OPERATION AND REFERENCE MANUAL

FOR

GEOMETRICS SEISMOGRAPH MODELS

SMARTSEIS ST
GEODE
STRATAVISOR NZ
ES-3000

Part # 28519-01
Rev. M
Software Version 9.30

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PREFACE

About This Manual

Note: *If you are an experienced practitioner, see the "Quickstart" manual (printed version provided separately). It may be all you need to get going.*

Geometrics manufactures four separate seismograph models designed primarily for refraction, 2D reflection, borehole, surface wave, and other engineering / shallow oil and gas surveys. Although they are different physically and in the set of software features they offer, they all run the same core software. There are seven different software "bundles" based on this core software, each having its own collection of features but having more similarities than differences. These are summarized in Table 1 on Page 6. This manual applies to all of them.

The manual is organized as follows:

- Section 1: System Overview
- Section 2: SCS Acquisition Control Software
- Appendix A: Setup Screens
- Appendix B: Hardware
- Appendix C: Wiring Diagrams
- Appendix D: Data Formats
- Appendix E: Specifications
-

Section 2, which covers the operating software in detail (called "SCS" for "Seismic Control Software"), makes up the bulk of this manual. It is organized on a one-to-one basis with the software menus. As such, there are five levels, as illustrated by the following example:

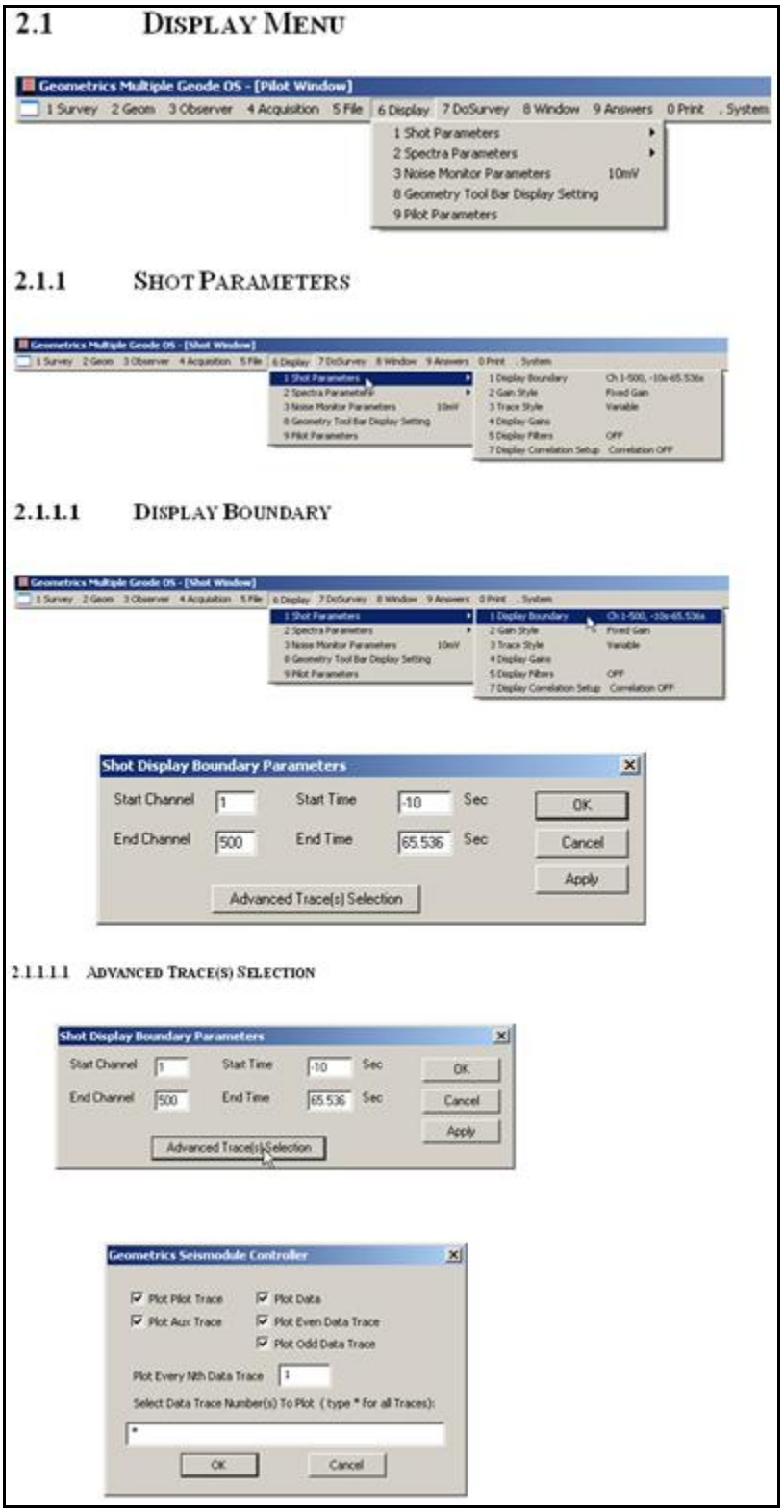
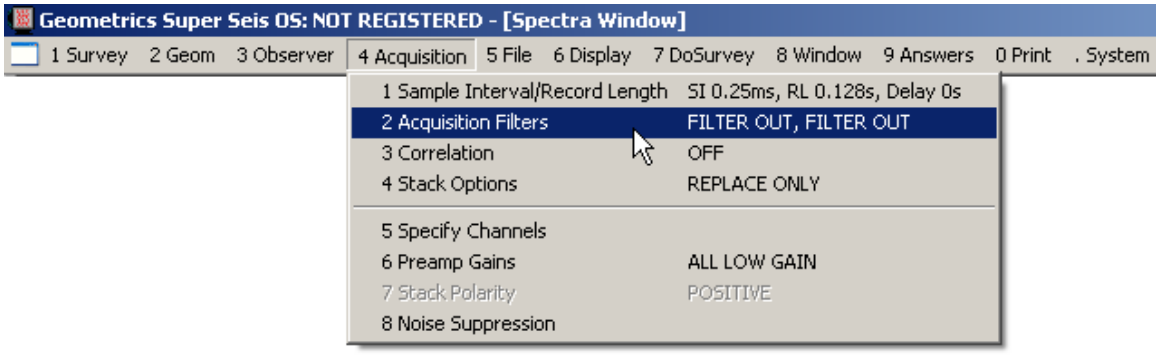


Figure 1: Manual sections and how they relate to SCS software menu levels.

Those menu items that are *not* standard (not part of the core SCS software) will be annotated, indicating those bundles in which they are found. For instance, "Acquisition Filters" is universal:



The section heading therefore looks like the following:

Figure 2: Appearance of section heading for universal software features

By contrast, "Correlation" is a standard feature only on the StrataVisor and multiple-Geode software (which operate under NZOS and MGOS, respectively; see Table 1, Page 6), and the section heading would look like this:

Figure 3: Appearance of section heading for software features included only in certain bundles (in this case, NZOS and MGOS).

Also, some features are not included in any of the software bundles and are available as options for purchase:

Figure 4: Appearance of section heading for optional software features.

In addition to menu items, the contents of a dialog box often depend on which software bundle you have:

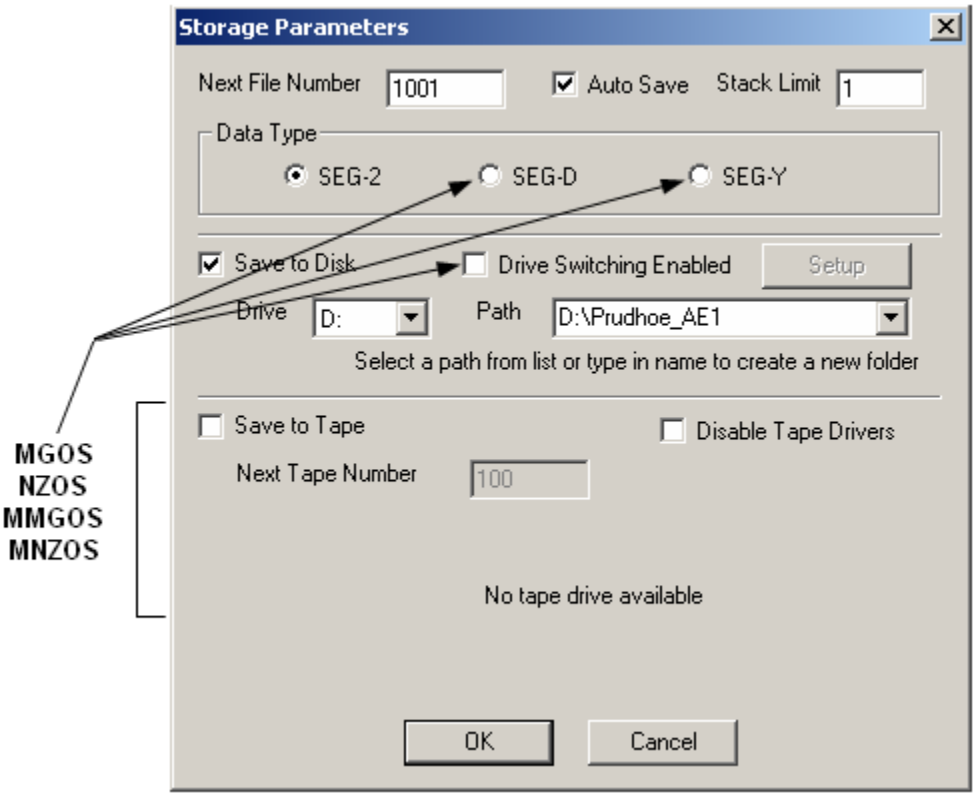


Figure 5: Annotated view of Storage Parameters dialog box identifying non-universal items and which software bundles they come with.

For instance, selecting File >> Storage Parameters in MGOS, NZOS, MMGOS, or MNZOS brings up the dialog box shown in Figure 5 above. If you are running STOS, the same dialog box would look like the following:

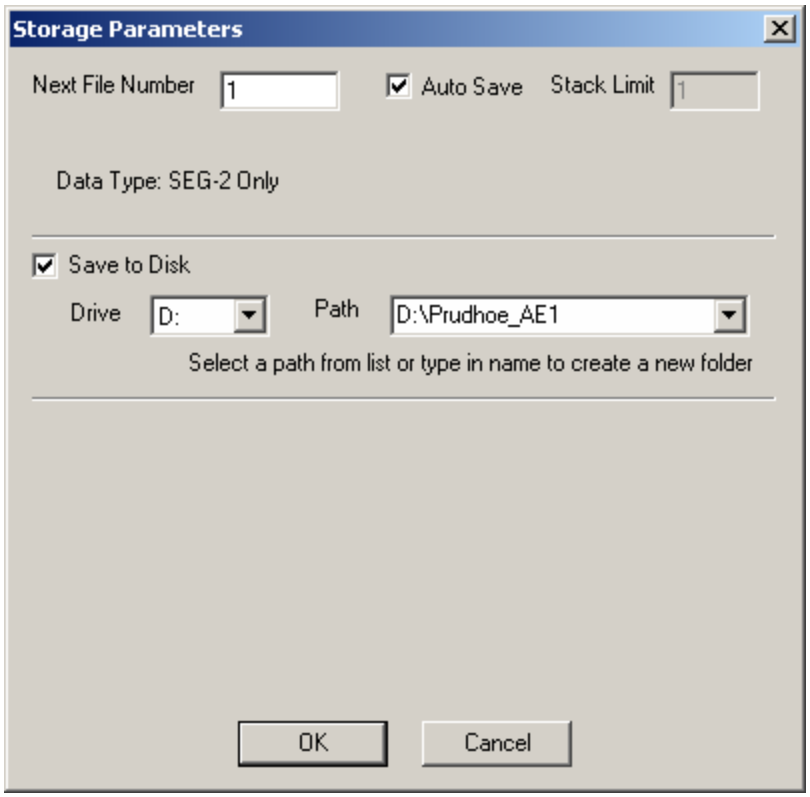
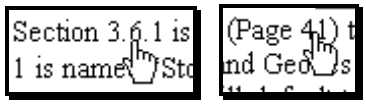
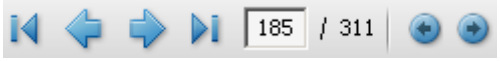


Figure 6: Storage Parameters dialog box of STOS.

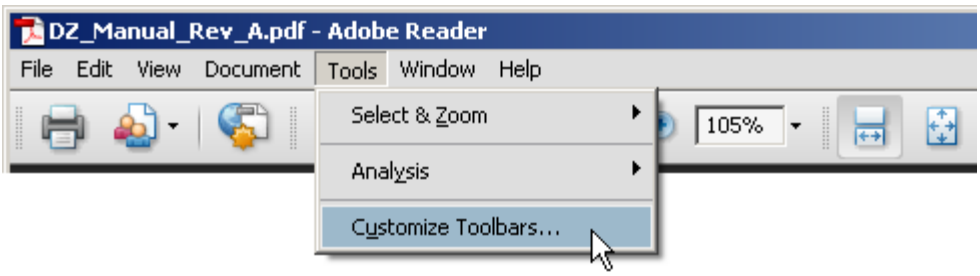
While having a hardcopy of this manual is handy, it is highly recommended that you keep the digital version on the desktop of your controller PC. It is searchable and extensively cross-referenced; all references to sections, pages, figures, tables, videos, and appendices are hyperlinked (click on the actual number):



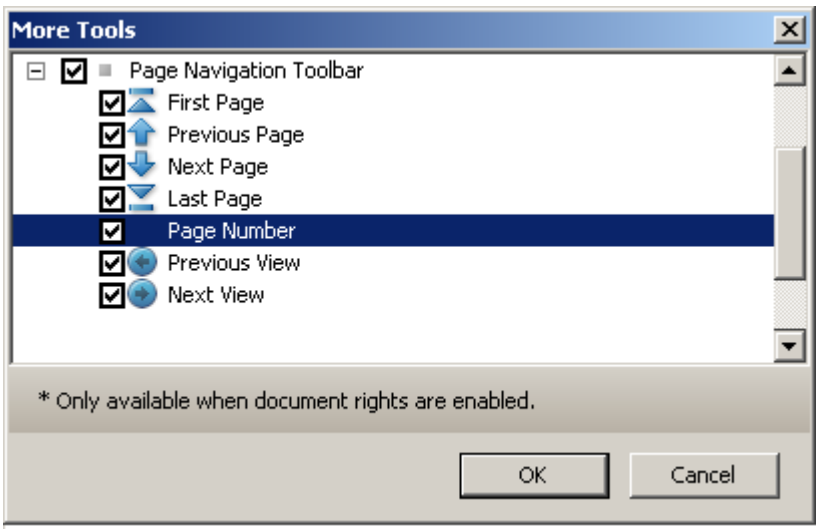
To take full advantage of the audio and visual components, you will need Acrobat Reader Version 9 or higher. It can be downloaded here: http://www.adobe.com/products/acrobat/readstep2.html. Be sure to enable the navigation tool buttons:



To do so, click on Tools >> Customize Toolbars:



Then check all of the buttons under Page Navigation Toolbar:



This manual accompanies software version 9.30. The most recent version of the software can be found here: ftp://geom.geometrics.com/pub/seismic/Geode-NZ/. Manuals can always be found here: ftp://geom.geometrics.com/pub/seismic/Manuals/. If you are asked for a password, please contact seismicsales@geometrics.com.

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Details of the Geode hardware can be found in Appendix B.1.

Details of the StrataVisor hardware can be found in Appendix B.2.

Details of the SmartSeis hardware can be found in Appendix B.3.

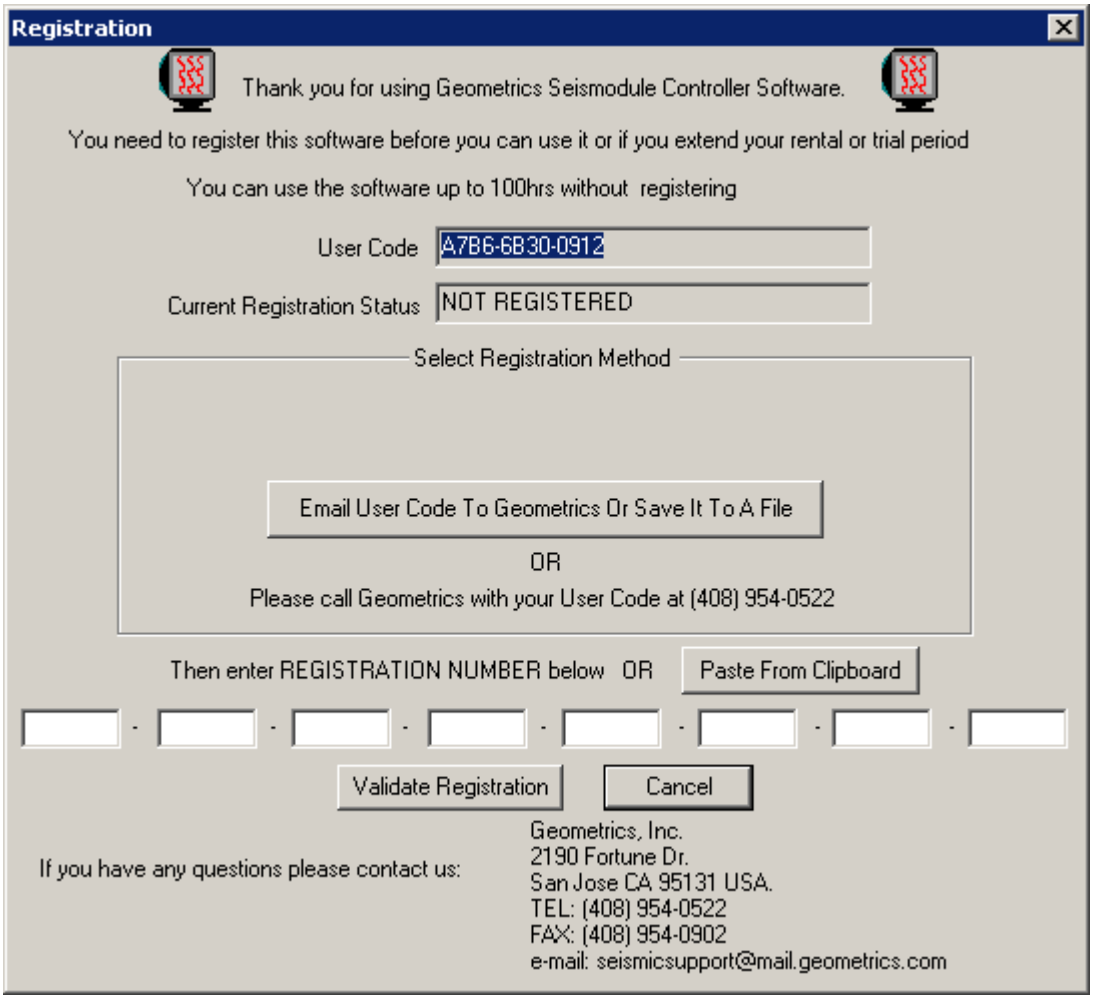
Details of the ES-3000 hardware can be found in Appendix B.4.

1.2 SEISMIC CONTROL SOFTWARE

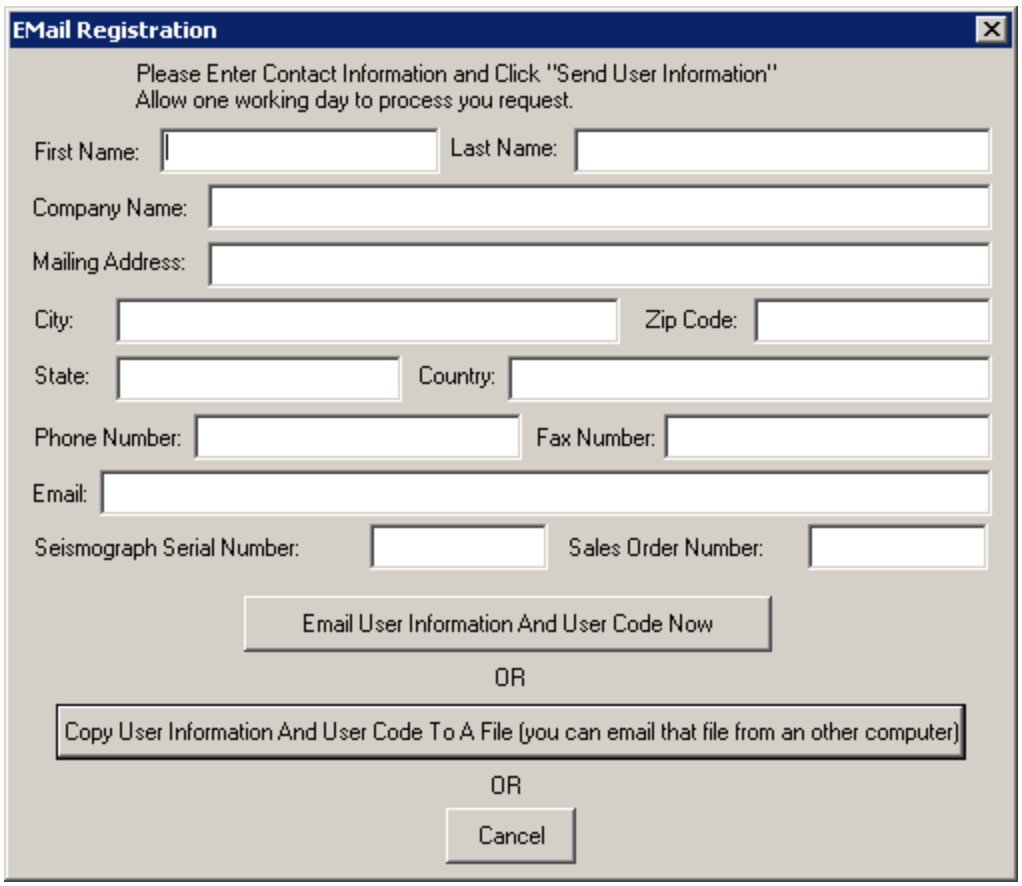
1.2.1 STARTING THE SOFTWARE FOR THE FIRST TIME

Note: *This applies to the Geode and ES-3000 only, which require installation of the software on a PC [typically] supplied by the user. If you have a SmartSeis ST or a StrataVisor NZ, the unit comes with the software pre-installed and pre-registered.*

The following registration screen will be displayed upon initial up of the software:



You have 100 hours of use before you must register your software. To register, you must send us the 12-digit code highlighted at the top of the registration screen. Pressing "**Email User Code to Geometrics Or Save It To A File"** will bring up the following form:



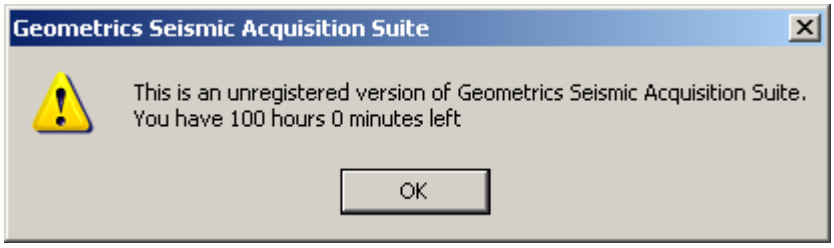
Please fill out the form; fields marked with a "*" must be completed. The serial number of any one of your Geode/ES-3000 modules will be sufficient. When you are finished, and if your controller PC is connected to the internet, press **Email User Information and User Code Now**. We'll send back a 40-digit enabling code, which you can simply copy and paste into the registration dialog.

If your controller PC is not connected to the internet, press "**Copy User Information And User Code To A File"**. Move the resulting .txt file to a PC that is online and email it to seismicsales@geometrics.com.

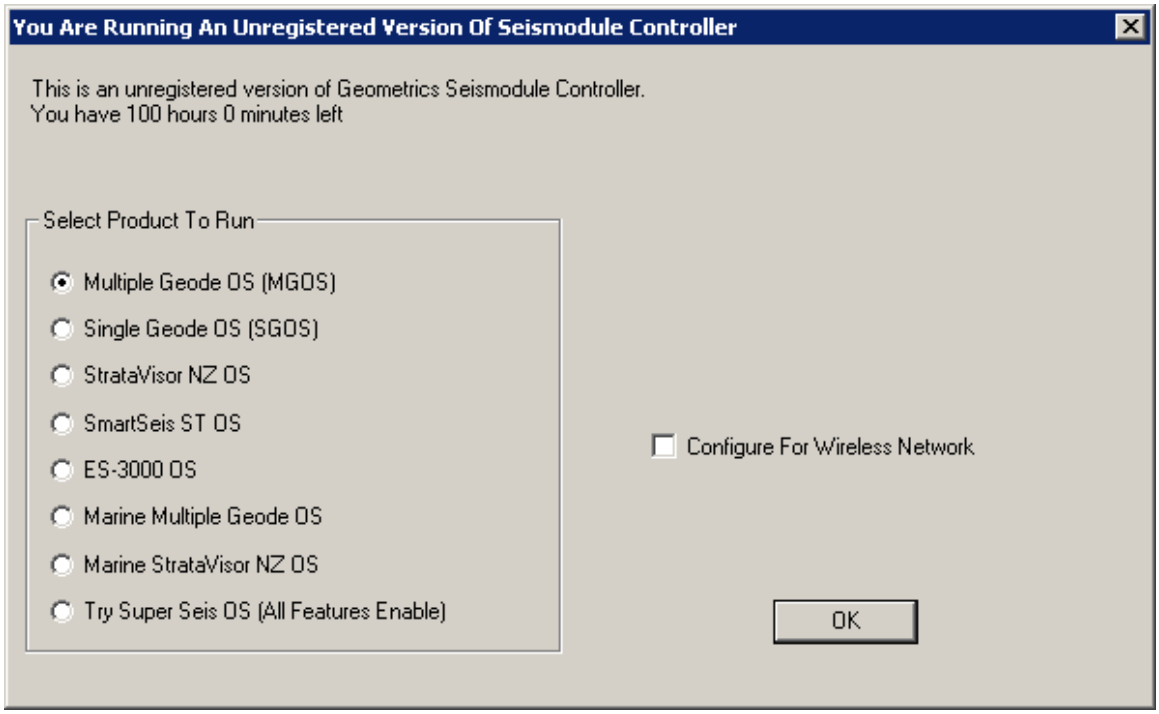
Note: *If you wish to bypass the form, just email the 12-digit code itself, along with at least one serial number, to the above address. It is not absolutely necessary that you fill out the entire form, but if you do, this information will be stored and included automatically in the event you ever need to send us a troubleshooting diagnostic report (Page 131).*

When you receive your code, copy it to the clipboard, start the software, and when the registration screen appears, press "**Paste From Clipboard**," and then press "**Validate Registration**." Your software should now be registered on this PC and you will not need to register again.

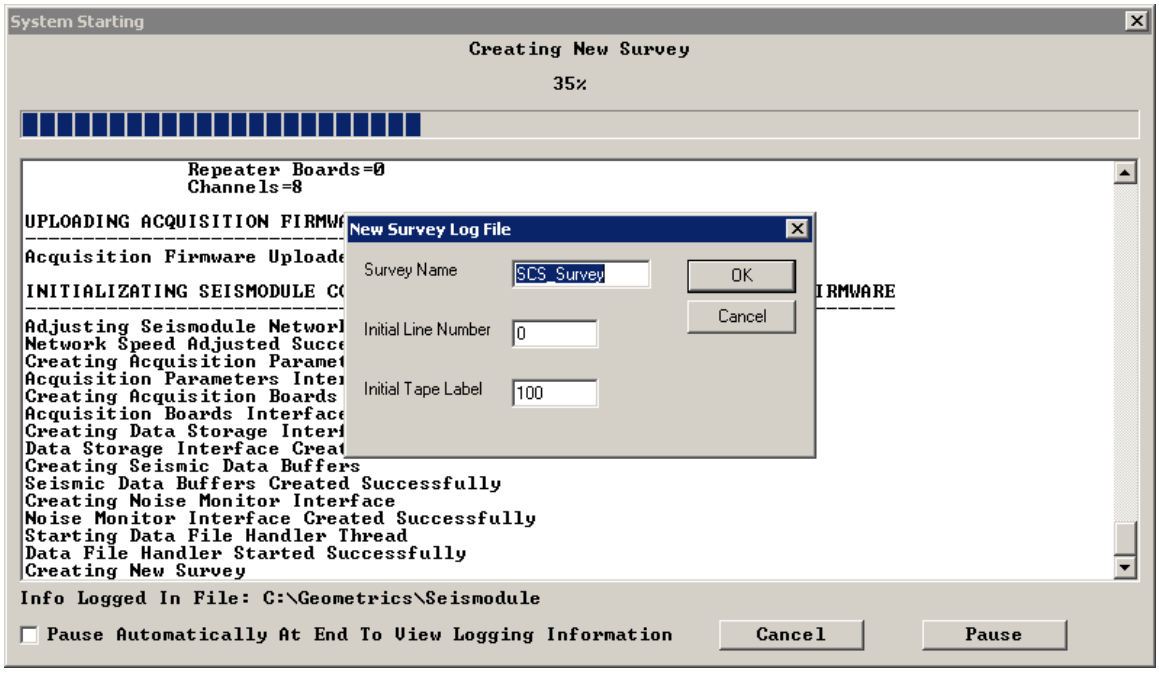
You can run the software in the meantime by simply pressing **Cancel** on the registration screen above. You will see the following message, telling you how much time you have left before you must register.



Press **OK**, and the following menu will appear:



This screen will be presented every time you start the software until you register it. It lists the various software bundles that we offer. Choose the one appropriate for your system, or if you would like to see all of the features (including optional ones), choose "SuperSeis". After pressing **OK**, you will see a startup script and be presented with a setup wizard:



Your seismograph is controlled by some subset of Geometrics' Seismic Controller Suite (SCS). Which features are available depend on which model of seismograph you purchased and which, if any, optional features were included. There are seven main software bundles, and they are summarized in Table 1 below:

Software Bundle	Seismograph	Rough description
SGOS	Geode (single unit, up to 24 channels)	Designed primarily for refraction. Runs a single Geode unit.
MGOS	Geode (single or multiple units)	Includes all features of SGOS, plus reflection features such as electronic rolling and real-time correlation. Controls multiple units on up to 10 separate network lines.
ESOS	ES-3000	Designed primarily for refraction. Very similar to SGOS.
STOS	SmartSeis ST	Identical to ESOS, with drivers for built-in keypad on SmartSeis.
NZOS	StrataVisor NZ	Identical to MGOS, with drivers for built-in keypad on StrataVisor.
Marine MGOS (MMGOS)	Geode (single or multiple units)	Includes features of MGOS plus marine features like real-time common-offset gather, trigger-time bar graph, gun energy window, etc.
Marine NZOS MNZOS	StrataVisor	Identical to Marine MGOS, with drivers for built-in keypad on StrataVisor.

Table 1: Various SCS software bundles.

In the following discussion, we will focus on only those features that come standard in at least one of the software bundles listed above. Those features not common to all will be indicated as such (see how in the Preface to this manual). Optional features will be dealt with in **Error! Reference source not found.**.

If you have a StrataVisor or SmartSeis, the SCS software will start automatically when you power up the seismograph. If you have a Geode or ES-3000 system, double-click on the SCS icon on the desktop to start the software: 

There are up to five separate windows and one main toolbar that can be displayed at any given time, depending on your particular system. Like any Windows™-based program, these windows can be positioned and sized at will, and your settings will be remembered from session to session. If you have a StrataVisor or SmartSeis, you will need to plug in the supplied field mouse to accomplish this, but once it is done you should not need a mouse in the field for most operations. The system is designed to be almost fully-operational with the built-in keypad.

Note: *We say "almost" fully operational with the built-in keypad because some special features actually do require a mouse. While you will rarely need it, if you have a StrataVisor or SmartSeis, it is highly recommended that you have the supplied field mouse handy at all times.*

On initial startup of SCS (automatic in the SmartSeis and StrataVisor), you should see something similar to the following (the exact content and configuration of the display will depend on what seismograph and software bundle you own – see Table 1):

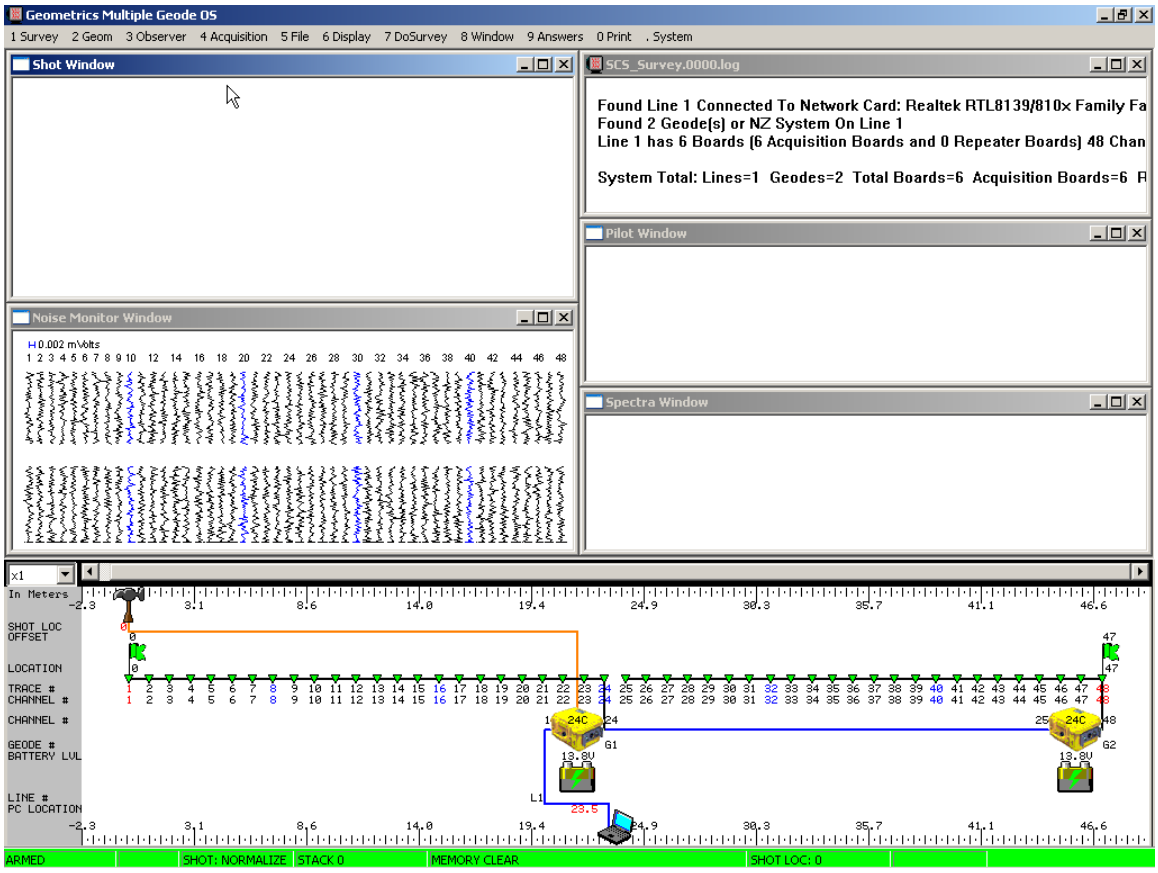
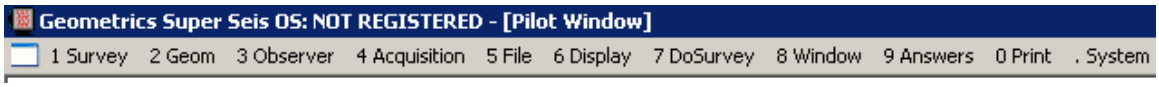


Figure 7: Screen shot of SCS control software. Screen shown above is for MGOS; depending on your system, you may see only a subset of these.

1.2.1.1 MAIN MENU BAR

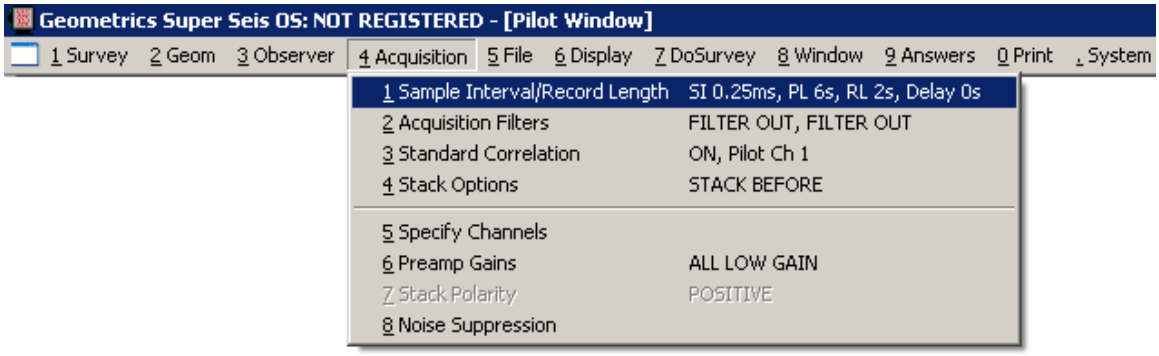
The main menu bar has been organized to follow the convention suggested and approved by many of our users over the years. Owners of previous Geometrics instruments such as the StrataVisor R and RX, the SmartSeis ST and the ES-2401 will recognize the left to right convention for setup and operation.

The main menu selections are displayed at the top of the screen:

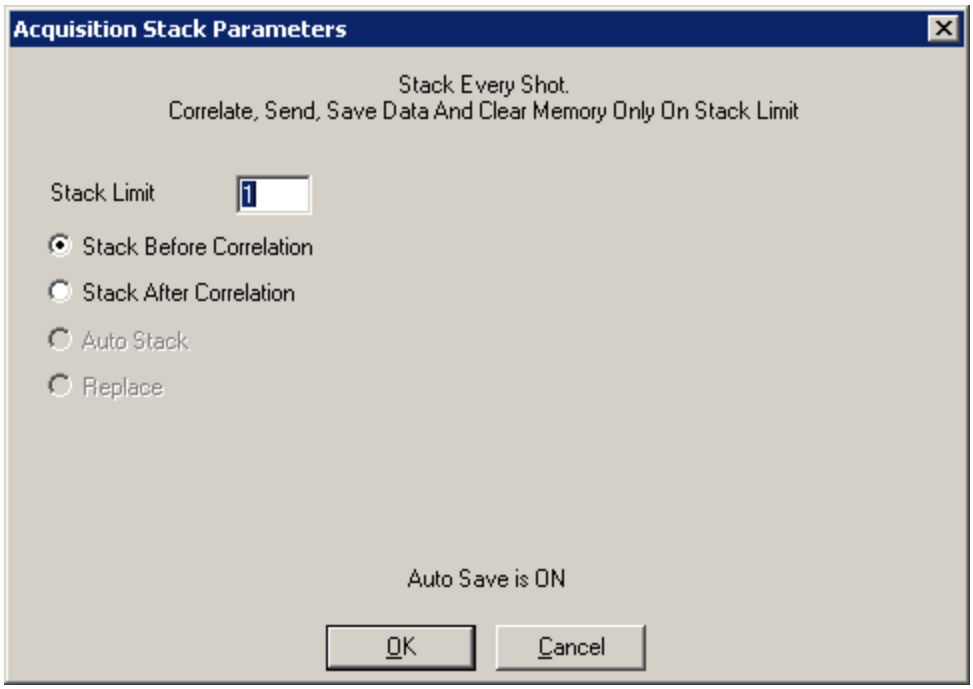


When the **MENU** key is pressed on the StrataVisor NZ or SmartSeis ST, the Do Survey menu will drop down and a secondary menu showing the corresponding choices appears. If you are using a laptop or computer, you can use your pointing device to highlight the menu items or use the **ALT** key in combination with any of the numbers preceding the selections in the main menu. For example **ALT- 7** pulls down the Do Survey menu.

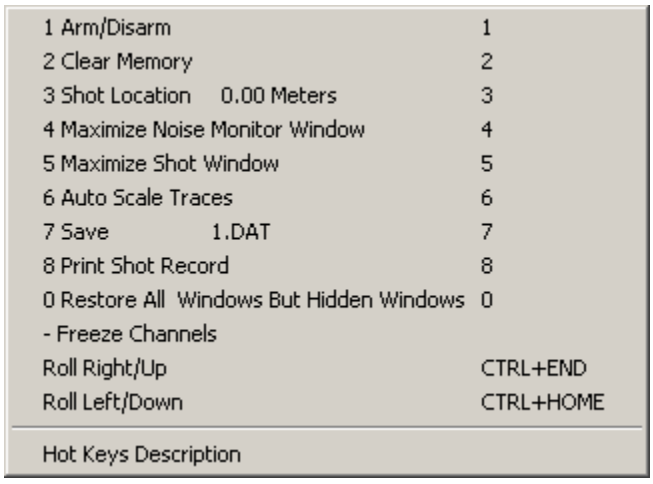
Many of the secondary menu items have numbers in front of them. You can select an item by pressing the corresponding number key instead of moving the cursor. Pressing the number key to select a menu item will be much faster when conducting actual surveys. For instance, let's say you want to go to the Stack Options dialog, which is in the Acquisition menu. Press **ALT-4** to display the Acquisition menu,



Then press **4** to open the Stack Options dialog:



In addition, some selections have "hot keys" that allow them to be selected without actually entering the menu. Any selection with a number to the right is hot key-enabled. For instance, you may armor disarm the seismograph from outside the menu system by simply pressing **1**:



See Table 6 on Page 103 for a description of hot keys and their functions.

Across the top you will see the list of main operational menus. Within each is a selection of submenus. Before we get into the descriptions of these, we will first discuss each of the five main display windows and the tool bar at the bottom.

1.2.1.2 SHOT WINDOW

The Shot Window displays the shot record in the time domain. An example is shown below. If Tool Tips are enabled, hovering over any trace with the mouse displays information about that trace:

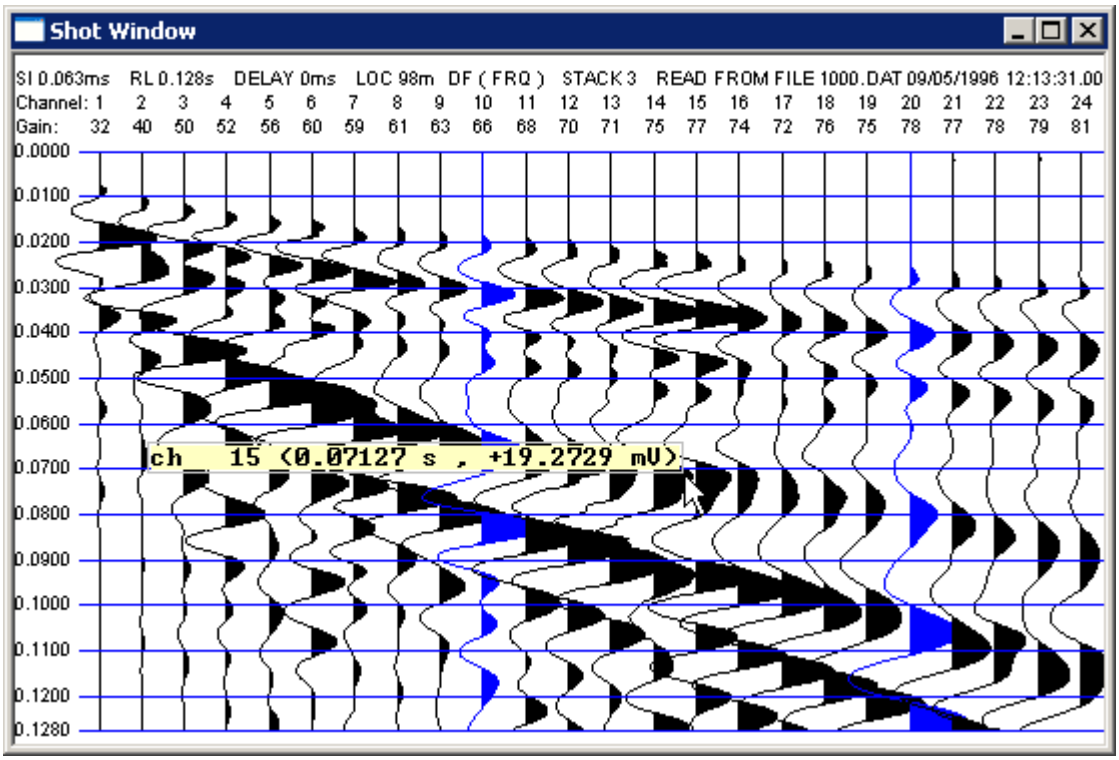


Figure 8: Example Shot window displaying seismic record in time domain.

There are three lines of information across the top of the display. The top rows are reserved for message lines showing the acquisition parameters, system status, the channel numbers, and trace amplitudes. The remaining area is reserved for displaying the seismic data. Time increases downwards, and horizontal timing lines are labeled in seconds. As we will see later, the time window and channels displayed are user-selectable. The first line of the header contains the following information (xx.xx will be some numerical value depending on the parameters selected):

SI xxxx is the sample interval in milliseconds.

RL xxxx is the record length seconds. The StrataVisor allows the use of all or part of the available memory, so the record duration will depend on the combination of sample rate and record length.

DELAY xxxx is the delay in the start of the record (in milliseconds) after the trigger signal, or if negative, is the amount of data prior to the trigger signal.

AF indicates that acquisition filters are enabled.

DF indicates that display filters are enabled.

STACK xxxx indicates how many stacks are currently in memory.

A message indicating the status or type of data will be displayed in the upper right hand corner of the screen:

MEMORY CLEAR indicates the memory has been cleared, and the stack count should be zero.

UNSAVED STACKED DATA is seismic data stacked into the memory (but not saved on disk).

SAVED AS xxxx.DAT indicates the stacked data has been saved on disk (in file XXXX.DAT).

READ FROM xxxx.DAT indicates data read from disk (from file xxxx.DAT).

The remaining two lines in the display header show the channel numbers and the relative trace sizes or display gains. Relative trace amplitudes are labeled in dB. Amplitudes are accurately displayed, so that absolute amplitude comparisons can be made when the traces are displayed in fixed gain (as opposed to automatic gain control [AGC]).

In systems with 48 or more channels, there may not be enough room to label every channel. In that case, we label as many as feasible.

1.2.1.3 SPECTRA WINDOW (MGOS/NZOS)

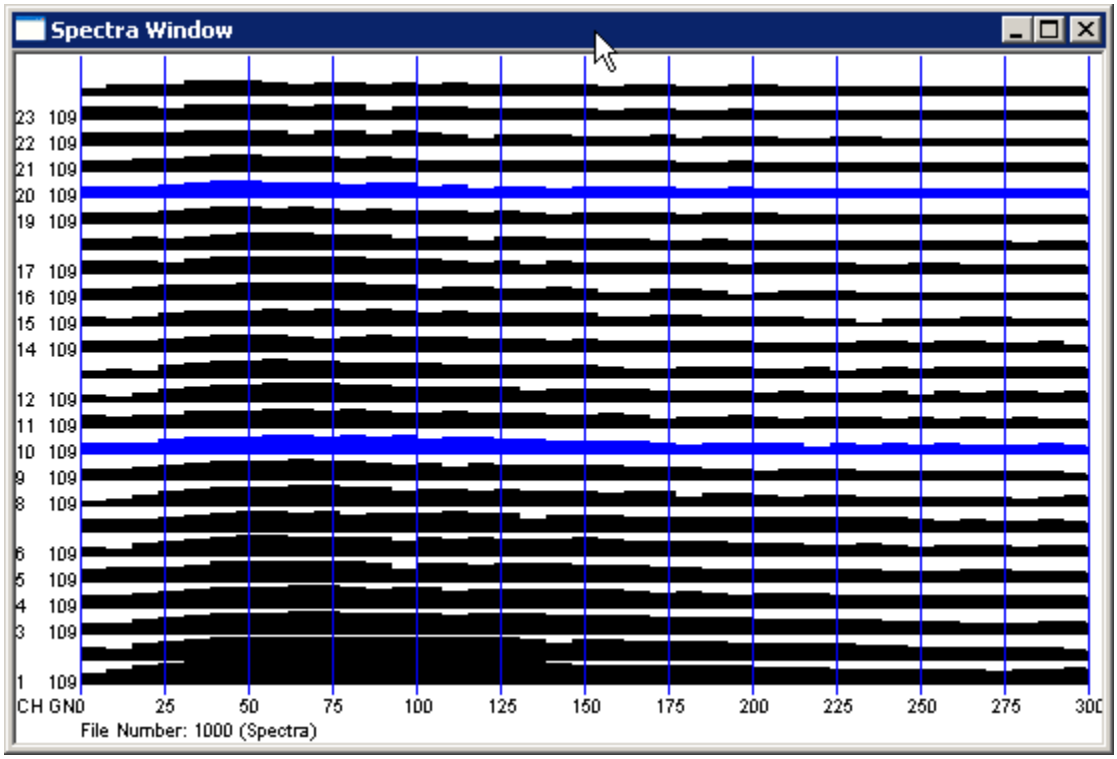


Figure 9: Example Spectra window displaying seismic record in frequency domain.

The Spectra window displays the seismic data in the frequency domain. The horizontal axis is frequency and the vertical axis is relative amplitude. Function is very similar to that of the Shot window.

This can be useful, particularly when troubleshooting or assessing data quality. Note that the Spectra window is a major user of CPU time. This window should generally be closed during production.

1.2.1.4 NOISE MONITOR WINDOW

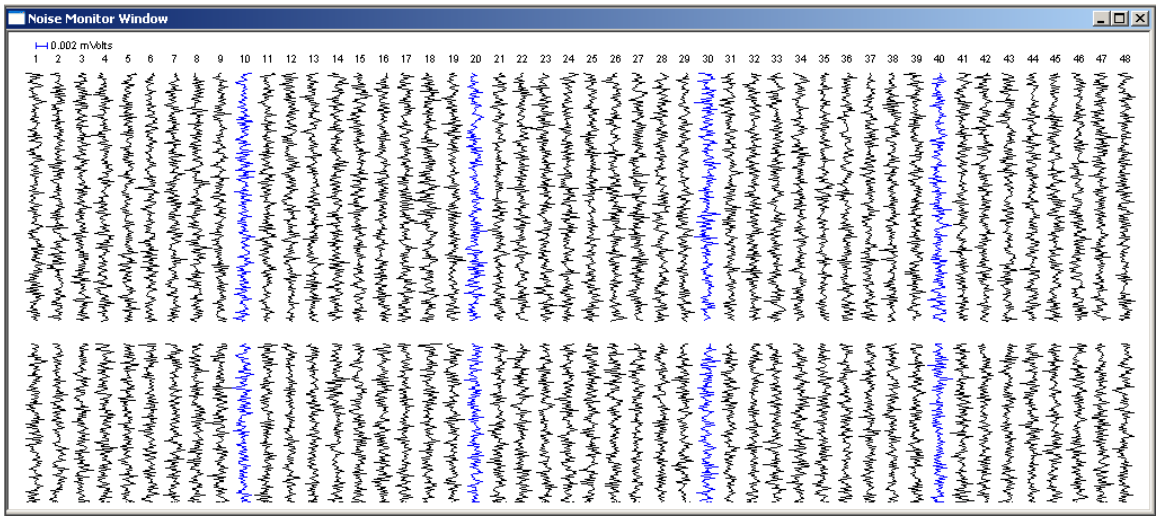


Figure 10: Example Noise window.

This is a real-time display of the signal coming in on each channel. It is useful for troubleshooting the geophone spread, analyzing and documenting ambient noise conditions, and for determining the best time to take a record. The sensitivity is displayed in the upper left-hand corner and can be controlled by using the up and down arrow keys on the keypad after the window has been selected (you can tell if the window is active by looking at the top bar – it should be a different color than the other window bars). Set the sensitivity to 0.05 mVolts and lightly touch one of the geophone connectors to get a feel for the function of the noise monitor.

1.2.1.5 SURVEY LOG WINDOW

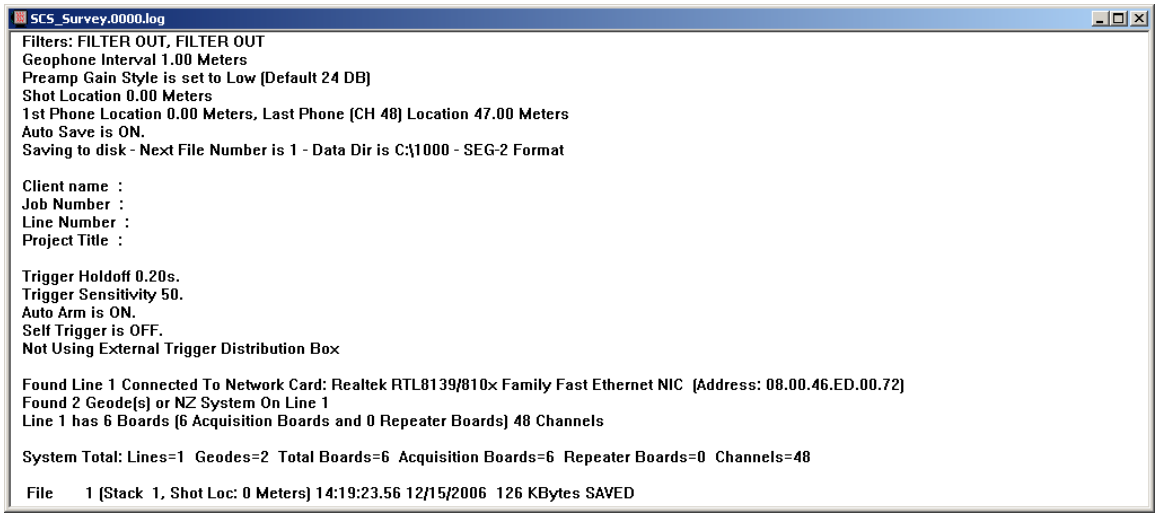


Figure 11: Example Survey Log window.

The Survey Log keeps track of everything that happens during the course of a survey. Initially it displays the basic settings of the seismograph, such as beginning line number, stack mode, sample interval, etc. (we will not dwell on these individual items now; that will come later with the in-depth discussion of the menus). Once data acquisition begins, the Survey Log will keep track of shot numbers, shot times, output devices, errors, and further parameter changes. The survey log functions as a complete accounting of the seismic survey.

1.2.1.6 PILOT WINDOW (MGOS/NZOS)

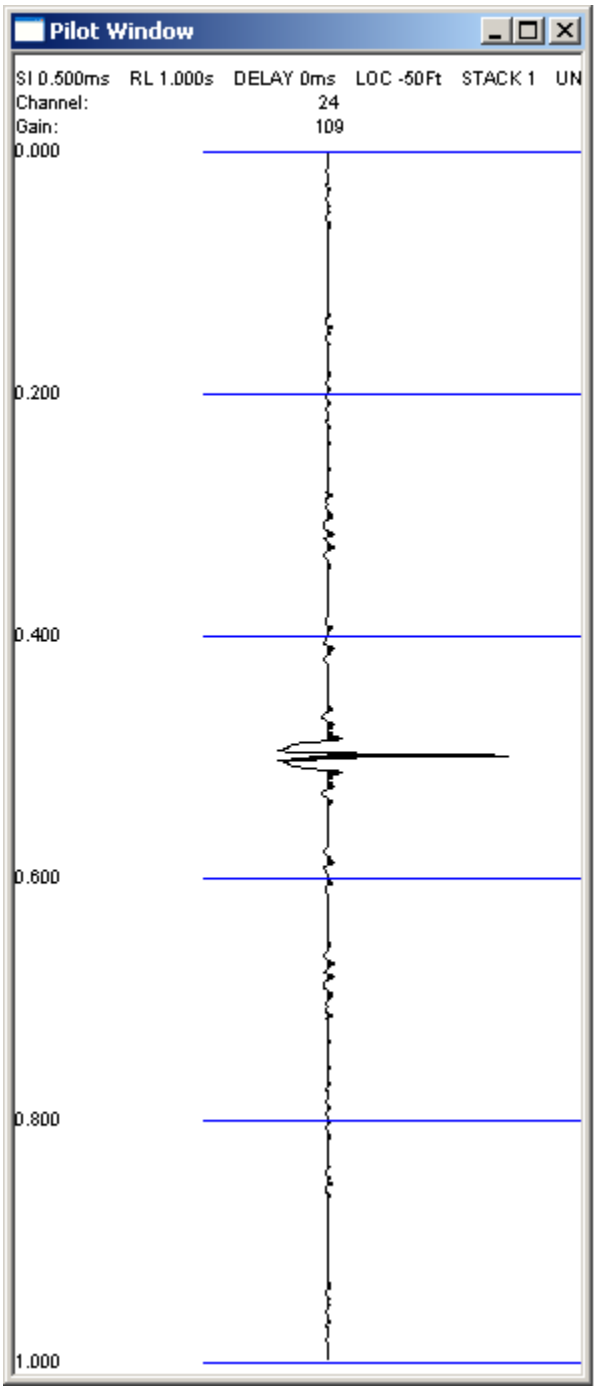


Figure 12: Example Pilot window showing autocorrelation pulse.

This window will be blank and is only used when correlating. When acquisition correlation is enabled, it will display the autocorrelation trace, preceded by its mirror image. Function is identical to that of the Shot window. See Section 2.6.8 on Page 91 for a more in-depth discussion.

Note: *This window only displays the pilot trace when acquisition correlation is enabled. It does not display anything when display or QC correlation is used.*

1.2.1.7 GATHER WINDOW (MMGOS, MNZOS)

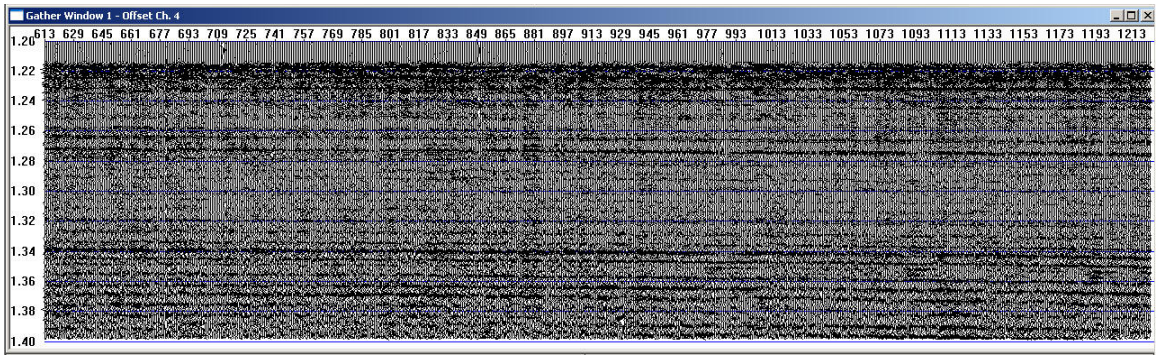


Figure 13: Example of common offset (near-trace) gather.

The Gather window displays a single user-specified trace from each shot record to build up a common-offset gather. It is left-scrolling and continuously updated. Depending on the survey area, the common offset gather (or "near trace gather") can rival a brute stack in quality and is a useful tool for monitoring data quality during the survey. An example is shown above.

1.2.1.8 NOISE WINDOW (MMGOS, MNZOS)

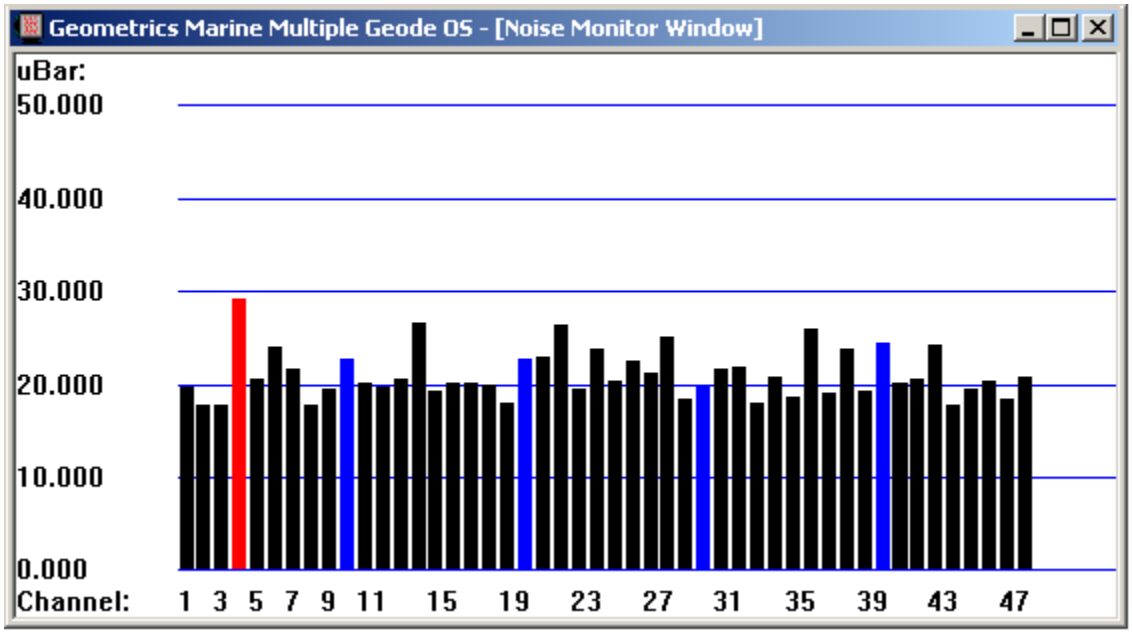


Figure 14: Noise bar graph.

The Noise Window displays a bar graph "snapshot" of the rms streamer noise, taken immediately prior to the trigger (above). Channels exceeding user-specified noise thresholds (see Page 89) are shown in red.

1.2.1.9 TRIGGER WINDOW (MMGOS, MNZOS)

The Trigger Window displays two parameters:

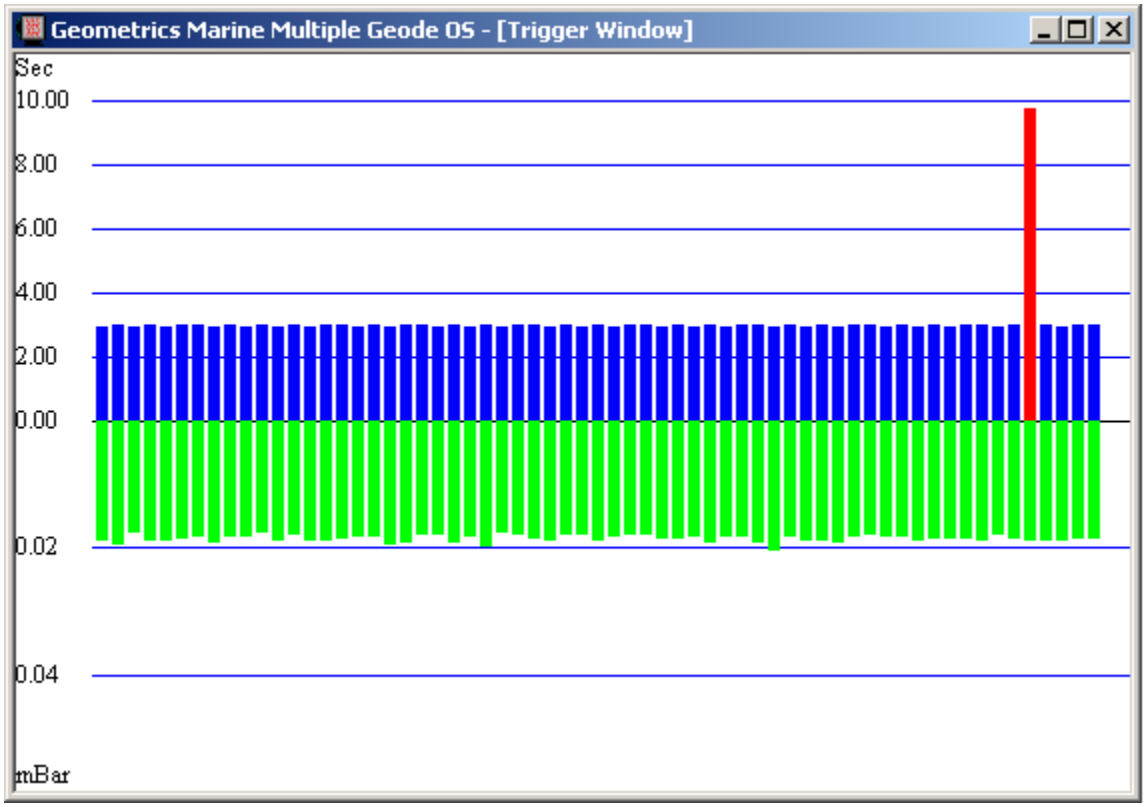


Figure 15: Trigger Window.

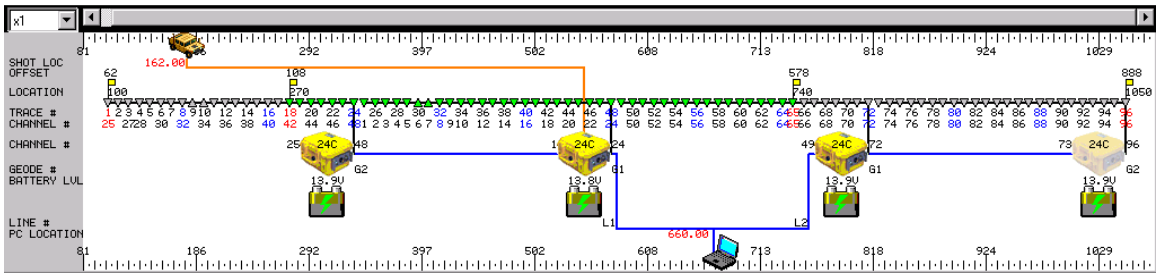
The top bar graph indicates the time between triggers. This is useful for catching missed or spurious triggers. A threshold can be set which, if exceeded, can cause an alarm to be sounded and the bar for that shot to be shown in red.

The bottom bar graph represents the rms amplitude of the near-field hydrophone. This can provide a crude check on source function; the idea is that the rms energy will not change much from shot to shot if the source(s) is firing consistently. You may set a threshold which, *if not reached or exceeded*, can cause an alarm to be sounded (see Page 142) and the bar for that shot to be shown in red. This is generally used only when a source controller is not available. If you are using a source controller, this feature will be superfluous.

Both graphs are continuously-updating and left-scrolling.

1.2.1.10 GEOMETRY GRAPHICAL USER INTERFACE

The Geometry GUI provides a graphical representation of your survey, along with a wide range of control capability. It is particularly useful when conducting reflection surveys, but can be useful in a wide range of applications. It summarizes, in one simple view, the physical positions and other attributes of the hardware on the ground, and allows graphical control of these.



The Geometry GUI operations are extensive and are described in Section 2.12 (Page 149).

1.2.1.11 STATUS BAR

The Status Bar is always visible at the bottom of the screen:

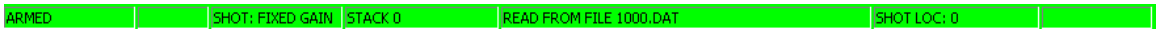


Figure 16: Status Bar.

It will be green when armed, yellow when busy, and red when disarmed. Whichever one of these states it is in will also be displayed at the left end of the Status Bar. Other items displayed will include the trace style, stack count, record status, and shot information.

Record status will be one of the following:

- MEMORY CLEAR – No data in buffer.
- UNSAVED STACKED DATA – Data in stack buffer and sent to the controller and displayed but not yet saved.
- INTERMEDIATE STACKED DATA IN ACQUISITION BOARD – Data in stack buffer but not yet sent to controller and not yet saved (if in Auto Save mode and not viewing intermediate stacks; see Page 54).
- SAVED AS FILE XXX.XXX (STACKED DATA) – Data written to storage media.

1.3 GETTING AROUND THE MENUS

The SCS software follows Windows™ conventions for the most part. Although written mainly for use with a mouse or other pointing device, the software can be driven to a large degree by a keyboard, or in the case of a StrataVisor NZ or SmartSeis ST, the built-in keypad (below).

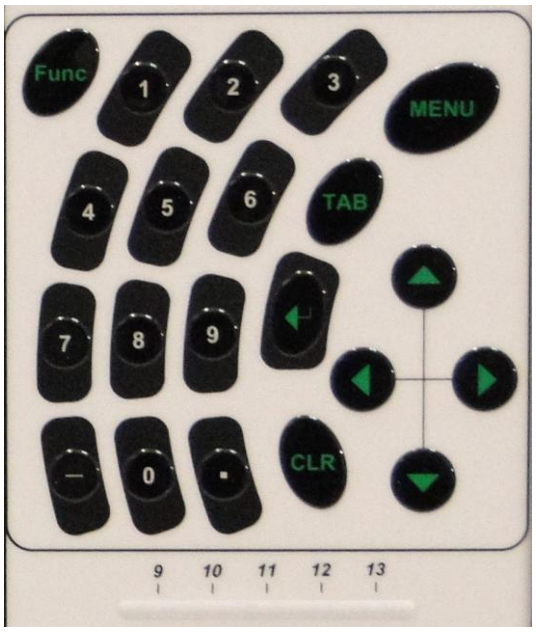
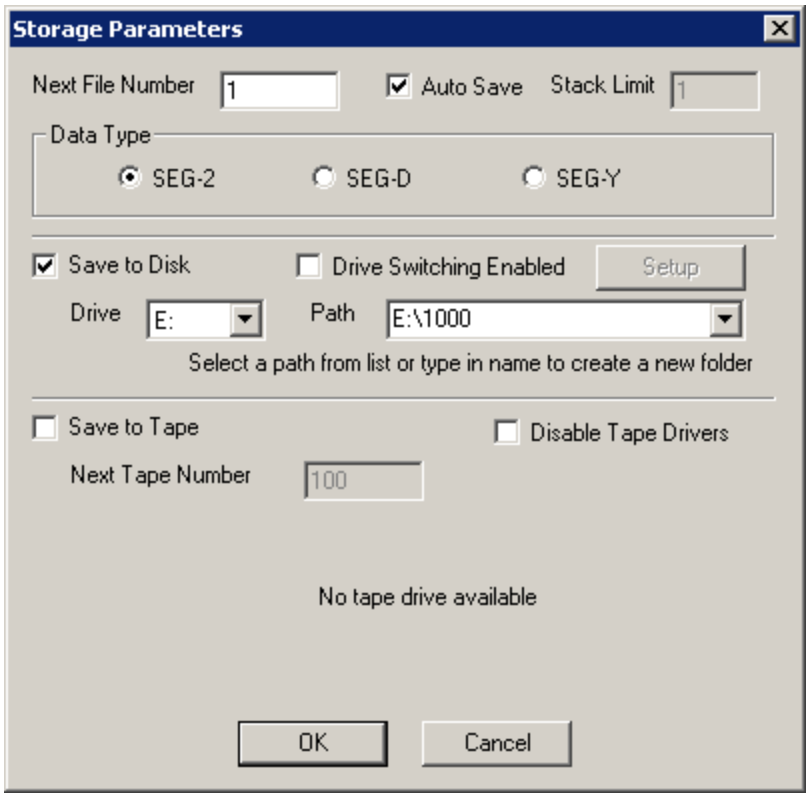


Figure 17: StrataVisor/SmartSeis built-in keypad.

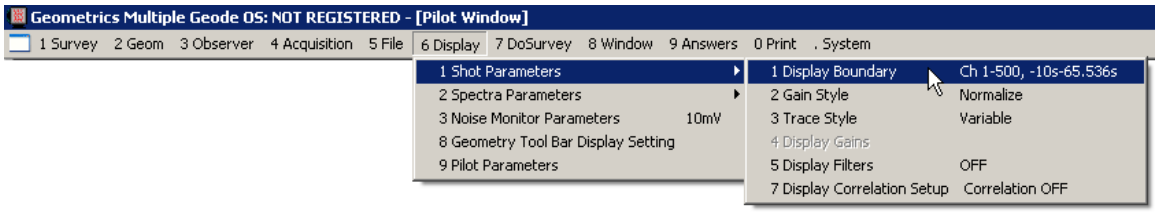
A description of important key functions follows:

- **Tab** key: The function of the **Tab** key is context-sensitive. When you are in a dialog box, the **Tab** key moves control from one class of selections to the next. For instance, in the File>>Storage Parameters Dialog Box (below), repeated pressing of the **Tab** key will cycle control through Next File Number, Auto Save, Stack Limit (if Auto Save is checked), Data Type, Save to Disk, Drive Switching Enabled, Setup (if Drive Switching Enabled is checked), Drive, Path, OK, and Cancel.

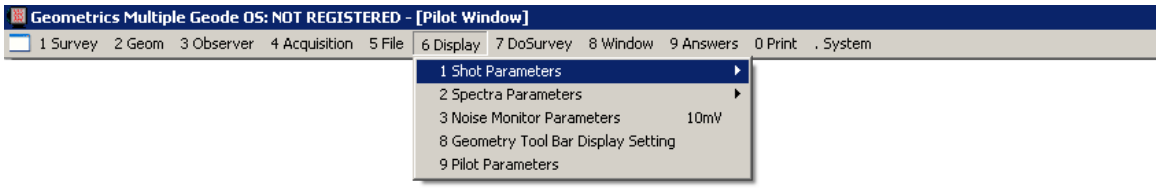


When you are not in a dialog box, the **Tab** key cycles through and activates/deactivates the various child windows listed in the Window Menu (these will vary depending on what software you own):

- **Arrow** keys: These are also context-sensitive. When you are in a dialog box, the **Arrow** keys move the cursor around within fields or between choices in a class. In the File>>Storage Parameters Dialog Box (above), the left/right **Arrow** keys will move the cursor among the digits in the Path field, without affecting the digits themselves. Within the Data Type class, the left/right **Arrow** keys will move between the SEG-2, SEG-D and SEG-Y radio buttons (if available). When the Main Menu is activated, the left/right **Arrow** keys navigate among the Main Menu items, and the up/down **Arrow** keys navigate within the drop-down menus. Highlighting an item on a drop-down menu that points to a sub-menu and pressing the right **Arrow** key will open the sub-menu:



Pressing the left **Arrow** key will close it:



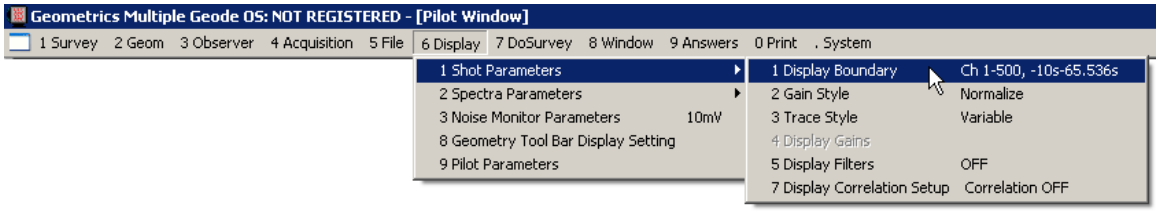
Note: *The* **Arrow** *keys also function as context-sensitive "hot keys"; see Page 99 for a full discussion of these special keys.*

- **Back Space** key: Pressing the **Back Space** key within a field, such as Path (above), will delete characters, as it does in any text editor.

- **Period (.)** key: When the cursor is on a check box, such as Auto Save, the period key will check/uncheck the box.

- **Spacebar:** The **Spacebar** functions identically to the **Period** key.

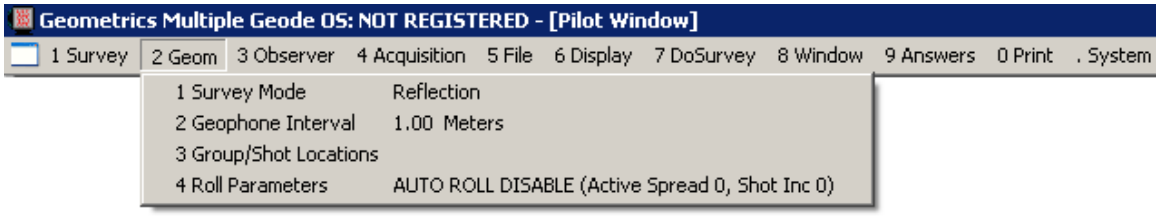
- **Enter** key: In most cases, the **Enter** key functions as a single left-click with the mouse. When a menu item is highlighted, pressing **Enter** will take you a level deeper. When a menu item consists of a command (for instance, Save), highlighting that item and pressing **Enter** will implement the command. When a menu item leads to a sub-menu, highlighting that item and pressing **Enter** will open the sub-menu:



The **Enter** key can also be used to throw toggle switches. In the above list of available windows, highlighting View Geometry Tool Bar and pressing **Enter** will uncheck this feature. Finally, when in a menu, pressing **Enter** implements the menu choices and closes the menu.

- **Esc** key: The **Esc** key abandons any changes made in a menu or dialog box and closes it.

- **Alt** key: When you are not in a menu or dialog box, pressing the **Alt** key simultaneously with the first letter of any Main Menu item will activate that item. For instance, pressing **Alt-G** will open the "Geom" drop-down:



Pressing **Alt-S** will open the next drop-down that begins with "S". In the above example, pressing **Alt-S** once will open the Survey drop-down; pressing it twice will open the System drop-down.

1.4 CHANNEL STATES

Any channel may be in one of several states, or modes, at any given time. It will be useful to define these early, as they are referred to throughout this manual. They are summarized in Table 2.

State	Definition	Notes
Enabled (Active)	Ready to acquire data; channel will be included in shot record.	
Disabled (Inactive)	Not ready to acquire data; channel will not be included in shot record.	
Frozen	Enabled, but temporarily unable to acquire data. If stacking, may contain data from previous stack(s).	A channel can be frozen at any time, and whatever data it may have in it at the time it is frozen will be preserved, even if the shot record is cleared (Page 93). When unfrozen, subsequent shots will be stacked (summed) with the existing data.

Table 2: Description of channel states.

1.5 CHANNEL TYPES

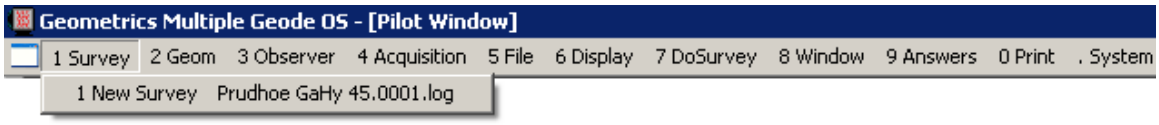
Any channel can be set to be either a data channel, an auxiliary channel, or a pilot channel. These are summarized in Table 3. The above channel states apply to all channel types.

Channel Type	Definition	Notes
Data	This is the most common channel designation and generally refers to the channels mapped to the receivers.	
Auxiliary	Auxiliary (AUX) channels are used to record things like time break confirmation or uphole time. They do not have coordinates, and they are ignored by the rolling process.	Any channel can be designated as an AUX channel. These are chiefly used when doing 2D reflection using a Geode system, and are usually in a separate Geode on a separate network line (see Page 36).
Pilot	The pilot channel is a special AUX channel dedicated to recording the "pilot" or reference signal from a non-impulsive source like a vibrator. This is the trace that the rest of the traces are cross-correlated with to produce a correlated record. Like all AUX channels, the pilot channel does not have coordinates; unlike other AUX channels it can optionally be rolled with the active spread (see Pages 50 and 91). Only one channel can be set as a pilot. When correlated, the autocorrelation trace is displayed in its own window (Figure 12, Page 15) and is useful for QC purposes.	

Table 3: Description of channel types.

2. SCS ACQUISITION CONTROL SOFTWARE

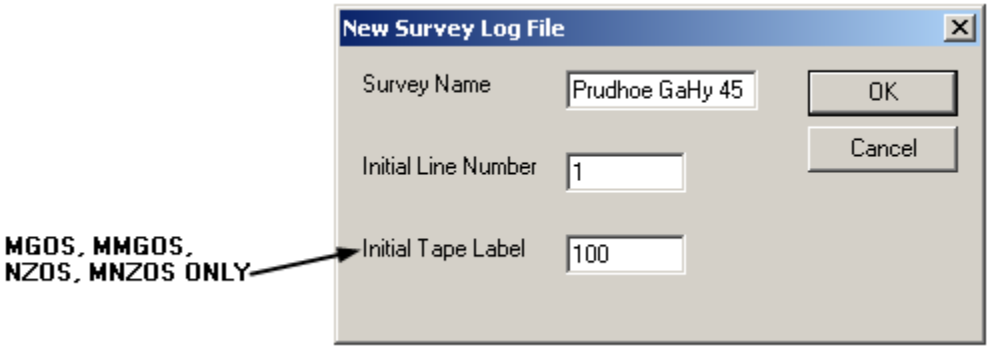
2.1 SURVEY MENU



There is only one choice under the Survey Menu. The current survey is displayed in the drop-down menu, as shown above.

2.1.1 NEW SURVEY

Clicking on New Survey will open the following dialog box:



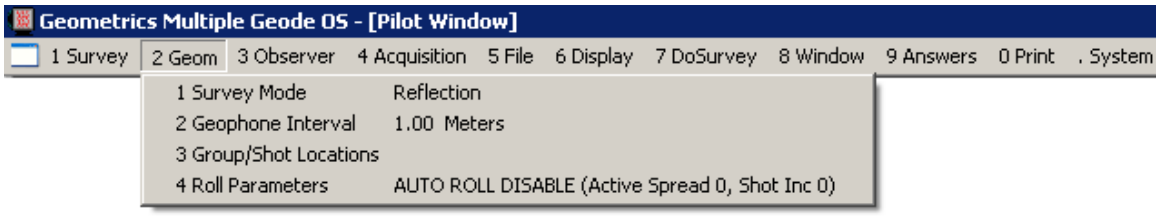
The New Survey dialog box is used to provide a name for the survey, an initial line number, and if writing to tape, an initial tape label. It is recommended that numbers be used for the line number and tape labels.

The Survey Name will be the file name for the survey log. This log is displayed in the Survey Log window, and will be saved in standard ASCII format. It may be printed off line with any text editor, such as Wordpad, and can be archived along with the seismic data.

The Initial Line Number is useful if you intend to include numerous geophone spreads into one "survey". In this case, you would update the line number (see the Observer menu) each time you picked up and moved the spread (as in a refraction survey). If you intend to begin a new "survey" with each new geophone spread, the line number may or may not be useful, depending on how you choose to do your bookkeeping.

If writing to tape, the Initial Tape Number is a useful parameter in that the survey log will indicate the tape number that each file is written to. When the tape is full and the operator inserts a new tape, the tape label number will automatically increment. It is good practice to label each tape with the appropriate tape number. By referring to the Survey Log, locating specific shot records will be greatly simplified.

2.2 GEOM[ETRY] MENU

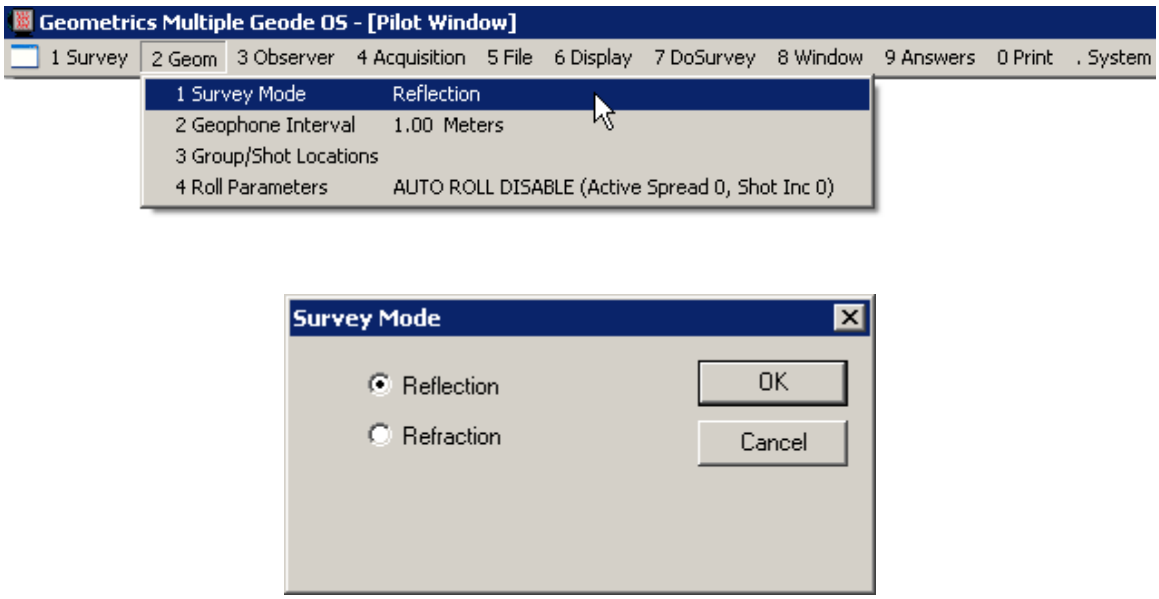


The Geometry menu is a collection of dialog boxes used to annotate the seismic data with the locations of the geophones and seismic source. It is also the place where you set up the rolling parameters.

The information in the Geometry menu is optional, and surveys may be conducted without reference to this menu. However, its use is highly recommended, particular in refraction surveys, as this information is essential when using the functions provided in the Answers menu. Most third-party refraction analysis packages also use this information.

Note: *If a file is read from disk, the coordinates displayed in the following menus will be from the record read in.*

2.2.1 SURVEY MODE

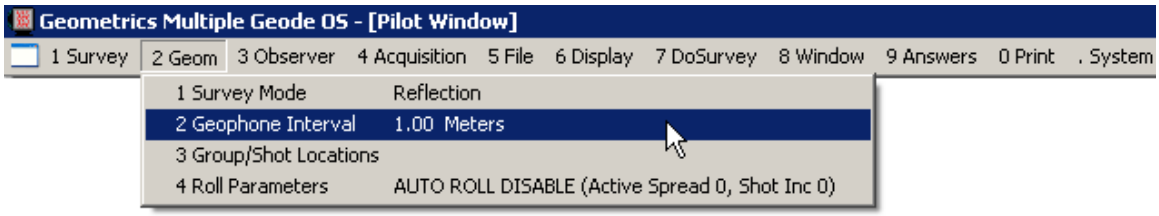


When you are in Refraction Mode, the seismic software treats some of the data scaling operations differently Autoscaling operations are done based on the amplitude of the noise before the first breaks to minimize the amount of manual scaling that may be necessary.

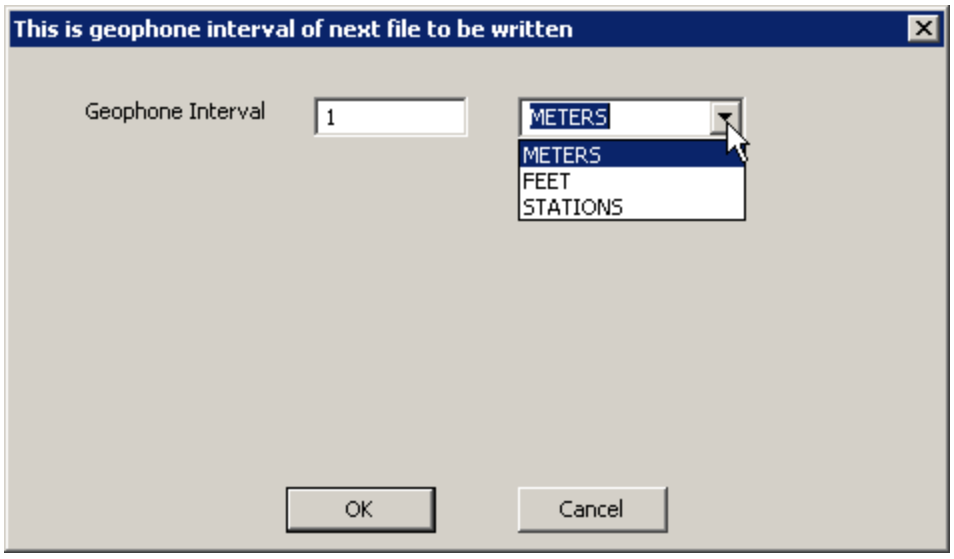
In Reflection Mode, trace autoscaling is done by normalizing each trace to the maximum value of the trace shown on the display.

Note: *These are display features only – they do not affect the actual data. Refraction data acquired while in reflection mode, and vice versa, are perfectly valid.*

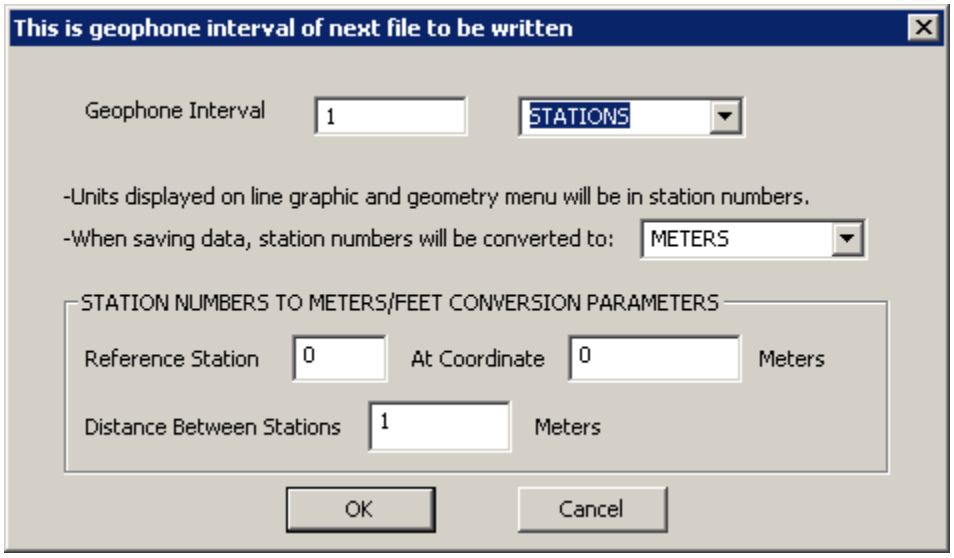
2.2.2 GEOPHONE INTERVAL



The Geophone Interval is the distance between geophones or groups of geophones. You may work in units of feet, meters, or stations.



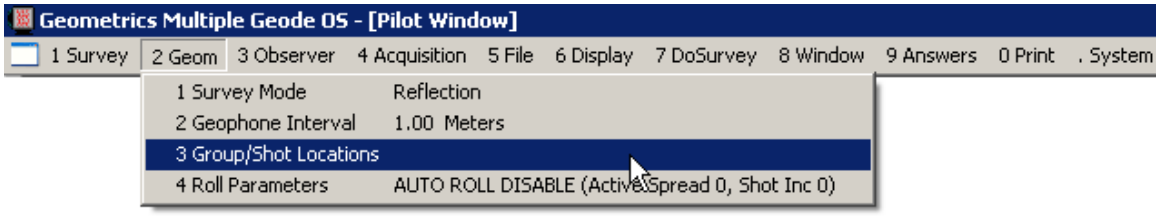
If you choose to work in stations, additional items will appear in the dialog box:

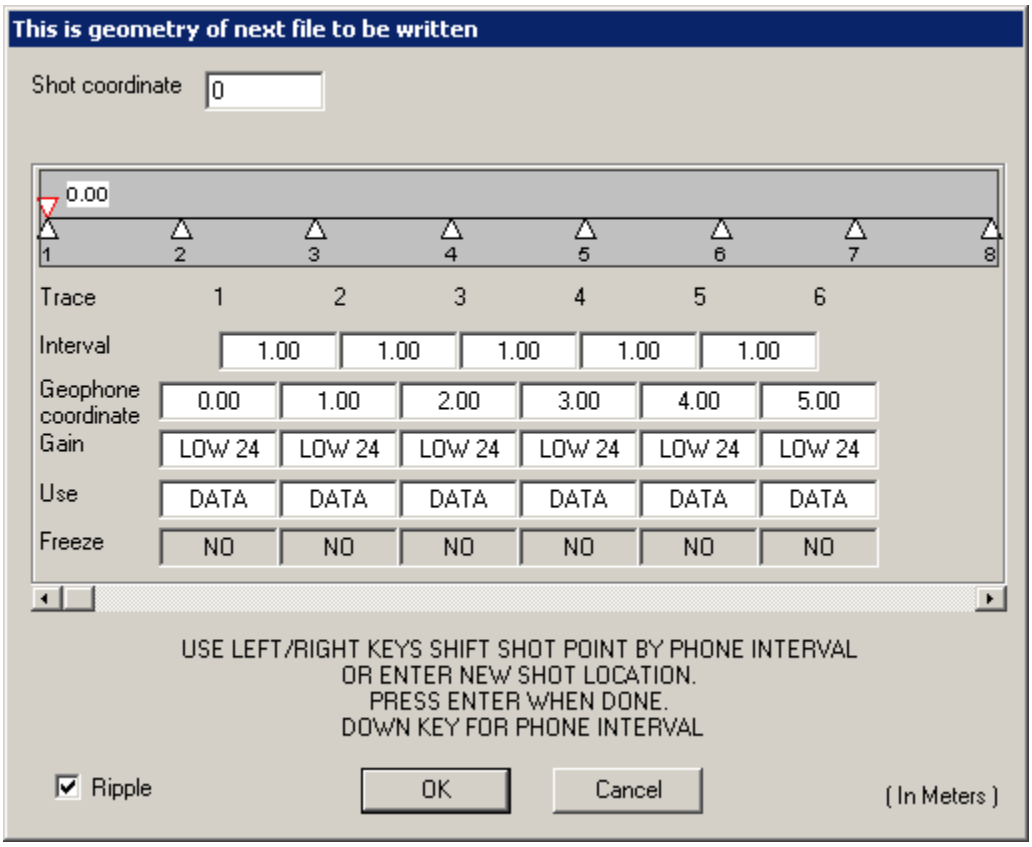


During acquisition, all reference to spread geometry will be in station numbers. The station numbers will be converted to either meters or feet when the data are saved. If you wish to tie a specific distance along the spread to each station number, you must enter a reference station number and its position in feet or meters. If you wish the distance units that are written to the file header to be accurate, you must enter the correct distance between stations.

Note: *Generally, station numbers are used when doing seismic reflection, and distance units (meters or feet) are used when doing seismic refraction. Most 3rd-party refraction packages expect meters or feet.*

2.2.3 GROUP/SHOT LOCATIONS





This dialog box allows you to input the current shot position, and to assign the physical locations of the geophones to the channel numbers. The title bar of the dialog box indicates whether the coordinates displayed refer to

- the next file to be written, or
- a file that was read in from storage

The geometry that you set up will also affect the coordinates displayed in the Geometry GUI (see Section 2.12, beginning on Page 149). In fact, you will find that the Geometry GUI can be used

as an alternative to that shown above and discussed here. But we have kept this "old style" around for the "old salts".

Regardless of whether your model of seismograph has a keypad, you may find using keys (rather than a mouse) to navigate this dialog box.

- The **TAB** key and up/down **Arrow** keys are used to navigate from category to category.
- When in the Shot Coordinate box, the left and right **Arrow** keys are used to increment or decrement the shot coordinate by the geophone interval entered above.
- In any other box, the left/right **Arrow** keys are used to navigate to the next or preceding entry within a category.

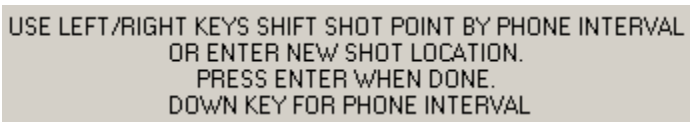
Only the positions of six channels are displayed at a time, regardless of the number of channels in the seismograph (although the graphic at the top will show all of the active channels). To view a different segment of the geophone spread, simply **TAB** or use the **Arrow** keys to move to the right (or if using a mouse, use the scroll bar). You will see the channel numbers change accordingly.

You can enter values into the Shot, Interval, and Geophone coordinate fields. A new value is 'accepted' in each of these fields by right-clicking on another field or by pressing the **TAB**, **Arrow** key or **ENTER** key. Special care should be exercised when entering data in the Shot coordinate box because accidentally pressing the right or left **Arrow** keys will increment or decrement the shot coordinate itself, probably to an unwanted value (see below). If you make a mistake typing an entry in any box, you can simply move to another category and return to the box that you wish to revise. The entire number will be highlighted, indicating that it will be replaced with the new value that you type in.

You will notice that as you move from line to line, instructions will be displayed at the bottom of the dialog box.

If you know the location of your shot, you may enter it in the Shot Coordinate field:

You should see the following in the bottom of the dialog box:



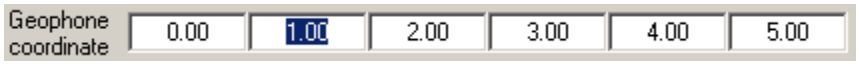
The accompanying graphic will show the shot relative to the geophones. As mentioned above, the shot point location can also be set by positioning the cursor over the Shot coordinate field and using the left and right **Arrow** keys. The shot shown in the graphic will be moved in increments equal to the geophone interval (Page 30). This is most useful when updating the shot location after having completed a shot. For instance, in a refraction survey, you may know you physically moved the shot to be between geophones 5 and 6, but you may not know the actual coordinates of that position. Use the **Arrow** keys to move the shot as close to that position as possible, and then fine-tune it based on the positions shown for the relevant geophones.

When you first define a survey, the interval between geophones (or groups of geophones) is set to whatever number was entered in the Geophone Interval dialog box discussed on Page 30. However, in this dialog box you have the flexibility to edit *individual* group intervals – this need not be constant throughout the spread. Highlight one of the Interval fields:

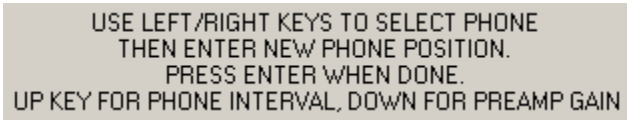
You should see the following in the bottom of the dialog box:

Type in the desired geophone interval.

Physical coordinates can be assigned to each channel. To do so, highlight one of the Geophone coordinate fields:



You should see the following in the bottom of the dialog box:



You will notice that as, you enter new geophone coordinates, the coordinates of the other geophones will be recalculated using the geophone interval in the line above. This allows rapid repositioning of the line by updating just one geophone position, rather than having to type a new location at every geophone location.

Note: *If using a variable geophone interval, it is best to enter the intervals first, before entering the coordinates. Coordinates are subservient to the intervals and are updated automatically when a geophone interval is changed. Always double-check the geophone coordinates when you change a geophone interval.*

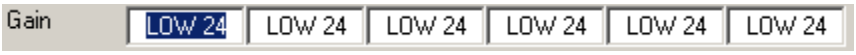
The seismograph has analog preamp gains that can be set to adjust the amplification of the signal being digitized. Generally, you should try to set the gains has high as possible without saturating the digitizing circuitry, causing distortion or "clipping". Clipping is not an issue in refraction or downhole surveys in which only the first breaks are of interest, but it must be avoided in reflection, MASW, and any other surveys where the full waveform is important.

Channels can be set to either "high" or "low" gain. The standard high gain setting is 36 dB; the standard low gain setting is 24 dB. However, other gain combinations are available, depending on jumper settings on the acquisition boards. One option is 12/24 dB, and another is 0 dB only. Please contact the factory if you have a need for non-standard gain settings.

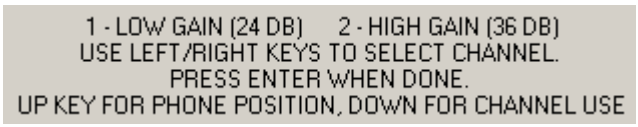
Gains should be configured to best fit the situation. For instance, if you are conducting a refraction survey, you can set all of the gains to "high". If you are doing reflection, you might set some sort of tapered gain, with those channels closest to the source being set lower than those farther out. Some testing prior to beginning the survey is recommended.

Note: *The electronic clipping discussed above is different from display clipping, which can be enabled in the* Display >> Trace Style *menu (Page 74). Display clipping is simply a convenient method for displaying the data and does not affect the value of the data.*

To set gains, highlight one of the gain fields:



You should see the following in the bottom of the dialog box:



Press the **1** key for low gain, and the **2** key for high gain. If the Ripple box is checked, that channel and all of the channels to the right of it will be set to the new gain. If not, only the gain of that particular channel will be changed.

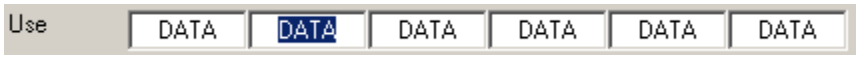
Channels can be designated as DATA, AUX, or INACTIVE.

Typically, most if not all channels set as DATA channels, and this is the default. They have coordinates, are affected by roll commands (see Page 100), and can be stacked.

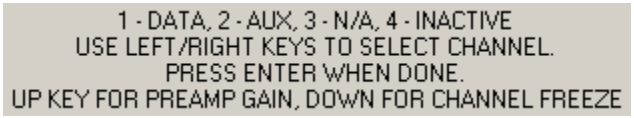
AUX channels are used for recording ancillary data during a survey. This may include shot timing, uphole data, vibrator information or any other time series. Auxiliary channels do not have an associated position, are unaffected by the rolling process, and are not stacked.

INACTIVE channels do not collect data. Inactive channels can have coordinates, and can be activated by the rolling process.

To change a channel setting, highlight one of the USE fields:



You should see the following in the bottom of the dialog box:



Press **1** for DATA, **2** for AUX, and **4** for INACTIVE. As when setting gains, DATA and INACTIVE will fill in to the right if Ripple is checked. AUX channels must be set one at a time.

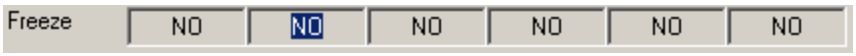
***Note**: There is another channel designation called "pilot", but it is not set here (see Pages 50, 91).*

***Note:** Channels can also be enabled and disabled from the Geometry GUI. See Page 153.*

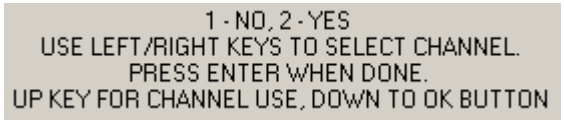
The "freeze" function stops data collection on a channel, and protects any data on the channel that is frozen. This feature is useful in refraction surveys once the first break is clearly identifiable on channels near the shot, but additional stacks are required on far offsets. For instance, let's say you are doing a 24-channel refraction spread. After six stacks, the first breaks on channels 1-20 look really good, but channels 21-24 need more work. To avoid the risk of ruining the good first breaks in an attempt to improve the last four channels, you can freeze the first 20. Once frozen, the data cannot be cleared and subsequent shots will not be stacked to these channels. You are free to continue to work on channels 21-24 without risking the data on 1-20. You can even clear the data (Page 93) on channels 21-24, without affecting channels 1-20.

***Note:** If you clear the data, the frozen channels will appear to have been cleared along with the unfrozen ones. However, that is not the case, and the protected data will reappear on the frozen channels with the next trigger.*

To freeze or unfreeze a channel, highlight one of the Freeze fields:



You should see the following in the bottom of the dialog box:



Press 1 to unfreeze and 2 to freeze. Frozen channels will be highlighted in the Shot Window:

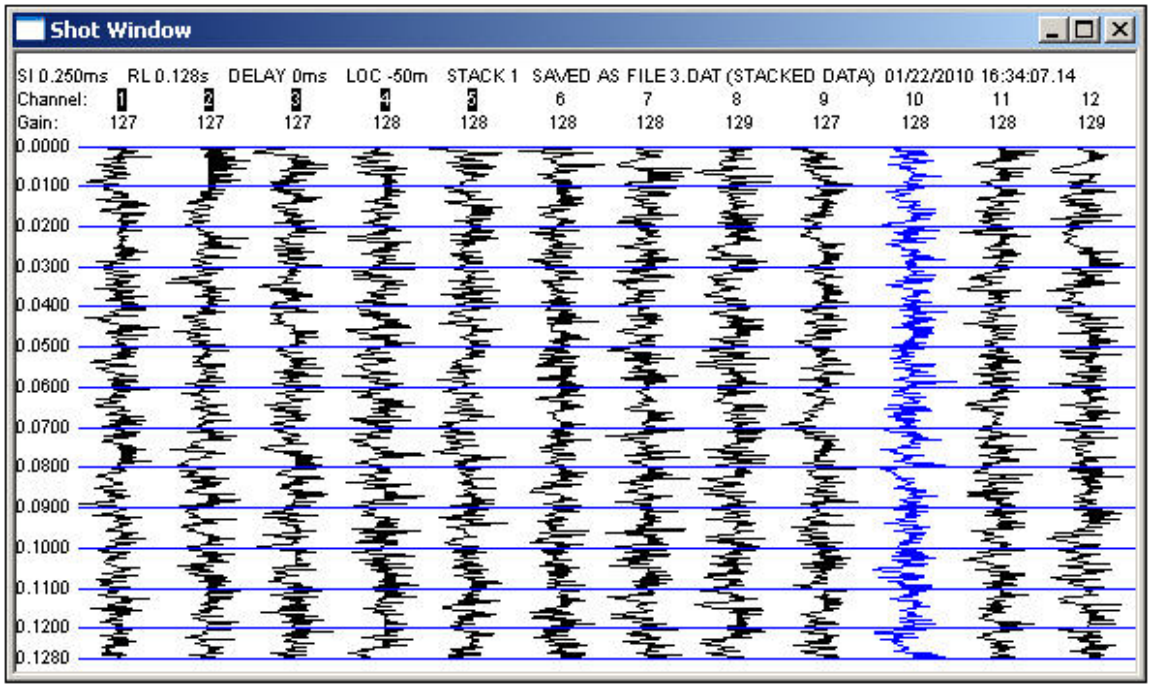
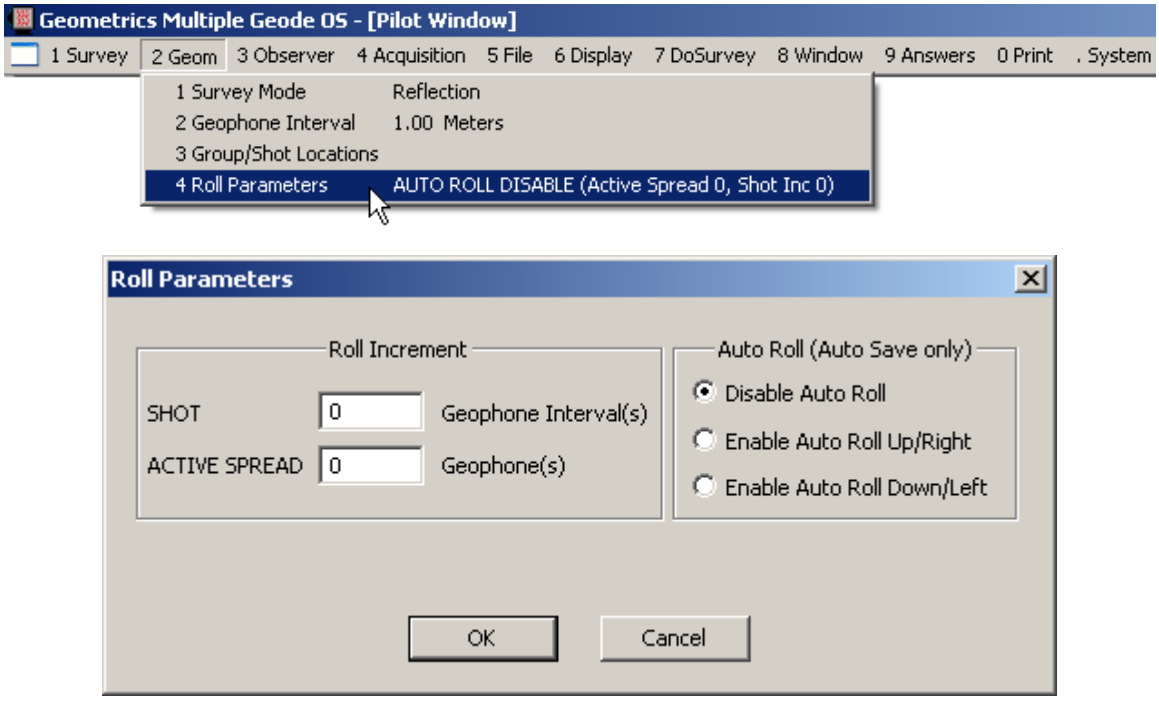


Figure 18: Shot record showing channels 1-5 frozen.

Note: *Freeze does not apply when in the Replace stacking mode (Page 56).*

2.2.4 ROLL PARAMETERS (MGOS, NZOS)



When conducting a CDP reflection survey, the active portion of the geophone spread typically moves in step with the source -- the offset between the source and the active spread generally remains constant. This requires that you have more geophones on the ground, and more channels, than you are recording on at any one time. For instance, you may "roll" 24 live channels through a spread of 48 geophones. In the past, this was accomplished via a mechanical roll switch, connected between the seismograph and the geophone cables, which controlled which geophones were electrically connected to the seismograph for each shot point. As the source was moved, the roll switch moved the active spread with it. All of the available channels could be recorded on for each shot.

With the StrataVisor and Geode, this operation is accomplished electronically through software, and requires that you record each shot on a subset of the total number of channels available. For instance, if you wish to roll 24 channels through 48 ground stations, you need a 48-channel system. Rolling is accomplished by rolling the *actively recording subset* of channels through the total channels available in the system. With each move of the source, the leading channel (or channels, depending on the shot increment) is disabled, and the trailing channel(s) is enabled. For instance, the first shot will be recorded on channels 1 through 24. Channels 25 through 48 will be inactive. If the shot and active spread increments are set to 1, and you then roll "up" (right), then for the next shot, channel 1 will be disabled, channel 25 will be enabled, and you will record on channels 2 through 25. Channel 1, along with 26 through 48, will be inactive. The third shot will be recorded on channels 3 through 26 and so on. When you "roll off" a Geode, you may then "leapfrog" that Geode and its geophones to the far end of the spread and continue indefinitely.

Note: *Before unplugging a Geode to move it to the far end of the line, you must shut down the software. After the Geode is connected to the far end of the line, start up the software and update the survey geometry before continuing.*

The rolling increments are set in terms of geophone intervals. A shot roll increment of 1 means that the shot position will move the distance of one geophone interval after each shot. An active spread roll increment of 1 means that one channel will be disabled at one end of the active spread, and another will be enabled at the other end. The direction of the roll depends on whether you roll up/right or down/left.

Note: *The roll increment should always be zero or a positive number.*

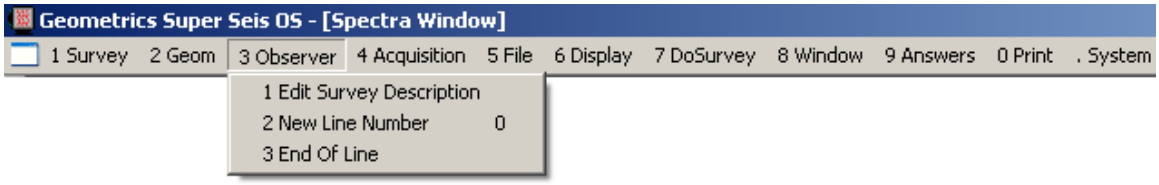
Rolling can be done manually or automatically upon saving. It will be done automatically if you click one of the Auto Roll radio buttons shown in the menu above. If you wish to roll manually, be sure Auto Roll is disabled, and press **CTRL-END** to roll up/right or **CTRL-HOME** to roll down/left (see the DoSurvey menu, Page 92).

Note: *Whatever the mechanism of rolling, whether automatic or manual, the source and spread will move according to the roll increments you have set. If the roll increments are set to zero, nothing will happen if you try to roll.*

Note: *Auto rolling only applies if* Auto Save *is enabled (Page 66). If you are saving data manually, you must also roll manually.*

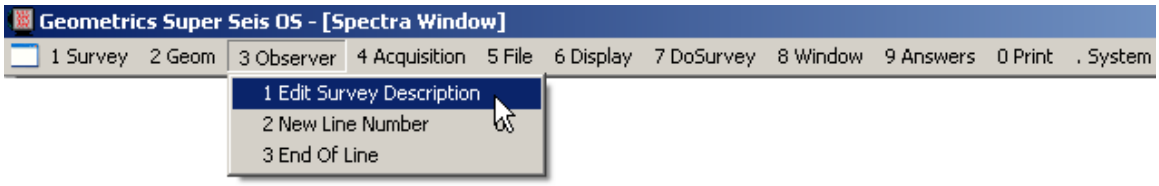
As mentioned above, in most CDP surveys, the roll increment and the shot increment are identical to each other – the source and active spread move in lock-step. However, this is not always the case. In some situations, you may roll only the source. An example of this would be when you are rolling on to the end of split-spread survey geometry. In that case, only the source would move until it is in the center of the active spread, and then the spread would move with the shot from there. This requires setting the spread roll increment to zero initially, and then changing it to match the source roll increment when the source reaches the center of the spread. Also, you might wish to shoot through an active spread, in which case the spread would never move. Static spreads are most common in refraction. See **Error! Reference source not found.** for some examples of rolling.

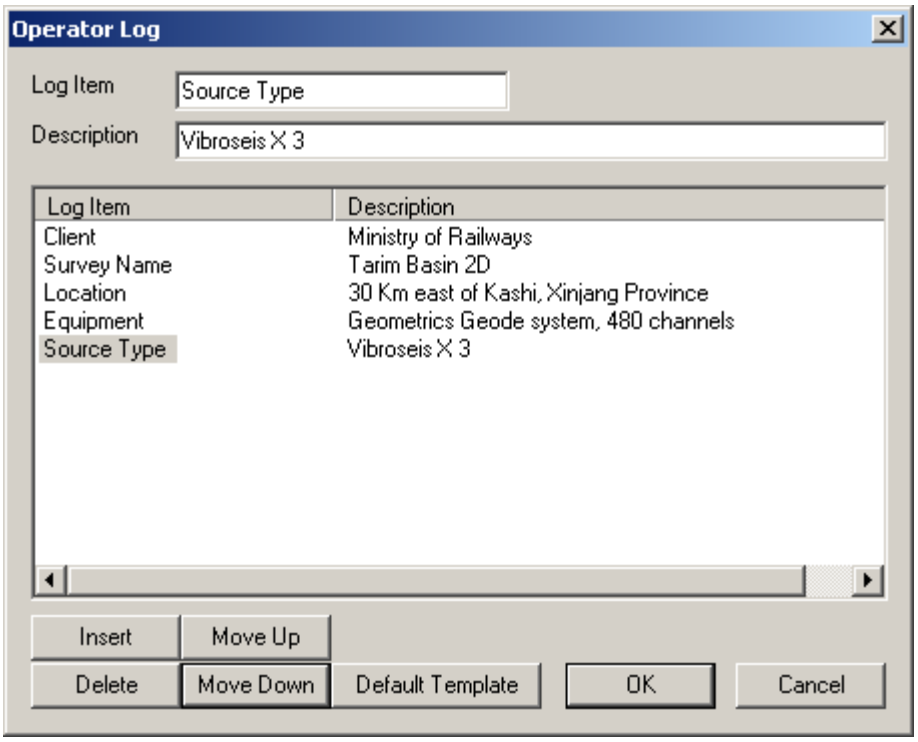
2.3 OBSERVER MENU



The Observer menu allows you to enter basic information about the survey: who the client is, the job #, site name, etc. This is also where you update the line number if you start a new "line" within a survey.

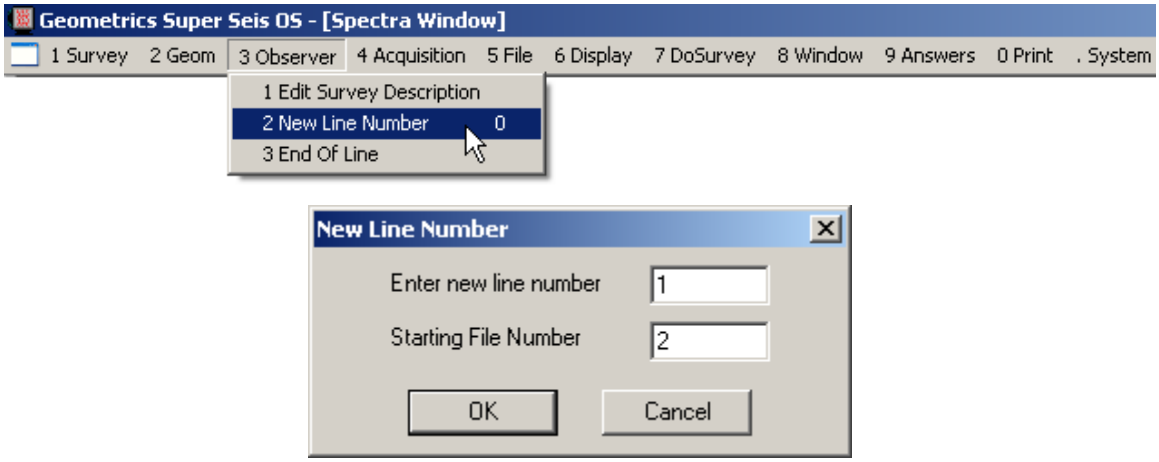
2.3.1 EDIT SURVEY DESCRIPTION





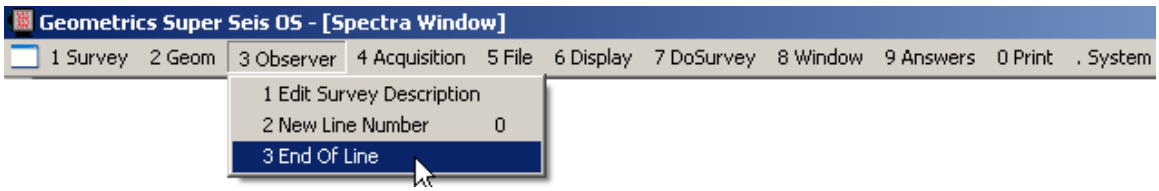
Use the Edit Survey Description utility to input job-specific information. This is completely customizable, and there is no limit to the amount of information you may enter here. You will likely create your own company template, which will be automatically remembered from session to session. The information entered here will be located at the beginning of the Survey Log (see Page 14). Obviously, if you are using a StrataVisor NZ or SmartSeis ST, you need an external keyboard to take full advantage of this feature.

2.3.2 NEW LINE NUMBER

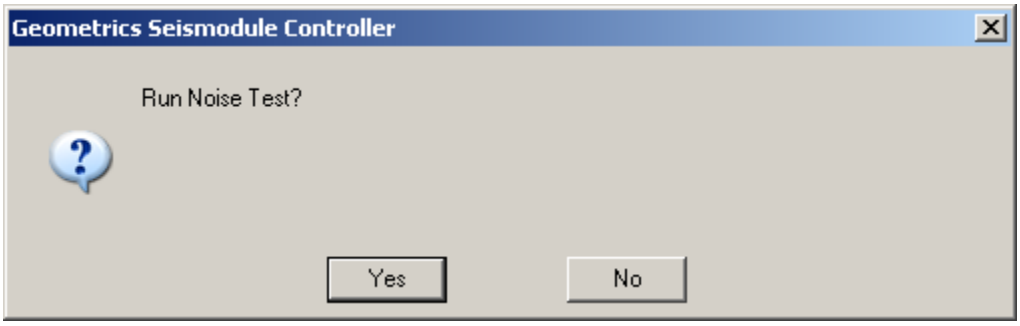


Depending how you conduct your survey and do your bookkeeping, you may prefer to break your survey out in terms of "lines". For instance, you may open a survey, and that survey may consist of several refraction lines. They may be end-to-end, side-by-side, or neither. How you define the terms "survey" and "line" is entirely up to you. A survey may consist of one line or a group of lines. A line may consist of one or several end-to-end geophone spreads. In any case, changing the line number in the middle of the survey simply updates the Survey Log. The data itself is not affected. If you elect to change the line number, you will also be given the opportunity to update the file number if you wish (also see Page 65). However, changing the line number does not affect your data storage parameters -- the data will still go to the same directory or folder. Consequently, if you update the file name within the same survey, you must take care to provide a unique file name, or change the destination folder. The software will not allow existing files to be overwritten -- you will be warned in this eventuality, and a letter of the alphabet will be added to the end of any duplicate file number.

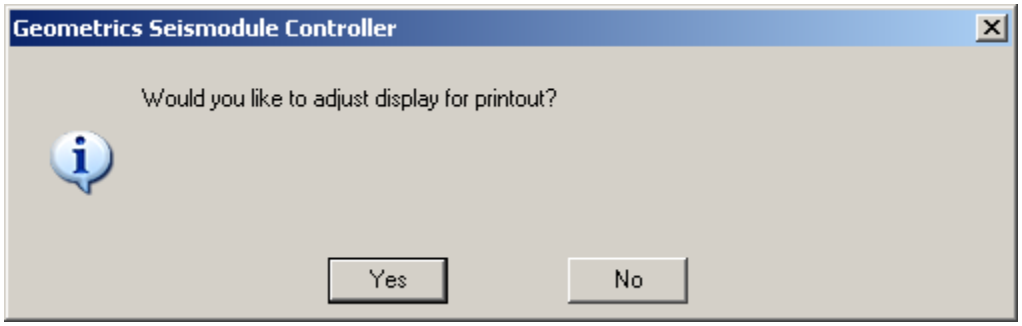
2.3.3 END OF LINE (MMGOS, MNZOS)



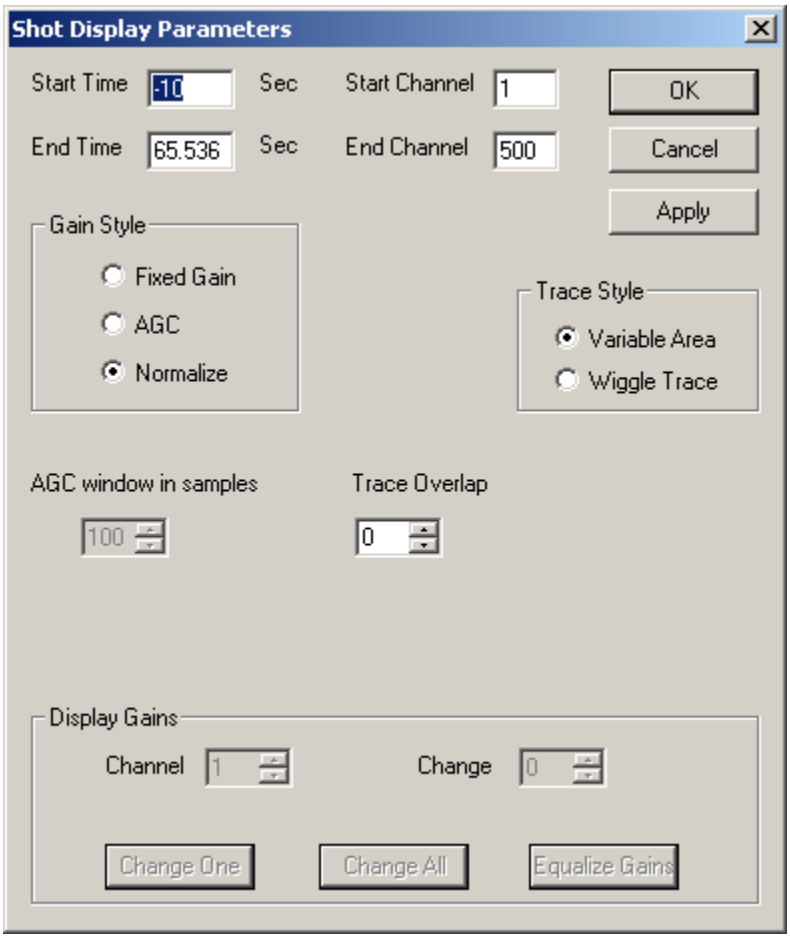
Selecting End of Line will prompt you for a noise test:



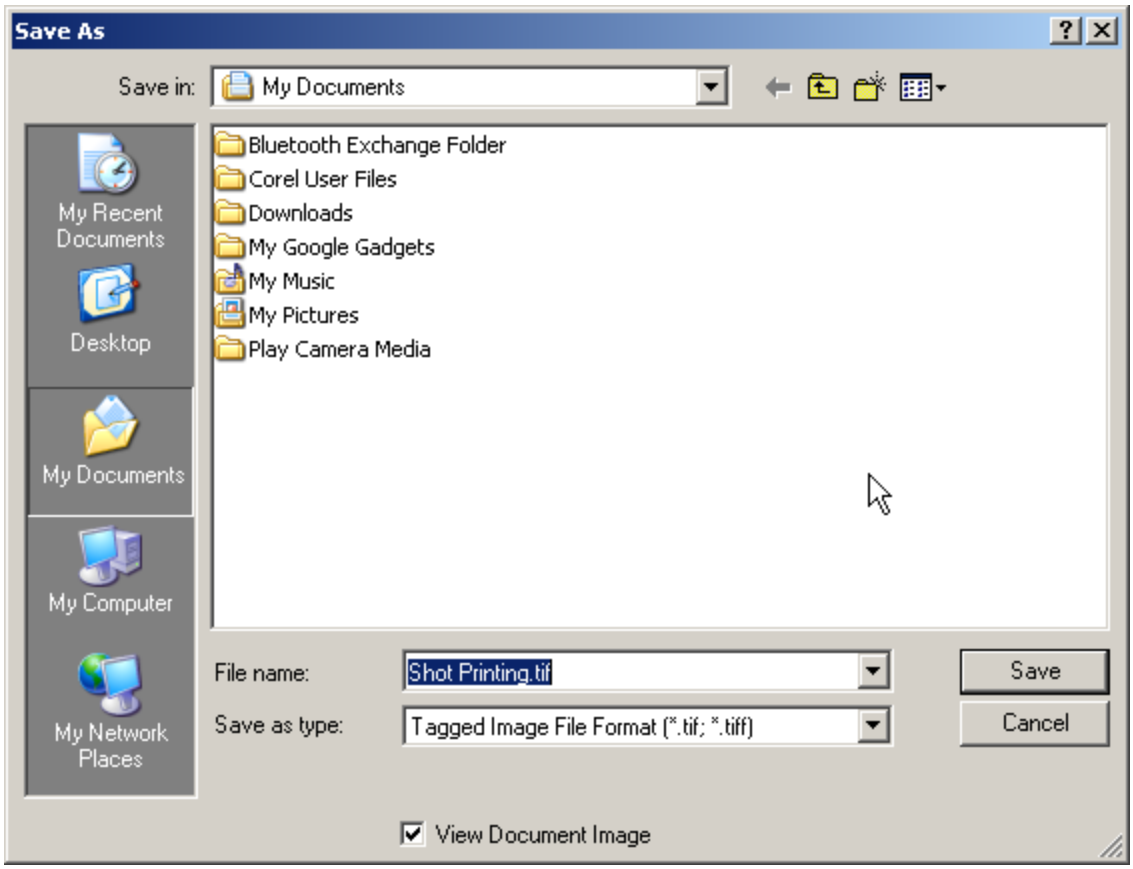
Either answer will cause the Line Number to be incremented by 1. Pressing **Yes** will also cause the seismograph to trigger itself and take a record. Next you will be prompted to adjust the display settings for printing.



Pressing **Yes** will display the Shot Display Parameters dialog box, discussed on Page 71:



Once you have optimized the noise record, press **OK**. If a printer is attached, you will be presented with a standard Windows™ print dialog. Otherwise you will be prompted to supply a TIF file name:



A noise analysis will be written to the Survey Log, showing the rms amplitude for each channel:

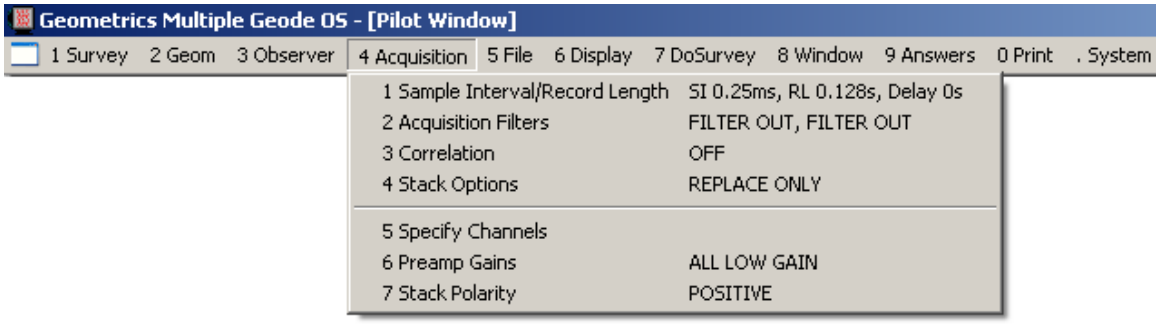
File 6 (Stack 1, Shot Loc: 0 Meters) 16:47:03.75 01/22/2010 126 KBytes SAVED
Noise Test (File Number: 6)
Survey: SCS_Survey
Line Number: 0
Date: 01/22/2010
Time: 16:47:03.75

Channel	1	2	3	4	5	6
Preamp (dB)	24	24	24	24	24	24
Noise (uBar)	0.07	0.08	0.07	0.07	0.07	0.07
	7	8	9	10	11	12
	24	24	24	24	24	24
	0.07	0.08	0.07	0.07	0.07	0.07
	13	14	15	16	17	18
	24	24	24	24	24	24
	0.07	0.06	0.06	0.07	0.07	0.07
	19	20	21	22	23	24
	24	24	24	24	24	24
	0.08	0.07	0.07	0.07	0.07	0.07
	25	26	27	28	29	30
	24	24	24	24	24	24
	0.07	0.07	0.08	0.07	0.07	0.07
	31	32	33	34	35	36
	24	24	24	24	24	24
	0.07	0.07	0.07	0.07	0.07	0.14
	37	38	39	40	41	42
	24	24	24	24	24	24
	0.22	0.07	0.07	0.07	0.07	0.08
	43	44	45	46	47	48
	24	24	24	24	24	24
	0.07	0.07	0.07	0.07	0.07	0.08

Average Noise RMS: 0.08 uBar

Figure 19: Example noise test summary.

2.4 ACQUISITION MENU

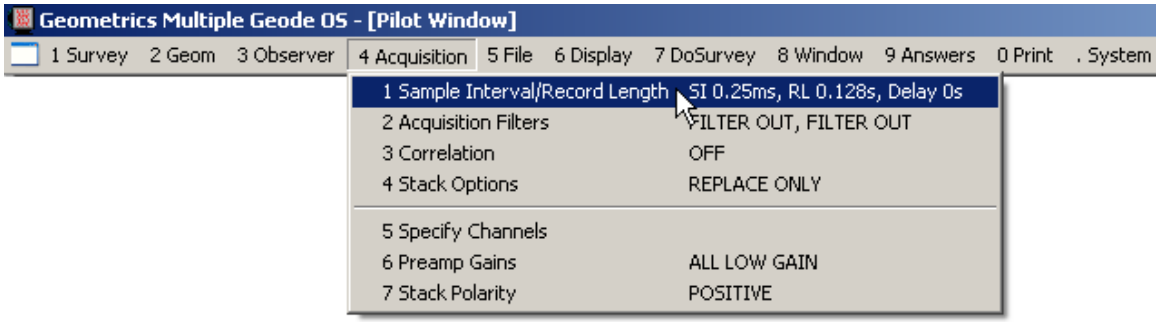


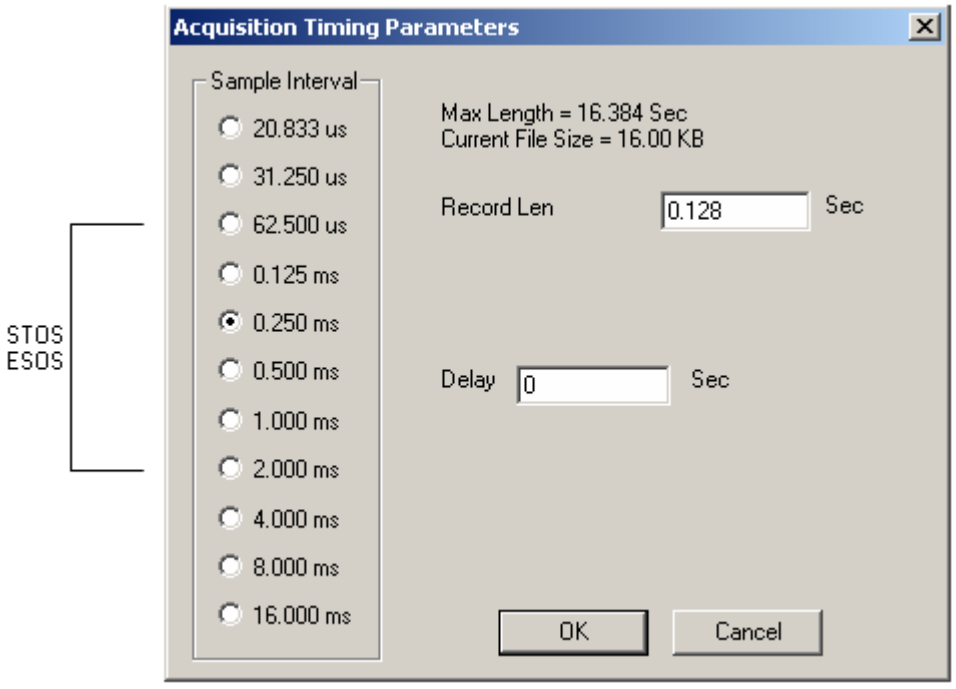
This menu contains the acquisition parameters -- those variables which affect how the data is acquired.

If newly acquired data is in the memory, the system will not allow you to change most of these parameters until you erase the data from memory, because stacking records with different acquisition parameters is illogical. For example, there is no logic in changing the sample rate between stacks. Attempting to change these parameters without clearing memory will result in a prompt to either save the data first or clear the memory.

Note: *Acquisition parameters are permanent in their effect on the data (unlike display parameters). You cannot change the sample interval, record length, or filters once the data is in memory or saved on disk.*

2.4.1 SAMPLE INTERVAL/RECORD LENGTH





The output of a geophone is continuous. When this continuous (or analog) signal enters the seismograph, it is digitized at even intervals and the resultant numbers are stored in memory. The "sample interval" is the time interval between data samples.

The sample interval is selected to match the scale and type of the survey. For instance, smaller sample intervals (faster sample rates) should be used for short surveys in hard (seismically-fast) materials. Large sample intervals are generally used for long refraction surveys and reflection surveys where events of interest arrive late in time.

Note: *The ES-3000 and SmartSeis ST are limited to a range of 62 µsec to 2ms.*

The "record length" is the length of the final record in seconds. This is the amount of time the system listens and records after each shot. In general, the longer the spread, the longer the required record length.

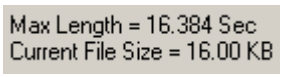
There is a limit to the number of samples per each seismic trace, depending on your system. These limits are summarized below:

Model	**Samples/trace (standard)**	**Samples/trace (optional)**
StrataVisor NZ	16384	32768, 65536
SmartSeis ST	4096	32768, 65536
Geode	16384	32768, 65536

ES-3000	4096	16384, 32768, 65536

Table 4: Standard and optional trace lengths for various seismograph models.

There is interplay between record length (in units of time) and sample interval. For a fixed record length, the smaller the sample interval, the greater the number of samples per trace. Conversely, for a given sample interval, the longer the record length, the greater the number of samples per trace. The maximum-allowable record length for a given sample interval will be dynamically displayed above the Record Len entry box (see above):



It is good practice to record only as long and/or sample only as fast as necessary to accomplish the goals of the survey. Large data files can be cumbersome to work with, so you should generally take care to keep them as small as possible. The appropriate parameters depend on the type and goal of the survey. Contact the factory if you need guidance.

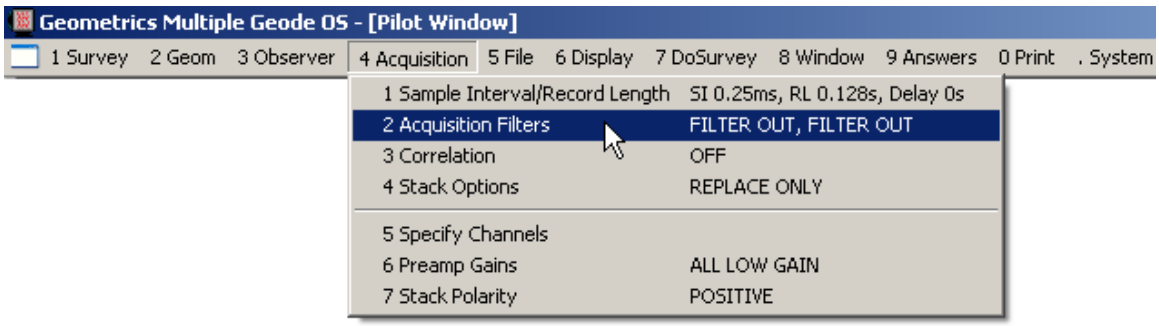
Rule of thumb: *For most hammer and plate refraction work, a total trace length of 2000 samples will work fine. First choose a record length (in seconds) that will suit your maximum shot-geophone offset. 0.2 seconds is a good place to start for a 200-ft (60m) spread. Once you have chosen a suitable record length, the sample interval that gets you closest to 2000 samples/trace will usually suffice. To determine the number of samples per trace, divide the sample interval into the total record length.*

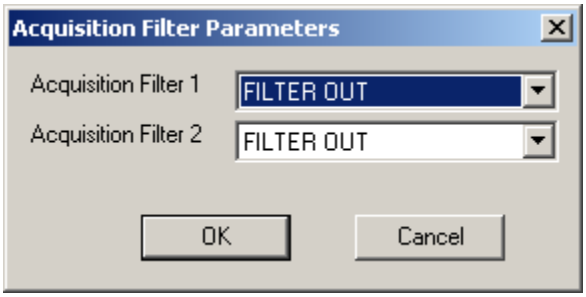
Delay can be used to postpone the start of the seismic record from the time the system receives a trigger signal. For some applications, the early portion of the record will not contain usable information. Typical of these are borehole surveys, where all the geophones may be located some distance from the shot, refraction surveys where there is a large offset from the first geophone, and marine surveys in deep water. Use of the delay allows the use of less memory and/or a faster sampling rate in these cases.

Delay can also be used to control the amount of data acquired *prior* to the shot, or "pre-trigger" data. This can be useful, especially with short shot-geophone offsets.

Just enter a negative number to record pre-trigger data. The timing information in the shot record automatically incorporates any delay used – the time grid will be annotated accordingly. You do not have to make corrections to the travel times when using a positive or negative delay.

2.4.2 ACQUISITION FILTERS

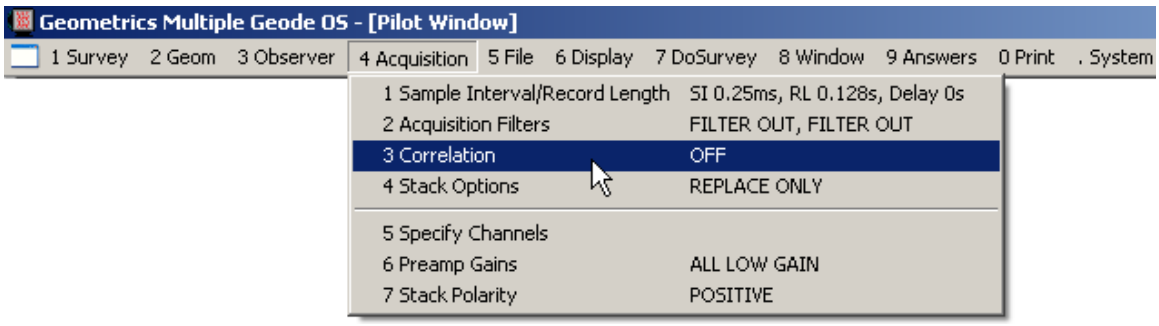




Acquisition Filters are digital filters that result in the data being saved in a filtered state. As such, **these filters are irreversible**. If you use them, use them carefully. Choose a filter from the drop-down menu; you may choose from a variety of low cut, high cut, and notch filters. All are standard Butterworth filters with a 24 dB/octave roll-off. You may enable two filters at once; to create a band pass filter, you can set a low cut and a high cut. Setting the same filter twice has a cascade effect – the roll-off is doubled to 48 dB/octave.

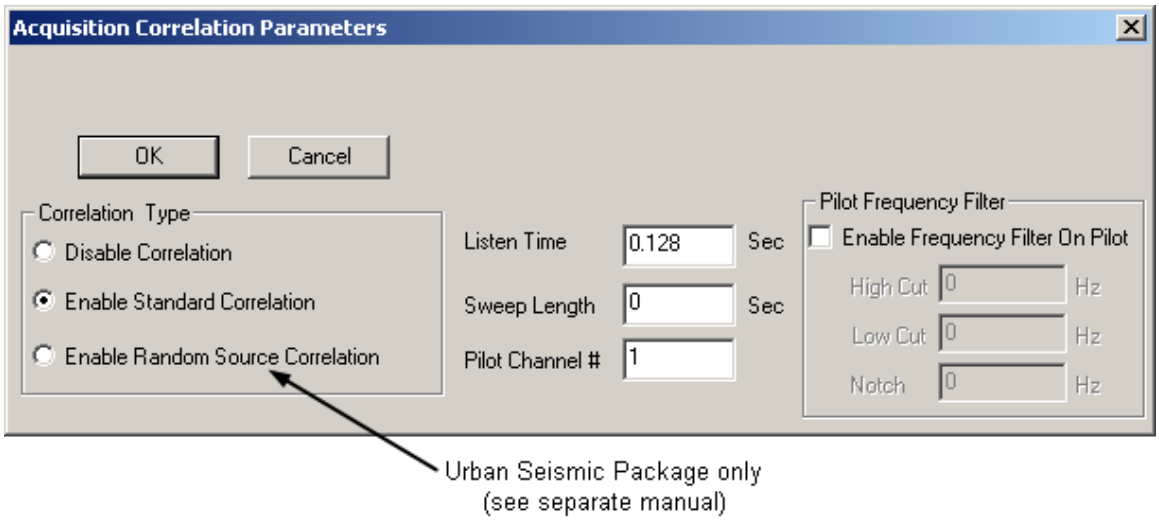
If you use filters, it is recommended that you use display filters (see Page 78). These affect the displayed data only.

2.4.3 CORRELATION (MGOS, NZOS)



Correlation provides access to the correlation options. Correlation is used if you are recording data generated with a swept or pseudo-random seismic source like a Wacker ("mini-Sosie", see separate manual at ftp://geom.geometrics.com/seismic/Misc/mini-sosie/). Correlation should be disabled if you are using an impulsive source like a hammer, weight drop, or explosives.

If Enable Standard Correlation is selected, you will see the following dialog box:



The Listen Time is the length of the final record. The Sweep Length is the time duration of the source, typically a vibrator. The Pilot Channel # is the channel the input sweep is connected to, and this is correlated against the raw data to produce a correlated record. You must assign a pilot channel if standard correlation is enabled.

Note: *Even if correlation is disabled, you may still set a pilot channel. This is necessary if you wish to use the* Display Correlation *option, which allows you to display correlated data while saving raw, uncorrelated data (see Page 79; also see Appendix* ***Error! Reference source not found.****).*

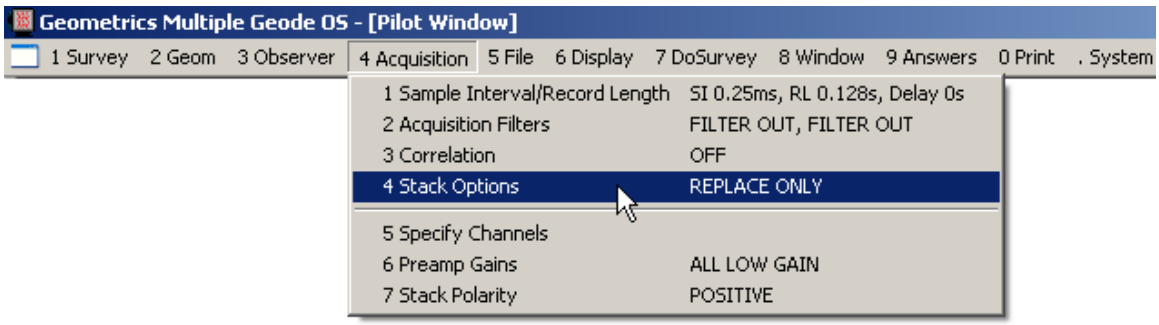
Note: *If you are not recording a pilot,* Pilot Channel # *should be set to -1.*

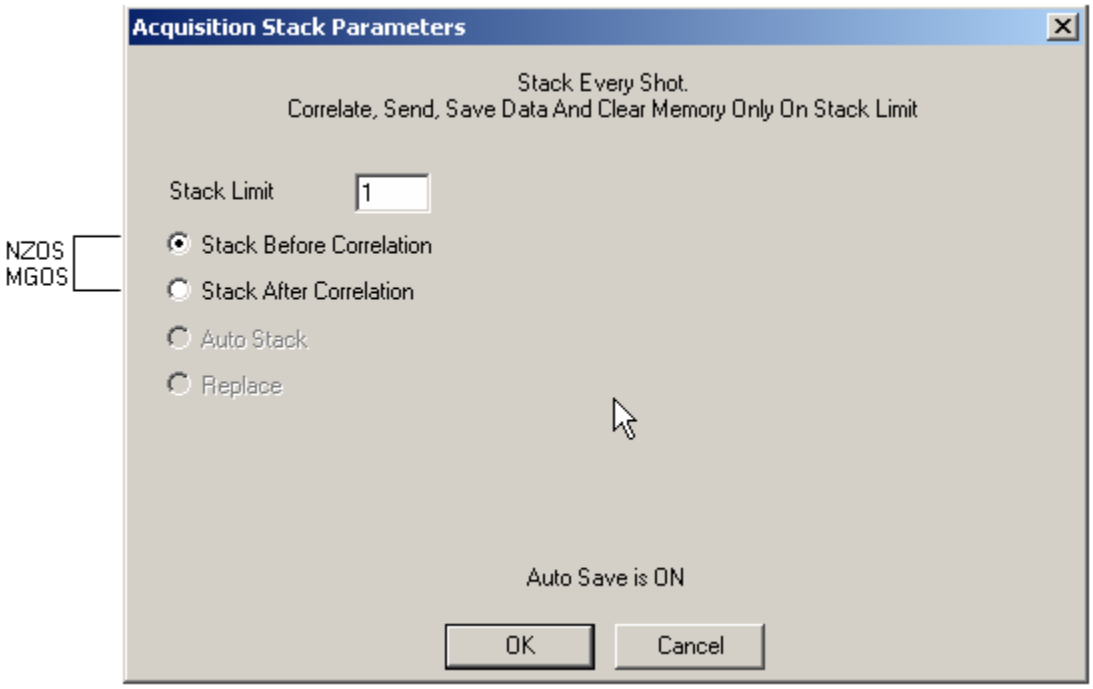
Note: *The term "standard correlation" is used here to differentiate between this and correlation for pseudo-random sources, such as mini-Sosie. If you have purchased the pseudo-random source software, there will be an additional correlation option in the above dialog box and operation is discussed in a separate manual, which can be found here: ftp://geom.geometrics.com/seismic/Misc/mini-sosie/.*

You may also, if you wish, apply a filter to the pilot signal prior to correlation. This is not generally used with a vibrator, being more appropriate for use with a pseudo-random source. If you wish to filter the pilot, click the Enable Frequency Filter on Pilot box and type in the desired corner frequencies.

Note: *If using a vibrator, filtering the pilot is not recommended.*

2.4.4 STACK OPTIONS (MGOS, NZOS, SGOS, STOS, ESOS)





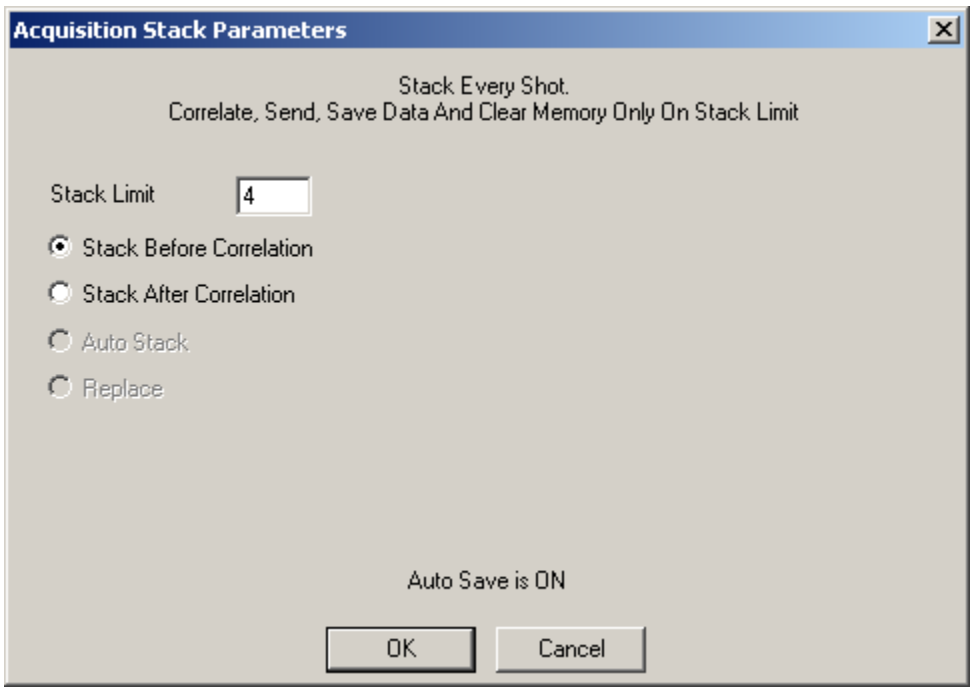
Stacking or summing the data is the process of adding data from successive shots to improve the signal-to-noise (S/N) ratio of the data. All Geometrics seismographs allow a virtually unlimited number of stacks, although for practical purposes, often only a few stacks are sufficient. Assuming the noise is random, stacking will improve the S/N ratio proportional to the square root of the number of stacks. A record comprised of four stacks will have twice the S/N ratio of a record comprised of a single stack.

SCS offers a variety of stacking options. The options are interdependent, and some are only available when certain others are enabled. In the following discussion, a "stack" is one of a series of shots (generally in the same location) that, when summed, make up the shot record.

There are four basic stack modes. Stack Before Correlation and Stack After Correlation only apply if correlation is enabled (Page 49). Auto Stack and Replace generally apply when using impulsive sources, or when using non-impulsive sources and recording raw, uncorrelated data.

The options available in this dialog depend on whether Auto Save is enabled or not; you should read Section 2.5.1, beginning on Page 65, before continuing. We will first consider the condition where Auto Save is enabled (which, in production reflection work, is the most common mode of operation).

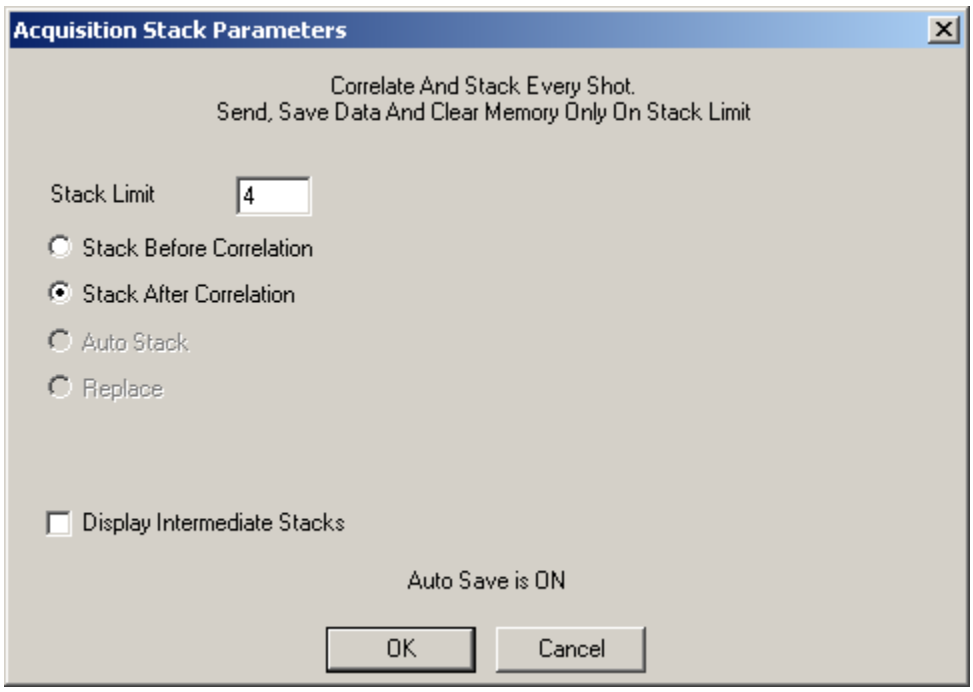
- Auto Save Enabled, Stack Before Correlation Mode Enabled



When recording correlated data, this option is the most efficient. Correlation is not done until the Stack Limit is reached, so the correlation process is only conducted once per shot point, regardless of the number of stacks. No data is sent to or displayed on the controller PC until the Stack Limit is reached. However, as confirmation that the stack was recorded, the stack count will be updated and displayed on the Status Bar (Page 19) and at the top of the Shot Window (Page 10). The individual stacks will also be recorded and displayed as events in the Log Window (Page 14). After the data are saved, there is no need to clear the shot record prior to taking the next shot; the current record will be replaced and the stack count will revert to 1 upon the next trigger. The pilot for the last stack in the sequence will be used for the correlation.

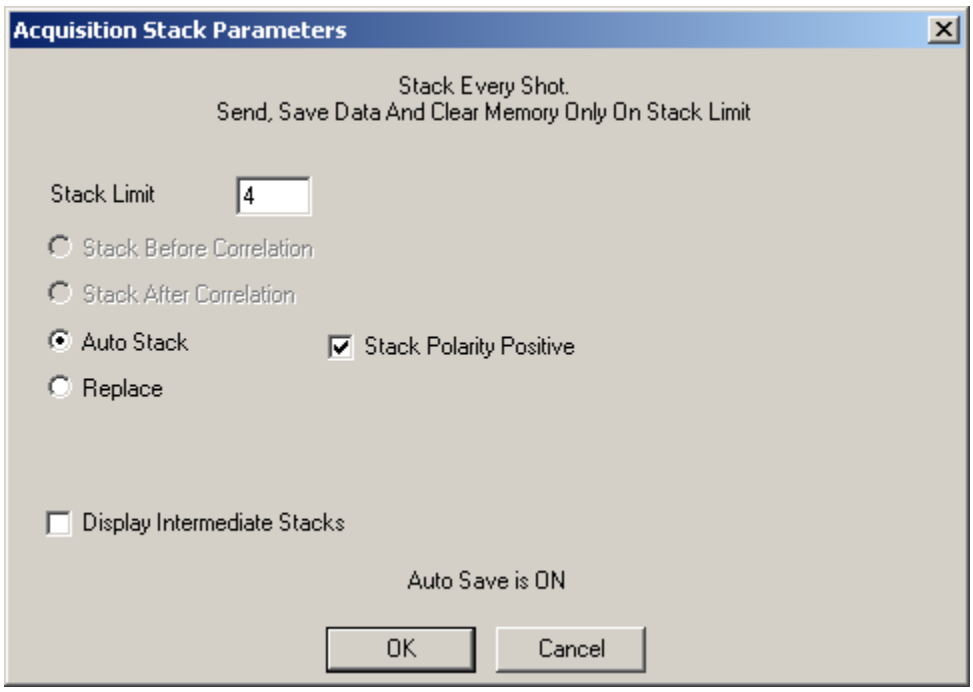
This mode assumes that the pilot signal does not change from sweep to sweep. If you are using a variable pilot (i.e., Varisweep™), you should stack *after* correlation (below).

- Auto Save Enabled, Stack After Correlation Mode Enabled



As mentioned above, this mode should be used when you are using a variable pilot. In this mode, each stack is correlated with its own, unique pilot prior to stacking. Instead of only a single correlation step at each shot point, there is one correlation for each stack. Since there are correlated data available after each stack, you have the option to Display Intermediate Stacks. Choosing to do so will slightly increase the time between stacks. As above, there is no need to clear the shot record after the data are saved; the current record will be replaced and the stack count will revert to 1 upon the next trigger.

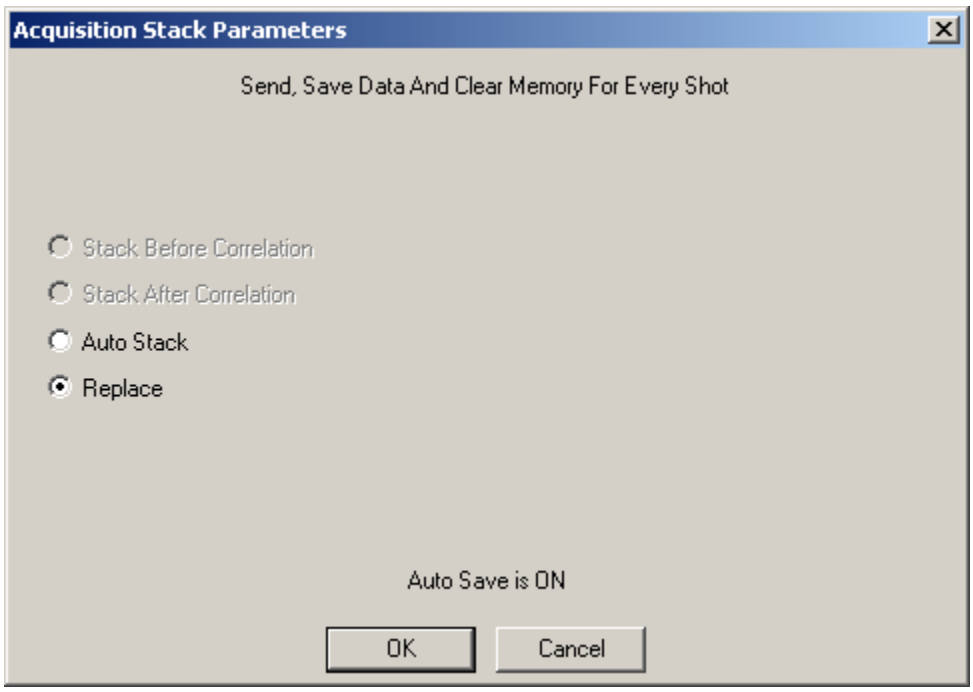
- Auto Save Enabled, Auto Stack Mode Enabled



This is the most common mode of operation when using impulsive sources such as explosives, accelerated weight drop, or hammer and plate. It is also used when using non-impulsive sources and recording raw, uncorrelated data. The individual stacks are automatically summed until the stack limit is reached. At that point, the data are saved automatically, and the system is ready for the next shot point. There is no need to clear the shot record after the data are saved; the current record will be replaced and the stack count will revert to 1 upon the next trigger. You may opt to view intermediate stacks; this may slow down production slightly.

An additional feature is the ability to change the polarity prior to stacking. This can be done at any time within the record. Unchecking the Stack Polarity Positive box will cause subsequent records to be flipped (multiplied by -1) prior to stacking (see Page 64).

- Auto Save Enabled, Replace Mode Enabled

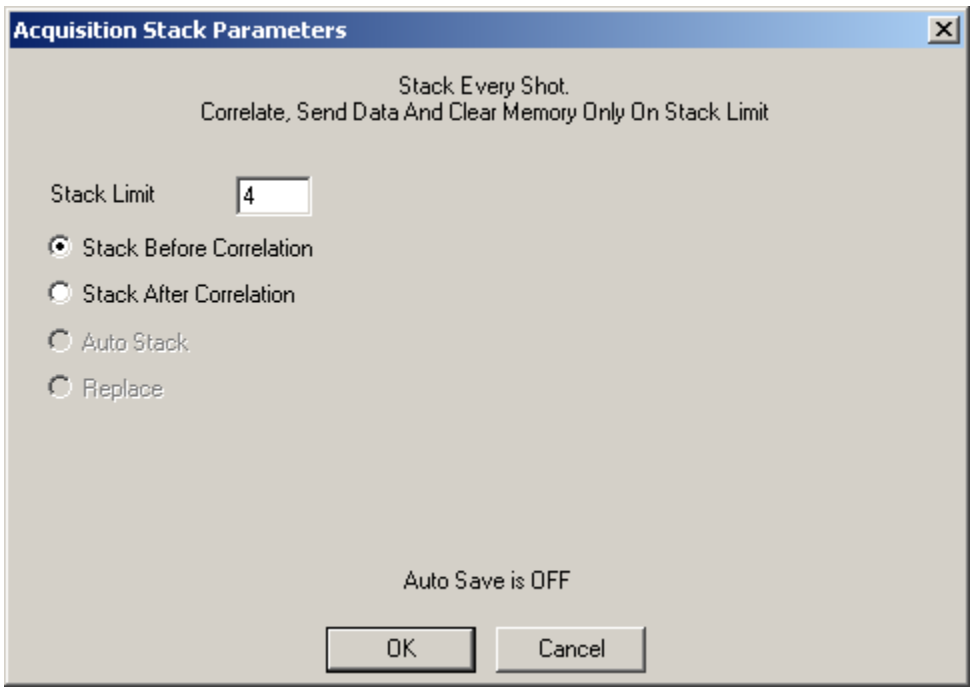


In Replace mode, stacking is essentially disabled; the stack count never exceeds 1. Each subsequent triggering of the system replaces the previous record. If the data are not saved, they will be lost when the system is triggered again.

Note: *When* Replace *mode is enabled along with* Auto Save*, the stack count does not apply – each individual stack will be saved automatically.* Replace *mode plus* Auto Save *is nearly identical to* Auto Stack *plus* Auto Save *and a* Stack Limit *of 1, but because of the way data are buffered in* Replace *mode, it is slightly faster. However, you must be in* Auto Stack *mode to freeze channels (see Page 99) or unstack (below).* Replace *mode is most often used in continuous recording applications (see Appendix* ***Error! Reference source not found.****).*

Following is a discussion of the various stack modes with Auto Save disabled.

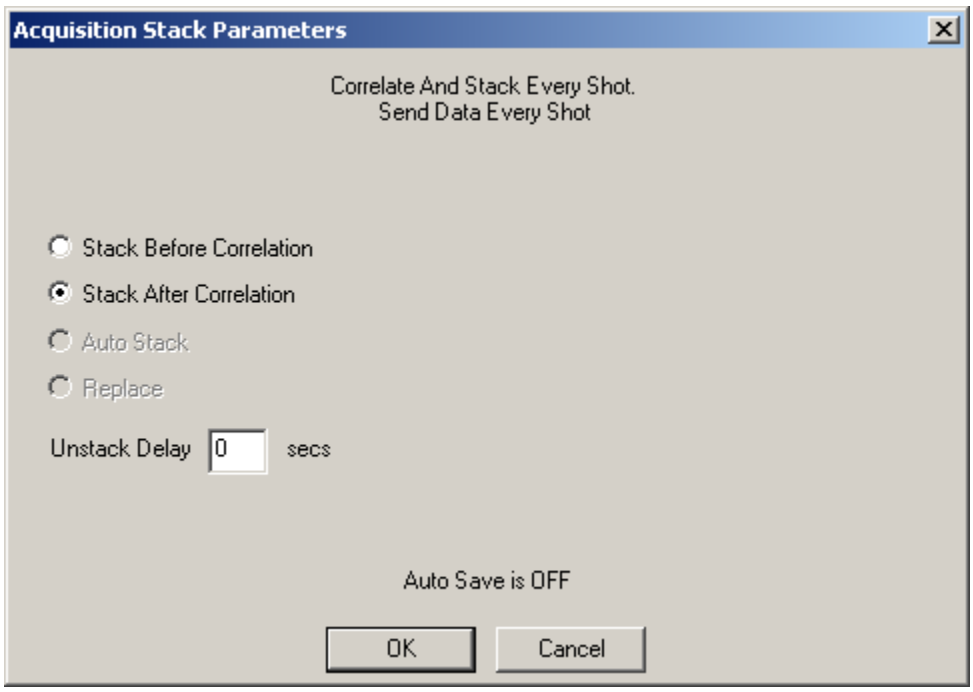
- Auto Save Disabled, Stack Before Correlation Mode Enabled



In this mode, note that even though Auto Save is disabled, the Stack Limit still applies, because SCS must know how many stacks to do before correlating the data. The pilot for the last stack in the sequence will be used for the correlation.

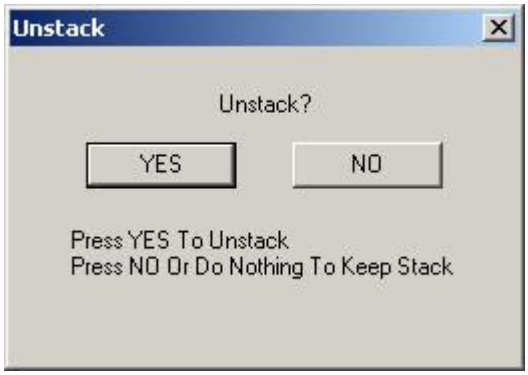
If you wish to save the correlated record, you must do so manually (Page 97). If you do not, it will be overwritten by the next record. There is no need to clear the data between records in this mode; the first stack of the next record will automatically replace the correlated version of the previous, and the stack count will automatically revert to 1.

- Auto Save Disabled, Stack After Correlation Mode Enabled



In this mode, every stack is automatically correlated and stacked. There is essentially no limit to the number of stacks you can do. No data are saved until you do so manually (Page 97). When you do save the data, the stack count does not automatically revert to 1 – subsequent records will continue to be correlated and stacked to the previous data. In this manner, you can save several records having different stack counts for the same shot point. If, after saving, you wish to restart fresh, with a stack count of 1 (you have moved to the next shot, for example), *you must clear the data manually* (Page 93).

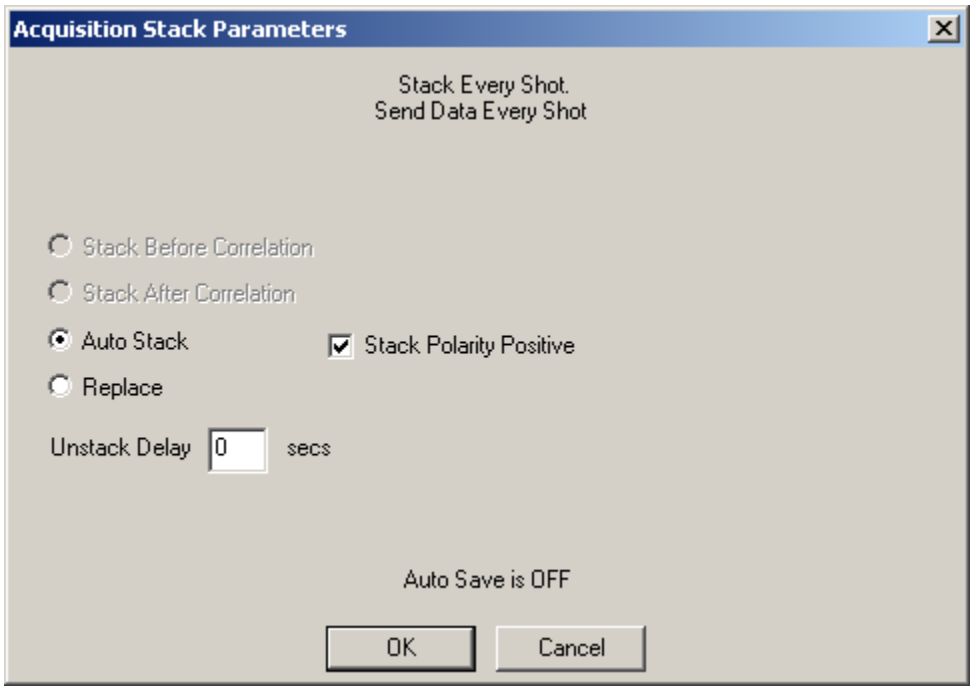
You may do selective stacking by entering a positive, non-zero number in the Unstack Delay field. Doing so will cause the following to be displayed after each shot:



You will have *n* seconds to decide whether you want to unstack the most recent stack or not, where *n* = the Unstack Delay. If you do, the stack count will be reduced by one. You may choose **NO** at any time; after *n* seconds, **NO** is chosen for you and the data cannot be unstacked.

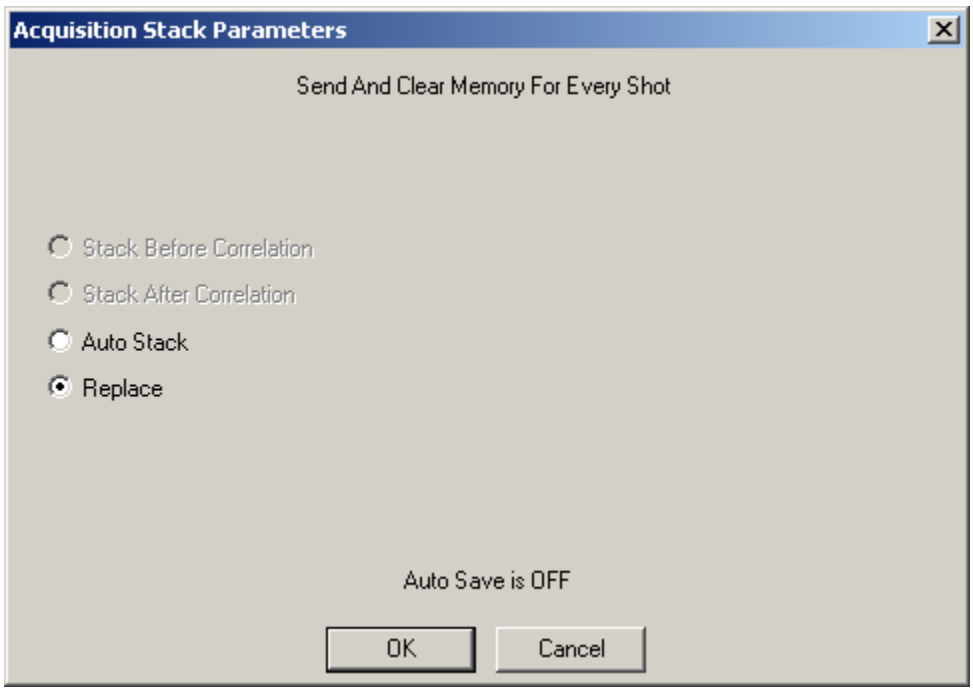
Note: *When* Unstack Delay *is enabled, the data shown in the Shot Window is the stacked data – it is not just the most recent, individual stack.*

- Auto Save Disabled, Auto Stack Mode Enabled



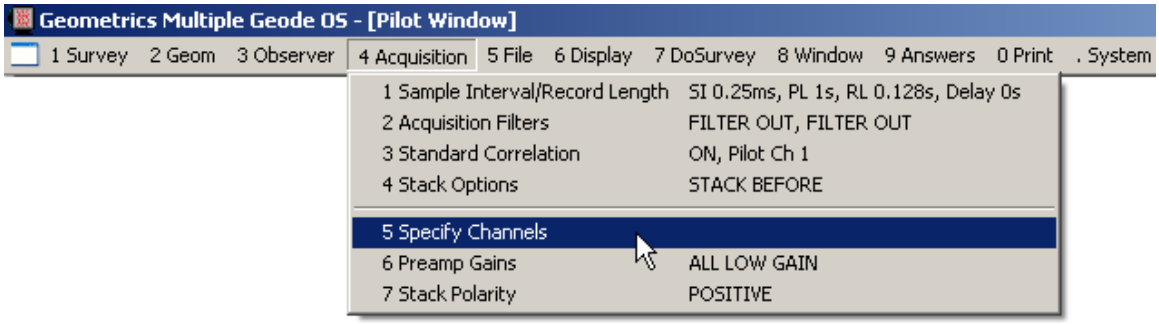
This is the most common mode when doing hammer-and-plate refraction work. It works exactly as that described immediately above, but without the correlation step. Each record is automatically stacked to the previous, you may manually save at any time, and you must clear the data (Page 93) in order to set the stack count back to 1. Selective stacking is enabled by setting a non-zero Unstack Delay as described above. Stack polarity was discussed on Page 55.

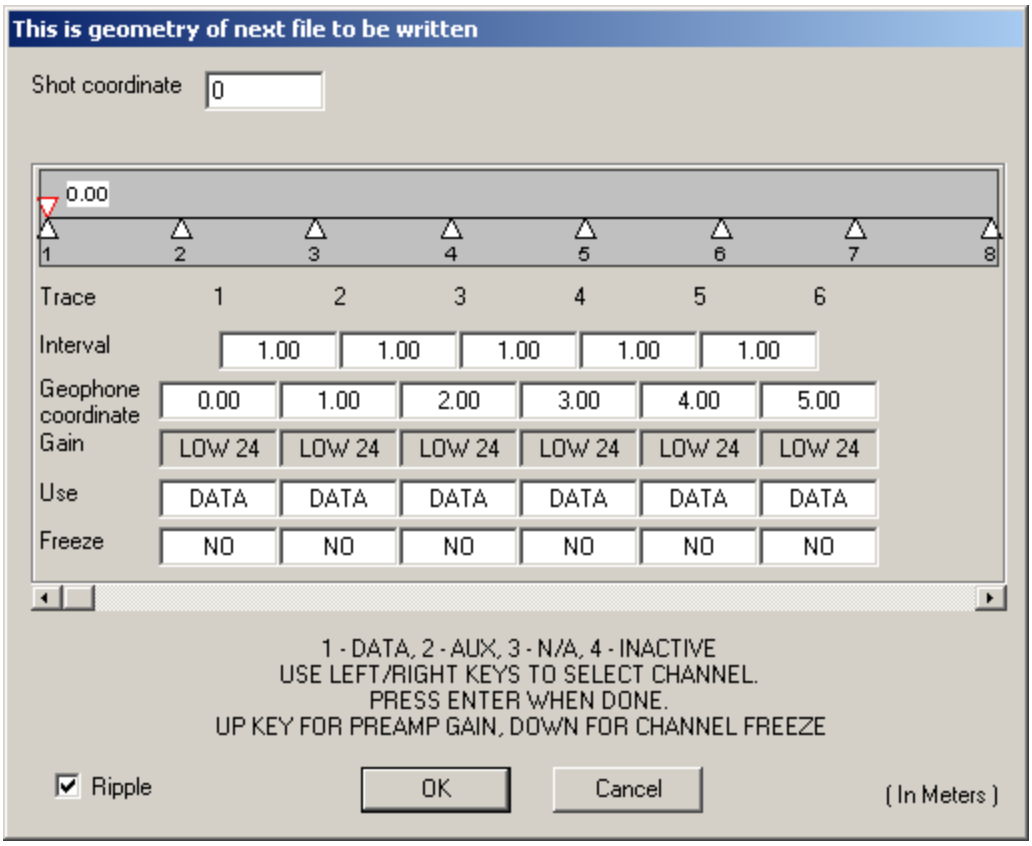
- Auto Save Disabled, Replace Mode Enabled



In this mode, stacking is disabled. Each record is sent to the controller and is either ignored or manually saved. The stack count never exceeds 1 (rarely used).

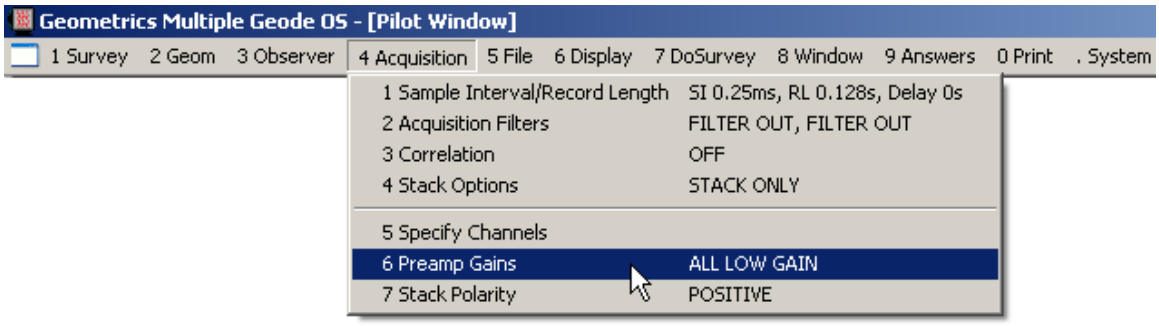
2.4.5 SPECIFY CHANNELS

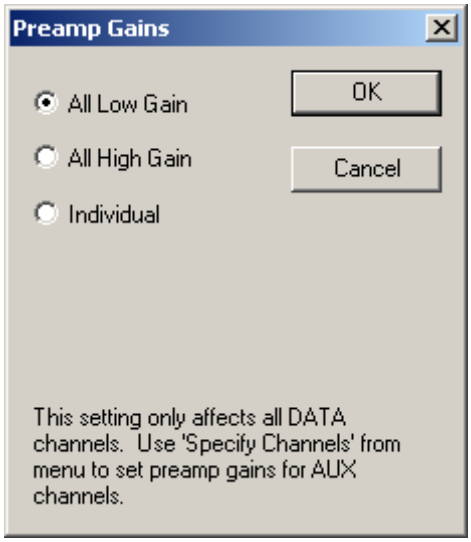




The above dialog box should look familiar; see Page 35. Also see Page 153.

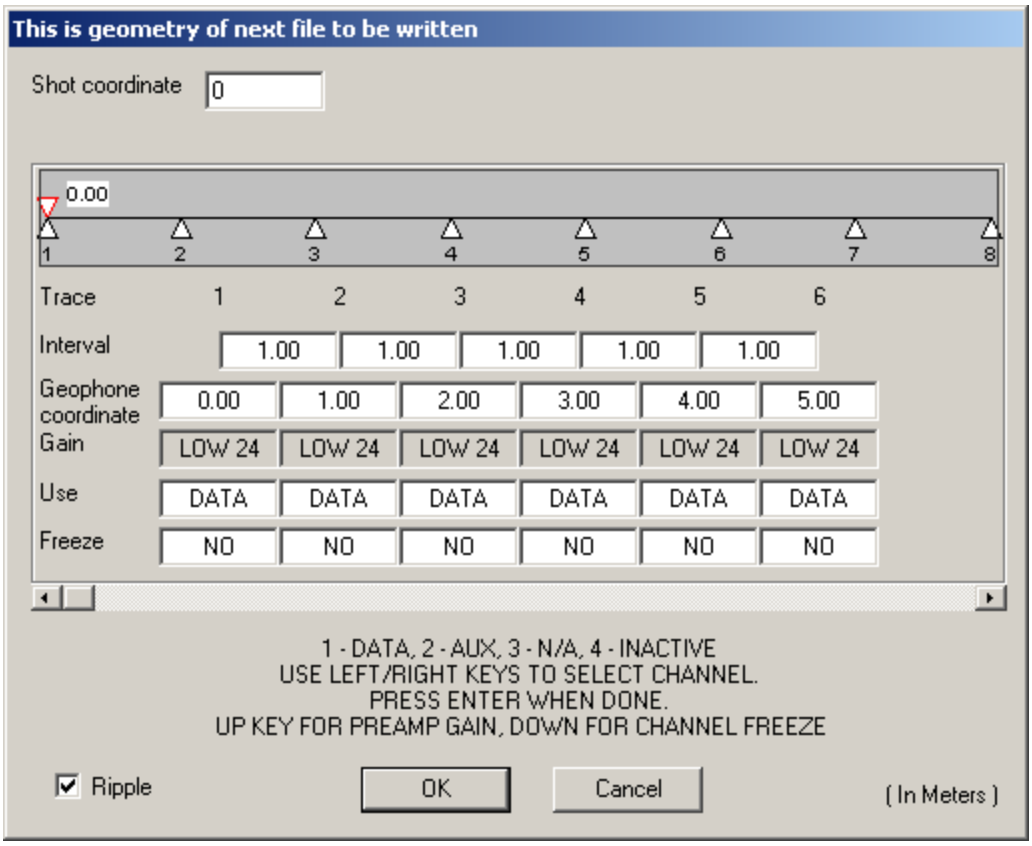
2.4.6 PREAMP GAINS





The preamp gains that are selectable from the software depend on jumper settings in the seismograph. There are three possible combinations, depending on jumper settings: 24/36 dB, 12/24 dB, and 0 dB. Unless specified otherwise, all Geometrics seismographs come from the factory set to 24/36 dB.

You may set all of the gains to the high or low setting, or you may set the gains individually. If you select Individual, you will see the familiar dialog box:



See Page 35 for a discussion of setting individual gains. Gains may also be set from the Geometry GUI; see Page 153.

Note: *When doing refraction, or any other survey in which you are only interested in first-arrivals, it doesn't matter if the channels are overdriven or "clipped" (Page 79), and you can usually set all channels to the higher gain. When doing reflection, you should set higher gains wherever you can without overdriving the channels. This may require some test shots.*

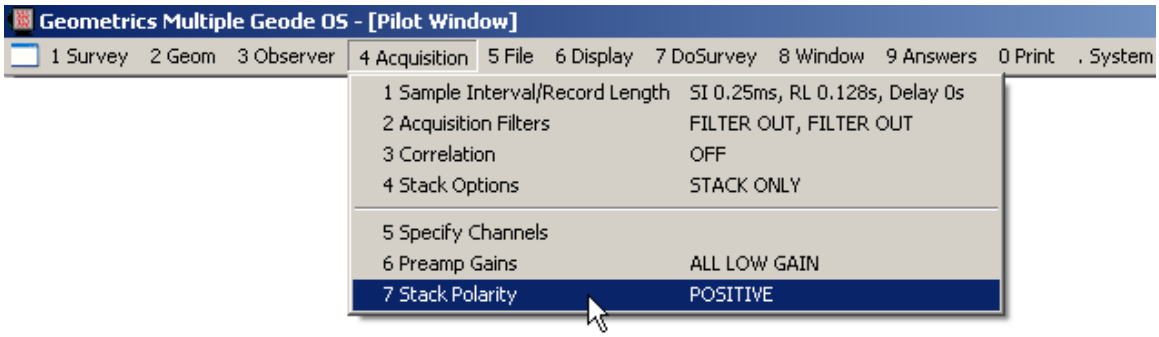
The de-scaling factors for the various preamp gain settings are as follows:

Gain (dB)	De-scaling Factor
0	2.6974E-03
12	6.7536E-04
24	1.6985E-04
36	4.2704E-05

Table 5: Preamp gain settings and associated de-scaling factors.

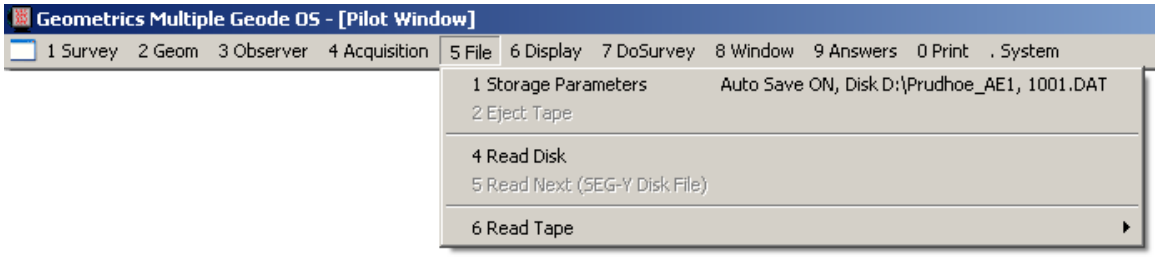
Preamp gains can also be set from the Geometry Toolbar; see Page 153.

2.4.7 STACK POLARITY (MGOS, NZOS, SGOS, STOS, ESOS)



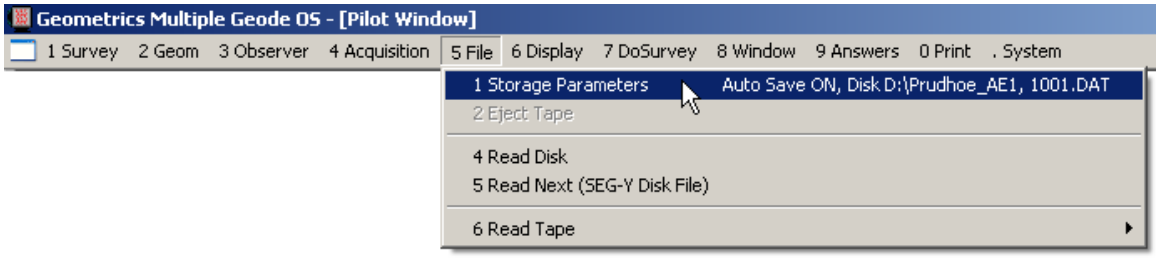
If you are doing shear wave work and employing reverse-polarity shots, reversing the Stack Polarity when you reverse the source polarity can be a useful shear wave enhancement tool. It will cause the subsequent shots to be flipped (multiplied by -1) prior to stacking, thereby enhancing the shear wave at the expense of the compressional wave. This is the only item in the Acquisition Menu that can be changed while data are in memory. It can also be changed in the Stack Options dialog box (Page 51).

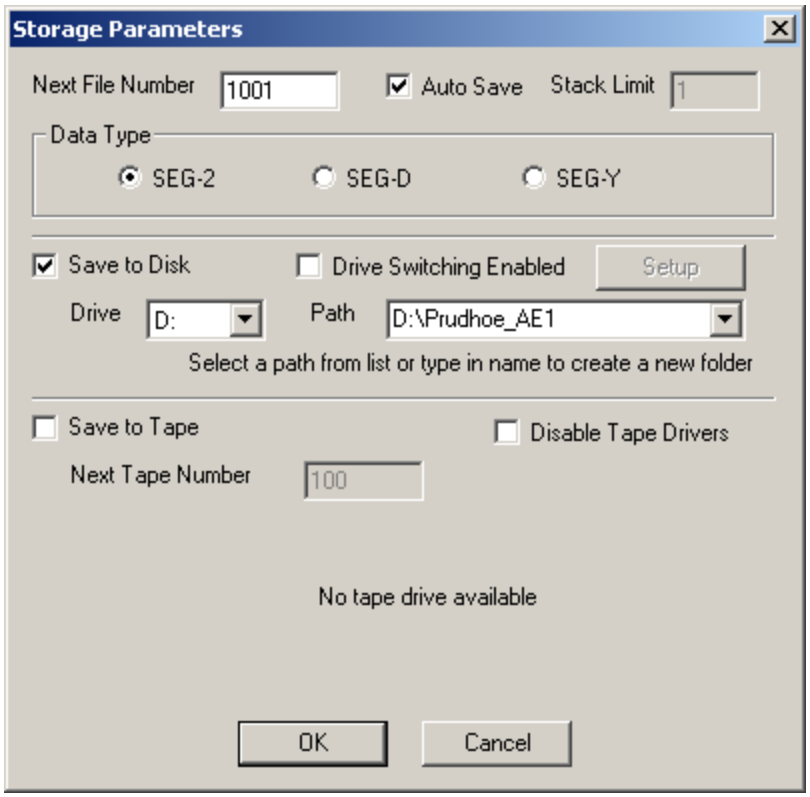
2.5 FILE MENU



The File Menu is where you set up your storage parameters (path, next file number, file format, etc.). You can also read in and display existing data files.

2.5.1 STORAGE PARAMETERS





The Storage Parameters dialog lets you specify how and where the data will be stored on disk.

The Next File Number is the name of the next SEG file that will be saved. This is incremented automatically.

If the file number already exists in the chosen path, a letter will be added to the end of the file number and this will be indicated in the Survey Log.

Note: *SCS will never overwrite existing SEG files.*

If you check the Auto Save box, enter a Stack Limit. The data will be saved automatically when the number of stacks reaches the stack limit. In the case of stacking before correlation (Page 56), the Stack Limit defines the number of stacks to do before correlating the record.

Note: *If you are in* Auto Save *mode, it is not necessary to clear the data before the next shot; the first stack of the next shot will replace it. Read Section 2.4.4, Page 51.*

Choose the SEG Data Format you wish to write the data in. See **Error! Reference source not found.** for information on the three formats supported by SCS.

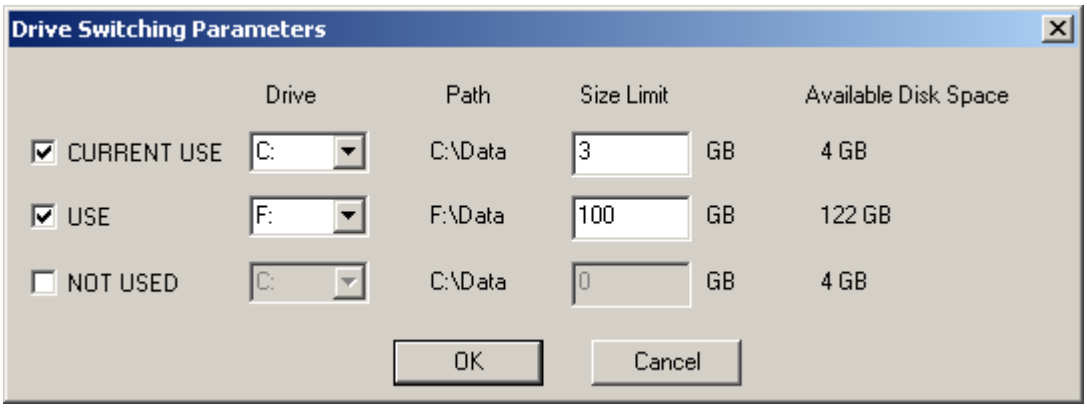
Note: *If Promax will be used to process SEG-D data, please see D.3.2.*

Note: *If you wish to integrate serial data into the file header (Page 135), you must record in SEG-D format. SEG-2 and SEG-Y do not support this feature. However, serial data will always be written to the Survey Log (Page 14), regardless of the SEG format chosen.*

Choose a Drive for the data to be written to from the drop-down menu; either choose a Path in the same way or type one in and SCS will create it.

Note: *Only top-level directories can be created from this dialog box, and only top-level directories from each drive are available in the drop-down list. SCS does not recognize subdirectories.*

You can enable up to three drives, and the software will automatically switch to a new drive when one becomes full or reaches its user-specified allotment of data. Check the Drive Switching Enabled (MGOS, NZOS, MMGOS, and MNZOS) box and press **Setup**. You will see the following dialog:

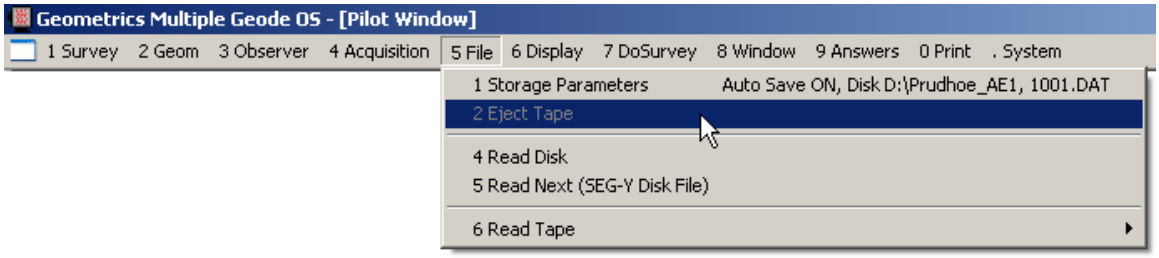


MGOS, NZOS, MMGOS, MNGOS

Check the boxes of the drives you wish to use and choose the drive letters from the drop-down menus. Enter the amount of data in Gb that you wish to store on each drive before it switches to the next one. In this mode, the path will default to `\Data` for each drive.

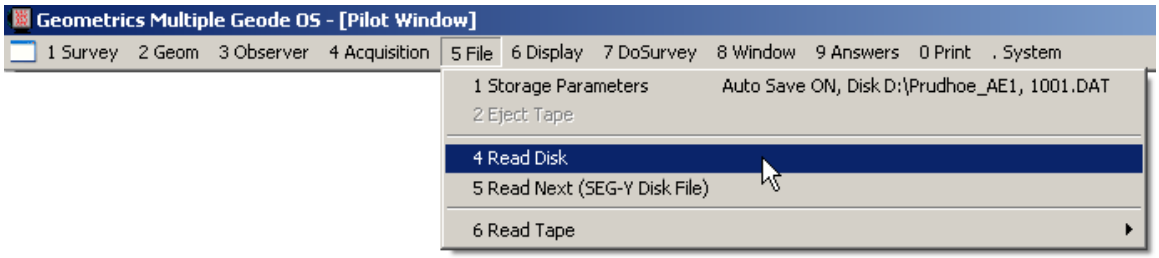
If you intend to save data to tape, the tape drive must be plugged in to the SCSI port and powered up before you boot the seismograph or laptop. Enter the number of the first tape in the Next Tape Number entry box. This number should be updated whenever you change tapes, and the tapes should be labeled with the appropriate tape number. The tape number and the files written to it will be recorded in the Survey Log for future data retrieval purposes.

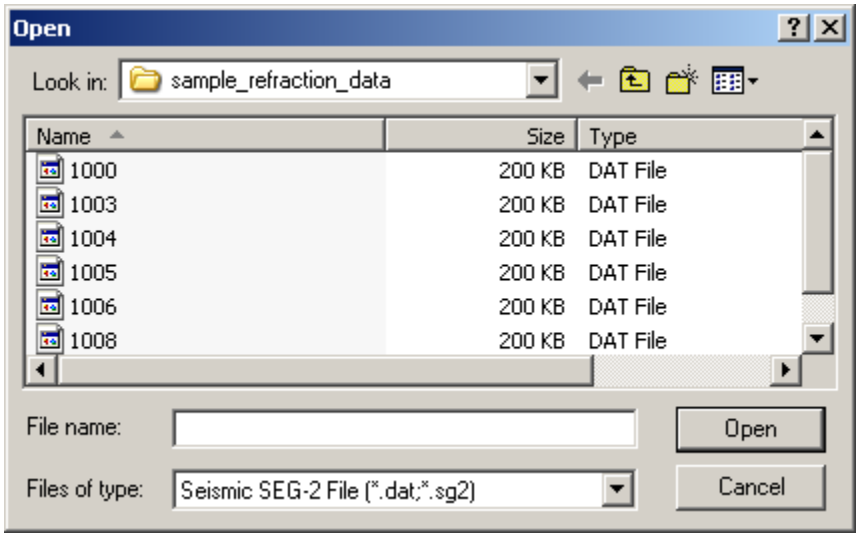
2.5.2 EJECT TAPE (MGOS, NZOS, MMGOS, MNZOS)



Selecting Eject Tape will eject the tape from the tape.

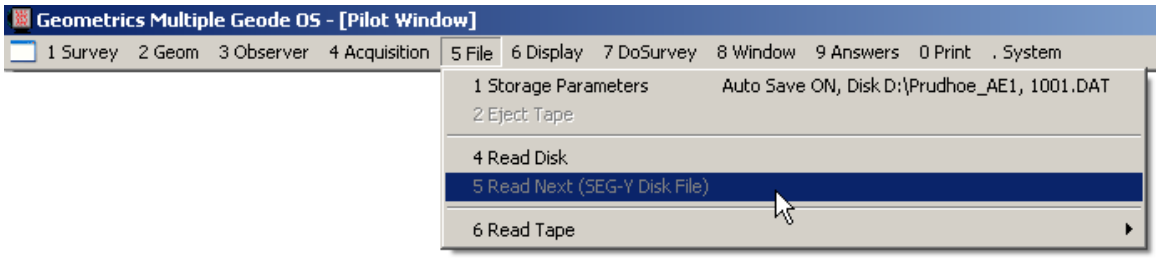
2.5.3 READ DISK





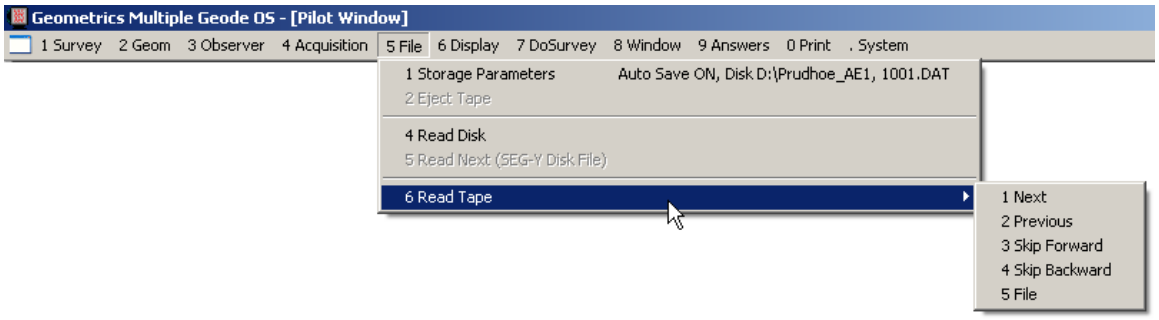
You may read in and display any file acquired with SCS. Choose Read Disk and select a file from the resulting dialog box. The data will be displayed in the Shot Window; use the Display >> Shot Parameters menu (Page 71) to customize the display.

2.5.4 READ NEXT (SEG-Y DISK FILE) (MGOS, NZOS, MMGOS, MNZOS)



Unlike SEG-2 and SEG-D files, SEG-Y files store many shot records in a single file. To read and display a SEG-Y file, you must first read the file in (see above). The first shot record in the file will be displayed. To view additional shot records within the file, you must use the Read Next SEG-Y Disk File command.

2.5.5 READ TAPE (MGOS, NZOS, MMGOS, MNZOS)

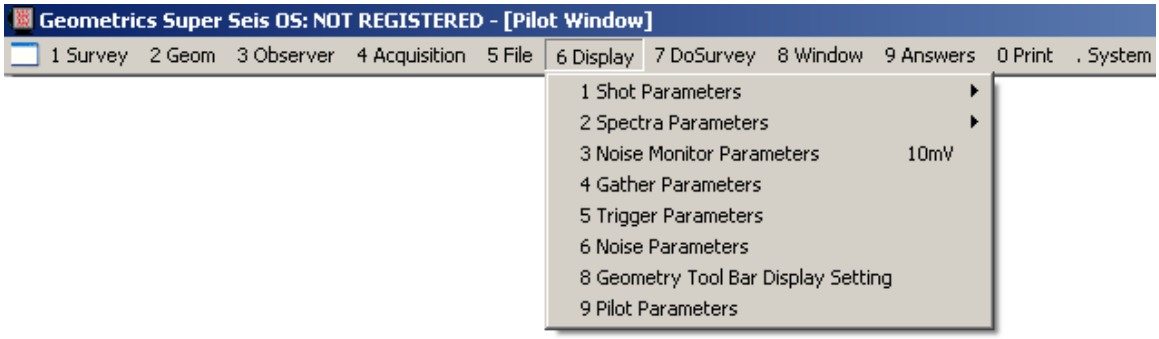


The Read Tape function allows you to read data from the tape back in to memory for display and printing.

- Next will read the next record on the tape.
- Previous will read the previous record on the tape.
- Skip Forward allows you to skip a user-specified number of records forward on the tape.
- Skip Backward allows you to skip a user-specified number of records backward on the tape.

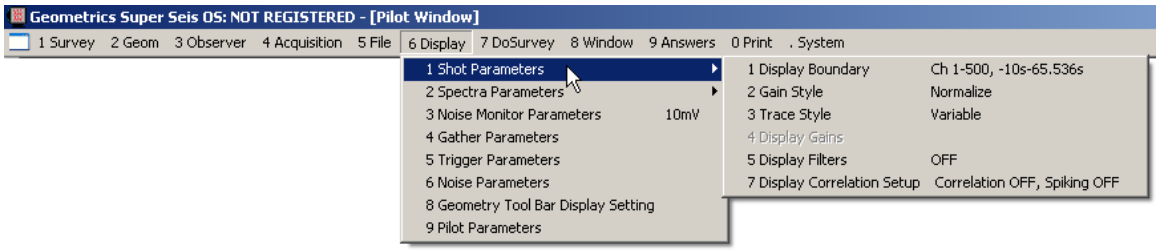
- File allows you to seek a user-specified record on the tape.

2.6 DISPLAY MENU



The Display menu is for controlling how data are displayed by SCS. None of the settings in this menu have any effect on the data themselves. All settings affect data display only.

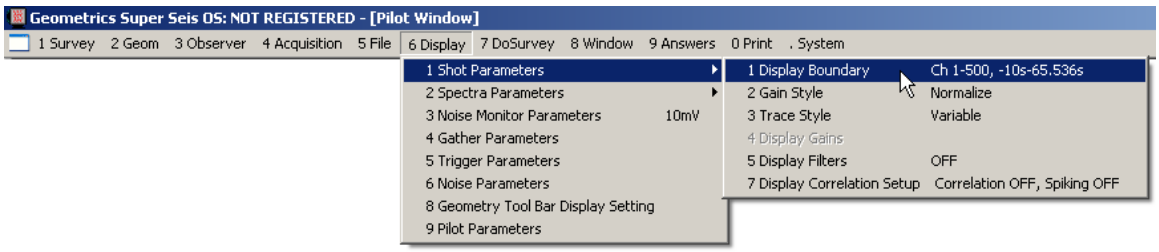
2.6.1 SHOT PARAMETERS

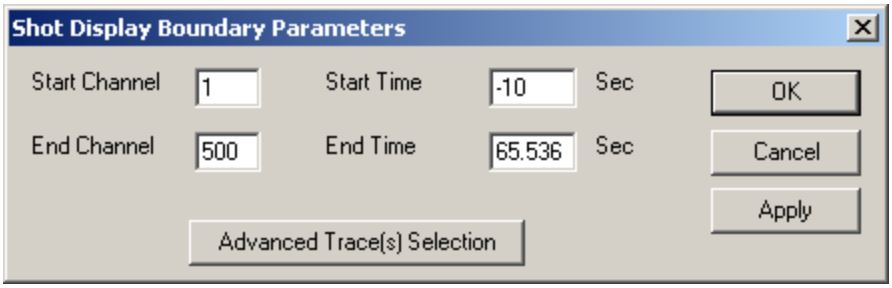


The Shot Parameters menu allows you to control the display of the shot record.

Tip: *Use the right* **Arrow** *key to bring up the* Shot Parameters *sub-menu.*

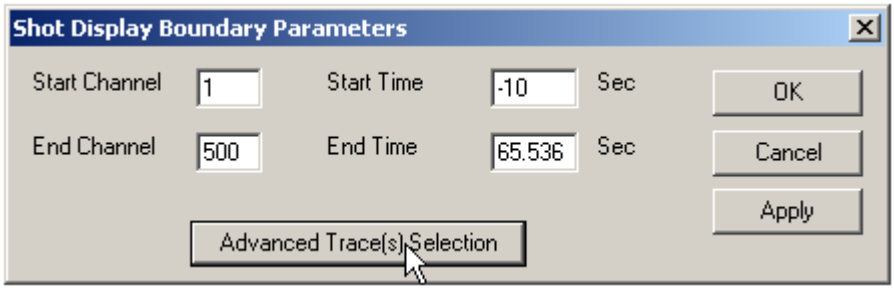
2.6.1.1 DISPLAY BOUNDARY

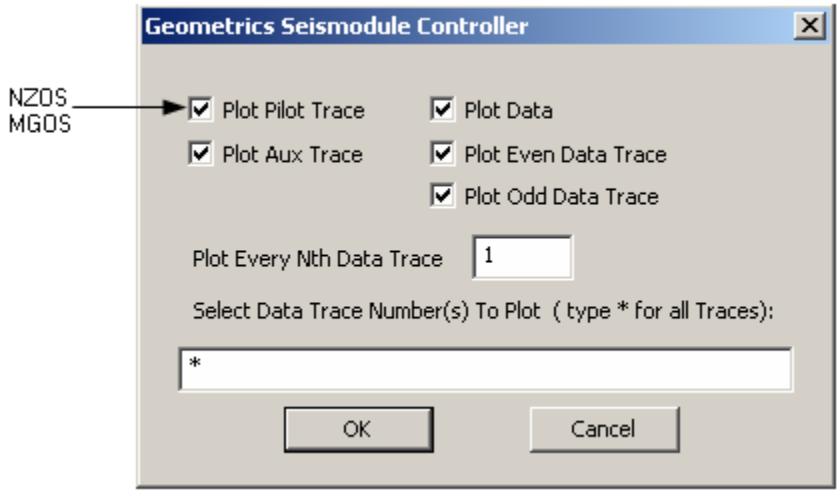




The Display Boundary dialog allows you to determine how much of the total record is actually displayed. You are under no obligation to display the entire record. You can adjust the window of the data that you are looking at to focus on events of interest.

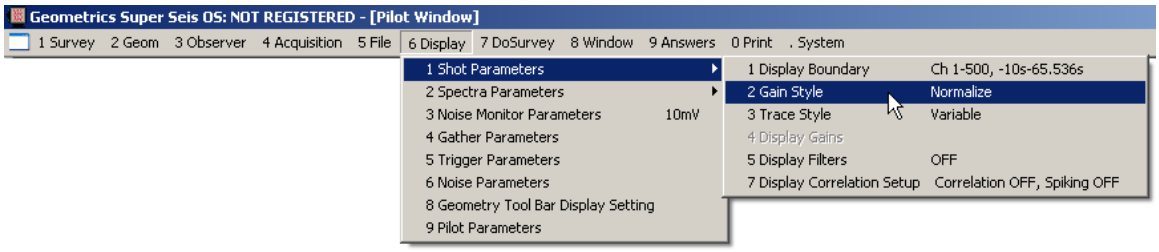
2.6.1.1.1 ADVANCED TRACE(S) SELECTION

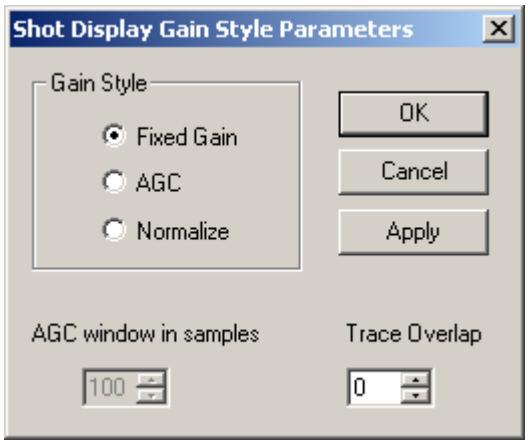




The Advanced Trace(s) Selection dialog gives you more control over which traces are actually displayed in the shot window, and is self-explanatory. If you list individual trace numbers to plot, they should be separated by a comma or space.

2.6.1.2 GAIN STYLE





There are three gain styles to choose from.

Fixed Gain applies the same gain multiple to the entire length of an individual trace (but not necessarily the same gain to all traces). This is most often the gain style of choice in refraction surveys.

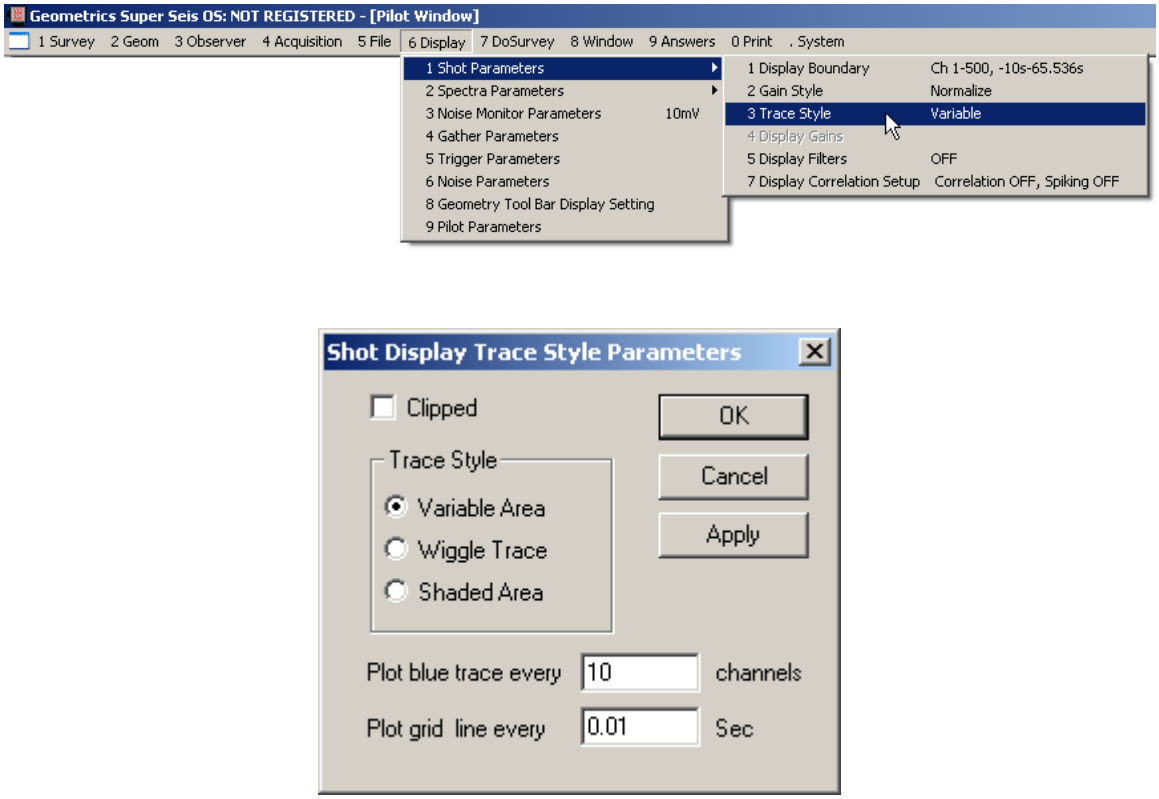
AGC ("automatic gain control") strives to equalize the amplitudes of early and late events in the seismic trace. This gain style is very useful in displaying seismic reflection data. The trace scale factor is adjusted continuously along the trace to adjust the trace excursions regardless of the relative strength of vibrations. If AGC is enabled, you must specify an AGC Window. The optimum choice will depend on the data and in particular the time length of the seismic wavelets in the data. The number entered should be in data samples, between 2 and 1000. The best choice is empirically determined, but need not be particularly precise. A wide range of values will give acceptable results. Windows that are too short will distort the waveforms; those too long will obscure some reflections. Since only the display is affected, experiment with different displays for a particular data set to see which gives the best records. When in doubt, start with 250.

To control the overall trace amplitudes when using AGC, you must specify a Trace Overlap. This is simply a scale factor, applied after the AGC is performed, that determines the display gain of each trace expressed in terms of how much the traces overlap each other. It is similar to Display Gains (discussed below) except that it forces the display gain of each trace to be the same. In most cases where you would use AGC, particularly reflection surveys, it is usually desirable to scale each trace identically after AGC has been applied.

Experiment with the Trace Overlap parameter to get a feel for its effect on the display.

Normalize takes the maximum amplitude of each trace and scales the entire trace proportionally by this value. This option is a good way of setting the gain on each channel so that you can view them all equally (e.g. in terms of the maximum value obtained) for each channel. As in AGC, the Trace Overlap value is used to set the size of the traces when they are normalized.

2.6.1.3 TRACE STYLE



Data can be shown in Variable Area, Wiggle Trace or Shaded Area form; these are shown in Figure 20. Variable Area and Shaded Area fill in the positive peaks, making reflection events more apparent, and are the most common trace styles used in 3D land surveys.

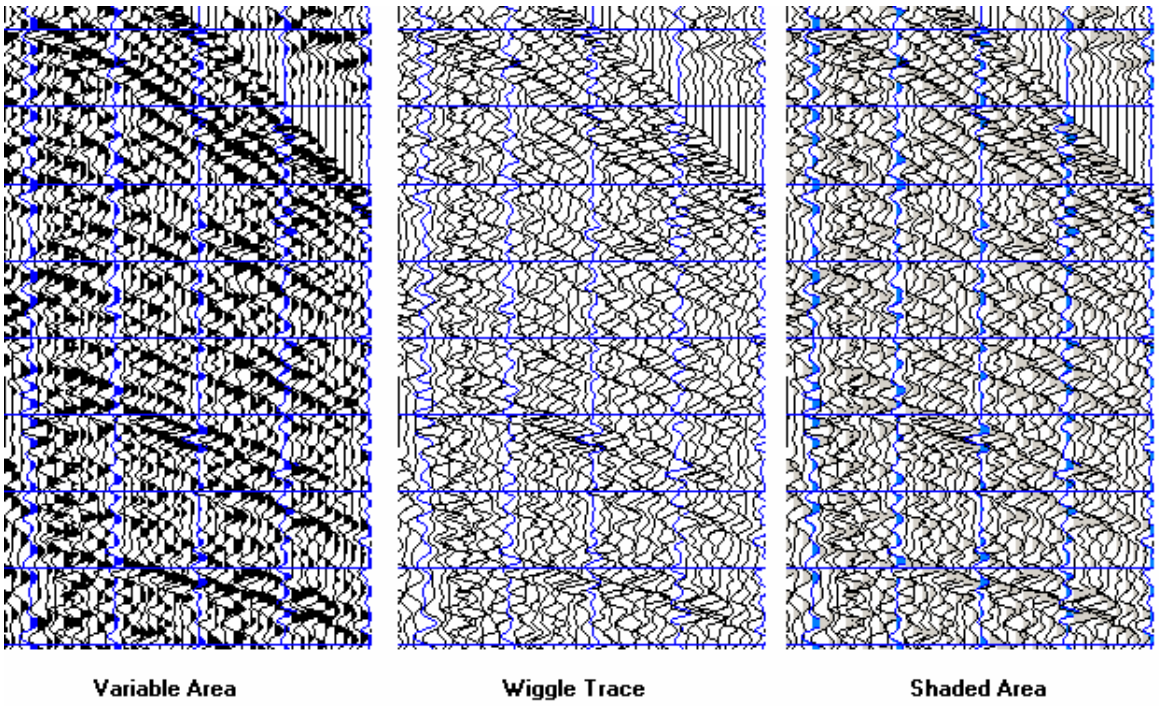


Figure 20: Trace styles available for Shot Window.

Any of the three trace styles can be displayed in clipped or unclipped from. Clipping is usually used only with the Variable Area trace style when you are looking at first breaks. The effect is illustrated in Figure 21 below. Each trace will be clipped according to the Trace Overlap parameter setting.

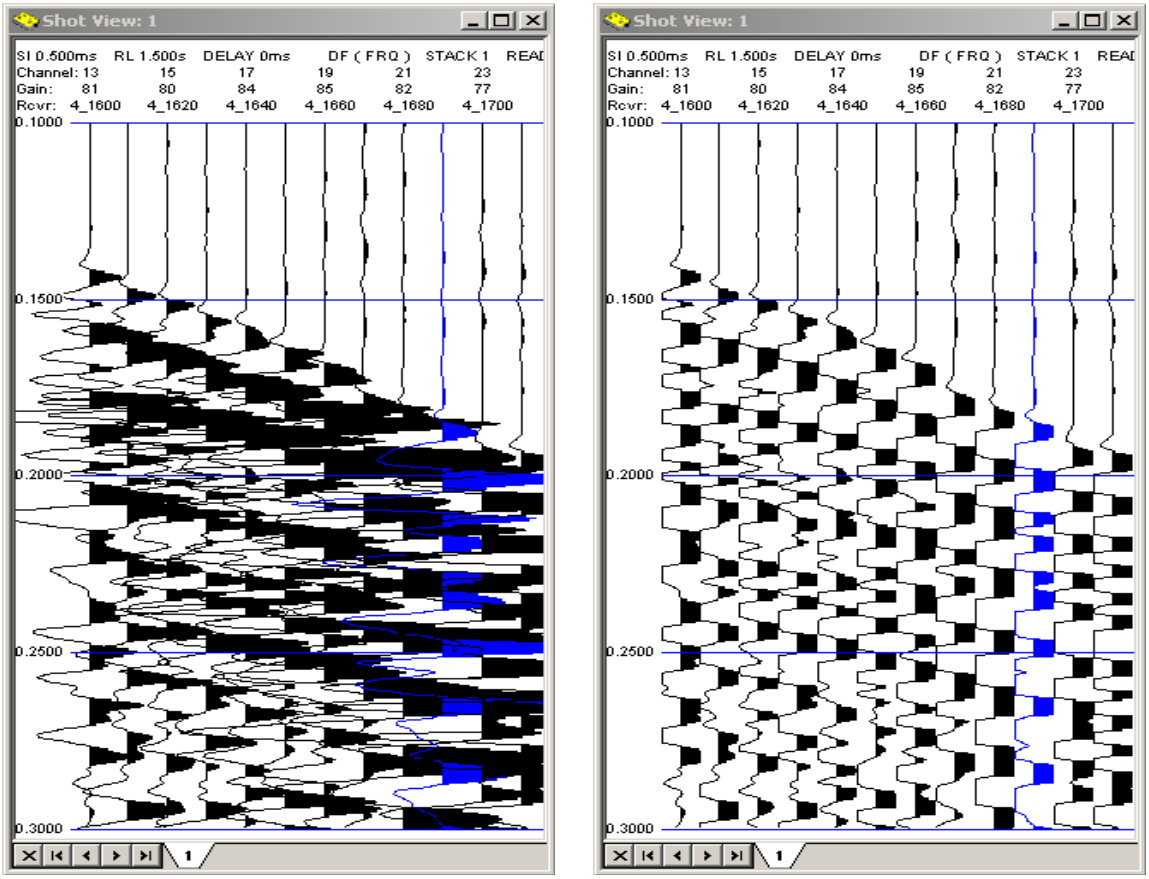
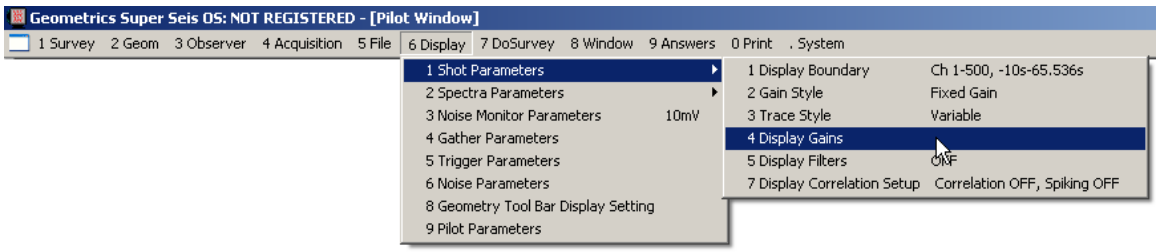


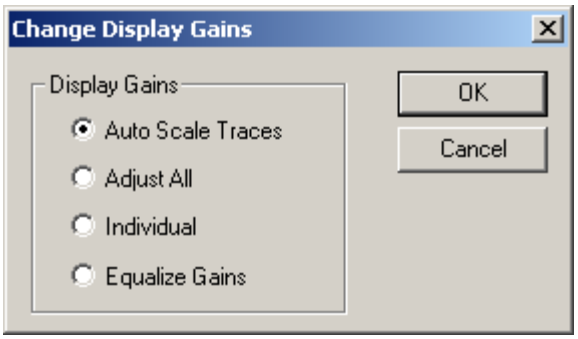
Figure 21: Unclipped vs. clipped traces.

Note: *The term "clipping", as used here, applies only to the display and should not be confused with "clipped" or overdriven channels (see Page 79).*

Experiment with the various trace styles to gain familiarity.

2.6.1.4 DISPLAY GAINS





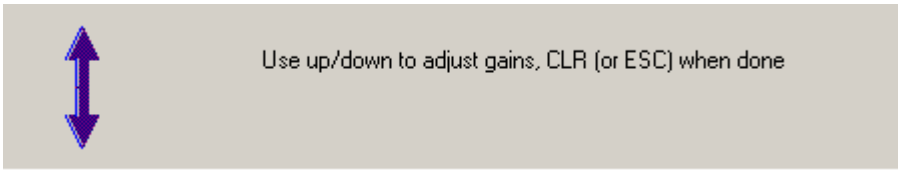
If you are using fixed gain, you may use the Display Gains menu to control the trace amplitudes.

Auto Scale Traces (Hot Key: **6**) automatically selects the trace size values to display the data on the screen. The Fixed Gain style is most often used in seismic refraction surveys, so this function attempts to set the trace sizes in order to best display the first breaks. With a new record, this function will quickly get to the best choice or at least close to the best choice. This utility is also contained in the DoSurvey menu for convenience.

Only the portion of the record currently displayed on the screen affects the calculation. If you change the Display Boundaries after scaling the data automatically, a different data set will be displayed on the screen with a less optimum choice. In that case, re-run Auto Scale Traces.

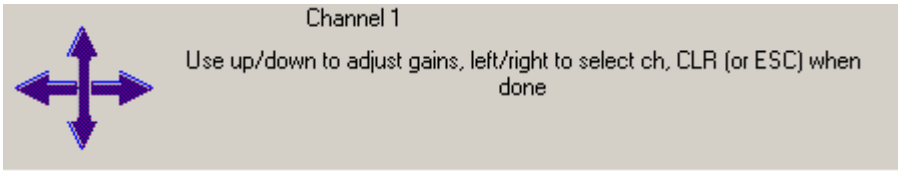
Adjust All and Individual are used to manually adjust the size of the trace. The relative amplitude scaling factors (trace sizes) are listed above the channel numbers on the screen (and on the plotted record). The units are dB, incrementing in +/- 3 dB steps. A 3 dB step is an increase of 41% or a decrease of 29%. Two steps (6 dB) is double or one-half the original value. When the Gain ~~Style is~~Style is set to Fixed Gain, the trace excursions and trace size factor can be used to compare true amplitudes at the input. This can be useful for assessing attenuation with distance.

When Adjust All (Hot Key: ~~→)is~~→) is chosen, the following will be displayed in the lower right-hand corner of the shot record:



In this mode, each press of an up/down **Arrow** key will increase/decrease the display gain of each channel by 3 dB.

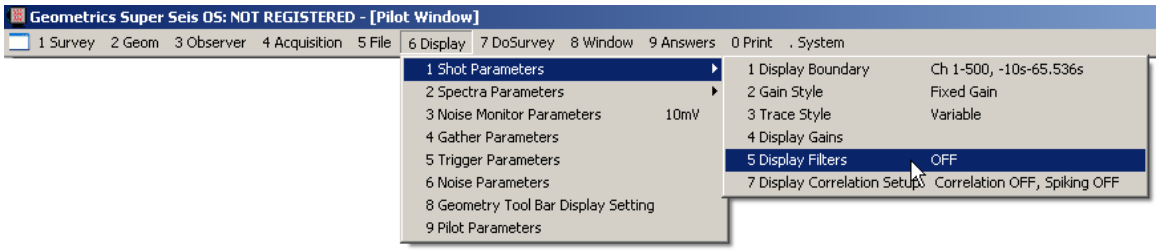
When Individual (Hot Key: ~~←)~~←) is chosen, the following will be displayed in the lower right-hand corner of the shot record:

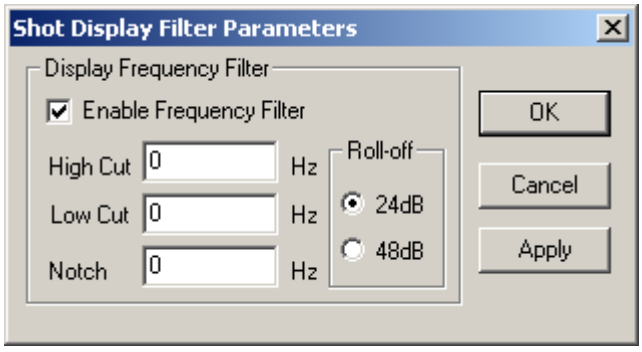


In this mode, the left/right **Arrow** keys are used to move from channel to channel. The number of the channel currently under control is displayed, the corresponding trace is highlighted, and each press of an up/down **Arrow** key will increase/decrease the display gain of the highlighted channel by 3 dB.

Choosing Equalize Gains will set all of the display gains equal to the current display gain of channel 1.

2.6.1.5 DISPLAY FILTERS

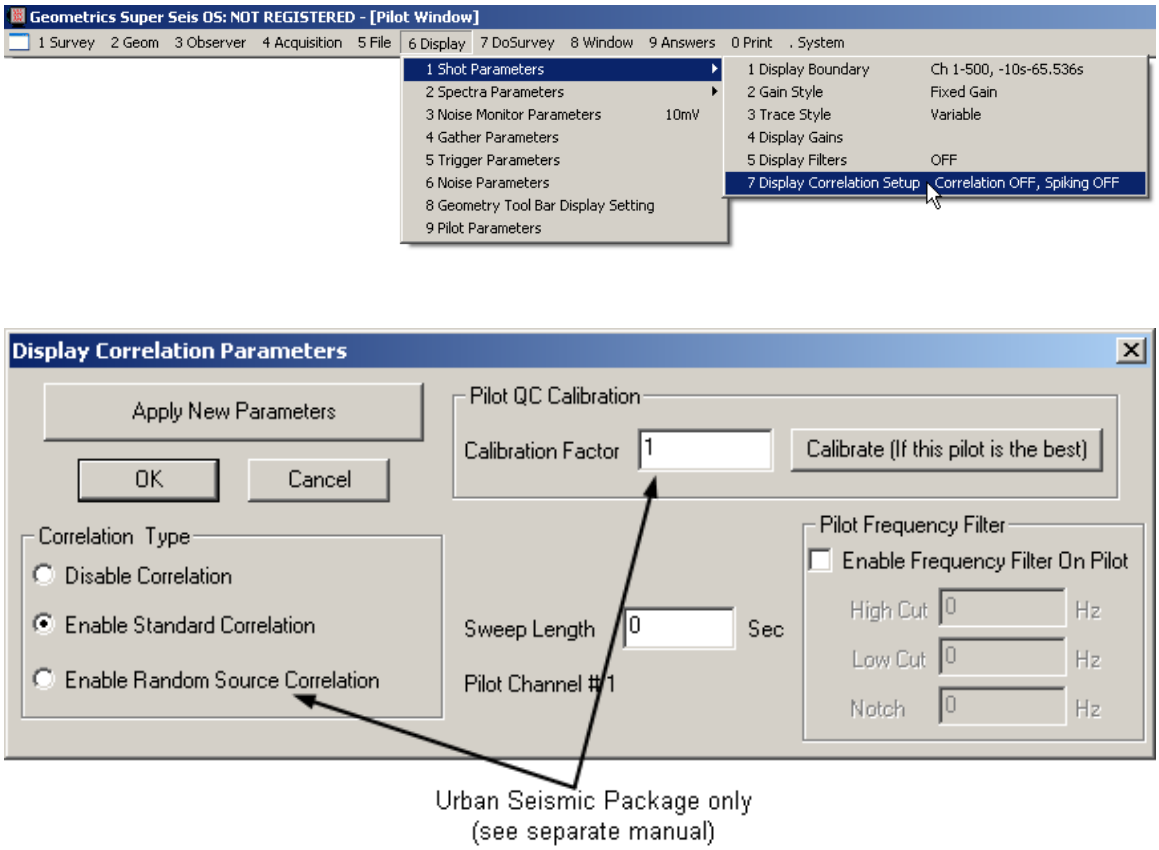




SCS is equipped with digital display filters. Display Filters act only on the data display, and do not affect the data stored to tape or disk. Operation and effect are identical to those of acquisition filters (Page 49), except that in display filters you may choose between 24 and 48 dB/octave filter slopes (all acquisition filters have attenuation slopes of 24 dB/octave).

Filters are useful for reducing noise from unwanted sources. This includes passing vehicles, ambient wind noise, or even coherent shot-generated noise like ground roll or air blast.

2.6.1.6 DISPLAY CORRELATION SETUP (MGOS, NZOS)

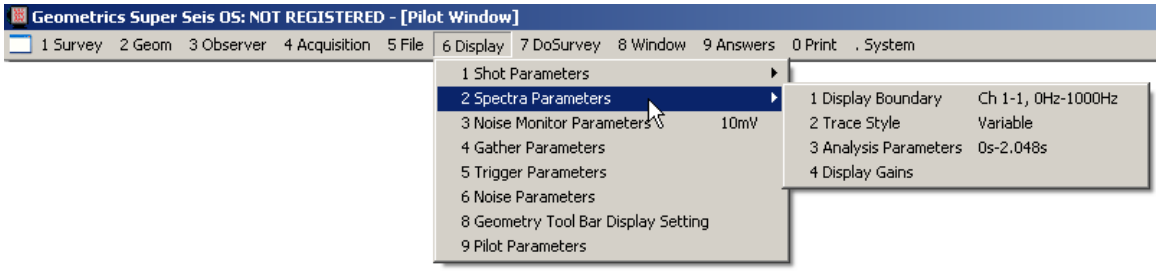


When acquiring data with a non-impulsive source, such as a vibrator, it is not necessary to correlate the data prior to storing. In fact, more and more practitioners are recording raw, uncorrelated data in the field, and doing the correlation step during processing. This allows the flexibility to apply pre-correlation steps such as spectral whiting of the pilot trace.

In this case, it is still useful to be able to view correlated data in the field for QC purposes. Display correlation is identical in function to acquisition correlation (Page 49), except that it only acts on the displayed data. The saved data will still be uncorrelated.

Note: *The maximum input on the channels is ± 2.8V. If this limit is exceeded, the A/D circuitry will be overdriven and the trace for that channel will be "clipped". Clipped traces are shown in red in the Shot Window. When doing refraction, where the only concern is first arrivals, clipping is generally not a problem. However, if you are doing a survey in which the entire waveform is important (such as reflection or MASW), clipping should be avoided. This can be accomplished by some combination of the following: reduce the source magnitude, turn down the gains of the clipped channels, or increase the distance between the shot and the clipped channels.*

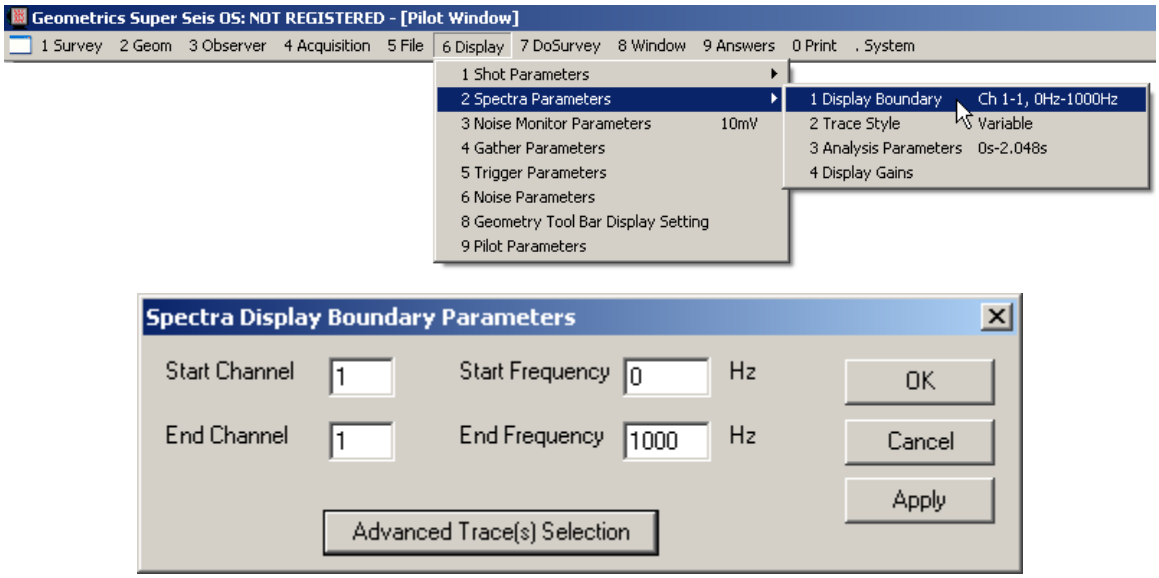
2.6.2 SPECTRA PARAMETERS (MGOS, NZOS, MMGOS, MNZOS)



The Spectra Window displays the seismic data in the frequency domain (Page 12). This can be a useful QC tool, especially in helping determine filter settings. Controlling the display is very similar to that of the (time domain) shot window.

Tip: *Use the right* **Arrow** *key to bring up the* Spectra Parameters *sub-menu.*

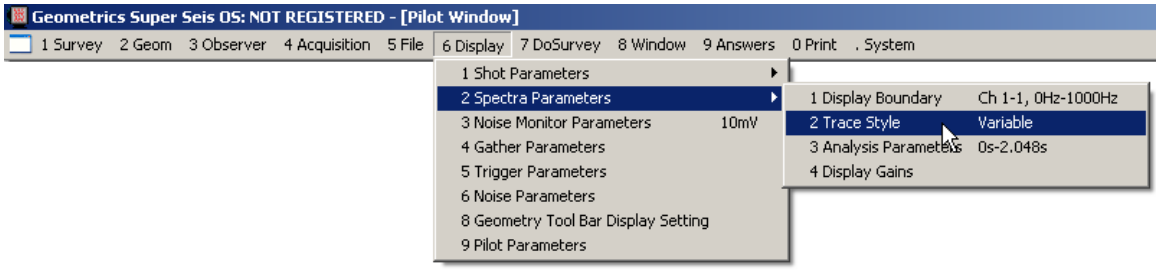
2.6.2.1 DISPLAY BOUNDARY (MGOS, NZOS, MMGOS, MNZOS)

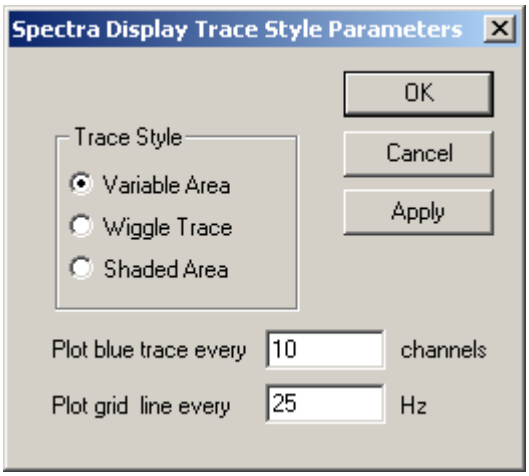


Selecting Display Boundary brings up the above dialog box. This works exactly the same as the display boundaries portion of the Shot >> Display Parameters dialog (Page 71), except that the Start Time and End Time have been replaced with Start Frequency and End Frequency.

Advanced Trace Display Settings is identical to that in the Shot Window dialog and is discussed on Page 72.

2.6.2.2 TRACE STYLE (MGOS, NZOS, MMGOS, MNZOS)

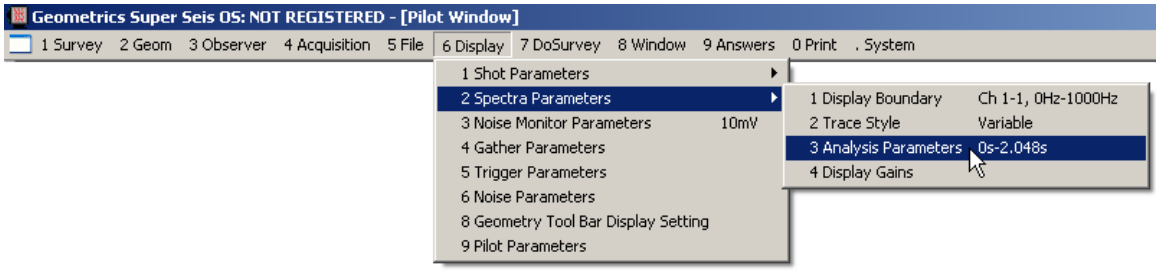




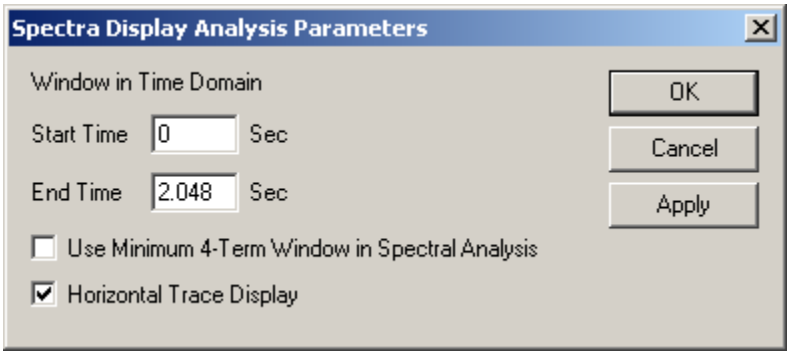
Trace styles are discussed on Page 74. As in the Shot Window, you can control the frequency of blue traces in the Spectra Window; a number larger than the total number of channels disables blue traces.

The spacing between grid lines is in Hz.

2.6.2.3 ANALYSIS PARAMETERS (MGOS, NZOS, MMGOS, MNZOS)



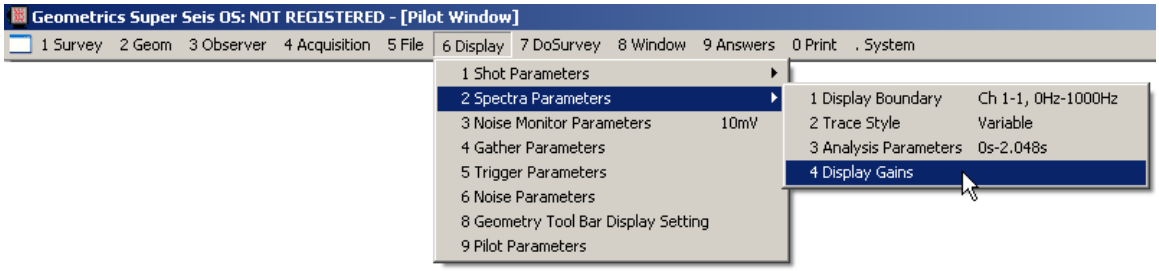
Choosing Analysis Parameters brings up the following dialog:



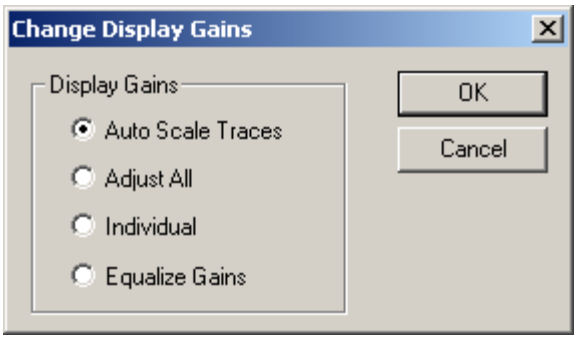
The Start Time and End Time specify the portion of the time-domain record in the Shot Window to convert to and display in the frequency domain. Checking the Use Minimum 4-Term Window in Spectral Analysis has a smoothing effect on the traces.

Finally, you can choose to display the traces vertically or horizontally.

2.6.2.4 DISPLAY GAINS (MGOS, NZOS, MMGOS, MNZOS)

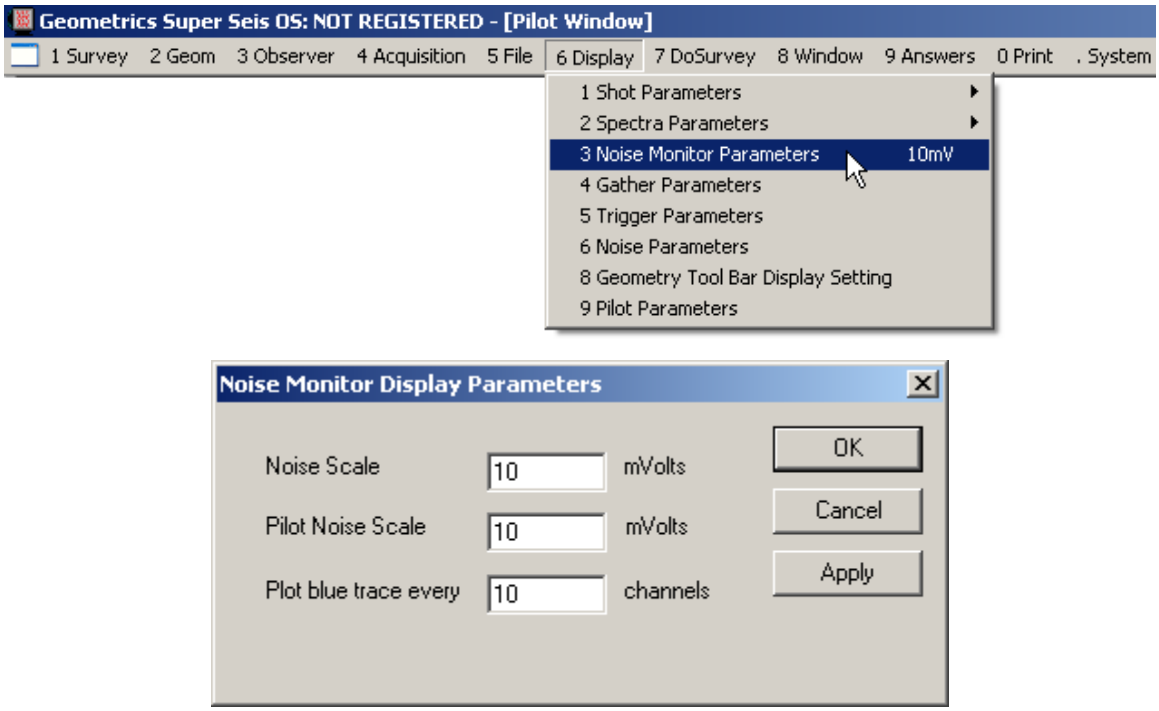


Display Gains are exactly the same as in the Shot Window:



These are discussed on Page 76.

2.6.3 NOISE MONITOR PARAMETERS



The Noise Monitor parameters dialog box allows you to control the way noise is displayed in the Noise Monitor Window (Page 13). Set the Noise Scale so that adjacent traces nearly overlap.

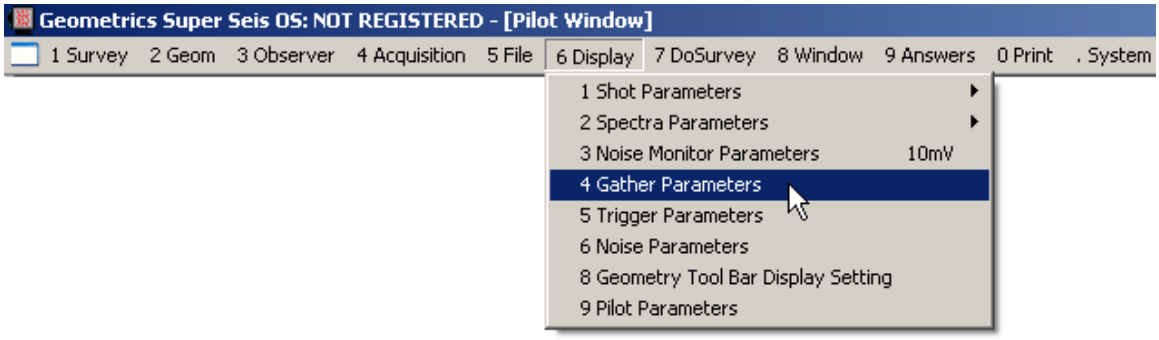
Note: *The* Noise Scale *may also be changed if you are in the Noise Monitor Window by using the up/down* **Arrow** *keys (Table 6, Page 102). The scale can be viewed in the upper left corner of the noise monitor.*

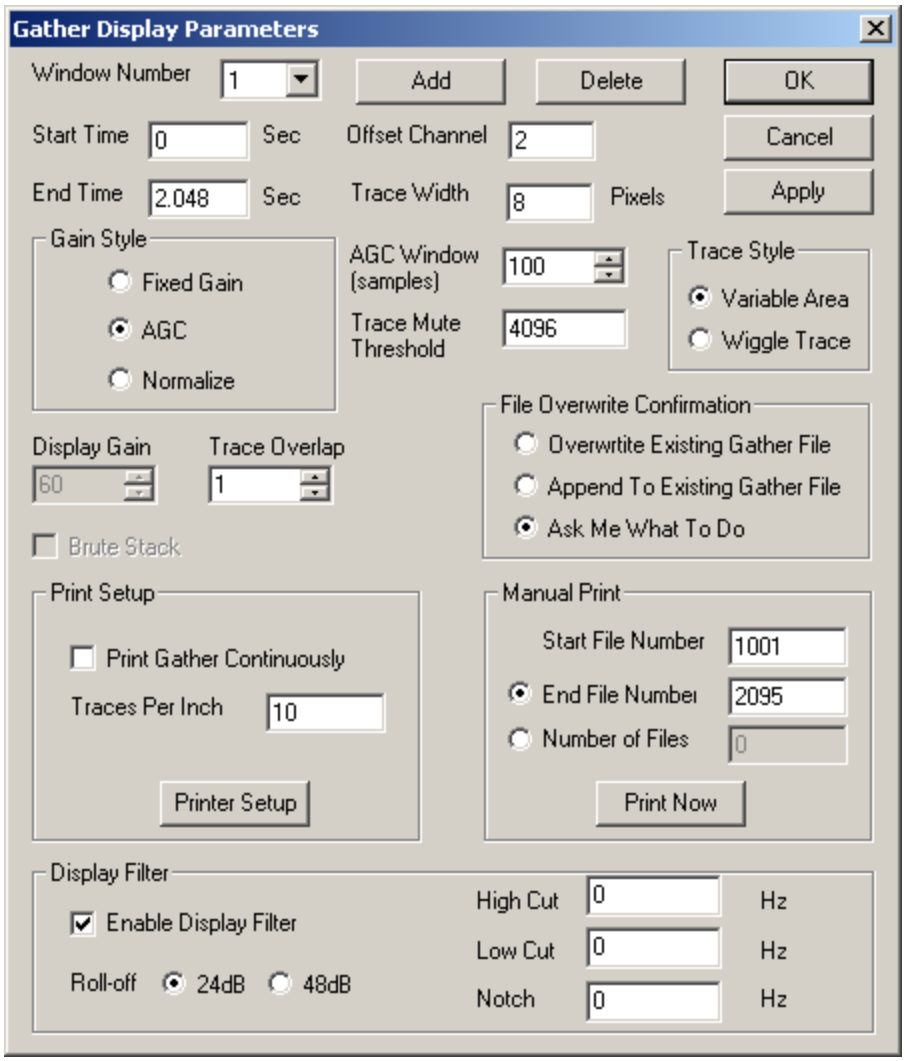
When performing vibrator surveys, the noise displayed on the pilot signal is often much greater than the noise displayed on the acquisition channels. It is very helpful to reduce this so the rest

of the display is not overwritten. The Pilot Noise Scale allows you to adjust the pilot noise level so all channels are visible.

For systems with large numbers of channels, you may prefer to show each *nth* trace in blue for convenience in locating yourself in the noise monitor and shot records. If you wish none of the traces to be shown in blue, enter a number larger than the total number of channels in this field.

2.6.4 GATHER PARAMETERS (MMGOS, MNZOS)





The gather display parameters are very similar to those for the Shot Window (Page 71). We will discuss only those unique to the Gather Display Parameters dialog box.

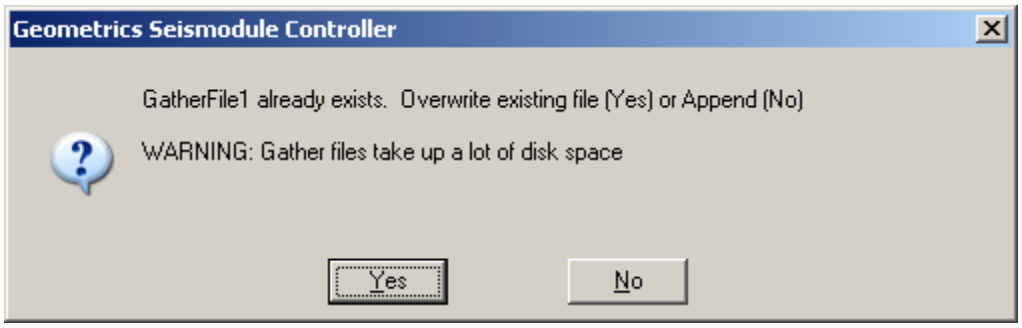
You may open as many as three gather windows. They are named automatically as GatherFile1.dat, GatherFile2.dat, and GatherFile1.dat. They are written to the Logfiles directory. Simply press the **Add** button to add gather windows. Choose the appropriate Window Number before setting your gather display parameters. Pressing the **Delete** button will delete the gather number displayed in the Window Number box.

Select an Offset Channel. This is the channel that will be stripped from each shot record and added to the gather. This is usually one of the channels closest to the source.

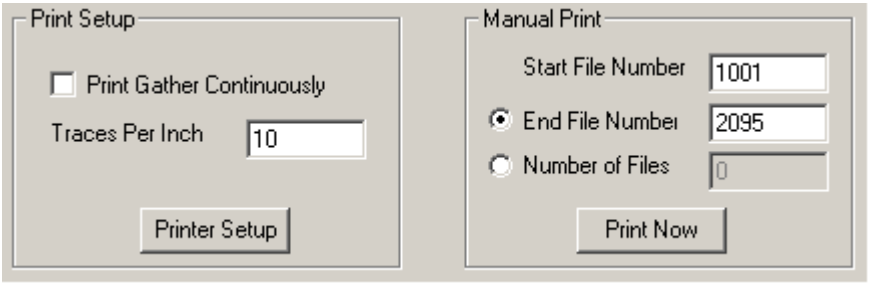
You may set the Trace Width to any number of pixels.

You may mute out the water column by setting an appropriate Trace Mute Threshold. This affects the display only; set by trial and error.

You may choose to overwrite or append to an existing gather each time you start SCS. If you select Ask Me What To Do, you will see the following message each time you start the software:



There are two ways to print the gather. If you wish to print it continuously, check the Print Gather Continuously box. Otherwise, you will use the **Print Now** button. Set the number of Traces Per Inch in the gather to your taste.

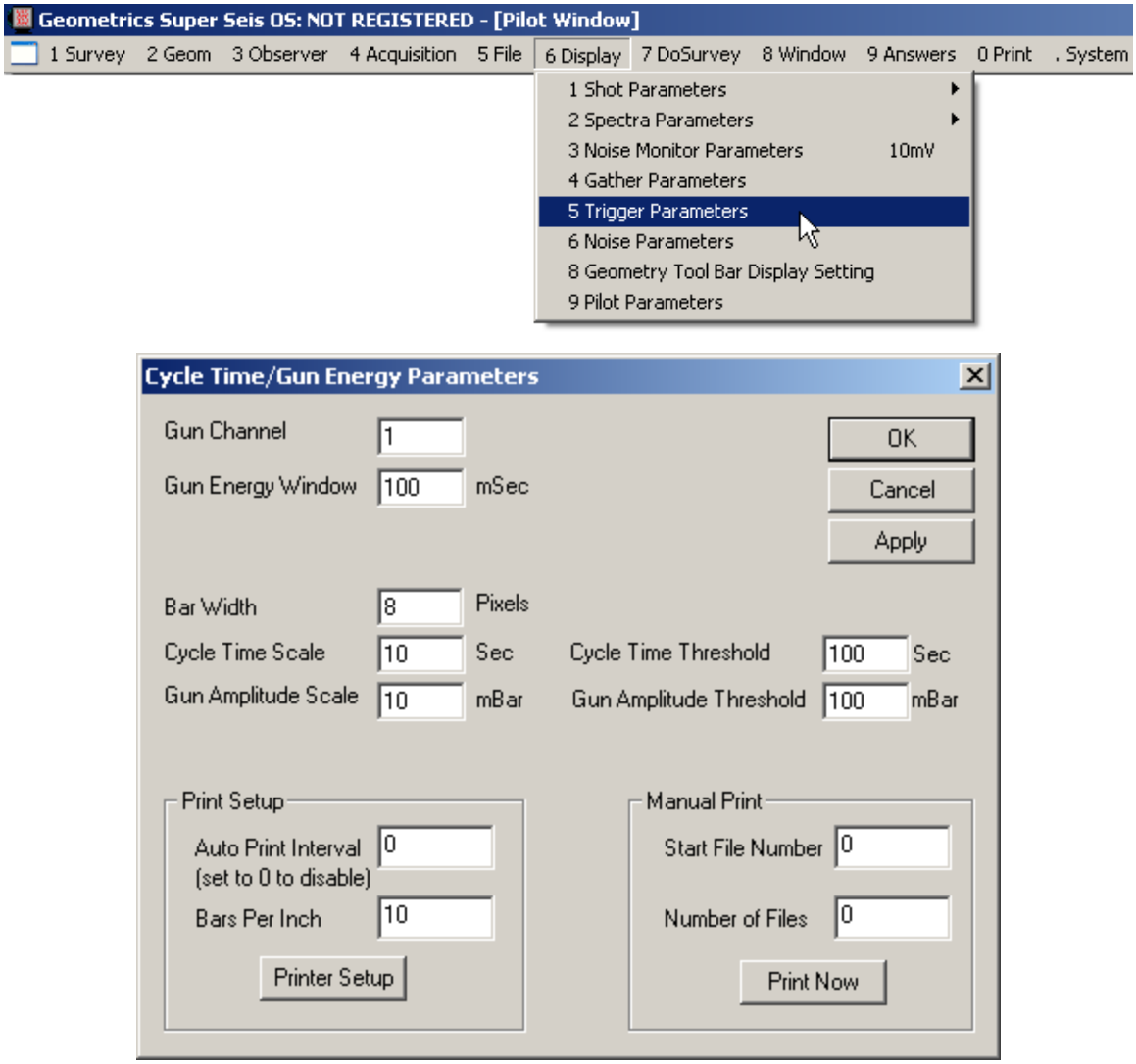


When printing the gather manually, choose a Start File Number and either an End File Number or a Number of Files. "Files" in this context means "traces" – there is one trace stripped out of every shot file. In the example above, the printed gather would have 1,787 traces (assuming the File Number Increment was 1 throughout the entire line).

Note: *Since the gather is displayed on the screen during the survey, it is generally recommended that you print the gather all at once at the end of the survey line, and use the printer for printing QC shot records.*

Note: *If you wish to print the gather continuously on roll paper, we recommend either an 8- or 12-inch Printrex thermal printer. In the* Printer Setup *dialog, you should set it to* Landscape *with a 2-inch page width.*

2.6.5 TRIGGER PARAMETERS (MMGOS, MNZOS)



The Trigger Parameters dialog window controls the appearance of the Trigger window, which displays a dual bar graph (page 18). The top bar graph shows the time between triggers. The bottom bar graph shows the rms amplitude of a user-selected channel, referred to as the "gun" channel. The generally corresponds to a hydrophone mounted on the airgun frame.

Specify a Gun Channel. This will often be an AUX channel (see Page 36). If so, you must enter its channel number. This will be the channel that is analyzed after each shot; it should be a hydrophone close to the source.

The Gun Energy Window is set in ms and defines the length of the time window used in calculating the rms amplitude in the gun channel. This window begins at the start of the record and should be long enough to include the firing of the source. Since you are looking at shot-to-shot variations, the absolute amplitude is not important and this window can generally be left at

100ms. If you are using a source delay of more than 100ms, you might want to lengthen this window to ensure that it captures the source firing.

The Bar Width is set in pixels.

Set the Cycle Time Scale to a value appropriate for your shooting rate. If you are shooting on distance, there will inevitably be some variation in the trigger time due to variations in vessel speed. Calculate the ideal trigger time based on your target speed and shot interval in distance, and set a Cycle Time Scale that is slightly larger. For instance, if you intend to shoot every 12.5 meters at 5 knots, your nominal shooting interval will be 4.9 seconds. A good setting would be about 5.5 or 6 seconds.

Set the Gun Amplitude Scale experimentally. This will depend on the source size and the offset between the source and the Gun Channel.

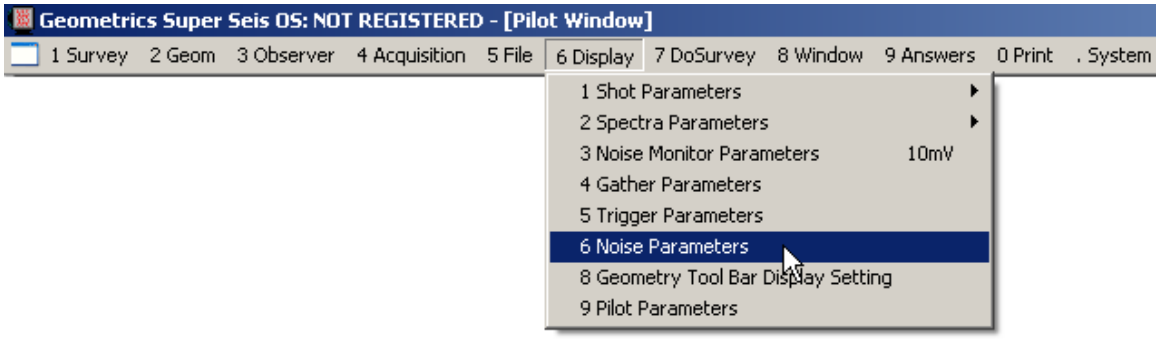
The Cycle Time Threshold should be set to a value that, if exceeded, would indicate a possible problem. A good way to choose this threshold is to observe the cycle times for the first 20-30 shots, see what the maximum is, and set the threshold just slightly higher than the maximum.

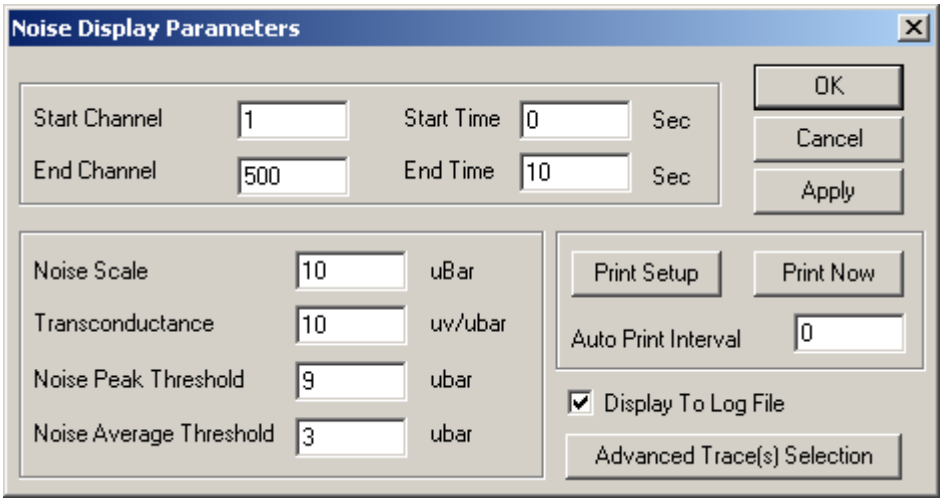
The Gun Amplitude Threshold should be determined in a manner similar to that for the Cycle Time Threshold. Remember, however, that in this case, you are setting a *minimum* value.

Printing is similar to printing a shot record and gather. You can print manually or automatically. To print automatically, set an Auto Print Interval other than zero. If you wish to print manually, enter a Start File Number and Number of Files, and then press **Print Now**.

The Bars Per Inch setting applies to both printing modes.

2.6.6 NOISE PARAMETERS (MMGOS, MNZOS)





The Noise Parameters dialog box controls the appearance of the bar graph in the Noise Window (see Page 17).

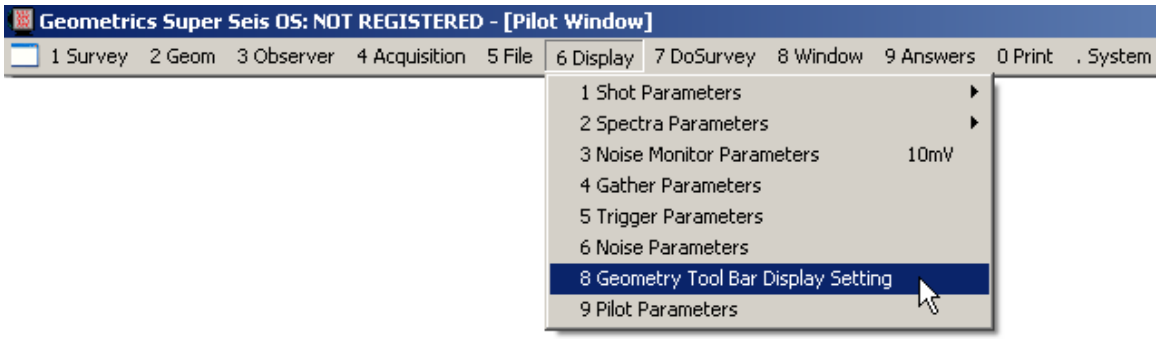
Set the Start Channel and End Channel to control which channels are included in the analysis (generally all).

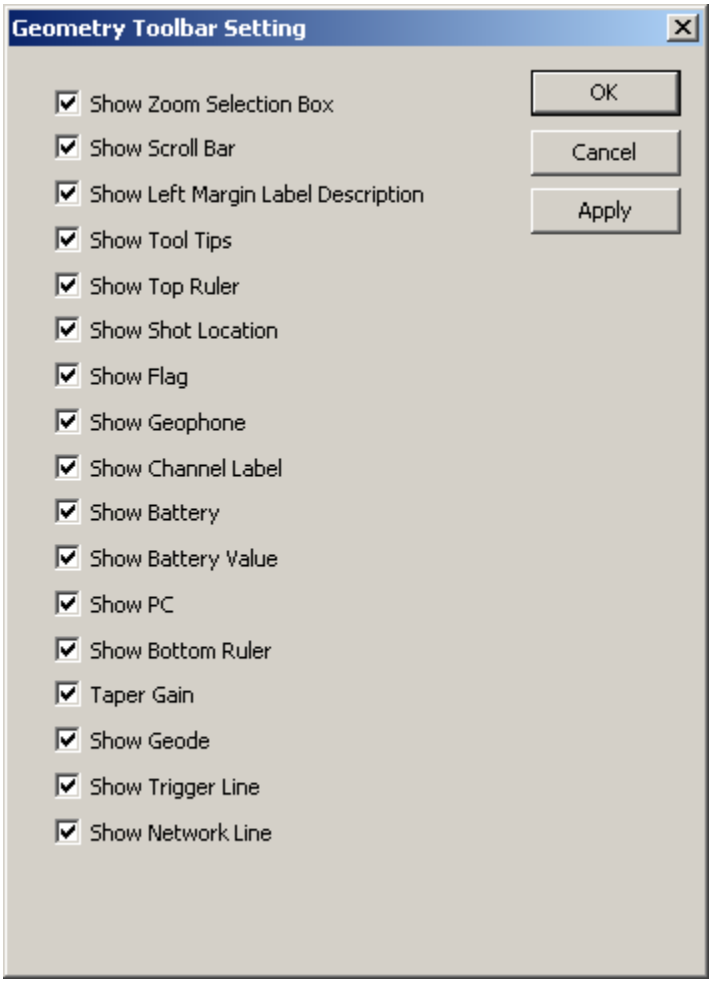
The Noise Scale controls the scale of the vertical axis of the noise bar graph. The Auto Print Interval allows you to print every *n*th noise bar graph. Leaving this parameter set to zero disables the auto print feature.

Transconductance refers to the hydrophone group sensitivity and can be obtained from the streamer manufacturer. If this is set correctly, the absolute noise levels in µbars can be reported. If it is not set correctly, then relative noise levels (as reported by the bar graph) will be correct, but absolute noise levels will be meaningless.

The Peak Noise Threshold is the maximum noise that is tolerable; the bar for any channel exceeding this level will be plotted in red.

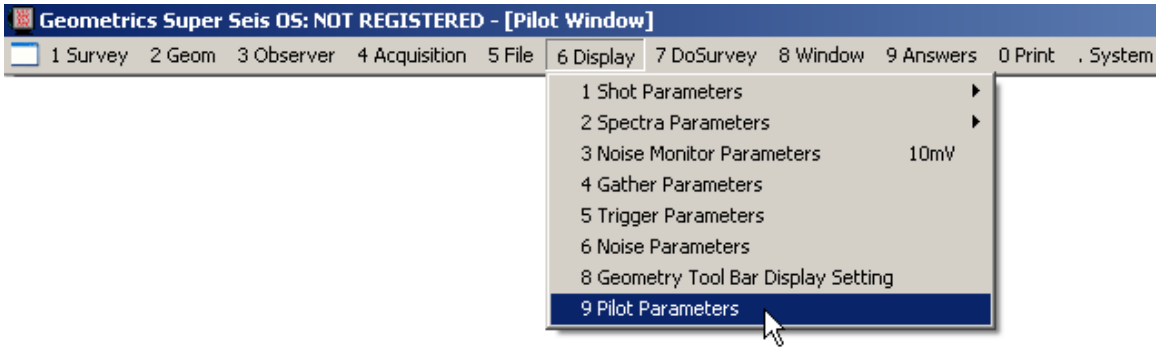
2.6.7 GEOMETRY TOOL BAR DISPLAY SETTINGS



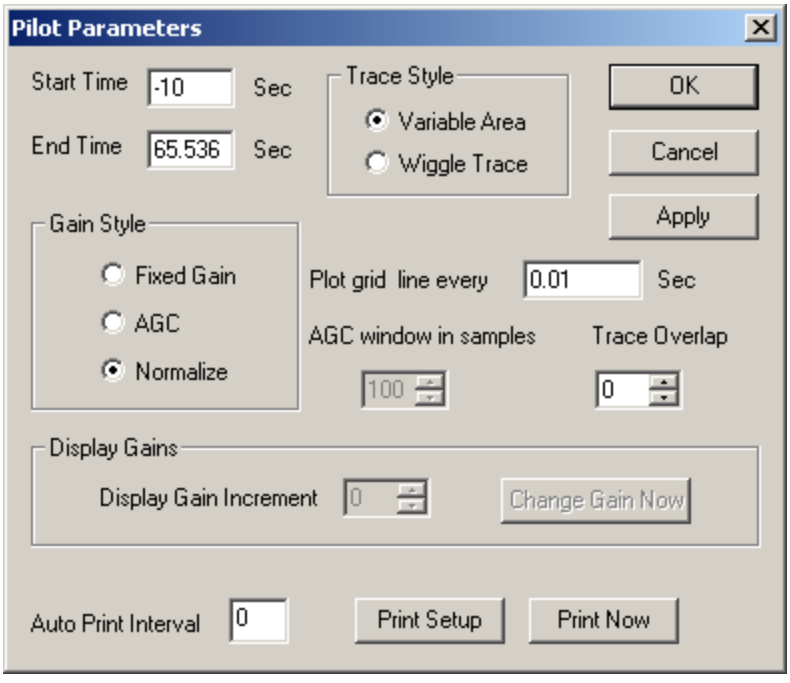


This dialog box allows you control the items included in the Geometry GUI described on Page 149

2.6.8 PILOT PARAMETERS (MGOS, NZOS)



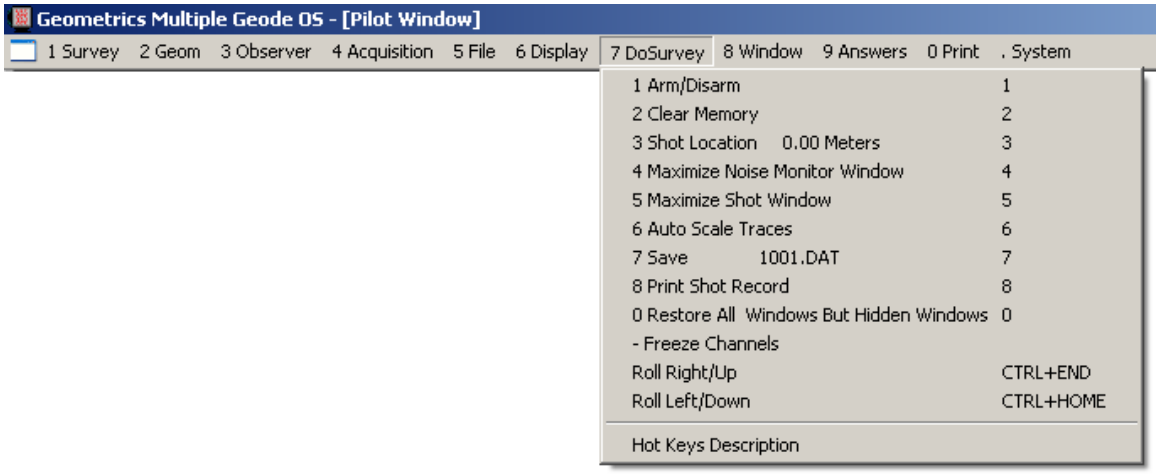
Selecting Pilot Parameters will bring up the following:



This allows you to control the appearance of the Pilot Window (Page 15). The display parameter controls are identical to those for the Shot Window and are discussed beginning on Page 71.

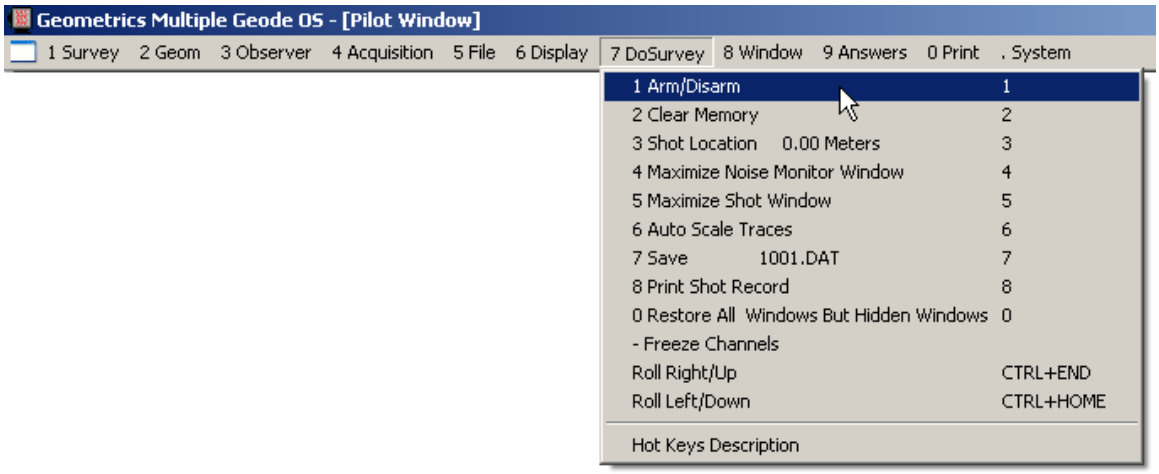
Note: *It is generally recommended that the pilot trace be displayed with* Fixed Gain *enabled and all filters disabled.*

2.7 DOSURVEY MENU



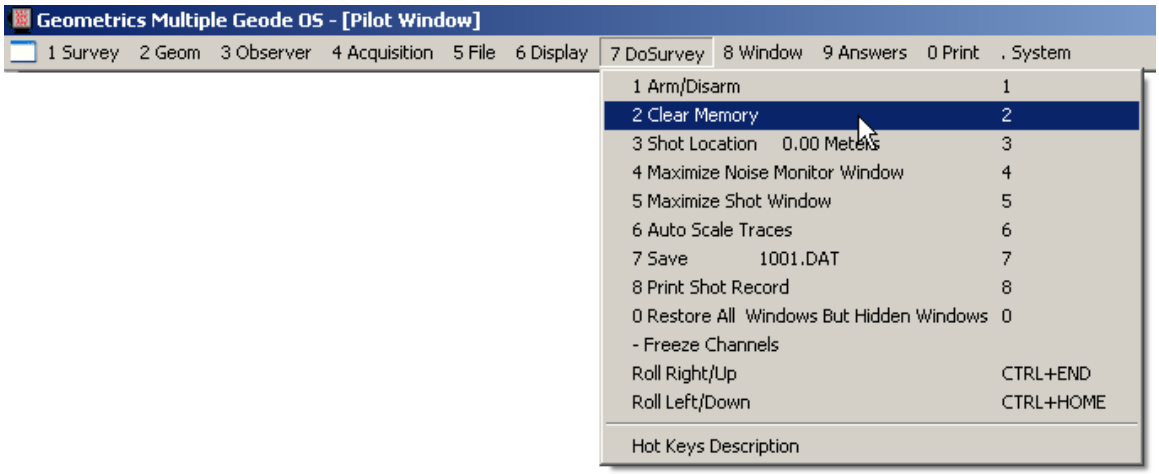
Once the system is set up, most of your interaction with the seismograph will be via the DoSurvey menu. This is the menu that appears by default whenever you press the **MENU** key on the StrataVisor/SmartSeis keypad or **ALT-7** on a laptop. Some items, such as Shot Location and Auto Scale Traces, are redundantly located here for convenience. Most of the items in the DoSurvey Menu are available as hot keys; those that are *global* hot keys are labeled to the right. These are worth memorizing; you will find them quite handy. See Table 6 on Page 103 for a summary of hot keys and their functions.

2.7.1 ARM/DISARM TOGGLE (HOT KEY: 1)



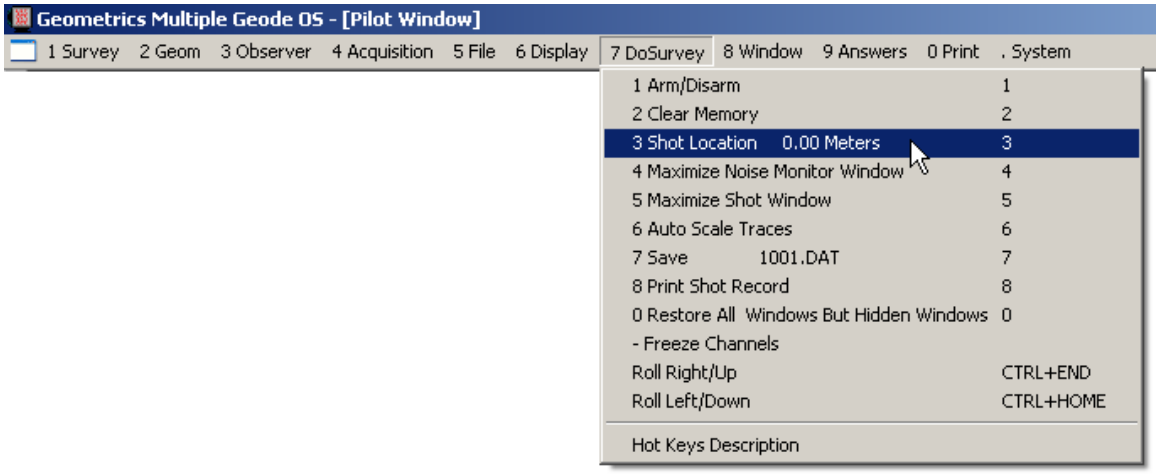
This is a toggle switch that toggles between an armed and disarmed state. When armed, the Status Bar (Page 19) at the bottom of the screen will be green; when disarmed, it will be red. ARMED or DISARMED will appear in the lower left.

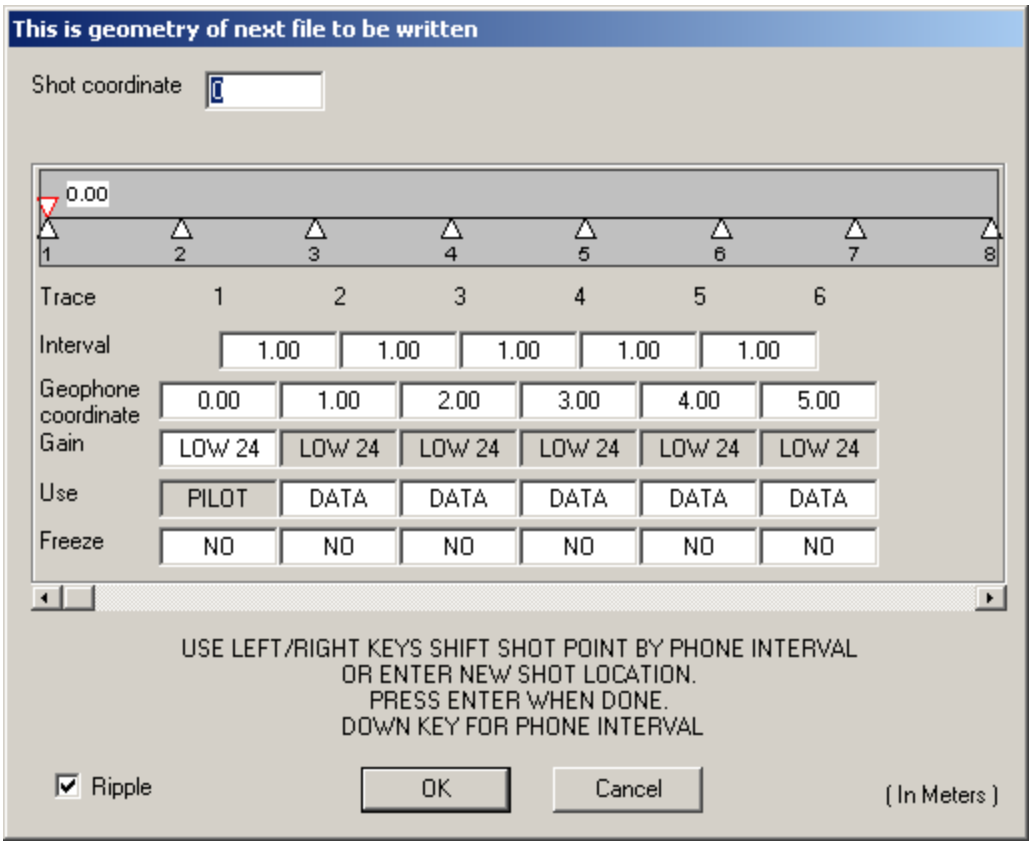
2.7.2 CLEAR MEMORY (HOT KEY: 2)



Clear Memory will clear the shot record from memory, either one you have just acquired or one you have read in (it will **not** delete it from the hard drive). If it has just been acquired and has not been saved to disk, you will be warned to that effect and be given a chance to save the record. If you are in Auto Save mode (Page 65), it is not necessary to clear the data after it is saved; it will be replaced by the first stack of the next shot.

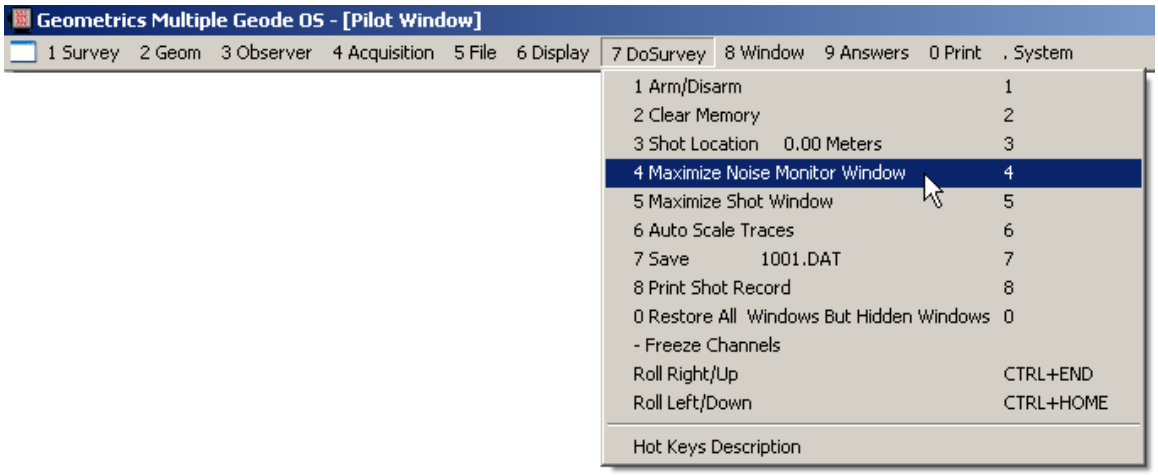
2.7.3 SHOT LOCATION (HOT KEY: 3)





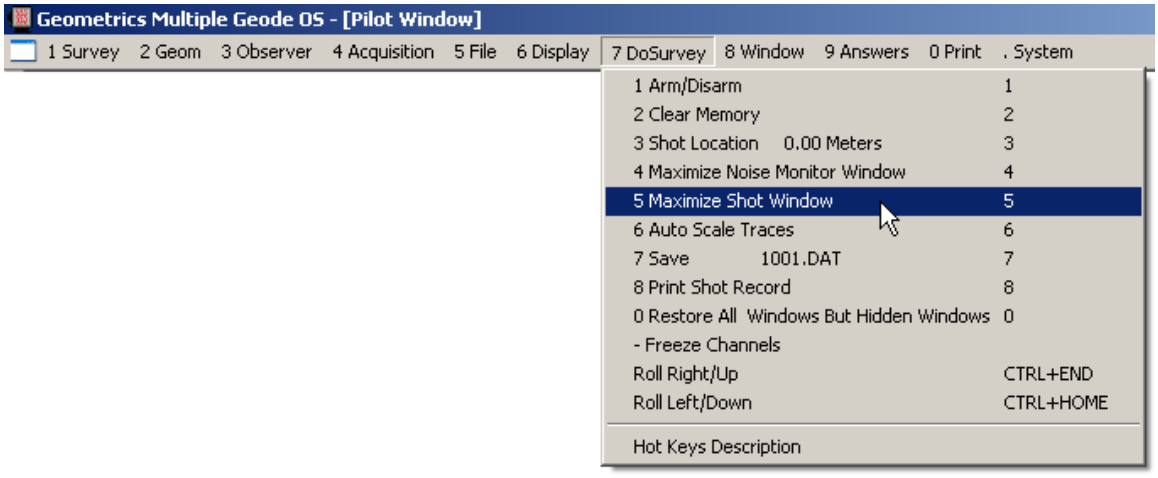
Selecting Shot Location displays the Geometry Menu, with the current Shot Location highlighted for easy manual update.

2.7.4 MAXIMIZE NOISE MONITOR WINDOW (HOT KEY: 4)



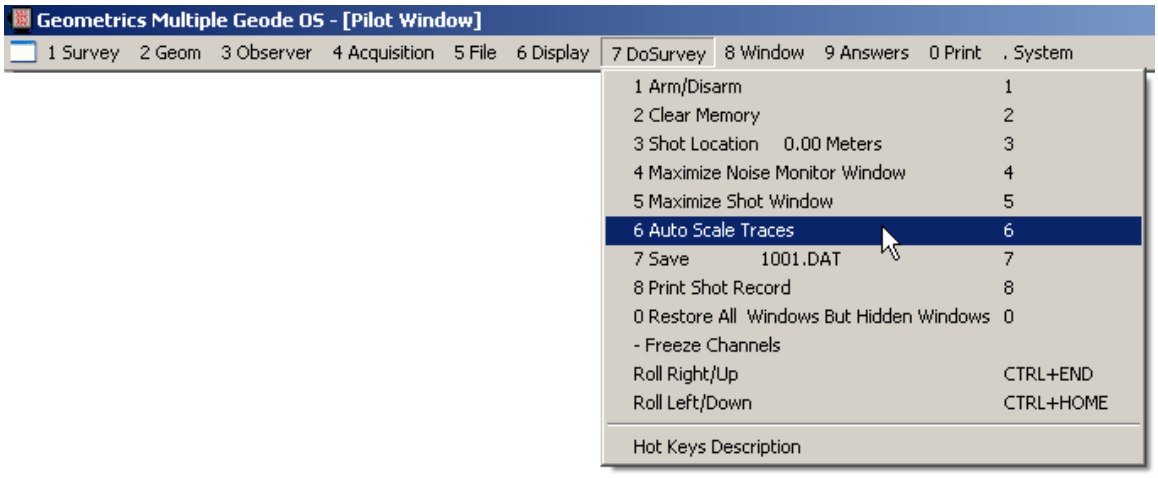
This selection is self-evident; no other windows will be displayed. The Noise Monitor Window shows the real time output from signals from the geophones. See Pages 13 and 83 for additional information.

2.7.5 MAXIMIZE SHOT WINDOW (HOT KEY: 5)



This is similar to the above. Only the Shot Window will be displayed.

2.7.6 AUTO SCALE TRACES (HOT KEY: 6)

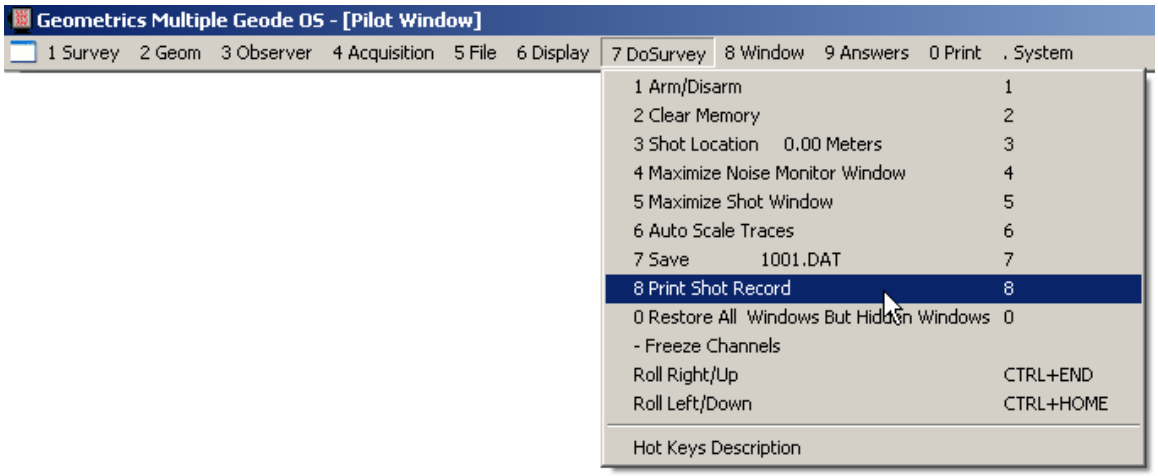


See Page 77 for a description of this feature.

2.7.7 SAVE (HOT KEY: 7)

You must manually save each record you wish to keep unless Auto Save is enabled. Note that there is a subtle difference in operation depending on whether you are saving data manually or automatically. It Auto Save mode, once the stack limit is reached, the data will be saved, and the next shot will replace the existing data and the stack count will be reset to 1. There is no need to clear data between shot points. In manual save mode, you must clear the memory after saving. If you don't, the first stack of the next shot point will simply be summed with the previous record. See Page 66 for further discussion of the Auto Save feature.

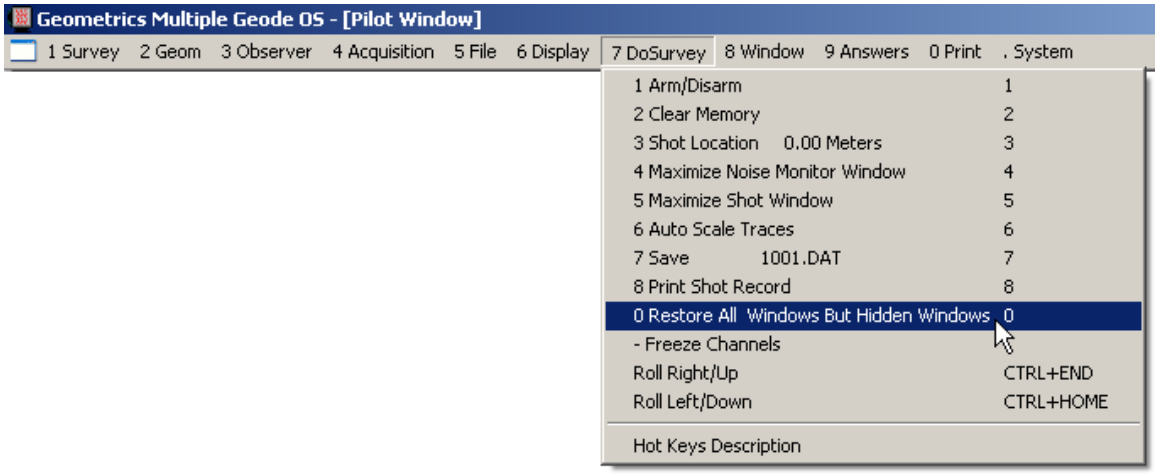
2.7.8 PRINT SHOT RECORD (HOT KEY: 8)



Print Shot Record simply prints the shot record in memory. This can be new data or data that have been read from storage. The data will be plotted according to the parameters set in the

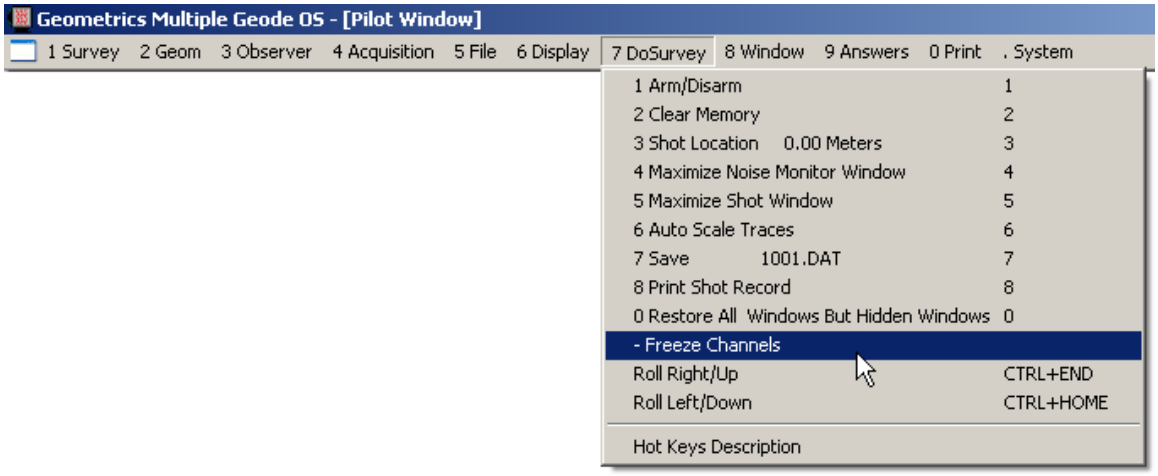
Display (Page 71) and Print (Page 113) menus. On the StrataVisor and SmartSeis, you may abort a print operation by pressing the **CLR** key.

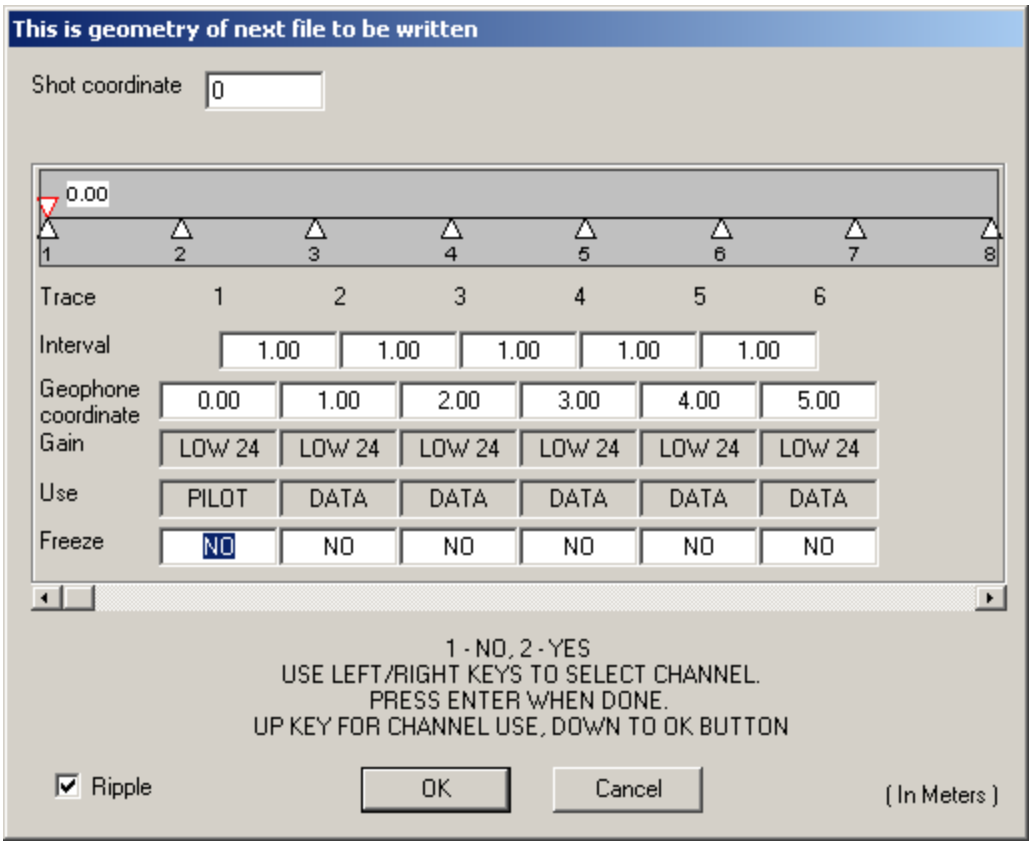
2.7.9 RESTORE ALL WINDOWS BUT HIDDEN WINDOWS (HOT KEY: 0)



This selection simply restores the windows back to their previous arrangement. It is useful after you have maximized a window. For instance, if you press **5** to maximize the Shot Window, pressing **0** will return the Shot Window to its previous size.

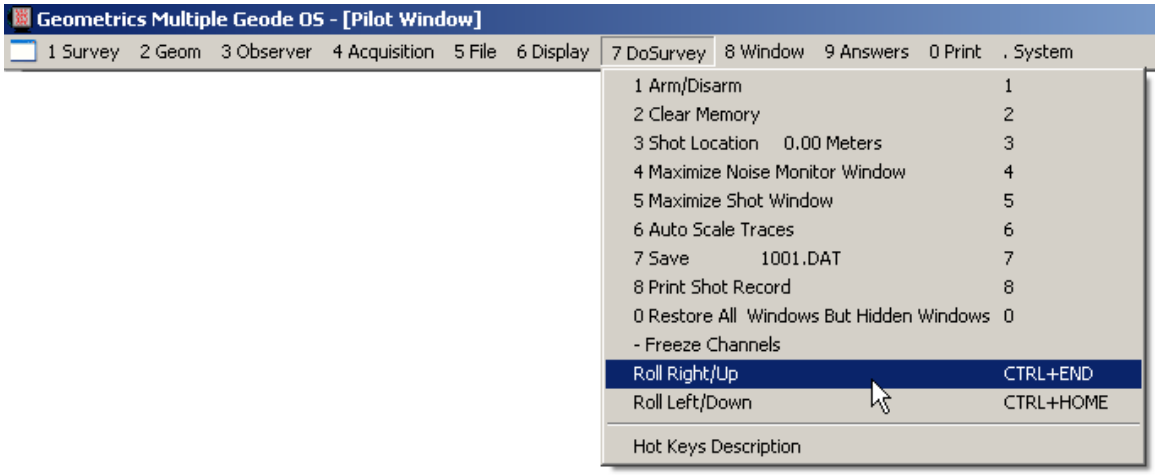
2.7.10 FREEZE CHANNELS





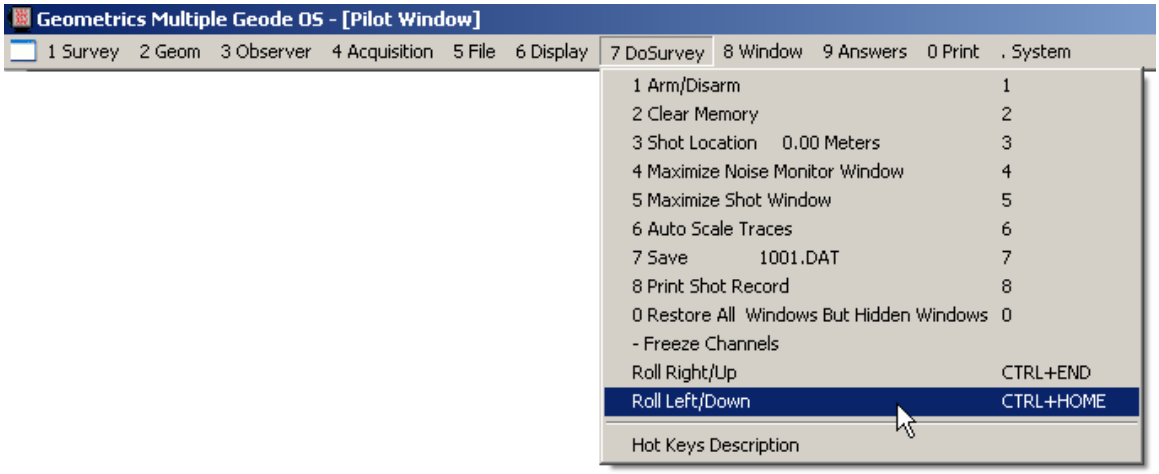
See Page 36 for a discussion of freezing channels.

2.7.11 ROLL RIGHT/UP (HOT KEY: CTRL+END) (MGOS, NZOS)



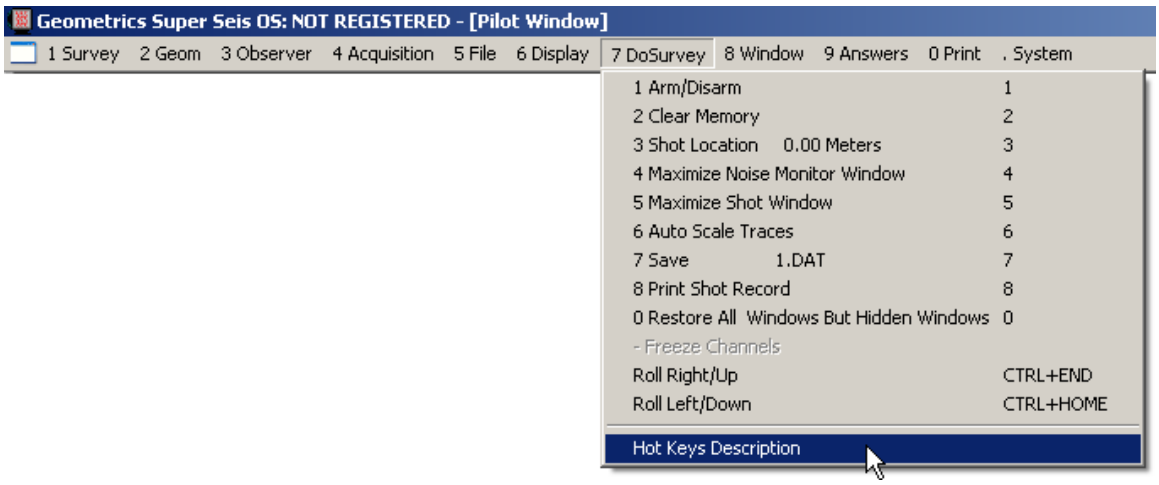
See Page 38 for a discussion of rolling.

2.7.12 ROLL LEFT/DOWN (HOT KEY: CTRL+HOME) (MGOS, NZOS)



See Page 38 for a discussion of rolling.

2.7.13 HOT KEYS DESCRIPTION



A complete summary of hot keys follows. Refer to this list at any time for a description of the various hot keys that are available with SCS.

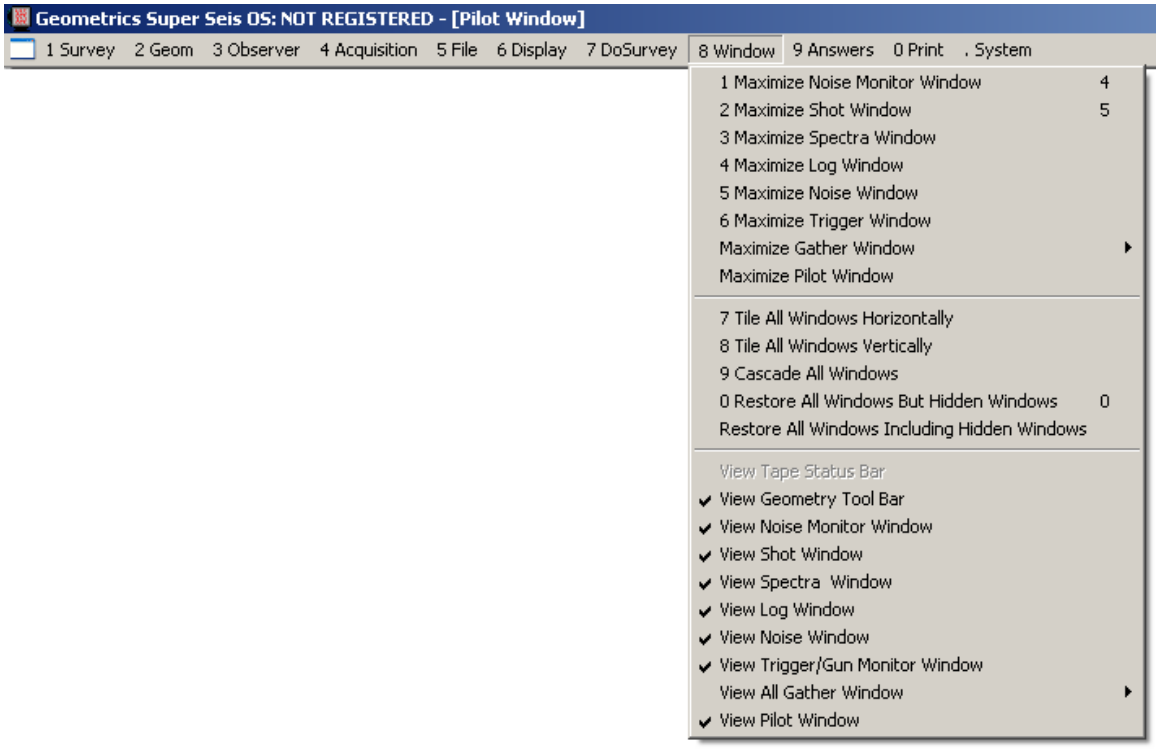
Hot Keys		
Hot Key	**Function**	**Active Window**
1	Arm/disarm toggle	Global – independent of which window is active
2	Clear shot record	
3	Shot location	
4	Maximize Noise Monitor Window	
5	Maximize Shot Window	
6	Auto scale traces	
7	Save data	
8	Print shot record	
9	QC correlate	
0	Restore windows	
TAB	Toggle active window	
CTRL+END CTRL+1	Roll up/right	
FUNC+1	Roll up/right (StrataVisor/SmartSeis)	
CTRL+HOME CTRL+7	Roll down/left	
FUNC+7	Roll down/left (StrataVisor/SmartSeis)	
t	Manual trigger	
↑ ↓	Scroll up/down	Shot Window
PAGE UP/PAGE DOWN	Compress/expand time scale	
FUNC+↑/ FUNC+↓	Compress/expand time scale (StrataVisor/SmartSeis)	

Table 6: List of hot keys and their functions.

Hot Keys (continued)		
Hot Key	**Function**	**Active Window**
→	Adjust all trace sizes (if in Fixed Gain) Change gain style (if in AGC or Normalize)	Shot Window
←	Adjust individual trace sizes (if in Fixed Gain) Change gain style (if in AGC or Normalize)	
-	Toggle trace clipping	
↑ ↓	Scroll up/down by one line	Log Window
PAGE UP/PAGE DOWN	Scroll up/down by one screen	
FUNC+↑/FUNC+↓	Scroll up/down by one screen (StrataVisor/SmartSeis)	
HOME/END	Scroll to beginning/end	
FUNC+→/FUNC+→	Scroll to beginning/end (StrataVisor/SmartSeis)	
↑ ↓	Increase/decrease data channel sensitivity	Noise Window
→ ←	Increase/decrease pilot channel sensitivity (if enabled)	

Table 6: List of hot keys and their functions (continued).

2.8 WINDOW MENU



The Window Menu allows you to control the appearance of your screen. It is divided into three parts. The top portion lists all of the available windows; left-clicking on any of these will cause the selected window to be maximized (note that the Noise Monitor and Shot windows can be maximized by their hot keys; see Table 6 on Page 103).

The second section is standard Windows™ fare, with the exception of the Restore commands. Restore All Windows But Hidden Windows (hot key: **0**) is discussed on Page 99. Restore All Windows Including Hidden Windows will include any windows that had been hidden previously (see below).

The third section is a series of toggle switches that allows you to specify which windows and tool bars to have as part of your overall display. Any window or tool bar that is not checked here will be left out of your display ("hidden"), unless you choose Restore All Windows Including Hidden Windows or if you chose to maximize that window (the "maximize" command applies to all window, including hidden windows).

Note: *Pressing the* _ *or* ✕ *in the upper right-hand corner does not disable the window, but merely minimizes it.*

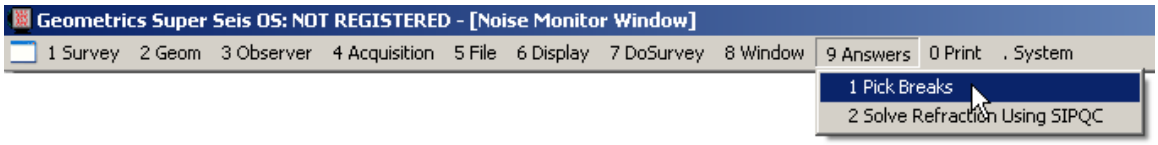
Note: *Pressing* ✕ *in the upper right-hand corner of the Survey Log Window terminates the survey.*

2.9 ANSWERS MENU (MGOS, NZOS, SGOS, STOS, ESOS)

The Answers Menu provides refraction interpretation tools. Remember, in order to use the utilities in this menu, you must enter the geometry accurately in the geometry menu.

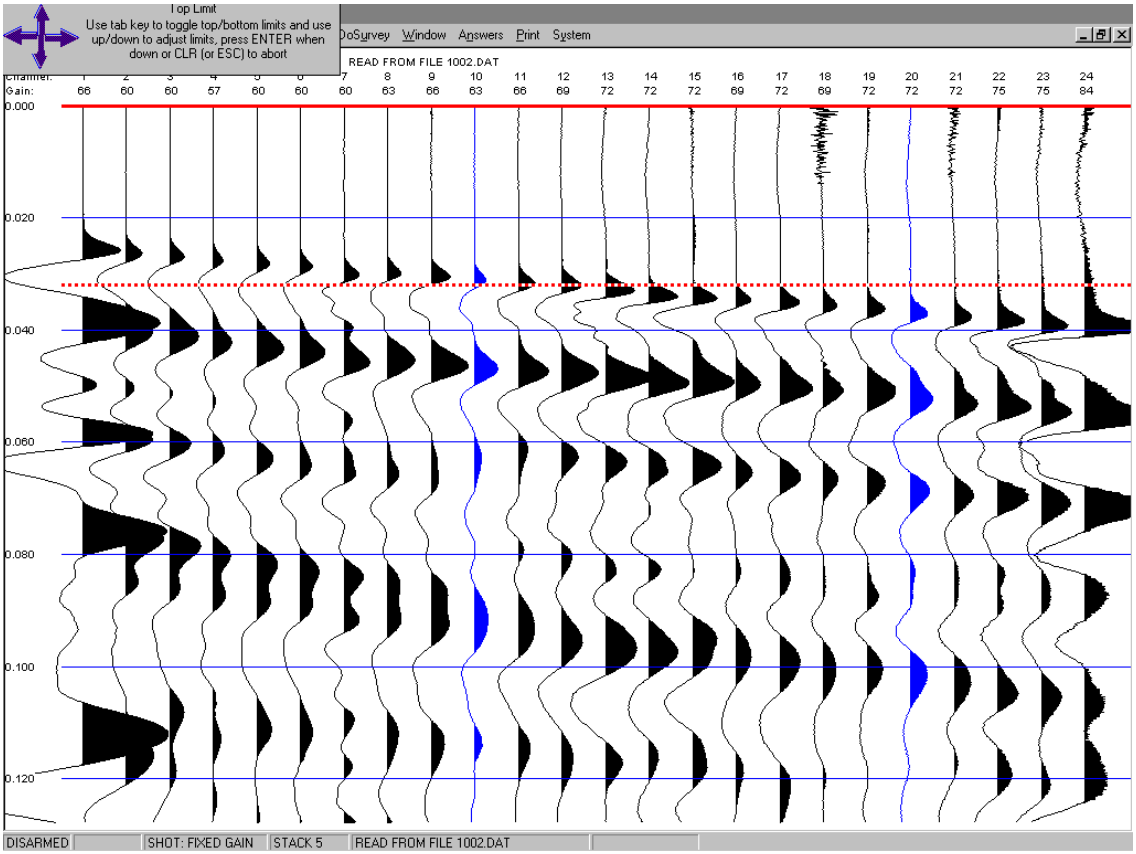
Note: *This section assumes a pre-existing understanding of the basics of seismic refraction analysis.*

2.9.1 PICK BREAKS (MGOS, NZOS, SGOS, STOS, ESOS)



The first step in analyzing refraction data is to identify the first arrivals of seismic energy on each trace. These first arrivals are identified as the first position where the trace deflects from a straight line. There is an automatic first break picker in the software that will help you identify the first break position. However, it will only work well when the picks (first arrivals) are very distinct.

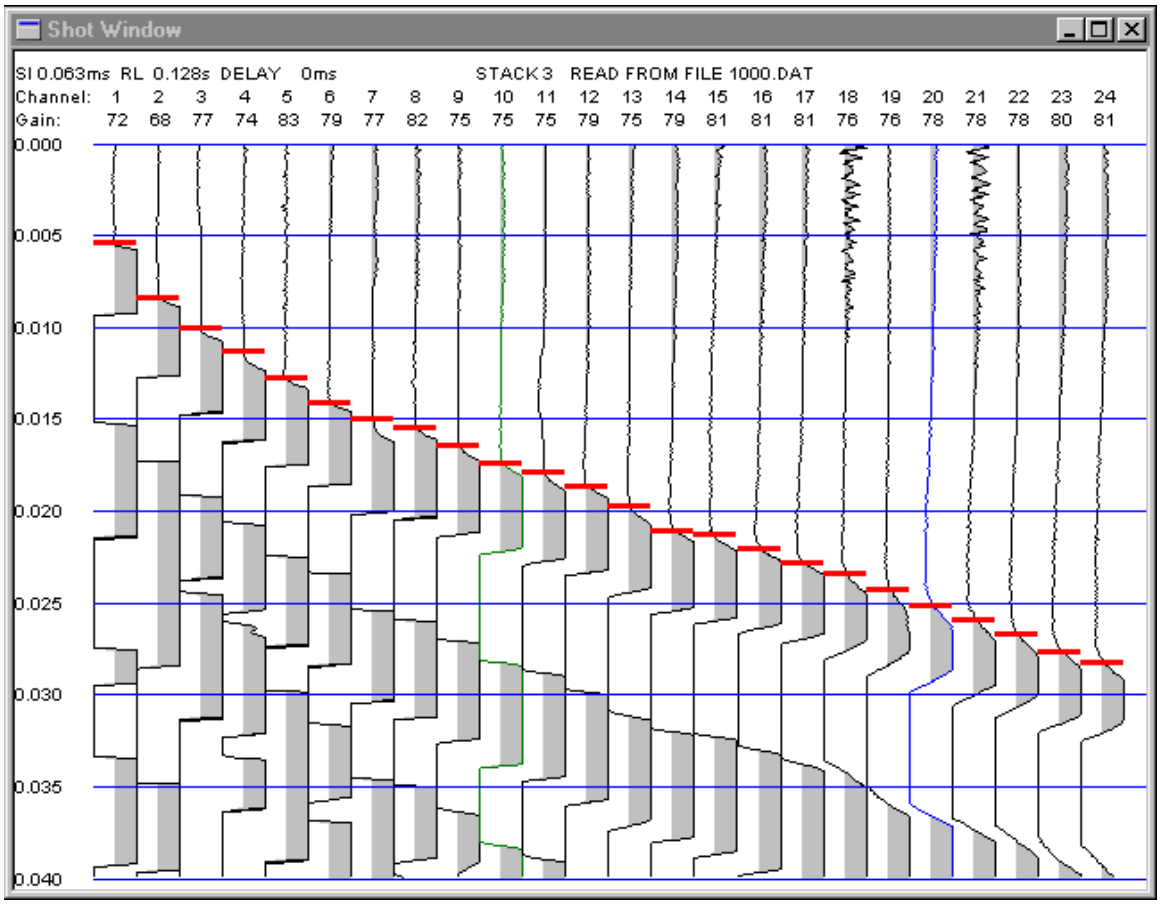
First, you will be asked to roughly identify the beginning and end of the area on the seismic record that contains the first arrival of energy. A solid and a dashed red line will be shown horizontally on the screen.



Use the arrow keys to move the top red line to just above the area that contains the first arrivals. Press the **TAB** key which toggles control to the other red line used to define the bottom of the pick area. This line is now made solid and can be adjusted to be just below the first break picks.

After you are satisfied with setting the pick boundary, press Enter and the seismograph will automatically pick the first breaks by putting a red marker on each trace.

The trace for the geophone nearest the impact point should have clear, early arrivals. First arrivals on traces from geophones further away should occur progressively later in time. An example record with first break picks is displayed here.



This is a particularly good set of first arrivals (picks) used for illustration - your data will not be as easy to identify and the automatic picking will likely require some adjustment. You will be offered the option of manually editing the first break picks. If you choose to do so, the trace you are operating on will be colored differently and the arrow keys can be used to move the pick up or down the display. Adjust your picks until they are similar to the ones shown above. It may be necessary to again go to the Display Menu and adjust the individual display gains to make the picks easier to see and edit.

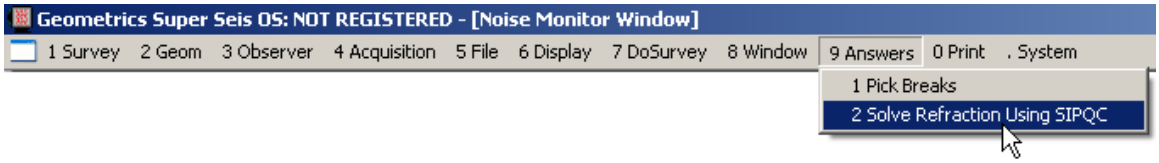
After you have selected all of the first arrivals of energy, the picks can be saved on disk by pressing Enter. The pick file will be saved with the same name as your data file, but with the extension '.bpk.' These files can be retrieved later for interpretation.

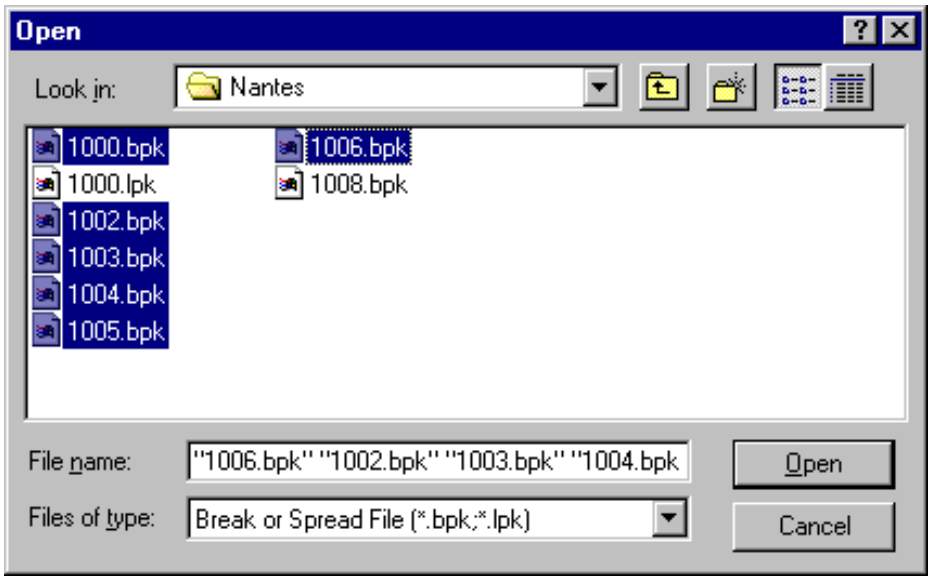
2.9.2 SOLVE REFRACTION USING SIPQC (ESOS, SGOS, STOS, MGOS, NZOS)

SIPQC is an interactive refraction interpretation program. It was originally developed by the United States Geological Survey, and a field QC version is embedded in SCS.

SIPQC uses first break pick files to generate a velocity cross section of the area under your seismic line. It will calculate a depth at each geophone if the data is of sufficient quality and density, otherwise it will estimate depth under each shot point. Up to 7 shots can be used in the analysis. First, all of the data files must have their first arrivals picked.

Once the first arrivals have been picked and saved, select Answers from the DoSurvey Menu and choose Solve Refraction Using SIPQC.





Choose the folder that contains your refraction data and choose 5 of the data files. You will be asked to give your spread a name that will help you track your interpretation.

Note: *If you are using a StrataVisor NZ or SmartSeis ST, this operation requires the use of the field mouse supplied with the instrument.*

The resulting time-distance graph shows all of the first break picks from each of your picked shot records. Each pick has been replaced with a number indicating the layer that SIPQC believes the first arrival energy came from. Picks from the same shot point are joined by a line.

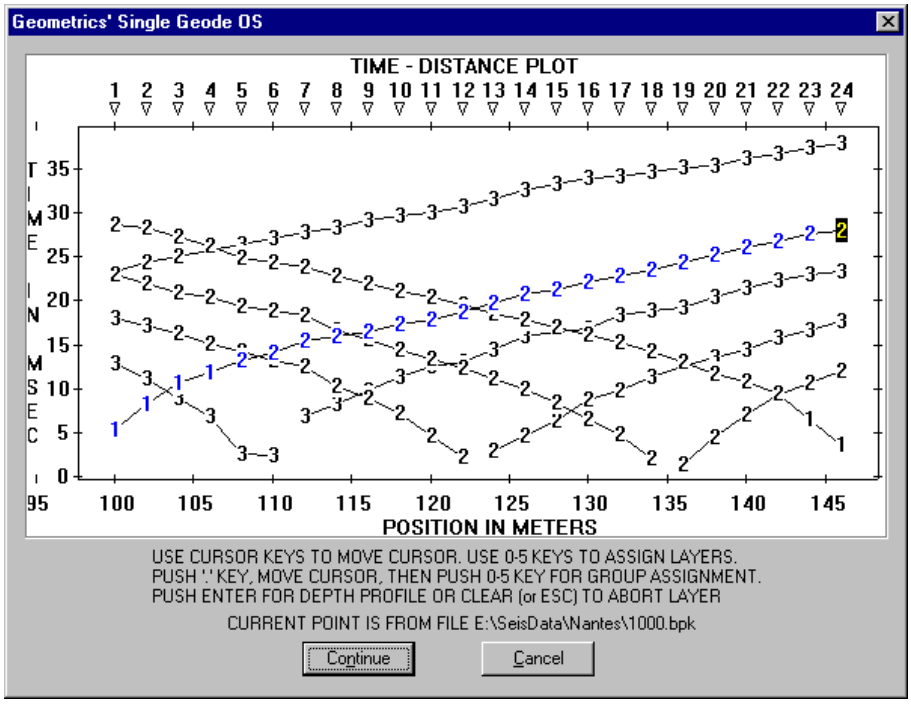


Figure 22: Time-distance plot showing layers assigned by SIPQC.

SIPQC is not perfect at assigning layering and will usually require editing. Use the **Arrow** keys to navigate within and between travel-time graphs, and enter the appropriate layer number for each. Layer numbers have been assigned in the plot below.

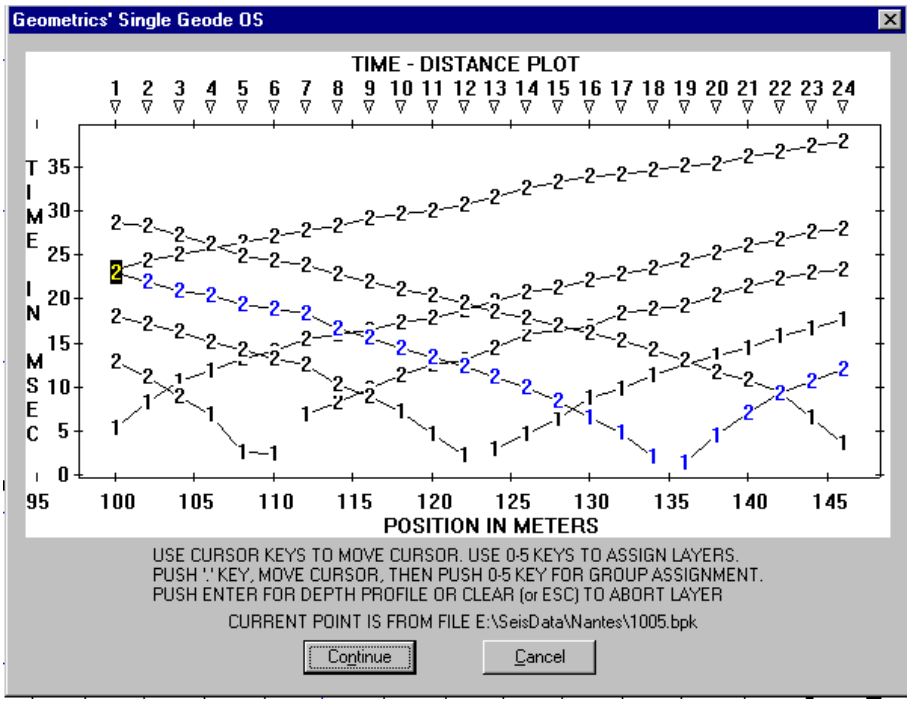


Figure 23: Travel-time plot showing final layer assignments.

Once you are satisfied with the layer assignments, you can calculate the velocity section by pressing Continue. A display similar to the one below will appear, showing a boundary(s) between the assigned layers. Any questionable first break picks will show as question marks on the plot. Letters indicate emergent ray points. For more detail, refer to the SIPQC manual.

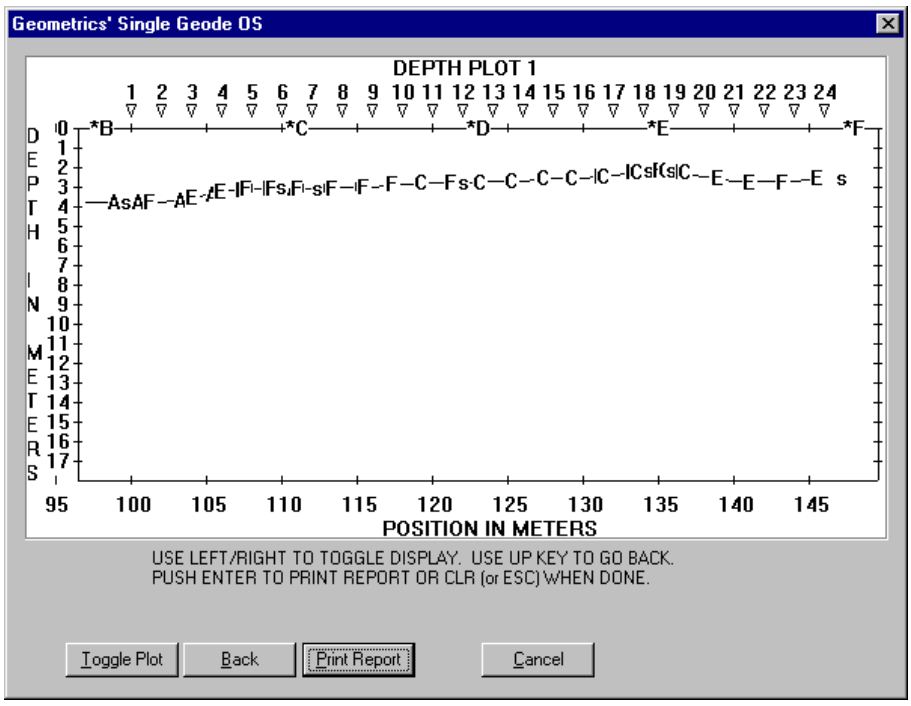


Figure 24: Velocity section showing ray emergent points.

To see a color version of the display with the calculated velocities, press Toggle Plot. The following display will be shown.

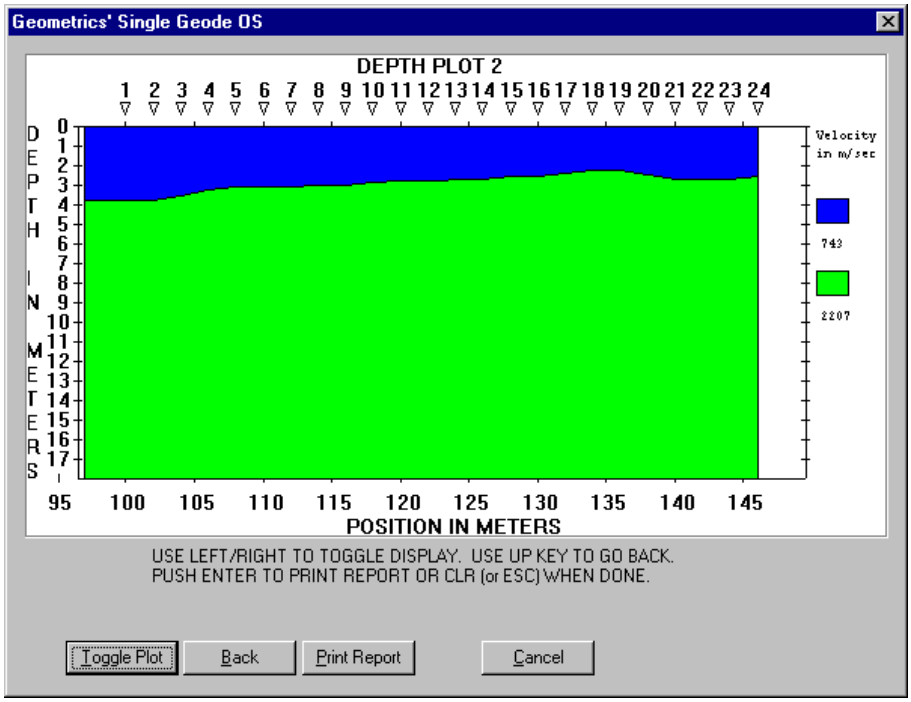
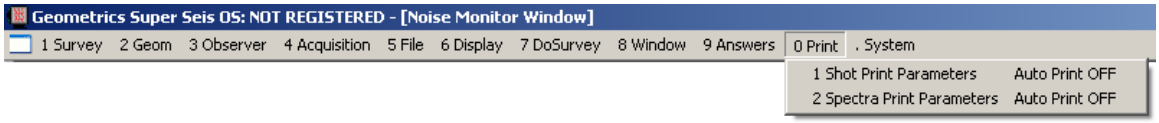


Figure 25: Color version of velocity section.

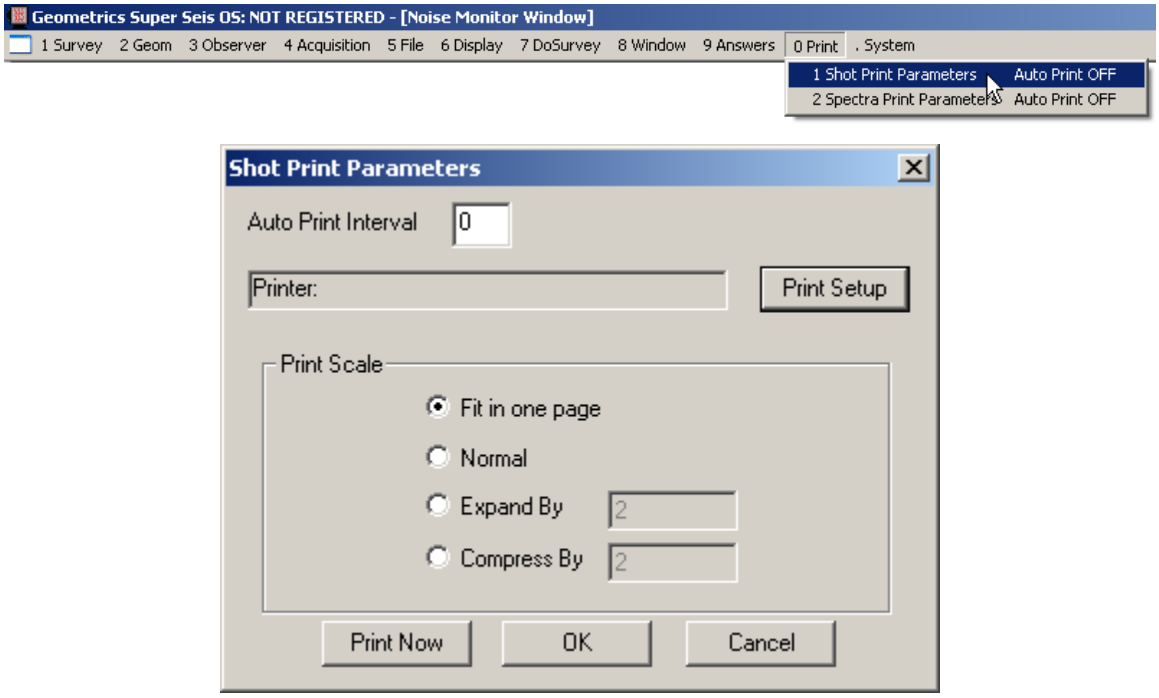
You can return to the layer assignment plot by pressing Back to try other layer assignments reflecting other interpretations. Press Print Report to print the cross section and a table of velocities and depths.

2.10 PRINT MENU

The Print Menu allows you to set up the printing parameters for the shot and spectra records.

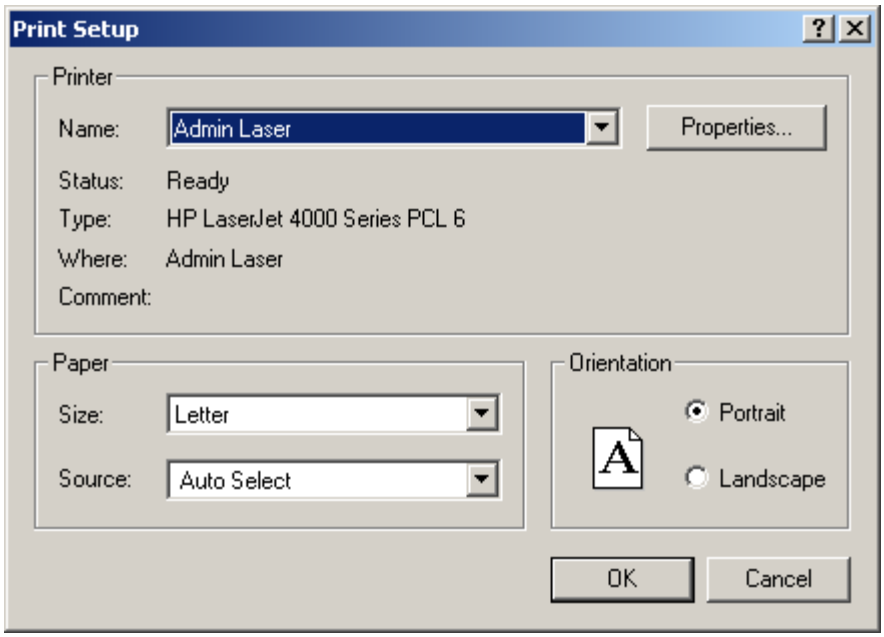


2.10.1 SHOT PRINT PARAMETERS



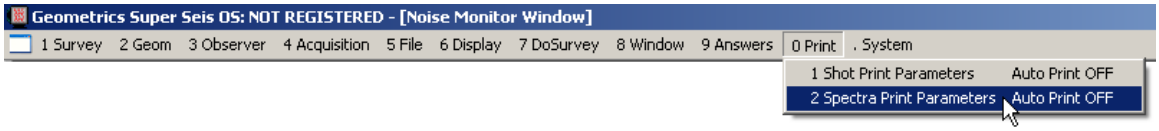
The Shot Print Parameters dialog box allows you to set the Print Scale and the Auto Print Interval. Setting an Auto Print Interval of zero disables this capability. You may also print manually from this box by pressing the Print Now button (it is usually simpler to print from the DoSurvey menu). Print scaling can be selected with the radio buttons. Note that print scaling is separate from the display scaling.

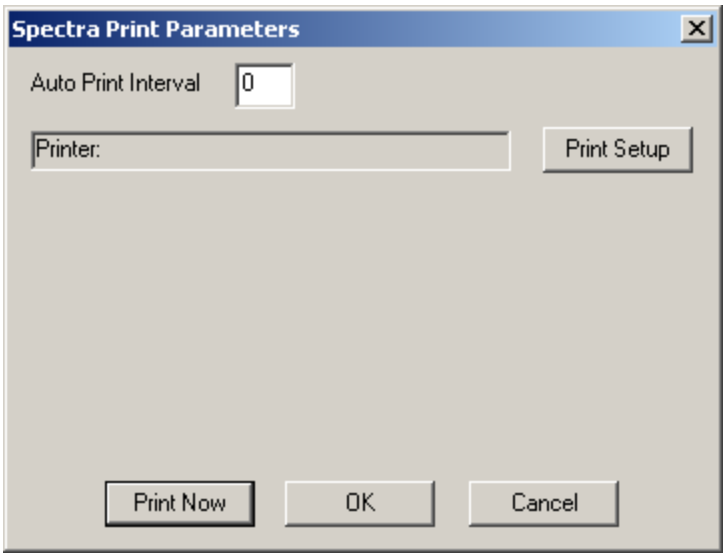
Pressing the Print Setup button will bring up the following dialog box:



If you are using a PC or laptop, you may configure SCS for the appropriate printer here. If you are using a StrataVisor or SmartSeis, your system is already set up to print to the internal thermal printer, and changing the print setup is not recommended.

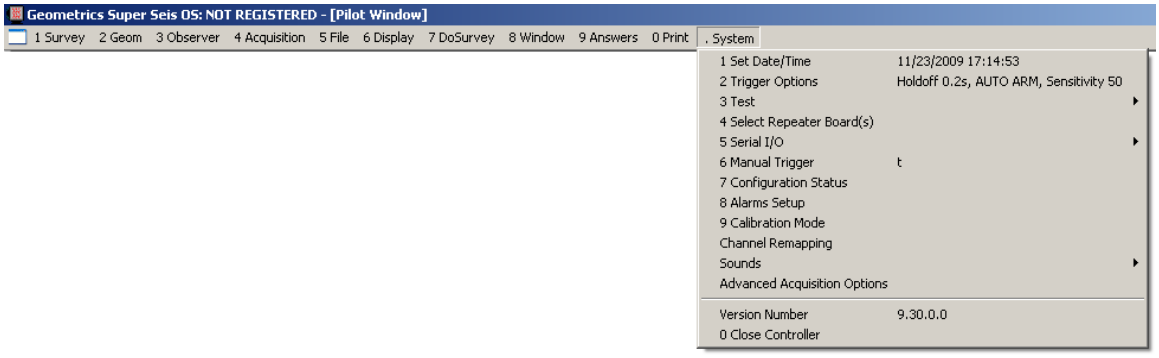
2.10.2 SPECTRA PRINT PARAMETERS (MGOS, NZOS, MMGOS, MNZOS)





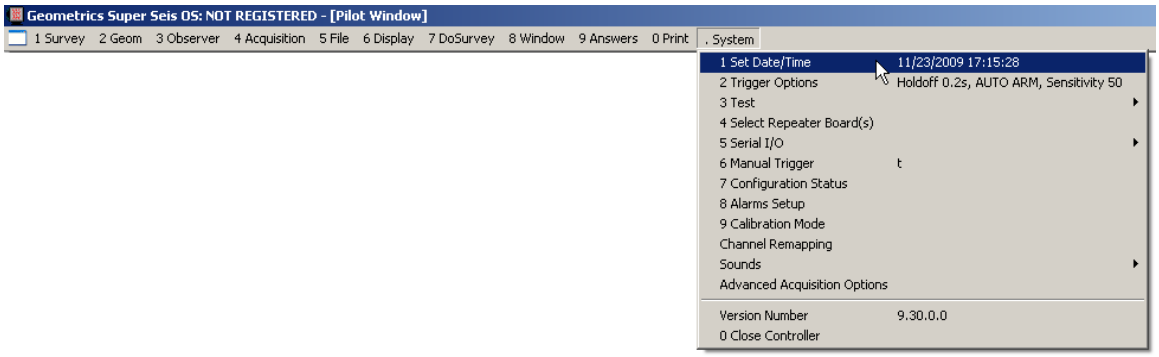
The Spectra Print Parameters dialog box allows you to set the Auto Print Interval and to print the spectra manually.

2.11 SYSTEM MENU

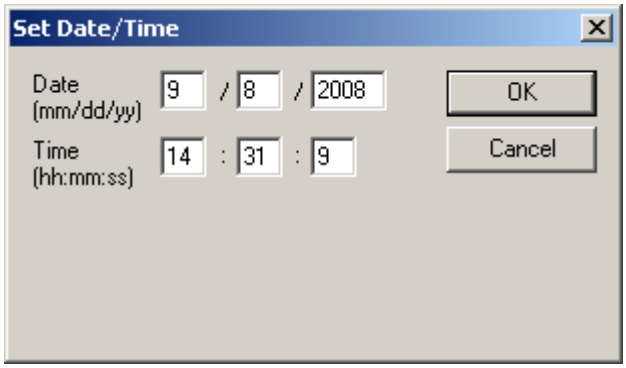


The System Menu contains items that are rarely modified during a survey, including all system tests.

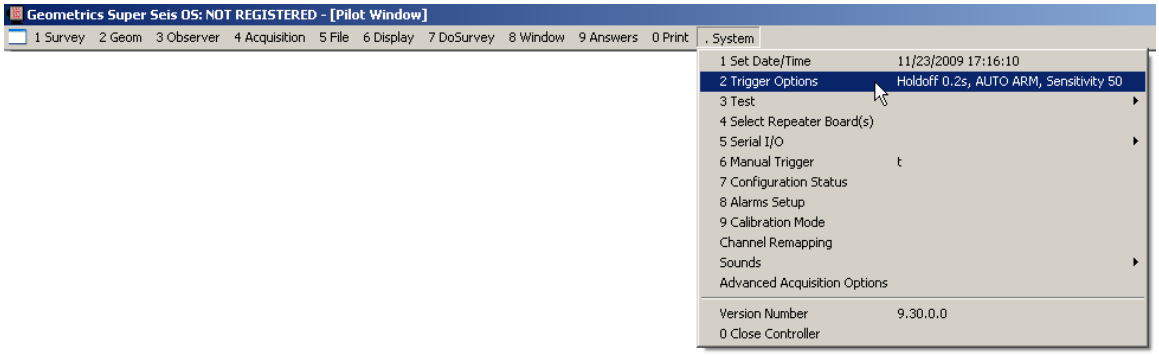
2.11.1 SET DATE/TIME



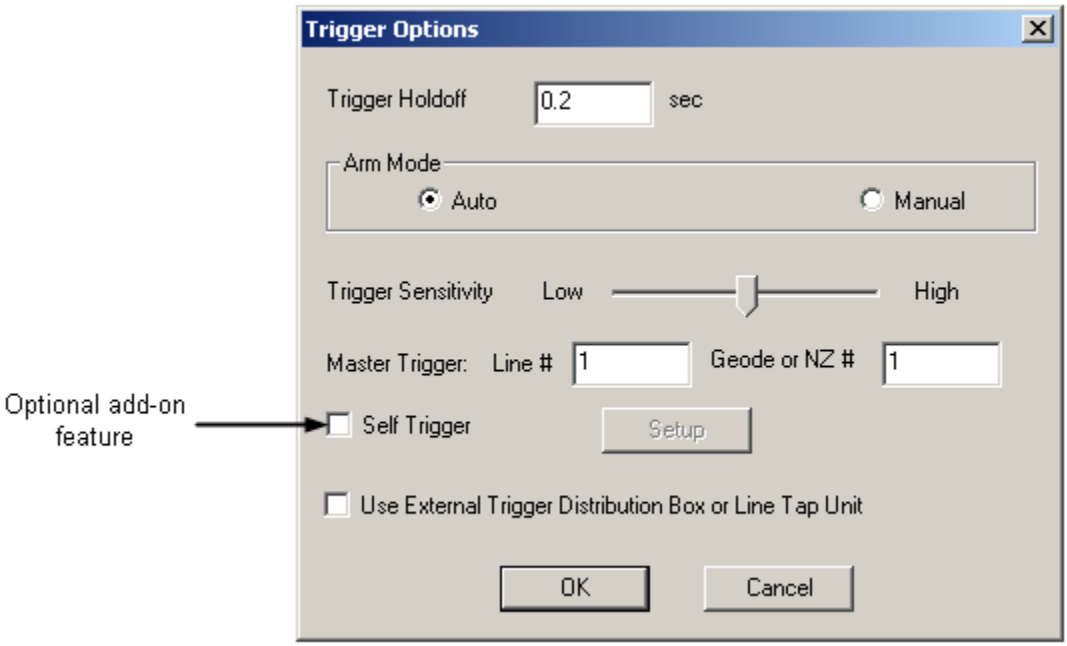
Choose Set Date/Time to bring up the following dialog and set the date and time of the controller PC:



2.11.2 TRIGGER OPTIONS



Selecting Trigger Options will bring up the following dialog:



The Trigger Holdoff is the amount of time the system will wait after the *end* of a record before it will respond to triggers again. For example, a holdoff of 0.2 seconds with a record length of 3 seconds will set an upper limit on the triggering rate of once every 3.2 seconds.

The default Arm Mode is Auto. In this mode, the system will automatically arm itself after each shot. In Manual mode, the system will be disarmed after each shot, and you must manually arm it (Page 92) before shooting.

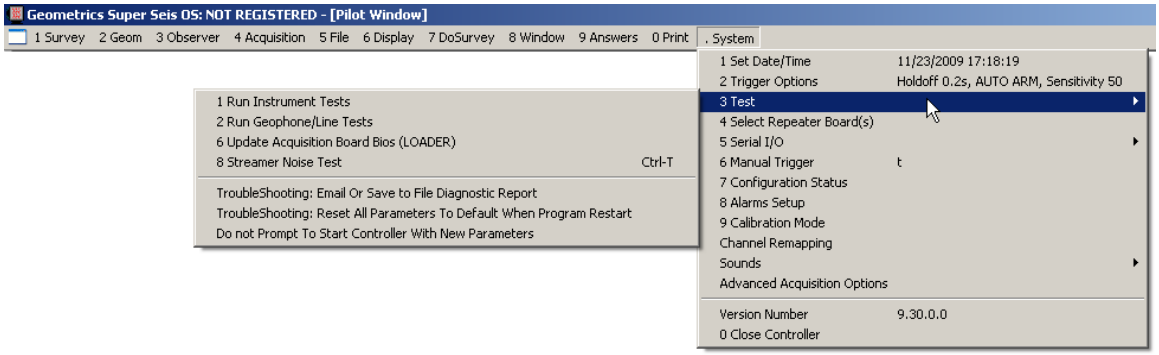
The Trigger Sensitivity can usually be left as shown above. Increase as necessary if your trigger signal is weak – most often this is necessary only when using a geophone to trigger. More commonly, noise on your trigger wire may cause false triggers. In this case, turning the sensitivity down is usually helpful.

Note: *Setting the* Trigger Sensitivity *all the way to* High *will cause the system to trigger continuously as fast as it is able. This is the mode of triggering used in continuous recording applications in which you are* ***not*** *using an external triggering device, such as a GPS clock (see Appendix* ***Error! Reference source not found.****).*

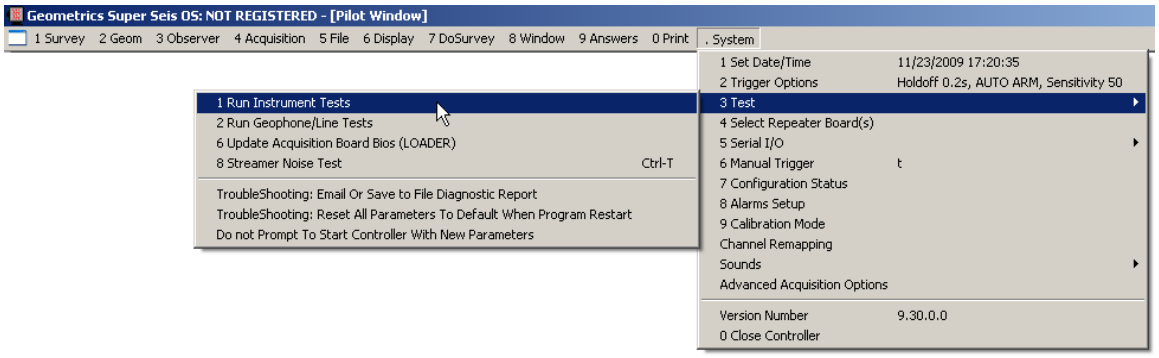
The Master Trigger is the Geode that the trigger line connected to. Type in the appropriate Line # and the Geode or NZ # on that line (see **Error! Reference source not found.** for a discussion of line, Geode, and channel numbering conventions).

If you purchased the Self Trigger feature, see Appendix **Error! Reference source not found.**.

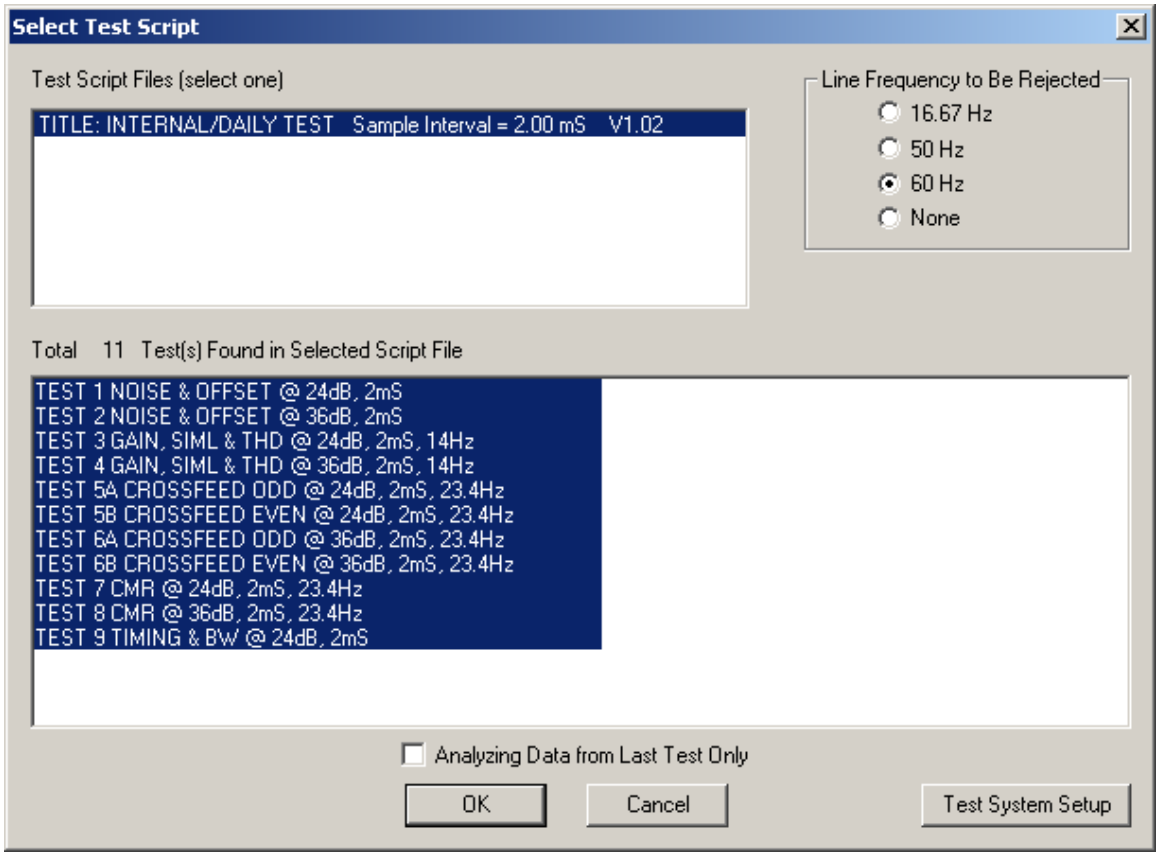
2.11.3 TEST



2.11.3.1 RUN INSTRUMENT TESTS (OPTIONAL ADD-ON FEATURE)



This will run the seismograph self-test to ensure it is performing to specification. This is a comprehensive performance test for daily, weekly or monthly use. The following dialog box will appear when Run Instrument Tests is selected:



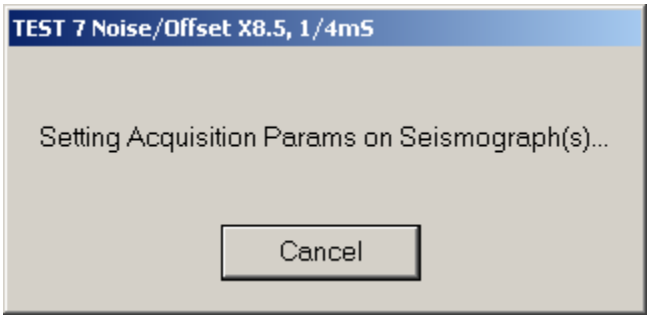
You may select the test script file to be run from the upper window, such as daily or monthly tests (only one test script is shown in the above dialog box), and select individual tests in the lower window if desired.

You may also select which line frequency is to be rejected in the test data analysis.

Test data files will be written to

`[drive]:\TEST_DIR` and analyzed, where [drive] is the drive letter set in the File >> Storage Parameters dialog box (see Page 65).

During the test, you will see a continually-updating message like the following, which will show the progress of the test:



The Log Window (Page 14) will document the testing process:

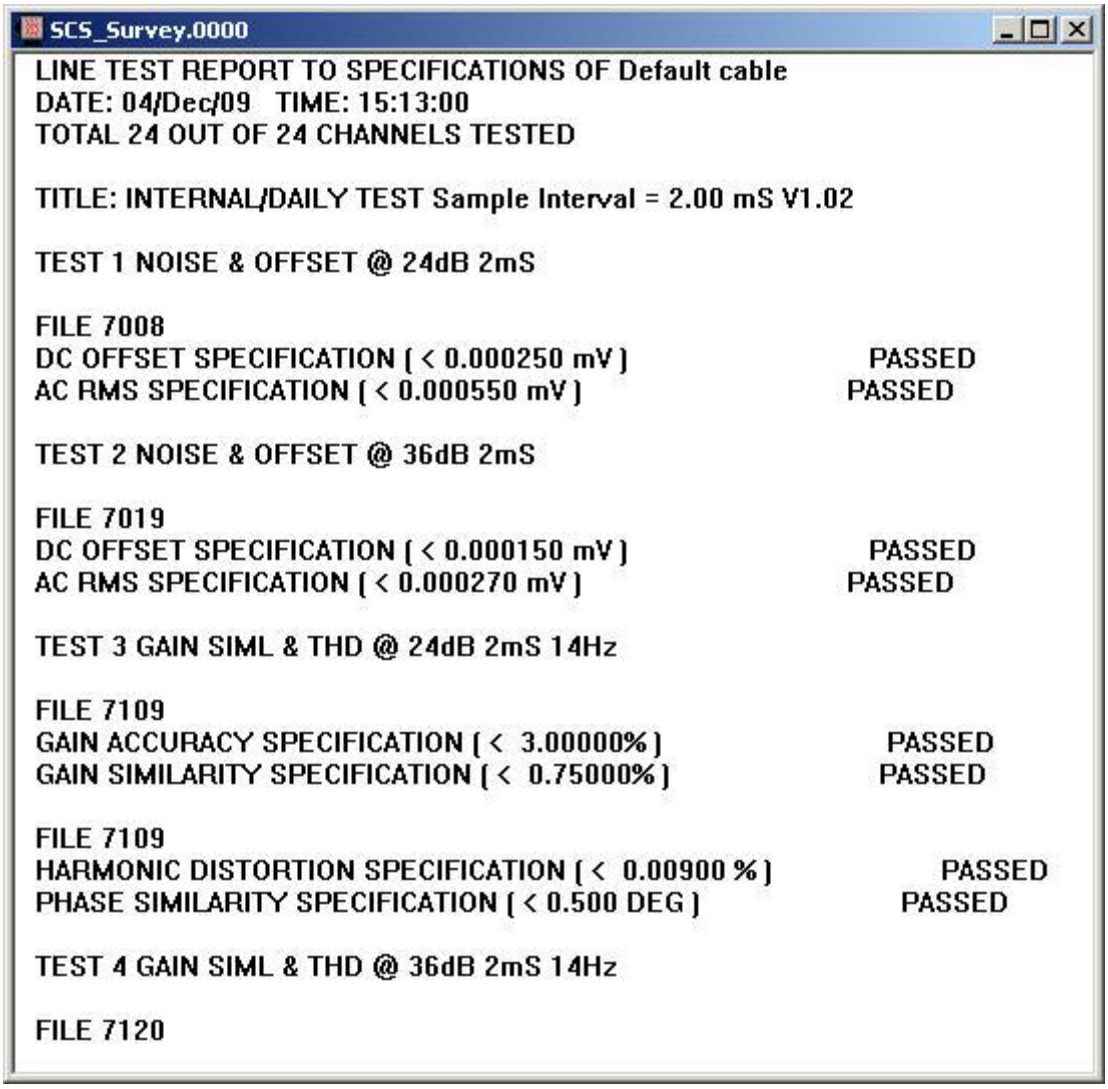
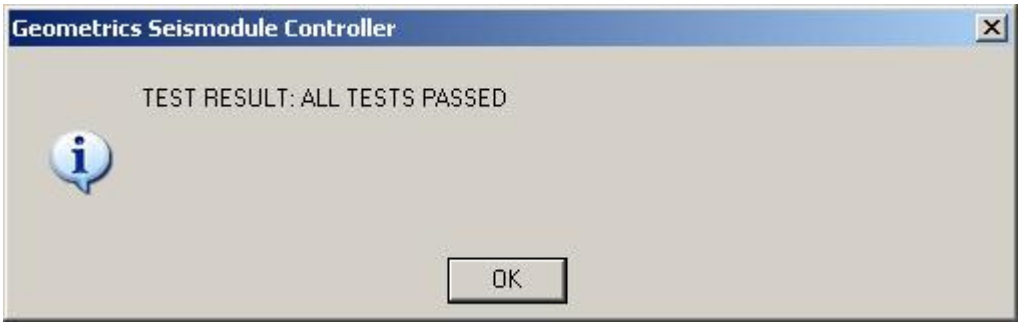
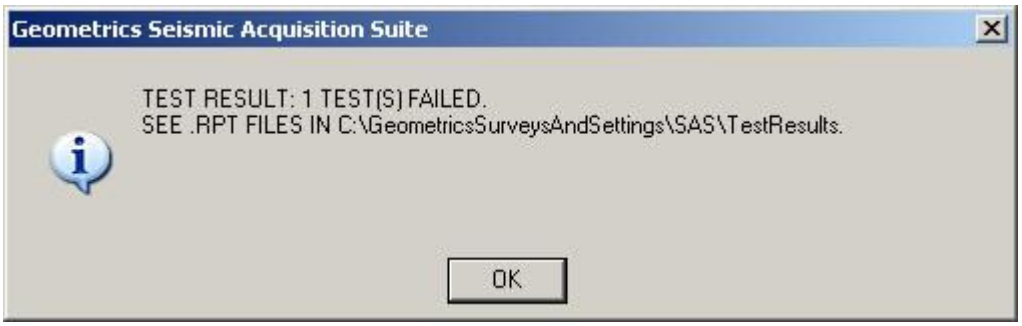


Figure 26: Short-form analog test results written to Survey Log

Hopefully you will see the following message when the test is completed:



If any of the tests failed, you will see something like the following:



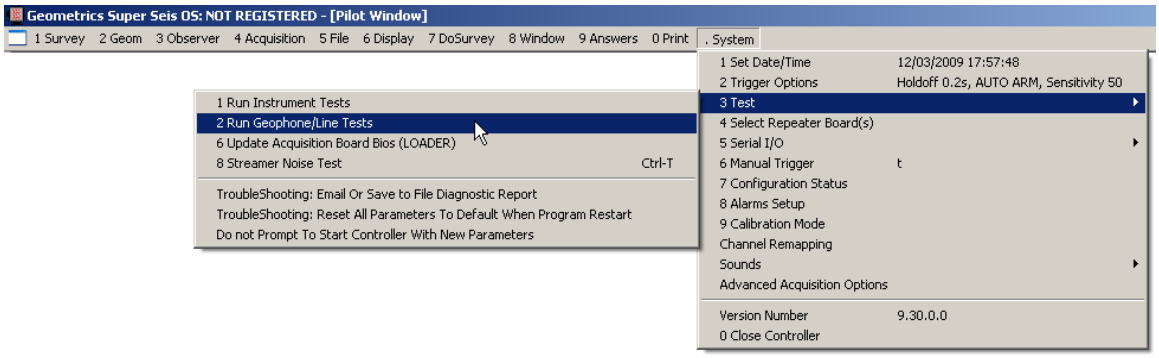
Two ASCII test files are written to TEST_DIR folder. LONG.RPT is comprehensive, while SHORT.RPT is a summary. See **Error! Reference source not found.** for examples of each. In addition, the long version is also written to a .csv file that can be imported into Microsoft Excel. This file is stored in `[drive]:\Logfiles` and is named according to the survey name (Page #) and the date and time of the test. For example:

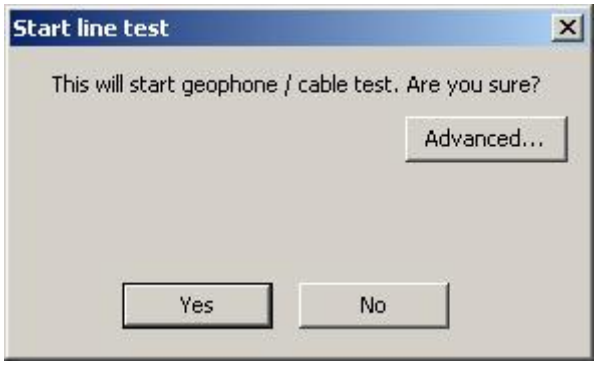
```
D:\Logfiles\PrudhoeBay.0001.04_Dec_09.16_47_17
```

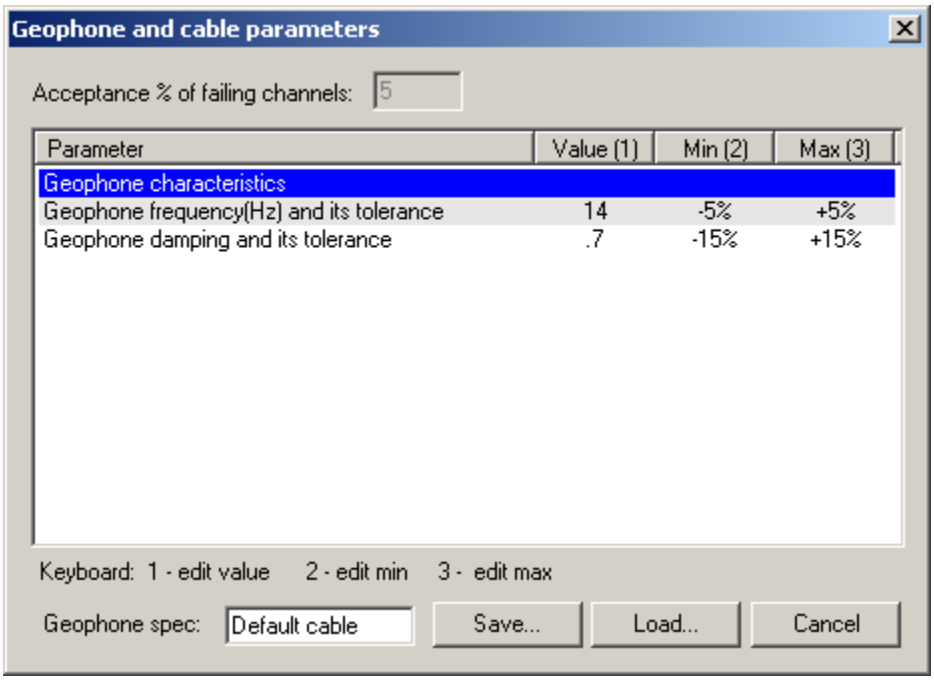
Note: *If subsequent analog tests are conducted within the same survey, the test data files, along with LONG.RPT and SHORT.RPT, will be overwritten. However, the .csv version of the long report will be preserved, and a new one will be created for the present test.*

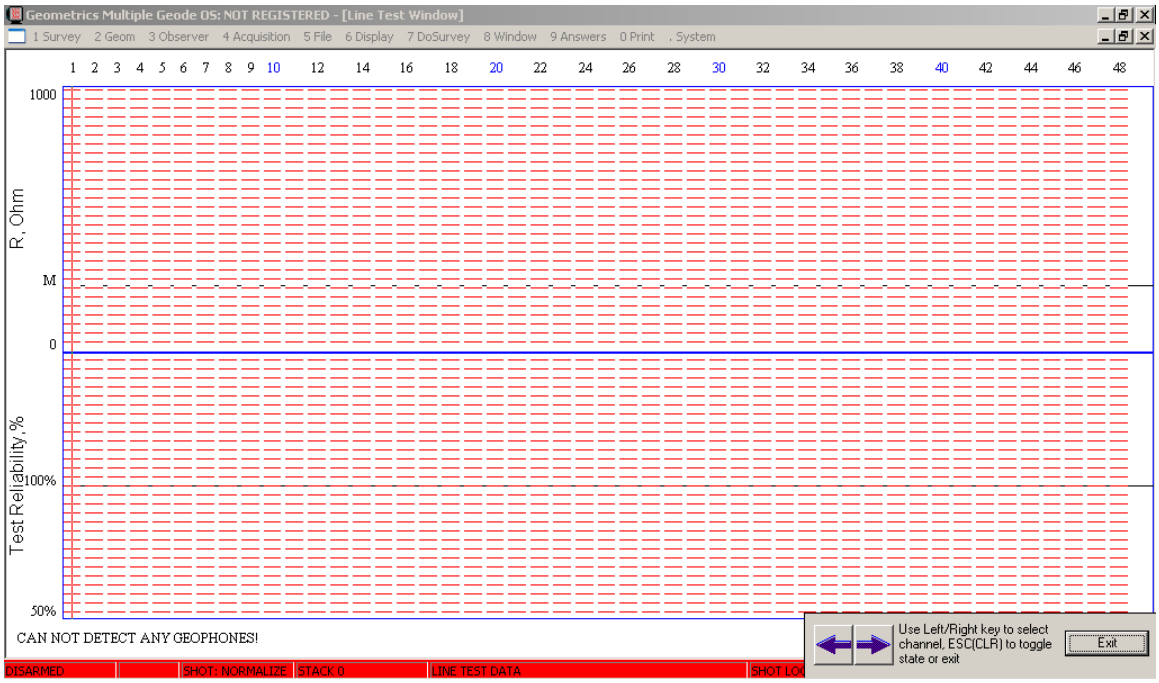
Note: *Only active channels (see Table 2, Page 26) will be tested.*

2.11.3.2 RUN GEOPHONE/LINE TESTS (MGOS, SGOS)



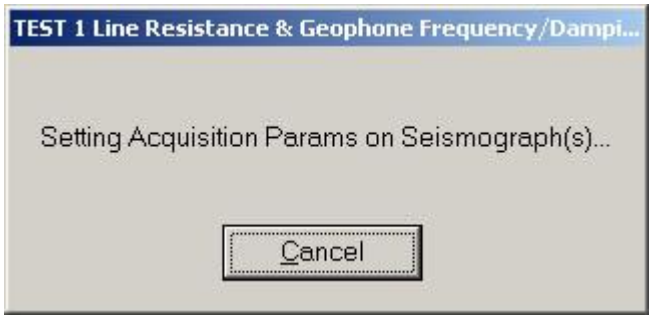




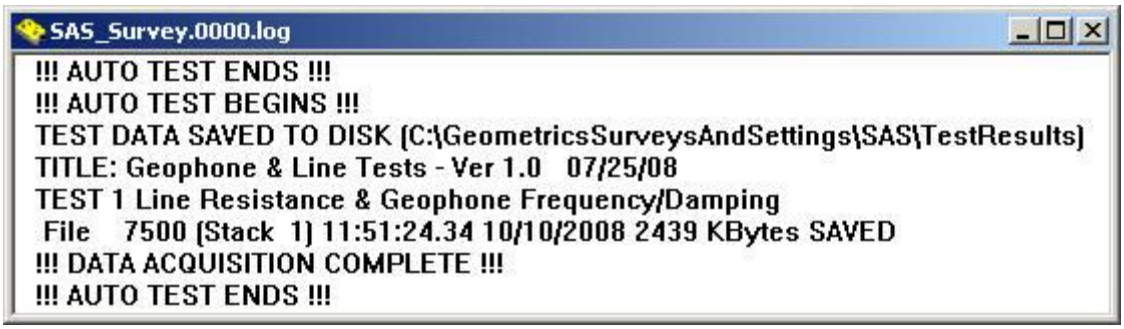


SCS has a sophisticated geophone testing algorithm that can measure geophone and line resistance, geophone frequency, geophone damping, and geophone sensitivity. In addition, a "reliability parameter" is reported for each channel. Reliability is a measure of how well the best-fit model matches the data. Generally, high reliability values indicate that the other reported parameters are probably accurate. Low reliability values indicate that the reported parameters are probably not accurate and could be due, for instance, to a geophone lying on its side or a geophone of a different frequency than expected.

When Run Geophone Test is selected, you will see a continually-updating message like the following, which will show the progress of the test:



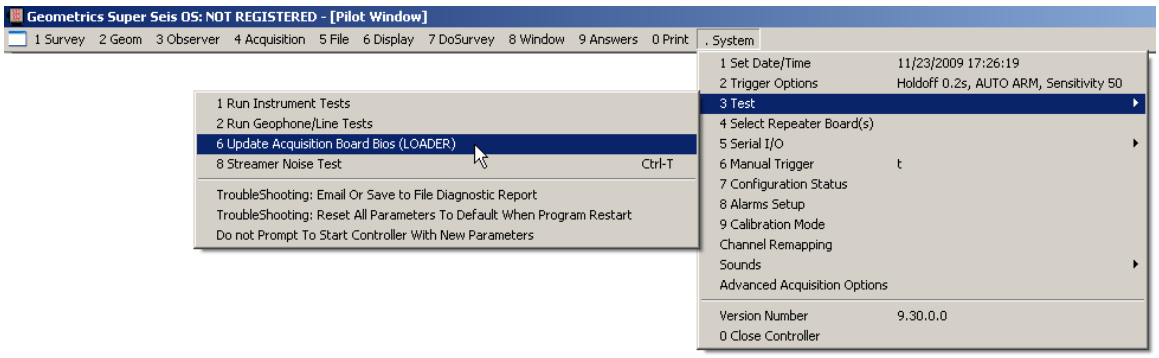
The Log Window will document the testing process:



As in analog testing, only active channels will be tested. In this case, unlike in analog testing, no test SEG files are created.

Note: *If one (or a minority) of the channels produces a phase that is far removed (more than 180 degrees) from those of the majority, it is possible that the majority will be flagged as failing, rather than the one (or minority). It is left to common sense to make the determination that the real culprit(s) is most likely to be the one (or minority), rather than the indicated majority.*

2.11.3.3 UPDATE ACQUISITION BOARD BIOS (LOADER)



BIOS

Note: *This process carries some risk of altering the Geode firmware in a way that can only be fixed by a factory return. Read this documentation carefully and contact the factory to make sure that you really need to undertake this procedure. Follow all steps* ***exactly****.*

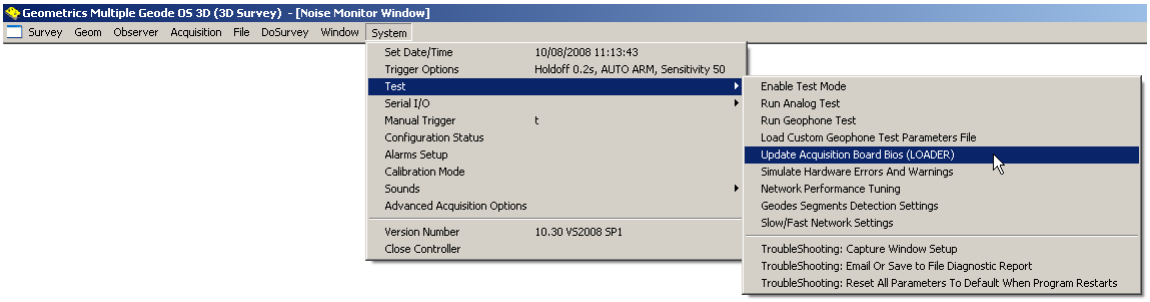
The firmware loader resides in flash memory on the Geode boards. The loader program runs like BIOS in a PC. It is the boot load code that talks to the controller and loads the Geode operating system code each time the Geode acquisition board is powered up.

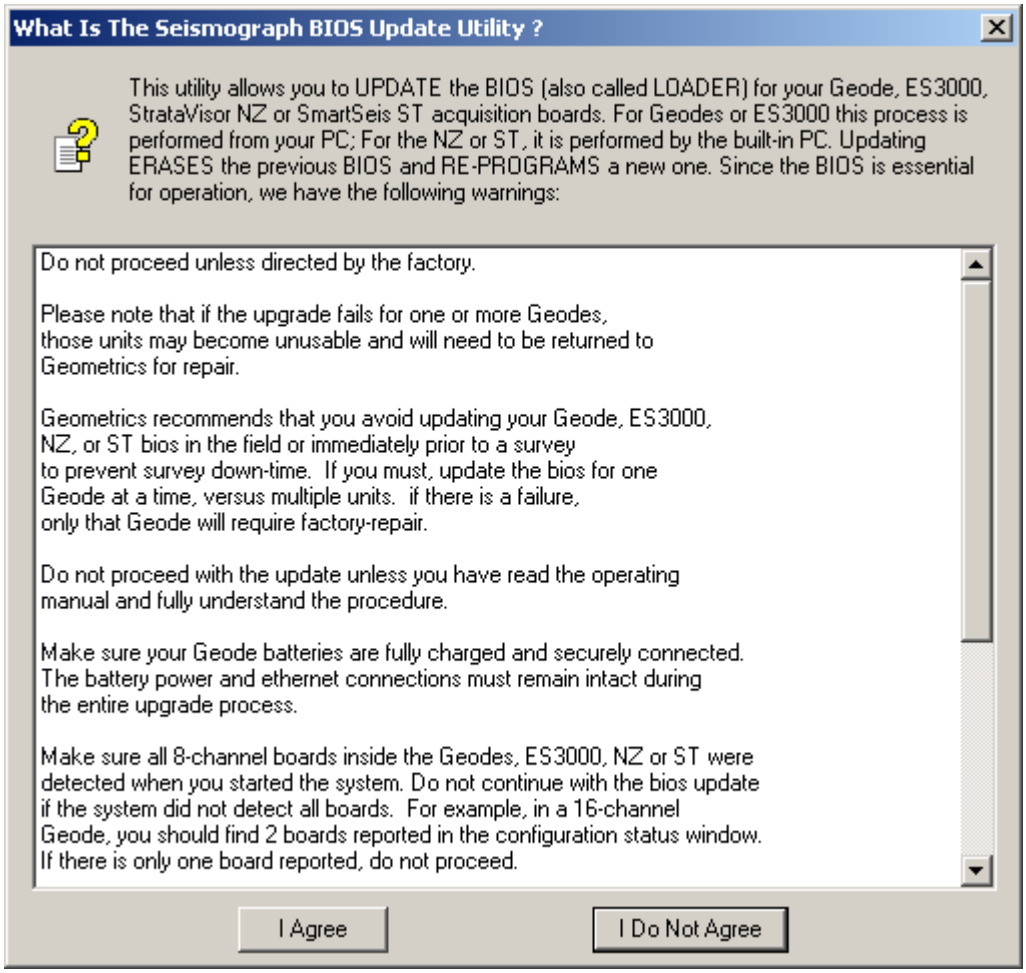
Geometrics will upgrade SCS from time to time, and installing the upgrade may require updating the loader code as well. Contact Geometrics periodically or check our web site for announcements of SCS upgrades/updates and whether a loader upgrade is required. Instructions on how to check your software versions can be found on Page 146.

Procedure

Once you have obtained the necessary loader files, please follow all steps exactly as shown:

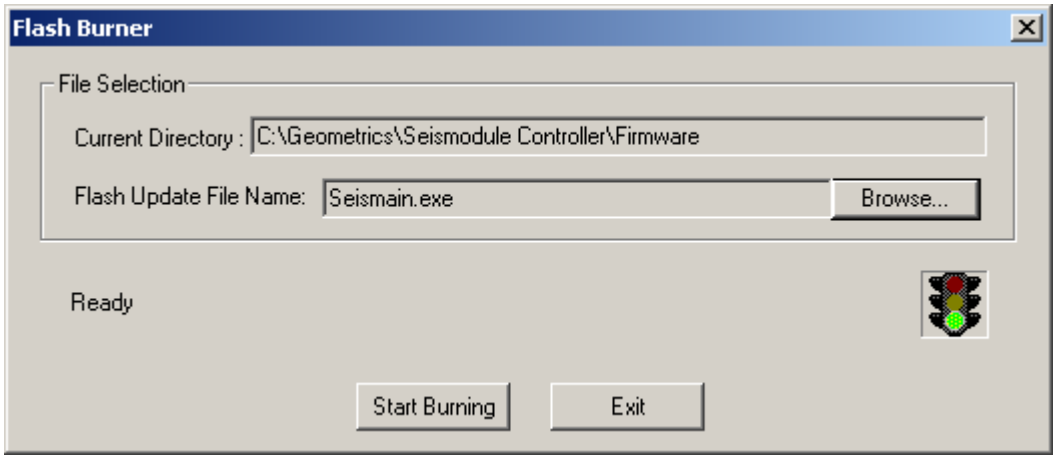
1) From the System >> Test Menu, select Update Acquisition Board Bios (LOADER)**:**





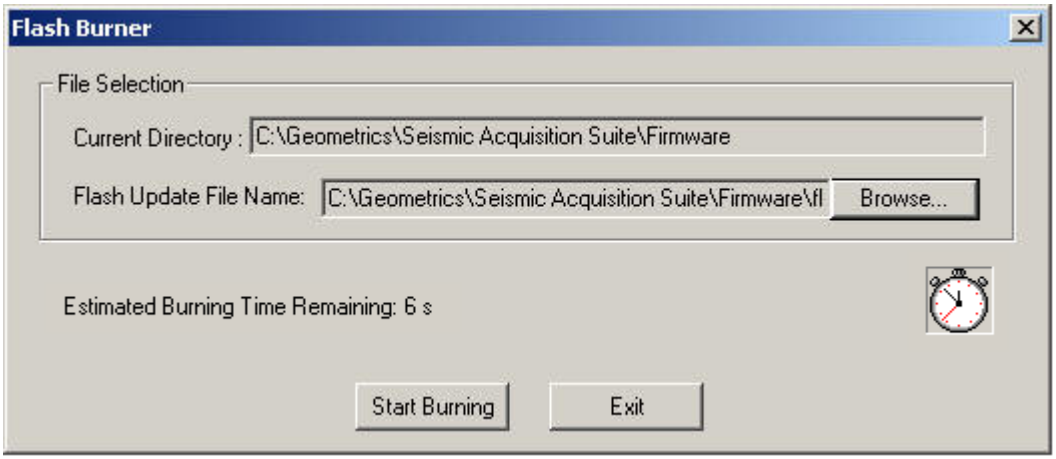
Read the warnings and press **I Agree** to proceed.

2) The following dialog box will appear. Press **Browse** and select the loader file obtained from Geometrics:

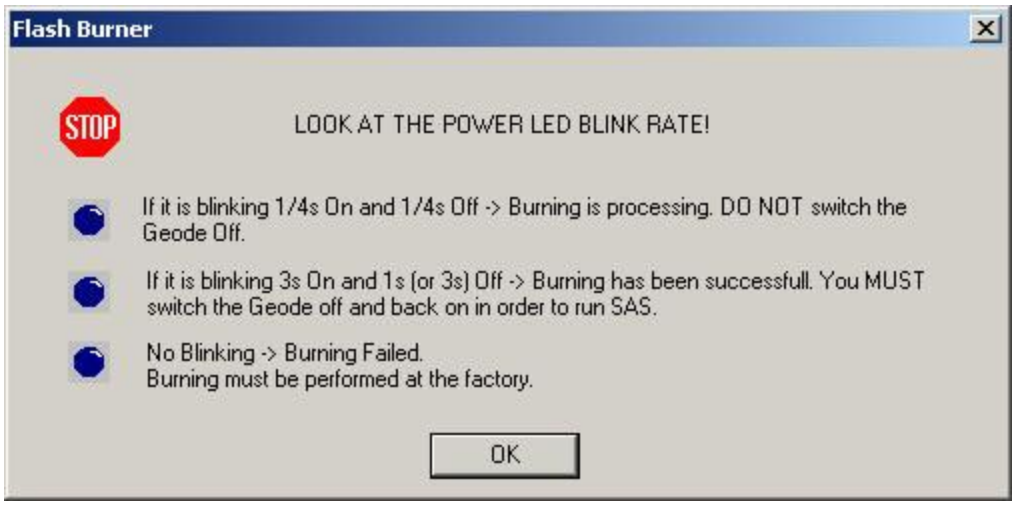


Do NOT remove the power or Ethernet cable from the Geode while updating the firmware!

3) Press the **Start Burning** button. You will be asked to confirm; once confirmed, a timer will appear:



4) Once burning is complete, the following message box will appear:



Do NOT remove the Ethernet cable or power from Geodes YET!

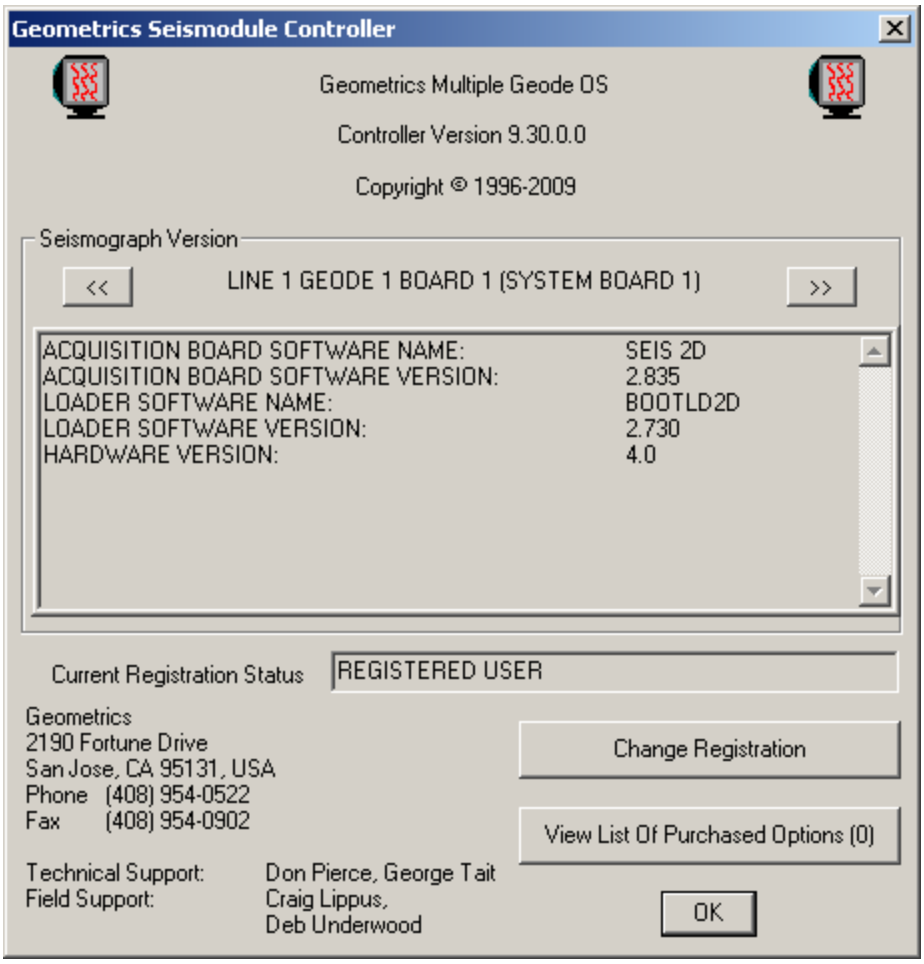
If the power LED on the Geode is blinking rapidly, burning is taking place. If the LED is blinking 3 seconds on and 1 second off, burning has been successful. If there is no blinking, it's time to call Geometrics! Burning must be undertaken at the factory. This is rare and as long as you follow the above directions exactly, should not happen.

5) Exit the program to close the software.

6) Turn off all of the Geodes by disconnecting the power cord. Turn them back on by plugging them back in and pressing the **Test** button.

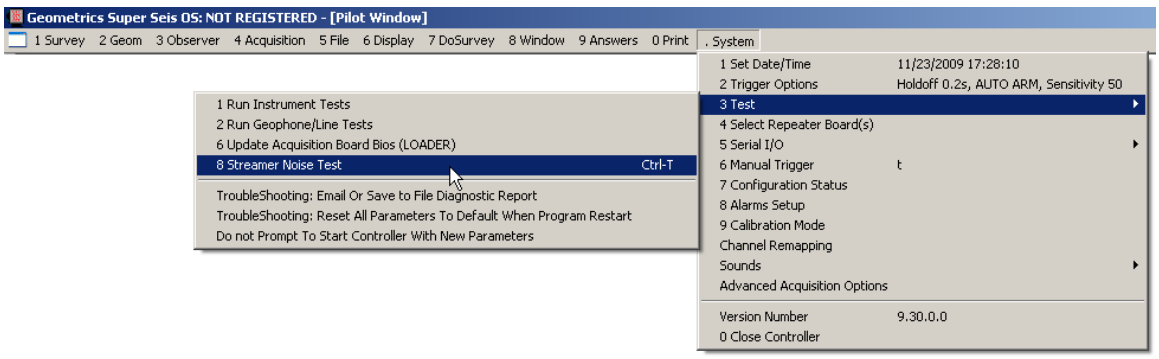
   The next steps will ascertain whether all of the boards in the Geodes were properly programmed.

7) Restart SCS. Select System >> Version. The following dialog will appear:

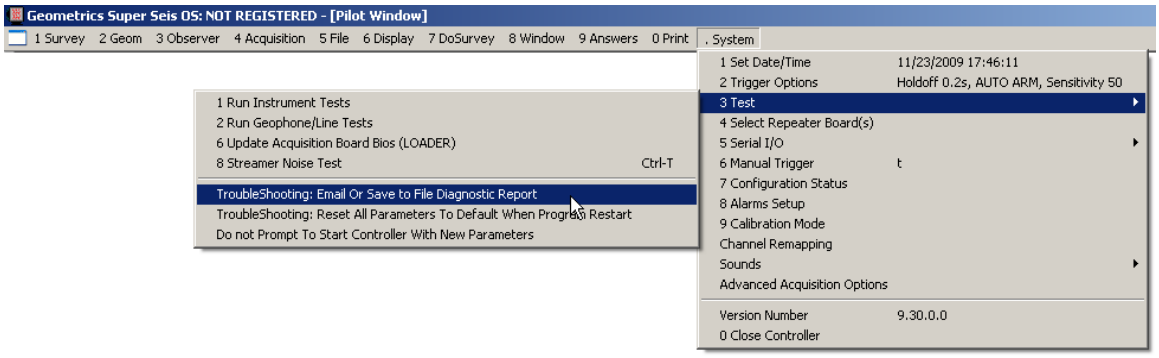


Check the loader version on each board by paging through them using the << >> buttons.

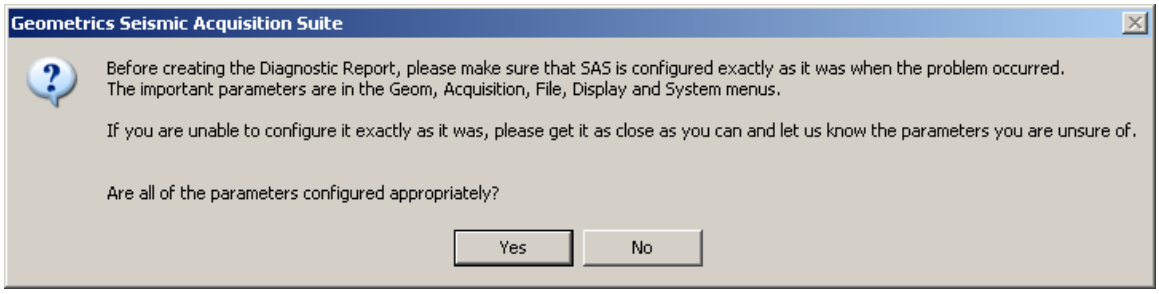
2.11.3.4 STREAMER NOISE TEST (MMGOS, MNZOS)



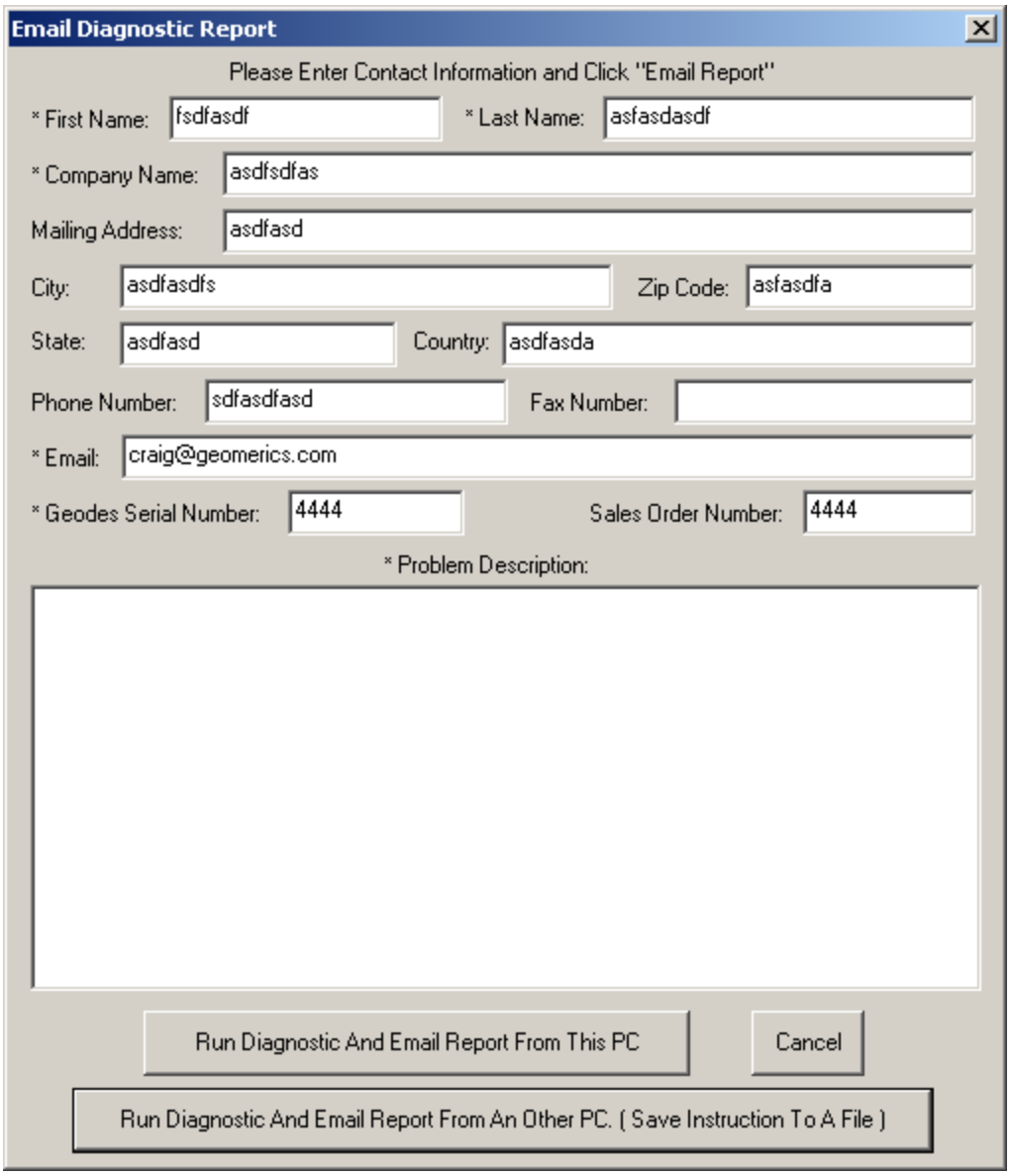
2.11.3.5 TROUBLESHOOTING: EMAIL OR SAVE TO FILE DIAGNOSTIC REPORT



If you are having trouble with the system, you can email a diagnostic report to Geometrics for evaluation. Selecting this item will bring up the following self-explanatory message:

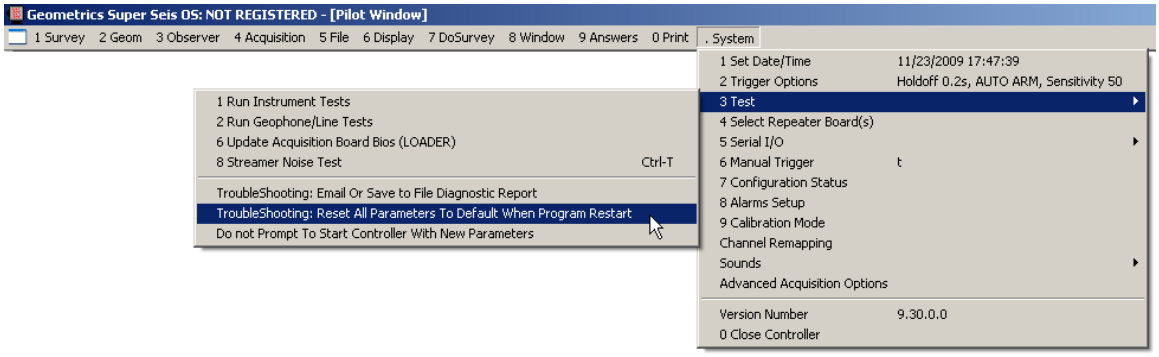


Pressing **Yes** will display the following form:

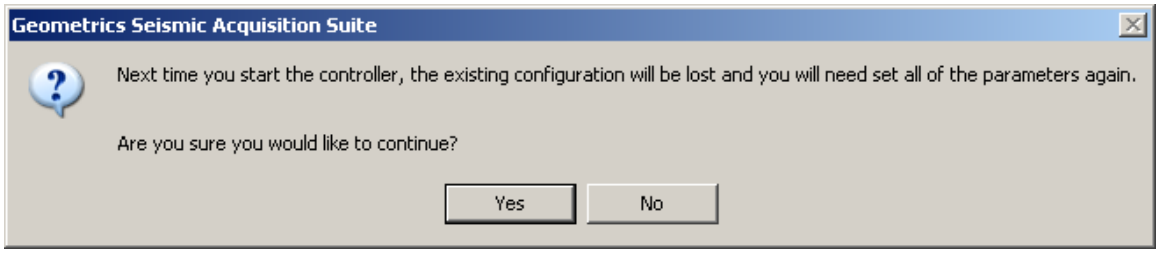


This should look familiar; see Page 3. If you filled the form out when you registered the software, some or all of the fields will already be filled in. If not, fill in the fields marked by an "*". Type in a detailed description of the problem, then press one of the buttons to run the diagnostic and save everything to a file, which you can copy to another computer and email to support@geometrics.com, or if your controller PC is connected to the internet, email it directly.

2.11.3.6 TROUBLESHOOTING: RESET ALL PARAMETERS TO DEFAULTS WHEN PROGRAM RESTARTS

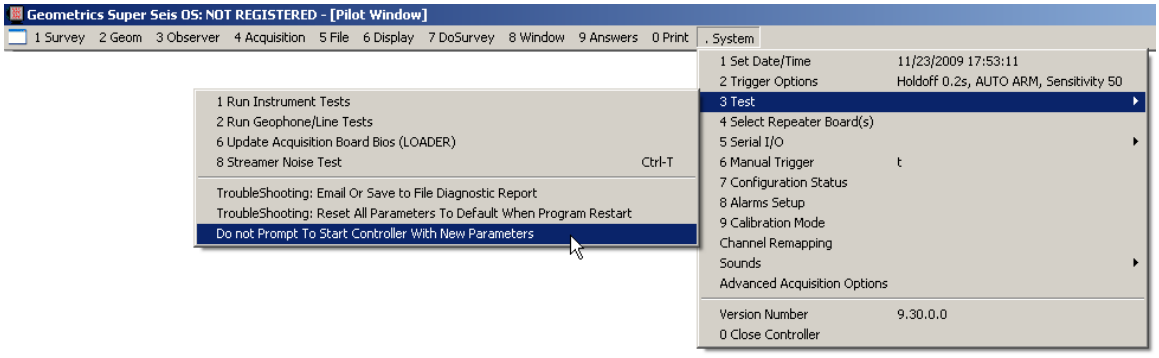


On occasion, initialization files can get corrupted or contain conflicting information, causing the program to be unstable. If this happens, restarting the program with default settings will fix this. Choosing this option will display the following message:

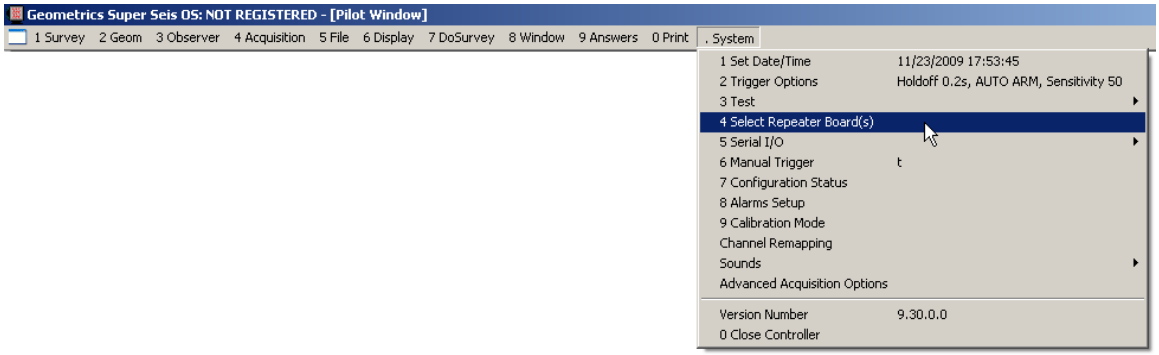


Press **Yes** and restart the software. No data will be lost, just configuration information.

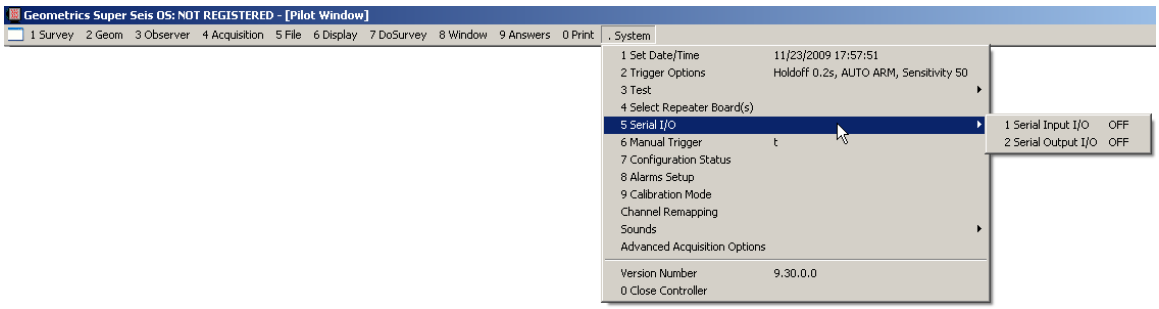
2.11.3.7 DO NOT PROMPT TO START CONTROLLER WITH NEW PARAMETERS



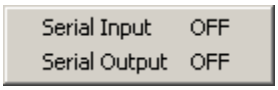
2.11.4 SELECT REPEATER BOARD(S) (MGOS, NZOS)



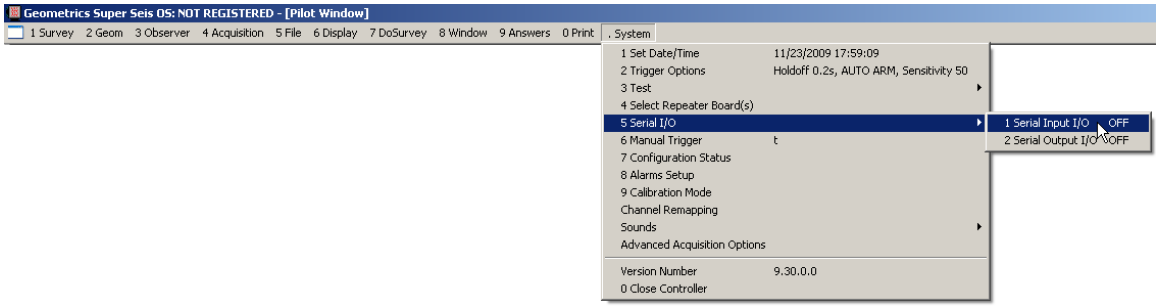
2.11.5 SERIAL I/O (MGOS, NZOS, SGOS, MMGOS, MNZOS)



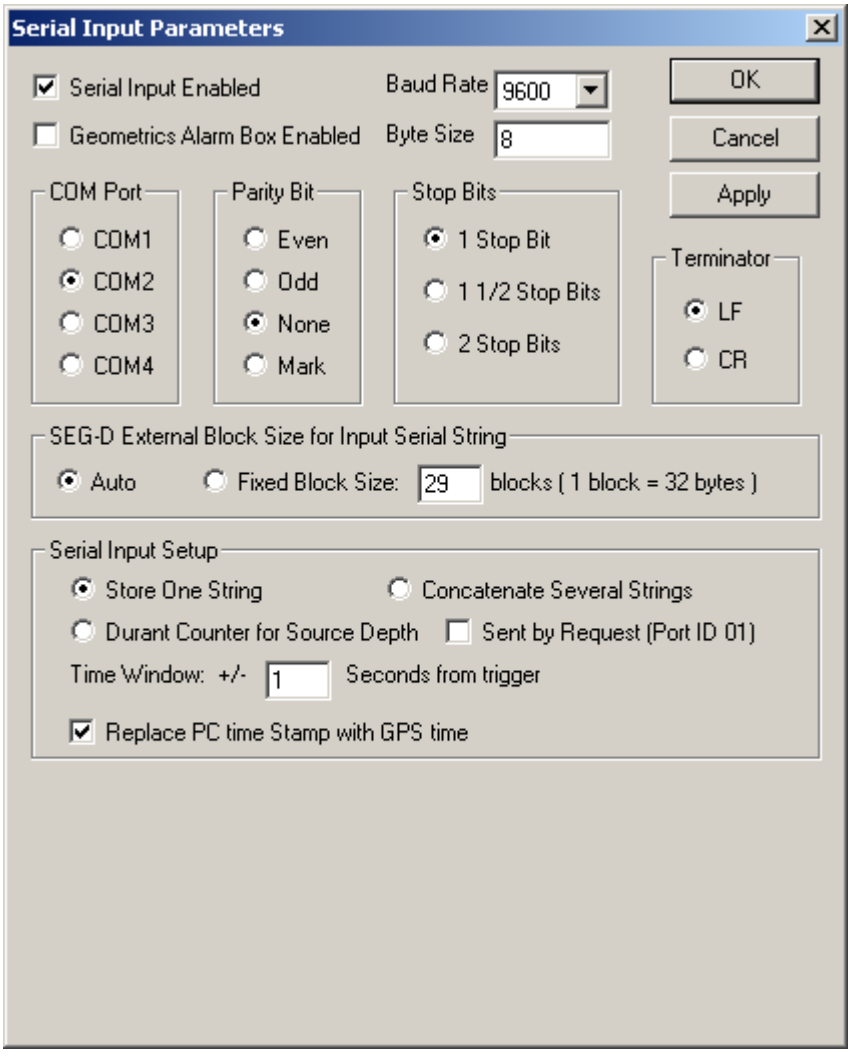
SCS can receive data on a serial port and write that data to the survey Log and the SEG-D header. Serial data can also be output by SAS to a peripheral PC if necessary. Selecting Serial I/O displays the following sub-menu:



2.11.5.1 SERIAL INPUT (MGOS, NZOS, SGOS, MMGOS, MNZOS)



To set this up, choose Serial Input to display the Serial Input Parameters Dialog box:



To enable this feature, check the Serial Input Enabled box.

Use Force One Vibrator

Enabling the Use Force One Vibrator option will enable monitoring of the serial port for incoming PSS format messages originating from a Force One or Force Two vibrator control unit. If the message contains a status indicating that the vibrator is pad-down and ready, the GPS string located within the status is extracted, stored and displayed along with other status information in Field Record List.

Serial Protocols

Carefully set the transmission protocol to match that of your serial device (i.e., GPS, navigation system, source controller).

- Set the COM port to whichever one the serial cable is connected to.
- Choose a Baud Rate from the drop-down list.
- Byte Size, Parity Bit, and Stop Bits are generally as shown above, and these are the defaults.

Line Termination

Indicate whether the incoming string is terminated with a Line Feed (LF, 0x0A) or a Carriage Return (CR, 0x0D).

Note: *It is important to set this parameter correctly. If you don't, you may not get any strings at all. Always run a test prior to starting the survey.*

The SEG-D External Block Size is generally set to Auto, and the block size is determined based on the number of bytes received on the serial port for each shot. You may also set a fixed block size if you desire.

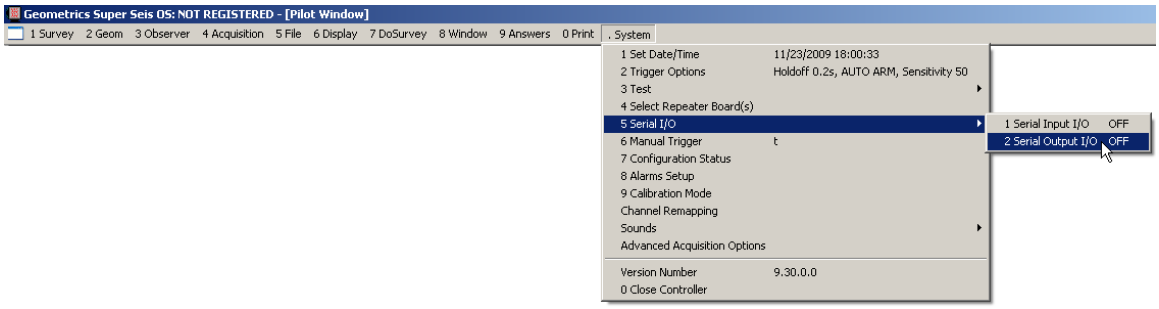
Serial Input Setup

The Serial Input Setup section controls how the strings are treated.

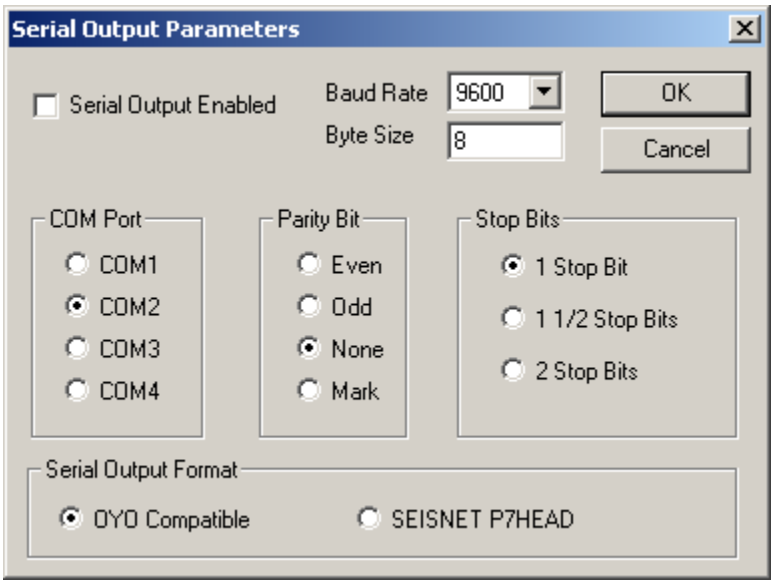
Many systems will send several different strings in a burst, delimited by either a CR or LF. Clicking the Store One String radio button will cause the system to store only the first string in the burst and ignore the others. Clicking the Concatenate Several Strings radio button will concatenate and store all of the strings in a burst.

Normally, records are time-stamped (trigger-time in header and DOS file time) based on the DOS clock. If you are logging GPS strings, you can elect to have this DOS time replaced with World Time, which is included in most if not all types of GPS strings. This is generally recommended. Just check the Use GPS String for Shot Time box.

2.11.5.2 SERIAL OUTPUT (SGOS, MGOS, NZOS, MMGOS, MNZOS)



The marine controller can also output a serial string for logging on a peripheral device. Choose Serial Output from the Serial I/O Menu:



You must set the transmission protocols to match the peripheral device you are communicating with, as when setting up serial input.

Serial Output Format

There are two formats to choose from for the output serial string. The first is Oyo Compatible. This format writes the FFID#, tape number, and number of active channels. Each field is right-justified and is 7 characters wide. The string is terminated with CRLF (0x0D 0x0A).

Example:

1 101 60

The SEISNET P7HEAD format follows the P7Header format. This string is terminated with LF (0x0A).

Example (all on one line in reality):

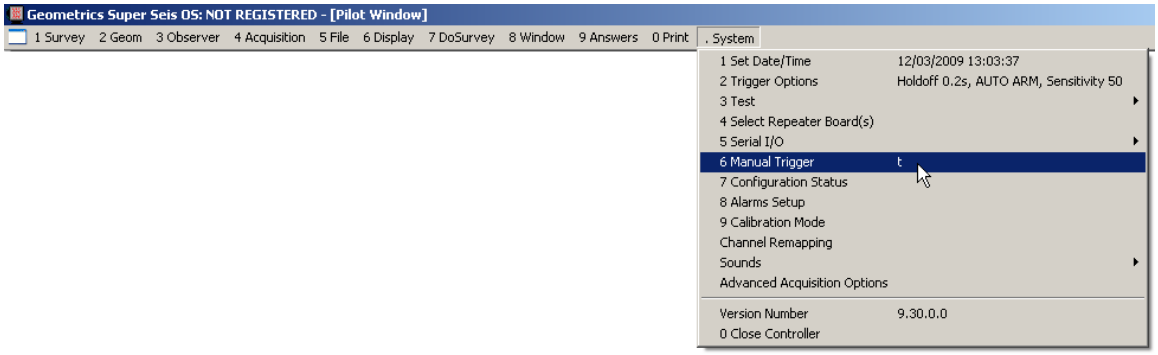
HDR 0000 195LOG 01200075DATE01210011TIME01340008UNIT01460001

REEL01510009FILE01610011SHOT01730005BUF 01800001TAPE01830013

4:09:38 2 101 4 4

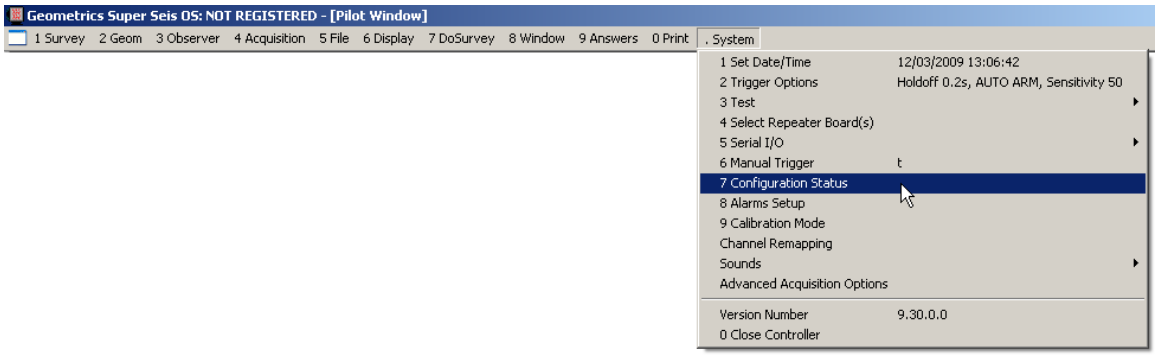
Note: *You may enable* Serial Input *and* Serial Output *at the same time, but you must use two separate serial ports.*

2.11.6 MANUAL TRIGGER



You may trigger the system manually at any time by selecting Manual Trigger from the menu or by pressing the **t** button.

2.11.7 CONFIGURATION STATUS



Choosing Configuration Status will display the following:

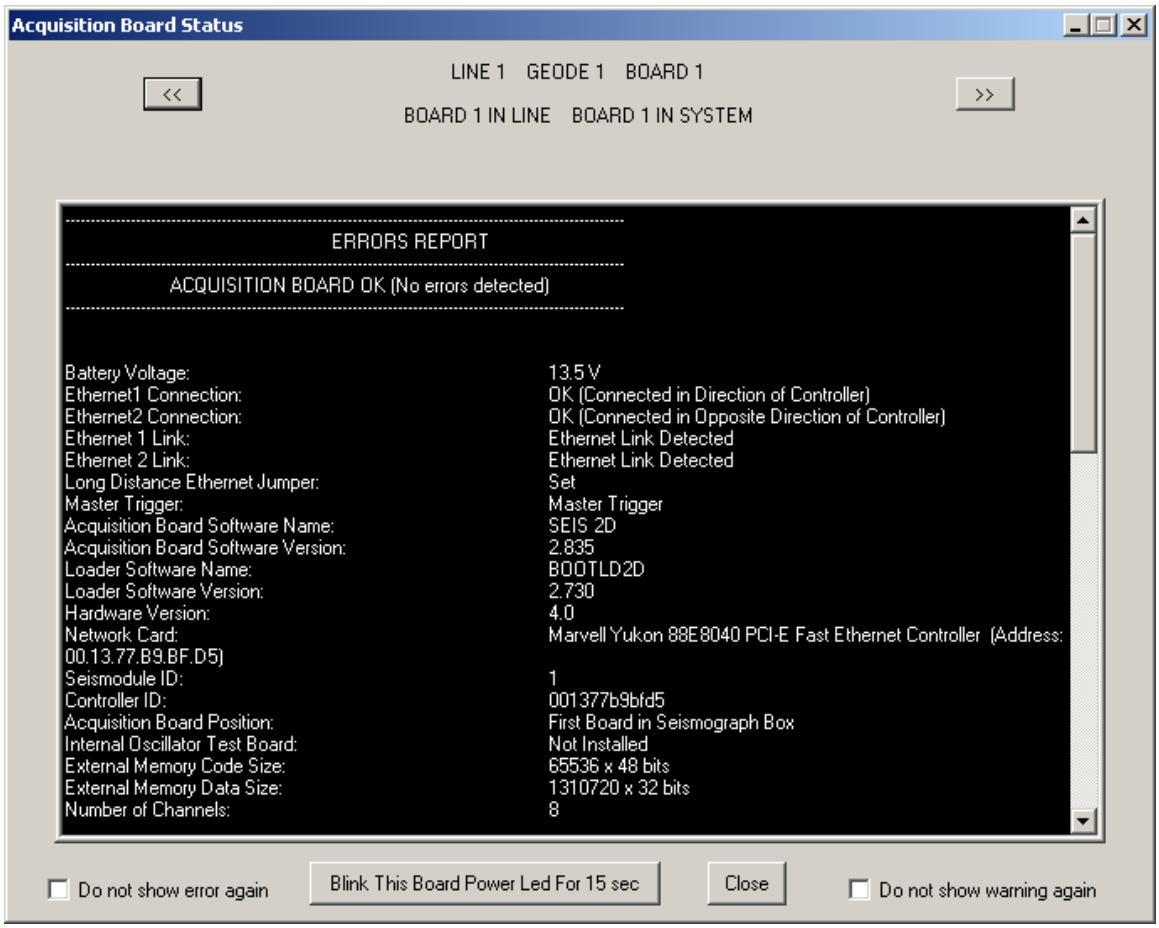


Figure 27: Acquisition Board Status Window.

It displays technical details about the 8-channel acquisition boards that can be useful when troubleshooting. If you are using Geodes, each Geode module will have 1, 2, or 3 acquisition boards, depending upon your specific configuration; hence the board-by-board, rather than Geode-by-Geode, basis. See **Error! Reference source not found.** to see how board numbers relate to channel numbers and their position in the overall layout.

You can move from board to board using the << and >> buttons. When using a multi-Geode system, you can "ping" any board (i.e., the Geode module that contains that board) for 15 seconds pressing the Blink **This Board Power Led for 15 sec** button. This can be very useful in helping the field crew find themselves on the line with respect to specific Geode modules.

The following window will pop up automatically in the event of an error or warning condition on an acquisition board:

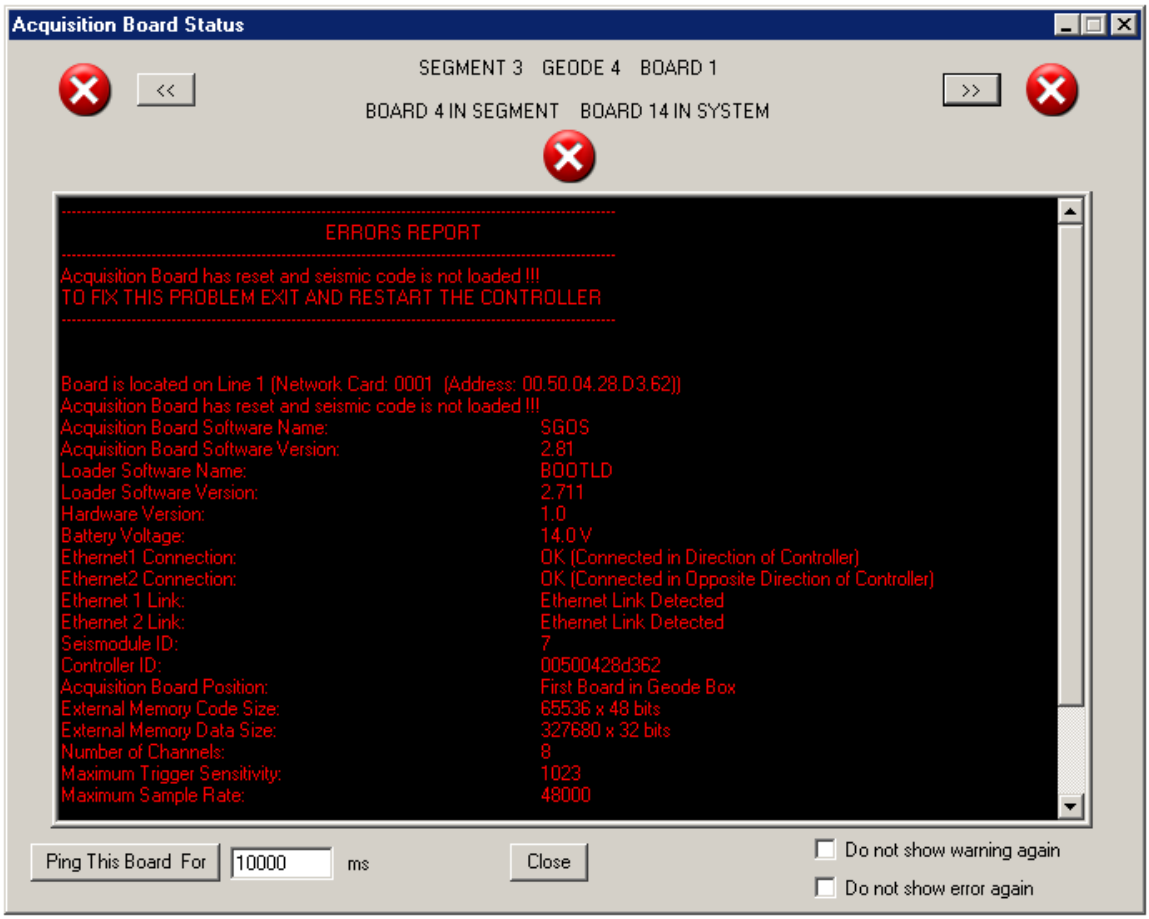
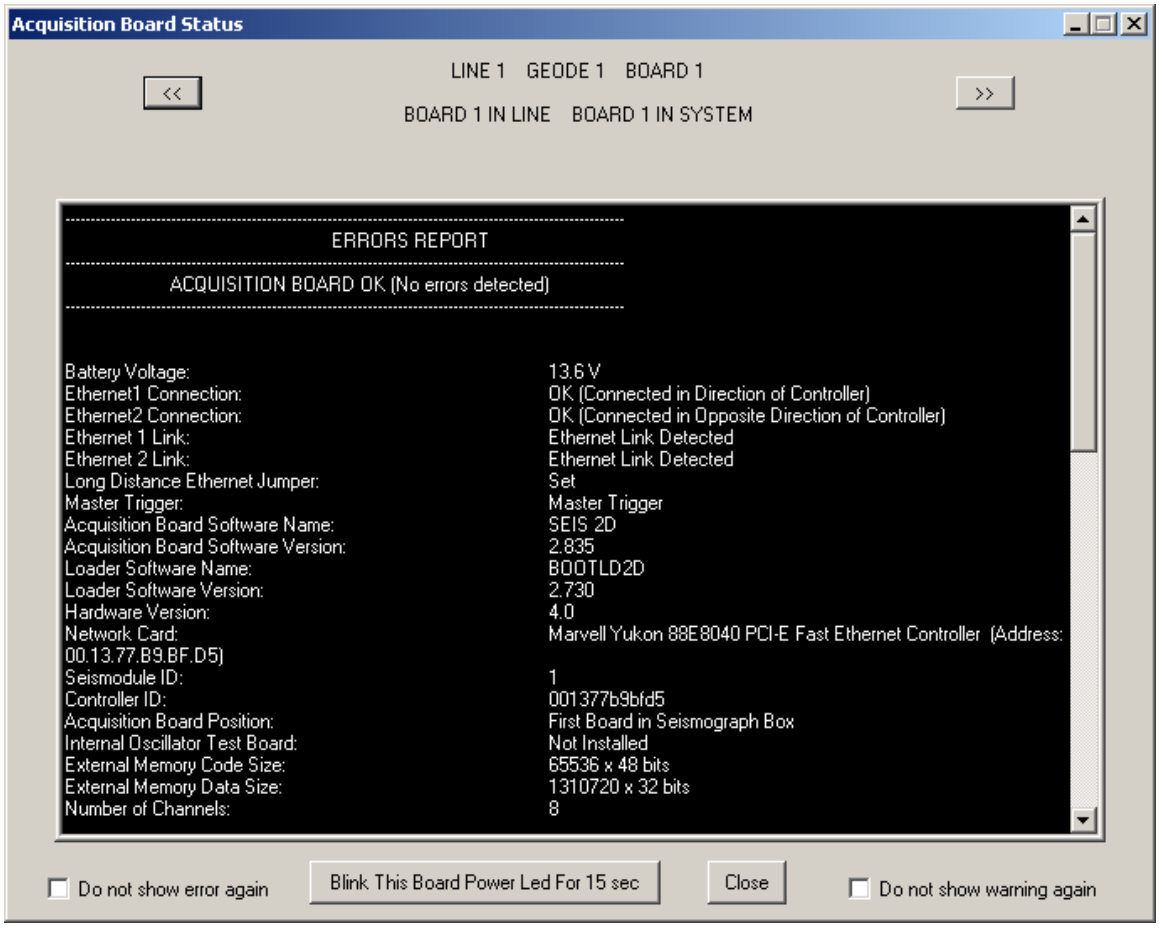


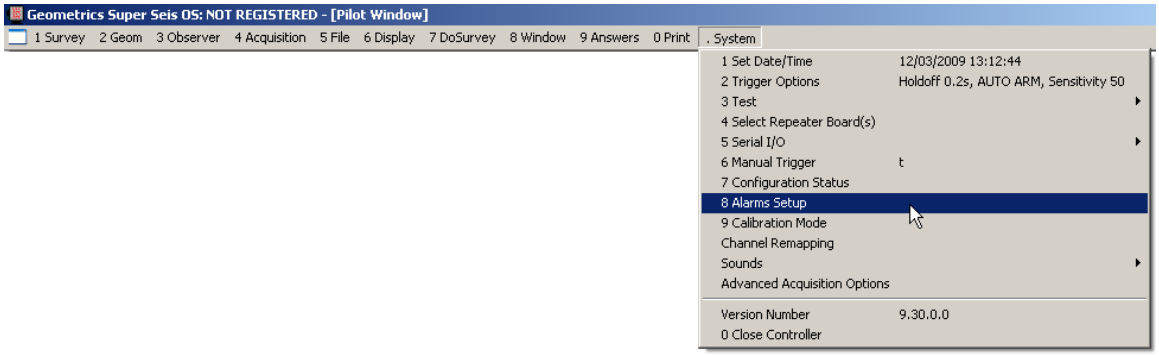
Figure 28: Acquisition board error message.

Above is for SAS.

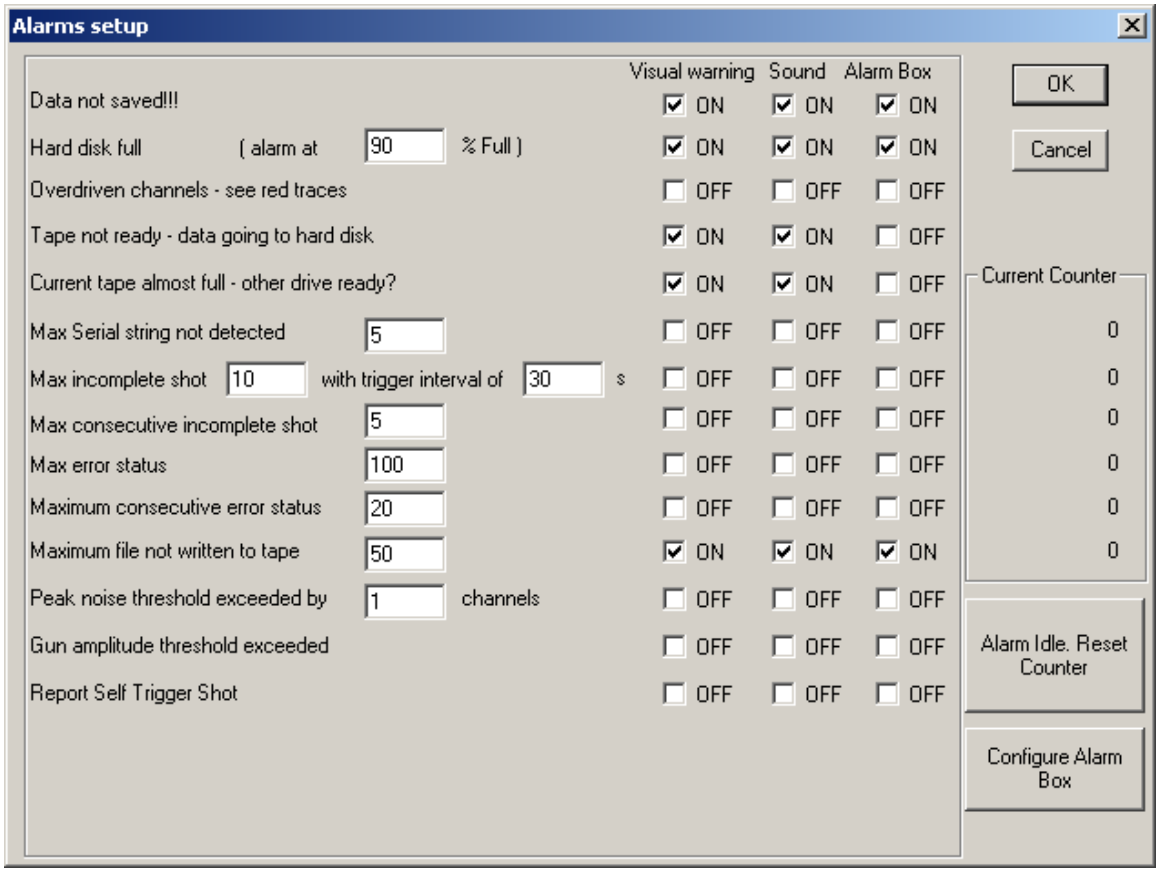
Depending on the warning or error message, it may continue to pop up after you close it, preventing you from dealing with the problem. If so, check one or both of the boxes in the lower right- and left-hand corners and press the **Close** button. The particular error message will not be repeated (but this doesn't mean the problem has been solved).


Acquisition Board Status
<<
LINE 1 GEODE 1 BOARD 1
BOARD 1 IN LINE BOARD 1 IN SYSTEM
>>
ERRORS REPORT
ACQUISITION BOARD OK (No errors detected)
Battery Voltage: 13.6 V
Ethernet1 Connection: OK (Connected in Direction of Controller)
Ethernet2 Connection: OK (Connected in Opposite Direction of Controller)
Ethernet 1 Link: Ethernet Link Detected
Ethernet 2 Link: Ethernet Link Detected
Long Distance Ethernet Jumper: Set
Master Trigger: Master Trigger
Acquisition Board Software Name: SEIS 2D
Acquisition Board Software Version: 2.835
Loader Software Name: BOOTLD2D
Loader Software Version: 2.730
Hardware Version: 4.0
Network Card: Marvell Yukon 88E8040 PCI-E Fast Ethernet Controller (Address: 00.13.77.B9.BF.D5)
Seismodule ID: 1
Controller ID: 001377b9bfd5
Acquisition Board Position: First Board in Seismograph Box
Internal Oscillator Test Board: Not Installed
External Memory Code Size: 65536 x 48 bits
External Memory Data Size: 1310720 x 32 bits
Number of Channels: 8
Do not show error again
Blink This Board Power Led For 15 sec
Close
Do not show warning again

2.11.8 ALARMS SETUP

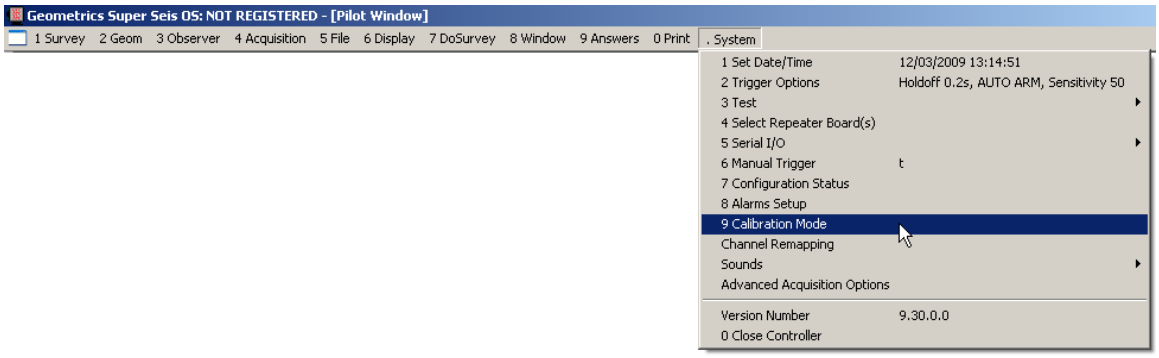


SCS provides user-enabled alarms to get the operator's attention in the event of a warning or error condition. Choosing this option will bring up the following dialog:

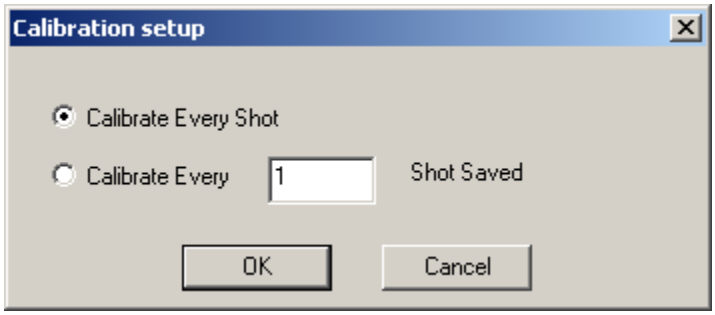


The alarms are self-explanatory; they can be visual, audible, or both. A sample alarm is shown below:

2.11.9 CALIBRATION MODE (MMGOS)

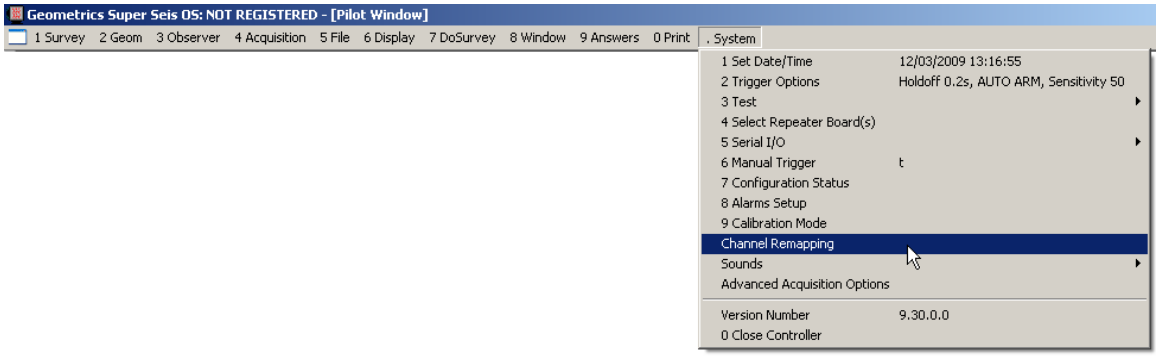


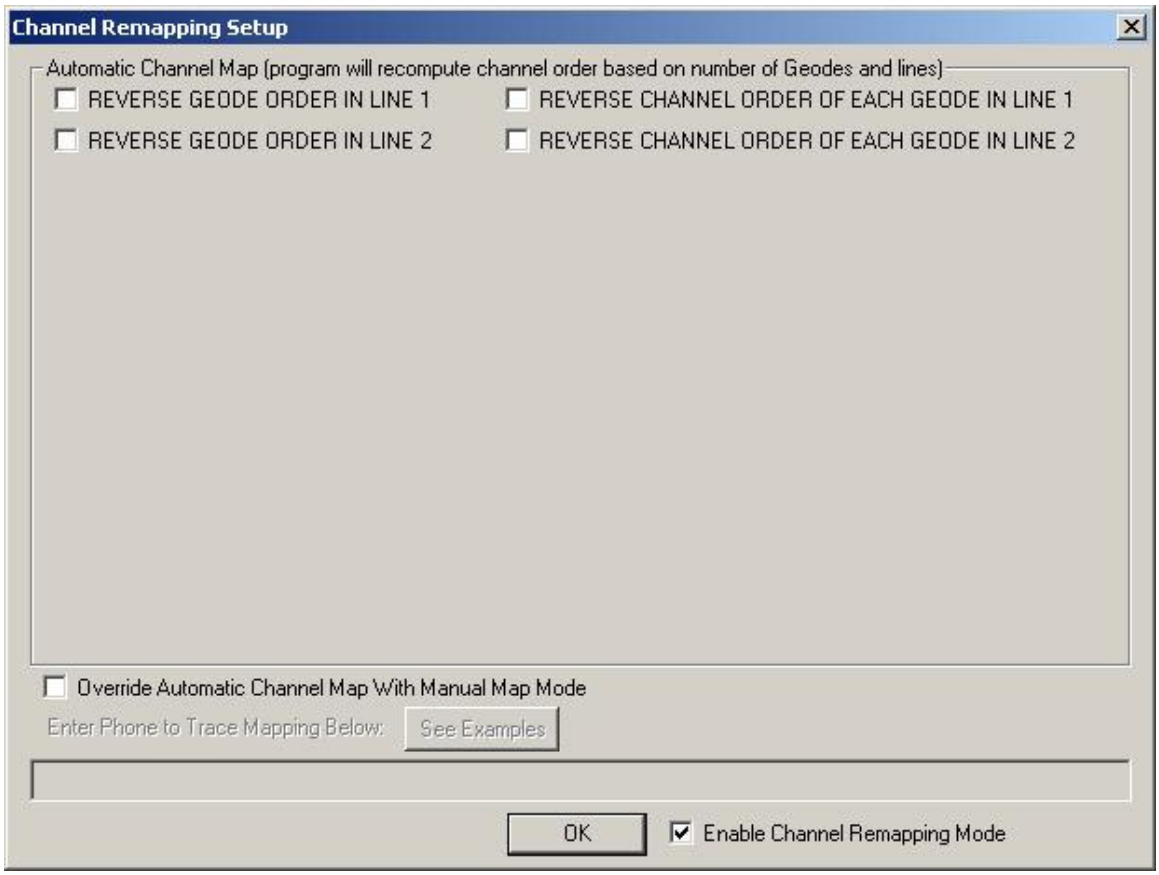
The Geode does a periodic DC offset calibration. By its nature, this requires about 3 seconds. You can control the frequency of this if the default of calibrating after every shot negatively impacts your production rates. Selecting this option brings up the following dialog:



If necessary, set it to calibrate after every *nth* Shot Saved, or disable it altogether (a calibration will still be done every time you change an acquisition parameter like a sample interval, record length, or preamp gain, or when you arm or disarm). Generally, once the Geodes reach operating temperature, the DC offset calibration is required less often, as DC offset tends to vary with temperature.

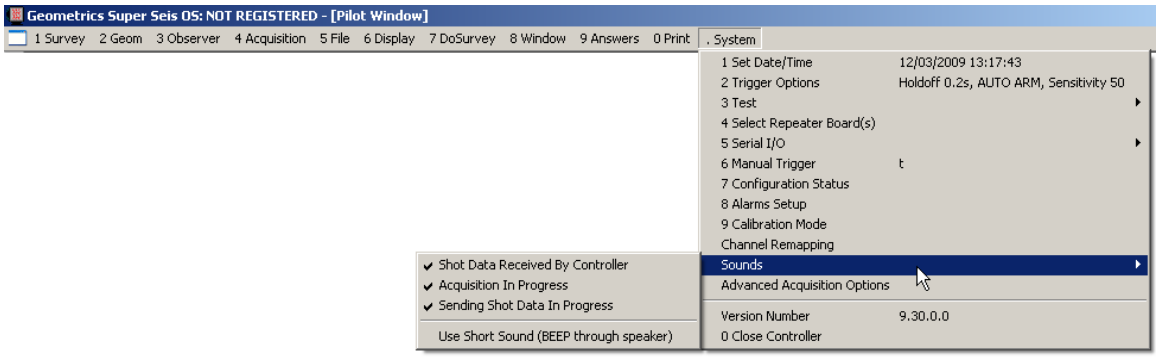
2.11.10 CHANNEL REMAPPING



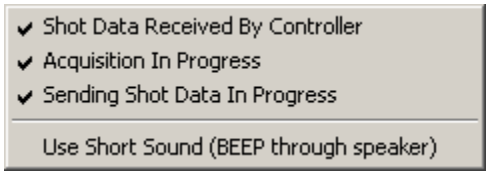


Channel remapping is a complicated subject and although it applies to all models and software bundles, it is most applicable to the Geode and is best discussed in that context. Please see **Error! Reference source not found.**.

2.11.11 SOUNDS

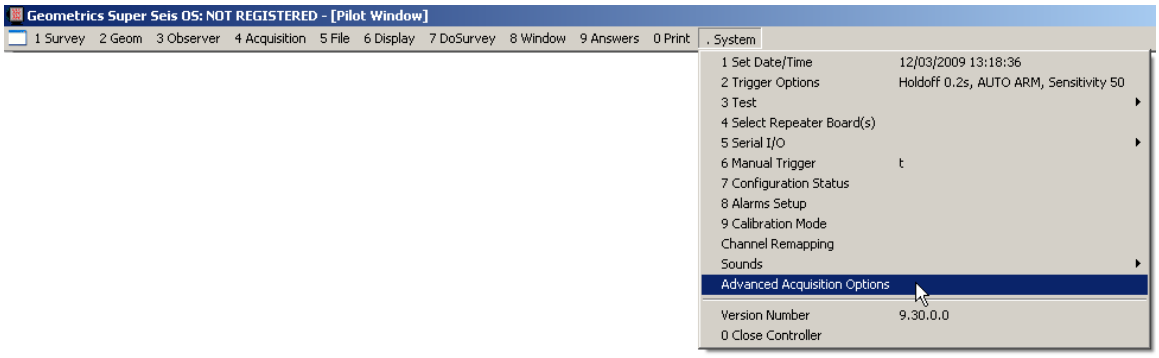


SAS emits various sounds to signal events. These can be toggled on or off. Selecting this item will reveal the following:



You may enable or disable the sounds as desired.

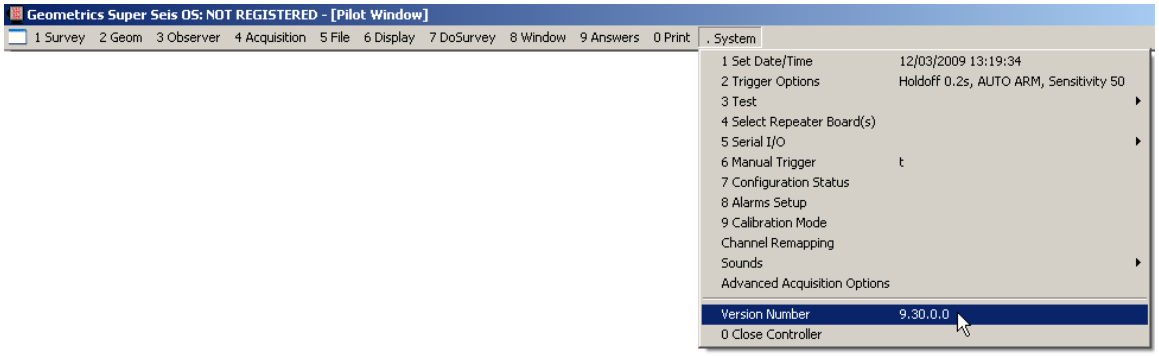
2.11.12 ADVANCED ACQUISITION OPTIONS (OPTIONAL ADD-ON FEATURE)



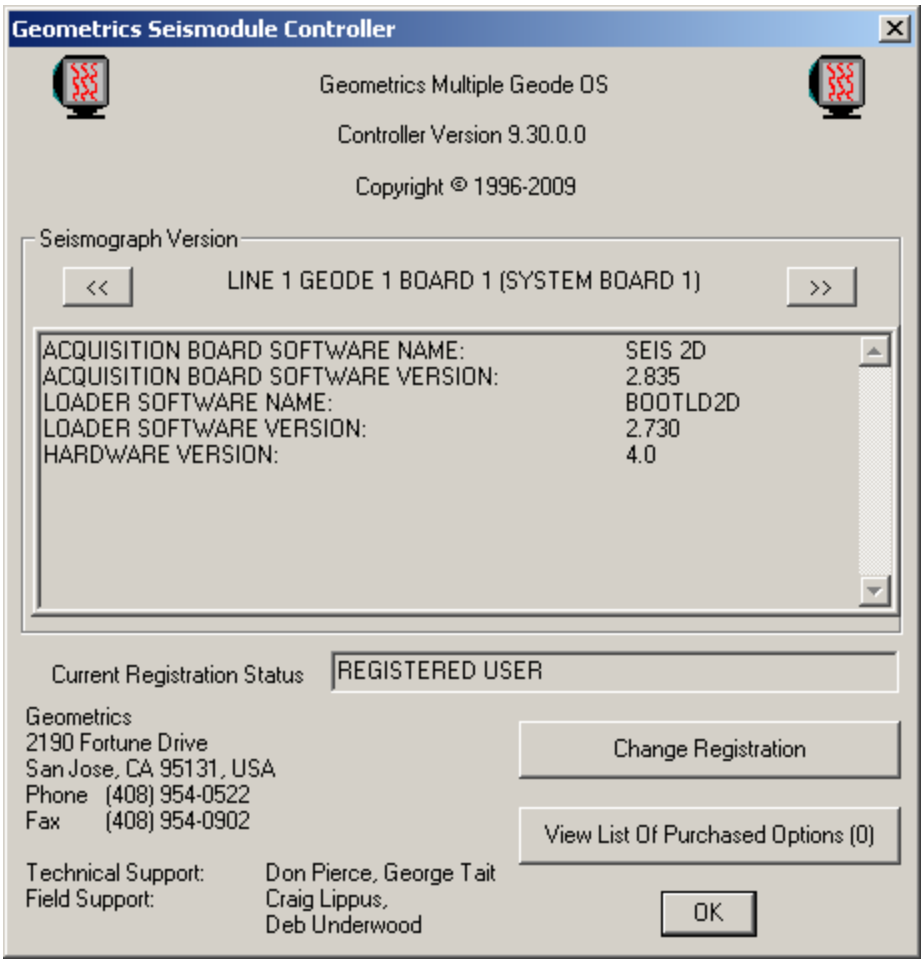
Subsample trigger synchronization is normally enabled, but there are rare instances in which you might want to disable it. Most often this is done in continuous recording mode.

Continuous Acquisition allows data to be recorded in a continuous fashion, meaning that each file is time-contiguous or time-overlapping with the next – no samples are missed. See Appendix **Error! Reference source not found.** for a complete discussion of Subsample Trigger Synchronization and Continuous Acquisition.

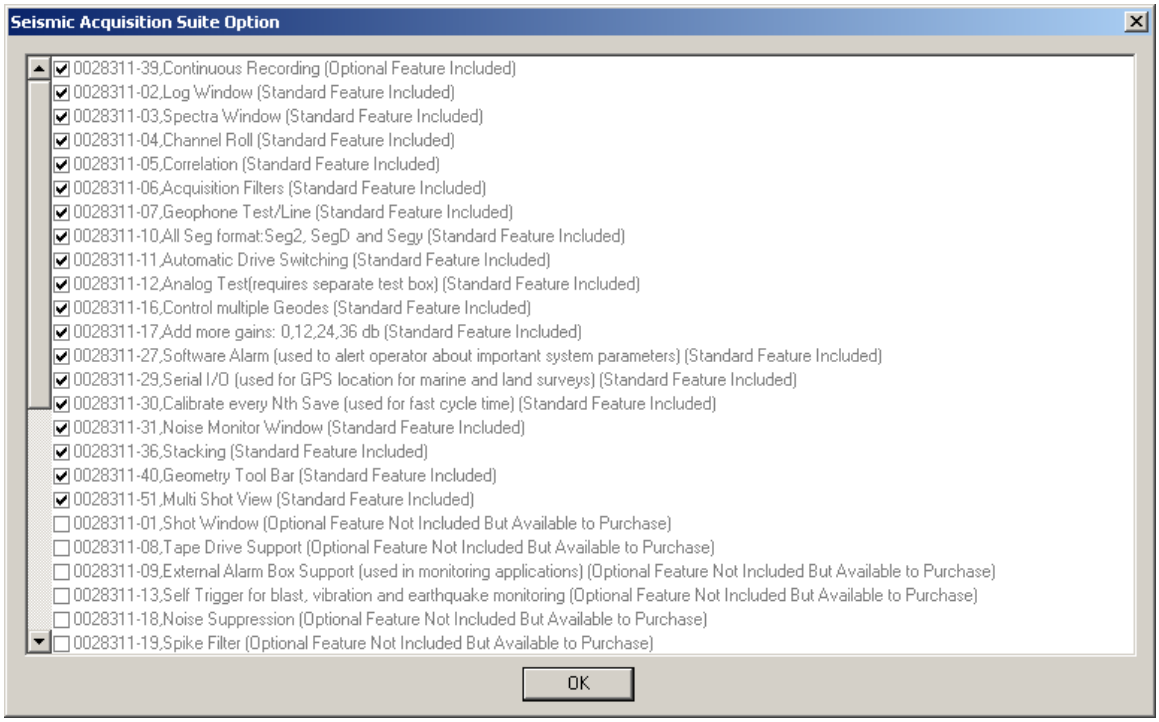
2.11.13 VERSION NUMBER



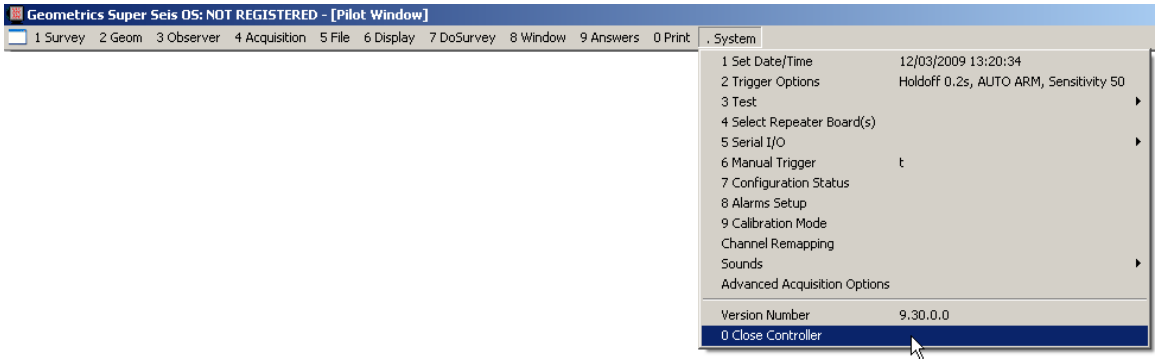
Selecting this option will bring up the following dialog:



It will display the version of SAS you are running, along with the firmware version on each board in each Geode. You can scroll from board to board using the << and >> keys. It also displays your registration status. Pressing **View List Of Features** will display all of the installed features, including optional features (the number in parentheses indicates the number of optional features installed):



2.11.14 CLOSE CONTROLLER



Selecting Close Controller will shut down SAS along with all of the LTUs and Geodes. This can also be accomplished by clicking on the ✕ in the upper right-hand corner of the main window.

2.12 GEOMETRY GRAPHICAL USER INTERFACE

The Geometry GUI provides a graphical representation of your survey, along with a wide range of control capability. It is particularly useful when conducting reflection surveys, but can be useful in a wide range of applications. It summarizes, in one simple view, the physical positions and other attributes of the hardware on the ground, and allows graphical control of these.

2.12.1 VISUAL ATTRIBUTES

Below is a typical display of a 96-channel, four-Geode layout. We will first describe the display itself, and follow with a description of its control capabilities.

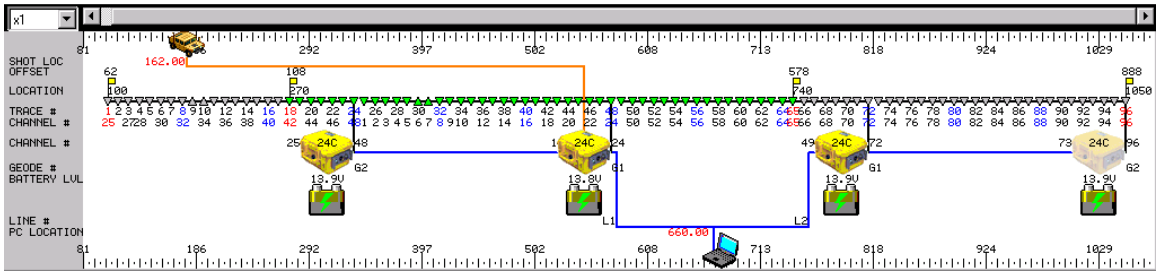


Figure 29: Example Geometry GUI.

The information in the display above is summarized below. Where appropriate, the actual setting, as shown above, is shown in brackets for reference. ##break up and caption table below.

Geometry GUI Symbols #make tables consistent	
Symbol/Annotation	**Meaning**
	**Active Geode** (yellow) – At least one channel in the Geode is active. The number of channels in the Geode module is indicated (in this case, 24).
	**Inactive Geode** (gray) – None of the channels in the Geode are active.

	**Warning** (flashing orange) – An orange-flashing Geode indicates a low battery (between 10.5 and 9.1 volts)
	**Error** (flashing red) – A red-flashing Geode indicates a loss of communication with that Geode or an inability to acquire data for some reason (i.e., a dead battery, <9.1 volts).
	**Battery level ≥ 10.5 volts.**
	**9.1 volts ≤ battery level < 10.5 volts** – Change battery soon.
	**Battery level < 9.1 volts** – Change battery now.
	Scale (x1 shows entire spread, ranges to x100 – this is also a drop-down menu).
	[Green] Active (data) channel. Triangle pointing down indicates low gain, up indicates high gain.
	[Grey] Inactive (data) channel (low gain, high gain).
	[Maroon] Aux channel (low gain, high gain).
	[Pink] Pilot channel (low gain, high gain).
	[Light green/blue] Active channel (low gain, high gain, frozen).
	[Grey/blue] Inactive channel (low gain, high gain, frozen).
	[Maroon/blue] Aux channel (low gain, high gain, frozen).
	[Violet/blue] Pilot channel (low gain, high gain, frozen).
	Shot location.
	PC controller location. This is for convenience only – the actual position of the PC is immaterial to the survey.
	Flag marking beginning or end of spread or beginning or end of active portion of spread. Labeled with shot offset (top) and flag location (bottom).
	[Orange] Trigger cable.
	[Black] Geophone (analog) cable.
	[Blue] Network (digital) cable.
SHOT LOC [162.00]	The shot location is indicated by the position of the yellow truck and is labeled in red. The red line is the trigger cable and indicates which Geode you have plugged the trigger into (Master Geode; Page 119).

OFFSET [62, 108, 578, 888]	The beginning and end locations of the spread, along with the beginning and end locations of the active portion of the spread, are indicated by a flag. The distance between the shot and the flag, or shot offset, is shown immediately above the flag.
LOCATION [100, 270, 740, 1050]	The location of each flag is indicated immediately below the flag.
TRACE # [1,2,3…96]	The trace number represents the position of the trace in the shot record, from 1 to n, where n is the number of channels. This number will always increase from left to right. Trace numbers corresponding to flags are shown in red.
CHANNEL #	The channel number indicates the physical channel number within the Geode module. With most systems, no distinction is made between the channel number and the trace number. However, as we will see later, the StrataVisor/Geode allows you to map the channels any way you wish via software to accommodate any geophone cable configuration. If no channel mapping is done, the trace number and the channel number will be the same. Generally, the channel number need not be displayed, but it can be useful in the initial mapping of your channels if this is necessary. Channel numbers corresponding to flags are shown in red.
CHANNEL #	The second channel number label refers to and is in line with the channel numbers on the Geode modules, and represents the channels that they are connected to.
GEODE # [G2, G1, G1, G2]	Each Geode on each network line is numbered automatically. The Geode closest to the controller, in terms of network topology, is always Geode number 1. In the above example, we have two separate networks, so there are two each of G1 and G2.
BATTERY LVL [13.9, 13.8, 13.9, 13.8]	This indicates the battery voltage for the Geode.
LINE # [L1, L2]	In the case of more than one network line, as above, the Geode software will automatically assign one to be Line 1 and the other to be Line 2. This assignment is arbitrary but consistent: the designation of the network ports on your PC will be the same with each session.
PC LOCATION [660.00]	This shows the location of the PC controller. For convenience only.

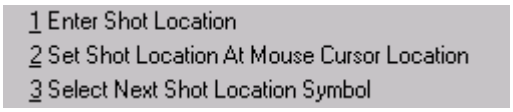
Table 7: Geometry GUI symbols and their meanings.

If “Tooltips” are enabled (see Page 157), moving your cursor over the channel symbol will display the channel number and its position:

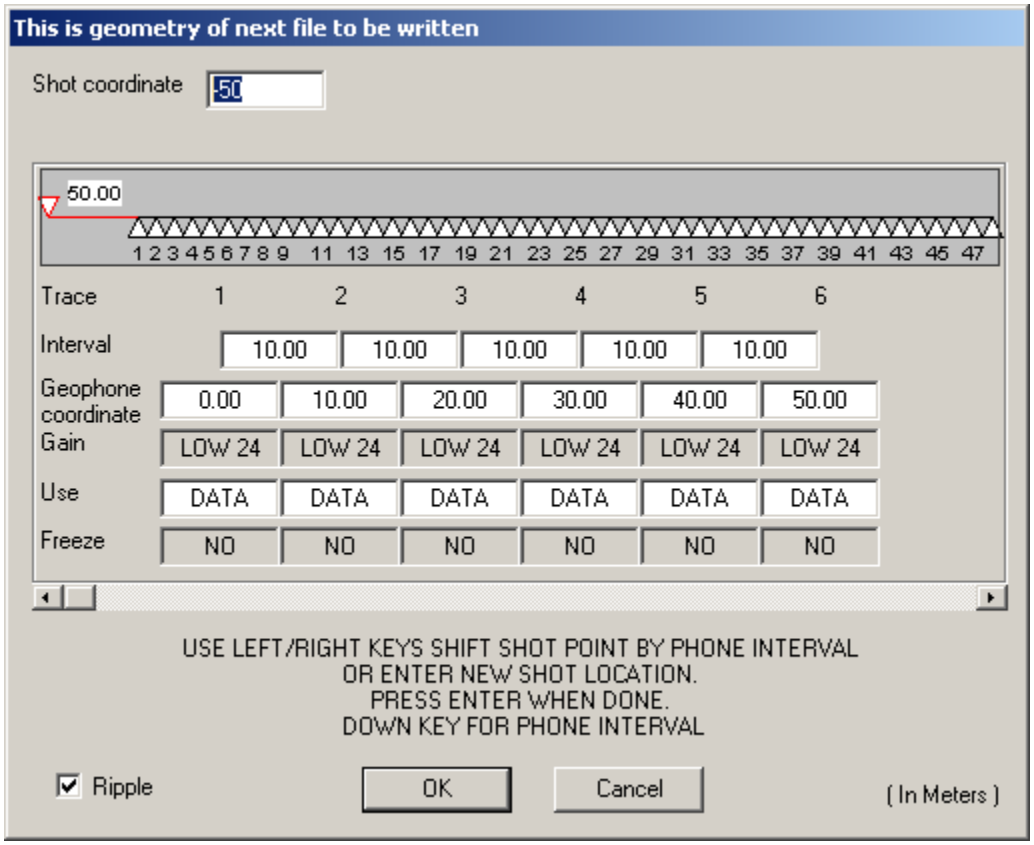
2.12.2 CONTROL FUNCTIONS

Various survey parameters can be controlled via the Geometry GUI. Right-clicking the mouse will bring up different menus, depending on where your pointer is at the time.

Right-clicking on the shot icon will display the following menu:



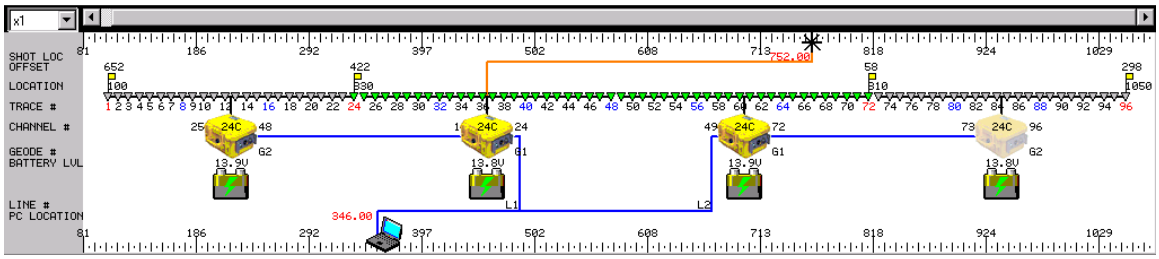
Choose Enter Shot Location to display the Geometry dialog and type in the shot location:



Enabling the Set Shot Location at Mouse Cursor Location toggle switch allows you to set the shot location by simply pointing and clicking at the location you wish to move the shot to.

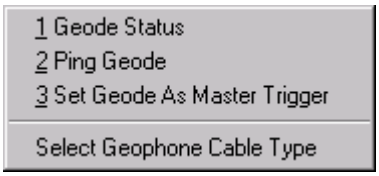
Note: *At any time, you may click and drag the shot icon to the desired location.*

Finally, choosing Select Next Shot Location Symbol will change the icon used to indicate the shot. For instance, to save screen space, you may choose to use a simple asterisk:



Note: *Double-clicking on the shot icon will cycle through the various choices.*

Right-clicking on a Geode module will display the following menu:



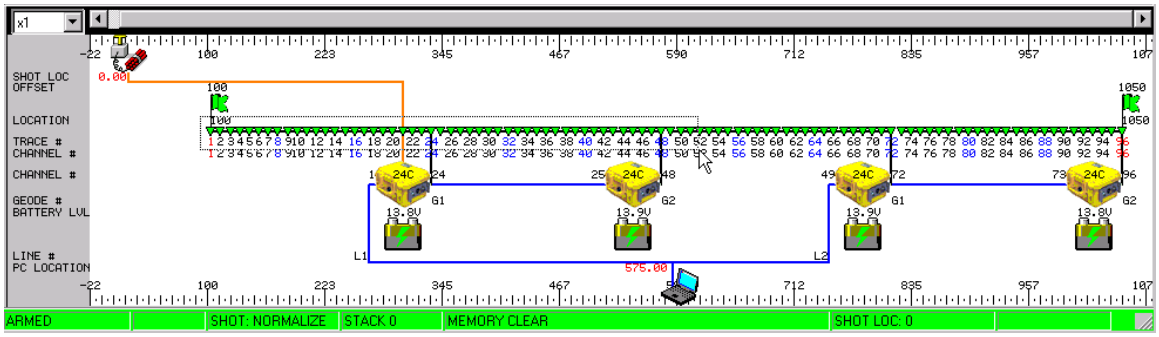
Geode Status is the same as Configuration Status in the System menu (see Page 138).

If you have remote power-up Geodes (red Test button on Geode, rather than green on/off button), you may "ping" it – it will emit a high-pitched beep for 15 seconds. This can be useful when troubleshooting the line.

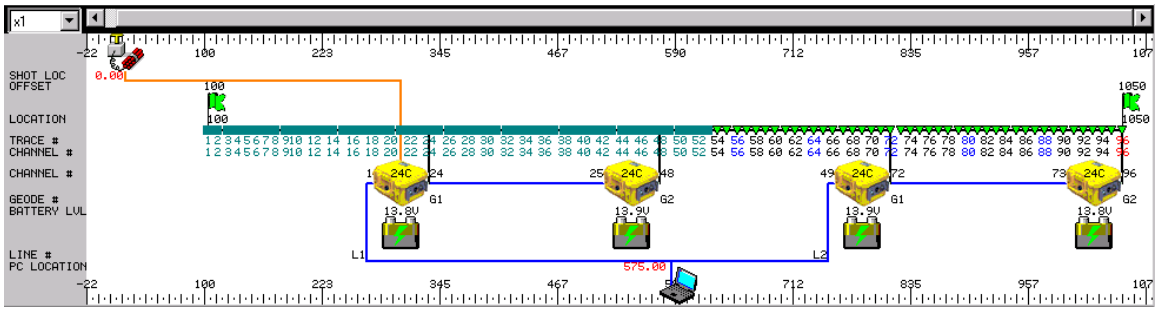
You may set any Geode to be the "Master Trigger" Geode. The trigger line (orange) will connect the source to the Master Geode (see Page 119).

In order for the channels to be mapped properly, you must select a Cable Type that matches yours. See Page 157 for a discussion.

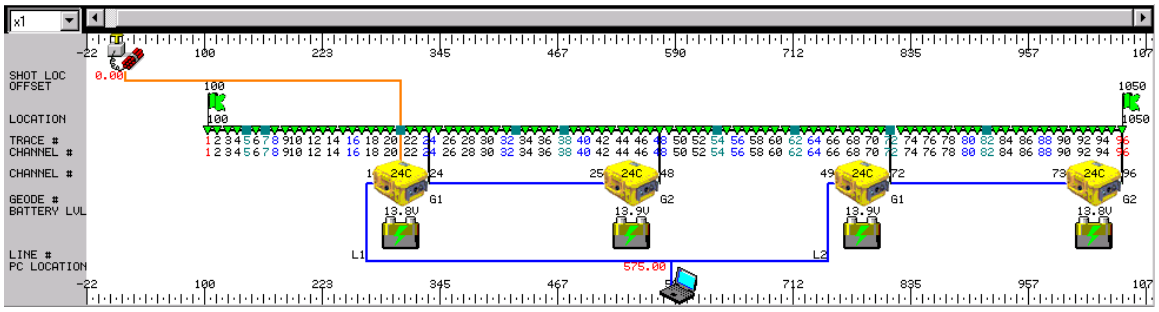
You may enable/disable or change channel preamp gains on single channels or groups of channels. To select a group of channels, use your mouse to draw a box around them:



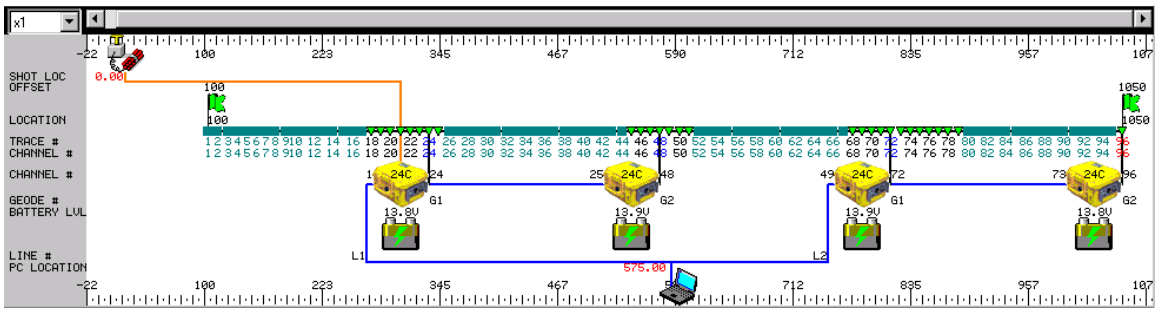
The selected group will be highlighted, as shown below:



If you wish to highlight non-contiguous channels, hold the **CTRL** button down and click on the desired channels:

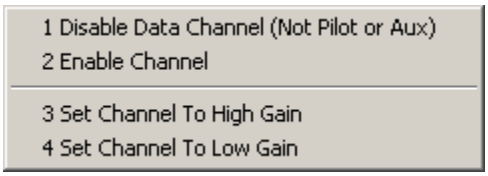


If you wish to highlight several non-contiguous *groups* of contiguous channels, hold the **CTRL** key down and draw boxes around those you wish to highlight:



In short, holding the **CTRL** key down allows you to select/deselect a channel or group of channels without affecting the status of the other channels. Experiment with the channel selection function to get a feel for how it works.

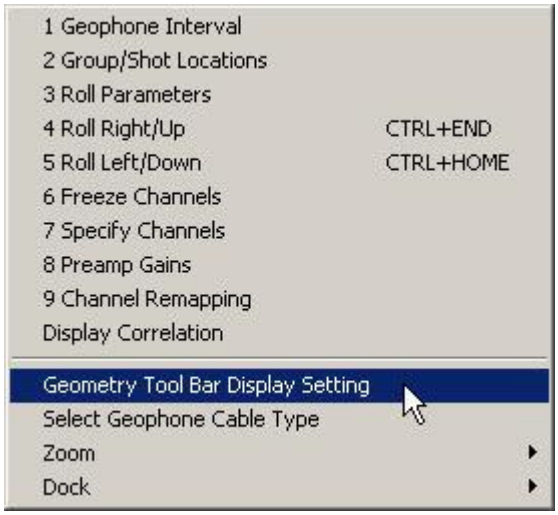
Once you have selected your channel(s), right-click to display the following menu:



Function should be self-evident. Enabling and disabling channels is also discussed on Page 60; see Page 61 for a discussion of preamp gains.

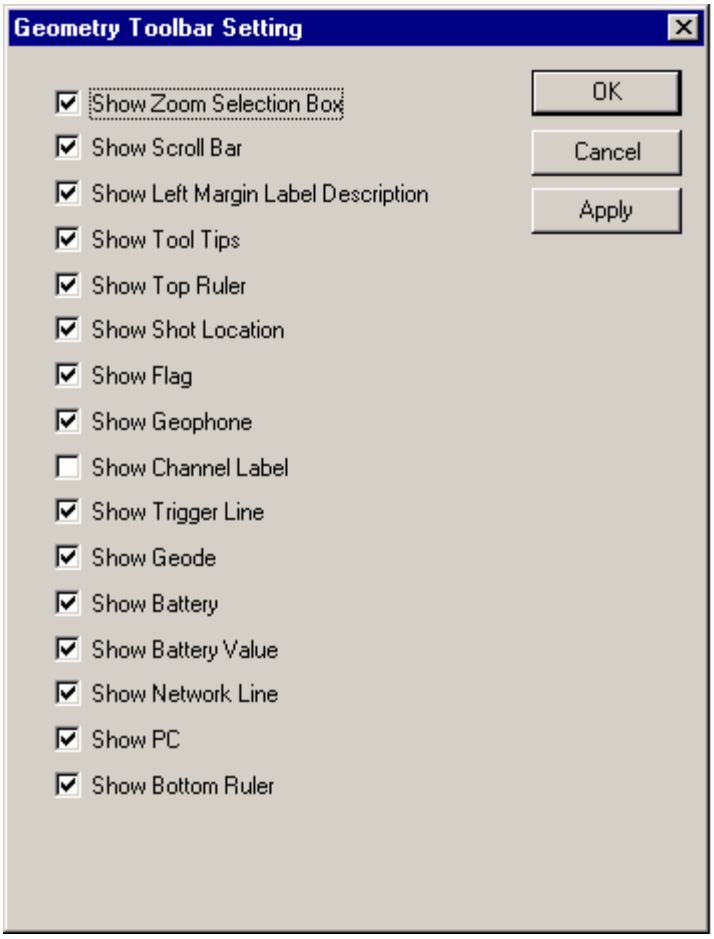
2.12.3 GEOMETRY TOOL BAR DISPLAY SETTINGS

Right-clicking on the white portion of the GUI will reveal the following menu:



The items in the upper half of the above menu are repeated here for convenience and have already been discussed. Click on any of the following items to review: Geophone Interval, Group/Shot Locations, Roll Parameters, Roll Right/Up, Roll Left/Down, Freeze Channels, Specify Channels, Preamp Gains, Channel Remapping, Display Correlation.

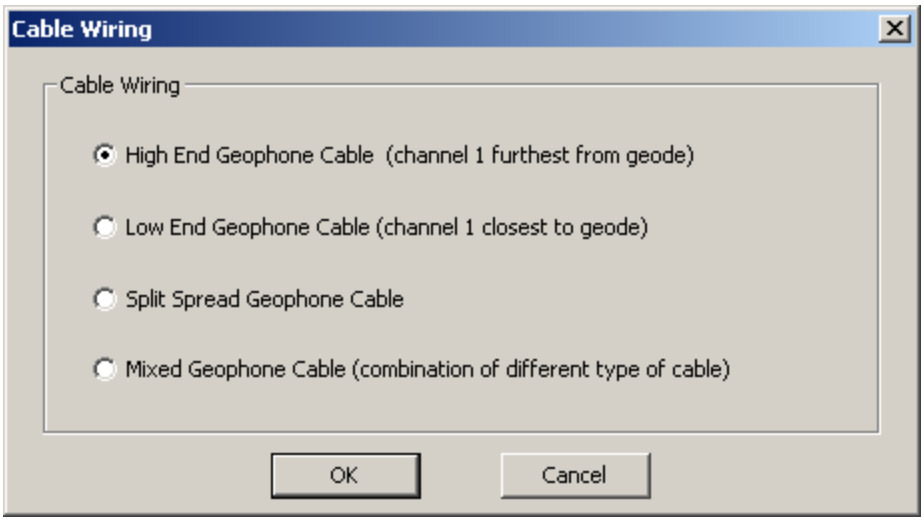
You may choose which information to display on the Geometry GUI by selecting Geometry Tool Bar Display Settings, which will reveal the following menu:



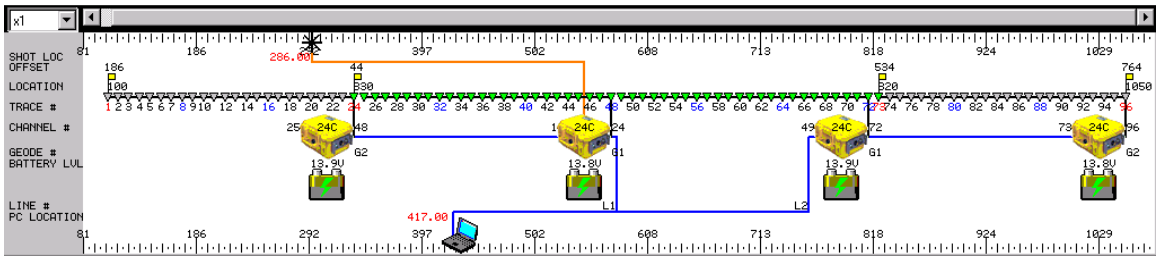
Using the above menu, you may de-select items to simplify the GUI and save screen space.

2.12.4 SELECT GEOPHONE CABLE TYPE

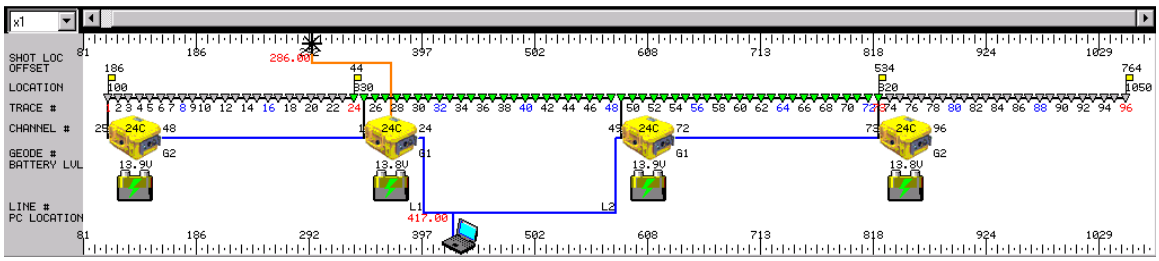
For purposes of display, and for mapping channels correctly, there are three basic cable types. In order for the geometry display to match what you have on the ground, you must indicate what kind of cable you have. Click on Select Geophone Cable Type to display the following menu:



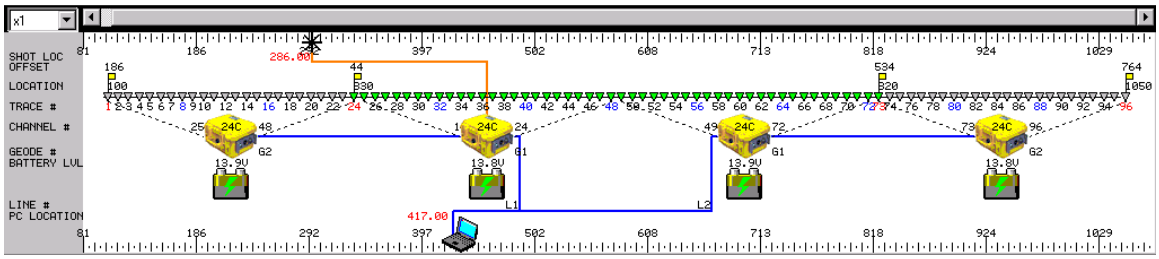
A “high end” cable means that channel 1 is connected to the furthest geophone from the Geode module:



A “low end” cable means that channel 1 is connected to the closest geophone to the Geode module:

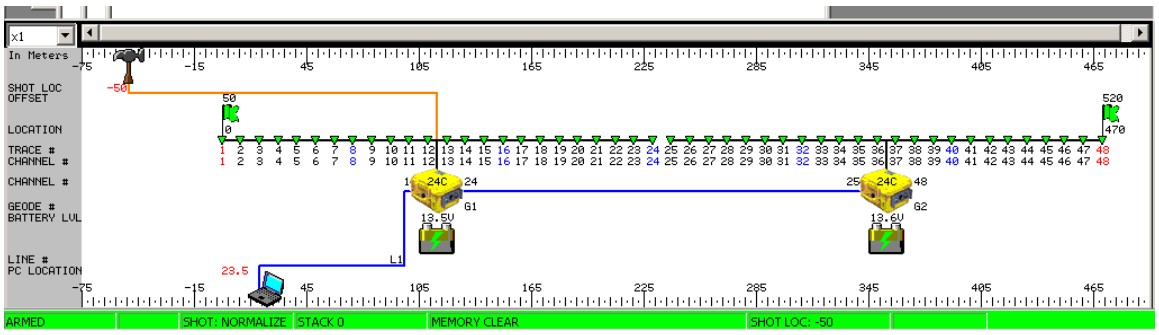


“A split spread” cable consists of two cables, with the Geode in the middle:



Choose “mixed” geophone cable if you have a combination of those described above, and your survey layout will be displayed as follows:

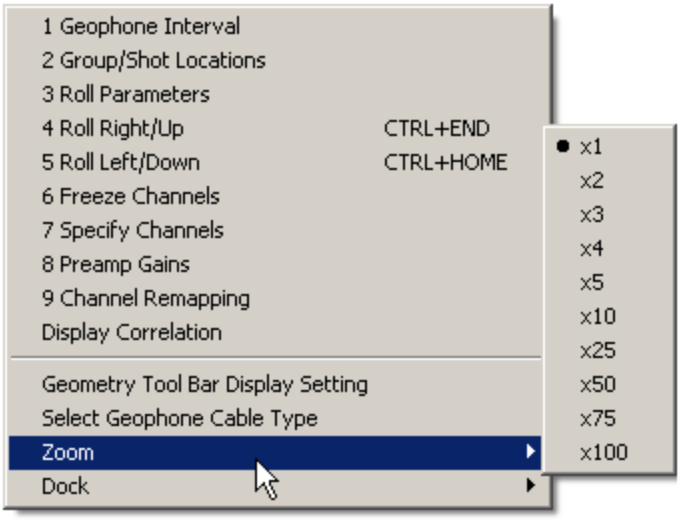
I get the above when I choose mixed, and I get the below when I choose “split spread”:



2.12.5 ZOOM

Click on Zoom to display the choices of scale, and choose the desired scale. Note that you can control the scale with the zoom selection box in the upper left hand corner of the Geometry GUI, as discussed on Page 159. However, it is included in this menu in the event you choose not to display zoom selection box.

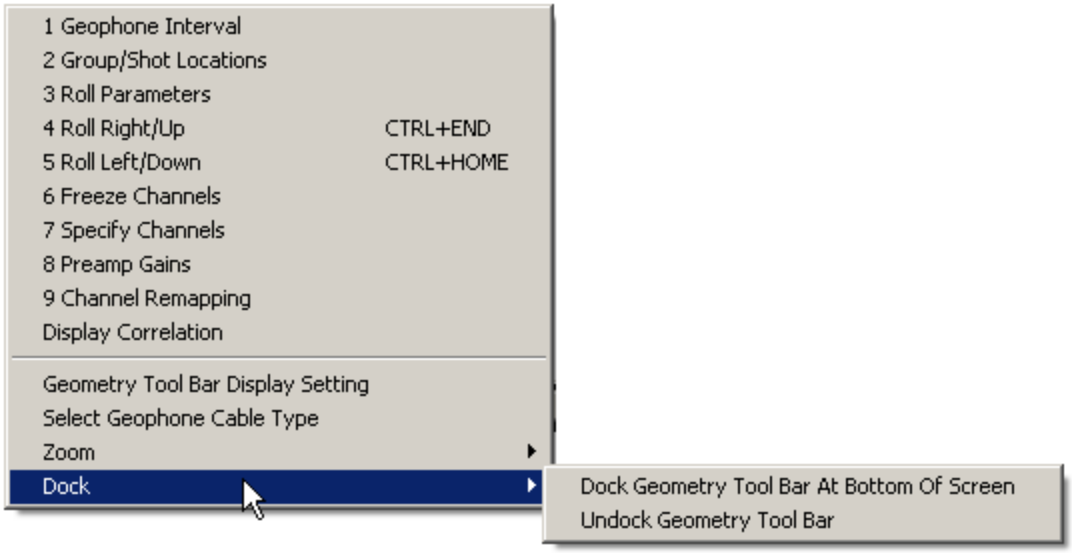
Note: *You may also control the scale by highlighting the zoom control box and using the left and right arrow keys. Also, the “Page Up” key will set the zoom to x1, and the “Page Down” key will set the zoom to x100.*



Note: *A zoom setting of x1 will result in the entire survey layout fitting within the visible portion of the GUI.*

2.12.6 DOCK

The Geometry GUI is a "dockable" toolbar. Generally, it is "docked" or "fastened" to the bottom of the display. However, if you would like to move it to another location, you can "undock" it and move it around like any other window. You may close it by clicking on the "X" in the upper right-hand corner. To bring it back, open the Window menu, and click on "View Geometry Tool Bar".



Note: *Since the Geometry GUI is a toolbar rather than a window, it will always be on top.*

APPENDICES

Appendix A. STARTUP SCREENS

What you see when you first start SCS depends on the hardware and/or software bundle that you purchased. The various possibilities are summarized below.

A.1 SMARTSEIS ST

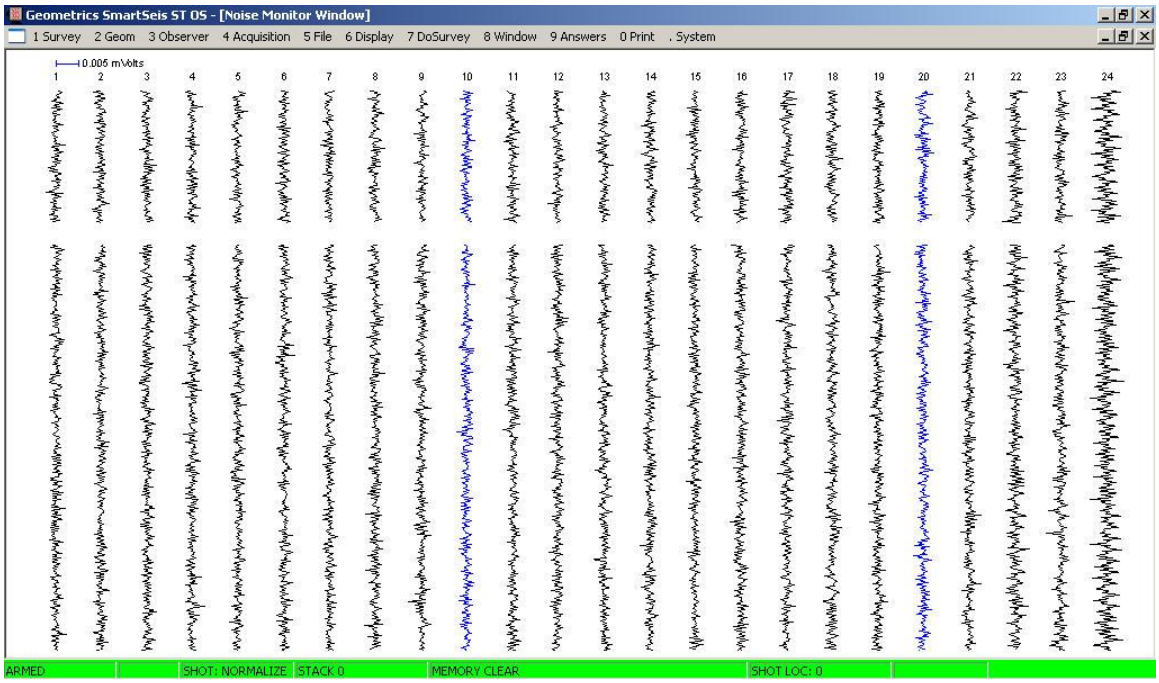
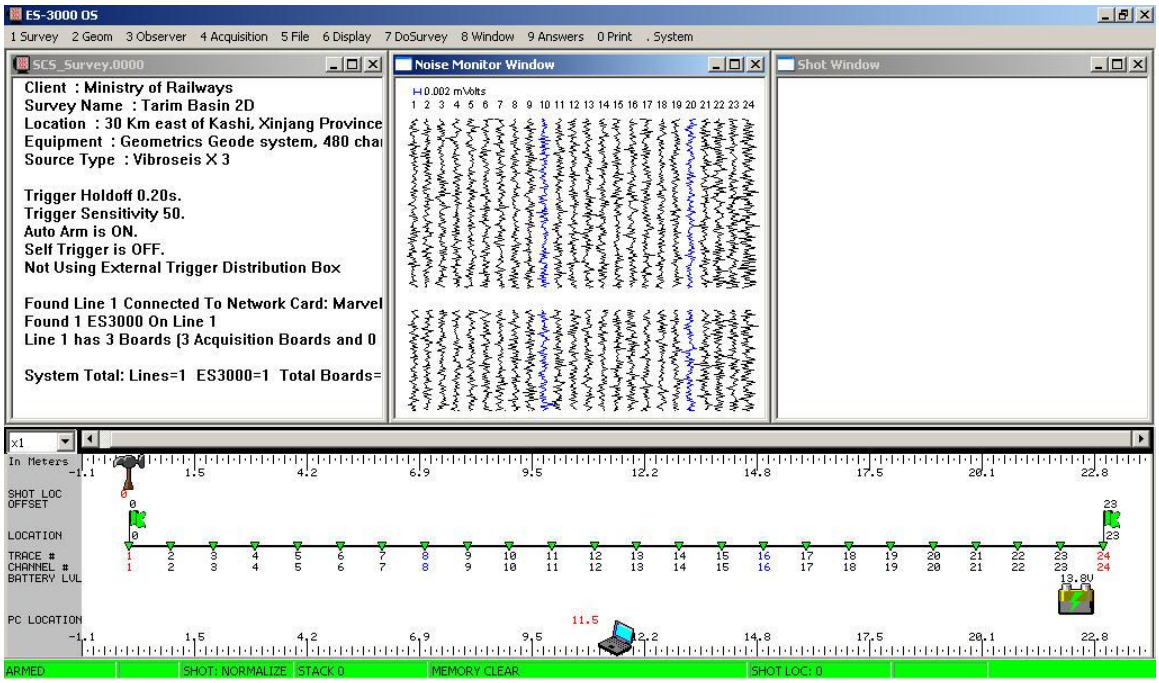


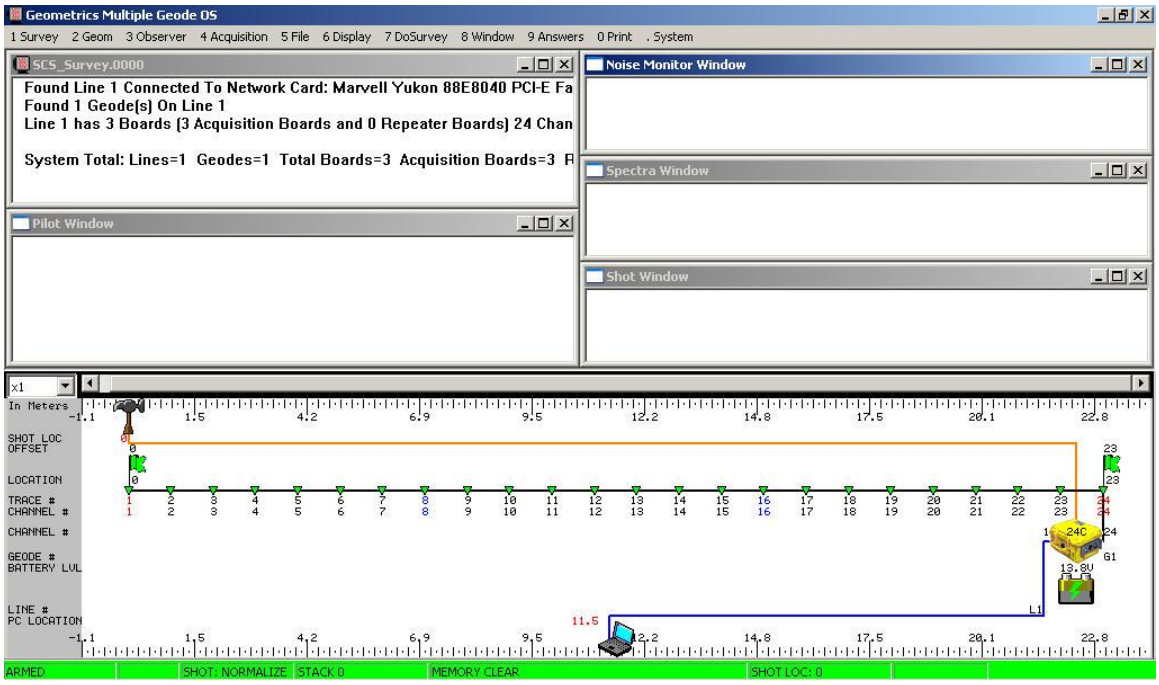
Figure A-1: Startup screen of SmartSeis (STOS).

When you turn on your SmartSeis ST, SCS will run atomically and default to the Noise Monitor window, as shown above. You can easily toggle between this and the Shot window using the **3** and **4** hot keys.

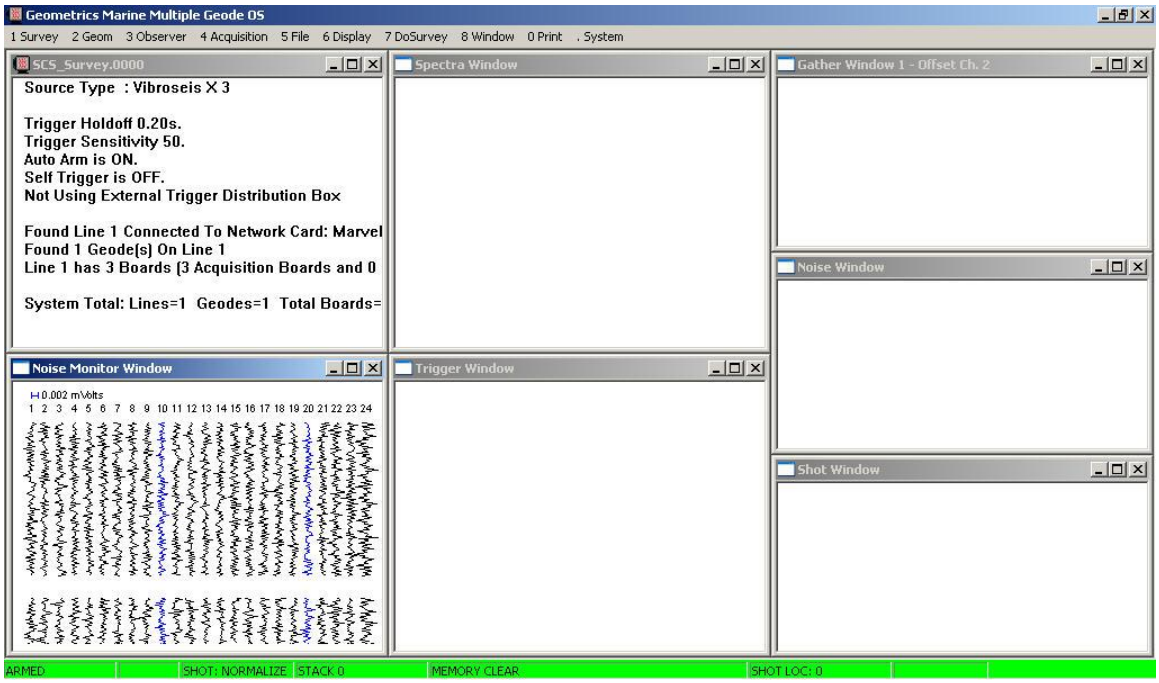
A.2 GEODE / SGOS AND ES-3000 ESOS



A.3 GEODE / MGOS AND STRATAVISOR NZOS



A.4 GEODE /MMGOS AND STRATAVISOR MNZOS


Geometrics Marine Multiple Geode OS
1 Survey 2 Geom 3 Observer 4 Acquisition 5 File 6 Display 7 DoSurvey 8 Window 0 Print . System
SCS_Survey.0000
Source Type : Vibroseis X 3
Trigger Holdoff 0.20s.
Trigger Sensitivity 50.
Auto Arm is ON.
Self Trigger is OFF.
Not Using External Trigger Distribution Box
Found Line 1 Connected To Network Card: Marvel
Found 1 Geode(s) On Line 1
Line 1 has 3 Boards (3 Acquisition Boards and 0
System Total: Lines=1 Geodes=1 Total Boards=
Spectra Window
Gather Window 1 - Offset Ch. 2
Noise Window
Noise Monitor Window
H 0.002 mVolts
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Trigger Window
Shot Window
ARMED
SHOT: NORMALIZE
STACK 0
MEMORY CLEAR
SHOT LOC: 0

Appendix B. HARDWARE

B.1 GEODE

The Geode is a "distributed" seismic system – the seismic recording modules are physically separated from the PC and are typically distributed on the ground among the geophones. Each individual Geode module contains 8, 12, 16, or 24 channels, and Geodes can be connected in series to build systems of 600 channels or more. An annotated picture of the Geode is shown in Figure B-1:

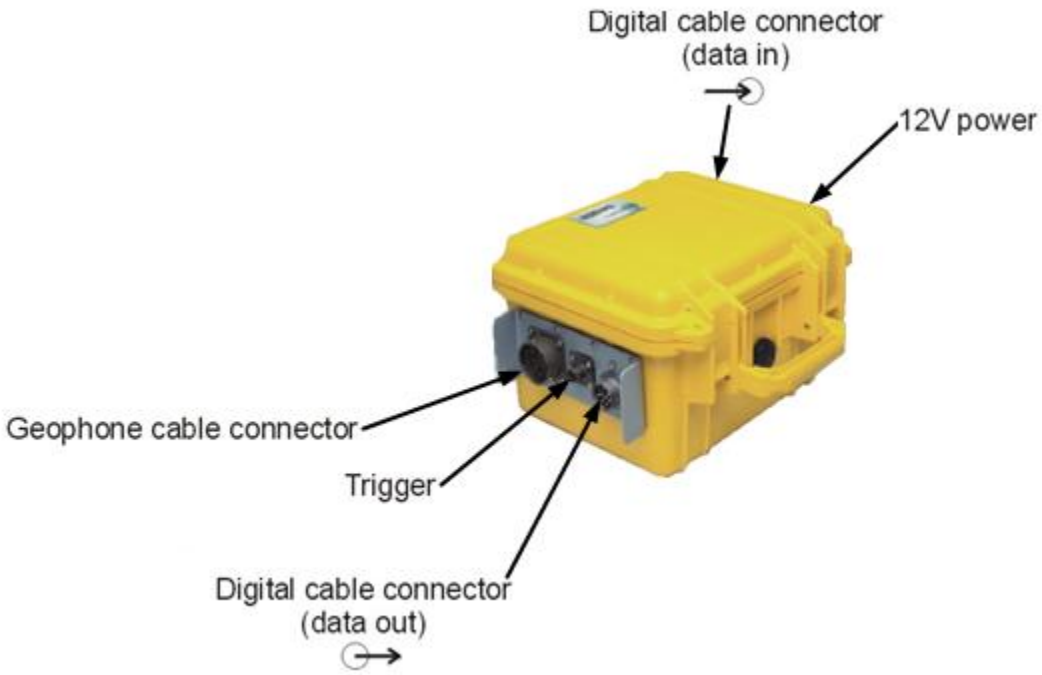


Figure B-1: Annotated photograph of Geode module.

A close-up of the various connectors is shown in Figure B-2 below:

Figure B-2: Geode connector plates.

The left half of Figure B-2 shows the geophone cable connector, trigger input connector, data-out connector, and a grounding plug. The right half shows the power and data-in connectors.

Figure B-3: Typical Geode accessories, clockwise from upper-left: digital interface cable, network interface box (NIB), power cable, hammer switch, trigger extension cable, geophone cable, geophone.

Typical accessories are pictured above and described below:

- **Digital interface cable:** Connects Geode to PC (via NIB, see below), Geode to Geode, or Geode to StrataVisor. Contains one Ethernet cable and a twisted pair for transmitting trigger signal from Master Geode (see Page 119) to rest of Geodes on network. Up to 250m long for Geode/Geode connections; maximum length for PC/Geode connection is 100m.

Note: *If you are connecting your Geode to a StrataVisor, and the distance between the two must be more than 100m, be sure to connect to the connector #1 on the StrataVisor. Connector 2 (and 3 and 4, if present) will only drive an Ethernet signal 100m. See Page 17.*

- **Network interface box (NIB):** adaptor that connects between digital interface cable and Ethernet port on PC (see Appendix B.1.1).
- **Power cable:** Connects Geode to 12V power source.
- **Hammer switch:** Inertial switch; typically mounted on sledgehammer handle. Provides contact closure to Master Geode module.
- **Trigger extension cable:** Connects between hammer switch and Master Geode; 90m long. Multiple cables can be plugged together to accommodate larger offsets.
- **Geophone cable:** Connects to geophone cable connector on Geode; passes analog output from geophones to Geode to be digitized.
- **Geophone:** Motion sensor; connects to connector on geophone cable.

What connects to what and how should be self-evident upon close examination of the above items. A schematic of a typical single-Geode layout is shown below:

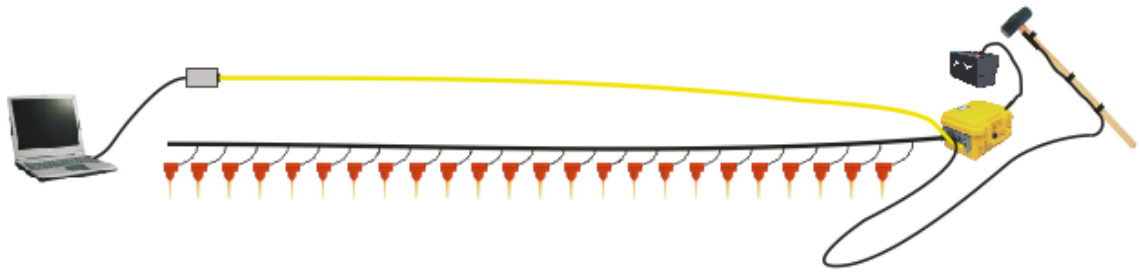


Figure B-4: Typical single-Geode layout.

Important: *The digital communications have polarity. One digital connector is for incoming digital data, the other is for outgoing digital data. If a Geode is connected backwards, it will not work.*

This is illustrated in Figure B-5:

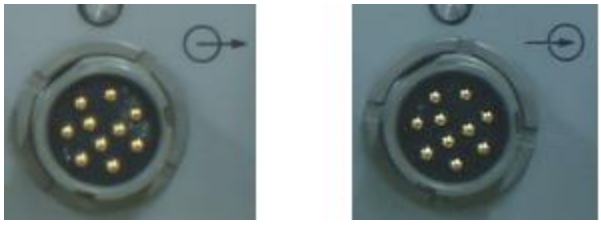


Figure B-5: Digital connectors on Geode.

The connector on the left is for data exiting the Geode (as signified by the ⊖→ symbol), and should be topologically toward the PC. The connector on the right is for data entering the Geode (from another Geode), and should be topologically toward the next Geode in the line. In Figure B-4 above, the latter is not used, since there is only one Geode.

An example of a two-Geode layout is shown below:

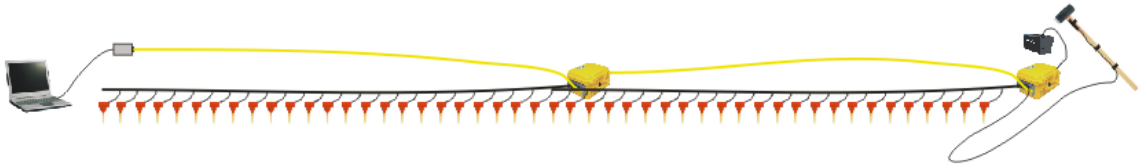


Figure B-6: Typical two-Geode layout.

The hammer switch can be plugged into any Geode, but that Geode must be designated in the software as the Master Geode (see Page 119).

There are a multitude of ways of configuring a Geode system, depending on the number of channels involved and the specific needs of the survey. This subject is inextricably tied to the subject of channel mapping; as such, the two are discussed in further detail in **ERROR! REFERENCE SOURCE NOT FOUND.**: **ERROR! REFERENCE SOURCE NOT FOUND.**.

B.1.1 NETWORK INTERFACE BOX (NIB)

The Geode connects to a PC via the Network Interface Box (NIB; see below). The NIB adapts the digital interface cable to a standard RJ-45 connector, which plugs into the network port on your PC. If you have two network ports and more than one Geode, you can use a dual NIB.

Figure B-7: Network Interface Boxes; single-line (left) and dual-line (right).

Using two network lines can increase productivity when using larger systems (>120 channels) by doubling the data throughput.

Note: *If you wish to use two network lines, you must use a dual NIB. Two single-line NIBs will not work. One of the functions of the dual NIB is to transmit the trigger signal from Geode line to the other – this is not done via Ethernet, but by an extra twisted pair.*

Note: *For special applications, as many as ten network lines can be used. Please contact Geometrics for assistance.*

Figure B-8: Front panel of Network Interface Box.

In addition to being an adaptor, the NIB performs the function of powering the Geodes up and down. Refer to the above figure. Prior to starting SCS, switch to the **Enable Power Up** position. This will power up a portion of the first acquisition board on the first Geode on each line, enabling them to respond to software commands. Upon starting SCS, a start command will be sent to each of these Geodes, which will in-turn power up the rest of the Geodes. Once the software is up and running and all Geodes are recognized, return the switch to the **Enable Power Down** position. This will not only extend the life of the standard 9V battery in the NIB, but it will also cause all of the Geodes to shut down when the software is closed.

Note: *If you forget to switch to the Enable Power Down position and the Geodes don't shut down when you close the software, you can restart the software, switch to Enable Power Down, and close the software again.*

B.1.2 TEST BUTTON

The **Test** button has two functions:

- It powers up the Geode for testing purposes. This can be done while laying out the instrumentation – no connection to the controller PC or SCS is required. For instance, if you push the **Test** button on two adjacent Geodes, a blinking link LED on each unit (see discussion of blink codes below) will indicate that each unit is receiving link pulses from the other.
- If the Geode is powered-up and in communication with the controller PC, pressing the **Test** button will cause the icon representing that Geode in the Map View to flash green notifying the operator that a member of the field crew is at that location. In addition, a short confirmation beep will be emitted by the Geode.

B.1.3 LIGHT-EMITTING DIODES

B.2 STRATAVISOR NZ

The StrataVisor NZ is an "all-in-one" seismic system -- the seismic recording hardware, PC, screen, and printer are all contained in a single unit (compare to the Geode). It typically contains either 24 or 48 channels, but is also available with 8, 12, 16, and 64 channels. An annotated photograph is shown below:

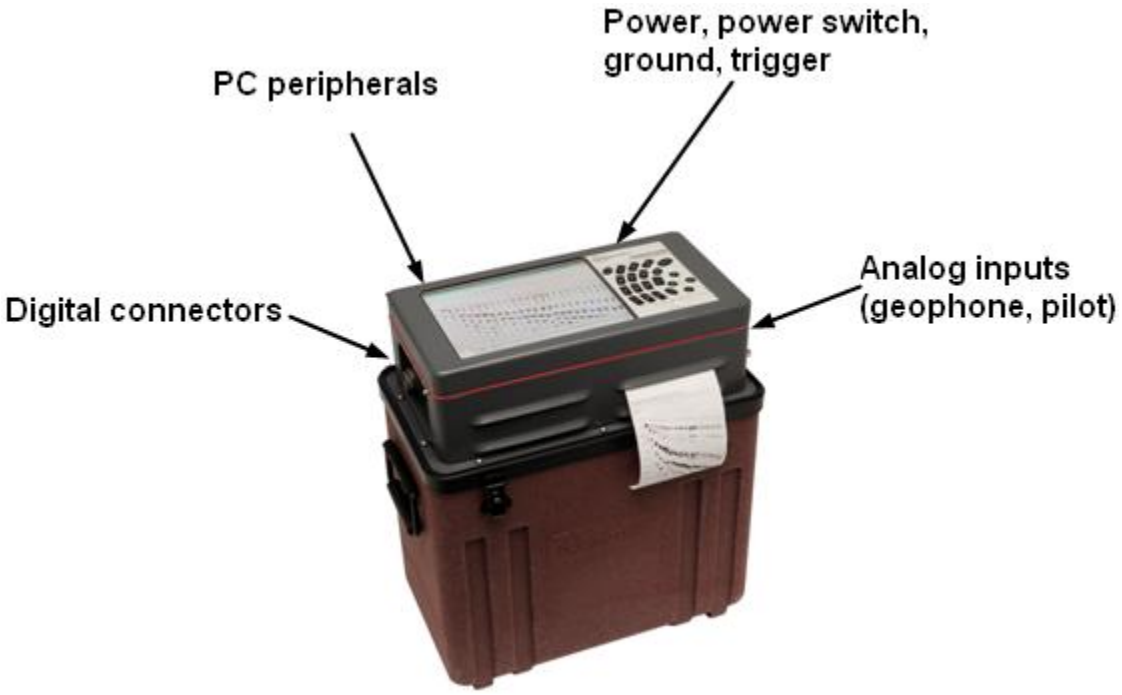


Figure B-9: Annotated photograph of StrataVisor NZ.

Close-ups and a discussion of the various connectors follow.

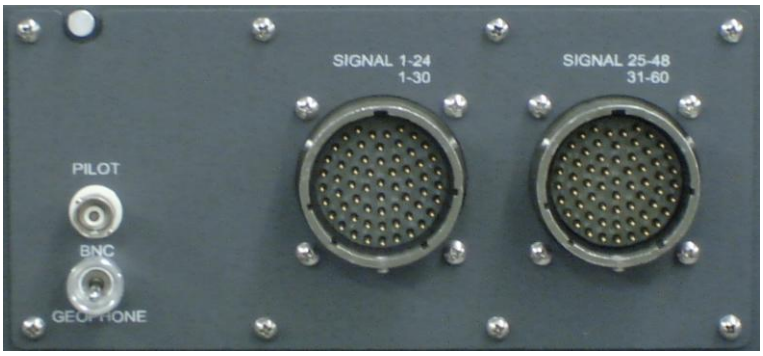


Figure B-10: Analog input connectors.

On the right side of the seismograph, you will see the connectors pictured above. The BNC connector labeled **PILOT** is wired to channel 1 via the toggle switch. If you are using a non-impulsive source such as a vibrator, this is where the pilot or reference trace from the source would connect to the seismograph (see Page 49). In this case, the toggle switch should be in the **BNC** position; this connects the BNC connector to channel 1. Otherwise the switch should be in the **GEOPHONE** condition.

Note: *If channel 1 appears dead, a common cause is that the toggle switch has been accidentally bumped into the BNC position when nothing is connected to the BNC, which disconnects channel 1 from the geophone cable connector.*

The other two connectors are geophone inputs for up to 60 channels (30 channels each). If you have a 64-channel system, there will be an additional connector for channels 61-64; these are typically used as AUX (see Table 3 on Page 27) or PILOT channels.

Figure B-11: PC peripherals connectors: RS-232, video, mouse, keyboard, USB, and printer.

On the back of the seismograph (above) are the connectors for standard PC peripherals, including RS-232 serial I/O, external video, external printer, USB, and mouse and keyboard (supplied with StrataVisor).

Note: *The mouse and keyboard must be connected to the StrataVisor at boot-up to be recognized.*

Also on the back are the power, ground, and trigger inputs, along with the power switch:

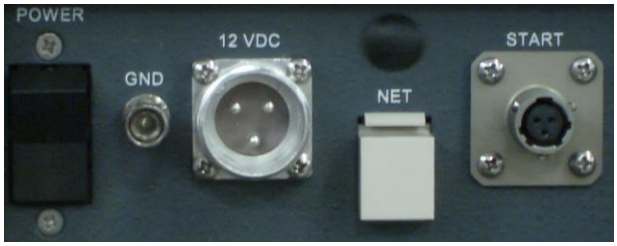


Figure B-12: Power switch, power and trigger inputs.

Figure B-13: Digital data connectors.

Finally, on the left side are digital data connectors. The StrataVisor channel count can be expanded by adding Geode modules; see discussion below on possible configurations.

Figure B-14: Typical StrataVisor accessories, clockwise from upper-left: power cables, hammer switch, trigger extension cable, geophone cable, and geophone.

Typical accessories are pictured above and described below:

- **Power cable:** Connects Geode to 12V power source.
- **Hammer switch:** Inertial switch; typically mounted on sledgehammer handle. Provides contact closure to StrataVisor (or Master Geode if Geodes are connected).
- **Trigger extension cable:** Connects between hammer switch and seismograph; 90m long. Multiple cables can be plugged together to accommodate larger offsets.
- **Geophone cable:** Connects to geophone cable connector on StrataVisor (and Geodes, if present); passes analog output from geophones to seismograph to be digitized.
- **Geophone:** Motion sensor; connects to connector on geophone cable.

What connects to what and how should be self-evident upon close examination of the above items.

B.2.1 EXAMPLE CONFIGURATIONS

Your field configuration for the StrataVisor depends in large part on the total number of channels. With systems of 24 channels or less, the StrataVisor is usually located at the end of the geophone spread, as shown in Figure B-15:

Figure B-15: Typical 8-24 channel StrataVisor layout.

With 48-channels, the StrataVisor is typically in the middle:

Figure B-16: Typical 48-channel StrataVisor layout.

The StrataVisor can be expanded to larger channel counts by plugging Geodes into one or more of the digital connectors shown in Figure B-13. If you do this, we highly recommend that you read **Error! Reference source not found.** regarding channel mapping.

Figure B-17: Expanding a 48-channel StrataVisor to a 96-channel system with the addition of two 24-channel Geodes.

Note: *The first Geode on digital line #1 (see Figure B-13 above) can be up to 250m from the StrataVisor topologically. However, the maximum cable length between the StrataVisor and first Geode on connectors 2, 3 and 4 is limited to 100m. If your geophone spacing is such that this distance exceeds 100 meters, we recommend that you use a single network line plugged into digital connector #1.*

B.3 SMARTSEIS ST

The SmartSeis ST is an "all-in-one" seismic system -- the seismic recording hardware, PC, screen, and printer are all contained in a single unit (compare to the Geode). It comes with 12 or 24 channels. An annotated photograph is shown above:

Figure B-18: Annotated photograph of SmartSeis ST.

Close-ups and a discussion of the various connectors follow.

Figure B-19: Geophone cable input connector.

On the right side of the SmartSeis, you will see the geophone cable connector (above).

Figure B-20: PC peripherals connectors: USB, video, and RS-232.

On the back of the seismograph (above) are the connectors for standard PC peripherals, including USB, external video, and RS-232 serial I/O.

Also on the back are the power, ground, and trigger inputs, along with the power switch:

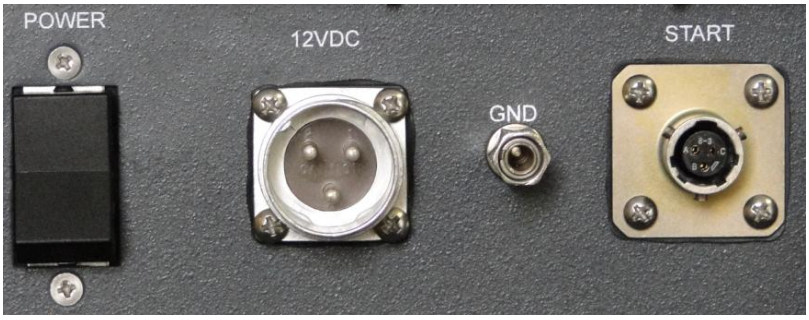


Figure B-21: Power switch, power, ground and trigger inputs.

Figure B-22: Typical SmartSeis accessories, clockwise from upper-left: power cables, hammer switch, trigger extension cable, geophone cable, and geophone.

Typical accessories are pictured above and described below:

- **Power cable:** Connects SmartSeis to 12V power source.
- **Hammer switch:** Inertial switch; typically mounted on sledgehammer handle. Provides contact closure to trigger input.
- **Trigger extension cable:** Connects between hammer switch and SmartSeis; 90m long. Multiple cables can be plugged together to accommodate larger offsets.
- **Geophone cable:** Connects to geophone cable connector on SmartSeis; passes analog output from geophones to SmartSeis to be digitized.
- **Geophone:** Motion sensor; connects to connector on geophone cable.

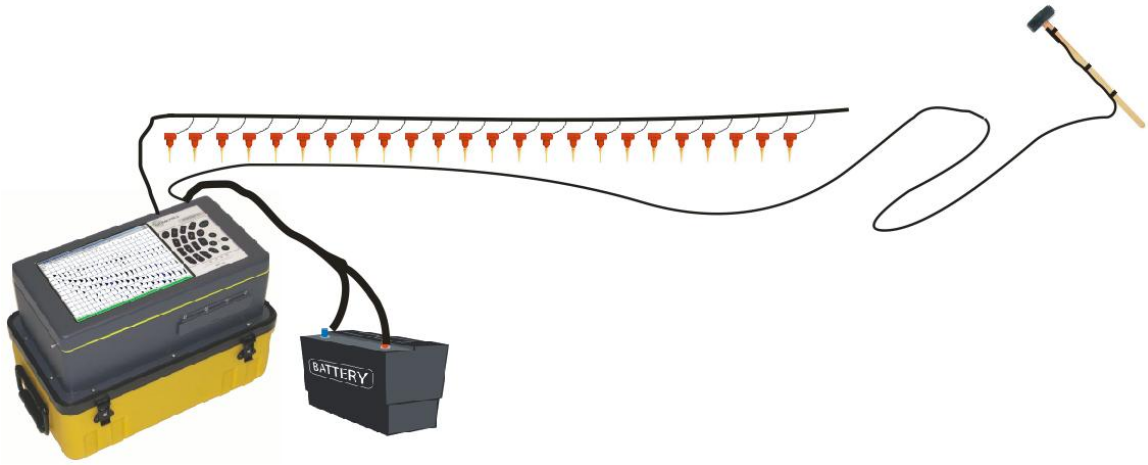


Figure B-23: SmartSeis ST layout.

B.4 ES-3000

The ES-3000 is similar to the Geode (Appendix B.1) in that it is controlled by a PC via an Ethernet link. Each individual ES-3000 module contains 8, 12, 16, or 24 channels. The main difference is that there is not a second digital data link for incoming data – the ES-3000 cannot be expanded to more than 24 channels. An annotated picture of the ES-3000 is shown in Figure B-24 below:

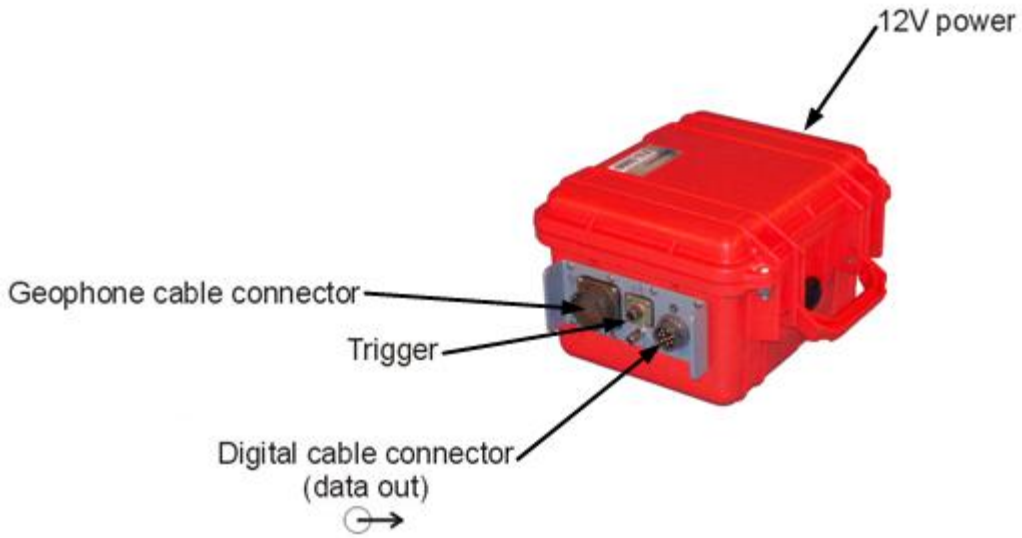


Figure B-24: Annotated photograph of ES-3000.

A close-up of the various connectors is shown in Figure B-25 below:

Figure B-25: ES-3000 connector plates.

The left half of Figure B-25 shows the geophone cable connector, trigger input connector, data-out connector, and a grounding plug. The right half shows the power connector.

Figure B-26: Typical ES-3000 accessories, clockwise from upper-left: digital interface cable, power cable, hammer switch, trigger extension cable, geophone cable, and geophone.

Typical accessories are pictured above and described below:

- **Digital interface cable:** Connects ES-3000 to PC Ethernet port.
- **Power cable:** Connects Es-3000 to 12V power source.
- **Hammer switch:** Inertial switch; typically mounted on sledgehammer handle. Provides contact closure to ES-3000.
- **Trigger extension cable:** Connects between hammer switch and ES-3000; 90m long. Multiple cables can be plugged together to accommodate larger offsets.
- **Geophone cable:** Connects to geophone cable connector on ES-3000; passes analog output from geophones to ES-3000 to be digitized.
- **Geophone:** Motion sensor; connects to connector on geophone cable.

What connects to what and how should be self-evident upon close examination of the above items. A schematic of a typical ES-3000 layout is shown below:

Figure B-27: Typical ES-3000 layout.

Appendix C. CONNECTOR WIRING INFORMATION

Two different types of connectors are typically used to input signals from the geophones. The section following details the two configurations.

C.1 GEOPHONE CONNECTORS

On some 12 and 24 channel StrataVisor™ seismographs, the inputs from the geophones connect to a 27-pin connector manufactured by Cannon. The mating connector (used on the geophone cables) is a Cannon NK-27-21C, Geometrics part No. 21-133-027. See the following table for the pin assignments.

Input Wiring for Systems with Cannon NK 27 Style Connectors			
3 to 12 Channels		**13 to 24 Channels**	
Channel	**Pin**	**Channel**	**Pin**
+1	23	+13	1
-1	24	-13	2
+2	21	+14	3
-2	22	-14	4
+3	19	+15	5
-3	20	-15	6
+4	17	+16	7
-4	18	-16	8
+5	15	+17	9
-5	16	-17	10
+6	13	+18	11
-6	14	-18	12
+7	11	+19	13
-7	12	-19	14
+8	9	+20	15
-8	10	-20	16
+9	7	+21	17
-9	8	-21	18
+10	5	+22	19
-10	6	-22	20
+11	3	+23	21
-11	4	-23	22
+12	1	+24	23
-12	2	-24	24
NC	25	NC	25
NC	26	NC	26
GND	27	GND	27

A geophone extension cable can be constructed with the above connector on one end and a Cannon NK-27-22C (Geometrics part No. 21-133-037) on the other end.

The Geode as well as the 48 and 60-channel StrataVisor™ seismographs use 61-pin Bendix connectors. The mating connector is Bendix PT06-24-61S(SR) Geometrics P/N 21-206-070 or an equivalent connector from another manufacturer. The wiring scheme is shown below.

Geophone Connector Pin Assignments for Geode 3 to 24 Channel Systems and For StrataVisor NZ 3-48 Channel Systems Using Bendix Style Connectors

Bendix Connector 1		Bendix Connector 2		Pin Configuration For Cannon NK27 Adapter Cable
Channel	**Pins**	**Channel**	**Pins**	**Pin**
1	z/AA	25	A/B	23/24
2	x/y	26	C/D	21/22
3	v/w	27	E/F	19/20
4	t/u	28	G/H	17/18
5	r/s	29	J/K	15/16
6	p/q	30	L/M	13/14
7	m/n	31	N/P	11/12
8	j/k	32	R/S	9/10
9	h/i	33	T/U	7/8
10	f/g	34	V/W	5/6
11	d/e	35	X/Y	3/4
12	b/c	36	Z/a	1/2
13	Z/a	37	b/c	1/2
14	X/Y	38	d/e	3/4
15	V/W	39	f/g	5/6
16	T/U	40	h/i	7/8
17	R/S	41	j/k	9/10
18	N/P	42	m/n	11/12
19	L/M	43	p/q	13/14
20	J/K	44	r/s	15/16
21	G/H	45	t/u	17/18
22	E/F	46	v/w	19/20
23	C/D	47	x/y	21/22
24	A/B	48	z/AA	23/24
GND	PP		PP	27

Notes:

1. Each channel has two inputs, the first listed in the table goes to the + input, second to the – input.
2. Pins BB through NN are not used in the StrataView/Visor 48 channel system

Geophone Connector Pin Assignments for StrataVisor NZ Seismographs with 49 to 60 Channels			
Bendix Connector 1		**Bendix Connector 2**	
Channel	**Pins**	**Channel**	**Pins**
1	z/AA	31	MM/NN
2	x/y	32	KK/LL
3	v/w	33	HH/JJ
4	t/u	34	FF/GG
5	r/s	35	DD/EE
6	p/q	36	BB/CC
7	m/n	37	A/B
8	j/k	38	C/D
9	h/i	39	E/F
10	f/g	40	G/H
11	d/e	41	J/K
12	b/c	42	L/M
13	Z/a	43	N/P
14	X/Y	44	R/S
15	V/W	45	T/U
16	T/U	46	V/W
17	R/S	47	X/Y
18	N/P	48	Z/a
19	L/M	49	b/c
20	J/K	50	d/e
21	G/H	51	f/g
22	E/F	52	h/i
23	C/D	53	j/k
24	A/B	54	m/n
25	BB/CC	55	p/q
26	DD/EE	56	r/s
27	FF/GG	57	t/u
28	HH/JJ	58	v/w
29	KK/LL	59	x/y
30	MM/NN	60	z/AA
GND	PP	GND	PP

Notes:

1. Each channel has two inputs, the first listed in the table goes to the + input, second to the – input.

C.2 POWER CONNECTOR

The power connector on a StrataVisor NZ is a 3-pin connector manufactured by Cannon. The mating connector used on the power cable is a Cannon WK-3-21C (Geometrics part no. 21-133-032).

Pin	Use
1	+12 V DC
2	common
3	not used

The Geode uses a waterproof connector made by Brad Harrison (41307N, 5 pin/16), Geometrics part number 60-201-001. It is wired as follows:

Pin	Use
1	not used
2	+12 V DC
3	chassis ground
4	not used
5	common

Some versions of the Geode may have a different, completely waterproof 5 pin connector. Contact the factory for an updated wiring pattern.

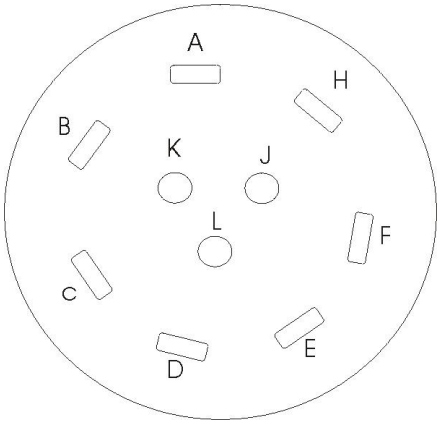
C.3 START CONNECTOR

The start or trigger connector is a 3-pin connector manufactured by Bendix and others. The mating connector, used on the standard hammer switch, HVB-1 blasters, and the hammer switch extension cable is a PT06A-8-3P(SR) (Geometrics part no. 21-206-003).

Pin	Use
A	Trigger input
B	Common
C	Not used

The other end of the hammer switch extension cable uses PT01A-8-3S(SR) (Geometrics part no. 21-207-038) wired with the same pin assignments.

C.4 DIGITAL INTERFACE CONNECTOR



The digital interface cable is pinless and is considered a network "crossover" cable since it is wired between two similar network devices. Cables are constructed using Belden 1752A cable. Follow the table below and make sure that the correct color coding is followed as specific pairs of wires are wrapped together to control capacitance in the cable to ensure long distance operation.

Pin Connection		Color	Function
J	K	WHITE/ORANGE	TX+ to RX+
K	J	WHITE/GREEN	RX+ to TX+
H	B	ORANGE	TX- to RX-
B	H	GREEN	RX- to TX-
C	C	BROWN	Remote Power Up+
D	D	BLUE	Trigger A
E	E	WHITE/BLUE	Trigger B
F	F	WHITE/BROWN	Power Up -
A n/c	L n/c		A and L are not connected

Note that Geometrics manufactures a digital cable tester (P/N 28143-01) to verify all conductors in the digital cable are connected.

Geode digital interface cables are available as either lightweight, or with an abrasion resistant coating. Maximum digital cable lengths are as follows:

- 250 m length between Geodes
- 250 m between the first Geode and an NZ with internal channels on the same line
- 100 m between network connections on NZs with no channels
- 100 m between the first Geode(s) and an NZC
- 100 m between a laptop and the first Geode

Appendix D. FILE FORMATS

D.1 FILE FORMAT

A "file" is the data from a seismic record recorded onto the disk. The data may be from a single shot, or data stacked from a number of hammer blows or "shots". The seismic record is held in memory in the seismograph until the operator decides to write it onto the disk (or tape). When data is written to disk, it is given a file name. The term "trace" is used to refer to the data from just one channel of the seismograph.

The formats available on the StrataVisor NZ and Geode are SEG-2, SEG-Y^{MGOS} and SEG-D^{MGOS}, the standards for seismic data files established by the Society of Exploration Geophysicists[1,2]. With the establishment of these standards, many data processing packages are able to read the files from Geometrics seismographs. Most third-party software developers have also standardized one or more of these formats. The complete standards are available from the SEG.

Linear dimensions and coordinates may be either meter, feet, or stations, but should be consistent throughout the file.

The following sections describe the SEG-2, SEG-Y^{MGOS} and SEG-D^{MGOS} formats used in the StrataVisor™ and Geode.

D.2 SEG-2 FILE STRUCTURE

The file is organized on the disk as blocks: a File Descriptor Block, followed by a sequence of Trace Descriptor Blocks and Data Blocks.

The *File Descriptor Block* contains information common to all the traces in the file, plus it

{beginning of file)

FILE DESCRIPTOR BLOCK
TRACE DESCRIPTOR BLOCK 1
DATA BLOCK 1
TRACE DESCRIPTOR BLOCK 2
DATA BLOCK 2
.....
.....
TRACE DESCRIPTOR BLOCK N
DATA BLOCK N

[1]Pullan, S. E., 1990, Recommended Standard for Seismic (Radar) Data Files in the Personal Computer Environment: Geophysics, Vol. 55, No. 9, September 1990, pp. 1260-1271.

[2]SEG Subcommittee on Field Tape Standards, Digital Field Tape Format Standards - SEG-D, REVISION 1: Geophysics, Vol. 59, No. 4, April, 1994, pp. 668-684.

provides information required to parse the rest of the overhead data. Another name for this block is the "File Header"

Each *Trace Descriptor Block* provides location, format, and other information pertinent to its corresponding Data Block (containing the data from a trace). Another name for this block is "Trace Header".

The *Data Block* consists of fixed point or floating point numbers as specified by their corresponding Trace Descriptor Block. This block contains the data from one channel (or one trace) of the seismograph.

There is a Trace Descriptor Block for each Data Block (in other words, there is a trace header for each block of data from one trace). The blocks are arranged in numerical order.

Pointers are written in the file blocks to indicate locations of the blocks with respect to the beginning of the file. Pointers are always long integers (32 bits). All addressing is to byte boundaries. All blocks start on double word (32 bit) boundaries.

Integers are 16-bit numbers written *low byte first* to conform to the Intel processors used with our software. Long integers are 32-bit numbers, also written low byte first. Hexadecimal number 4547 would be written 47 45 in the file. A 32-bit (4-byte) data sample, such as 0001D340 would be written 40 D3 01 00.

A typical file is shown later in an example, with interpretable characters shown in the right side column. Referring to this example will be helpful in understanding the following descriptions of the data format.

D.2.1.1 FILE DESCRIPTOR BLOCK

The first block in the file is the File Descriptor Block. The construction of the File Descriptor Block is:

Byte	
0-1	3a55 (File Descriptor Block ID)
2-3	REVISION NUMBER
4-5	SIZE OF TRACE POINTER SUB-BLOCK (M)
6-7	NUMBER OF TRACES IN FILE (N)
8	SIZE OF STRING TERMINATOR
9	FIRST STRING TERMINATOR CHARACTER
10	SECOND STRING TERMINATOR CHARACTER
11	SIZE OF LINE TERMINATOR
12	FIRST LINE TERMINATOR CHARACTER
13	SECOND LINE TERMINATOR CHARACTER
14-31	RESERVED
32-35	POINTER TO TRACE DESCRIPTOR BLOCK 1
36-39	POINTER TO TRACE DESCRIPTOR BLOCK 2
- - - -	- -
- - - -	POINTER TO TRACE DESCRIPTOR BLOCK N
33+M	STRING 1
	STRING 2
	. . . . .
M	STRING Z

This block holds information common to all traces in the file and pertaining to the structure and interpretation of the file. It consists of

(i) 32 bytes providing the block identifier, the revision number, the size of the Trace Pointer sub-block, the number of traces in this file, and the string and line terminator,

(ii) a Trace Pointer sub-block giving pointers to the start of each Trace Descriptor Block in the file, and

(iii) followed by optional strings with information related to the *entire* file such as date, time, delay, constant, high cut filter frequency, line number, low cut filter frequency, notch filter frequency, sample interval, shot coordinate, shot interval, shot map, and shot offset.

The *File Descriptor Block ID* (bytes 0 and 1 of this block and of the file) contains the integer 3a55 (in hexadecimal). This integer identifies the file as a seismic data file following this standard and identifies this block as the Record Descriptor Block (55 appears first, since it is the low byte).

The *File Standard Revision Number* (bytes 2 and 3) appear next.

Bytes 4 and 5 contain an integer giving the *size of the Trace Pointer Sub-block* in bytes (see below). All blocks start on double-word boundaries and are divisible by four.

Bytes 6 and 7 contain the *number of traces in this file*.

The *String Terminator* is one or two non-printable ASCII characters (decimal ASCII codes 0 through 31) used to separate the strings that hold the information in character string form in this (the File Descriptor) block, and the Trace Descriptor Blocks. Byte 8 is 01 (hex) and bytes 9 and 10 are 00 (hex) indicating the string terminator used by the StrataVisor™ is the NULL character.

The *Line Terminator* is one or two ASCII characters used to separate the lines of text in the Notes Block. In the StrataVisor™, byte 11 is 01 (size of line terminator, 01 hex), byte 12 is 0A (line terminator character), and byte 13 is 00 (hex) indicating the Line Terminator used by the StrataVisor™ is the Linefeed (0A) character.

Bytes 14 through 31 are reserved and written as 00.

The *Trace Pointer Sub-block* starts at byte 32, and contains pointers (unsigned long integers) to the start of each Trace Descriptor Block in the file. The length of this sub-block in bytes is specified in bytes 4 and 5, and the number of pointers (corresponding to the number of traces) contained in the sub-block is specified in bytes 6 and 7 (see above).

Following the Trace Pointer Sub-block is a free format section containing strings to provide optional information common to all traces in the file (the acquisition parameters, date and time, line geometry, etc.). Each string starts with an integer giving the length of the string (the offset to the next string), followed by a key word naming the parameter in the string, followed by the value (in ASCII), and terminated by the null character string terminator (indicated in bytes 8, 9, and 10 above). A list of key words used in the descriptor blocks will be found later in this chapter.

D.2.1.2 TRACE DESCRIPTOR BLOCK

The Trace Descriptor Block contains information relative to an individual trace (seismograph channel). Each Trace Descriptor Block is followed by a Data Block containing the data for that trace. The construction of the Trace Descriptor Block is:

Byte	
0-1	4422 (Trace descriptor block ID)
2-3	SIZE OF THIS BLOCK IN BYTES (X)
4-7	SIZE OF FOLLOWING DATA BLOCK IN BYTES (Y)
8-11	NUMBER OF SAMPLES IN DATA BLOCK
12	DATA FORMAT CODE
13-31	RESERVED
32	STRING 1
	STRING 2
	. . . . .
X	STRING Z

The actual byte number for the start of the Trace Descriptor Block varies with the length of the Record Descriptor Block. The optional strings follow with information pertinent to that block (channel number, descaling factor, geophone group location, number of stacks, etc.).

The *Trace Descriptor* (bytes 0 and 1) contains the integer 4422 (hex) to identify this block as a Trace Descriptor Block.

The *Block size* (bytes 2 and 3) contains the integer giving the size of this block in bytes.

The *Size of Data Block* (bytes 4 through 7) contains the long (32-bit) integer giving the size of the following Data Block corresponding to this Trace Descriptor Block.

The *Number of Samples in Data Block* (bytes 8 through 11) contains the integer giving the size of the Data Block in samples.

The *Data Format Code* (bytes 12) specifies the data format in the following data block according to the following table:

Byte value	Data Format
01	16-bit fixed point
02	32-bit fixed point
03	20-bit floating point (SEG convention)
04	32-bit floating point (IEEE standard)
05	64-bit floating point (IEEE standard)

The StrataVisor™ presently offers data recording in code 02, 32-bit fixed point data. Contact the factory regarding 32 bit floating point (04).

The next twenty bytes (bytes 13 through 31) are a series of zeros. This space is reserved.

The rest of the Trace Descriptor Block contains a series of strings. The string format and convention is the same as that used in the File Descriptor Block.

D.2.2 DATA BLOCK

A data block follows each Trace Descriptor Block. This is the data for the corresponding trace in the selected format. Except for the last trace (or a single channel record), the Data Block will be followed by the Trace Descriptor Block for the next trace.

D.2.2.1 STRING FORMAT

The Record and Trace Descriptor Blocks contain strings that provide information about the survey or the specific trace. Each string starts with an integer giving the length of the string, followed by a keyword that names the parameter in the string, then the value (in ASCII format) corresponding to that word, and then ends with the string terminator (null character). Keywords can not have embedded spaces (use _ for space, decimal ASCII code 95). The keyword and the associated data are separated by one or more spaces or tabs. To assist application program string searches, all strings are ordered alphabetically according to the keyword, and all alpha characters are uppercase.

Numeric values may be decimal integers or decimal floating point numbers. Negative decimal numbers are preceded by a minus sign "-". Decimal floating point numbers may use an "E" to express the number in scientific notation. Decimal points must be followed by a numeric character. The numbers in the following list are allowable numeric expressions. Unless stated otherwise, integers must have magnitude less than 32,000 (16 bits).

12, -3, -12.657, -34.6, -1.345E24, -2.3E6, -5.6E-11, -2.0E-9

Some values like time and date are expressed in the special indicated format.

D.2.2.2 KEY WORDS USED IN FILE DESCRIPTOR BLOCK

The File Descriptor Block normally contains the following strings. Other strings may be added later. Not all strings supported by the SEG standard are used by the StrataVisor™.

ACQUISITION_DATE

The date the data were acquired, in dd/mmm/yyyy format. For example April 1, 1988 would be stored as 01/APR/1988.

ACQUISITION_TIME

The time of day the data were acquired. The format is 24-hour time stored in hh:mm:ss format. For example 3:30PM would be stored as 15:30:00.

GENERAL_CONSTANT

A positive decimal number of 12 or fewer digits, entered by the operator as a general purpose number.

INSTRUMENT_GEOMETRICS_StrataVisor™

Identifies instrument used to collect the data.

TRACE_SORT

Identifies the trace sort. "As Acquired" is used for normal field records.

UNITS

Identifies measuring system, e.g. feet, meters. NONE is written to designate that system does not differentiate between systems.

NOTE

This string appears as the last string and contains notes and parameters not defined in the standard.

D.2.2.3 KEY WORDS USED IN TRACE DESCRIPTOR BLOCKS

CHANNEL_NUMBER

The channel number is a positive integer identifying the seismograph channel (or trace).

DELAY

The delay value is a floating point number expressing the time (in seconds) elapsed from the start pulse to recording the first sample in the Data Block.

DESCALING_FACTOR

A floating point number used to determine the true amplitude of the input signal. To convert from a data sample value to the actual input voltage (in millivolts) to the seismograph from the geophone, the formula is:

> input voltage due to one shot =
> data point * DESCALING_FACTOR / STACK_COUNT

Notice that an individual trace is corrected for multiple hammer blows by dividing by the number of stacks, so the result is the average input voltage from a single shot. Thus, the trace header allows for different stack counts on each trace, and when selected channels are frozen they not only stop acquiring data, but the stack counter also stops. On the Geode/NZ system, the scaling factor will be different for different preamp gains. For 36 dB preamp gain, the descaling factor is 4.270400E-5; for 24 dB the descaling factor is 1.698500E-004.

HIGH_CUT_FILTER

The HIGH_CUT_FILTER values are positive decimal integers expressing the high cut filter 3 dB frequency in Hz and slope in dB per octave. A value of 0 for the frequency indicates the filter was not implemented.

LINE_NUMBER

The line id is a collection of printable ASCII characters.

LOW_CUT_FILTER

The LOW_CUT_FILTER values are positive decimal integers expressing the low cut filter 3 dB frequency in Hz and slope in dB per octave. A value of 0 for the frequency indicates the filter was not implemented.

NOTCH_FREQUENCY

The NOTCH_FREQUENCY value is a positive decimal integer or floating point number expressing the notch filter frequency in Hz. A value of 0 indicates a notch filter was not implemented.

RECEIVER_LOCATION

This is the location of the geophone group for the particular trace. It is the dimension along the line, using the same linear coordinate system as the SOURCE_LOCATION.

In the file, each geophone group will have a location specified in the Trace Descriptor Block, as does the shot point in the Record Descriptor, providing that the operator has correctly entered the information in the geometry menu during data acquisition. Note however, that use of file storage for location is optional, that the operator's log may contain the same information, and that the files may be edited later to insert or correct this information.

SAMPLE_INTERVAL

The value is a floating point number expressing the time between samples in seconds.

SOURCE_LOCATION

This is the location of the shot. This value is a linear coordinate specifying location along the survey line relative to some reference. May specify depth in a drill hole.

STACK_COUNT

This stack count is a positive integer indicating the number of times data were stacked into an individual trace. This number may be different for each channel (trace).

D.2.2.4 SEG-2 FILE FORMAT EXAMPLE

Following is a listing of a typical file. The byte column lists the byte number in sequence. The right side column shows the interpreted code, where the byte corresponds to an ASCII character that can be interpreted on a standard line printer. Non-interpretable code is shown as a ".". The Record Descriptor Block starts at byte 0000, with the number 3a55 (listed low byte first). The first Trace Descriptor Block starts at byte 0138, with the number 4422.

Byte Numbers in Hexadecimal lower byte first Interpreted Code

```
00000000  55 3A 01 00  80 10 18 00  01 00 00 01  0A 00 00 00  U:··············
00000010  00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00  ················
00000020  D0 11 00 00  B0 2C 00 00  90 47 00 00  70 62 00 00  ·····,···G··pb··
00000030  50 7D 00 00  30 98 00 00  14 B3 00 00  F8 CD 00 00  P}··0···········
00000040  DC E8 00 00  C0 03 01 00  A4 1E 01 00  88 39 01 00  ·············9··
00000050  6C 54 01 00  50 6F 01 00  34 8A 01 00  18 A5 01 00  lT··Po··4·······
00000060  FC BF 01 00  E0 DA 01 00  C4 F5 01 00  A8 10 02 00  ················
00000070  8C 2B 02 00  70 46 02 00  54 61 02 00  38 7C 02 00  ·+··pF··Ta··8|··
00000080  00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00  ················
00000090  00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00  ················
000000A0  00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00  ················
000000B0  00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00  ················
                                      .
                                      .
                                      .
                                  strings
                                      .
                                      .
00001050  00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00  ················
00001060  00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00  ················
00001070  00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00  ················
00001080  00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00  ················
00001090  00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00  ················
000010A0  1F 00 41 43  51 55 49 53  49 54 49 4F  4E 5F 44 41  ··ACQUISITION_DA
000010B0  54 45 20 31  38 2F 4F 63  74 2F 32 30  30 31 00 1C  TE 18/Oct/2001··
000010C0  00 41 43 51  55 49 53 49  54 49 4F 4E  5F 54 49 4D  ·ACQUISITION_TIM
000010D0  45 20 31 36  3A 31 39 3A  33 39 00 15  00 43 4F 4D  E 16:19:39···COM
000010E0  50 41 4E 59  20 47 65 6F  6D 65 74 72  69 63 73 00  PANY Geometrics·
000010F0  22 00 49 4E  53 54 52 55  4D 45 4E 54  20 47 45 4F  "·INSTRUMENT GEO
00001100  4D 45 54 52  49 43 53 20  4D 47 4F 53  20 30 30 30  METRICS MGOS 000
00001110  30 00 0E 00  4A 4F 42 5F  49 44 20 30  30 30 30 00  0···JOB_ID 0000·
00001120  14 00 4F 42  53 45 52 56  45 52 20 4F  62 73 65 72  ··OBSERVER Obser
00001130  76 65 72 00  19 00 54 52  41 43 45 5F  53 4F 52 54  ver···TRACE_SORT
00001140  20 41 53 5F  41 43 51 55  49 52 45 44  00 0D 00 55  AS_ACQUIRED···U
00001150  4E 49 54 53  20 46 45 45  54 00 72 00  4E 4F 54 45  NITS FEET·r·NOTE
00001160  20 0A 20 42  41 53 45 5F  49 4E 54 45  52 56 41 4C  · BASE_INTERVAL
00001170  20 32 2E 30  30 20 0A 20  53 48 4F 54  5F 49 4E 43  2.00 · SHOT_INC
00001180  52 45 4D 45  4E 54 20 30  2E 30 30 20  0A 20 50 48  REMENT 0.00 · PH
00001190  4F 4E 45 5F  49 4E 43 52  45 4D 45 4E  54 20 30 2E  ONE_INCREMENT 0.
000011A0  30 30 20 0A  20 41 47 43  5F 57 49 4E  44 4F 57 20  00 · AGC_WINDOW
000011B0  30 20 0A 20  44 49 53 50  4C 41 59 5F  46 49 4C 54  0 · DISPLAY_FILT
000011C0  45 52 53 20  30 20 30 20  0A 0A 00 00  00 00 00 00  ERS 0 0 ·· ····
000011D0  22 44 E0 01  00 19 00 00  40 06 00 00  04 00 00 00  "D·····@·····
000011E0  00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00  ················
000011F0  19 00 41 4C  49 41 53 5F  46 49 4C 54  45 52 20 33  ··ALIAS_FILTER 3
00001200  33 33 33 2E  33 33 20 30  00 1A 00 41  4D 50 4C 49  333.33 0···AMPLI
00001210  54 55 44 45  5F 52 45 43  4F 56 45 52  59 20 4E 4F  TUDE_RECOVERY NO
00001220  4E 45 00 13  00 43 48 41  4E 4E 45 4C  5F 4E 55 4D  NE···CHANNEL_NUM
00001230  42 45 52 20  31 00 0F 00  44 45 4C 41  59 20 2D 30  BER 1···DELAY -0
00001240  2E 30 31 30  00 21 00 44  45 53 43 41  4C 49 4E 47  .010·!·DESCALING
00001250  5F 46 41 43  54 4F 52 20  34 2E 32 37  30 34 30 30  _FACTOR 4.270400
00001260  45 2D 30 30  35 00 1E 00  44 49 47 49  54 41 4C 5F  E-005···DIGITAL_
00001270  48 49 47 48  5F 43 55 54  5F 46 49 4C  54 45 52 20  HIGH_CUT_FILTER
00001280  30 20 30 00  1D 00 44 49  47 49 54 41  4C 5F 4C 4F  0 0···DIGITAL_LO
```

```
00001290  57 5F 43 55  54 5F 46 49  4C 54 45 52  20 30 20 30  W_CUT_FILTER 0 0
000012A0  00 13 00 46  49 58 45 44  5F 47 41 49  4E 20 33 36  ···FIXED_GAIN 36
000012B0  20 44 42 00  0C 00 4C 49  4E 45 5F 49  44 20 30 00   DB···LINE_ID 0·
000012C0  15 00 4C 4F  57 5F 43 55  54 5F 46 49  4C 54 45 52  ··LOW_CUT_FILTER
000012D0  20 30 20 30  00 14 00 4E  4F 54 43 48  5F 46 52 45   0 0···NOTCH_FRE
000012E0  51 55 45 4E  43 59 20 30  00 20 00 52  41 57 5F 52  QUENCY 0· ·RAW_R
000012F0  45 43 4F 52  44 20 43 3A  5C 6C 69 6E  65 20 32 5C  ECORD C:\line 2\
00001300  32 30 30 31  2E 64 61 74  00 19 00 52  45 43 45 49  2001.dat···RECEI
00001310  56 45 52 5F  4C 4F 43 41  54 49 4F 4E  20 30 2E 30  VER_LOCATION 0.0
00001320  30 00 1B 00  53 41 4D 50  4C 45 5F 49  4E 54 45 52  0···SAMPLE_INTER
00001330  56 41 4C 20  30 2E 30 30  30 31 32 35  00 1C 00 53  VAL 0.000125···S
00001340  48 4F 54 5F  53 45 51 55  45 4E 43 45  5F 4E 55 4D  HOT_SEQUENCE_NUM
00001350  42 45 52 20  32 30 30 31  00 12 00 53  4B 45 57 20  BER 2001···SKEW
00001360  2D 30 2E 30  30 30 30 36  32 35 00 19  00 53 4F 55  -0.0000625···SOU
00001370  52 43 45 5F  4C 4F 43 41  54 49 4F 4E  20 2D 31 30  RCE_LOCATION -10
00001380  2E 30 30 00  0A 00 53 54  41 43 4B 20  38 00 1F 00  .00···STACK 8···
00001390  4E 4F 54 45  20 0A 20 44  49 53 50 4C  41 59 5F 53  NOTE · DISPLAY_S
000013A0  43 41 4C 45  20 34 37 20  20 0A 0A 00  00 00 00 00  CALE 47  ········
000013B0  E0 FB 5B 40  64 F1 81 42  D2 74 86 42  AD A0 CA 42  ··[@d··B·t·B···B
000013C0  0E A5 96 42  30 F9 14 42  1C 10 4D 42  DF C0 04 C2  ···B0··B··MB····
000013D0  9C 85 0C C2  18 EB 75 41  76 AD 4B 42  EE 5F 60 42  ·····uAv·KB·_`B
000013E0  88 28 EF 41  B1 27 13 42  CB 30 0C 42  F8 7F 28 42  ·(·A·'·B·0·B·□(B
000013F0  54 42 63 41  B2 96 EA 41  48 2B 56 42  BC 99 E9 41  TBcA···AH+VB···A
00001400  80 65 DA 41  6C 19 74 42  61 7A E7 42  9E 4F AD 42  ·e·Al·tBaz·B·O·B
00001410  BC E8 BD 42  D5 87 02 43  E1 B1 C3 42  1A 4A C6 42  ···B···C···B·J·B
00001420  EA 73 EC 42  73 4B 1D 43  2C 35 16 43  47 E6 04 43  ·s·BsK·C,5·CG··C
00001430  6A 96 44 43  78 C1 37 43  2F B8 24 43  BD 9B 38 43  j·DCx·7C/·$C··8C
00001440  02 CC 10 43  5B C5 68 43  1E FC 67 43  B4 E1 B1 42  ···C[·hC··gC···B
00001450  DA D1 C1 42  0A 54 E7 42  64 9B CE 42  6C 93 69 41  ···B·T·Bd··Bl·iA
00001460  00 32 93 40  16 B5 E8 41  7A A0 4A C2  99 F6 FB 40  ·2·@···Az·J····@
00001470  9A AC 0C 42  BE AD 0A C2  10 54 6E C2  08 79 CA C2  ···B·····Tn··y··
00001480  DC 7A 89 C2  86 56 BE C1  13 58 87 C2  9E 5A 29 C2  ·z···V···X···Z)·
00001490  20 E5 03 42  50 3F 84 C1  B0 34 62 41  B6 E3 9A 41   ··BP?···4bA···A
000014A0  58 8A 15 41  6C E5 B4 41  7C 55 1F 43  F7 7C 86 43  X··Al··A|U·C·|·C
000014B0  67 60 68 43  4E 89 09 43  CE 93 81 42  64 33 81 42  g`hCN··C···Bd3·B
000014C0  C0 4C 5D BF  C0 37 D2 3F  C4 D7 33 42  98 79 A9 C1  ·L]··7·?··3B·y··
000014D0  E6 D6 57 C2  00 D9 AA C2  F9 5C 34 C3  CA 7B 3A C3  ··W·····\4··{:·
000014E0  EE 87 21 C3  0C 6D 5C C3  95 27 42 C3  D2 A8 13 C3  ··!··m\··'B·····
000014F0  45 0A 52 C3  A9 41 4D C3  C9 1D 0A C3  35 EB 09 C3  E·R··AM·····5···
00001500  7B 67 09 C3  F8 20 B1 C2  49 E9 83 C2  CE 90 B1 C2  {g···  ··I·····
00001510  10 DE C8 C2  69 1D 10 C3  12 E1 F5 C2  0C F5 B9 C2  ····i···········
00001520  D8 D0 09 C3  8A FB 32 C2  06 C2 9A C2  8B 64 46 C3  ·····2·····dF·
00001530  6E 0A 37 C3  44 07 56 C3  D4 27 8C C3  F6 9C BE C3  n·7·D·V··'·····
00001540  52 81 CE C3  8D E4 C0 C3  8F FF B4 C3  8D 38 BB C3  R·············8··
00001550  81 FD BA C3  5C C4 4E C3  5A C7 1A C3  DC C1 EC C2  ····\·N·Z·······
00001560  C0 41 B0 3F  48 DF 75 C2  A4 73 56 C1  CE 09 D4 41  ·A·?H·u··sV····A
00001570  D5 96 94 C2  00 C2 DA 40  34 75 EF 41  28 DD AD C1  ·······@4u·A(···
00001580  BA 23 52 42  BD BB 4F 43  0A 3D 77 43  F8 94 67 43  ·#RB··OC·=wC··gC
00001590  AB 28 99 43  CB 82 56 43  86 4E 1F 43  62 32 C5 42  ·(·C··VC·N·Cb2·B
000015A0  10 8D FA C0  42 81 80 C2  08 98 37 C3  12 AC 46 C3  ····B·····7···F·
000015B0  6A F7 3B C3  91 C9 19 C3  8B 00 47 C3  22 63 79 C3  j·;······G·"cy·
000015C0  E9 0F 4E C3  E6 01 69 C3  21 0D 82 C3  B4 3C 93 C3  ··N···i·!····<··
000015D0  1F 13 A7 C3  C7 2C AA C3  50 EF BD C3  3F 32 D7 C3  ·····,··P···?2··
000015E0  F6 65 AA C3  33 25 B7 C3  4A EA D4 C3  B3 1C A2 C3  ·e··3%··J·······
```

data from trace 1 continues

D.3 SEG-D FILE STRUCTURE

The following section describes the SEG-D format used in the StrataVisor™. Three general header blocks, scan type header, demux trace header, and trace header extension are used in SEG-D format to store trace information. The following are the fields used in each header block:

- General header, block #2 - Expanded File Number (if number is greater than 9999), SEG-D Revision Number (= 1), Extended Record Length, Gen. Header Block # (= 2), Last Four Bytes of General header block #2 (= descaling factor).

- General header, block #3 - Source Line Number (integer), Source Line Number (fraction), Source Point Number (integer), Source Point Number (fraction), Gen. Header Block # (= 3).

- 1st Scan type header - Scan Type Number (= 1), Channel Set Number (= 1), Channel Set Start Time, Channel Set End Time, Number of Channels, Channel Type (= 1 for data channel), Channel Gain (= 3, always fixed gain), Alias Filter Frequency (if any*), Alias Filter Slope (if any*), Low Cut Filter (if any*), Low Cut Filter Slope (if any*), First Notch Filter (if any*), Second Notch Filter (if any*), Vertical Stack.

- 2nd Scan type header - Scan Type Number (= 1), Channel Set Number (= 2), Channel Set Start Time, Channel Set End Time, Number of Channels, Channel Type (= 7 for pilot or aux channel), Channel Gain (= 3, always fixed gain), Alias Filter Frequency (if any*), Alias Filter Slope (if any*), Low Cut Filter (if any*), Low Cut Filter Slope (if any*), First Notch Filter (if any*), Second Notch Filter (if any*), Vertical Stack.

For each channel:

- Demux trace header - File Number (if number is less than 10000), Channel Set Number, Trace Number, Trace Header Exten. (= 1), Sample Skew, Extended File Number (if number is greater than 9999).

    - Trace header extension - Receiver Point Number.

All fields that are not used will be recorded as zero. The data followed by each demux trace header and trace header extension has 8085 data format that stands for 32-bit IEEE demultiplexed.

*If there is no filter selected, all these fields will be recorded as zero. High cut filter is recorded in Alias Filter Frequency and Alias Filter Slope. If both filters are high cut filters, the one with lower frequency is recorded. Similarly, if both filters are low cut filters, the one with higher frequency is recorded.

D.3.1 SEG-D FILE FORMAT EXAMPLE

Byte Numbers in Hexadecimal lower byte first Interpreted Code

```
 000000   10 54 80 58  00 00 00 00  00 00 96 23  47 15 54 12   .T.X.......#G.T.
 000010   00 00 F8 00  00 00 04 00  00 8F FF 01  02 00 00 00   ................
 000020   00 00 00 00  00 00 00 00  00 00 01 00  00 00 00 02   ................
 000030   00 00 02 00  00 00 00 00  00 00 00 00  9D 4F 65 36   .............Oe6
 000040   00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00   ................
 000050   00 00 03 00  00 00 00 00  00 00 00 00  00 00 00 00   ................
 000060   01 01 00 00  01 00 00 00  00 24 10 03  00 00 00 00   .........$......
 000070   00 00 00 00  00 00 00 00  00 00 00 00  00 01 00 00   ................
 000080   01 02 00 00  01 00 00 00  00 00 70 03  00 00 00 00   ..........p.....
 000090   00 00 00 00  00 00 00 00  00 00 00 00  00 01 00 00   ................
 0000A0   10 54 01 01  00 01 00 00  00 01 AB 00  00 00 00 00   .T..............
 0000B0   00 00 00 00  00 00 00 00  27 10 00 00  00 00 00 00   ........'.......
 0000C0   00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00   ................
 0000D0   00 00 00 00  3A 4B 55 98  38 80 FC C8  38 FA CF 14   ....:KU.8...8...
 0000E0   B9 24 D1 39  BA 6C 7A 1A  BA 34 0B 82  38 BA 50 B0   .$.9.lz..4..8.P.
 0000F0   3A 37 A0 C1  3A 1A 11 7D  39 41 7B 2C  39 48 A5 A9   :7..:..}9A{,9H..
 000100   39 00 FC C8  3A 3A 50 B0  3A 88 27 45  39 21 3B FA   9...::P.:.'E9!;.
 000110   BA 43 45 CC  BA 2A 31 17  3A A3 06 9A  3A BA 50 B0   .CE..*1.:...:.P.
 000120   38 B3 26 33  3A 52 80 15  39 B4 F0 D2  BA 0F 51 C2   8.&3:R..9.....Q.
 000130   BA 3D 00 9E  BA 80 FC C8  39 1A 11 7D  3A 3E CB 3E   .=......9..}:>.>
 000140   B8 DE 25 20  BA 41 7B 2C  B9 CC 3A E8  B9 EE 44 B9   ..% .A{,..:...D.
 000150   B9 8D 87 23  39 94 B1 A0  B9 C8 A5 A9  B9 F7 39 D5   ...#9.........9.
 000160   B9 86 5C A6  BA 75 6F 36  B9 C6 DB 0A  39 5A 8F E2   ..\..uo6....9Z..
```

data from trace 1 continues

D.3.2 SEG-D PROMAX COMPATIBILITY

Geometrics normally uses the general header (block 2, bytes 15-17) to specify the record length in units of time. We then write (extended record length / base scan interval) the number of samples in each trace. If the delay were zero and the record length one second, for example, we would write the start time in the scan type header to be zero (the start of the record) and the end time to be one second. If the base scan interval were 1ms, we would write 1000 samples of data.

Promax, however, expects something a bit different. By default, it uses the scan type header information. It expects (end time – start time) / sample rate + 1 samples per trace. From this perspective, we write one less sample than would be calculated using the end time and start time we write in the scan type header. Users of Promax may need to adjust the import settings to adjust for this discrepancy.

D.4 SEG-Y FILE STRUCTURE

The following are the fields filled in SEG-Y header:

```
Reel header part 1 (EBCDIC):
Number 2:  LINE      x
Number 4:  INSTRUMENT   Geometrics StrataView
Number 5:  TRACE/RECORD    xxxxxxxx
Number 6:  SAMPLE INTERVAL  xxxxxxxx usec  RECORD LEN   xxxxxxx
Number 10: FILTERS  LOW CUT   xxxx HZ   HIGH CUT  xxxxxx HZ
NOTCH  xxx HZ

Reel header part 2 (binary):
Byte 3205-3208: Line number
Byte 3213-3214: Number of traces
Byte 3217-3218: Sample Interval
Byte 3221-3222: Number of Samples
Byte 3225-3226: Data sample format code (2 = 4 bytes fixed
points)
Byte 3255-3256: Measurement system (2 = feet)

Trace header (binary):
Byte 9-12:      Field record number
Byte 13-16:          Trace number
Byte 29-30:          Trace ID code (1 = seismic data)
Byte 31-32:          Number of vertical stacks
Byte 33-34:          Number of horizontal stacks (1)
Byte 71-72:          Scalar (1)
Byte 73-76:          Source coordinate - X
Byte 81-84:          Group coordinate - X
Byte 115-116:   Number of Samples
Byte 117-118:   Sample Interval
Byte 145-146:   Notch filter frequency
Byte 147-148:   Notch filter slope
Byte 149-150:   Low cut filter frequency
Byte 151-152:   High cut filter frequency
Byte 153-154:   Low cut filter slope
Byte 155-156:   High cut filter slope
Byte 157-158:   Year data
Byte 159-160:   Day of year
Byte 161-162:   Hour
Byte 163-164:   Minute
Byte 165-166:   Second
Byte 167-168:   Time base code (1 = local)

Note: Value inside parenthesis is the default value in that
field.  All filter information, if not used, will record as all
zeros.
```

D.5 STORAGE CAPACITY

The number of files which can be stored on a disk drive varies with the amount of disk or tape space required for a seismic record, which of course depends on the number of channels, data format, and record length.

To calculate the number of bytes required, multiply the (number of channels used) * (record length in samples) * (number of bytes in a data word), then add some for the header information (approximately 700 bytes for the file header and Nx600 bytes for the trace headers).

The amount of disk space or tape used depends on the record length as selected in the **Acquisition Timing** menu. The number of bytes in a data word is 4 (for 32-bit data storage format).

The following table shows the number of files stored for different media for some combinations of channels, record length, and memory. These numbers are approximate.

Representative File Sizes

No. of Channels	Record Length	File Size (samples)	Files per Gigabyte
12	2048	106K	9400
12	4096	204K	4900
12	8192	394K	2500
12	16396	794K	1250
24	2048	212K	4700
24	4096	410K	2400
24	8192	800K	1250
48	2048	423K	2300
48	4096	816K	1200
48	8192	1600K	600
60	2048	528K	1900
60	4096	1020K	1000

Warning. *There are many combinations of record length which will not fit on a floppy disk. In some cases you can solve this problem by running a file compression program. In others, it will be necessary to write to an external SCSI*

device or to connect the seismograph to another computer through the RS-232 port and use a file transfer program such as Lap-Link.

Appendix E. SPECIFICATIONS

StrataVisor NZ and Geode Seismographs

Configurations: 3, 6, 8, 12, 16 or 24 channels in weatherproof field deployable Geode module. Geode is operated from either 98/NT/2K/XP based laptop[1] or by Geometrics' ruggedized StrataVisor NZ field computer. Single Geodes are operated using SGOS software, which contains basic seismograph functions used for engineering surveys. Multiple Geodes can be connected together to build systems with many channels and many lines using MGOS software.

A/D Conversion: 24 bit result using Crystal Semiconductor sigma-delta converters and Geometrics proprietary over sampling.

Dynamic Range: 144 dB (system), 110 dB (instantaneous, measured) at 2 ms, 24 dB.

Distortion: 0.0005% @ 2 ms, 1.75 to 208 Hz.

Bandwidth: 1.75 Hz to 20 kHz. Low corner frequency option available.

Common Mode Rejection: > 100dB at <= 100 Hz, 36 dB.

Crosstalk: -125 dB at 23.5 Hz, 24 dB, 2 ms.

Noise Floor: 0.20 uV, RFI at 2 ms, 36 dB, 1.75 to 208 Hz.

Stacking Trigger Accuracy: 1/32 of sample interval.

Maximum Input Signal: 2.8V PP at 0dB

Input Impedance: 20 kOhm, 0.02 uf.

Preamplifier Gains: Software selectable between 24 and 36 dB. Can be jumpered to allow selection of 12 or 24 dB or jumpered to 0 dB.

Anti-alias Filters: -3 dB at 83% of Nyquist frequency, down 90 dB.

Acquisition and Display Filters:

Low Cut: OUT, 10, 15, 25, 35, 50, 70, 100, 140, 200, 280, 400 Hz, 24 or 48 dB/octave, Butterworth.
Notch: 50, 60, 150, 180 Hz and OUT, with the 50 dB rejection bandwidth 2% of center frequency.
High Cut: OUT, 250, 500 or 1000 Hz, 24 or 48 dB/ octave.

Sample Interval: 0.02, 0.03125, 0.0625, 0.125, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0 ms.

Correlation: Optional high-speed hardware correlator available in each Geode for fast cycle time with vibrators and pseudo-random (MiniSosie) sources[2].

Maximum Record Length: 16,384 samples per channel standard, 65,536 samples per channel optional.

Pre-trigger Data: Up to 4,096 Samples.

Delay: 0 to 9999 ms in 1 sample interval steps.

Data Transmission: Uses reliable Ethernet connections and requires no custom transmission software. Interfaces directly with network capabilities of Windows 98/NT/2K/XP.

Auxiliary Channels: All Geode channels can be programmed as either AUX or DATA. Fixed data and aux channels available in StrataVisor NZ.

Roll Along: Built-in, no external roll box required.

Line Testing: Real time noise monitor displays real-time output from geophones. Optional geophones pulse test helps identify bad geophones and shorted or broken cables[2].

Instrument Tests: Optional built-in daily, weekly and monthly testing available[2]. External laboratory quality test system available to measure noise, crosstalk, dynamic range, gain similarity and trigger accuracy to factory specification.

Data Formats: SEG-2 standard with SGOS. SEG-D and SEG-Y available2.

System Software:

Single Geode Operating Software (SGOS): Includes full compliment of acquisition, display, plotting, filtering and storage features.
Multiple Geode Operating Software (MGOS): Allows single laptop to control multiple Geodes and adds additional preamp gains, correlation, expanded record length, tape writing, geophone pulse test, expanded test and diagnostics and roll along capability.

StrataVisor NZ Software: Functionally similar to MGOS above but operates on ruggedized NZ field system.

Data Storage: Stores data locally on laptop hard drive for transfer to portable media[2].

Plotters: Drives a variety of NT compatible printers including Printrex 4, 8 and 12 inch plotters. Consult factory.

Triggering: Positive, negative or contact closure, software adjustable threshold.

Power: Requires 12V external battery. Uses 0.65W/channel during acquisition, sleep mode reduces power consumption by 70% while in standby.

Environmental: Geode:-30 to 70degrees C. Waterproof and submersible. Withstands a 1 m drop onto concrete on 6 sides and 8 corners. NZ: Starts from +5^{o}C to 40^{o}C. Operates from –5^{o}C to 45^{o}C.

Physical: **Geode**: 12.2"L x 9 3/4"W x 7"D (31cmL x 24.75cmW x 17.75cm), weighs 3.5 kg.
NZ field PC with no channels: 10.5“L x 18"W x 21“D (26.7cmL x 45.7 cmW x 53.34 cmD), weighs 30 lb (13.5 kg)
Seismic recorder with 3-64 internal channels: 10.5“L x 18"W x 13 “D (26.7cm L x 45.7 cmW x 33 cmD), weighs 20 lb (9 kg)

Operating System: Windows 98/NT/XP/2000.

Data Processing and Interpretation: Includes refraction software with first break picking, layer assignment, depth below each geophone using delay time, refraction tomography and reflection processing software. Consult factory for individual data sheets.

1- Laptop computers are NOT field devices. They are easily damaged by harsh treatment or exposure to extreme environments. They have a short battery life. Geometrics StrataVisor NZ is designed to operate in harsh conditions for extended periods and should be used with the Geode for professional surveys when reliability is important..

2 - Available with MGOS software only.

ES-3000 Seismographs

Configurations: 8 and 12 channels in weatherproof field deployable module. ES-3000 is operated from Windows 98/NT/2K/XP based laptop[1]

A/D Conversion: 24 bit result using Crystal Semiconductor sigma-delta converters and Geometrics proprietary over sampling.

Dynamic Range: 144 dB (system), 110 dB (instantaneous, measured) at 2 ms, 24 dB.

Distortion: 0.0005% @ 2 ms, 1.75 to 208 Hz.

Bandwidth: 1.75 Hz to 8 kHz.

Common Mode Rejection: > 100dB at <= 100 Hz, 36 dB.

Crosstalk: -125 dB at 23.5 Hz, 24 dB, 2 ms.

Noise Floor: 0.20 uV, RFI at 2 ms, 36 dB, 1.75 to 208 Hz.

Stacking Trigger Accuracy: 1/32 of sample interval.

Maximum Input Signal: 175 mV PP at 24dB

Input Impedance: 20 kOhm, 0.02 uf.

Preamplifier Gains: Software selectable between 24 and 36 dB.

Anti-alias Filters: -3 dB at 83% of Nyquist frequency, down 90 dB.

Acquisition and Display Filters:
Low Cut: OUT, 10, 15, 25, 35, 50, 70, 100, 140, 200, 280, 400 Hz, 24 or 48 dB/octave, Butterworth.

Notch: 50, 60, 150, 180 Hz and OUT, with the 50 dB rejection bandwidth 2% of center frequency.
High Cut: OUT, 250, 500 or 1000 Hz, 24 or 48 dB/ octave.

Sample Interval: 0.0625, 0.125, 0.25, 0.5, 1.0, 2.0 ms.

Maximum Record Length: 4,096 samples per channel standard.

Pre-trigger Data: Up to 4,096 Samples.

Delay: 0 to 9999 ms in 1 sample interval steps.

Data Transmission: Uses reliable Ethernet connections and requires no custom transmission software. Interfaces directly with network capabilities of Windows 98/NT/2K/XP.

Auxiliary Channels: All ES-3000 channels can be programmed as either AUX or DATA. Fixed data and aux channels available in StrataVisor NZ.

Data Formats: SEG-2 standard.

System Software:

ES-3000 Operating Software (ESOS): Includes full compliment of acquisition, display, plotting, filtering and storage features.

Data Storage: Stores data locally on laptop hard drive for transfer to portable media[2].

Plotters: Drives a variety of NT compatible printers including Printrex 4, 8 and 12 inch plotters. Consult factory.

Triggering: Positive, negative or contact closure, software adjustable threshold.

Power: Requires 12V external battery. Uses 0.65W/channel during acquisition, sleep mode reduces power consumption by 70% while in standby.

Environmental: ES-3000:-30 to 70 degrees C. Waterproof and submersible. Withstands a 1 m drop onto concrete on 6 sides and 8 corners.

Physical: **ES-3000**: 12.2"L x 9 3/4"W x 7"D (31cmL x 24.75cmW x 17.75cm), weighs 3.5 kg.

Operating System: Windows 98/NT/XP/2000.

Data Processing and Interpretation: Includes refraction software with first break picking, layer assignment, depth below each geophone using delay time, refraction tomography and reflection processing software. Consult factory for individual data sheets.

1- Laptop computers are NOT field devices. They are easily damaged by harsh treatment or exposure to extreme environments. They have a short battery life. Geometrics StrataVisor NZ is designed to operate in harsh conditions for extended periods and should be used with the Geode for professional surveys when reliability is important..

2 – Some additional features are available as options.

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