Profiler interface will freeze. If the system freezes the User must to turn off the Profiler, re-boot the PDA and then turn on the Profiler and re-establish Bluetooth communications between the PDA and the Profiler.

Important Notice Regarding Profiler Calibration and Calibration Files

The User should **never** move or delete the Profiler calibration files from their location in the PDA memory. Moving or deleting these files will compromise the system calibration. They are not User accessible files.

Copies of these files can be found on the Profiler accessory CD that was supplied with the system. If the files are mistakenly deleted they can be copied from the backup CD directly into the PDA \\My Windows Mobile-Based Device\Program Files\Profiler\ directory. These backup files allow the User to restore the system calibration and parameter files.

GSSI recommends that these files be copied from the Profiler Accessory CD and stored in a safe location on a PC as additional backup in the event the Accessory CD and the calibration files on it are lost or become corrupted or damaged.

GSSI recomends that the User always carry copies of the calibration files into the field.

The Profiler employs a continuously self-calibrating system. In the event of system calibration failure (or corruption or deletion of the system calibration file) the Profiler will prompt the user with the error message: FAILED TO OPEN PROFILER PARAMS FILE, or FAILED TO OPEN CALIBRATION FILE. If the User is prompted with this warning, the backup calibration and parameter files will have to be re-loaded into the PDA\\My Windows Mobile-Based Device\Program Files\Profiler directory.

Set In-Phase Zero Level

This function performs a zero level adjustment of the In-Phase components of the selected frequencies to remove any In-Phase signal offset. The zero level values are set for display purposes only. The data is recorded and stored in raw form. The values(s) is used to zero the displayed data are saved in the file header.

- The acquired In-Phase data is stored with the raw In-Phase component values.
- The User can also set the line-frequency filter for either 60 Hz or 50 Hz line noise.
- The zero level setting is performed only after the operating frequencies and line frequency filter have been selected by the User and the Field and Operator Calibrations have been performed.
- The Quadrature component values are **not** zeroed prior to data acquisition.

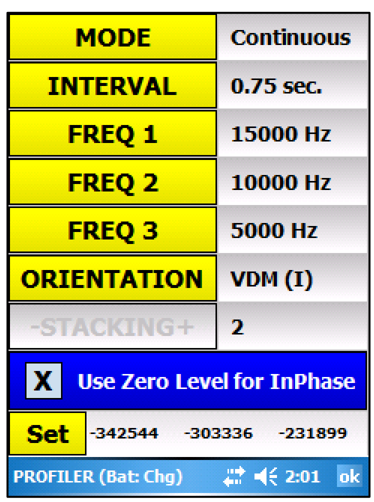


Figure 49: Use Zero Level for In Phase.

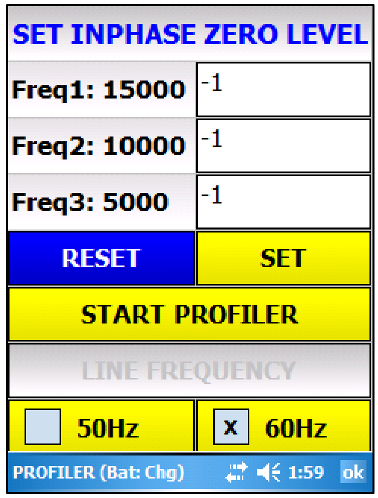


Figure 50: In-Phase Zero Level and Line Filter menu.

The User should navigate to the **Select Parameters** menu and select **Use Zero Level for In-Phase**. The User should perform the In Phase zero in an area where they are confident they are not in proximity to buried metal or near-surface metallic objects. The User should be holding the instrument at the height at which data will be collected with either the shoulder strap or low carry handle. The User should remove all metallic objects from their person prior to setting the zero levels.

Line Frequency

The Profiler has been designed to identify noisy line frequency bands. The Line Frequency selection enables either the 50 Hz or 60 Hz line frequency filter. The User should select the appropriate line frequency filter setting for the region in which they are operating e.g., in the U.S. the filter setting should be 60 Hz; in Japan and Europe this filter setting should be set to 50 Hz.

Set In-Phase Zero

1. Select Set from Select Parameters menu.
2. Select Start Profiler from Set In-phase Zero menu.
3. The Profiler will begin to beep and the Blue communication status lights will begin to flash. The user will see a series of numbers displayed for the each of the selected transmit frequencies.

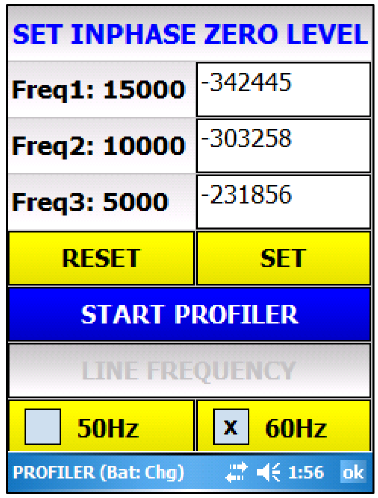


Figure 51: In-Phase Zero Level START

The values for the selected frequencies will begin to rise or fall depending upon the frequency selected. The Set In-Phase Zero display field will now change to **Stop Profiler**.

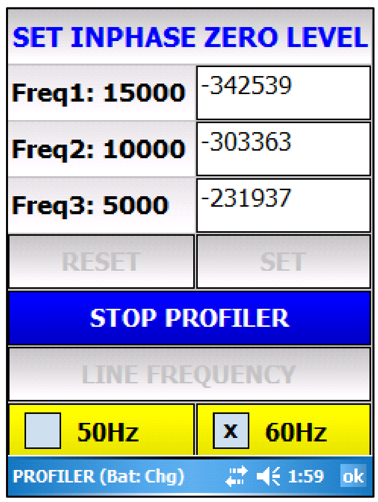


Figure 52: In-Phase Zero Level Running.

4 The User should wait approximately 10-20 seconds for the values to stabilize, i.e., the rate of change in In-Phase values will decrease.

5 Once the In-Phase signals have stabilized select Stop Profiler**.**

6 Tap SET in the Set In-Phase Zero Level menu.

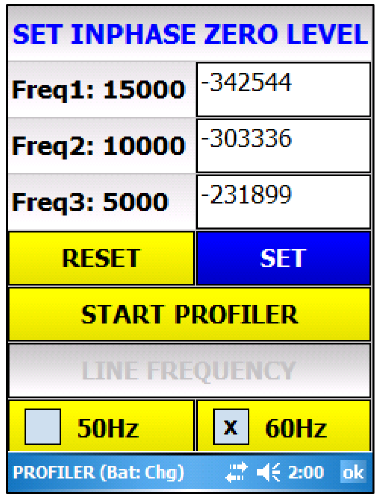


Figure 53: In-Phase Zero Level SET

7 The User should then select OK to return to the Select Parameters menu and check the Use Zero Level box. A black X will appear in the box indicating that the displayed In-Phase component will have the Set Zero level values added (or subtracted) from the acquired In-Phase values.

8 To reset the In Phase Zero levels select Reset. This will set the In Phase Zero Levels to -1. The Set In Phase Zero Level procedure can then then be repeated.

Select Grid Configuration (Grid Config.)

GRID CONFIG Menu

The Grid Config menu contains all of the entry fields for user selectable grid configuration parameters including the coordinates for the survey limits, the distance between instrument readings and the spacing between successive transects. To access this menu select Main > Grid Config.

- XMIN (page 45)
- XMAX (page 45)
- YMIN (page 45)
- YMAX (page 45)
- STEP (page 45)
- SPACING (page 46)
- MARK SPACING (page 46)
- GRID TYPE (page 47)
- DIRECTION (page 47)
- UNITS (page 48)

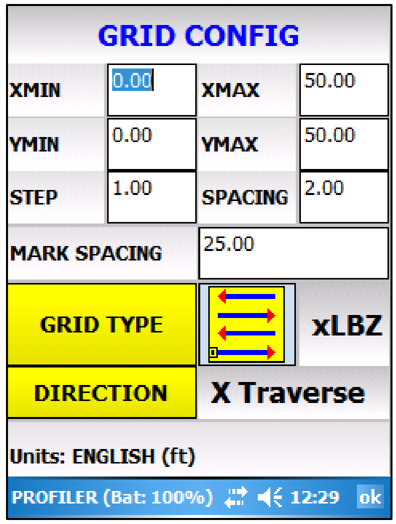


Figure 54: Grid Configuration menu.

Set Units

The User must select the survey units in the Project Parameters menu prior to setting the Grid Parameters. If the User sets the Units to METRIC, then sets the Grid Parameters, and then resets the Units to ENGLISH, the Grid Parameter units will contain conversion rounding errors. At this point the user would have to re-enter the correct Grid Parameter values prior to collecting data.

- All survey grid parameters can be selected by selecting the white ***value*** field next to each parameter. The PDA on-screen keyboard will pop-up at the bottom of the menu display.
- To enter numeric information, select the numeric keypad function on the keyboard by selecting the 123 box on the upper left corner of the keyboard.

XMin

The minimum coordinate for the X-axis. This value can be negative or positive.

XMax

The maximum coordinate for the X-axis. This value can be negative or positive.

YMin

The minimum coordinate for the y-axis. This value can be negative or positive.

YMax

The maximum coordinate for the Y-axis. This value can be negative or positive.

Step

Stationary Mode: This parameter is (generally) the distance interval between successive instrument readings.

Continuous Mode: This parameter is the ***reading number***. The ***distance*** between steps in the Continuous mode is a function of the data acquisition rate (Interval setting) of the instrument, and the speed at which the instrument is moved over the surface.

- The maximum positive value for Step cannot exceed the maximum X or Y transect value, i.e. the Step value cannot exceed XMax or YMax.
- The value for Step must always be positive.
- Fractional values for the Step, i.e., 0.5, can be entered by the operator. If fractional values are used, the Step (station) number will increment at the value selected.

Note: GSSI recommends that only whole number values (1, 2, 3, etc.) or ***even*** fractional values be used for the **Step** value. If the step value is number such that when divided into the transect maximum it yields a floating point repeating decimal, the transect value will be rounded down.

Example: the grid coordinates entered by the user are Y Min=0, X Min=0, Y Max=50 and X Max=50. The User enters a value of 0.75 for the Step, the X Max value will automatically be rounded down to 49.50 by the system when the User exits the Grid Config menu. This rule applies for any multiple of .75. e.g. the value 1.5 results in the repeating decimal fraction of 33.3333 if divided into 50.

Note: The User should not use odd **Step** values if the Xmax or Ymax value is an even number. The User should not use even **Step** values if the Xmax or Ymax value is an odd number.

SPACING

The distance interval between successive transects of the survey grid. The value entered for Spacing must be positive. When data is collected in Stationary mode this is the actual (desired) station spacing. When data is collected in Continuous mode this is (essentially) an estimate. We recommend that when collecting data in the Continuous mode that the user conducts a test transect to determine how many actual readings are acquired for a particular data rate and user 'pace' along a transect. The User can then adjust the Spacing value that more closely reflects the actual distance between readings.

Note: As with Step (see example above), fractional values for the Spacing, i.e., 0.5, can be entered by the User. If fractional values are used, the Spacing number (line separation) will increment at the value selected. Values for the Spacing that divide into the transect maximum (X or Y) and yield a result that is a repeating decimal will be rounded down.

Note: The User should not use odd **Spacing** values if the Xmax or Ymax value is an even number. The User should not use even **Spacing** values if the Xmax or Ymax value is an odd number.

MARK SPACING

The distance (in Feet or Meters) between fiducial marks placed in the data file when data is collected in Continuous mode. User or fiducial marks can be entered into the data files by pressing the Enter (↵) key.

Note: If the User is placing fiducial marks in the data, the User must be sure that the value entered into the Mark Spacing field is the distance at which marks are entered during data collection. MagMap2000 uses these fiducial marks for linear interpolation of data collected in the continuous mode. If the value entered for **Mark Spacing** is incorrect, the MagMap2000 program will interpolate the transect distances and the distances between the fiducial marks incorrectly. The User must then use the line start/end and mark editing functions in MagMap2000 to input the correct distance between the marks and correct the overall length of the survey transects (see MagMap 2000 manual, Chapter 4: Editing of the Map).

Maximum Readings

The Profiler will store a maximum of 500,000 grid point readings.

GRID TYPE

The small, black square box on the Grid Type icon indicates the starting point (origin location) of your survey.

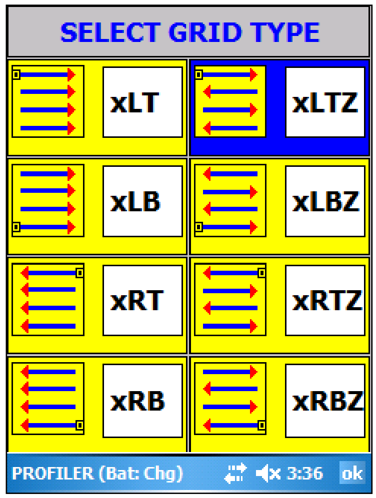


Figure 55: Select Grid Type (X) menu.

DIRECTION

The system will toggle between X Traverse and Y Traverse. The traverse direction indicates the orientation of the survey along the X or Y-axis.

- If X Traverse is selected, the Grid Type field will display an icon indicating a traverse type oriented along the X (east-west) axis.
- If Y Traverse is selected, the Grid Type field will display an icon indicating a traverse oriented along the Y (north-south) axis.
- This menu displays all the possible X-axis survey transect directions available to the User. The label convention is as follows:
    - **xLB:** X-axis profiling starting at the left bottom (LB) corner of the survey grid with all transects proceeding in the same direction (unidirectional).
    - **xLBZ:** X-axis profiling starting in the left bottom (LB) corner of the survey grid with lines collected in a zigzag (Z) fashion.
- All of the icons on the left of the display are for surveys conducted in one (1) direction.
- All of the icons on the right of the display are surveys conducted in a zigzag fashion. For example xRBZ indicates X profiling conducted in zigzag (Z) fashion starting from the right bottom (RB) of the survey grid.

After selecting the appropriate icon, tap **OK** on the PDA Status Bar to return to the Grid Setup menu.

To conduct profiling in the Y direction, select Direction for Y Traverse and Grid Type Y illustrates the Y Traverse, Y Grid Types.

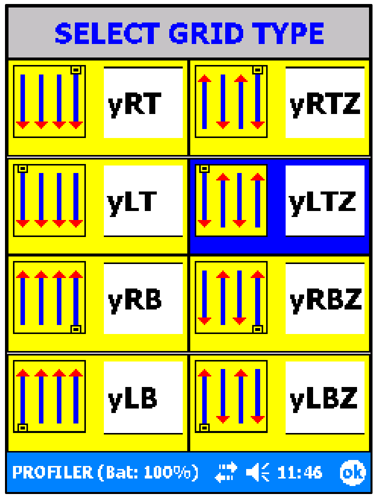


Figure 56: Select Grid menu – Grid type yLTZ.

This menu displays all the possible Y-axis survey transect directions available to the User. The label convention is as follows:

- **yLB:** Y-axis profiling, starting at the left bottom (LB) corner of the survey grid (unidirectional).
- **yLBZ:** Y-axis profiling starting in the left bottom (LB) corner of the survey grid with lines collected in a zigzag (Z) fashion.
- All of the icons on the left of the display are for surveys conducted in one (1) direction.
- All of the icons on the right of the display are surveys conducted in a zigzag direction. For example, yRBZ indicates Y-axis profiling conducted in zigzag (Z) fashion starting from the right bottom (RB) of the survey grid.

After selecting the appropriate grid type icon, select OK from the PDA Status Bar or PDA keypad to return to the Grid Config menu.

Units

This field displays the linear units that the User selected for the survey.

Save Setup

Once all acquisition parameters have been selected, information on the survey parameters and grid configuration can be saved for easy recall. To escape from the Select Parameters menu tap OK on the PDA Status Bar to accept the current data acquisition parameters.

1. The data acquisition setup can be saved by selecting Main > Save Setup. Select Save Setup.

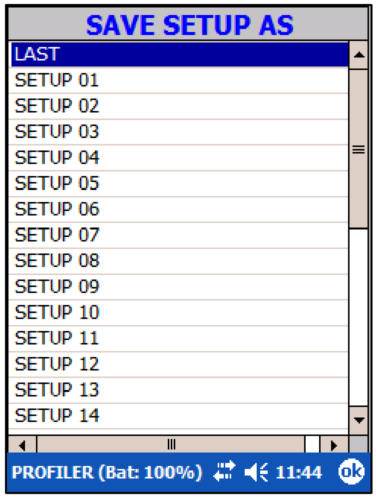


Figure 57: Save Setup menu.

2 The User must select a **Setup Number** location. There are thirty (30) memory locations available to the user to save survey setup parameters. To select a Survey memory location, simply tap on the Survey number and then tap **OK** on the PDA Status Bar to return to the Main menu.

Data Collection and Run Time Menu

1 Once the User has configured the Profiler for data collection, the User should navigate to the Collect Data menu. To begin data collection the User should select Start Data Collection. The PDA screen will change to the data display screen.

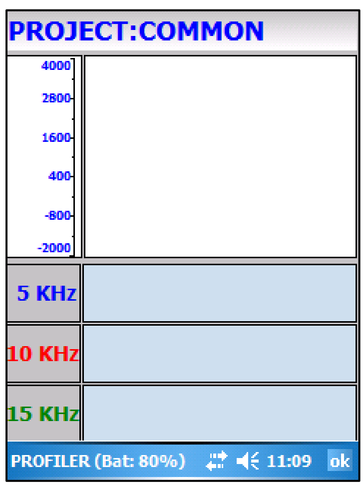


Figure 58: Start Data collection.

2 The screen will display the chart format selected by the User and the transmit frequencies selected by the User. The data collection screen will also display the Project folder which the User selected in the Review Parameters menu. It is in this folder that all subsequent data will be stored.

3 To start data collection the User must select the Enter key (↵) on the PDA keypad. The PDA will begin to display the data in the display graph and as numeric values next to each of the transmit frequencies selected. The Line Number (L.0.00) and the Station number (S0.00) will be displayed at the top of the screen. The system will also display the Traverse type (X Tr) selected by the User in the Grid Config. menu.

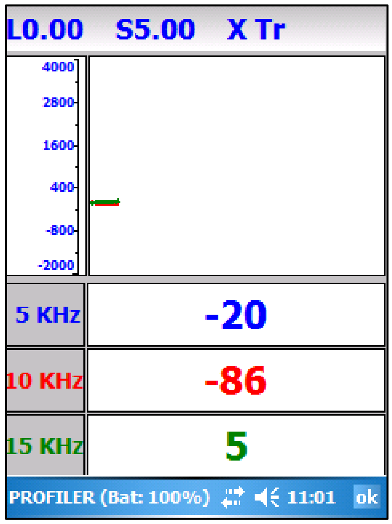


Figure 59: Data Collection screen.

4 The Profiler data collection can be run in three (3) different GPS display modes during data collection; DISABLED, TRAJECTORY and FREE WAY.

- The User must select the GPS display mode ***prior*** to starting data collection.
- The first mode is GPS DISPLAY **DISABLED**.

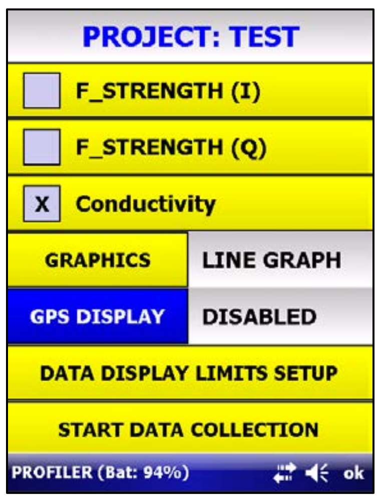


Figure 60: Collect Data menu – GPS disabled.

- In the disabled mode the data display is limited to the graph and numeric data display.
- The second GPS mode is **TRAJECTORY**.

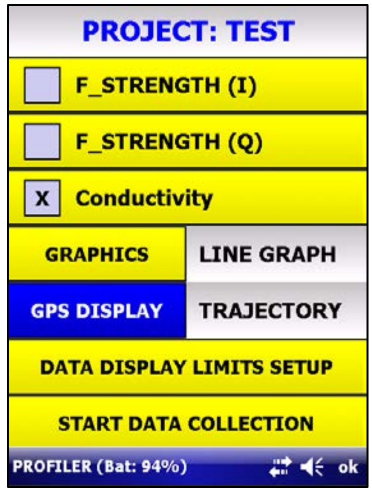


Figure 61: GPS Display -Trajectory.

5 If the Profiler has been configured to collect data on a survey grid *without* GPS, the data display screen can be changed to the TRAJECTORY screen by tapping the PDA screen during data collection.

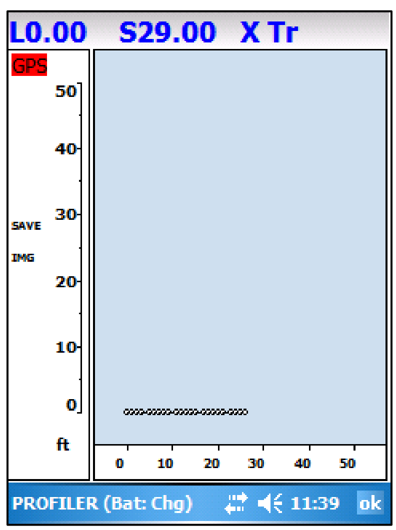


Figure 62: Trajectory – No GPS.

6 This screen will display the Line number (L0.0) and the station\reading number (S29.00) and grid type (XTr). The GPS status indicator in the upper left of the data collection screen is red indicating that there is no GPS signal. The SAVE IMG (SAVE IMAGE) can be tapped by the User with the PDA stylus to save a *.JPG file of the current screen. As data collection proceeds, the TRAJECTORY screen will be continuously updated. When the User reaches the end of the line they must select OK from the PDA keypad or OK from PDA screen. This will bring up the Run Time menu.

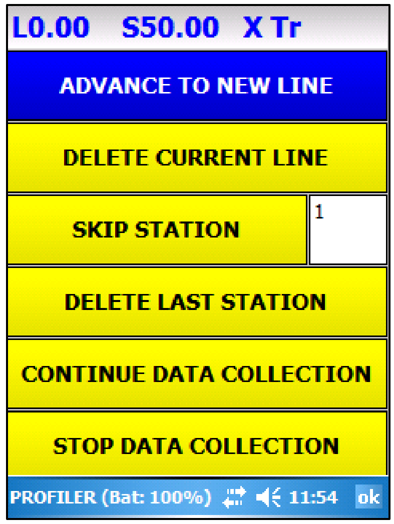


Figure 63: Run Time menu.

7 To advance to a new line the User should select Advance To New Line. The line number will increment (or decrement).

8 The User should then select Continue Data Collection to restart data collection on the new line.

- If the User taps the data collection screen, the Trajectory will now display the updated position on the grid.

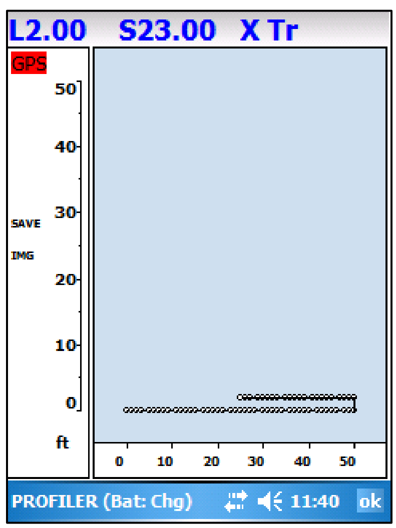


Figure 64: Trajectory Display.

9 The data collection Run Time menu provides the User with a number of functions that can be performed during data collection.

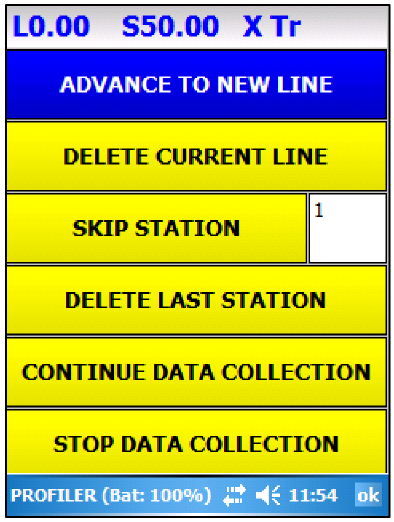


Figure 65: Run Time menu.

Advance to New Line: Increments or decrements the line number based upon the value for Spacing entered in the Grid Config. menu.

Delete Current Line: Deletes the current line. This function can be used to delete *all* lines in the *current grid*.

Skip Station: Skips or increments the station number based on the value entered in Step in the Grid Config. menu.

Delete Last Station: Deletes the last station collected. This function can be used to delete *all* stations\reading in the *current line*.

Continue Data Collection: Re-initiates data collection.

Stop Data Collection: Stops data collection.

Fiduciary\User Marks

As mentioned in the Grid Configuration (Grid Cong.) section (above 44), the User may enter fiduciary (or User) marks in the data file during data collection by pressing the Enter (↵) key on the PDA keypad during data collection. If the User is placing fiducial marks in the data, it is crucial that the value entered into the Mark Spacing field in the Grid Config. menu is the same the distance at which marks are entered during data collection.

MagMap2000 uses these fiducial marks to perform linear interpolation i.e., ‘rubbersheeting’of data collected in the continuous mode. If the value entered for Mark Spacing is incorrect, MagMap 2000 will interpolate the transect distances and the distances between the fiducial marks incorrectly. The User will then have to use the line start/end and mark editing functions in MagMap to input the correct distance between the marks and correct the overall length of the survey transects (see MagMap 2000 manual, Chapter 4: Editing of the Map).

When operating the Proflier in DISABLE mode, the fiduciary marks will be displayed on the Trajectory screen as red circles.

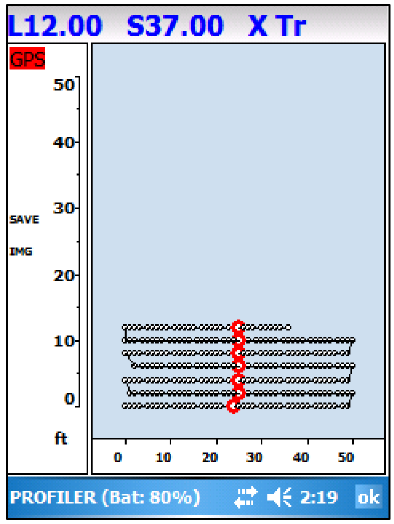


Figure 66: Fiduciary Marks – Trajectory –GPS Disabled.

If the User enables either internal or external GPS, the Trajectory map will be drawn using the GPS fix positions on the display. When data collection is started, the latitude, longitude and the HDOP (Horizontal Dilution of Precision) data from the GPS will be displayed between the data graph display and the data numeric display.

GPS Mode – Freeway Mode - Levels

The third GPS mode is **LEVELS**.

When operating the Profiler with the GPS enabled, the User may select the **Levels** display to generate a color anomaly map of the survey area in real time. The mode enables the User to display a color anomaly map of a survey area over which the User may (or may not) wish to set up a precise survey grid. The User should use the Grid Config menu to set the X and Y axis extents in order that the PDA display 'covers' the entire survey area. GSSI recommends setting the X and Y grid maximums as close to the size of the survey area as possible. The User may adjust the displayed area (Zoom or Shift) during data collection. The data collected in the levels mode uses only the GPS position data to draw the color map display data point locations. The spacing between survey lines may or may not be consistent nor accurately reflect the line spacing as set in the Grid Config. menu. The accuracy of the color map display depends upon the size of the survey area (the display scale), the rate at which data is collected and the Users pace along the transects.

1. In the System Setup menu the User must enable the Internal or External GPS. When using and external GPS system the User must configure the GPS COM port parameters as described in the GPS Menu section.

Note: Since the accuracy of the internal WAAS GPS is limited, it is not suitable for pinpointing small isolated targets in the Freeway\Levels mode. GSSI recommends using an external ***survey grade*** GPS system capable of at least sub-meter accuracy when operating in the GPS Freeway – Levels mode. Users which have the Profiler software installed in a Trimble Geo XH or Geo XT handheld GPS units should use the internal GPS.

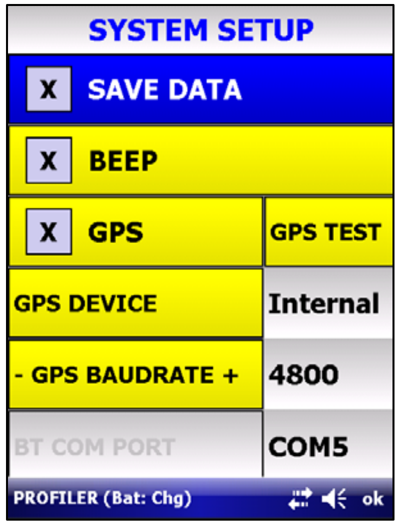


Figure 67: System Setup – GPS Enabled.

2 The User must confirm that the GPS solution is Valid by conducting sa GPS TEST.

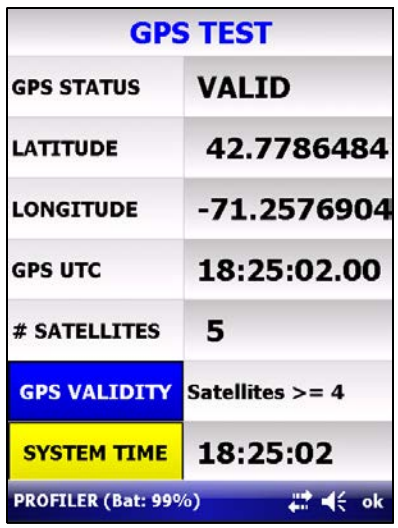


Figure 68: GPS Test – Status VALID.

3 Once the User has established the GPS solution is valid the User should navigate to the Collect Data menu and select the GPS DISPLAY type Levels.

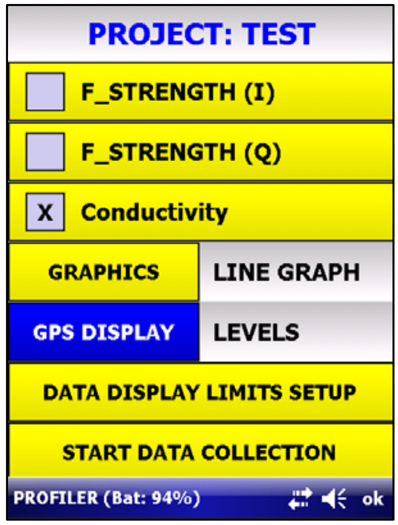


Figure 69: Collect Data – GPS DISPLAY – Levels.

4 The User must then navigate to the Select Parameters menu and select the 'Freeway' data collection mode. In the Freeway mode the data mapped to the Levels color map display is positioned based upon GPS information only. The system does not use any of the Grid Config. parameters to draw the data to the screen. In addition, the file is saved as one continuous line of data. Survey line numbers and grid position information (station numbers) are not saved to the file.

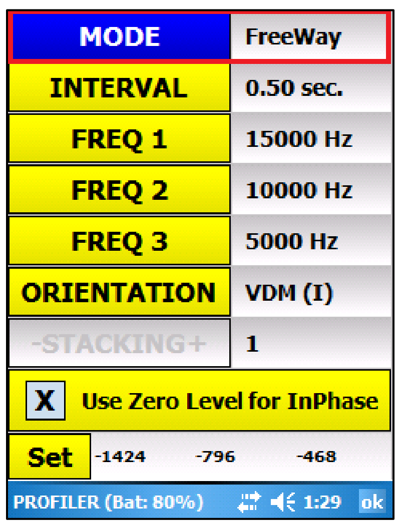


Figure 70: Select Parameters – Freeway Mode.

5 The User should then navigate to the Display Preferences menu, and select Data Display Colors.

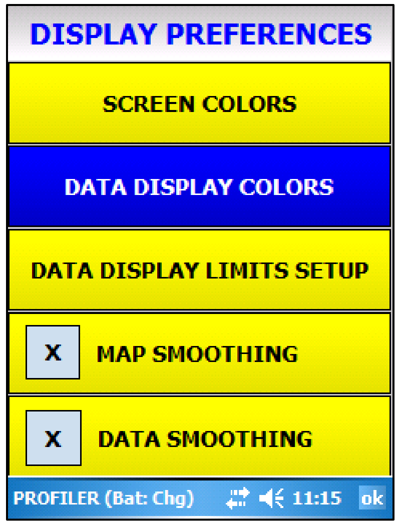


Figure 71: DISPLAY PREFERECNES – Data Display Colors.

6 The Data Display Colors menu allows the User to set the data display color for data displayed in line graph or bar graph mode. The section of the Data Display Colors menu that controls the Levels display functions is outline in **red** in the figure below.

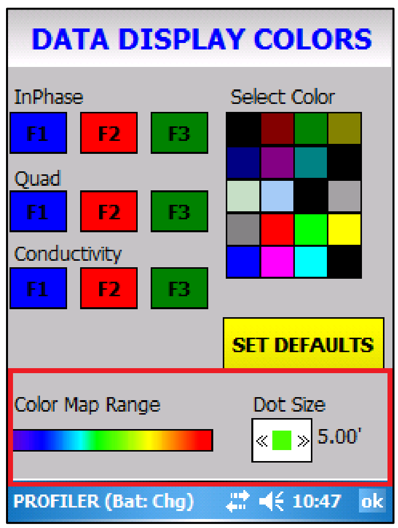


Figure 72: Levels Display – Color Map Range and Dot Size – Standard Rainbow Map Range(256).

The Color Map Range allows the User to select three different color map scales, or ranges. These are applied to the data component (In-Phase, Quadrature or Conductivity) selected for display. These include the standard 'rainbow' display which contains 256 color bins, the 'coarse' rainbow display which contains 128 color bins.

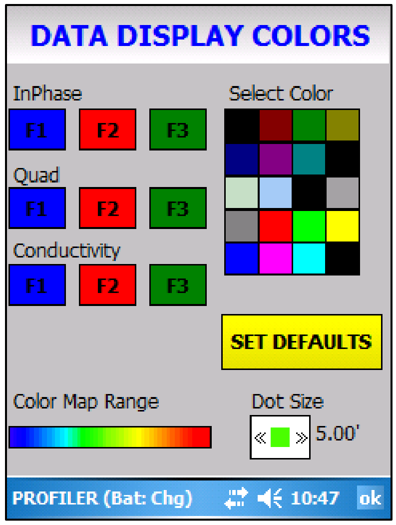


Figure 73: Levels Display – Coarse Color Map Range (128).

The coarse ‘broken’ rainbow display which contains 32 color bins and an assymetric color distribution.

Note: When using the Levels function the User may only display ***one*** component type i.e. In-Phase, Quadrature or Conductivity.

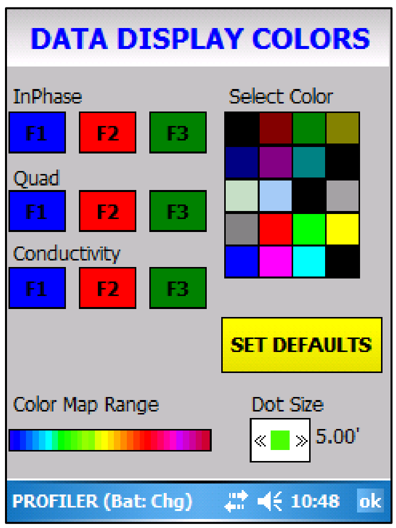


Figure 74: Levels Display – Coarse ‘broken’ color map range (32).

The “Dot Size’ parameter allows the User to adjust the size of the color map node on the data collection color map display. The dot size paramter will be scaled to the display scale width as set by the User in the Grid Config menu. The Dot Size will generally have to be adjusted, or tweaked, during the start of the survey to obtain a smooth color distribution.

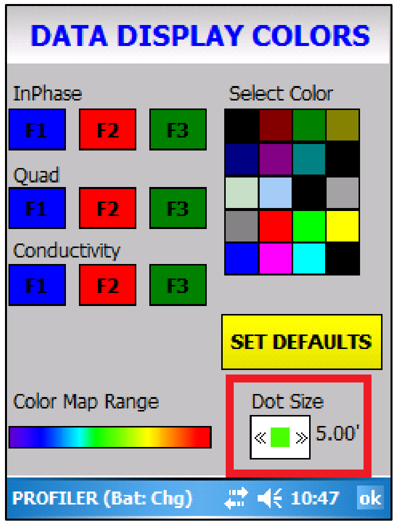


Figure 75: Levels Display – Dot Size.

The User may change the color dot size by selecting the left << or right >> arrows with the PDA stylus, The Color Dot size will increment and decrement in steps of .2 (in feet or meters).

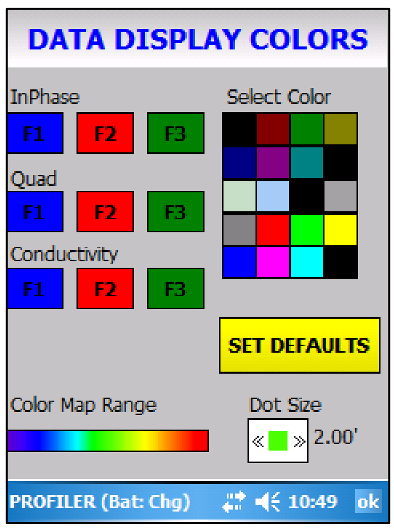


Figure 76: Levels Display – Dot Size 2.00'.

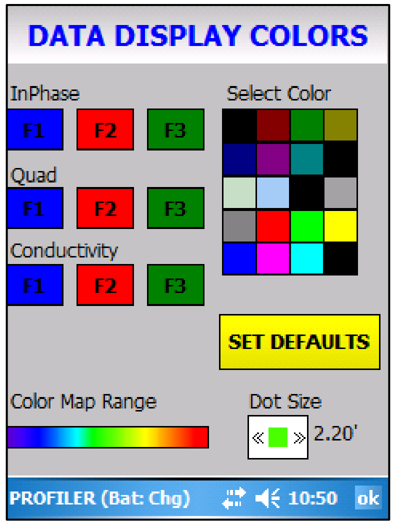


Figure 77: Levels Display – Dot Size 2.20'.

7 Once the User has selected the desired map range and dot size parameters, navigate to Collect Data menu. Start data collection by selecting Start Data Collection and then tap the PDA display or press the Enter key on the PDA keypad. The system will display the collect data display screen, however the system will not start until the User presses the Enter key again. The system will then begin to collect data.

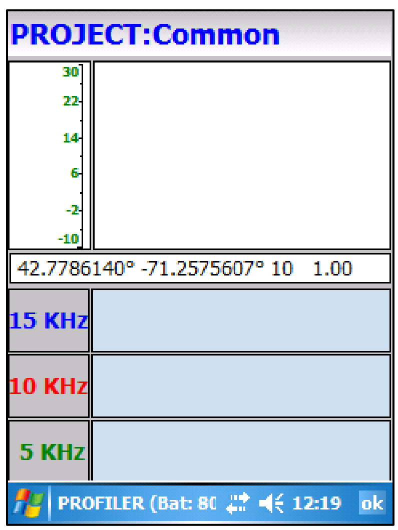


Figure 78: Collect Data – Freeway\Levels.

8 Once the system begins to collect data, the User should ***immediately*** tap the PDA screen to change from the Line\Bar graph data dispay to the Color Map display and begin to walk along the starting transect. The Profiler will display the first five (5) to ten (10) readings in the center of the map display until it has enough GPS information to establish a heading.

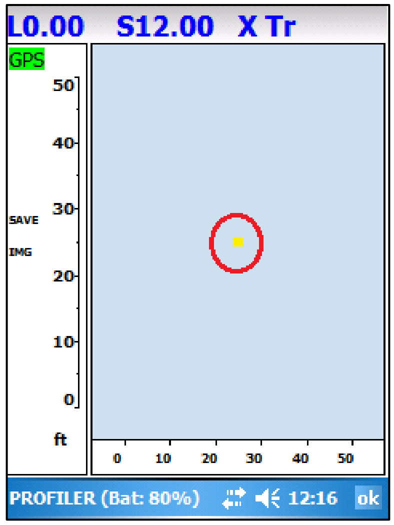


Figure 79: Color Map Display – Initial readings centered.

9 Once the system has established a heading it will reposition the data along the X (bottom) axis.

Note: The data will always be positioned along the x axis regardless of the grid type (X or Y) selected by the User.

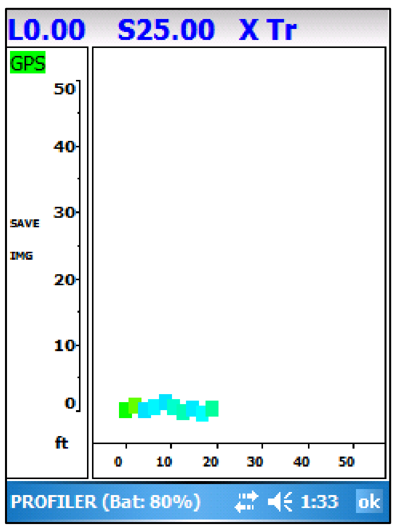


Figure 80: Transect Heading moved to X axis – Dot Size 2.

10 The GPS quality will be indicated by a **green** GPS symbol in the upper left of the display. The User may save a bitmap image of the current display by tapping the 'SAVE IMG' field on the Y (vertical) axis at any time during data collection.

Adjusting Dot Size

The User will in most cases, have to conduct several initial test transects in order to adjust the dot size in order to generate a 'smooth' display. The spacing of the dots will depend upon the speed of data acquisition, the scale of the display, the transect spacing and the Users walking pace along the transect.

In the figure below we have selected a 50 X 50 ft grid and are collecting data at a speed of 2 Hz i.e., 2 readings per second. The transects are 'spaced' approximately 2 feet apart. Inspection of the figure reveals that we have a slight 'gap' between the first two transects and that some of our 'dots' overlap along the transect and that the color dots from the adjacent transects do not overlap

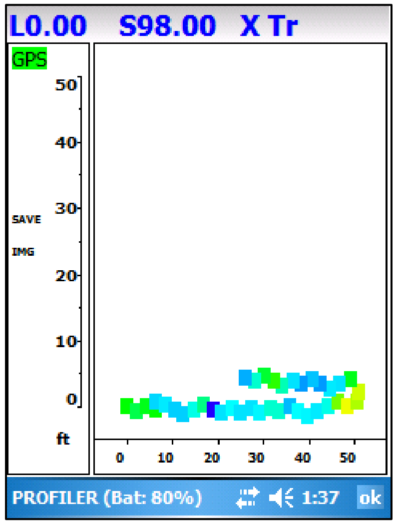


Figure 81:Color Map – Dot Size 2.

When conducting surveys over large areas this does not usually present an interpretation problem, however over smaller areas it is advisable to adjust the dot size so that the transects overlap.

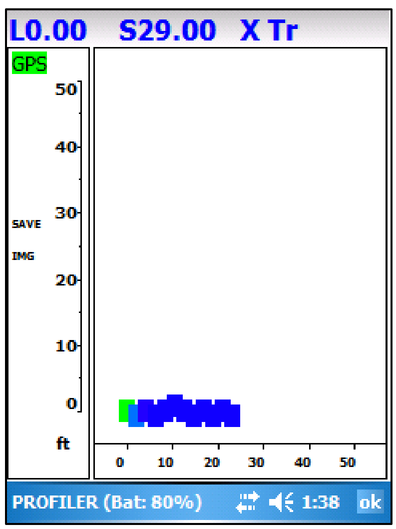


Figure 82: Color Map – Dot Size 3.

After re-starting data collection with the new dot size and continuing with the survey, the User may still find that gaps as well as overlaps will appear due to pace and heading errors i.e., the User is not walking an absolutely straight line at a constant speed.

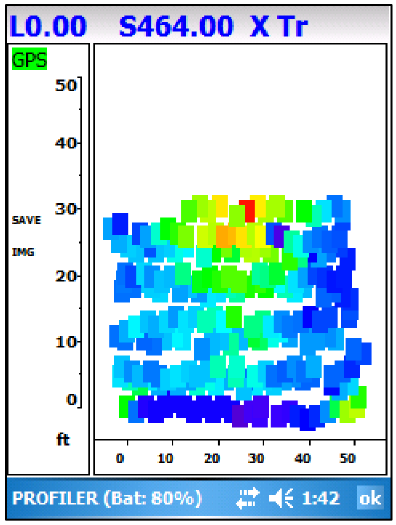


Figure 83: Color Map – Dot Size 3.

If desired, the User can increase the dot size further to cover the gaps between the transects or adjust their pace and heading to suit the chosen display scale.

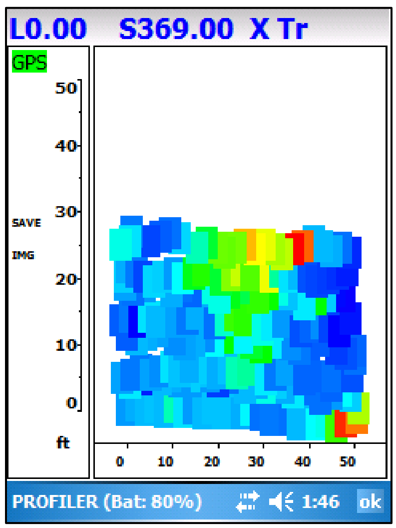


Figure 84: Color Map – Dot Size 5.

The User also has the option of ‘zooming’ or ‘shifting’ the display by pressing the left, right and up or down arrow keys on the PDA keypad. This function allows the User to continue to collect data beyond the limits of the initial grid dimensions entered in the Grid Config menu. In the example below we have shifted the Y-axis 10 ft to the south and the X-axis 10 feet to the east and have continued data collection ‘outside’ the extents of the original 50 X 50 foot grid.

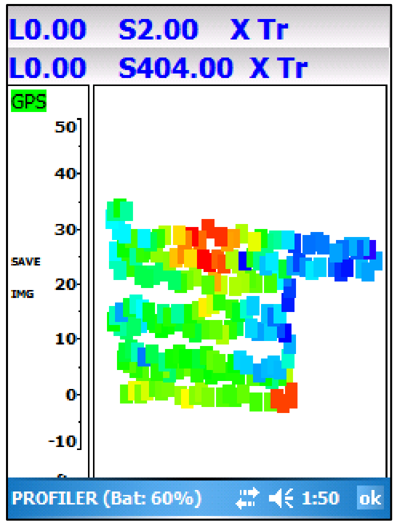


Figure 85: Grid Shift.

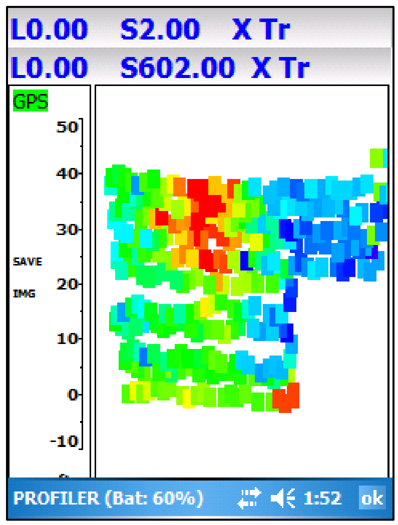


Figure 86: Grid Shift.

When the User has completed the survey they may select "SAVE IMG" on the vertical axis of the color map display to save a bitmap image of the color map display.

Review Data

Review Data Menu

The Review Data menu allows the User to review, delete or quick contour data which was collected with User grid parameters.

Select Main > Review Data.

- Project (page 65)
- File (page 66)
- REVIEW LAST FILE (page 66)
- REVIEW (page 66)
- DELETE PROJECTS (page 68)
- DELETE FILES (page 69)

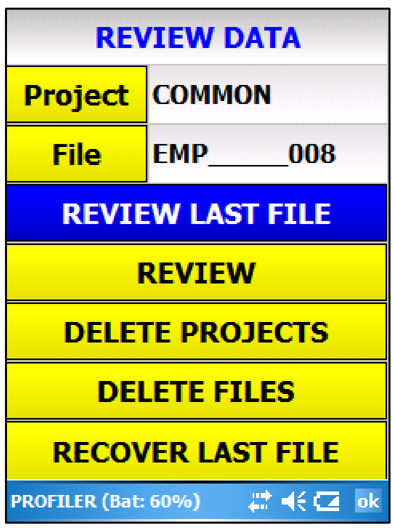


Figure 87: Review Data menu.

Project

To select the appropriate Project folder, tap Project. The PDA will then display the stored project folders.

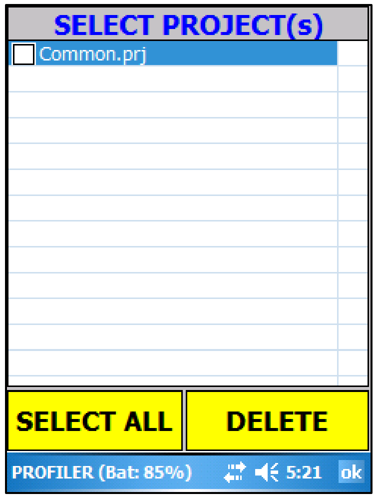


Figure 88: Select Project Folder menu.

Select the Project in which the file to be reviewed resides.

Note: Common.prj is the default Profiler project directory. Once the desired Project has been selected, the project name will appear in the Project field.

File

The User may then select the desired file(s). Tap File and select the desired file name to Review the file.

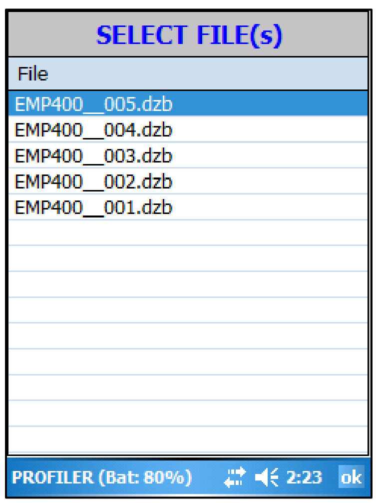


Figure 89: Select File(s) menu.

REVIEW

Once a file has been selected the Select Data Value screen will be displayed.

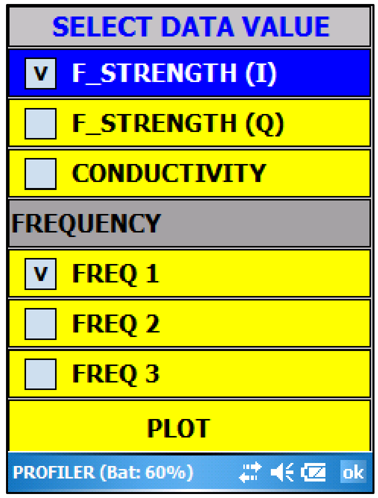


Figure 90: Select Data Value menu.

From this screen, the User may select the frequency and the specific component of that frequency to be displayed as a contour map. The Profiler contouring algorithm is very simple and uses a triangular nearest-neighbor method to grid and contour the data. This function serves as a quick way to review your acquired data in the field.

Example: The User can select the transmit frequency, FREQ 1 through FREQ 3, and F_Strength for either the In-Phase or Quadrature components, or Conductivity, and then select **PLOT**. The system will now generate a contour plot.

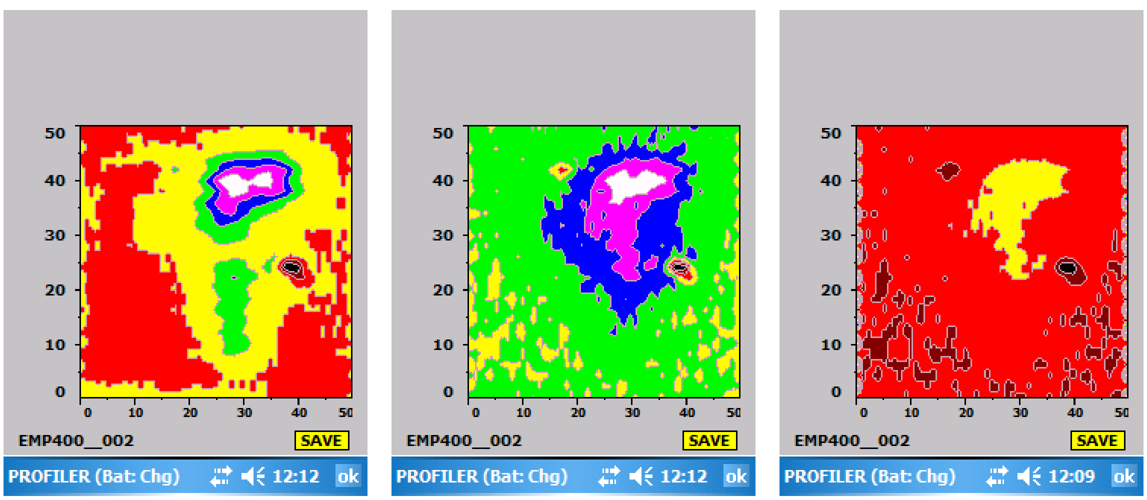


Figure 91: Review Data Contour Plot In-Phase (left), Quadrature (center) and Conductivity (right).

The User will note that the display provides no contour level information. This display is designed to provide the operator with a quick look at the data in the field in order to identify possible features of interest. The User can change the contour level colors and contour type by tapping on the display with the PDA stylus. This will switch the display to the Color Map Tables menu.

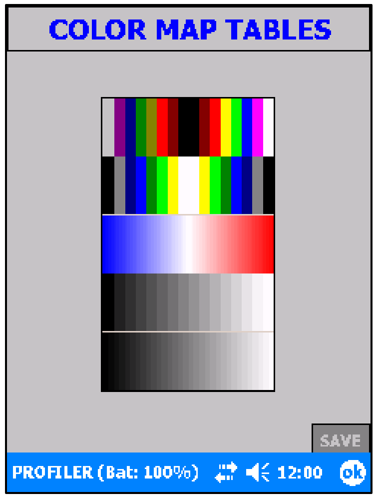


Figure 92: Contour Plot Color Map Table.

There are five (5) system defined Color Tables. These are displayed horizontally on Color Map Tables menu as five separate color bands:

- 2 - 16-shade color tables (top)
- 1 - 256-shade color table (blue, white, red-middle)
- 1 – 16-shade grayscale (second from bottom)
- 1 – 256-shade grayscale (bottom)

Tap on the desired color table and then tap OK from the PDA status bar**,** the screen will switch back to the contour map display and the data will be displayed with the new user-selected color table.

To save the quick contour map as an *.bmp file, tap **Save** in the bottom right corner of the Review Data Contour Plot display. This file will be written into the active Project folder.

DELETE PROJECT

To delete a project folder select Review Data > Delete Projects. The User may delete single projects by selecting the box next to the project to be deleted, or the user can Select All and all of the projects in the user memory will be deleted.

Note: Projects can also be deleted by connecting the PDA to your PC via ActiveSync\Windows Mobile and deleting the appropriate Project folder from the Profiler\Data directory.

Note: There is NO user protection in this menu display. The system will NOT prompt the user with a *Confirmation **Warning*** when deleting projects**.**

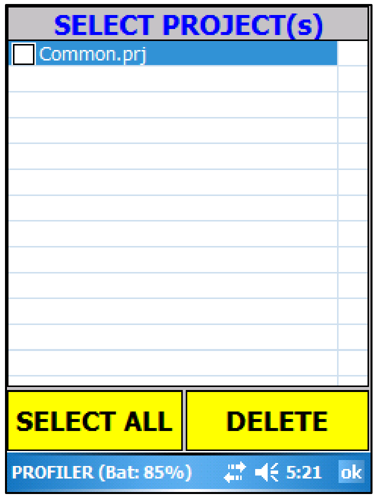


Figure 93: Delete Project(s) menu.

DELETE FILES

- To delete a file, groups of files or an entire directory of files, select Review Data > Delete Files. The Delete File menu display will appear.
- To delete a single file, select the box next to the file to be deleted, and then tap Delete.
- To delete groups of files, select the boxes next to the files to be deleted, and then tap Delete.
- To delete all of the files Select All, and all of the files in the current working project folder will be deleted when Delete is tapped.

Note: Files can also be deleted by connecting the PDA to a PC via ActiveSync, selecting the appropriate Project folder and deleting the appropriate files from the folder.

Note: There is **NO** user protection in this menu display. The system will **NOT** prompt the user with a ***Confirmation Warning*** when deleting files.

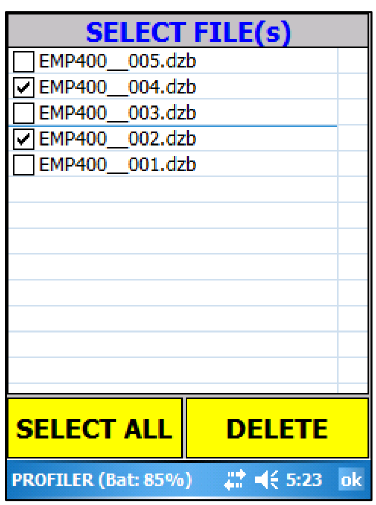


Figure 94: Delete File menu.

RECOVER LAST FILE

In the event that the Bluetooth communications between the PDA and the Profiler is lost during data collection, the User may recover the data by using the **Recover Last File** function

Shutting Down the System

To shut down the data collection interface after completion of the survey, return to the Main menu, and tap OK on the PDA status bar. The system will then display the program exit screen.

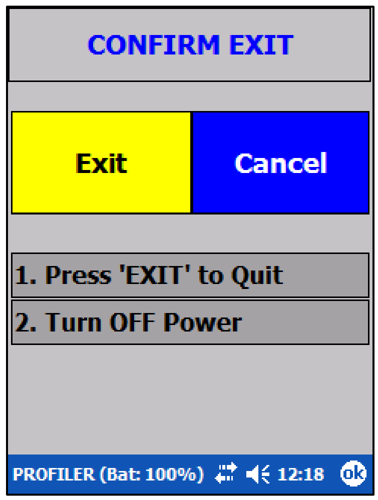


Figure 95: Profiler Program Exit.

To escape from the program tap Exit. If you selected OK on the PDA status bar inadvertently, while in the Main menu, tap Cancel and the system will return you to the Main menu.

Chapter 3: Transferring, Converting and Exporting Profiler Data

The TDS RECON-400 PDA utilizes a USB connection and Windows Mobile (Microsoft® ActiveSync) to transfer data from the PDA. The User must have Windows Mobile or ActiveSync version 4.1.0 (or higher) installed on their computer and/or the Profiler File Transfer Utility program.

If the User does not have ActiveSync installed on their PC it can be downloaded from the Microsoft support site at the following URL: http://www.microsoft.com/en-us/download/details.aspx?id=15.

The User should also have installed the MagMap2000 software which was supplied with the system. Additional 3rd party software such as ArcheoSurveyor, GEOSOFT or SURFER are commonly used for data processing, and the gridding and contouring of EM data.

Transferring Data

1. To transfer data, the User must first connect the USB cable supplied with your Profiler to the PDA.
2. The USB cable has a flat A type USB connector and a square B type connector. The square B end should be plugged into the USB port on your PDA.

Figure 96: USB B connector plugged into PDA USB port.

3. The User should now plug the flat USB type A connector into a free USB port on their PC.

Figure 97: USB A connector plugged into free PC USB port.

4 Data can be transferred directly from the PDA to the computer with Windows Mobile Device Center or Activesync, or the User may use Profiler File Transfer Program/File Transfer Utility interface. The File Transfer Utility interface is designed to access the Profiler storage memory.

Note: It is necessary to install Windows Mobile\ActiveSync in order for the File Transfer Utility to function correctly.

Transferring Data Using ActiveSync

1 Prior to transferring data to the PC, the User should create a destination folder for the data on their PC. Upon connection of the PDA to the computer, the system will display the Windows Mobile Device Center menu.

Figure 98: Windows Mobile Device Center.

OR the Pocket PC Sync Setup Wizard.

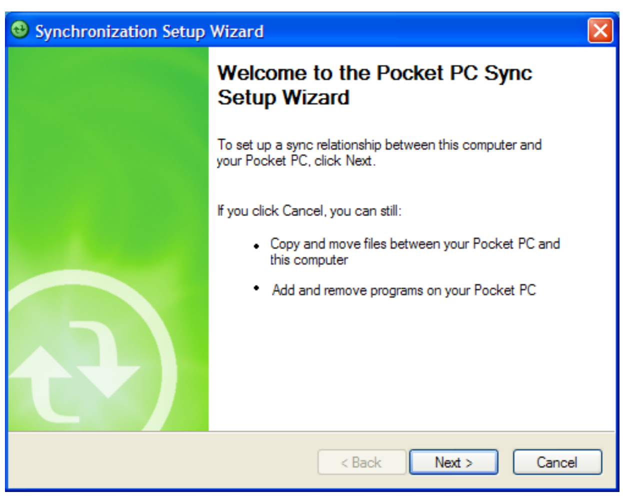


Figure 99: Synchronization Setup Wizard.

2 If the PC has Windows Mobile installed, the User should select Connect without Setting up your Device.

Figure 100: Windows Mobile Connection.

3 The User should then select File Management.

Figure 101: Windows Mobile File Management.

4 The User should select Browse the contents of your device.

Figure 102: Windows Mobile Browse Contents.

5 The system will now display the Recon PDA as a drive.

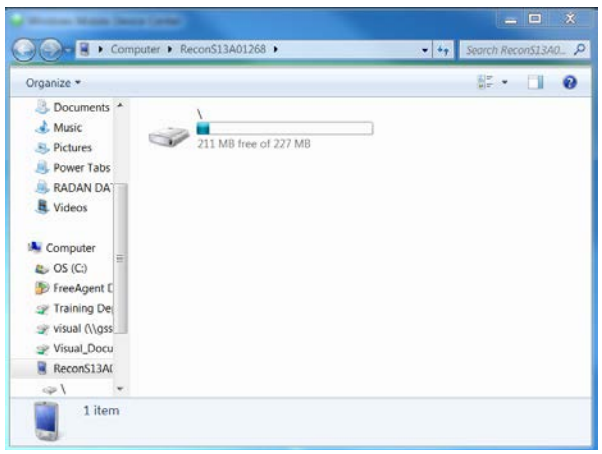


Figure 103: Windows Mobile Browse Contents.

6 The User should then browse the PDA to the system root and open the PROFILER folder..

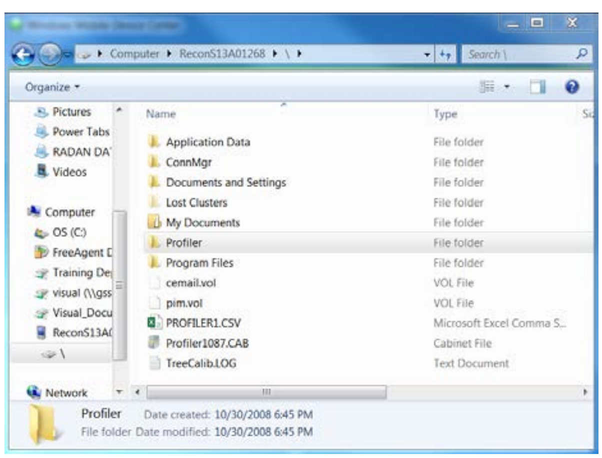


Figure 104: Profiler folder.

7 Inside the Profiler folder the User will find the DATA folder..

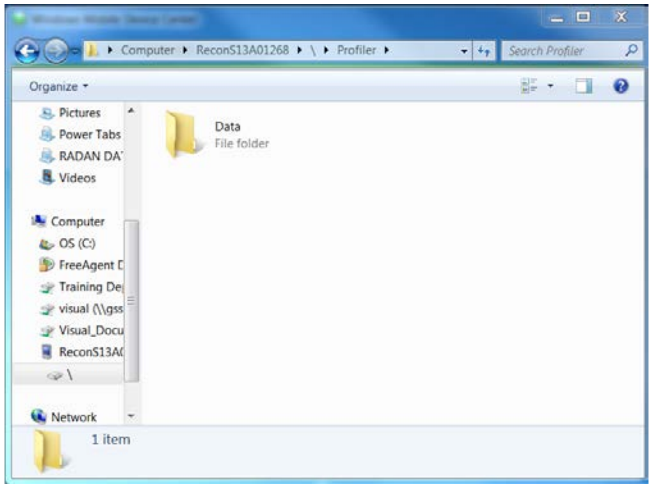


Figure 105: Profiler\Data Folder.

8 The User should open the DATA folder and then open the desired project folder.

Note: COMMON is the default Profiler project folder.

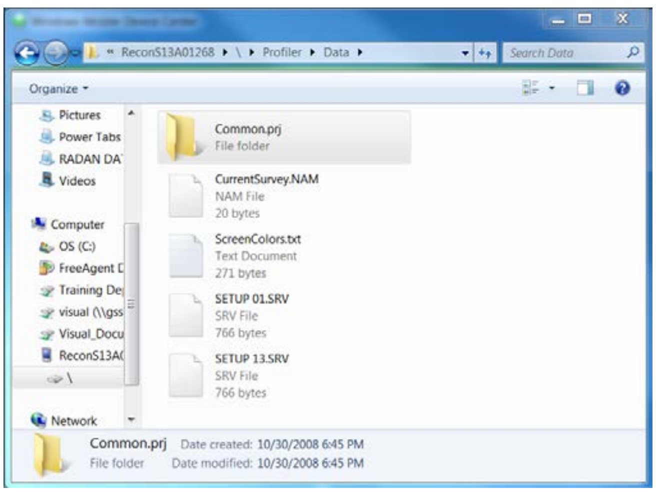


Figure 106: Profiler Common Project folder.

9 The User should open the desired project folder and **COPY or MOVE** the Profiler files to the desired location on their PC.

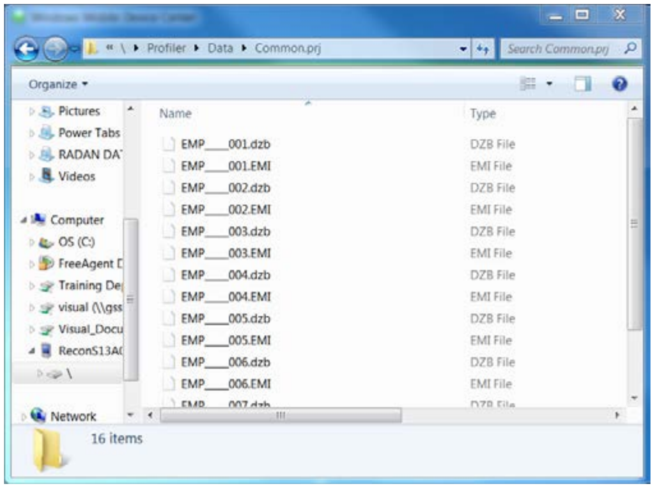


Figure 107: Contents of Project folder.

The User will note there are three (3) files types:

EMP400___00#.dzb: This is binary data file of the survey grid collected. This file is used to create the Review Data contour map. This file can also be displayed in the 3D Mode in the GSSI GPR data processing program, RADAN™.

EMP400___00#.EMI: This is the CSV file stored by the EMP-400. It may be opened in EXCEL as a comma separated variable file (CSV) file. It is suggested that EXCEL be used only to review the .EMI data file. If it is necessary to edit the file, GSSI recommends that the file first be converted to an *.dat file in the MagMap program. This file can then be opened and edited in MapMap 2000 or Surfer. After any edits are made, the operator must remember to save the file as an *.dat file type.

The *.EMI file is recognized by MagMap2000 as a native file type. MagMap2000 has been modified to read the EMP400 file header. MagMap 2000 will automatically perform linear interpolation on data collected with the EMP-400 in the Continuous mode. An example EMP400___00#.EMI file is illustrated in Figure 115.

EMP400___00#.GPS: This is the GPS file required by MagMap2000 to integrate the GPS and EM data. It is formatted as a standard NMEA GGA string. The can be opened in Excel as a comma delimited file. A GPS file is stored by the system if the WAAS GPS is enabled or the User has connected an external GPS unit to the PDA.

If the User's PC has ActiveSync installed the User should select '**Cancel**.

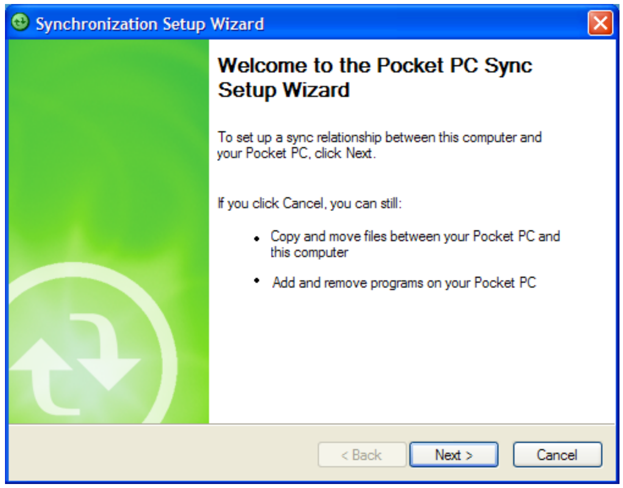


Figure 108: Pocket PC Sync Setup Wizard.

10 ActiveSync will then connect the PDA and PC and the ActiveSync connection window will appear.

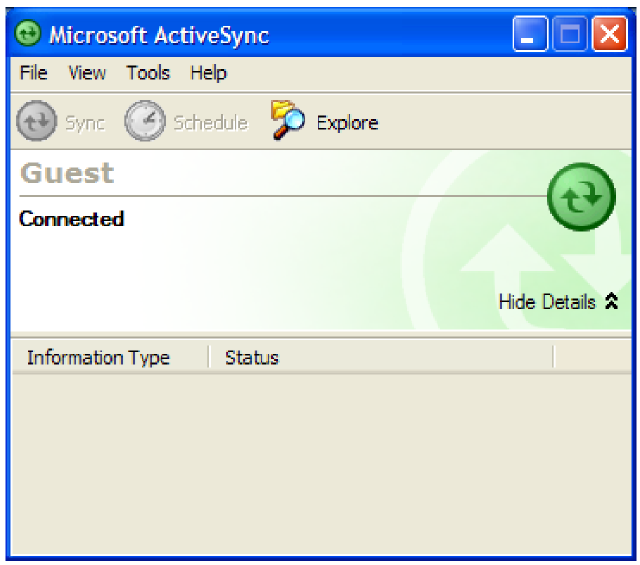


Figure 109: ActiveSync Explorer Connection window.

11 To access the PDA system and memory, select the Explore icon. This will access the Mobile Device window.

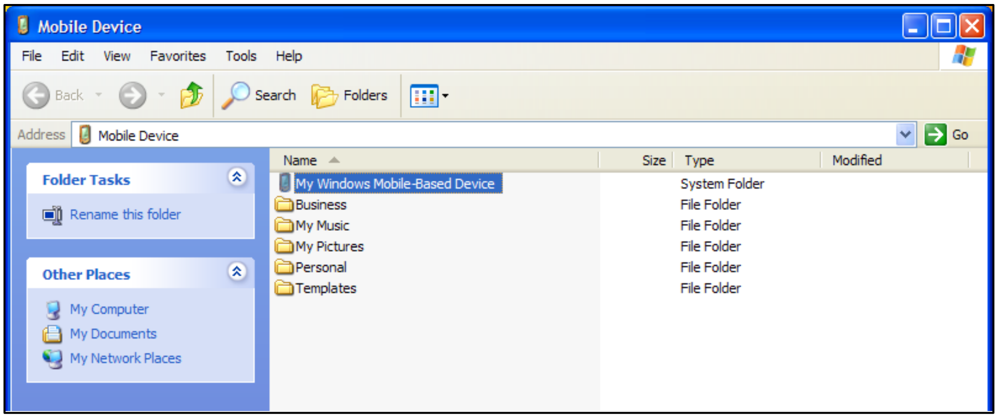


Figure 110: Mobile device window.

12 The User should now select My Windows Mobile-Based Device. This will access the PDA Root directory.

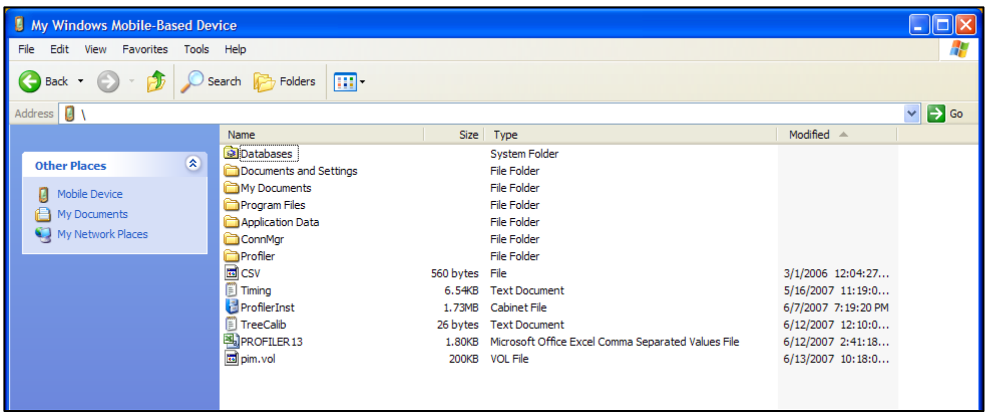


Figure 111: Mobile-device root directory window.

13 The User should now select the Profiler folder and then open the DATA folder.

Note: The User should not access and files or directories in the PDA root directory other than the Profiler file folder. Some files in the PDA root directory are required system files or log files. These files should not be opened, moved or deleted from the PDA root directory. GSSI assumes no responsibility for the proper operation of the EMP-400 if any of these files have been accessed, moved or deleted.

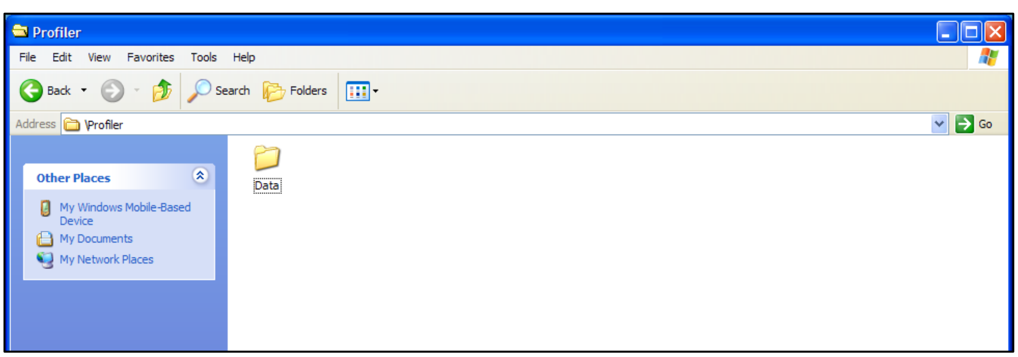


Figure 112: Profiler Data directory window.

14 The User should now select the DATA folder. This folder contains the PROJECT folders as well as parameter and setup files. This file should not be moved or deleted by the User. GSSI assumes no responsibility for the proper operation of the Profiler if any of these files have been moved or deleted.

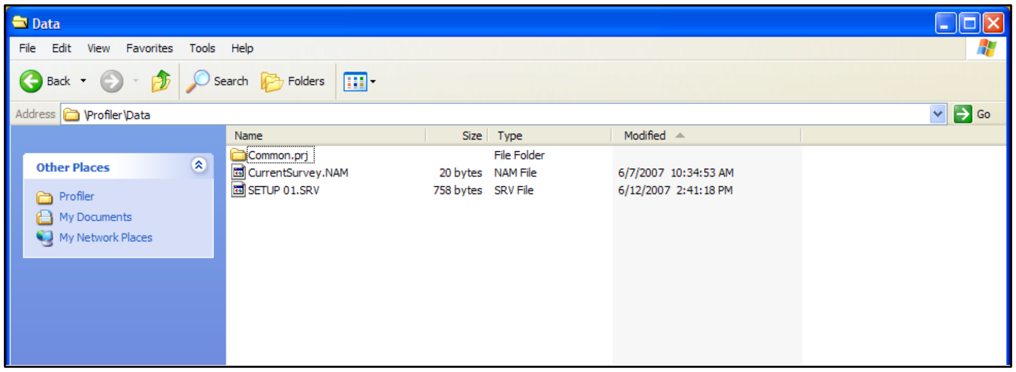


Figure 113: Profiler data directory.

15 If the User has not created a custom project directory, all of the Profiler data files will be found in the Common directory.

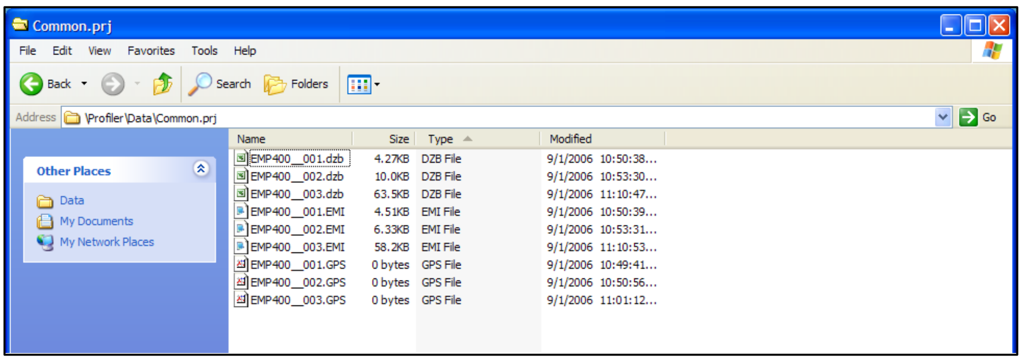


Figure 114: Profiler data file types.

The user will note there are three (3) files types:

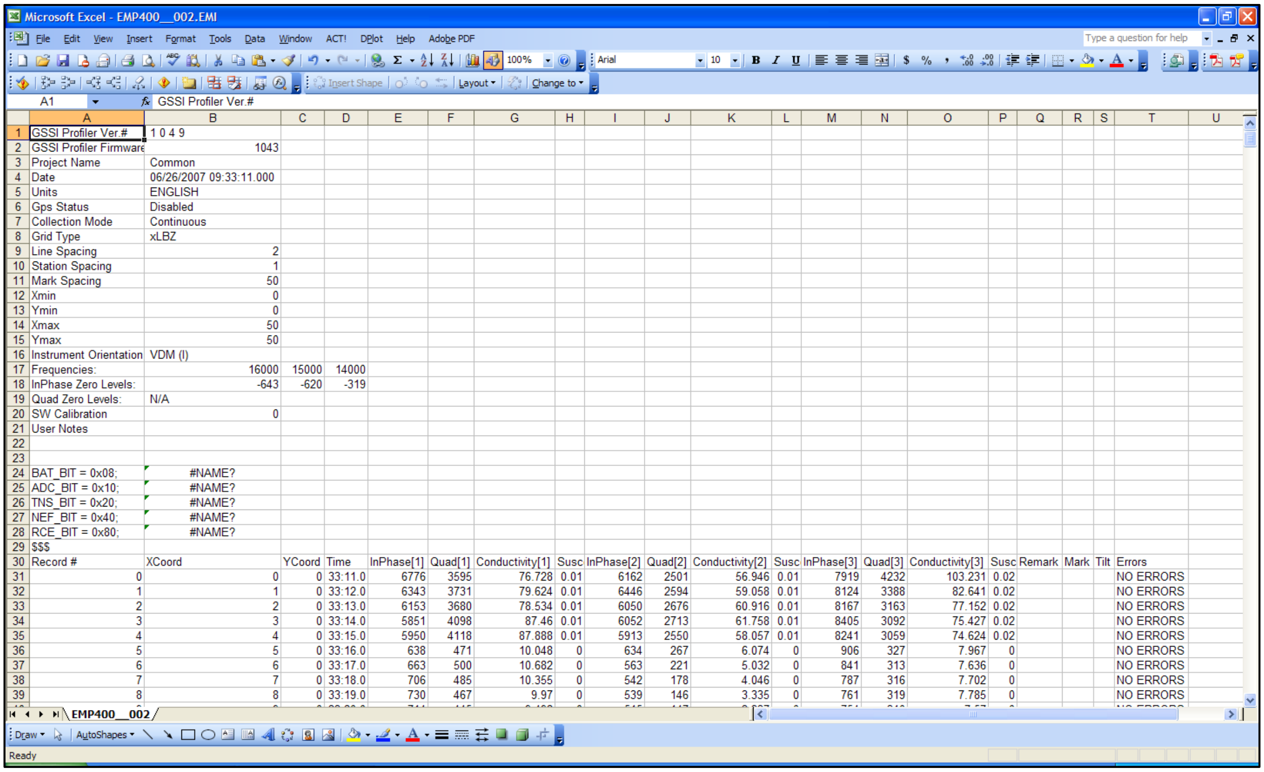
EMP400___00#.dzb: This is file of the survey grid collected. This files is used to create the Review Data contour map. This file can also be displayed in the 3D Mode in the GSSI GPR data processing program, RADAN™.

EMP400___00#.EMI: This is a CSV data file stored by the EMP-400. It is converted to an ASCII text type file upon transfer from the PDA. It may be opened in EXCEL as a comma separated variable file (CSV) file. It is suggested that EXCEL be used only to review the .EMI data file. If it is necessary to edit the file, GSSI recommends that the file first be converted to an *.dat file in the MagMap program. This file can then be opened and edited in MapMap 2000 or Surfer. After any edits are made, the operator must remember to save the file as an *.dat file type.

The *.EMI file is recognized by MagMap2000 as a native file type. MagMap2000 has been modified to read the EMP400 file header. MagMap 2000 will automatically perform linear interpolation on data collected with the EMP-400 in the Continuous mode.

EMP400___00#.GPS: This is the GPS file required by MagMap2000 to integrate the GPS and EM data. It is formatted as a standard NMEA GGA string. The can be opened in Excel as a comma delimited file.

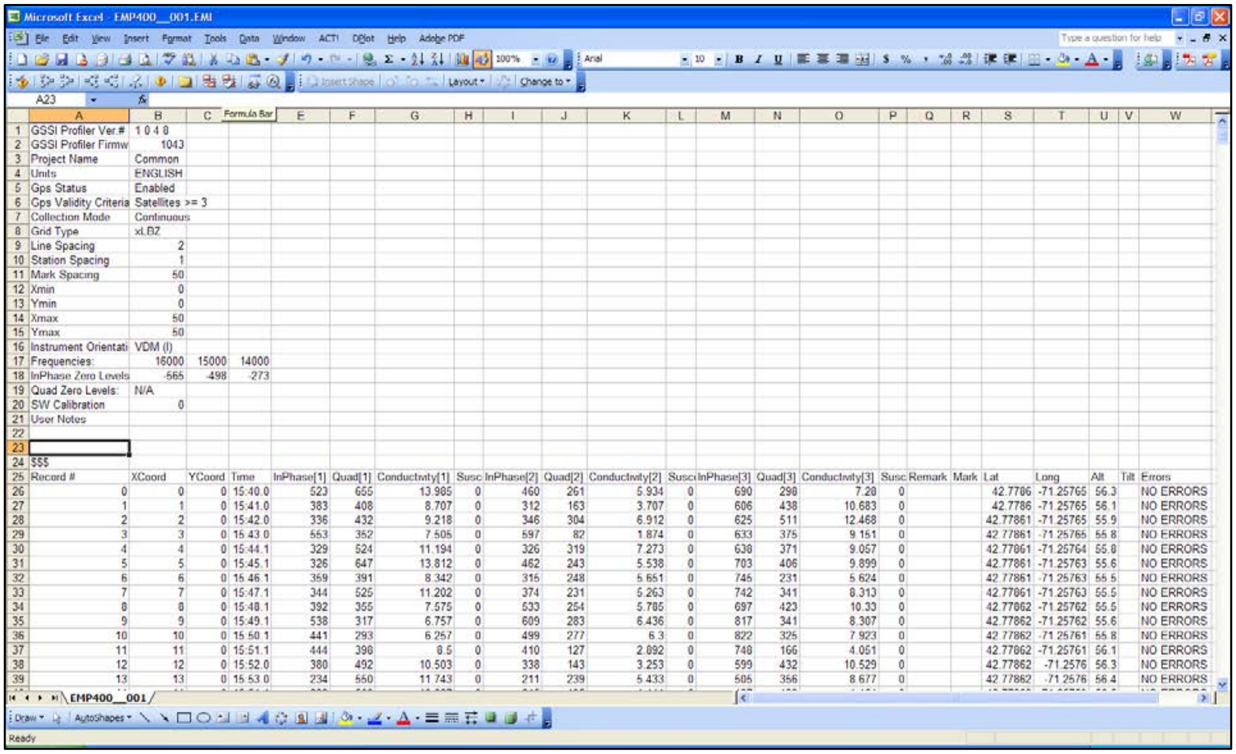
A GPS file is stored by the system if the WAAS GPS is enabled or the user has connected an external GPS unit to the PDA (see Section 2.2: Check System Diagnostic Parameters).



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	GSSI Profiler Ver.#	1 0 4 9																			
2	GSSI Profiler Firmware	1043																			
3	Project Name	Common																			
4	Date	06/26/2007 09:33:11.000																			
5	Units	ENGLISH																			
6	Gps Status	Disabled																			
7	Collection Mode	Continuous																			
8	Grid Type	xLBZ																			
9	Line Spacing	2																			
10	Station Spacing	1																			
11	Mark Spacing	50																			
12	Xmin	0																			
13	Ymin	0																			
14	Xmax	50																			
15	Ymax	50																			
16	Instrument Orientation	VDM (I)																			
17	Frequencies:	16000	15000	14000																	
18	InPhase Zero Levels:	-643	-620	-319																	
19	Quad Zero Levels:	N/A																			
20	SW Calibration	0																			
21	User Notes																				
22																					
23																					
24	BAT_BIT = 0x08;	#NAME?																			
25	ADC_BIT = 0x10;	#NAME?																			
26	TNS_BIT = 0x20;	#NAME?																			
27	NEF_BIT = 0x40;	#NAME?																			
28	RCE_BIT = 0x80;	#NAME?																			
29	$$$																				
30	Record #	XCoord	YCoord	Time	InPhase[1]	Quad[1]	Conductivity[1]	Susc	InPhase[2]	Quad[2]	Conductivity[2]	Susc	InPhase[3]	Quad[3]	Conductivity[3]	Susc	Remark	Mark	Tilt	Errors	
31	0	0	0	33:11.0	6776	3595	76.728	0.01	6162	2501	56.946	0.01	7919	4232	103.231	0.02				NO ERRORS	
32	1	1	0	33:12.0	6343	3731	79.624	0.01	6446	2594	59.058	0.01	8124	3388	82.641	0.02				NO ERRORS	
33	2	2	0	33:13.0	6153	3680	78.534	0.01	6050	2676	60.916	0.01	8167	3163	77.152	0.02				NO ERRORS	
34	3	3	0	33:14.0	5851	4098	87.46	0.01	6052	2713	61.758	0.01	8405	3092	75.427	0.02				NO ERRORS	
35	4	4	0	33:15.0	5950	4118	87.888	0.01	5913	2550	58.057	0.01	8241	3059	74.624	0.02				NO ERRORS	
36	5	5	0	33:16.0	638	471	10.048	0	634	267	6.074	0	906	327	7.967	0				NO ERRORS	
37	6	6	0	33:17.0	663	500	10.682	0	563	221	5.032	0	841	313	7.636	0				NO ERRORS	
38	7	7	0	33:18.0	706	485	10.355	0	542	178	4.046	0	787	316	7.702	0				NO ERRORS	
39	8	8	0	33:19.0	730	467	9.97	0	539	146	3.335	0	761	319	7.785	0				NO ERRORS	

Figure 115: Profiler *.EMI data file example.

Figure 116 is an example of a multi frequency file collected with a GPS system. All of the data acquisition and grid parameter information is written in the header above the data. The header is separated from the data section of the file by the $$$ signs. The GPS information; latitude, longitude and elevation (ALT), is written inside the EMI file. In this example they are found in columns ‘S’, ‘T’ and ‘U’.



Microsoft Excel - EMP400__001.EMI

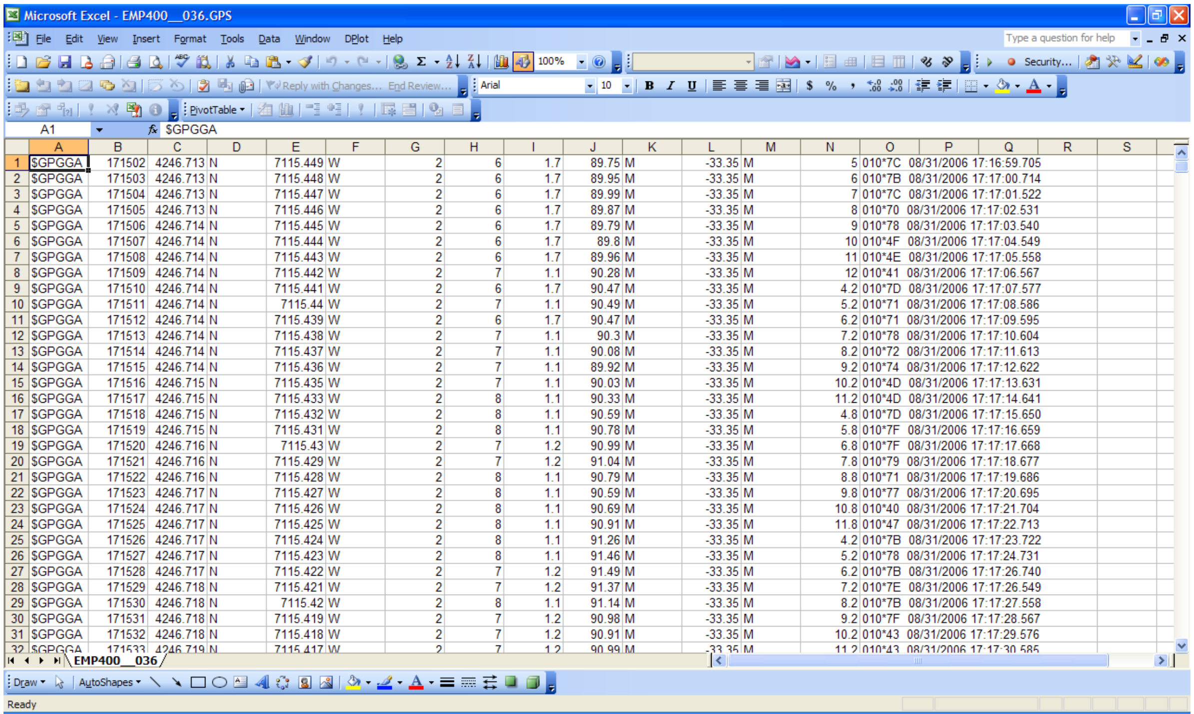
Row	A	B	C	D
1	GSSI Profiler Ver.#	1 0 4 8		
2	GSSI Profiler Firmw	1043		
3	Project Name	Common		
4	Units	ENGLISH		
5	Gps Status	Enabled		
6	Gps Validity Criteria	Satellites >= 3		
7	Collection Mode	Continuous		
8	Grid Type	xLBZ		
9	Line Spacing	2		
10	Station Spacing	1		
11	Mark Spacing	50		
12	Xmin	0		
13	Ymin	0		
14	Xmax	50		
15	Ymax	50		
16	Instrument Orientati	VDM (I)		
17	Frequencies:	16000	15000	14000
18	InPhase Zero Levels	-565	-498	-273
19	Quad Zero Levels:	N/A		
20	SW Calibration	0		
21	User Notes			
22				
23				
24	$$$			

Row	Record #	XCoord	YCoord	Time	InPhase[1]	Quad[1]	Conductivity[1]	Susc	InPhase[2]	Quad[2]	Conductivity[2]	Susc	InPhase[3]	Quad[3]	Conductivity[3]	Susc	Remark	Mark	Lat	Long	Alt	Tilt	Errors
26	0	0	0	15:40.0	523	655	13.985	0	460	261	5.934	0	690	298	7.28	0			42.7786	-71.25765	56.3		NO ERRORS
27	1	1	0	15:41.0	383	408	8.707	0	312	163	3.707	0	606	438	10.683	0			42.7786	-71.25765	56.1		NO ERRORS
28	2	2	0	15:42.0	336	432	9.218	0	346	304	6.912	0	625	511	12.468	0			42.77861	-71.25765	55.9		NO ERRORS
29	3	3	0	15:43.0	563	352	7.505	0	597	82	1.874	0	633	375	9.151	0			42.77861	-71.25765	55.8		NO ERRORS
30	4	4	0	15:44.1	329	524	11.194	0	326	319	7.273	0	638	371	9.057	0			42.77861	-71.25764	55.8		NO ERRORS
31	5	5	0	15:45.1	326	647	13.812	0	462	243	5.538	0	703	406	9.899	0			42.77861	-71.25763	55.6		NO ERRORS
32	6	6	0	15:46.1	369	391	8.342	0	316	248	5.651	0	746	231	5.624	0			42.77861	-71.25763	55.5		NO ERRORS
33	7	7	0	15:47.1	344	525	11.202	0	374	231	5.263	0	742	341	8.313	0			42.77861	-71.25763	55.5		NO ERRORS
34	8	8	0	15:48.1	392	355	7.575	0	533	254	5.785	0	697	423	10.33	0			42.77862	-71.25762	55.5		NO ERRORS
35	9	9	0	15:49.1	538	317	6.757	0	609	283	6.436	0	817	341	8.307	0			42.77862	-71.25762	55.6		NO ERRORS
36	10	10	0	15:50.1	441	293	6.257	0	499	277	6.3	0	822	325	7.923	0			42.77862	-71.25761	55.8		NO ERRORS
37	11	11	0	15:51.1	444	398	8.5	0	410	127	2.892	0	748	166	4.051	0			42.77862	-71.25761	56.1		NO ERRORS
38	12	12	0	15:52.0	380	492	10.503	0	338	143	3.253	0	599	432	10.529	0			42.77862	-71.2576	56.3		NO ERRORS
39	13	13	0	15:53.0	234	550	11.743	0	211	239	5.433	0	505	356	8.677	0			42.77862	-71.2576	56.4		NO ERRORS

Figure 116: Profiler *.EMI data file with GPS.

Figure 117 illustrates the standard Profiler GPS file. The format of all Profiler GPS files is standard NMEA GGA format.

This file is compatible with the MagMap2000 GPS Conversion and Processing functions. It can also be converted to other co-ordinate types by the User in MagMap2000 and with the appropriate formulas in Microsoft Excel™.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	$GPGGA	171502	4246.713	N	7115.449	W	2	6	1.7	89.75	M	-33.35	M	5	010*7C	08/31/2006	17:16:59.705
2	$GPGGA	171503	4246.713	N	7115.448	W	2	6	1.7	89.95	M	-33.35	M	6	010*7B	08/31/2006	17:17:00.714
3	$GPGGA	171504	4246.713	N	7115.447	W	2	6	1.7	89.99	M	-33.35	M	7	010*7C	08/31/2006	17:17:01.522
4	$GPGGA	171505	4246.713	N	7115.446	W	2	6	1.7	89.87	M	-33.35	M	8	010*70	08/31/2006	17:17:02.531
5	$GPGGA	171506	4246.714	N	7115.445	W	2	6	1.7	89.79	M	-33.35	M	9	010*78	08/31/2006	17:17:03.540
6	$GPGGA	171507	4246.714	N	7115.444	W	2	6	1.7	89.8	M	-33.35	M	10	010*4F	08/31/2006	17:17:04.549
7	$GPGGA	171508	4246.714	N	7115.443	W	2	6	1.7	89.96	M	-33.35	M	11	010*4E	08/31/2006	17:17:05.558
8	$GPGGA	171509	4246.714	N	7115.442	W	2	7	1.1	90.28	M	-33.35	M	12	010*41	08/31/2006	17:17:06.567
9	$GPGGA	171510	4246.714	N	7115.441	W	2	6	1.7	90.47	M	-33.35	M	4.2	010*7D	08/31/2006	17:17:07.577
10	$GPGGA	171511	4246.714	N	7115.44	W	2	7	1.1	90.49	M	-33.35	M	5.2	010*71	08/31/2006	17:17:08.586
11	$GPGGA	171512	4246.714	N	7115.439	W	2	6	1.7	90.47	M	-33.35	M	6.2	010*71	08/31/2006	17:17:09.595
12	$GPGGA	171513	4246.714	N	7115.438	W	2	7	1.1	90.3	M	-33.35	M	7.2	010*78	08/31/2006	17:17:10.604
13	$GPGGA	171514	4246.714	N	7115.437	W	2	7	1.1	90.08	M	-33.35	M	8.2	010*72	08/31/2006	17:17:11.613
14	$GPGGA	171515	4246.714	N	7115.436	W	2	7	1.1	89.92	M	-33.35	M	9.2	010*74	08/31/2006	17:17:12.622
15	$GPGGA	171516	4246.715	N	7115.435	W	2	7	1.1	90.03	M	-33.35	M	10.2	010*4D	08/31/2006	17:17:13.631
16	$GPGGA	171517	4246.715	N	7115.433	W	2	8	1.1	90.33	M	-33.35	M	11.2	010*4D	08/31/2006	17:17:14.641
17	$GPGGA	171518	4246.715	N	7115.432	W	2	8	1.1	90.59	M	-33.35	M	4.8	010*7D	08/31/2006	17:17:15.650
18	$GPGGA	171519	4246.715	N	7115.431	W	2	8	1.1	90.78	M	-33.35	M	5.8	010*7F	08/31/2006	17:17:16.659
19	$GPGGA	171520	4246.716	N	7115.43	W	2	7	1.2	90.99	M	-33.35	M	6.8	010*7F	08/31/2006	17:17:17.668
20	$GPGGA	171521	4246.716	N	7115.429	W	2	7	1.2	91.04	M	-33.35	M	7.8	010*79	08/31/2006	17:17:18.677
21	$GPGGA	171522	4246.716	N	7115.428	W	2	8	1.1	90.79	M	-33.35	M	8.8	010*71	08/31/2006	17:17:19.686
22	$GPGGA	171523	4246.717	N	7115.427	W	2	8	1.1	90.59	M	-33.35	M	9.8	010*77	08/31/2006	17:17:20.695
23	$GPGGA	171524	4246.717	N	7115.426	W	2	8	1.1	90.69	M	-33.35	M	10.8	010*40	08/31/2006	17:17:21.704
24	$GPGGA	171525	4246.717	N	7115.425	W	2	8	1.1	90.91	M	-33.35	M	11.8	010*47	08/31/2006	17:17:22.713
25	$GPGGA	171526	4246.717	N	7115.424	W	2	8	1.1	91.26	M	-33.35	M	4.2	010*7B	08/31/2006	17:17:23.722
26	$GPGGA	171527	4246.717	N	7115.423	W	2	8	1.1	91.46	M	-33.35	M	5.2	010*78	08/31/2006	17:17:24.731
27	$GPGGA	171528	4246.717	N	7115.422	W	2	7	1.2	91.49	M	-33.35	M	6.2	010*7B	08/31/2006	17:17:26.740
28	$GPGGA	171529	4246.718	N	7115.421	W	2	7	1.2	91.37	M	-33.35	M	7.2	010*7E	08/31/2006	17:17:26.549
29	$GPGGA	171530	4246.718	N	7115.42	W	2	8	1.1	91.14	M	-33.35	M	8.2	010*7B	08/31/2006	17:17:27.558
30	$GPGGA	171531	4246.718	N	7115.419	W	2	7	1.2	90.98	M	-33.35	M	9.2	010*7F	08/31/2006	17:17:28.567
31	$GPGGA	171532	4246.718	N	7115.418	W	2	7	1.2	90.91	M	-33.35	M	10.2	010*43	08/31/2006	17:17:29.576
32	$GPGGA	171533	4246.719	N	7115.417	W	2	7	1.2	90.99	M	-33.35	M	11.2	010*43	08/31/2006	17:17:30.585

Figure 117: Profiler GGA *.GPS data file example.

The EMP400__#.dzb file type is a two dimensional binary bitmap. It is used to generate the contour map display in the Review Data menu of the PDA.

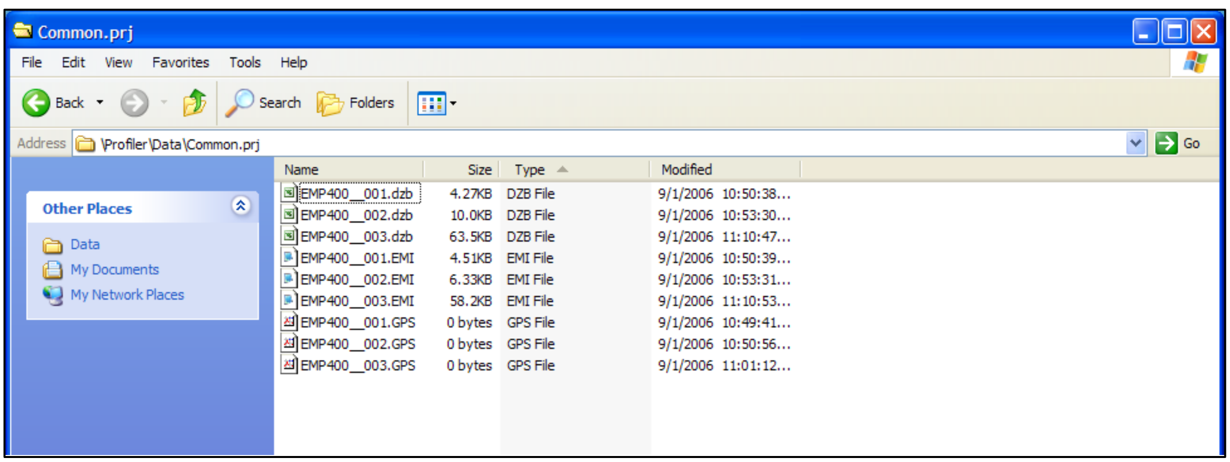


Figure 118: Profiler data files.

Prior to transferring data to the PC, the User should create a destination folder for the data. Once the folder has been created on the PC, the user simply has to use the Windows copy, paste, or move functions to copy or move data from the PDA to the destination folder on the PC.

Transferring Data Using File Transfer Utility

Data can also be transferred from the PDA to PC by using the Profiler Transfer Utility. As indicated, the File Transfer Utility requires that ActiveSync be installed on the PC and the PDA

The File Transfer Utility can be copied directly from the Accessories CD provided with your EMP-400 to your PC desktop. Double-click the File Manager desktop icon. The File Manger screen will be displayed.

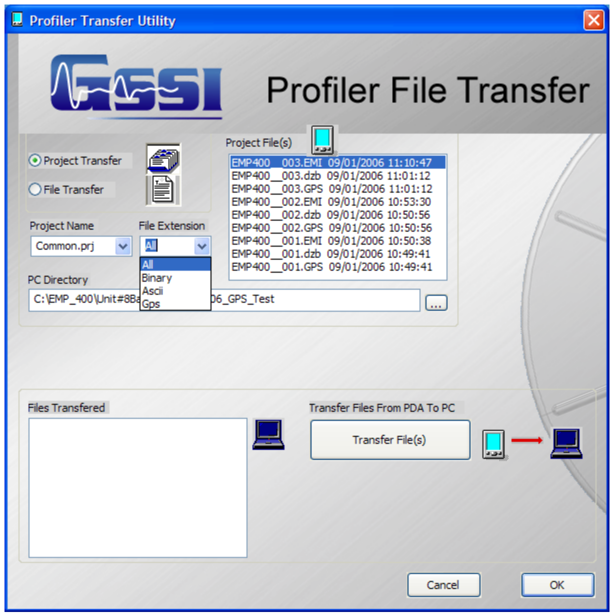


Figure 119: Profiler File Transfer Utility screen.

The File Transfer Utility allows the User to transfer single files, groups of files, entire project folders and/or specific file types e.g. binary *.dzb files, ASCII *.EMI files or *.GPS files.

- The Project Transfer button allows the user to transfer complete project folders (*.prj) from the PDA to the PC.
- The File Transfer button allows the user to transfer selected files (*.EMI, *.GPS or *.DZB) from the PDA to the PC.
- The PC Directory button allows the user to select the target directory for the files to be transferred from the PDA to the PC.

Once the desired file/project and target directory selections have been made, select **Transfer Files from PDA to PC**. The transferred files will appear in the Files Transferred Window.

Converting Files in MagMap2000

The MagMap2000 program is provided with the Profiler EMP-400 for two principal purposes:

1. To perform linear interpolation of survey line data collected in the Continuous mode, and to allow the user to edit survey lines, survey points and marker positions using the grid editing commands available in MagMap2000.
2. To integrate GGA GPS data with EMP-400 data.

Converting and Exporting EMP-400 EM Files

Once the User has transferred the Profiler files to the computer, open MagMap2000 by clicking the MagMap2000 icon located on your desktop.

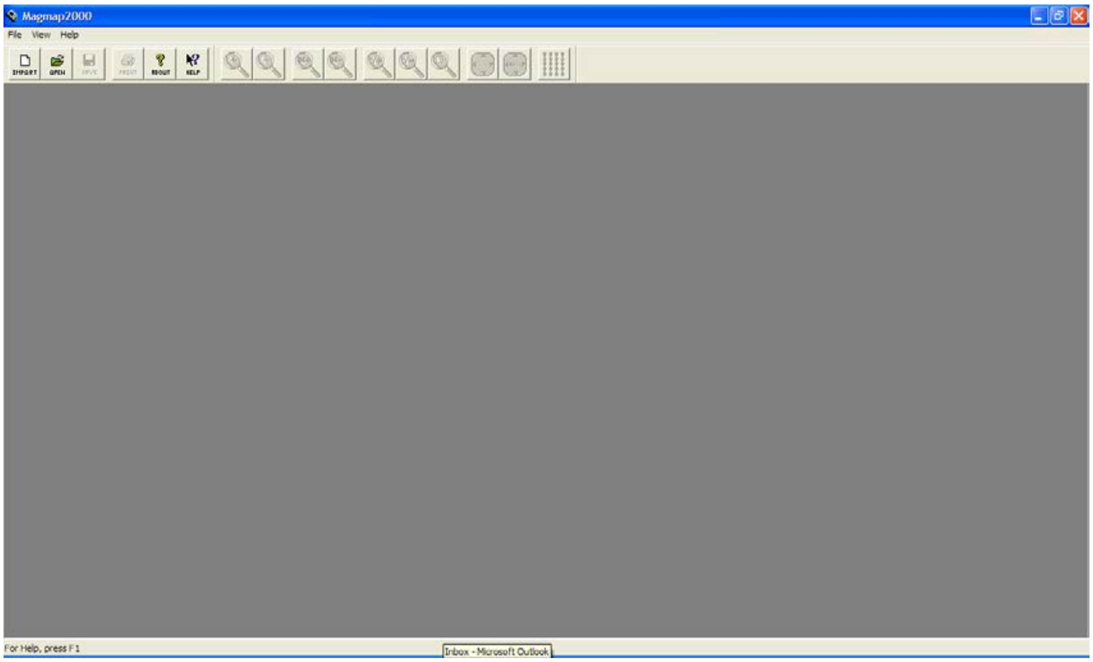


Figure 120: MagMap2000 Main menu.

1. To open an *.EMI file, select the file Open tab from the Main menu. Using the Look In Directory search bar, select the directory where the files were stored..
    - Upon first opening the program, the User may have to select the Files of Type box located at the bottom of the File Open dialog box, and select the GSSI Profiler (*.EMI) file type. The system will now recognize the *.EMI files.

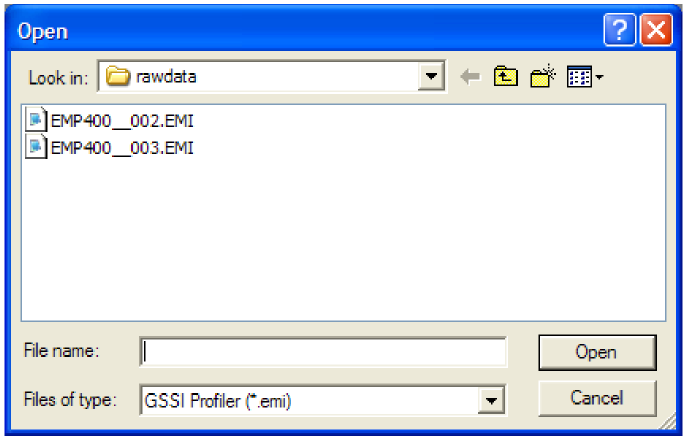


Figure 121: MagMap2000 File Open dialog box.

2 Once the User has selected the *.EMI file type, the File Open dialog box should display a list of the Profiler*.EMI files. To open a file, select the file with the cursor and click Open, or simply double-click on the desired file.

3 Upon opening the file, the MagMap2000 program will open the GSSI Profiler Information display. This is information comprises data stored in the file header.

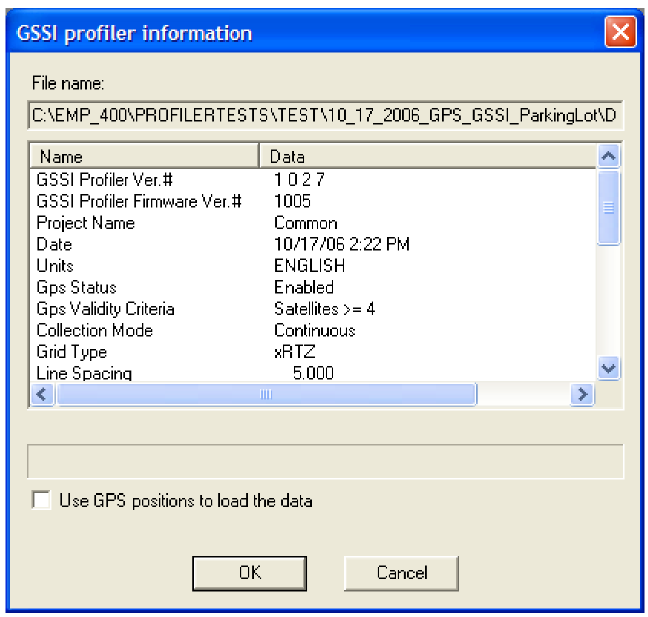


Figure 122: MagMap2000 GSSI Profiler Header Information Display(NEW).

4 If the User is satisfied that the information in the file header is correct select OK.

- If the data was collected in Continuous mode, MagMap2000 will read the information in the grid information; origin location, grid type, X and Y origin location, transect spacing and mark spacing and will generate an ***interpolated*** grid of the collected data.
- If marks (user or fiducial) are present in the data, MagMap2000 will interpolate between the line start mark, the user fiducial marks and the line end mark.

As discussed in Chapter 2 Fiducial Marks, it is important that the User has entered the correct value for the Marker Spacing in the Grid Config menu. In the following example the data file is an xLBZ grid with X and Y origin at zero. The origin is in the lower left hand corner of the grid. The grid has an X and Y maximum of 50. The Step is set to one (1) and the Line Spacing has been set to two (2). The distance between the marks has been set at 50 (the line length).

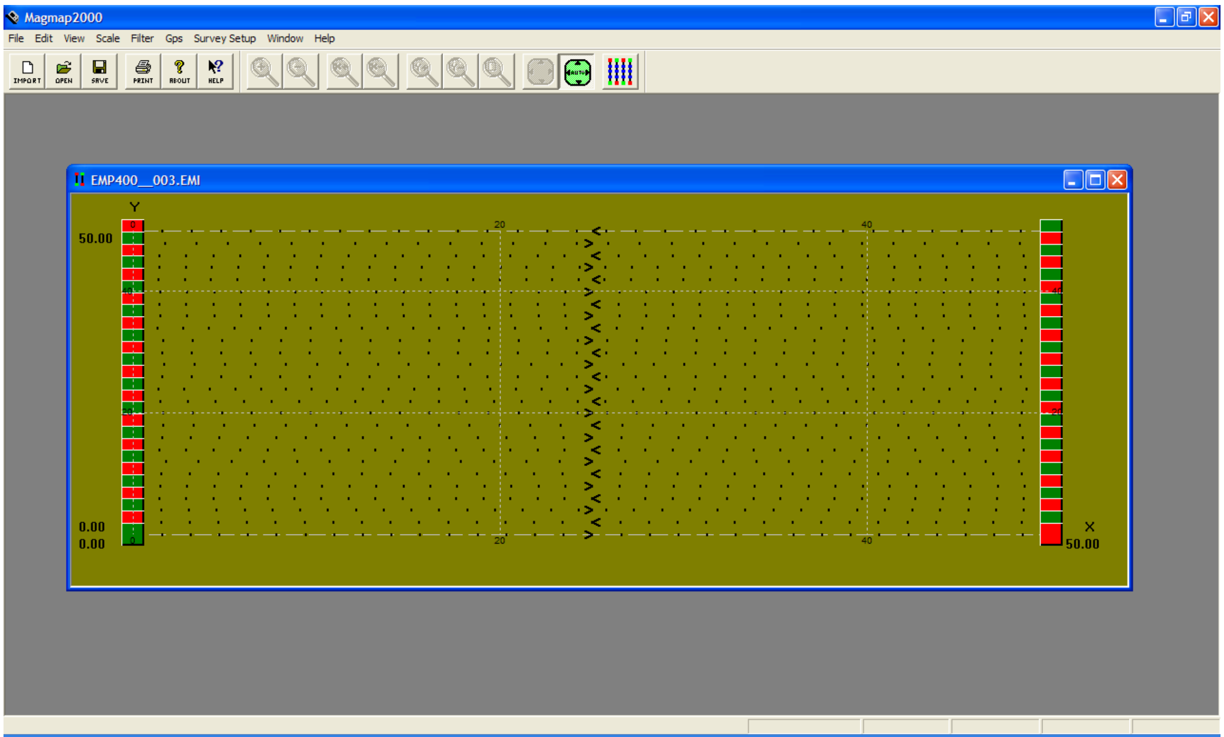


Figure 123: MagMap2000 *.EMI File Grid Display.

In this figure, the **green** squares correspond to the beginning of each transect, the **red** squares correspond to the end of each transect. The location of each data point is indicated by a dot (•) and the direction in which each transect was collected in is indicated by a > or a < arrow. The origin coordinates 0.00, 0.00 and the line end coordinates **X** = 50.00, **Y** = 50.00 correspond to the grid limits for this example grid.

5 The file is now ready to be exported. From the MagMap2000 Main menu toolbar, select File > Export. This will bring up the Export Setting dialog box.

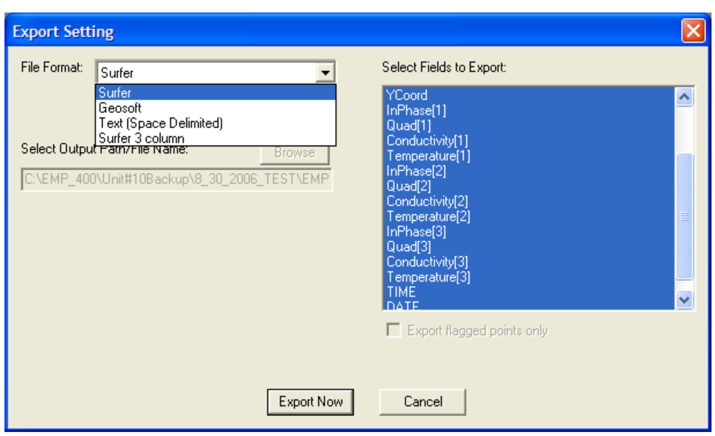
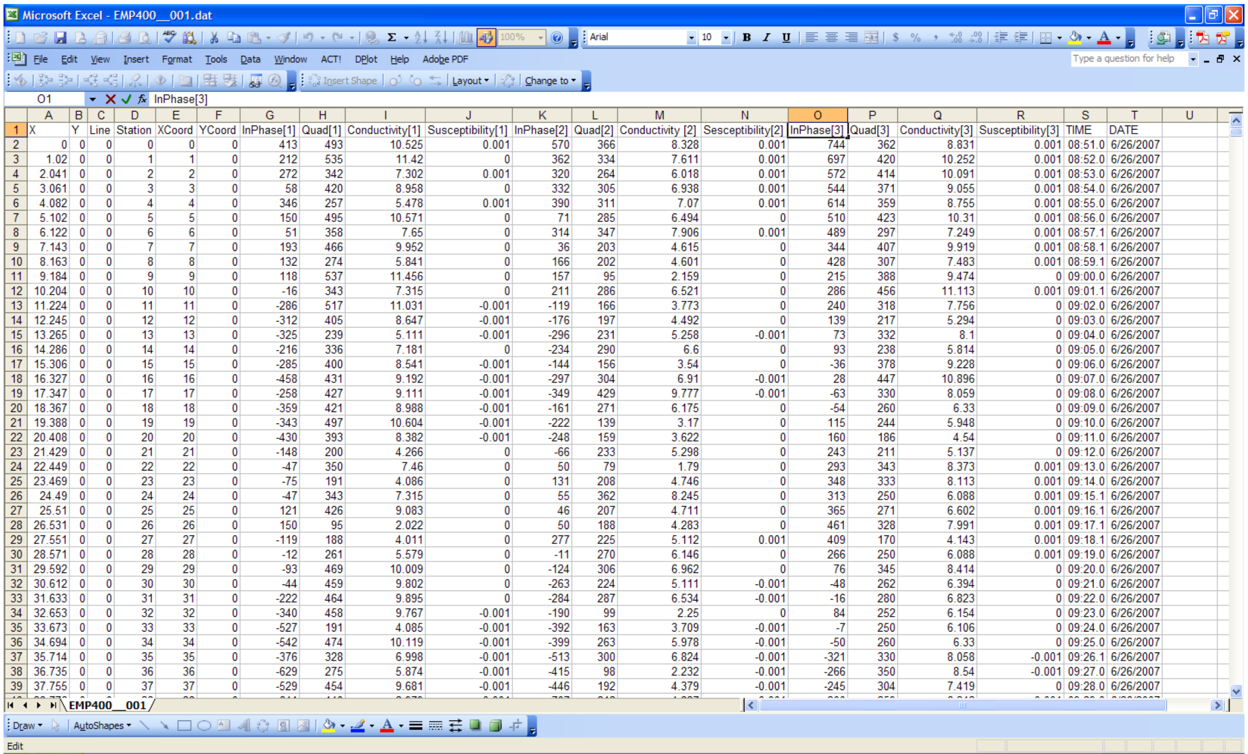


Figure 124: MagMap2000 File Header display.

The file can currently be exported in SURFER, GEOSOFT, TEXT (Space Delimited) and SURFER 3 column (X, Y, Z) data file formats. The converted file will be created and can be written back into the directory of choice by using the Select Output Path/File Name tab. After designating a file name and the target directory for the export file, select Export Now. In this example we have chosen a SURFER*.dat file type.

This interpolated file is now ready to be gridded and contoured. This example data file shows interpolated X (position) data in column A and Y (line) data in column B for the positions of each data point.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	X	Y	Line	Station	XCoord	YCoord	InPhase[1]	Quad[1]	Conductivity[1]	Susceptibility[1]	InPhase[2]	Quad[2]	Conductivity [2]	Sesceptibility[2]	InPhase[3]	Quad[3]	Conductivity[3]	Susceptibility[3]	TIME	DATE
2	0	0	0	0	0	0	413	493	10.525	0.001	570	366	8.328	0.001	744	362	8.831	0.001	08:51.0	6/26/2007
3	1.02	0	0	1	1	0	212	535	11.42	0	362	334	7.611	0.001	697	420	10.252	0.001	08:52.0	6/26/2007
4	2.041	0	0	2	2	0	272	342	7.302	0.001	320	264	6.018	0.001	572	414	10.091	0.001	08:53.0	6/26/2007
5	3.061	0	0	3	3	0	58	420	8.958	0	332	305	6.938	0.001	544	371	9.055	0.001	08:54.0	6/26/2007
6	4.082	0	0	4	4	0	346	257	5.478	0.001	390	311	7.07	0.001	614	359	8.755	0.001	08:55.0	6/26/2007
7	5.102	0	0	5	5	0	150	495	10.571	0	71	285	6.494	0	510	423	10.31	0.001	08:56.0	6/26/2007
8	6.122	0	0	6	6	0	51	358	7.65	0	314	347	7.906	0.001	489	297	7.249	0.001	08:57.1	6/26/2007
9	7.143	0	0	7	7	0	193	466	9.952	0	36	203	4.615	0	344	407	9.919	0.001	08:58.1	6/26/2007
10	8.163	0	0	8	8	0	132	274	5.841	0	166	202	4.601	0	428	307	7.483	0.001	08:59.1	6/26/2007
11	9.184	0	0	9	9	0	118	537	11.456	0	157	95	2.159	0	215	388	9.474	0	09:00.0	6/26/2007
12	10.204	0	0	10	10	0	-16	343	7.315	0	211	286	6.521	0	286	456	11.113	0.001	09:01.1	6/26/2007
13	11.224	0	0	11	11	0	-286	517	11.031	-0.001	-119	166	3.773	0	240	318	7.756	0	09:02.0	6/26/2007
14	12.245	0	0	12	12	0	-312	405	8.647	-0.001	-176	197	4.492	0	139	217	5.294	0	09:03.0	6/26/2007
15	13.265	0	0	13	13	0	-325	239	5.111	-0.001	-296	231	5.258	-0.001	73	332	8.1	0	09:04.0	6/26/2007
16	14.286	0	0	14	14	0	-216	336	7.181	0	-234	290	6.6	0	93	238	5.814	0	09:05.0	6/26/2007
17	15.306	0	0	15	15	0	-285	400	8.541	-0.001	-144	156	3.54	0	-36	378	9.228	0	09:06.0	6/26/2007
18	16.327	0	0	16	16	0	-458	431	9.192	-0.001	-297	304	6.91	-0.001	28	447	10.896	0	09:07.0	6/26/2007
19	17.347	0	0	17	17	0	-258	427	9.111	-0.001	-349	429	9.777	-0.001	-63	330	8.059	0	09:08.0	6/26/2007
20	18.367	0	0	18	18	0	-359	421	8.988	-0.001	-161	271	6.175	0	-54	260	6.33	0	09:09.0	6/26/2007
21	19.388	0	0	19	19	0	-343	497	10.604	-0.001	-222	139	3.17	0	115	244	5.948	0	09:10.0	6/26/2007
22	20.408	0	0	20	20	0	-430	393	8.382	-0.001	-248	159	3.622	0	160	186	4.54	0	09:11.0	6/26/2007
23	21.429	0	0	21	21	0	-148	200	4.266	0	-66	233	5.298	0	243	211	5.137	0	09:12.0	6/26/2007
24	22.449	0	0	22	22	0	-47	350	7.46	0	50	79	1.79	0	293	343	8.373	0.001	09:13.0	6/26/2007
25	23.469	0	0	23	23	0	-75	191	4.086	0	131	208	4.746	0	348	333	8.113	0.001	09:14.0	6/26/2007
26	24.49	0	0	24	24	0	-47	343	7.315	0	55	362	8.245	0	313	250	6.088	0.001	09:15.1	6/26/2007
27	25.51	0	0	25	25	0	121	426	9.083	0	46	207	4.711	0	365	271	6.602	0.001	09:16.1	6/26/2007
28	26.531	0	0	26	26	0	150	95	2.022	0	50	188	4.283	0	461	328	7.991	0.001	09:17.1	6/26/2007
29	27.551	0	0	27	27	0	-119	188	4.011	0	277	225	5.112	0.001	409	170	4.143	0.001	09:18.1	6/26/2007
30	28.571	0	0	28	28	0	-12	261	5.579	0	-11	270	6.146	0	266	250	6.088	0.001	09:19.0	6/26/2007
31	29.592	0	0	29	29	0	-93	469	10.009	0	-124	306	6.962	0	76	345	8.414	0	09:20.0	6/26/2007
32	30.612	0	0	30	30	0	-44	459	9.802	0	-263	224	5.111	-0.001	-48	262	6.394	0	09:21.0	6/26/2007
33	31.633	0	0	31	31	0	-222	464	9.895	0	-284	287	6.534	-0.001	-16	280	6.823	0	09:22.0	6/26/2007
34	32.653	0	0	32	32	0	-340	458	9.767	-0.001	-190	99	2.25	0	84	252	6.154	0	09:23.0	6/26/2007
35	33.673	0	0	33	33	0	-527	191	4.085	-0.001	-392	163	3.709	-0.001	-7	250	6.106	0	09:24.0	6/26/2007
36	34.694	0	0	34	34	0	-542	474	10.119	-0.001	-399	263	5.978	-0.001	-50	260	6.33	0	09:25.0	6/26/2007
37	35.714	0	0	35	35	0	-376	328	6.998	-0.001	-513	300	6.824	-0.001	-321	330	8.058	-0.001	09:26.1	6/26/2007
38	36.735	0	0	36	36	0	-629	275	5.874	-0.001	-415	98	2.232	-0.001	-266	350	8.54	-0.001	09:27.0	6/26/2007
39	37.755	0	0	37	37	0	-529	454	9.681	-0.001	-446	192	4.379	-0.001	-245	304	7.419	0	09:28.0	6/26/2007

Figure 125: EMP400 *.EMI File converted to a Surfer *.DAT file.

Working with *.EMI and GPS Files in MagMap2000

The Profiler incorporates an integrated 12-channel WAAS GPS receiver for collecting geo-referenced EM data and can be easily configured with an external GPS or DGPS system via the PDA RS-232 interface.

When data is collected with the GPS enabled, the Profiler will create an EMP400___00#.GPS file for each data file collected. This file is required by MagMap2000 to integrate GPS and EM data. It is formatted as a standard NMEA GGA string. In addition, the Profiler will store the GPS data ***in*** the *.EMI file in Decimal Degrees format. This allows the user to bypass the MagMap2000 program and its associated GPS smoothing and editing functions, if desired.

1. To begin working with the EMP400.EMI and GPS files, open MagMap2000.

2. Select File and open a EMP400.EMI file. If the GPS was enabled during data collection, the MagMap2000 program will 'look' for an EMP400___00#.GPS file in the same folder location as the EMP400.EMI file.

3. To open an EMP400.EMI file, select the File Open tab from the Main menu. Using the Look In Directory search bar, select the directory in which the EMP400.EMI files were saved.

4. Upon first opening the program, the User may have to select the Files of Type box in the file open dialog box and select the GSSI Profiler (*.EMI) file type before the system will recognize *.EMI files.

5. Once the User has selected a file to process, the MagMap2000 program will open the GSSI Profiler Information display. This is information comprises data stored in the file header.

   - If the check box Use GPS to Load the Data is selected, the program will load the data with GGA GPS coordinates in the associated EMP400___00#.GPS file and convert then to Decimal Degrees.
   - If the check box Use GPS to Load Data is checked and the *.GPS file is **not** in the same location (directory\folder) as the Profiler *.EMI file, MagMap2000 will issue a warning, Warning! GPS Status is enabled but no GPS file is available. The operator may also receive this warning if the EMI or GPS file is corrupted in any way.
   - If the check box Use GPS to Load data is left unchecked, MagMap2000 will use the grid parameter information stored in the file header to grid the data.

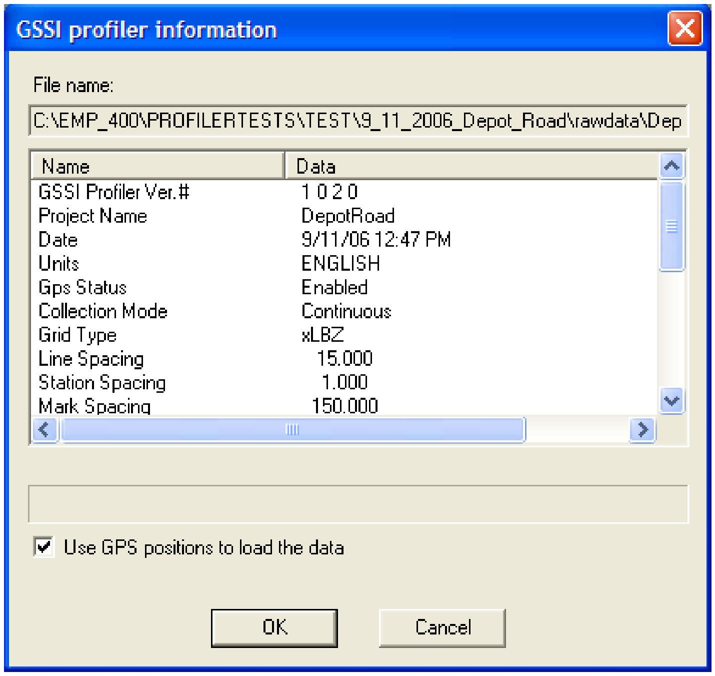


Figure 126: File Open dialogue box.

After selecting Use GPS positions to load the data, MagMap 2000 will display the data in Decimal Degrees format. The green squares indicate the start coordinate of a survey line, and the **red** squares indicate the end coordinate of a survey line. The blue squares indicate reading locations and the **black** arrows superimposed on the blue squares indicate the direction in which the transects were acquired.

Note: In some cases during the course of an EM survey using GPS, the GPS system may drop a fix, or in the case of a system receiving a DGPS correction signal, the GPS system may lose signal lock or the update period for the DGPS correction signal may be exceeded. In these instances, MagMap 2000 will log the last correct position data, and drop the fix at the location at which the DGPS correction signal was lost.

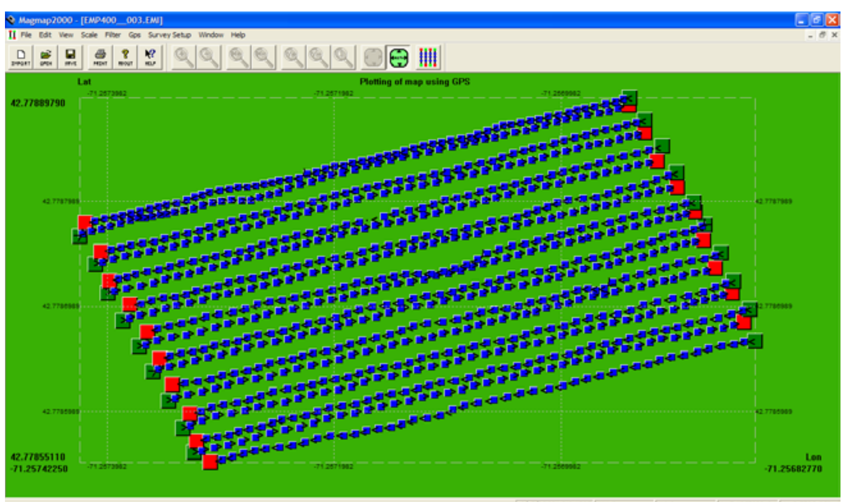


Figure 127: EM\GPS plotted data.

Converting Decimal Degree Geographic Coordinates to UTM

There are several functions available for smoothing/transforming the EM/GPS data in MagMap2000.

1 The first function is the UTM transformation (**U**niversal **T**ransverse **M**ercator). This function will transform the GPS decimal degrees geographical coordinates to UTM coordinates. Select GPS for the MagMap2000 toolbar, and then select UTM Setup.

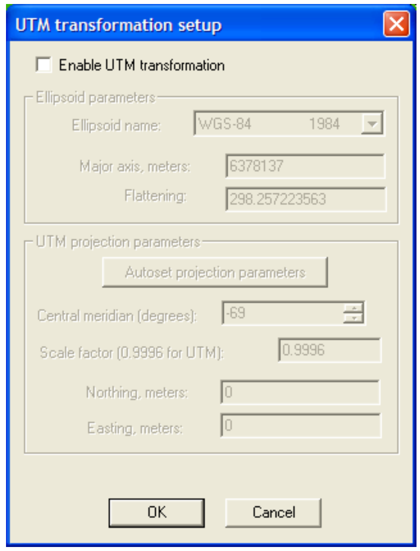


Figure 128: UTM Setup dialog box.

2 To convert to UTM coordinates, select the Enable UTM transformation box.

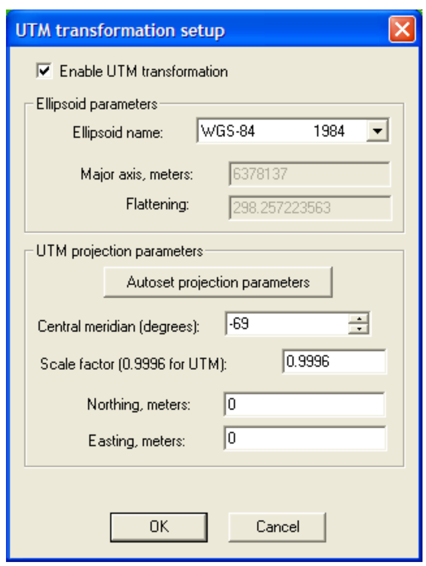


Figure 129: UTM Setup dialog box.

- **Enable UTM Transformation:** This function allows the User to turn the UTM transformation on or off. When it is turned off, MagMap2000 will use geographical coordinates. MagMap2000 will use the given parameters to calculate UTM parameters when it is selected.

- **Ellipsoid Name:** This is the type of ellipsoid used to approximate the shape of the earth. Since the Earth is not a perfect sphere, some ellipsoids may be closer approximations to the region where the survey was conducted than others. The current standard ellipsoid is the WGS-84 (World Geodetic System, 1984 ellipsoid).
- **Autoset Projection Parameters:** This function is useful when the User does not know what the prime Meridian being used is, or when the data lies in an area where the prime meridian may change.
- **Prime (Central) Meridian:** If the User has not selected Autoset projection parameters, the User must fill this value in. This value has a large affect on the UTM coordinates generated due to the non-uniformity of a particular ellipsoid. It can be quickly estimated as the value of the longitude, however the User should look it up. The UTM system uses zone code instead of specific projections. Each zone has a central meridian. Zone 14, for example, has a central meridian of 99 degrees west longitude. The zone extends from 96 to 102 degrees west longitude. The table below (adapted from the MagMap 2000 User Guide 24891-01 Rev G) lists the UTM zone code as used in the GCTPC projection transformation package.

Zone	C.M.	Range	Zone	C.M	Range
01	177W	180W-174W	31	003E	00E-006E
02	171W	174W-168W	32	009E	006E-012E
03	165W	168W-162W	33	015E	0012E-018E
04	159W	162W-156W	34	021E	018E-024E
05	153W	156W-150W	35	027E	024E-030E
06	147W	150W-144W	36	033E	030E-036E
07	141W	144W-138W	37	039E	036E-042E
08	135W	138W-132W	38	045E	042E-048E
09	129W	132W-126W	39	051E	048E-054E
10	123W	126W-120W	40	057E	054E-060E
11	117W	120W-114W	41	063E	060E-066E
12	111W	114W-108W	42	069E	066E-072E
13	105W	108W-102W	43	075E	072E-078E
14	099W	102W-096W	44	081E	078E-084E
15	093W	096W-090W	45	087E	084E-090E
16	087W	090W-084W	46	093E	090E-096E
17	081W	084W-078W	47	099E	096E-102E
18	075W	078W-072W	48	105E	102E-108E
19	069W	072W-066W	49	111E	108E-114E
20	063W	066W-060W	50	117E	114E-120E
21	057W	060W-054W	51	123E	120E-126E
22	051W	054W-048W	52	129E	126E-132E
23	045W	048W-042W	53	135E	132E-138E
24	039W	042W-036W	54	141E	138E-144E
25	033W	036W-030W	55	147E	144E-150E
26	027W	030W-024W	56	153E	150E-156E
27	021W	024W-018W	57	159E	156E-162E
28	015W	018W-012W	58	165E	162E-168E
29	009W	012W-006W	59	171E	168E-174E
30	003W	006W-000E	60	177E	174E-180W

Northing/Easting: These are constant values that you (usually) add to your UTM coordinates. UTM Coordinates are usually large numbers of approximately a million meters; however, your survey may be on the order of tens, hundreds or thousands of meters. This allows you to simplify your final numbers by adding or subtracting the large offset values.

In most cases it is advisable to let the program automatically set the UTM parameters since an incorrect value for the prime meridian can seriously affect how the data will appear on the display.

If the User is satisfied with the UTM conversion settings, select OK.

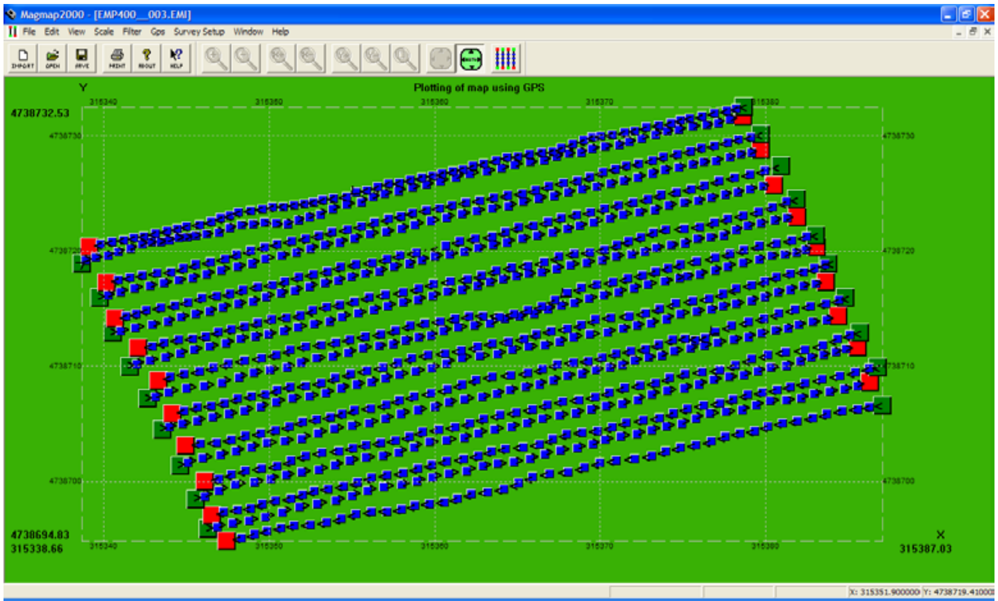


Figure 130: Decimal Degree data converted to UTM coordinates.

Smoothing GPS Positions

The MagMap2000 GPS Smooth Position allows the User to smooth the GPS data and eliminates spikes in the GPS position data. MagMap2000 uses a smoothing spline of the third degree to smooth GPS data. We start with the GPS Position screen illustrated in Figure 131.

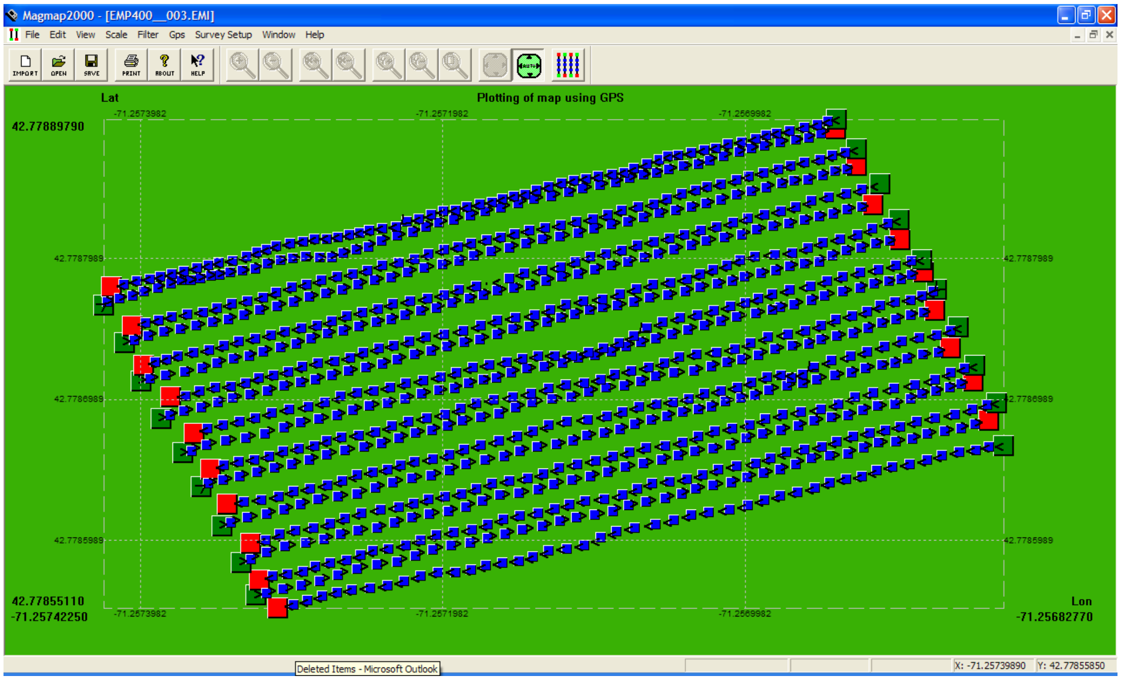


Figure 131: GPS Position display.

1 After selecting the GPS menu option > Smooth positions, select the GPS Smooth Position option from the Main menu and the Line Smoothing Parameters Setup window will be displayed.

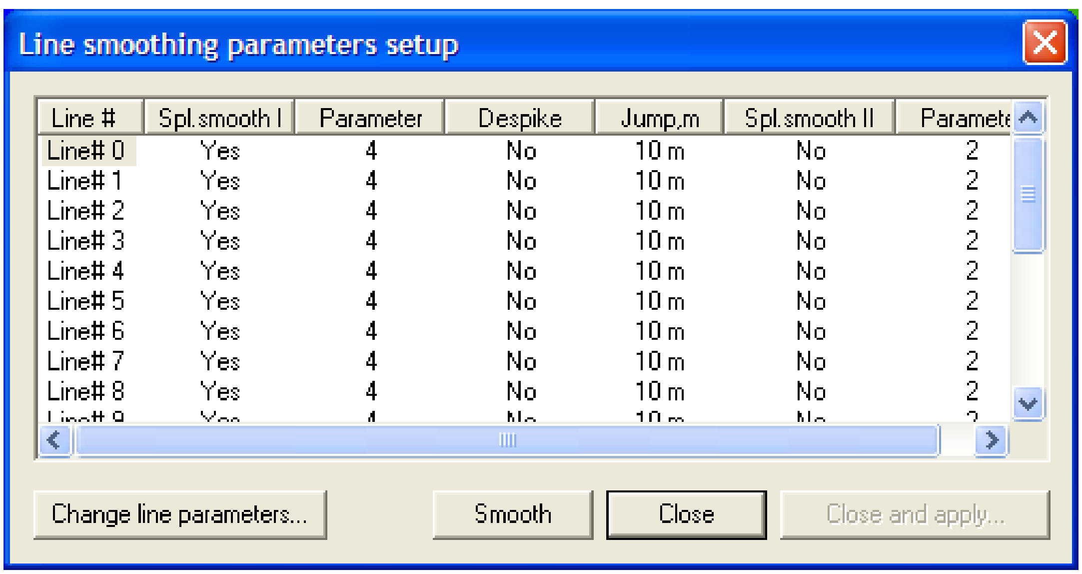


Figure 132: GPS Line Smoothing Parameters dialog box.

This dialog box lists all of the lines in the survey (in this example 19). The User will also see a series of parameters that can be set to manipulate the magnitude and type of smoothing. This dialog box allows the User to set the smoothing parameters for each line. Any of the parameters, may be selected and modified except Line#. The parameters are:

Line #: This is the number of the line to be smoothed.

Spl. Smooth 1: Turns the smoothing on or off for any given line.

Parameter: This controls the degree of smoothing applied to the selected line. The higher the value, the greater the degree of smoothing.

Despike: This allows the User to select whether you would like to despike before smoothing.

Jump: This controls the distance that is considered a spike. The smoothing algorithm will calculate a smoothing curve. It will then calculate the distance between the smoothed points and your original points. If any of these distances are greater than the distance specified in jump, the point will be replaced by a point on the smoothed curve. All points falling within the jump distance of the smoothed curve will be smoothed. All points falling outside the jump distance of the smoothed curve will be left untouched.

Note: It is recommended that the User perform a second smoothing after using the jump function to despike the curve since the curve is not actually smoothed. The first smoothing spline is used only for calculating if a given point is a spike. If smoothing is performed a second time, the program will smooth the despiked data.

Spl. Smooth II: This enables the User to turn on a higher degree of smoothing. This will be performed after the first despiking and smoothing have been performed.

Parameter: This controls the degree of smoothing for the second pass smoothing; the higher the value, the greater the degree of smoothing.

The User can also change the parameters for an individual line by selecting the line number and then selecting Change Line Parameters. This is illustrated in Figure 133 for Line # 0.

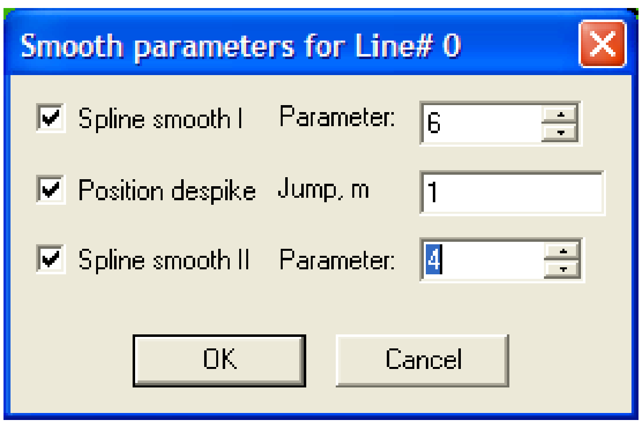


Figure 133: Smooth Line Parameters (Line #0).

In this example, we have changed the first smoothing parameter from four (the default value) to six for a higher degree of smoothing. We have also increased the second smoothing parameter to four (default value of two). We have also included a position despike with a jump of one meter. After selecting OK these changes are reflected in the Line smoothing parameters setup dialog box.

To perform the smoothing, select Smooth. If all lines were selected for smoothing, a series of yellow lines will be displayed that indicate what your smoothed data will look like after the changes are applied.

Note: No changes are applied to the data until the User selects Close > Apply. If the results of the smoothing operation are unacceptable, the User can exit the screen by selecting Close, or change the smoothing parameters and select Smooth again.

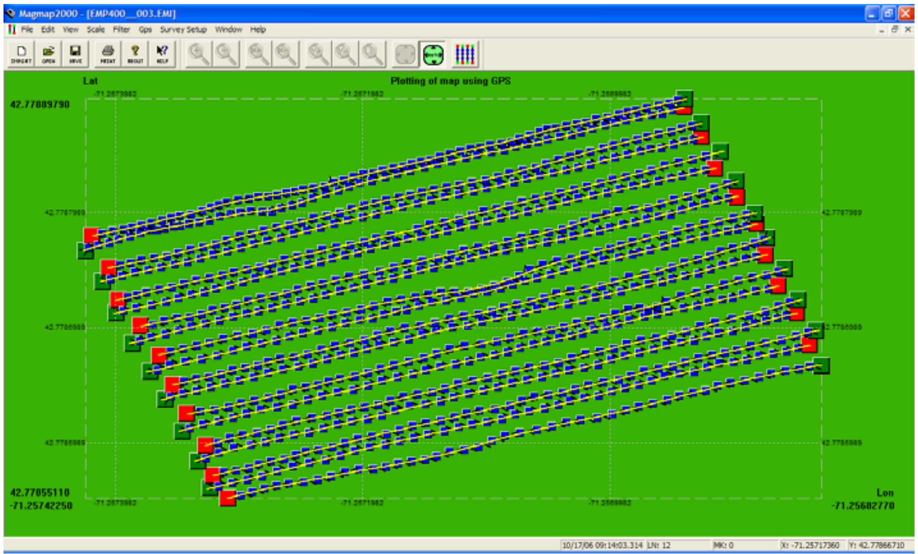


Figure 134: GPS locations as they appear (in blue) and after smoothing and despiking (yellow lines).

An inspection of Figure 134 shows that some lines are straighter than others. In this example, some transects required the operator to walk around obstacles during data collection. However, all lines have had the same degree of smoothing applied.

The User could smooth out Line 0 and 1 (top of the map) and Lines 8 and 9 (middle of the map) by applying another pass of smoothing with a higher smoothing parameter. Once the User has selected Close > Apply, the changes to the GPS positions are permanently applied and cannot be undone. To undo changes to the GPS positions, the User would have to reload the original file and re-smooth the data.

The smoothed data is illustrated in Figure 135.

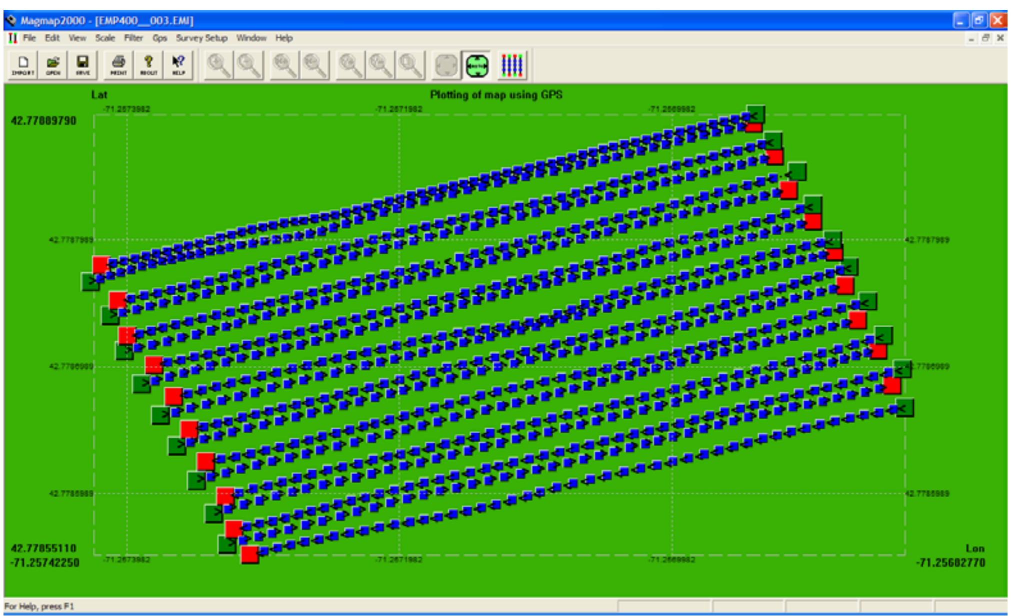


Figure 135: GPS locations, as they appear after 1 pass smoothing and despiking.

For other tips on smoothing procedures and warnings about smoothing, we refer the user to Section 8.5.1 of the MagMap 2000 User Guide.

Appendix A: Understanding GPS and WAAS

GPS - What is it?

WAAS GPS is a navigation system designed to provide instantaneous position, velocity and time information almost anywhere on the globe at any time, and in any weather. It typically provides positioning accuracies of approximately 3 meters. Since GPS receivers need to see much of the sky, it works poorly indoors, in the woods and in urban and semi-urban areas where nearby buildings create GPS signal multi-path problems.

Why do I need it?

You probably don't. In fact, for many EM applications you can just use a measuring tape and stakes or spray paint to measure and mark out your grid and take notes about your site an transect start and stop locations. Since post-survey verification digging or drilling often requires more precision than 3 meters, knowing approximately where you are is not helpful. However, as surveys become larger and as technologies improve, WAAS GPS can be very helpful in telling you where you are on a map, or what road you turned onto, or what section of the site you have already covered. Increasingly WAAS GPS is claiming a legitimate place in the ever-increasing size and variety of geophysical applications.

How does it work?

Standard GPS works by three-dimensional trilateration of the distance from a constellation of GPS satellites in space. The satellites measure the time is takes a GPS satellite signal to travel from one point to another very accurately and then estimate the distance based on the travel-time of the signal using the speed of light as the signal velocity. Getting the travel-time calculations from just three satellites is enough to know where you approximately are on the earth. Four or more satellites are required for higher accuracy. Getting the travel-time from 6 or more satellites greatly decreases the uncertainty of your position. Typically, around buildings and trees you might see six satellites, plenty to know where you are to within 3 meters. The degree of precision depends on many things like how well distributed the satellites are in the sky or the precise travel path the signal takes to get from the GPS satellites to your GPS receiver.

Main Sources of Error

The GPS signal travel-times and paths are directly affected by the medium through which the signals are transmitted. For GPS, this means the signal from the satellites to your receiver can be slowed down and bent by changes in the Ionosphere, the Troposphere and nearby objects. These sources of error are illustrated in Figure 136. These sources of error can be reduced using expensive tricks like dual frequency systems, Klobuchar modeling, and Real Time Kinematic (RTK) solutions. The least expensive way to correct for these errors is through Differential GPS (DGPS), where data from a second stationary base station GPS is subtracted from a roving GPS or in the form of a differential GPS signal coming from a GPS satellite or ground beacon. Such differential signals are provide at extra cost through subscription services such as OMNISTAR or THALES. Compared to the distance from the satellite, the distance between a base station and rover is insignificant, which means that the travel paths through the ionosphere and troposphere are (essentially) identical. The difference between the two positions subtracts out atmospheric effects, leaving just the rover position.

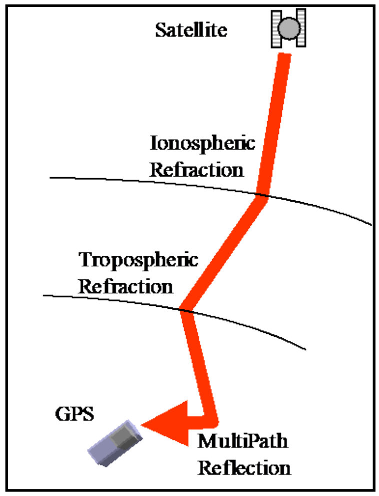


Figure 136: Main Sources of GPS Error.

What is WAAS?

The **W**ide **A**rea **A**ugmentation **S**ystem (WAAS) is a form of differential GPS that uses geostationary GPS satellites to transmit an error correction estimate back down to your GPS receiver. The measured positions of ground reference stations, strategically positioned across the country, are transmitted up to the WAAS satellites. Your receiver reads the signal from the WAAS reference station closest to you. It uses a combination of specialized WAAS satellites and ground-based stations to send correction signals to WAAS GPS receivers, as well as providing integrity information for each satellite's signal and is equivalent or better than RAIM (Receiver Autonomous Integrity Monitoring), thereby improving the accuracy of the standard GPS signal by approximately 5 times.

The European Geostationary Navigation Overlay System (EGNOS) is the European equivalent to this United States system. In Asia, it's the Japanese Multi-Functional Satellite Augmentation System (MSAS). The International Civil Aviation Organization (ICAO) calls this type of system a Satellite Based Augmentation System (SBAS). A typical WAAS system is illustrated in Figure 137.

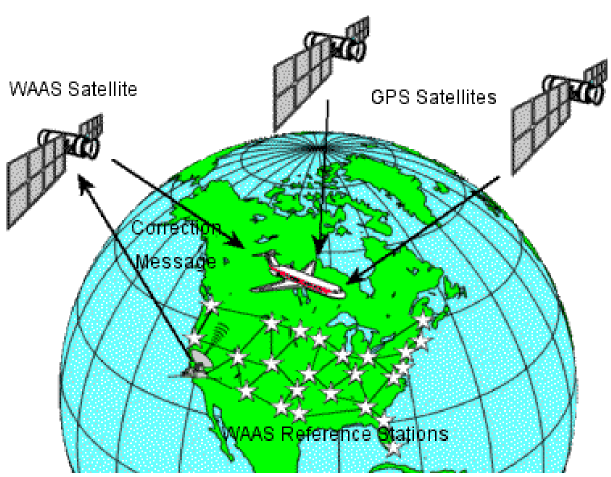


Figure 137: GPS Satellites and WAAS Satellite and reference stations.

WAAS testing in September 2002 confirmed accuracy performance of 1 – 2 meters horizontal and 2 –3 meters vertical throughout the majority of the continental U.S. and portions of Alaska. (SEE: http://gps.faa.gov/Programs/WAAS/waas.htm).

What is NMEA?

The **N**ational **M**arine **E**lectronics **A**ssociation (NEMA) has generated a standard set of messages for communicating GPS information. The EMP-400 uses the NMEA 0183 version 2.1 protocols. The Profiler EMP-400 WAAS GPS receiver has been configured to send a **GGA** message string and the PDA will accept **only** a GGA message string. No other NMEA strings are supported for the Profiler by GSSI.

Appendix B: Example of GGA Data String

STRING: $GPGGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh

GGA = Global Positioning System Fix Data

1 = UTC of Position
2 = Latitude
3 = N or S
4 = Longitude
5 = E or W
6 = GPS quality indicator (0=invalid; 1=GPS fix; 2=Diff. GPS fix)
7 = Number of satellites in use [not those in view]
8 = Horizontal dilution of position
9 = Antenna altitude above/below mean sea level (geoid)
10 = Meters (Antenna height unit)
11 = Geoidal separation (Diff. between WGS-84 earth ellipsoid and mean sea level. -=geoid is below WGS-84 ellipsoid)
12 = Meters (Units of geoidal separation)
13 = Age in seconds since last update from diff. reference station
14 = Diff. reference station ID#

Appendix C: Conducting a Survey

Prior to conducting any survey, the user should evaluate the objective(s) of the investigation and the survey site conditions. The survey objective should be carefully considered, as this will determine the frequency(ies) of operation, the mode(s) of instrument operation and the spatial sampling density required. The local surficial geology should be investigated in detail, as the on-site geologic conditions will be a principal factor in determining the effectiveness of the induction method. Site conditions such as topography, the presence and proximity of surface cultural features and surface vegetation should all be evaluated. These will affect survey logistics, data quality, and ultimately the survey results.

C.1 Survey Planning

Survey planning can be broken down into two phases. The first phase involves collecting information on the site geology, hydrogeology, and the site history, as well as evaluating the physical conditions at the site and its suitability for conducting an EM survey. Any site conditions which may present obstacles to the efficient collection of high quality data must be taken into consideration, or dealt with directly prior to moving on to the second phase, survey grid setup.

EM surveys often have multiple objectives. These may include the detection of buried objects such as metallic tanks, drums or buried foundations, the detection and delineation of waste burial pits or trenches, the mapping of the surficial soils and/or overburden materials, the detection and delineation of contamination plumes in the soil and groundwater or mapping the location and extent of geologic or archaeological features.

If there are multiple survey objectives, it is generally desirable and more cost effective to plan the survey coverage so that it will be effective in addressing the most difficult of the survey objectives. The required level of survey coverage that will provide adequate information to meet the most difficult survey objective will generally be more than sufficient to meet the requirements of other secondary goals. The frequency(ies) of operation, spatial sampling density, the mode of operation (i.e., the instrument geometry) and, in some cases, the speed at which the data is collected, determine the level of survey coverage and measurement precision.

As we have indicated above, the first phase in survey planning is to acquire as much information as possible on the geologic and hydrogeologic conditions of the site. This information should be collected from as many sources as possible. These sources could include maps of the surficial geology of the area (surficial geology maps of most areas of the US are available from the USGS), as well as data from local or on-site well logs, test borings and/or test pits. It is also extremely useful to obtain any available reports of previous geologic or geophysical investigations that may have been conducted at the site. Publications on the application of EM for similar types of surveys should be carefully reviewed. These studies can provide valuable insight on data collection methods, data processing and data interpretation.

In urban and semi-urban areas, collecting data on the land-use history of the site (if possible) is also extremely important.

The review of all available geologic information enables the survey planner to assess the on-site geologic conditions and their possible affects on the overall effectiveness of the method, to make estimates of the magnitude of the conductivity contrasts that may be encountered and to make estimates of measurement sensitivity and probable depths of exploration (DOE).

The land-use history data can provide the survey planner with information on the approximate location and distribution of extant or historical man-made features. When evaluated within the context of the primary survey objective, this information is of primary importance in any planning decisions regarding survey grid location, orientation, and transect spacing.

The topographic variations at the site should also be evaluated during the survey planning stages. Significant topographic variation in some geologic settings can have an effect on subsurface induction readings. The possible impact of topographic variations on the data should be evaluated to determine their possible effects on the measurements. If deemed necessary, topographic data should be collected. The contoured topography data can then be compared to the induction measurements to ascertain if there is any relationship between topographic variation and the measured subsurface conductivity variations.

The presence and distribution of man-made cultural artifacts on the surface should also be evaluated. The presence and location of electrical conductors (e.g., fences, cars, metallic light posts, etc.) and large structures on the surface will have an adverse effect on the quality of EM data. In some cases, it may be necessary to modify survey coverage to avoid the influence of these features. It the survey site has areas of significant vegetation, or is completely covered by vegetation, it should be cut and removed prior to grid layout and data collection to assure that it does not present an obstacle to the operator during the process of data collection. Ideally, the site should be cleared to the extent that surface growth would not present an obstacle to the operator and the instrument during the continuous collection of data. This assures that an operator can maintain a steady, constant walking pace during data collection and maintain steady orientation of the instrument.

C.2 Survey Grid Setup

Once all available information regarding the site has been collected and evaluated, the investigator can proceed to the survey grid setup. Survey grid setup requires the following tools:

- Survey Tapes – preferably three double-sided tapes with English units on one side and Metric Units on the other.
- Plastic survey flags.
- Wooden survey stakes.
- Mallet for driving stakes.
- Rolls of plastic fluorescent flagging tape.
- Marking paint, chalk or lumber crayons.
- A permanent marker for marking survey stations on survey stakes or flags.
- A field notebook for logging notes on surface features, topography and surface conditions.
- A quality compass, preferably a survey grade instrument.
- A set of ropes with distance intervals marked on them with colored tape, flagging or knots. These ropes are very useful, as they allow the investigator to follow a straight, distance-indexed line along each survey transect. It is useful to have two, as they can be leapfrogged from one transect to the next as the survey progresses. The distance intervals marked are generally 5, 10 or 20 feet for a survey conducted in English units and 1, 5 and 10 meters in metric units. The marked distance interval required for a particular survey will be determined by the survey objective and the required level of survey detail and survey control.

It is standard field practice to lay out an orthogonal grid of survey lines. These lines must be laid out so that they provide the required level of survey coverage to meet the objective(s) of the survey i.e. the objective(s) that require the highest spatial resolution. During the course of survey layout, it is a standard and highly recommended practice to create a map of the survey grid with specific grid locations referenced to permanent or semi-permanent surface features. The investigator should update this map, along with the survey notes if any of the data acquisition or survey grid parameters are changed during the survey.

In many cases, the origin is a pre-surveyed point or benchmark, or a GPS geo-referenced location. In the absence of a pre-existing survey origin, the investigator will have to select a relative survey origin point. This point may be the corner of a lot, a building, or some other permanent surface feature. The investigator must act as surveyor and lay out two orthogonal baselines. Standard surveying practice is to define the direction of the baseline relative to geographic north and east. Often the requirements of survey coverage and site conditions require that the baseline direction be something other than a cardinal point (i.e. due north or due east). Standard mapping convention is to orient north to the top on the site map and east to the right on the site map. The baseline is designated north if its compass bearing is more than 45° north-northeast i.e. the baseline is aligned more in a north-south than east-west direction. Otherwise, the baseline direction is defined as east. The easiest way to lay out an orthogonal grid is to use the right triangle method. This assures that the baseline and transect lines are at right angles to each other and that the survey grid is square. This is achieved by laying out two survey tapes to a distance that is approximately 25-50% of the actual survey gird size at approximately right angles to each other. Using the familiar Pythagorean Theorem; $\boldsymbol{A}^2 + \boldsymbol{B}^2 = \boldsymbol{C}^2$**,** one can quickly and easily lay out orthogonal baselines. An example for performing this is illustrated in Figure 138.

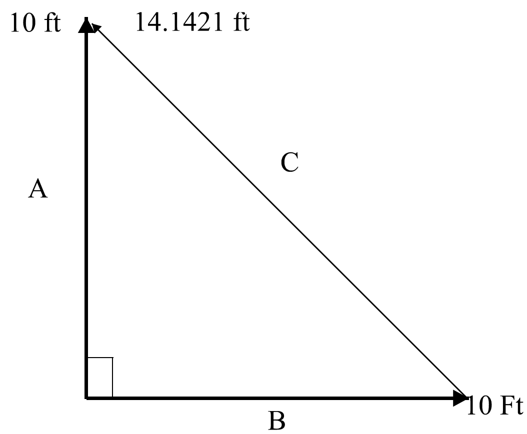


Figure 138: Right triangle method for establishing and orthogonal survey grid baseline. Leg A = 10 ft. Leg B = 10 ft. Leg C (the Hypotenuse) = 14.1421 ft.

Given the relationship $A^2 + B^2 = C^2$ and that the Leg A =10 ft and the Leg B = 10 ft, we can see that $A^2 + B^2 = 200$. Taking the square root of $C = \sqrt{200}$, we arrive at C = 14.1421 ft. If we place the end of the third tape (C) at the 10 ft mark of B and the 14.1421 ft mark of tape (C) at the 10 ft mark of A, we will have a right triangle and the baseline will be square. The transect lines for the survey can now be marked off at regular intervals. Site conditions and line lengths may necessitate the laying out of several of these corners, particularly on large open survey sites, to assure that the entire grid is square, that the survey lines are parallel and that the line spacing is consistent at the beginning and end of the transects. This method can easily be expanded for larger survey areas by using multiples of 10 for the A and B legs of the triangle and calculating the square root of the sum $A^2 + B^2$.

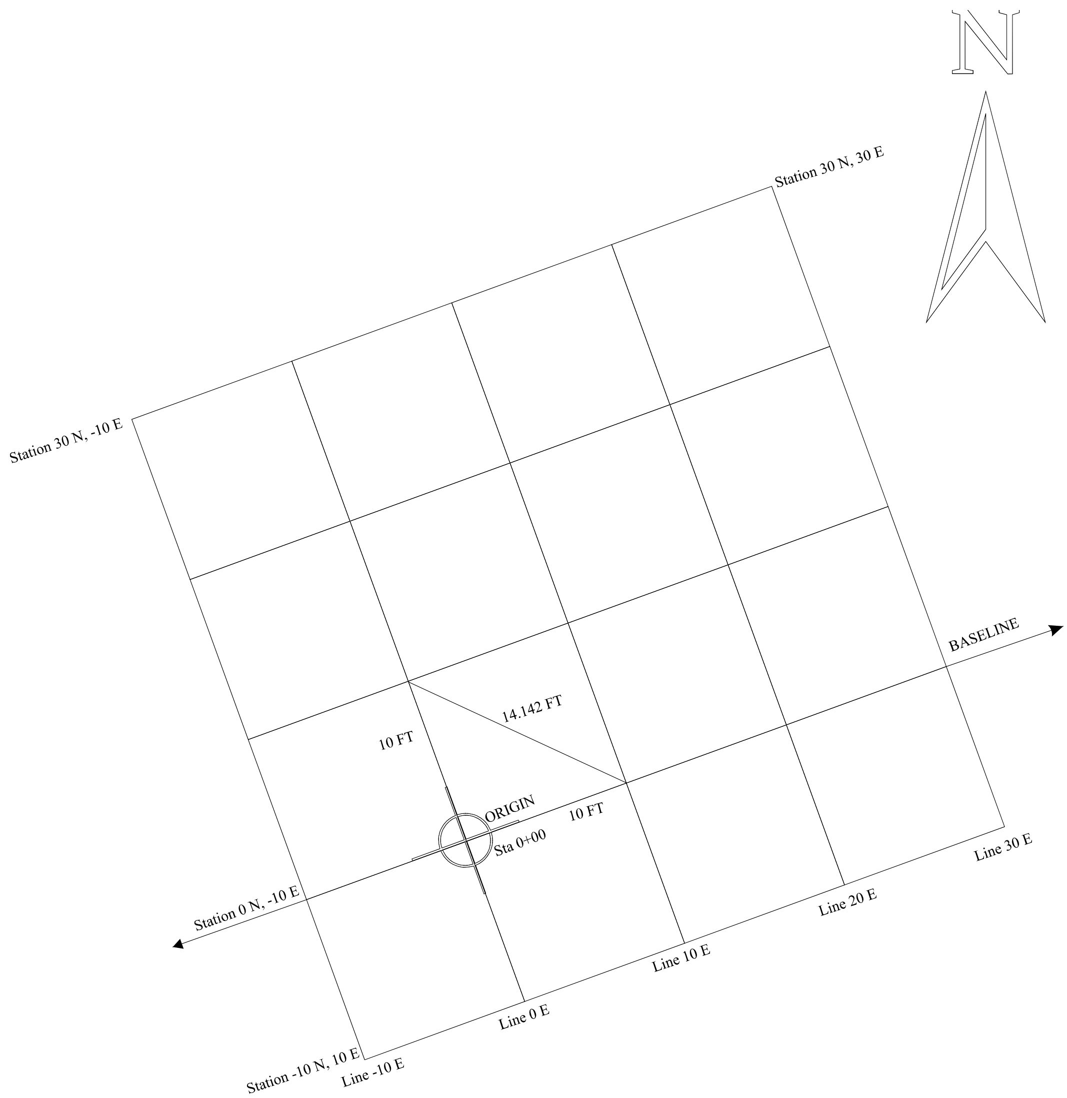


Figure 139: Example section of site plan map.

Figure 139 is an illustration of an example site plan map. This is an example of the line-and-station system used by most investigators in the field. An origin (relative, benchmarked or geo-referenced) is defined for the local co-ordinate system. The distance along the baseline from the survey origin to an orthogonal survey line is (generally) given as the survey line number i.e. a transect line 20 feet east of the origin would be survey line 20E, a survey line 20 feet west of the origin would be survey line -20E (or 20 W) and so forth. The distance along the survey (or transect) line is the station, or station number. If the baseline is oriented north, then the survey direction is east. In this illustration, the baseline is east and the survey direction is both north and east.

It is best practice to collect data in both directions. The survey grid should be laid out in such a fashion that the survey lines are normal (i.e., perpendicular) to the presumed or visible trend of any feature(s) of interest. Based upon anomalous instrument readings acquired during the course of the survey, supplemental lines that are intermediate to the survey grid lines or oblique i.e., at an angle, to the survey grid, should be acquired to better constrain the location and extent of suspected anomalies.

The use of GPS systems to collect geo-referenced data along with geophysical data has become much more prevalent in recent years and the EMP-400 is equipped with a WAAS (Wide Area Augmentation System) GPS and is compatible with external, high-resolution GPS systems.

In many survey locations, the absence of sufficient satellite coverage and the multi-path interference caused by nearby buildings or other structures may render the use of GPS positioning systems impractical or problematic at best.

The investigator should carefully evaluate the line-of sight conditions at the site and the true position accuracy of the GPS system to be used. The user should always consult a GPS mission planner and a have recent satellite ephemeris and almanac data on the position of visible satellites prior to using a GPS system for geo-referenced survey data. (Note: A free mission planner called QuickPlan and the current ephemeris and updated almanac can be downloaded from Trimble at: www.trimble.com/support_trl.asp?NAV=Collection-3627.)

The positional accuracy of the survey is directly related to the regularity of the line spacing and consistency of the measurement interval along each survey line. This is where survey ropes can prove to be extremely useful. When strung between the endpoints of the survey line, they provide a straight line for the investigator to follow as data is collected. In situations where survey ropes are impractical (e.g., collecting data along very long transects) plastic survey pin-flags, or stationed wooded stakes should be used at 10 to 20 foot intervals, or 5 to 10 meters intervals, to serve as a walking guide for the investigator.

C.3 An Example Survey

Let us assume for the moment that the objective of our survey is to detect and delineate the buried foundation of an old paint factory. Review of geologic and hydrogeologic data indicate that the surficial geology of the area was originally part of an outwash plain characterized by buried stream channels, gravel deposits and course to fine grain inter-bedded sand and silt. Historical records indicate that the site has seen significant modification and that most of the native subsurface materials have been re-distributed, removed and/or replaced by heterogeneous fill materials of variable composition. Review of available records indicates that masses of buried paint cans have been buried in shallow (< 4 ft deep) trenches, or as individual groups of cans scattered about the site. These are suspect as being the point sources for groundwater pollution detected in on-site monitoring wells. In this case, the detection of small, metallic targets buried at moderate to shallow depths would present the most difficult of the survey objectives. Given the site geologic conditions, small metallic targets will only be detectable at relatively shallow depths and at small lateral distances from the instrument.

To meet the survey objective, we would like to have the transects a short distance apart, approximately 1 meter. Ideally we would like to operate the instrument in close proximity to the surface; approximately 10-20 cm. As no hard data is available to us on the actual depth of burial of the targets, we must assume that they are buried at or near the maximum depth of investigation range of the instrument.

As the geologic and land-use data indicate that the subsurface materials are generally resistive, the frequency(ies) of operation should be selected such that the response from the depth range of interest is maximized. Given a site with these conditions, a general rule of thumb would be to conduct preliminary test transects in the mid to upper frequency range of instrument, i.e., from 9 to 16 kHz. As system response and depth of exploration are a function of both subsurface conductivity and the frequency(ies) of operation, it is advisable that the user conduct test transects at several frequencies prior to commencing the survey.

The system can be operated in either the in-line orientation, with the instrument transmitter and receiver aligned and parallel with the survey transect, or the broadside orientation with the instrument transmitter and receiver on two parallel traverse lines and the line between the transmitter and receiver aligned perpendicular to the transect direction.

Each method has its advantages and disadvantages. Under certain field conditions, collecting data with the in-line method affords the operator somewhat greater control over unwanted movement of the coils during data collection. Using the broadside method, controlling the orientation of the instrument can prove more difficult, as the instrument may tend to swing from side to side as the operator walks along the survey transect. This type of coil motion can have adverse affects on the quality of the data.

In areas of significant surface vegetation, in-line operation is advantageous, as the instrument presents a smaller cross-section to surface obstructions such as high grass, brush, bushes, and trees. Operation in the in-line orientation may be desirable in locations where the operator has a priori information regarding the trend of linear conductive targets, such as large metallic utilities, the orientation of buried foundation walls, or the strike of a geologic feature, such as a conductive dike. In-line survey transects can then be collected perpendicular to the trend (strike) of the target, reducing possible asymmetries in the target response.

As the transmitter and receiver are on separate transects, data collected along a survey transect in the broadside orientation will cover a larger area than a traverse collected in the in-line orientation for an instrument with fixed coil spacing. Operation in the broadside orientation will also (generally) produce narrower, tighter anomalies, and therefore better spatial resolution than operation in the in-line orientation. This is because standard data-point plotting convention for moving source methods is to plot each measurement at the midpoint between the transmitter and receiver. Given a conductive target of limited dimension and two traverses collected over the target, one in the in-line orientation and the other in the broadside orientation, the number of survey data points along the transect at which the instrument will register a response is much smaller for the broadside orientation than the in-line orientation. The instrument response for an in-line transect over such a target will be stretched out along the line of the transect in comparison to the response from an equivalent broadside transect.

Appendix D: Replacing Profiler Calibration Files

1 Connect the PDA to the PC with the USB cable provided with the system. Locate the folder where the backup Calibration Files are stored. This folder will include a PROFILER.CAL file and a PROFILER.PRM file.

2 Wait for ActiveSync (or Windows Mobile) to prompt you with the Pocket PC Sync Setup Wizard. Select **Cancel** as you do not want to establish a sync relationship between the PDA and your computer.

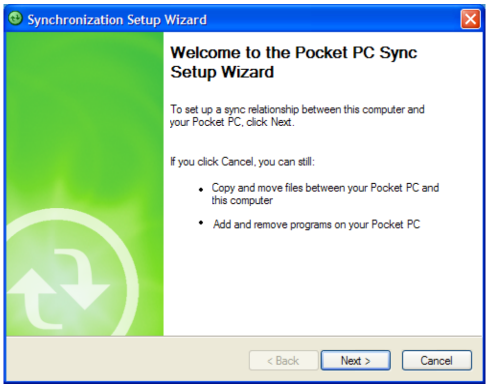


Figure 140: Pocket PC Sync Setup Wizard.

3 ActiveSync will then connect the PDA and PC and the ActiveSync connection window will appear. When connection is established, the ActiveSync window will display **Connected**.

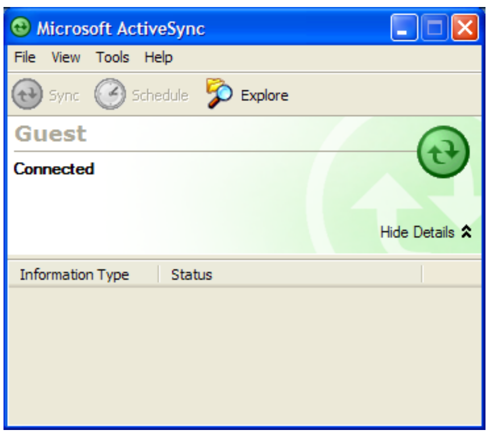


Figure 141: ActiveSync window.

4 Access the PDA Operating system and memory by selecting the **Explore** icon. This will access the Mobile Device window.

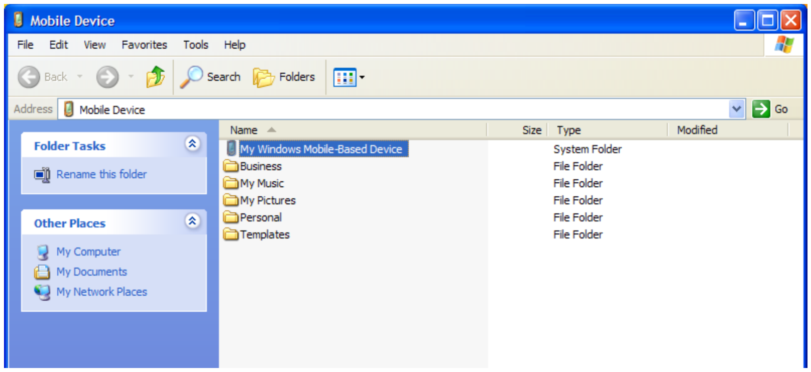


Figure 142: Mobile device window.

5 The User should select the **My Windows Mobile-Based Device** icon. This will access the PDA Root directory.

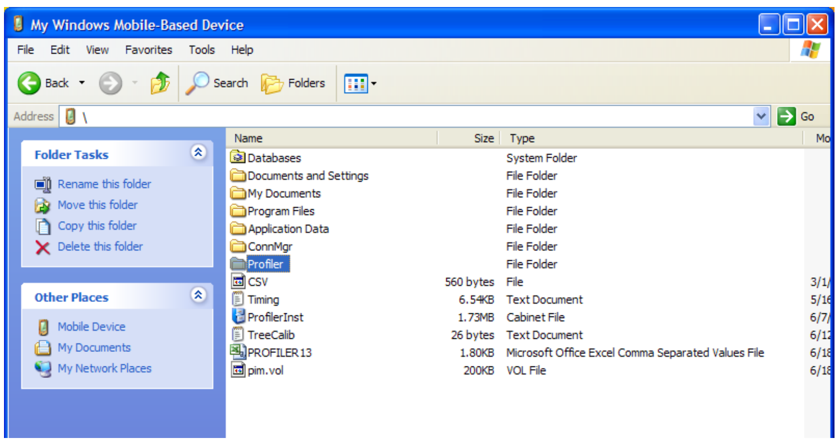


Figure 143: PDA Root directory.

6 The User should now select the Program Files folder. This will allow access to the Profiler Program folder.

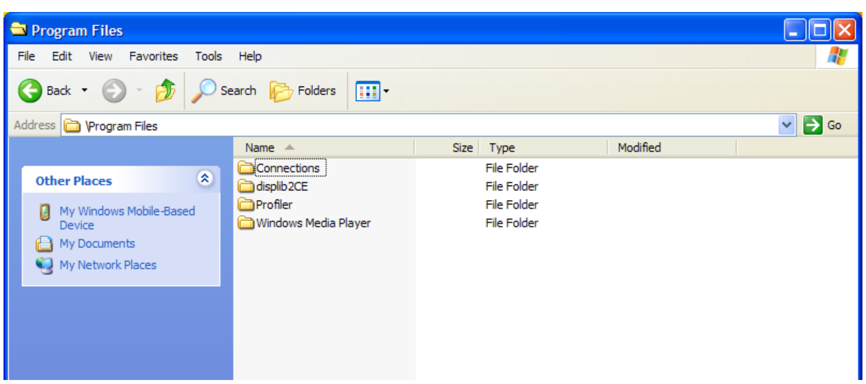


Figure 144: Profiler Program folder.

7 The user should now select the **Profiler** folder. This folder contains the following PROFILER.PRM, PROFILER#.CAL (# indicates serial number of the Profiler EMP-400). The files PROFILER.PRM, and PROFILER#.CAL are the system calibration files.

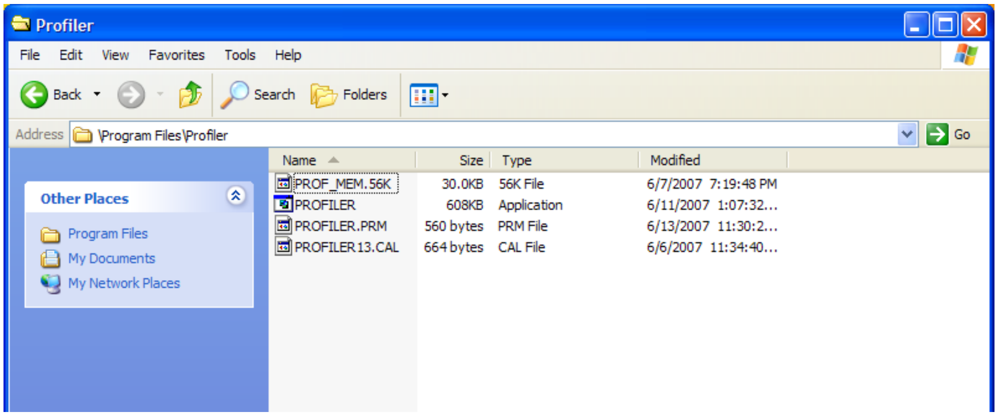


Figure 145: Contents of Profiler directory.

Note: The user should NEVER move the Profiler executable PROFILER.EXE or the PROF_MEM_56K file. Doing so will prevent the system from operating.

Caution: GSSI assumes no liability for the proper operation of the EMP-400 if these files are moved or deleted.

The User should **Copy** the **backup** PROFILER#.CAL and PROFILER.PRM from their PC to the Profiler Program Files folder. Upon transfer of the calibration files from the PC to the PDA, the system will prompt the User with a file conversion request. The User should select OK when prompted with this request. The Calibration files have now been replaced.

8 The User can now disconnect the PC from the PDA by disconnecting the USB ActiveSync cable.

9 Restart the EMP-400 and the PDA as described at the start of Chapter 2.

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