

StrataVisor™ NX Operations Manual

**StrataVisor™ NX
Operations Manual**
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Introduction

The StrataVisor™ is unlike any earlier seismograph. It is easy to use and it gives you answers in the field; features made possible by an internal computer programmed to help you solve your problems in looking beneath the surface.

Surprisingly, you will find that the StrataVisor™ combines simplicity of use with remarkable improvements in capability. The StrataVisor™, with greater than 120-dB dynamic range, is a high-performance exploration seismograph, applicable to reflection, refraction, borehole and other specialized seismic surveys.

To expand on these capabilities, the system stores its data on either floppy disk, hard disk or SCSI tape. The recording media are Windows™ compatible, and may be read on any Windows™ -compatible computer equipped with the same storage device. The built-in computer is based on a single or dual-processor Pentium. It may be accessed with an external keyboard and mouse to run popular third-party or your own programs.

Depending on your level of experience, you may wish to proceed directly to Chapter 2 for an abbreviated set of instructions (designed for experienced users), or start with Chapter 1 (which provides an expanded tutorial). Chapter 3 contains a detailed explanation of the menus; while the remaining chapters and appendices provide supplementary and reference information. Chapter 4 describes the use of particularly advanced capabilities of the StrataVisor™, including its use in marine surveys, and using the correlator and extended memory for swept vibrator sources.

The StrataVisor™ Seismograph is a software-controlled device which will receive periodic enhancements. Thus, it is likely that the menus and operating instructions in this manual may differ in minor respects from those on your instrument. As a general rule, operating menus will be self-explanatory and this will not cause any inconvenience or confusion. There may be "README.xxx" files on the system disk containing updated information. This particular edition of the StrataVisor™ manual coincided with the release of Version 3.88 of the StrataVisor™ software.

It is absolutely essential that we maintain a record of StrataVisor™ users so that we can provide you with periodic updates of this manual and the system operating software. Copy the user's registration form and send it to us when you take possession of the instrument and whenever a new user takes responsibility for the StrataVisor™ Seismograph. We would welcome comments on the instrument and suggestions for improvements in this manual. Feedback from our users is extremely important to Geometrics.

StrataVisor™ Configurations

Chassis Styles

The StrataVisor™ is available with two different chassis:

- 1 - portable 12-72 channel chassis, 12 volt DC supply
- 2 - rack mount/table top 12-132 channel chassis, 110/220 AC supply

The portable configuration is best suited for outdoor applications where site access is limited and the instrument and power may have to be hand carried. The unit is weather resistant, and is waterproof when the lid is on and properly fastened. The portable unit is also well suited for small boat deployment where space is critical.

The rack mount configuration is best suited for mounting in a recording vehicle or instrument room of a ship. The StrataVisor™ comes with appropriate shelf and mounting hardware to fit a standard 19-inch rack.

Note that the portable system can also be rack mounted with an optional mounting kit available from Geometrics.

Deployments

The flexible StrataVisor™ system can be operated in several different deployments:

- 1) stand-alone single box seismograph (either portable or rack mount chassis).
- 2) as a 'master' for a group of StrataVisor™ seismographs, controlling all operations from a single keypad.
- 3) as a 'slave' in a group of StrataVisor™ seismographs, controlled by another 'master' StrataVisor™ seismograph.
- 4) as a 'slave' to a CNT-1 controller, used in either a land or marine deployment.

This manual discusses operation of the StrataVisor™ in general terms that apply to deployments 1 or 2. For details concerning the CNT-1 controller or correct version of slave software, please contact Geometrics.

Chapter 1. First Time Operator's Overview

This chapter is written for less experienced users of exploration seismographs. It is not intended to teach fundamental geophysics. If you consider yourself an experienced user of modern exploration seismographs, you may wish to go directly to Chapter 2, which contains a condensed set of operating instructions.

The operator should read the application literature sent with the instrument, as well as standard textbooks on geophysics.¹

This manual will focus on the instrument, its use, and a few things not found in textbooks. You should also read Chapter 3 which explains operation of the menus, and Chapter 5 which provides details on the actual hardware: seismograph, geophones, cables, etc.

For first time use, keep things simple. In fact, practice first in a comfortable office to gain thorough familiarity with the menus and equipment. Then, the first practice survey should be a refraction survey, done close to home, with a sledgehammer source, and short geophone spread (say 10 feet or 5 meters between geophones). Chapter 1 is written with this elementary setup assumed, and the operator can extrapolate this experience to more complex surveys and those using explosive or other types of sources.

Preparation and Setup

Before going to the field, see that paper is loaded in the printer. Open the case, then the front panel (press the two latches on either side) and look at the paper supply. If necessary, load paper, using the instructions inside the front panel lid.

Unpack the system and gather your accessories. If you are using a portable StrataVisor™, you will need a 12-volt battery if one was not purchased with the system. Current drain of the StrataVisor™ varies depending on the number of channels and the options installed. The small systems draw about 8 amps, requiring a moderate capacity battery (60 amp hours) for a day in the field. If you are using the rack mount version, you will require 110/220 VAC mains power or an appropriate generator.

¹For example, Exploration Geophysics of the Shallow Subsurface, by H. Robert Burger, 1992, published by Prentice Hall, ISBN 0-13-296773-1

The portable StrataVisor™ will normally be operated vertically; it is rain resistant in this position, and the display is readily viewable. Do not leave the instrument exposed in a heavy rain. Place the StrataVisor™ up on a reasonably flat surface and remove the cover.

Spread the geophone cable in a line. Plant (by pressing the spike into the ground) a geophone by each connector (called a takeout) on the cable. The geophone connectors will have a method to encourage proper polarity connections (such as wide and narrow color-coded clips). Connect the geophones to their connectors, and the geophone cable to the seismograph. If you are using a 24-channel StrataVisor™, you will locate the seismograph in the center of the line and use two 12-takeout geophone cables and 24 geophones. StrataVisor™ seismographs with more than 24 channels may use a variety of different cable arrangements.

Connect the 12-volt battery with the red clip to positive and black clip to the negative lead. If the connections are reversed, it will not damage the instrument, but it will not function.

Operation

Turn on the switch near the power connector. One of the light-emitting diodes (LED) on the front panel should light, indicating the battery voltage. Note and remember which LED lights for a fully charged battery or stable AC power. As the battery charge is expended, the voltage will decrease and an LED lower down the scale will light. The transition will be particularly fast in the last few minutes of operation. This voltage indicator will provide advance warning of battery discharge, as well as aid in troubleshooting power problems.

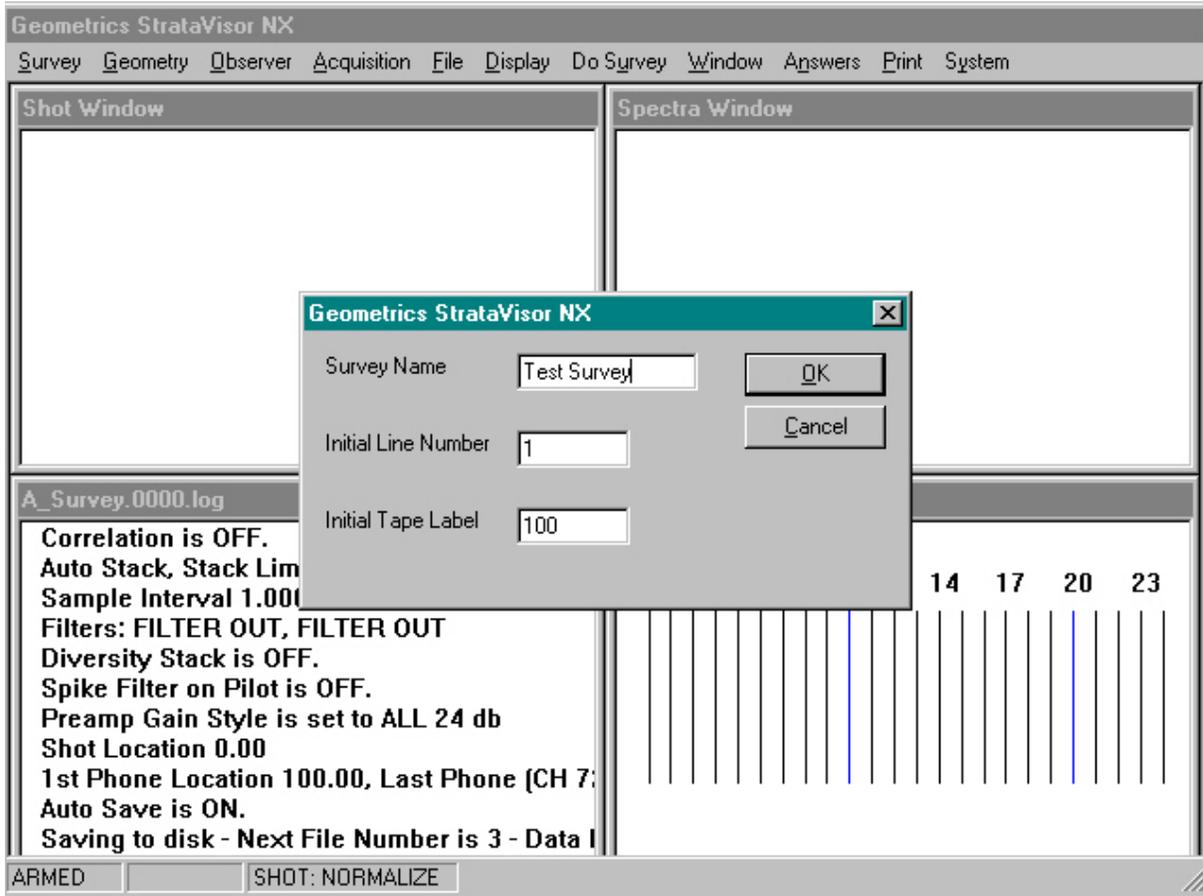
Wait several seconds while the system powers up, conducts its internal tests and loads the seismic software. During the power up cycle, the screen should display text, then the StrataVisor™ user interface.

If you have a black and white screen: *If the screen is blank or faint, adjust the display contrast with the two arrow keys just above the battery level indicator.* The display may be completely blank until the contrast is adjusted. There is a backlight for the screen, which may be turned on or off, depending on which gives the best display in the ambient lighting conditions. The backlight on-off control is in the **Display** menu discussed later. If you have an external CRT monitor plugged in, the LCD screen will be blank.

Once you have used the system, it will store the most recent settings. That means that the controls are set as they were when the instrument was last used, as though your seismograph had mechanical switches. Although this is a Windows™ user-interface, every effort has been made to make the system fully functional from the built-in keypad. Use of the keypad is described in detail in Chapter 3; you might visit that section to gain familiarity before continuing. Note that the menus in some systems may differ slightly from what is displayed in this manual. Consult the README.xxx file for additional information pertinent to your instrument, or call Geometrics.

Beginning a Survey

Position the cursor over **Survey** in the top left corner of the screen. You will be asked to start a **New Survey**:

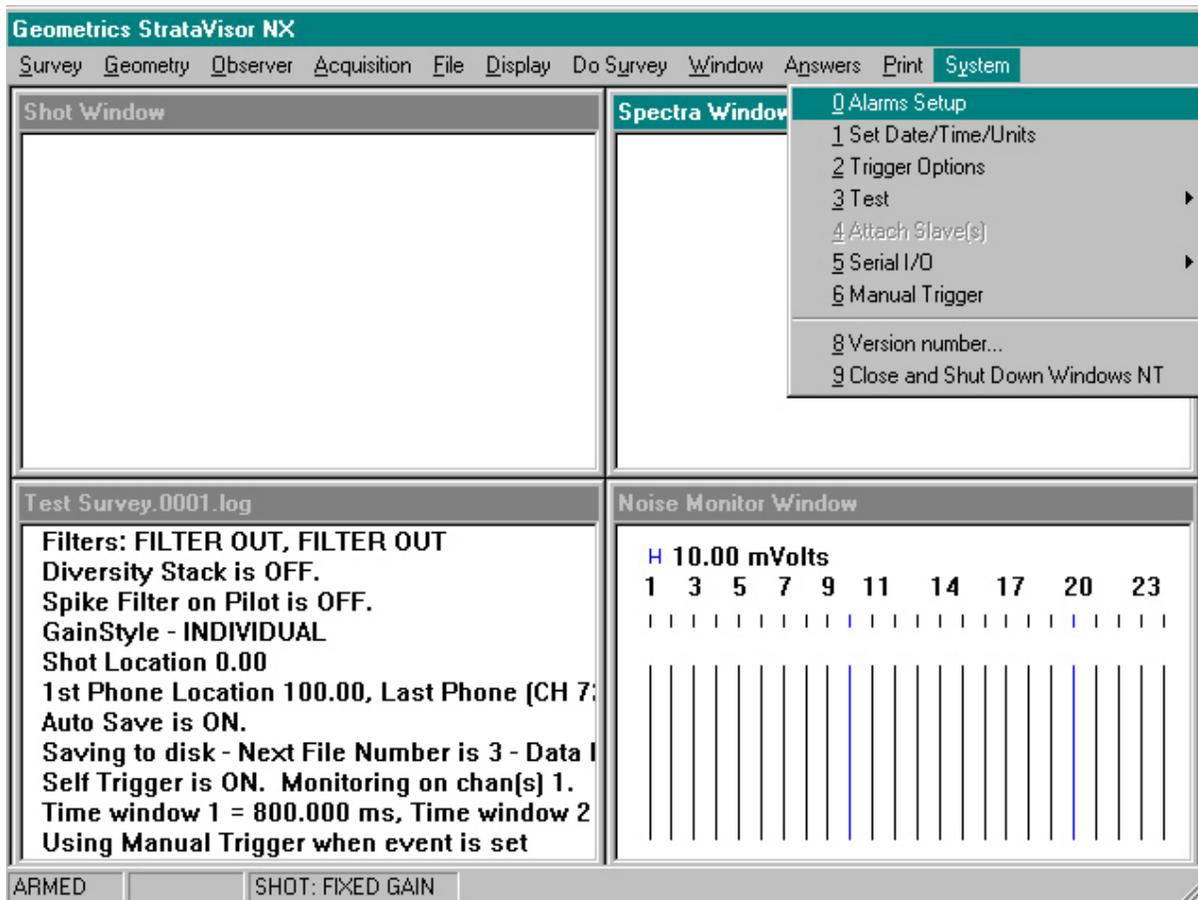


Enter a *Survey Name* and *Line Number*. You will see these entries reflected in the Survey Log.

Geometry

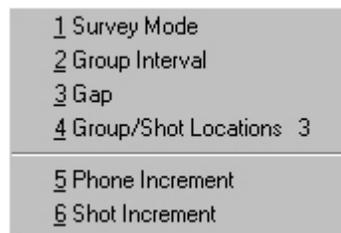
The term "geometry" is used to describe the locations of the geophones and the seismic energy source. Since seismic data processing requires knowing the locations of these items, their coordinates can be recorded with the data. Historically, this was done with field notes; the StrataVisor™ logs this data on disk as part of the seismic data file. Although it is not absolutely necessary to enter this information in order to do a survey, it is critical if you plan to use the analysis functions in the **Answers** menu, which you will see later can give you answers right in the field.

You will need to set the distance between geophones and the shot location. Press the **MENU** key. One of the menu selections (**DoSurvey**) will be highlighted. This secondary menu will be used routinely during actual surveys, and thus it always appears first for your convenience. However, before starting to survey, you need to set up the system. Press the right arrow to highlight the **System** menu. Next, press **ENTER** to bring up the secondary menu:

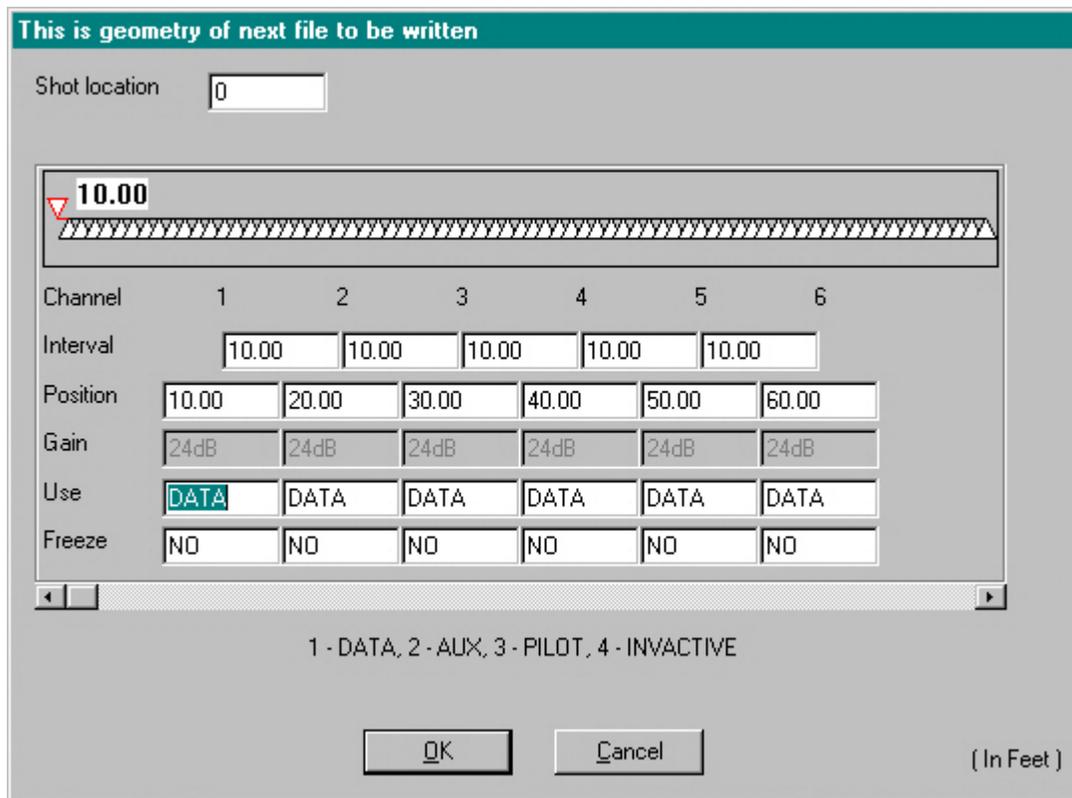


For now, turn off all alarms. Set the clock and calendar for your time zone, and set the units to meters or feet. Make sure **Serial Input** and **Serial Output** are disabled. **Set Trigger Holdoff** to 0.2, and enable **Auto Arm**. Do this by positioning the cursor over the item in the list, or press the matching number key. Follow the directions on the screen to change the settings. If in doubt, refer to the **System** section in Chapter 3.

Now set the line geometry. Position the cursor over **Geometry** and press **ENTER**:



Set the **Survey Mode** to *refraction*. The **Group Interval** or geophone spacing refers to the spacing between geophones (in more advanced surveys, particularly reflection surveys, a group of 3-12 geophones is connected to each channel). Choose the appropriate geophone spacing. **Gap** does not apply to refraction surveys and is grayed out. Next, you must enter the geophone and shot locations in your chosen coordinate system. Choose **Group/Shot Locations** and you will see the following:



This window displays the line geometry as well as other parameters. For now, we will stick to geometry. *Gain*, *Freeze*, and *Use* will be discussed in detail in Chapter 3.

Select a shot location of zero for now. Then, select the position of the first geophone (connected to channel 1), and use the right arrow key to move out of that field. You will see that the rest of the geophone locations have been set automatically according to the position of the first and the **Group Interval** you entered earlier (you can view the positions of the more distant geophones by moving the cursor to the right – the channel numbers and positions will scroll to the left). The graphic will now display your spread, and indicate the distance between the shot and the nearest geophone. Your units are displayed in the lower right-hand corner. Press **OK**.

Next, make sure **Shot Increment** and **Geophone Increment** are set to zero. Once this is done, you are finished setting up the survey geometry. We will skip **Observer** for now; this is discussed in detail in Chapter 3.

Acquisition

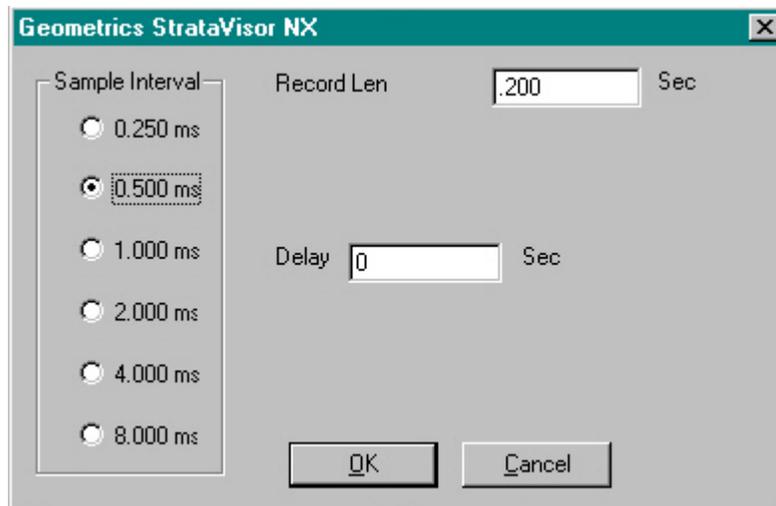
In seismic data acquisition, electrical signals from the geophones are amplified, digitized, and stored in the seismograph's memory. The variables which effect the process are selected in the **Acquisition** menu. Inappropriate choices of acquisition parameters can be corrected by clearing the memory and repeating the shot.

If you are summing multiple impacts, certain of these settings should not be changed between blows. Thus, the seismograph will not allow you to change those parameters when data is in the memory. The memory must first be erased. If you attempt to change these parameters while data is in memory, you will be asked if it is OK to clear the memory first.

Choose **Acquisition** to display the acquisition menu:



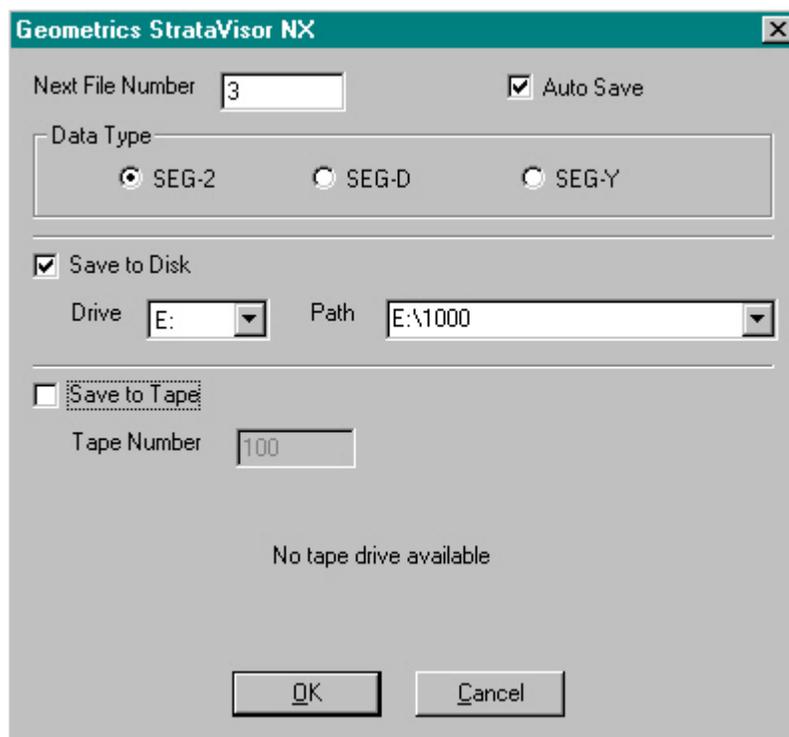
First, select **Acquisition Timing**:



Set a *Sample Interval* of 0.500 ms and a *Record Length* of 0.200 seconds. Leave the *Delay* at zero for now, and select **OK**. The subject of record length and sample rate is discussed in greater detail in Chapter 3.

We will not concern ourselves with the rest of the parameters at this point. Just make sure that **Acquisition Filters** and **Correlation** are disabled, stacking is set to **Autostack** mode, all channels are set to **DATA**, **Preamp Gains** are set to 48db, and Self Trigger is disabled. See Chapter 3 if you are unsure how to do this.

Next you must set up the data storage parameters. Select **File** and then **Storage Parameters** and you will set the following menu:



Set the *Next File Number* to 1001. This will be the name of the first file that you save. It will increment automatically with each subsequent save. Disable *AutoSave*, and set the *Data Type* to SEG-2. Enable *Save to Disk*, set *Drive* to E:, and choose or create a *Path* (folder). This is where the data will be stored when saved. Make sure *Save to Tape* is disabled, and select **OK**.

We will skip **Display** for now and come back to it once we have collected some data. Now select **DoSurvey** to display the following menu:

1	Arm	1
2	Clear Memory	
3	Shot Location	0.00 3
4	Noise Display	4
5	Trace Display	5
6	Auto Scale Traces	6
7	Save	4.DAT
8	Print Shot Record	8
9	Unstack	
0	Disarm	0
-	Set Freeze Channels	

Select **Noise Display**. This will maximize the noise monitor window. In the noise display mode, signals from the geophones wiggle the traces on the screen. *Use the up and down arrow keys to adjust the noise monitor sensitivity, until small excursions are visible on the traces.* The sensitivity is displayed in the upper left-hand corner; you should see this change as you press the arrow keys. These trace excursions represent the background vibrations sensed by each geophone. The screen will display a set of moving traces, writing the noise record on the screen. Stomp the ground and you should see a noise burst on the traces representing the geophones closest to you. If there are two people present, one can walk the line while the other observes the footsteps on the screen. This noise display is a useful diagnostic tool. You can confirm that your cable and geophones are working properly, identify noise problems, and time your shots to coincide with quiet periods.

Let the seismic noise settle a little, and look at the relative amplitudes of each trace on the noise monitor display. If the geophones are all connected and properly planted, and if the cables are good, all traces should look about the same. Unusually small or large excursions on any trace are indicative of some problem that should be investigated. Temporarily disconnect a geophone to see the effect of a common problem.

The level of background noise can be measured using the scale factor displayed in the upper left-hand corner. It can be noted as a quantitative measure of background noise.

Your next step is to generate the seismic wave and record it on the instrument. A metal plate (called a striker plate) is normally used as the impact point for the hammer. Place it on the ground near the end of the string of geophones, separated from the first geophone by the distance set in the **Geometry** menu.

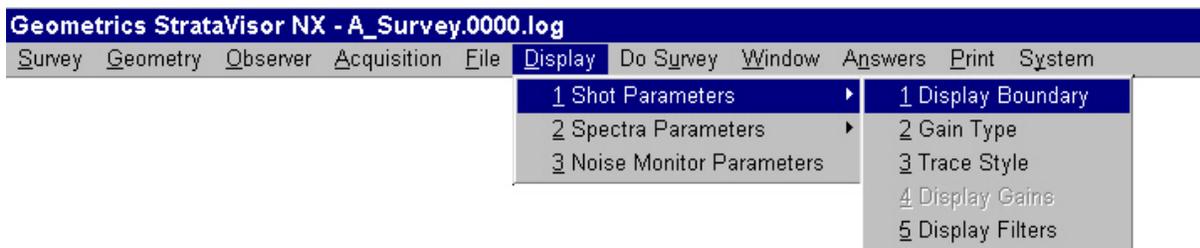
Attach the hammer switch to the hammer, taping it to the top edge of the handle near the head with stretchy electrical tape. Note that there is an orientation indication on the switch itself; make sure to mount the switch with the black dot against the handle. Tape the wire to the handle near the hammer switch, and again near the end of the handle. Connect the hammer switch to the start connector on the seismograph. Since working with the hammer will probably trigger the seismograph, clear the memory (Clear Memory in the **DoSurvey** menu) again.

The hammer blow should be timed for quiet periods (when background seismic vibrations decrease) as monitored by the noise display. Advise anyone in the area to stand still and not talk while recording data. Hit the striker plate to create a seismic impulse and trigger the seismograph. When swinging the hammer, the hammer switch should be on the top side of the handle, away from the ground.

Data Display

After a moment or two, the noise monitor record will disappear and a seismic record will appear on the screen. The data may not look right yet; perhaps there will be only straight lines, or wildly overlapping traces. The **Display** menu is used to control how the data looks on the screen. The display functions may be changed at any time. They do not affect the original data stored in memory, only the way it looks on the screen (and the paper plot).

Press the **MENU** key and move the cursor to **Display** and then **Shot Parameters** and you will see the following:



Select the **Gain Type** option and choose *Fixed Gain*.

Select the **Display Gains** option, then select *AutoScale Traces* and press **OK**.

Press **CLR** to remove the menu from the screen and expose the traces. You should see a seismic record on the screen, similar to the one shown below in Figure 1.1. You can time specific events on the record by using the timing lines on the display.

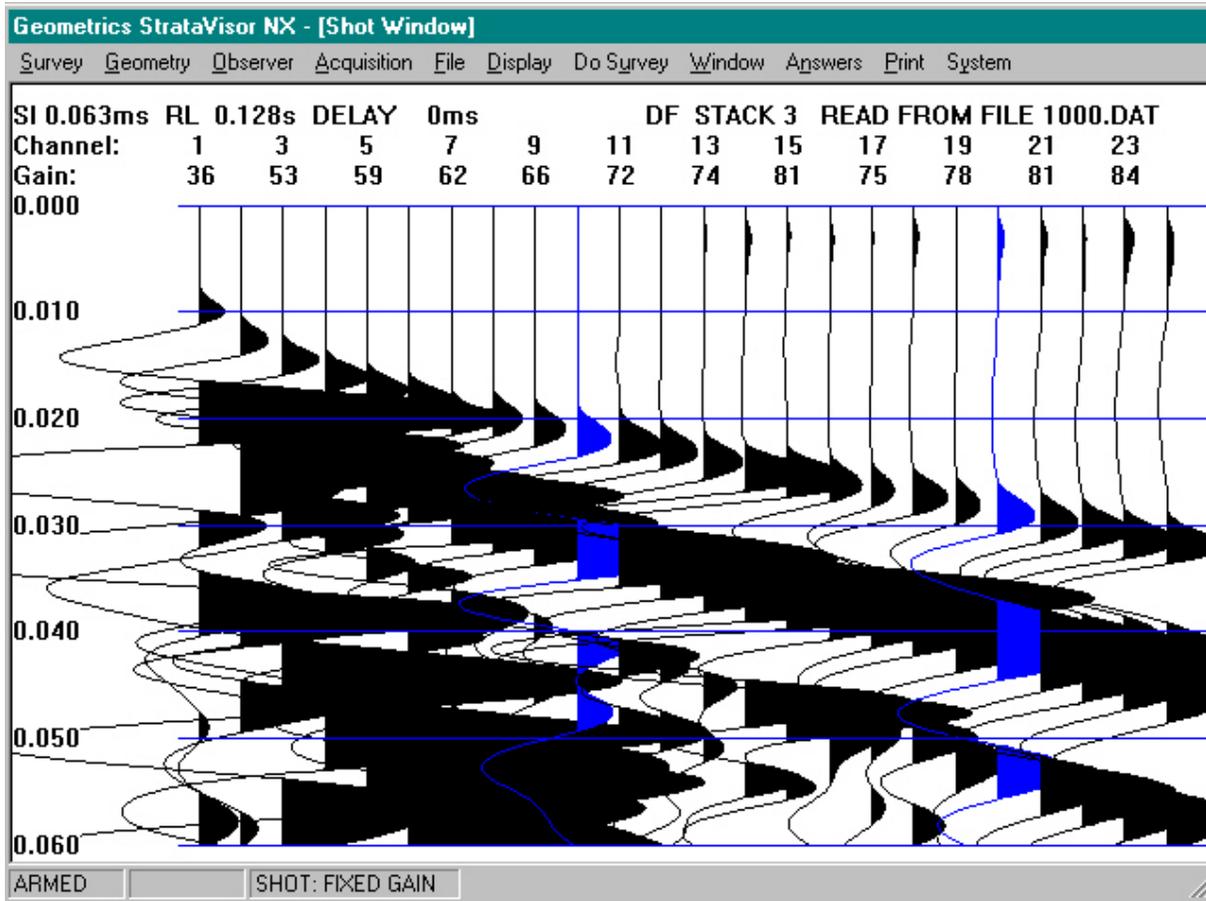


Figure 1.1 - Seismic refraction record.

Press the **MENU** key and select the **Pick Breaks** command from the **Answers** menu:



The seismograph will automatically adjust the traces, pick the first breaks (putting a marker on each trace) and position the traces so that the first breaks are on the screen.

There should be a collection of traces with excursions representing the vibrations at each geophone. The trace for the geophone nearest the impact point should have clear, early arrivals. First arrivals on traces from geophones further away should occur later and later in time. An example record with first break picks is displayed below in Figure 1.2.

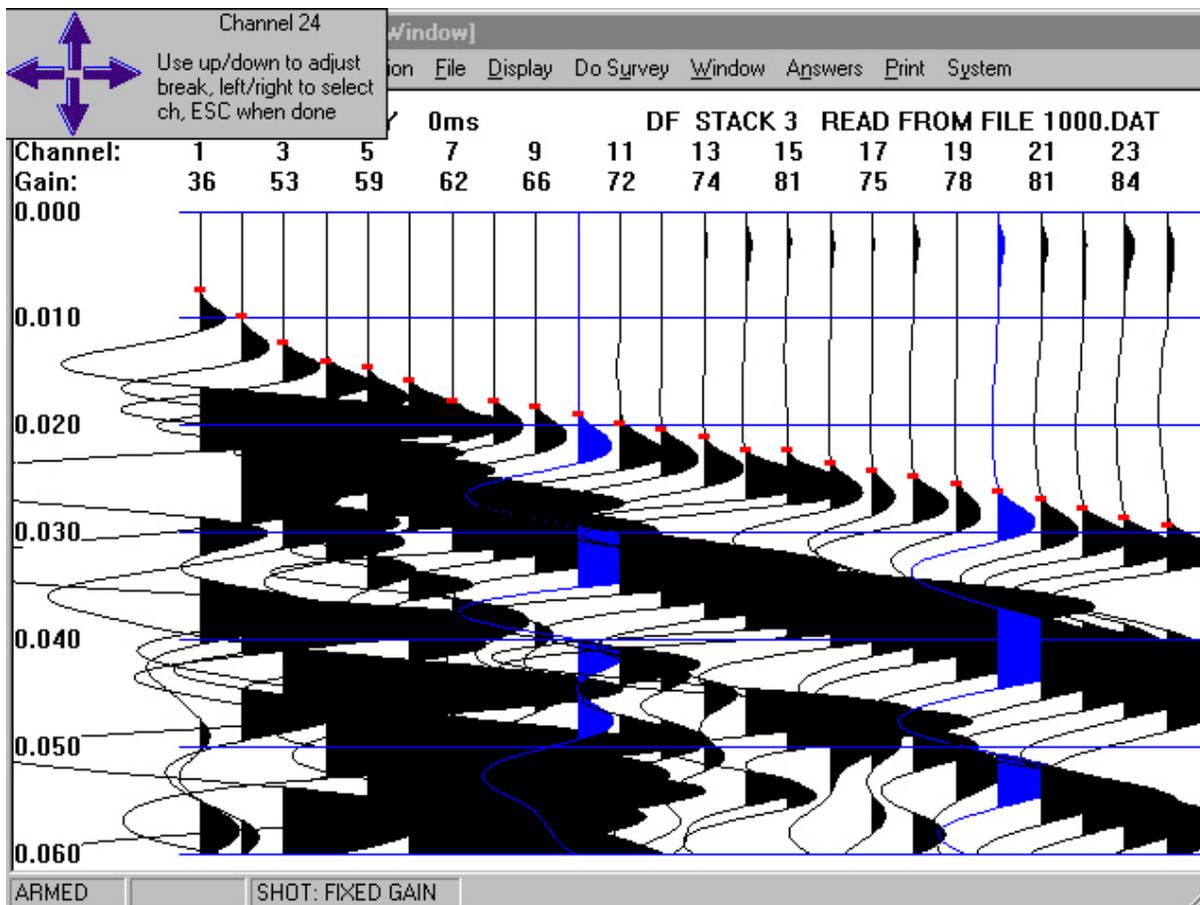


Figure 1.2 - Refraction record showing first break picks.

You will be offered the option of manually editing the first break picks and saving these numbers on the active disk drive. Remember that you should have the values in the geometry menu properly entered as part of this stored information. It may be necessary to go to the **Display** menu and adjust the individual display gains to make the picks easier to see and edit.

At this point, you may wish to experiment a little with the display functions to change the look of the record and to gain familiarity with the system. The display gain adjustments control the excursions of the individual traces on the screen. If necessary, use the *Individual* function in the **Display Gains** submenu to adjust the appearance of the display (see Chapter 3 if you need directions). Adjusting the *Start Time* and *End Time* under **Display Boundary** will stretch the waveforms on the screen, so that the first arrivals are easier to pick, or compress them so that more of the record is visible on the screen. Examination of the entire record should also show surface waves and perhaps signals from the sound of the hammer striking the plate.

Print

Make a paper copy by using the **Print** button in the **DoSurvey** menu. To stretch or compress the printed record, go to the **Print** menu and experiment with the *Normal*, *Expand*, and *Compress* options in the **Shot Print Parameters** submenu. These change the character of the seismic record, and the best choice will depend on a particular data set and the type of information displayed. Expanding or compressing the record can compensate for a less than optimum choice of sample rate or record length. On the StrataVisor™, the print and screen display scales are independent, providing flexibility in use. The numbers above the traces on the printout are, from top to bottom, the channel number, display gain multiplier, and preamp gain setting.

Observe the display gain multipliers. The numbers are different, with smaller numbers for those traces near the impact point. Traces away from the impact point will have larger display gain numbers. The display gain number is related to the amplification applied to the original data to display the traces. Thus, a small signal (like that from the more distant geophones) will require more amplification to make the excursions a usable size.

The display gain numbers are in decibels, or dB, and they change in 3 dB steps from 0 to 150. Only the last two digits are shown. You can tell if the number should be added to 100 if it is not divisible by three. For example, if the number 47 is shown, the value is actually 147 (a number is divisible by three if the sum of its digits is divisible by three). Each 3 dB step is an increase of 1.414 times the previous value; 6 dB is 2 times. Thus, the display gain increments in a logarithmic manner, providing a very wide range of adjustment. Reducing the display gain decreases the excursions by .707 for -3 dB and by 2 for -6 dB. As a general rule, you need not concern yourself with these numbers, but they are diagnostic of certain problems. For example, if a trace is "dead" (shows no excursions) and the display gain value is small, that means that the display gain is turned down too low. If the number is large, that means the signal is very small, perhaps from a bad or disconnected geophone or other cause.

As a learning exercise, you can compare the relative strength of the vibrations on each trace. Use the *Equalize Gains* option under **Display Gains** and adjust each number to the same value. Then, use *Adjust All* to increase or decrease all the traces simultaneously until the display is scaled to the best value. The near traces will have very large excursions and the far traces will be straight lines. In this mode, it is easy to judge the attenuation of the seismic signal with distance from the impact point. Make a copy if desired, then use *the AutoScale Traces* and *Individual* options to return the traces to a normalized display.

Signal Enhancement

The distant traces may be noisy. A noisy seismic trace is caused when extraneous vibrations are mixed with the signal, sometimes making it difficult to identify the first arrivals. These vibrations come from wind, vehicles, airplanes, and people. Because the signal on the geophones furthest from the seismic source are quite small, seismic noise is normally more of a problem on the far traces.

When working with explosive sources, noise is generally not a problem. If the signals are too weak, you just use more dynamite the next time. That is not the case with a sledgehammer and other mechanical sources; you can only hit the ground with a certain amount of energy. To extend the depth penetration attainable with a sledgehammer, the StrataVisor™ can add signals from multiple hammer blows. This process is usually called "signal enhancement" or "summing" or "stacking". The record is saved in the memory, and each time the ground is hit, the new data is added to the old sum, and the signal grows. Ambient noise is usually random, and it does not increase as much, so the "signal-to-noise" ratio improves as you strike the ground repeatedly. In practice, the noise increases as the square root of the number of blows, while the signal increases linearly. Thus, the improvement in the signal-to-noise ratio is proportional to the square root of the number of impacts. As an example, four stacks are two times better than one, and eight stacks are three times better than one.

Try summing. First, go to the **DoSurvey** menu and clear the memory. In the **Acquisition** menu set the stack mode to *Autostack*. Hit the striker plate with the hammer. When you see data on the screen, swing the hammer a second time. The record should grow larger as two records are now stacked into the memory. Further impacts should cause the traces to continue to grow, and the stack count will be updated in the upper right portion of the display. Traces that were noisy will still be noisy, but a larger seismic signal will be superimposed on the record. Using the display gain adjustments will shrink the traces back near their original size, and there should be much less noise relative to signal now. First arrivals should be more distinct and easier to pick, with the greatest improvement evident especially on those traces distant from the energy source.

Although the StrataVisor™ is designed to stack thousands of hammer blows without problems, there is a practical limit to the improvement available from signal enhancement, usually around 10 to 20 blows.

Freeze

Freeze is used to lock in the data on individual channels. This stops the selected channels from stacking or from erasing. This utility is often useful when working in noisy conditions, where many hammer impacts are needed to produce a usable record. Commonly, some traces will have good first breaks and others will be noisy (random chance dictates that some channels will be bad). Use Freeze to save the good traces, then focus on the noisy weak channels individually or in small groups. The advantage to freezing the channels with good signals is that they are protected from degradation during subsequent stacks. Freeze is also used in specialized surveys, such as when recording "Optimum Window" reflections (where you collect data on only one channel at a time) and borehole shear wave studies (where you might activate two channels while hitting one end of a plank, then two others while you hit the other end, then two others while you hit the top).

To try this function, select **Specify Channels** in the **Acquisition** menu (alternatively, you can get to the same place by choosing **Group/Shot Locations** in the **Geometry** menu). The bottom row of entry fields will indicate which channels, if any, are currently frozen. Position the cursor in the entry field of the channel you would like to freeze and press "2". It should change from "No" to "Yes". Press **ENTER**. The channel numbers on the frozen traces will be displayed in reverse video. Clear the memory. Notice that the frozen channels remained on the screen. Hit the ground a few times and observe that the frozen channels do not change while the unfrozen channels will, growing with each impact.

Unfreeze all the channels and clear the memory with the **Clear Memory** function.

Other Display Modes

Several different types of traces can be displayed on the screen. The different display style options are selectable in the **Trace Style** submenu under **Display/Shot Parameters**. The basic mode is wiggly lines, each representing the motion of the ground at a geophone. This is the classic form of a seismogram, and is called "wiggly trace" (or wriggle trace) as shown in Figure 1.3. Wiggle trace is a good mode for getting an overview of the record, but less useful than the other modes for most purposes.

Once seismographs made the transition from analog to digital instruments, data were processed on computers. Interpreters found that if you shaded the positive trace excursions black, it was easier to see reflections in the record. The StrataVisor™ offers this option, called "variable area". An example is shown in Figure 1.4. Variable area is generally better for reflection surveys, although no reflections are visible in this record yet.

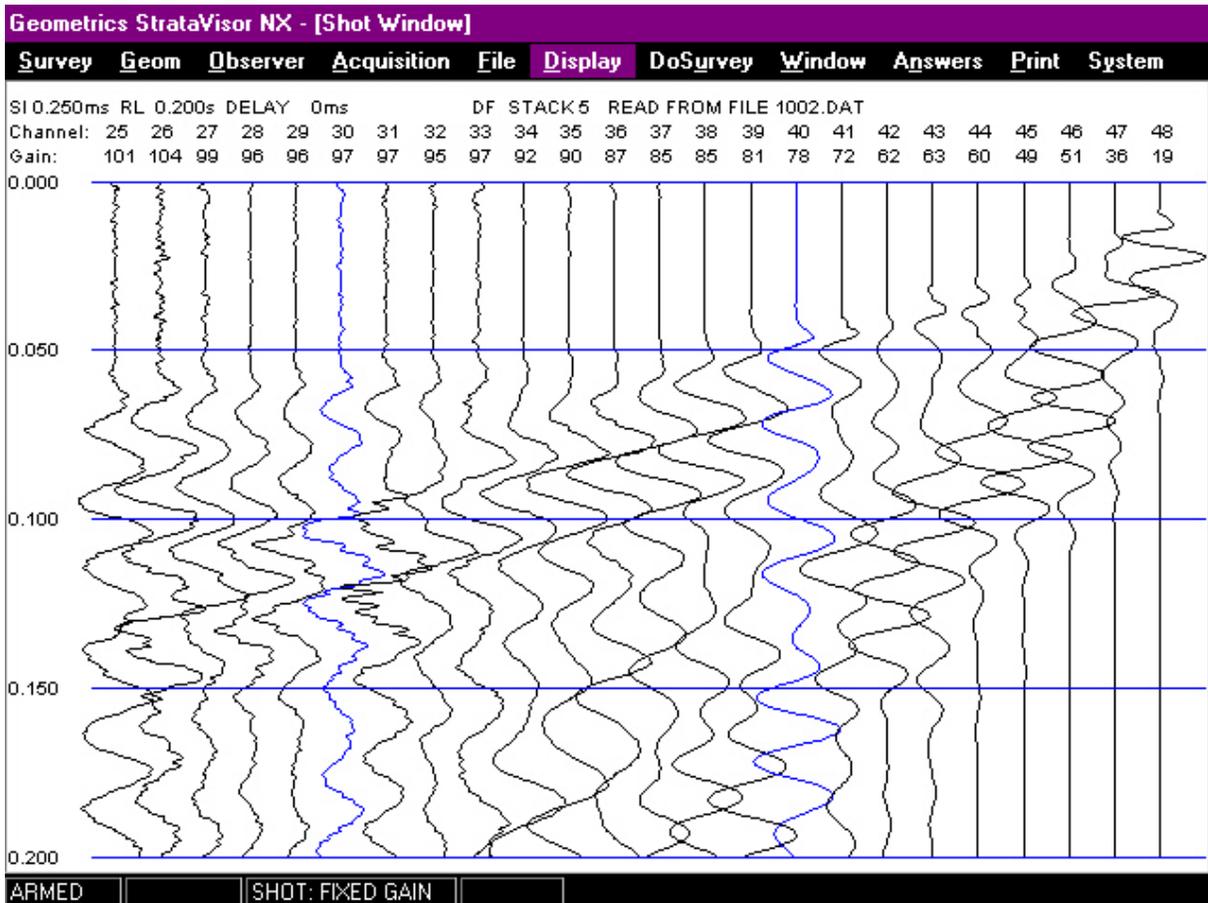


Figure 1.3 - Record displayed in wiggle trace format.

Variable area turns much of the record solid black, obscuring portions of the individual traces. This suggests another option, which has been called "shaded area". In shaded area, the positive excursions are shaded gray instead of black, and you can see individual traces even when they pass through the shaded portion. See the example in Figure 1.5. *Choose variable area or shaded area* for reflection surveys, depending on which works best for an individual recording.

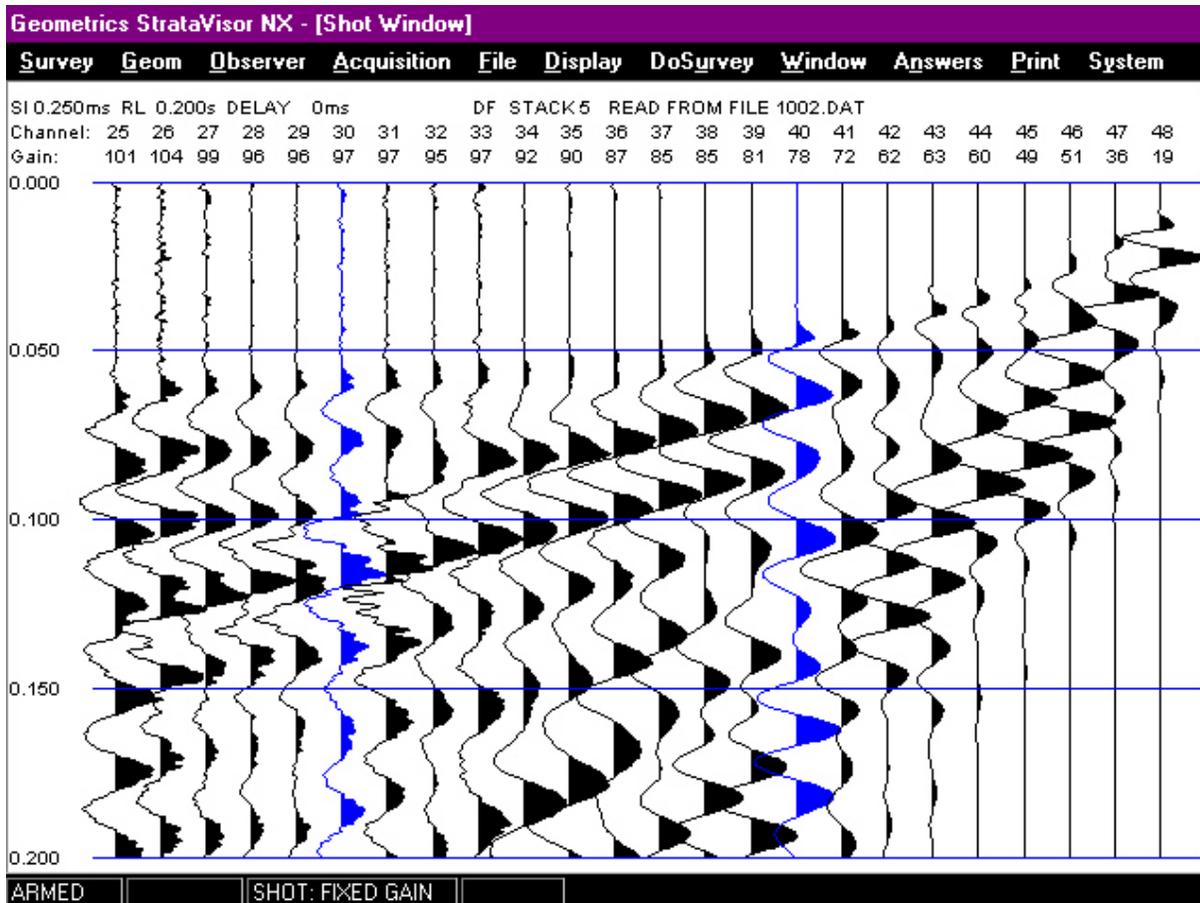


Figure 1.4 - Record displayed in variable area format.

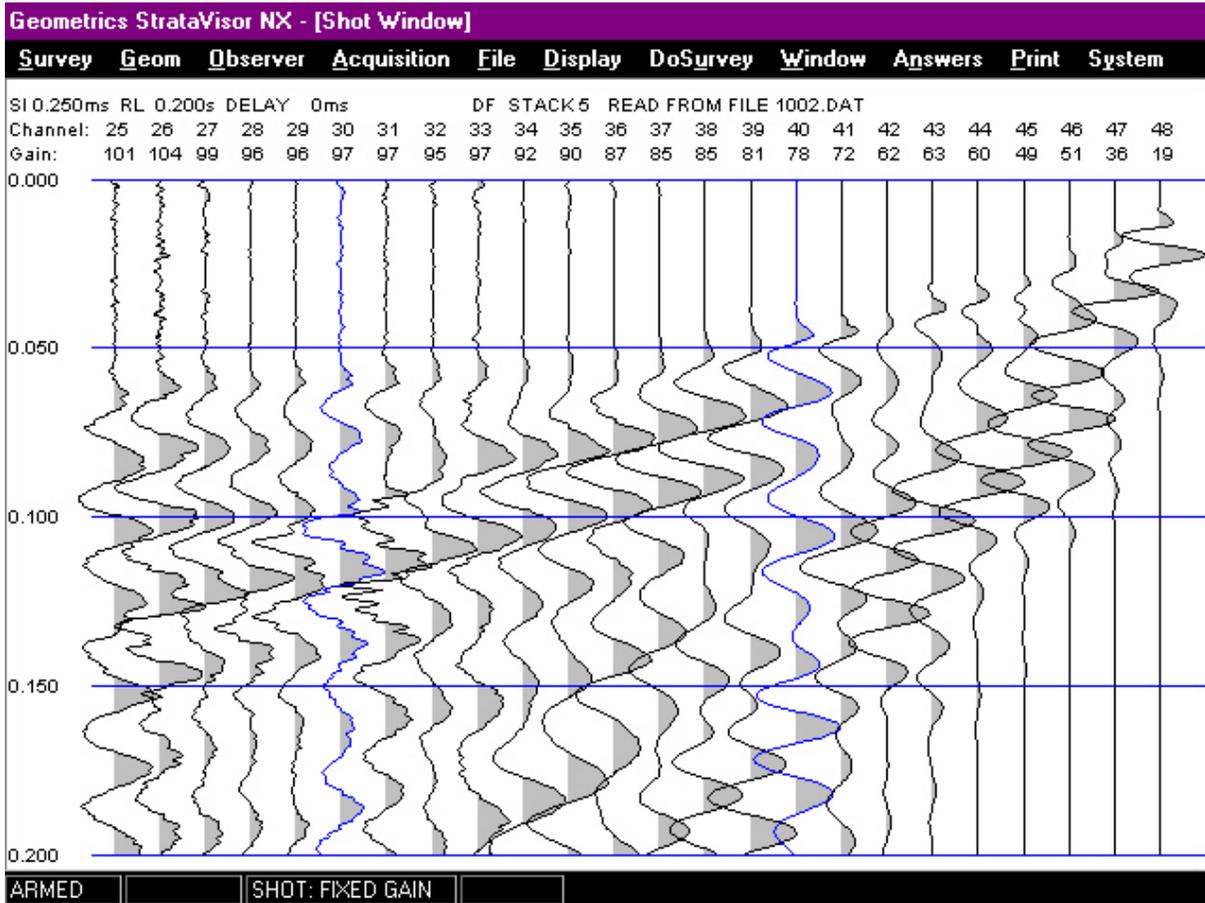


Figure 1.5 - Record displayed in shaded area format.

In refraction surveys, the first arrival of the wave at the geophone is the major event. In either variable area or wiggle trace, adjacent traces can swing over and obscure the first arrivals, especially when the display gain is increased to sharpen the first breaks. To solve this problem, there is another mode called "clipped". In this mode, the traces are stopped just before they get halfway to the next trace, and a flat top replaces the normal swing. No trace can interfere with viewing another, so this mode is preferred for picking first arrivals for refraction surveys. The traces look strange, and you lose the character of the later arrivals, but you don't care, the information you want to see is clearly visible, as in Figure 1.6. "Clipped" is available in combination with wiggle trace, variable area or shaded area.

Although "clipped" is a better form for picking refraction records, its tendency to obscure the character of the wave makes it difficult to use. To really see the seismic picture, you need the whole waveform, with background noise, first arrivals, sound waves, and surface waves displayed. Seeing the whole picture allows you to predict the location of the desired first arrivals almost exactly, and you should work with normal wiggle trace first, adjusting the display gain for the best image. Then, you can switch to the clipped format to eliminate overlap between traces. It will be very helpful to have the data stored on the hard disk or on the floppy disk, even though you may have a "pickable" paper record in the field.

Experiment with these options. Hit the ground with the hammer to produce a new record on the screen. Change the display by switching the *Trace Style* to each of the other combinations. Observe the effect on the trace display. Print a copy if desired.

AGC

Until now, the display has been in "fixed" gain, which means that the display gain scale factor on a particular trace is constant throughout the length of the record (though the scale factor on *individual* traces may be different). Notice that each trace contains a quiet early portion, a large signal as the vibrations pass the geophone, and then a quiet portion near the end. For many applications (particularly reflection surveys) you might wish to use a different gain at different times in the record. The automatic gain control (AGC) performs this function, increasing or decreasing the display gain to keep the excursions at some reasonable value throughout the record.

The particular type of AGC used in the StrataVisor™ is called "digital AGC". The average signal in a section of the trace, called a "window", is used to adjust the display gain (larger or smaller) for the data sample in the middle of the window time period. Then, the window is advanced slightly and the adjustment repeated for the next data sample. Digital AGC is able to look ahead in time, see a large signal coming, turn the display gain down in advance, and properly display large first arrivals. Look at the record in Figure 1.7; the very early portion of the record looks noisy on the far traces. This is normal, since the AGC increases the display

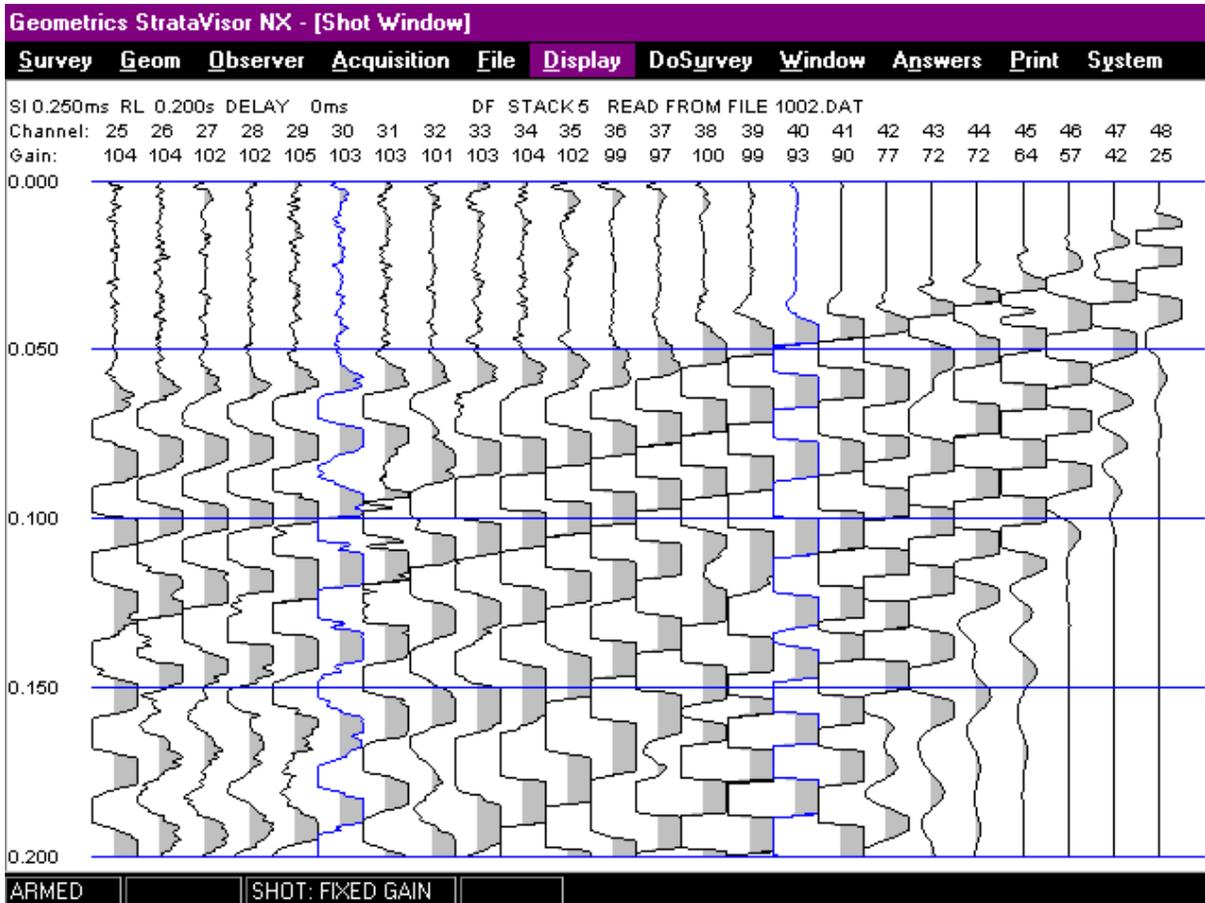


Figure 1.6 - Record of data displayed in “clipped shaded” format. The trace displays are increased to sharpen the first arrivals for better first break picking.

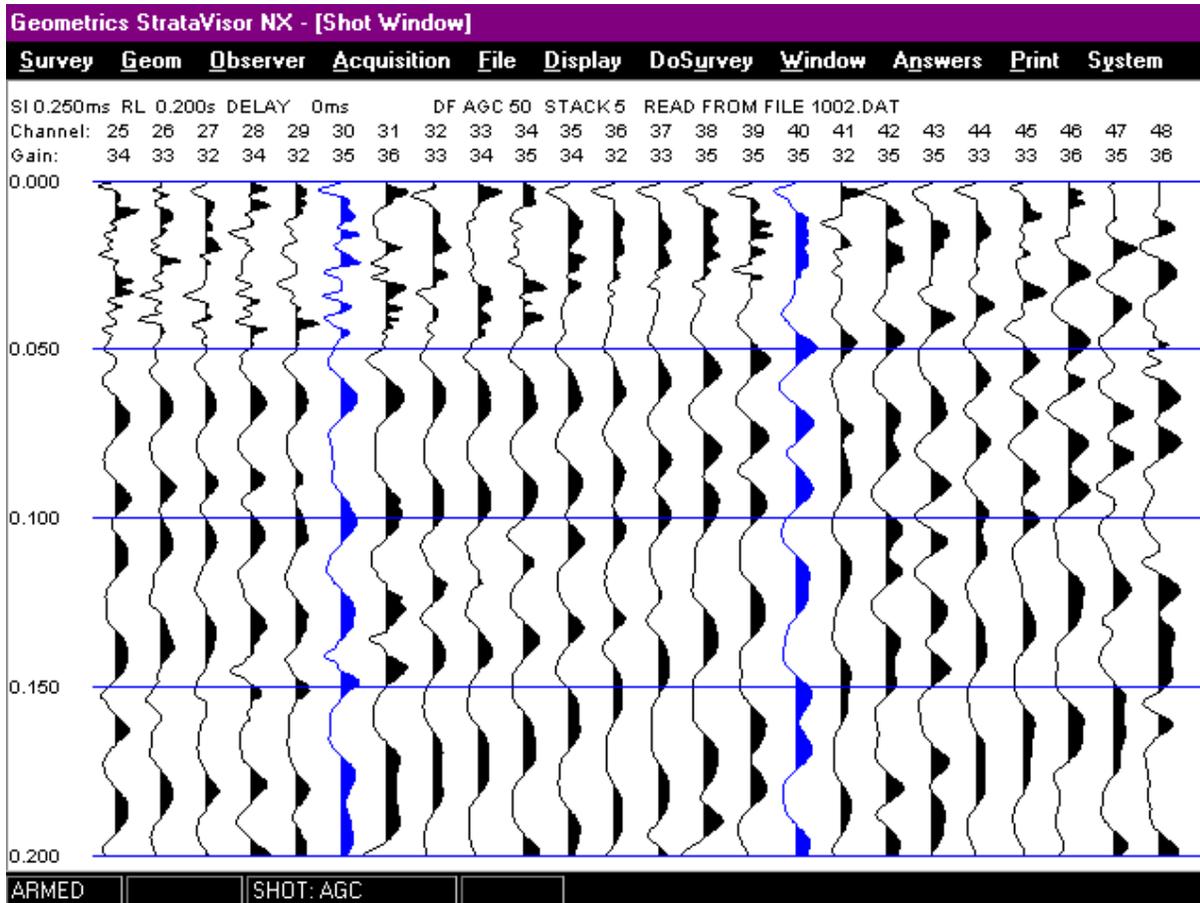


Figure 1.7 - Record displayed with AGC. Note the increased noise in early portions of trace before the first arrivals and at the end of trace 1.

gain until something shows, even if it's only background noise. Then, as the window advances to include the first arrivals, the gain is decreased in anticipation. The process continues throughout the record. Look at trace number 1. Notice that every portion of the record has some wiggles. Compare trace 1 in this record with trace 1 in the prior examples.

The length of the AGC window (in data samples) can be selected by the operator to fit the data set. For very shallow reflection surveys, with high frequency signals, the window should be relatively short. For deep reflections, use longer time windows. As a general rule, adopting a standard number of samples (say 250) will work for most cases, regardless of the sample interval used. It is usually not advisable to use AGC in refraction surveys.

Turn the AGC on, setting the window length to 250. The appearance of the wave will be quite different than in the previous experiment. Identification of events in the record now depends on the character of the wave and comparisons to adjacent traces (rather than on amplitude).

Clear the memory and stack a few impacts with AGC on. Now switch to *Fixed Gain* and readjust the display gains. Remember that AGC, like the rest of the display menu items, has no effect on the original data stored in memory, only on how it looks when displayed and plotted.

AGC is an advanced function, normally only used for reflection surveys, and new users should use fixed gain trace display.

Once familiar with basic data acquisition and display, the operator should experiment with some enhancements, described in the following section.

Use of the Filters

Filters are like the tone controls on a music system. Different frequencies (such as bass and treble sounds) can be boosted or attenuated to affect the sound. Likewise, the filters in the StrataVisor™ can attenuate low or high frequencies in the seismic record.

The seismic record will contain many different signals: refractions, reflections, surface waves, vibrations from traffic or wind, and other interference. Most of these are considered "noise" and are undesirable. Some noise signals are different in frequency than the desired signals, and filters may be used to improve the visibility of the desired signals. In particular, noise from a source some distance away tends to be lower in frequency than the desired seismic data (because the earth carries the low frequency signals for long distances).

Some signals may be considered noise, even though they are not random. The prime example is surface waves, which will grow with every hammer blow, but which can obscure useful reflection arrivals. Surface waves are always lower in frequency than shallow reflections, and you can use a low-cut filter to reduce them, letting the reflections appear.

Another example of non-random noise is 60 Hz (50 Hz in many countries) electrical interference, often encountered when working in urban areas near power lines. “Notch” filters are provided to deal with this type of unwanted noise.

Noise from wind may be either high frequencies (from wind blowing on the geophones) or low frequencies (from wind blowing on trees or buildings, which then push on the ground). Different types of filters can be used to reduce either type of noise.

The StrataVisor™ offers two sets of filters: *Acquisition* and *Display*. The acquisition filters are "real-time" digital filters which operate on the incoming data just like traditional analog filters. When data is acquired with acquisition filters, their effect becomes part of the record stored in memory.

The display filters, on the other hand, are temporary. They operate on the data after it is stored in memory, and the type and corner frequencies can be changed to examine the effect of different filters on the stored data. When display filters are used, the filtered data is displayed on the screen and a paper copy can be plotted, but the original data is held in memory. If the record is saved on a disk, the original, raw data is saved, not the filtered result. This allows the user to select a different set of filters when the data is processed or read back into the StrataVisor™ for analysis. With the exception of notch filters, it is generally better to use display rather than acquisition filters to preserve the option for later changes during analysis.

Low-cut filters are used to remove low-frequency signals (like surface waves, and noise from distant traffic). Notch filters are used to reject interference from power lines. High-cut filters attenuate higher frequencies, such as wind noise or nearby machinery. Each filter has a cutoff or "corner" frequency, which can be selected in the menu. Low-cut filters attenuate frequencies below the corner frequency, and high-cut filters attenuate frequencies above the corner frequency. Notch filters attenuate frequencies near their frequency, passing those above or below. Display filters are available in both 24dB/octave and 48db/octave attenuation rates.

To experiment with the display filters, select **Display Filters** in the **Shot Parameters** menu and select LOWCUT 50 HZ. You may need to first check the *Enable Display Filters* checkbox. Optimize the trace display and print a copy. Repeat the experiment with other, higher frequency, low-cut filter settings. Compare the records from each filter (including the one made earlier with no filter) to see the effect of the low-cut filter. If there is noise from a low frequency source, it should get progressively smaller as higher frequency filters are used. The first arrivals should grow more distinct, and then later fade away again as you pass into the frequency range where they are also filtered out.

There may be a range of filter settings where reflections are visible on the record. The low frequency surface waves should disappear when higher frequency low-cut filters are used. Figure 1.8 shows a record displayed in variable area with a 24 db/octave low-cut filter (and AGC). This is the same survey line used for the previous examples; note that some of the low-frequency surface waves have been removed and a possible reflection is visible in the data between 90 and 100 milliseconds on the far traces.

Try the same experiment with the notch filters. These will be less dramatic in their effect on the record and changes may not be visible at all unless there is some power line noise present. Remember that ideally they will not change the character of the seismic record (although there is always some change in the signal from removing 50 or 60 Hz information). Since 3-phase power lines also radiate at three times the fundamental frequency, 150 and 180 Hz notch filters are also provided.

Repeating the experiment with the high-cut filters should show some reduction in high frequencies, particularly at 250 Hz. This may be evidenced by rounding of first breaks or other effects.

You will need to choose between acquisition and display filters. Acquisition filters have the disadvantage of permanence, but the advantage of eliminating so-called edge effects at the beginning and end of the record. In general, when a notch filter is required, it is better to select one in the acquisition menu.

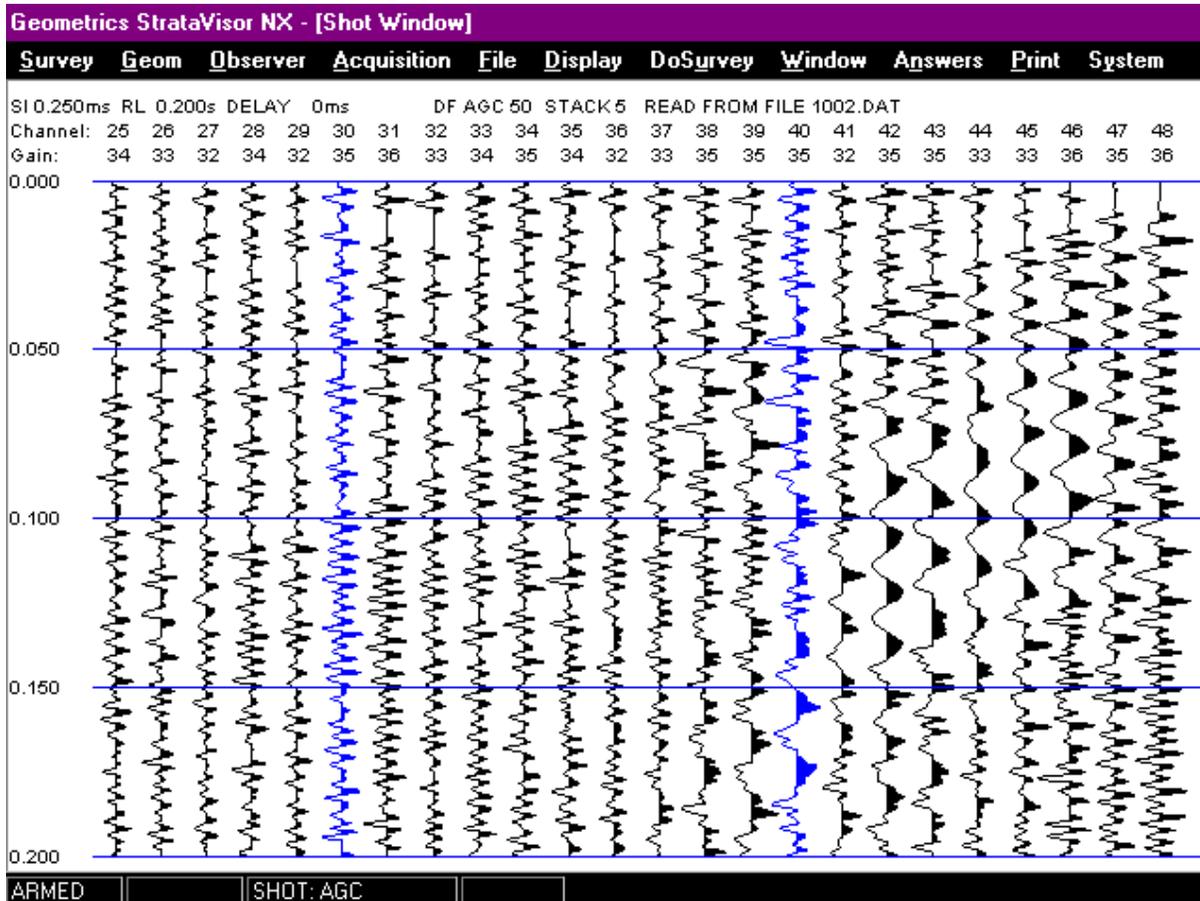


Figure 1.8 - Record of data recorded with a low-cut filter.

Using Delay

Normally, the seismograph begins recording data instantly when the source triggers. The *Delay* function is provided to postpone the start of the record by a selected time. This is applicable to surveys where there is a substantial distance between the shotpoint and the nearest geophone, and where there is no usable information in the early part of the record. Examples might be velocity logging of deep boreholes, or off-end shots in deep refraction surveys.

The delay can also be used to increase the effective record length by shooting sequential records with and without a delay and then merging the files.

To test the delay, take a sample record as was done earlier. Print a copy. Then, in the **Acquisition Timing** menu, enter a delay equivalent to some point prior to a recognizable portion of the record. Repeat the shot with the delay and compare the two records. Notice that the record made with the delay has not recorded the early portion of the record, but has appended some additional time to the record. The time lines (and annotated time lines on the plotted record) are automatically adjusted for the delay values, so times picked on the record are referenced to shot time.

Delay can also be set to a negative number, which means that the record will display some data prior to the actual trigger. This is helpful when using an energy source which is difficult to time precisely, such as a weight drop or air gun. One of the seismic channels can be connected to the trigger signal or to a motion sensor near the source to record the time of impact, or "zero" time. Routinely using a little negative delay (~10 msec) will help the automatic first break picking program do a better job.

Set the delay back to -10 msec.

Using Negative Stack Polarity

Reducing the Number of Acquisition Channels

The number of channels in use may be reduced when not needed. In borehole surveys, it is common to use only three geophones (or even one). Reducing the number of channels limits the size of the shot records, so that more records may be stored on a single disk.

To change the number of active channels, clear the data and select **Specify Channels** in the **Acquisition** menu. Move the cursor to the channel you wish to disable and press "4" to make it inactive. This channel and all of those to the right of it will no longer be visible on the display and will not record data until reactivated.

Storing Data

If you have used a seismograph before, chances are that your result was a paper plot which you took home, picked the arrivals, analyzed, and interpreted. If that is the case, you know that records which looked fine in the field can suddenly develop poor first arrivals when examined in the office. Perhaps even the location was uncertain. The StrataVisor™ will save the digital records on a disk. Once saved, they can be read back into memory, or read, displayed, and interpreted on a personal computer. This can be extremely useful, even for ordinary refraction surveys, since the records plotted in the field are rarely optimum and often difficult to pick. Plotting the records again in the office, and picking them from the screen or an optimized paper plot is a great improvement. Automatic refraction analysis on the computer is an even greater benefit. Digital recording and processing are required for reflection surveys.

When recording data, it is generally advisable to save the data to the internal hard disk or an external tape drive (or both). In the **File/Storage Parameters** menu, enable either *Save to Disk* and/or *Save to Tape*. If saving to disk, indicate a path or folder. This is the folder your data will be stored in. See Chapter 4 (Advanced Features) for a discussion of tape drives and other storage media.

Data may be transferred from the hard disk to 3.5" floppy via the internal floppy drive. Currently you must use standard Windows™ file copying and transfer procedures. A future version of the software will include utilities that will allow this operation from the built-in keypad, obviating the need for mouse and keyboard.

At this point, you should know how to acquire data, save it on disk, and read the data back. You should also be quite familiar with the use of the system menus at this point.

Answers

The **Answers** menu is used to analyze the seismic data. Programs are provided to allow a fairly complete seismic refraction solution, including layer depths and velocities which may be interpreted into geologic structure.

A proper seismic refraction interpretation should have at least two records, one with the source at each end of the line. More detail, and deeper information, can be obtained by also locating the source well off either end of the line and in the interior. For each shot, **the Pick Breaks** function will assist in picking the first breaks and saving the data on disk. *Be sure that the line geometry is properly entered for each shotpoint.* To help you remember, the StrataVisor™ will prompt you for geometry data at appropriate intervals if you are in the refraction mode.

Once the first breaks are saved, you may use the Optim@Survey refraction interpretation program to output of the velocity cross section on the plotter. See the Optim manual for detailed instructions on how to use this software.

Conclusion

By now, you should appreciate that the StrataVisor™ is an extremely powerful and easy-to-use seismograph. Only a portion of the features have been examined, and you should continue your familiarization by reading the rest of this manual and conducting further field experiments. Try different choices in the **Acquisition** and other menus to see their effects. As a general rule, the StrataVisor™ is very forgiving, and will gather the highest quality data possible with a minimum of effort in the field. While we have concentrated on refraction, the StrataVisor™ was designed as a reflection seismograph as well, and is capable of both shallow and deep reflection, cross-well tomographic, and VSP surveys. You are encouraged to explore these possibilities further. Geometrics can offer advice, short courses, and application notes to assist you.

Chapter 2. Condensed Operating Instructions

This section of the manual is provided for users who are experienced in the use of seismic equipment. Every effort has been made to make the operation of the StrataVisor™ simple and self-explanatory, and you may be able operate the system by just reading this introductory material.

You should acquaint yourself with the rest of the manual at your convenience. Note that some menu items may differ slightly from those printed in the manual, due to continual improvements to the software. Consult the README.xxx files on your instrument or contact Geometrics.

System Setup

You will need a 12-volt battery if you did not receive one with the system. If you are using the 110/220VAC configuration, you will need stable AC power. Current drain of the StrataVisor™ varies depending on the number of channels and the options installed. The small systems draw about 8 amps at 12 volts, requiring a moderate capacity battery (60 amp hours) for a day in the field. For larger systems, a good rule of thumb is 50 watts plus 1 watt per channel. Connect the battery pack, with the red clip to positive and black clip to the negative lead. If the connections are reversed, it will not damage the instrument, but it will not work. Connect the geophone cables, geophones, and energy source.

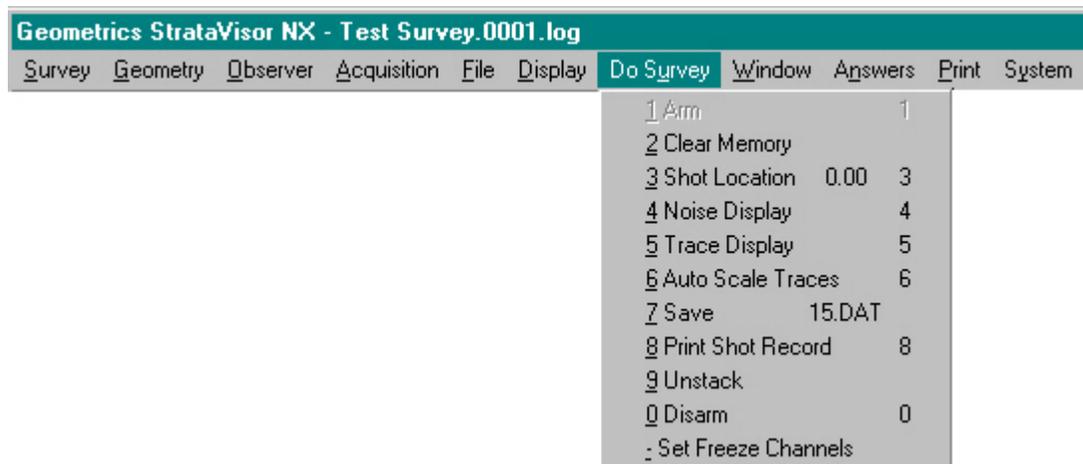
Switch on the instrument with the switch near the power connector. One of the light-emitting diodes (LED) on the battery level indicator should light. Wait several seconds while the system powers up, conducts its internal tests and loads its software. After the power up cycle, the screen should display the StrataVisor™ user-interface. *If you have a black and white LCD, and the screen is blank or faint, adjust the display contrast with the two arrow keys just above the battery level indicator.*

The seismic record is displayed on the screen, with operating menus overlaid when used to control the instrument. The default display consists of four windows: the shot record, noise monitor, survey log, and spectra window. Like any Windows™ program, this display can be customized by the user, and display settings will be remembered in subsequent sessions. You will spend most of your time looking at the shot record (which, until you trigger the system, will be blank), so you may want to maximize this window by choosing **Trace Display** from the **Window** or **DoSurvey** menu. A useful configuration is to maximize the trace display window, and then superimpose the **Noise Monitor** window on top of it, somewhere out of the way. The information contained in the various windows should be self-explanatory. Detailed explanation may be found in Chapter 3, Interactive Menus.

Menu Operation

The StrataVisor™ operation is through a set of interactive menus and sub-menus. These are engaged by pressing the **MENU** key, and making choices with the arrow keys, **ENTER**, and **CLR**, “.”, and “*”. In general, use the arrow keys to move around in the menus, the **ENTER** key to make a selection, the **CLR** (clear) key to exit from menus or escape without making changes. Use the “*” like you would a tab key to move from one entry box to the next. The “.” is used like a left mouse click to enable/disable checkboxes.

When **MENU** is pressed, The **DoSurvey** menu will be highlighted:



Use the left and right arrows to move between menu choices, and the secondary menu will change depending on which item of the main menu is selected. Use the up and down arrows to select items on the secondary menus. Work your way through the list and examine each set of menus. You can also select a menu item by pressing the key for the number next to the item in the menu. If you are using a portable system and are limited to a keypad, this is faster than using the arrow keys to move the cursor, and for repetitive operations in routine surveys, you will soon memorize the numbers corresponding to the functions. For further convenience, some menu items, primarily in the **DoSurvey** menu, have associated "hot keys". These items may be activated from outside the menu system by pressing the appropriate hot key, listed to the right of the item.

The secondary menus may either be action items (e.g., **Print Shot Record**, **Noise Display**) or they may be names for third level (tertiary) or even fourth level menus (e.g., **Filters**, **Preamp Gains**). In either case, the action or the tertiary menu is selected with the **ENTER** key or its corresponding number. If you press **ENTER** while **Print Shot Record** is selected, the seismograph will print a copy of the seismic record. Try printing a copy of the record. Load paper if necessary, using the instructions on the inside panel.

Experiment with the menus and explore the function of each. Since this chapter is for experienced users, and since the menus of the StrataVisor™ are generally self-explanatory, obvious features will not be discussed here. Refer to Chapter 3 for detailed information about any menu item that is not clear. Some are unique to the StrataVisor™ and will require investigation.

After you are familiar with the menus and their structure, you should be able to operate the system.

There are some subtleties, listed below:

- a. While in the noise display, the noise monitor sensitivity can be set with the up and down arrow keys. The same gain is used on all channels. The sensitivity will be displayed on the screen (top left), so that the operator can log ambient noise in millivolts. If you know the sensitivity of the geophones, you can convert noise level in volts into seismic motion levels.

The noise monitor can also function as a qualitative geophone and line test. (Note that the StrataVisor™ also has a geophone pulse test, described later). If any geophone (or cable) is open, shorted, or has a stuck coil, its trace on the noise channel should be noticeably different than the other channels. Some problems may be indicated by excessive signal, perhaps an open or leaky conductor near a power line for instance. In general, this geophone test can be as diagnostic as a simple continuity/leakage test.

- b. There are two sets of signal filters available. The filters in the **Acquisition** menu operate on the incoming data, just like analog filters. Once data is acquired with these filters, the effect is permanent, and filtered data is stored in memory (and will be saved on disk).

The filters in the **Display** menu are post-acquisition filters, which only affect the data shown on the display and printed on the plotter. The original raw data is held in memory and saved on disk. As a general rule, it is better to acquire your data with a wider bandwidth, then filter it later. This gives you more information content and flexibility in processing.

When data is saved on disk, some of the display settings are saved in the header. When the file is read back, these same settings are used. However, the data will be displayed with the current display filters, not the ones used when the data was saved.

The StrataVisor™ has digital anti-alias filters. The corner frequency is selected automatically when the sample interval is set.

- c. *Sample Interval* and *Record Length* are interdependent parameters on the StrataVisor™. To allow use of less than the maximum memory, there is a menu option to select just a portion of the available memory (see Chapter 3). Set the sample interval first, then record length. Changing the sample interval will affect the number of samples in a record. The software will try to keep the record time the same.
- d. Many acquisition parameters cannot be changed with data in memory. Clear the memory first before changing those parameters that affect how data is acquired (e.g. sample rate, filters, record length, etc.). Parameters which may be changed include freeze, stack mode, and stack polarity.

When a record is read from disk or tape, the acquisition parameters displayed on the top of the LCD (sample interval, record length, delay, acquisition filter settings, stack count) will reflect those read from the header, not the instrument settings. *However, the parameters listed in the secondary menus, including gain type and display filters, will continue to reflect the current instrument settings. This is particularly significant in the **Geometry** menu which contains the line geometry. To find the line geometry parameters which were stored on a disk file, it is necessary to **print** a copy of the record and read the values listed in the print header.*

- e. When saving a file, the system will assign a default file name, one digit higher than the last file saved. If a new name is selected, that will become the new base name. The StrataVisor™ will not overwrite existing files.

The StrataVisor™ will also allow the use of folders as with any Windows™ computer. You may assign folders to the project, the day, and even the line if desired. Once a folder is selected (using the **Storage Parameters** menu options), the files will be saved in that folder. Since a folder is established on each individual disk, their use on the 3¹/₂-inch floppies should be avoided. Swapping disks may lead to directory errors.

- f. Under the **Geometry** menu are entries for line geometry and other file header information. It is good field practice to make these entries, and they are required for a number of operations, including all the **Answers** programs and for saving or printing files in the refraction mode. See Chapter 3 for a detailed explanation of these parameters.

The shot and geophone locations will be incremented as defined in the **Phone Increment** and **Shot Increment** entries of the **Geometry** menu. If these parameters are set to zero, the operator will be prompted to update the geometry before saving or printing the data from each shot. Consult Chapter 3 for details.

- g. The **System** menu includes, among other things, a choice of units, meters or feet, used in the programs under the **Answers** menu, plus a clock and calendar. Set these parameters appropriately.

Acquire Data

Go to the **Geometry** menu and set those parameters to reflect the survey line.

Clear the memory in the **DoSurvey** menu. Select the **Acquisition** menu and set the acquisition parameters for the line: sample rate, record length, filter settings, etc.

Engage the **Noise Display** (found in the **DoSurvey** and **Window** menus). Raise or lower the sensitivity by pressing the up or down arrow keys. The screen should graphically display the noise level on each of the active channels, continuously updating. Check to see that all the traces are functional, thus testing the geophones and cables. The background noise level will vary with the situation. Stomp on the ground and watch the noise display respond.

Operate the energy source to trigger the seismograph. The noise monitor display will disappear, and be replaced by the seismic record.

Examine the Record

Select the **Display** menu and adjust the display parameters for the desired record display. **Display Gains** includes an automatic selection, usually a good place to start to get some usable data on the screen. Other choices include variable area/wiggle trace modes, digital filter functions, AGC, time window, and channels displayed. Since you can observe the effect of each change, little explanation is required. Practice with the various settings to get a feel for their effects on the display.

You may need to readjust the trace size whenever changing between AGC and fixed gain displays. AGC has the effect of keeping trace amplitude relatively the same for the entire record, whereas fixed gain gives a more familiar display with large first arrivals and smaller later waveforms. Try an AGC window length of 250 samples as a first choice.

Print a copy (in the **DoSurvey** menu). Change the printer scale if the physical length of the record is too long or too short (see **Shot Print Parameters** in the **Print** menu).

If the record is noisy, and it is difficult to recognize the significant arrivals, you may wish to repeat the energy source and stack additional shots. Note that stacking in the AGC mode does not increase trace size as in a conventional seismograph, but the data should become more noise free.

Save the Data

The **Save** command, which commands the system to save the seismic record onto the default storage medium, is located in the **DoSurvey** menu. The remaining storage commands are located in the **File** menu.

You can save files on either Drive A: (the 3¹/₂ -inch floppy) , Drive E: (the internal hard disk), or to tape. To use a floppy, check to see that the default drive is A:, insert a formatted disk into the disk drive, and press **Save**. To use the hard disk, select Drive E: and make a folder if desired. See details in Chapter 4 (Advanced Features) regarding loading and assigning tapes.

The shot and geophone group locations (set in the **Geometry** menu) will be saved with the data file. Read that section of Chapter 3 for an explanation of these variables.

When saving a file, the system will suggest a number for the file name, listed in the **DoSurvey** menu. Select **Save** and press **ENTER** to use the suggested name or, (if you want to change) select a new name-number in the **File** menu under **Storage Parameters**. The data will be saved under that selected file name. The next time you save a file, the system will suggest a name one digit higher. A file name can have 8 digits, and it should always be numerical.

The seismic record will be saved with the extension .DAT, .SGD, or .SGY, indicating the data file format. Related files (such as first breaks) will be saved with the same name but a different extension.

It is unlikely that the system will save the data incorrectly, without providing an error message. However, you can check by first clearing the memory, then reading the same file from disk using the **Read Disk** option in the **File** menu. It is not necessary to clear the data from memory first, but it may be reassuring.

Once the operating parameters are set, the commands used to acquire data are all located in the **DoSurvey** menu, which is also the menu selected when you press the **MENU** key. This grouping in sequence of routine commands will expedite actual surveys.

This concludes the experienced user operation section. It is assumed that the reader will exercise the system and learn the subtleties of the menu through experimentation. There is a significant amount of material not discussed in this section which is felt to be obvious to an experienced user, but no doubt some subjects were not covered in adequate depth. For additional information, read the rest of this manual.

Chapter 3. Interactive Menus

This section describes the display, keypad, and interactive menu. The menu section is organized in a glossary style so that individual sections may be used alone to explain menu items in detail.

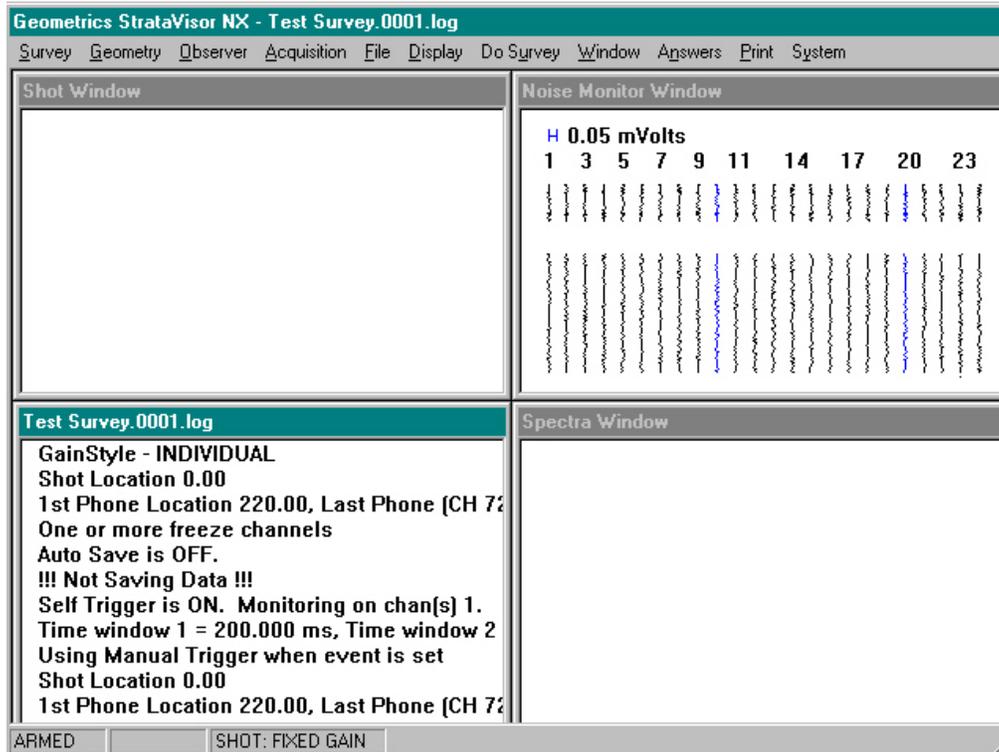
The Display

The StrataVisor™ is available with either a black and white or color LCD. If you have the black and white version, the front panel will include adjustments for contrast. Also, you will have an optional backlight, which can be turned on and off via the **Backlight** option in the **Display** menu. Generally, the backlight is not needed outdoors, and it is best to leave it off to save battery power. This display is of 640 by 480 resolution and is VGA compatible. If an external monitor is plugged in to the video port, the resulting display will be color and the built-in LCD will be automatically disabled. If you wish to use an external monitor, it must be plugged in to the StrataVisor™ at the time of boot-up.

If you have a color LCD, the backlight is always on, and there will be no contrast controls. The color LCD is of 800 by 600 resolution and is also VGA compatible.

There are four separate windows that can be displayed at any given time. 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 portable system, you will need to plug in a mouse to accomplish this, but once it is done you should not need a mouse in the field. The system is designed to be fully operational with the built-in keypad.

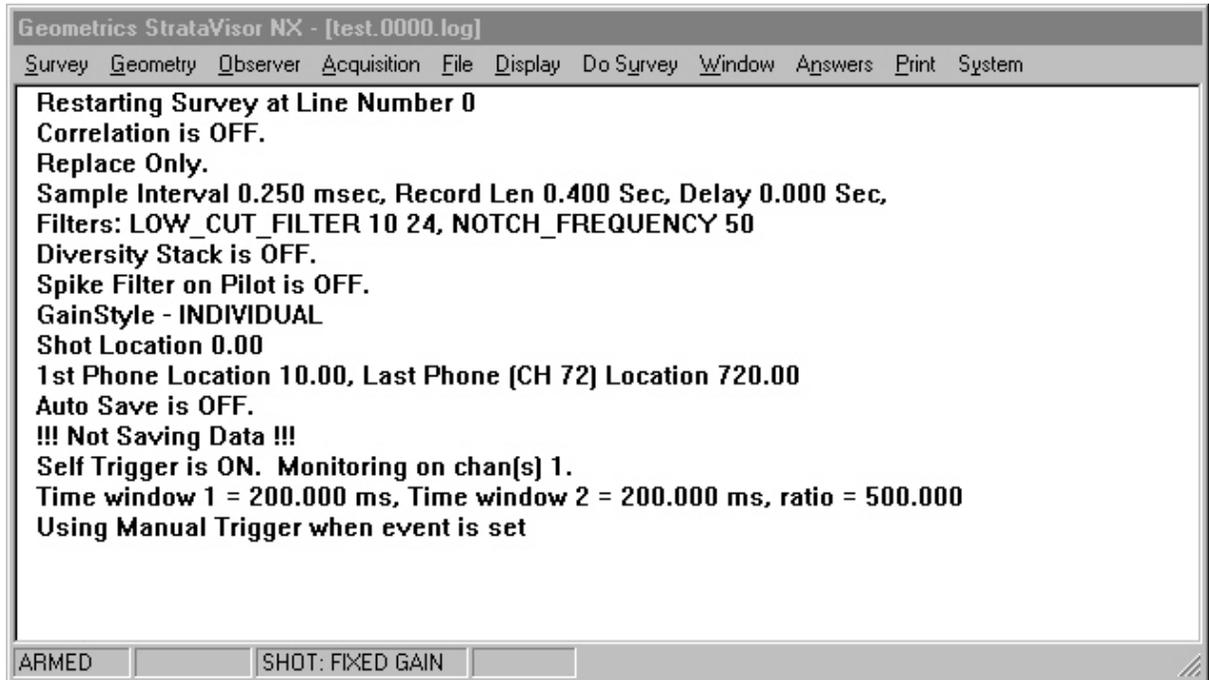
On initial power-up of your StrataVisor, you should see the following:



Across the top you will see the list of main operational menus. Within each are generally a selection of submenus. Before we get in to the description of these, we will first discuss each of the four display windows.

Survey Log Window

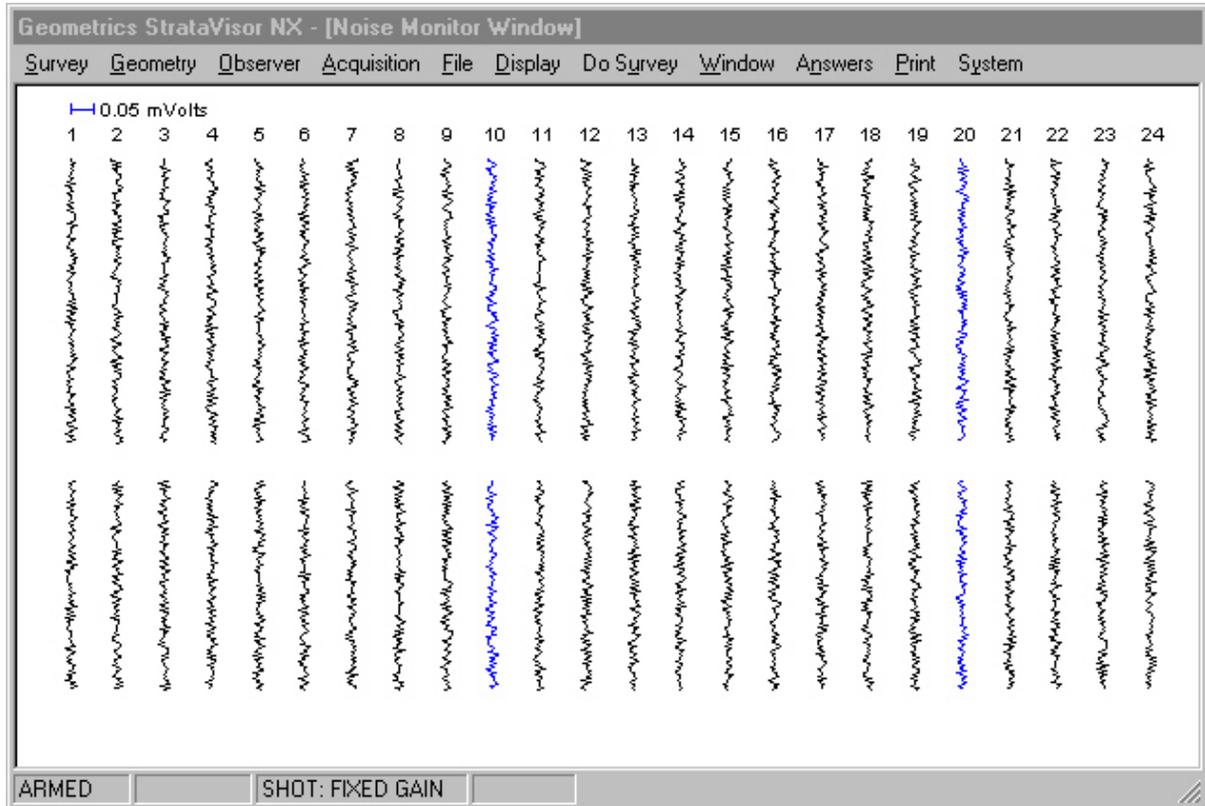
To view the survey log, press **MENU** to highlight the menu bar, then choose **Window** and **Log Display**. This will maximize the survey log:



The survey log keeps track of everything that happens during the course of a survey. Initially it displays the basic settings of the StrataVisor™, 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.

Noise Display Window

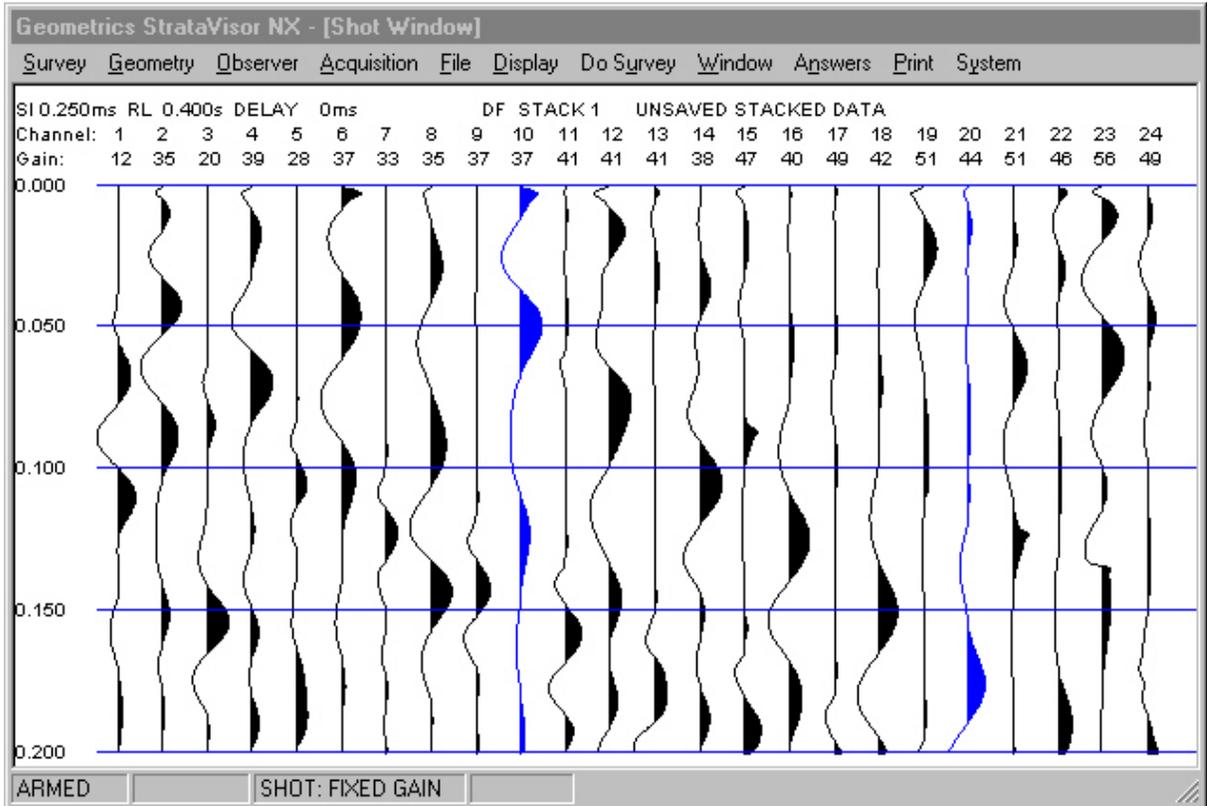
Next, go to the **Window** menu and choose **Noise Display**:



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. 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.

Shot Record Display Window

Now, choose **Trace Display** from the **Window** menu. Since you have collected no data, the bulk of this window will be blank. Take a noise record by choosing **Manual Trigger** in the **System** menu. This will cause the system to take a record and display the results:



Your display may look somewhat different depending on your display parameter settings, but at a minimum you should see a series of straight or wiggly lines similar to those shown above. Each wiggly line or trace corresponds to a channel in the seismograph. In a real survey, each channel will correspond to a geophone on the ground and will represent the ground motion at that location.

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, 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.

AGC or FIXED will indicate the gain style setting (no indication of gain style indicates that it is set to NORMAL).

STACK MODE will be displayed, either **A** for AUTOSTACK (automatic) or **P** for PREVIEW (which allows the operator to examine a new data set before stacking it to memory) or **R** for REPLACE (which will automatically replace the data with a new record).

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 – no data, and the stack count should be zero.

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

UNSAVED PREVIEW DATA indicates the data on the screen is new seismic data to be rejected or accepted (stacked) by the operator.

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 AGC, or automatic gain control).

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

The Keypad

B/W Screen

The keypad on the black and white system has 20 keys, including numbers **0** through **9**, **MENU**, **ENTER**, **CLR** (clear), "-" (hyphen or minus), "." (decimal point), "*" (asterisk), and 4 **arrow** keys. Every effort has been made to render the operating software fully operational from the keypad, precluding the need for a mouse. Still, as the WindowsTM operating system was designed around the mouse, you might find it useful to have one handy for special operations such as customizing your display, as well as operations outside the StrataVisorTM acquisition software. It is assumed that the reader is reasonably versed in operating WindowsTM-based programs, and most of the discussion going forward assumes the user is operating the system via the built-in keypad.

Color Screen

The keypad on the color system is nearly identical to that on the black and white system, with some slight differences:

- 1) The "*" key described above is labeled "**TAB**".
- 2) The **ENTER** key described above is labeled with a return arrow (↵).
- 3) There is an addition Function key, labeled "**Fcn**". This key currently has no function, but someday we'll find one for it.

Function of the Keys

The **MENU** key is used to select the operating menu. Pressing this key automatically takes you to the **DoSurvey** menu, since this is the menu most often used while surveying.

The **arrow** keys are used to position the cursor among menu options on the screen. The left arrow key can also be used as a backspace to delete the last digit when entering a string of numbers.

CLR is used to back out of the menu or to recover from errors.

ENTER or "=" is used to make a selection after positioning the cursor or after keying in a number.

"-" is used to designate a negative number or to designate a range of numbers, i.e. 1-12 (for numbers 1 through 12).

"." (decimal point or period) is used to insert a decimal point or to act as a left mouse click to fill in check boxes.

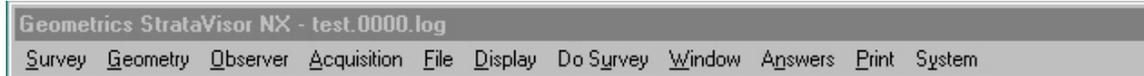
The "*" (asterisk) or **TAB** key acts as a TAB key does in Windows™, moving control from entry field to entry field. It works slightly differently than the arrow keys. The best way to understand the functions of these and the rest of the keys is to practice. You will become fluent with their operation in a short time.

External Keyboard

Your seismograph may also be operated from an external computer-style with a PS-2 connector. Just plug the keyboard into the connector provided (some keyboards may require being plugged in during boot-up). With an alphanumeric keyboard, folders, project names, and other parameters may be named with letters as well as numbers. *However, it is recommended that shot record file names be numerical, as this is what most processing software will be expecting.*

The Menus

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



When the **MENU** key is pressed, one of the selections will be highlighted. Below this line, overlaying the data display, will be a box containing secondary menu selections. The selections will correspond to the highlighted main menu item. There may be a single selection shown, or a long list. Some selections are execution statements, meaning that an action will be performed if **ENTER** (or the selection's number) is pressed while the selected item is highlighted. Other selections will cause another menu to be displayed, or present a request for a number to be entered, or require further action. In operation, the menu system is quite easy to use.

The secondary menu items are numbered. *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, especially after the operator has learned the numbers. 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 arm the system from outside the menu system by simply pressing 1 (see the DoSurvey menu).

Survey menus are used for setting up and naming a new survey.

Geometry menus are used to record the locations of the geophones and the energy source.

Observer menus are used to set up the survey log and update the line and shot record number.

Acquisition menus control the data gathering parameters (such as sample interval, record length, filters).

File menus control the saving/reading of data files to/from disk.

Display menus control the way the data is displayed on the screen and plotted.

DoSurvey contains the functions normally used to acquire, display, and analyze data in a production mode.

Window menus are used to maximize and minimize individual display windows.

Answers menus are used to run the field quality control software programs to analyze the data.

Print menus control printing related parameters.

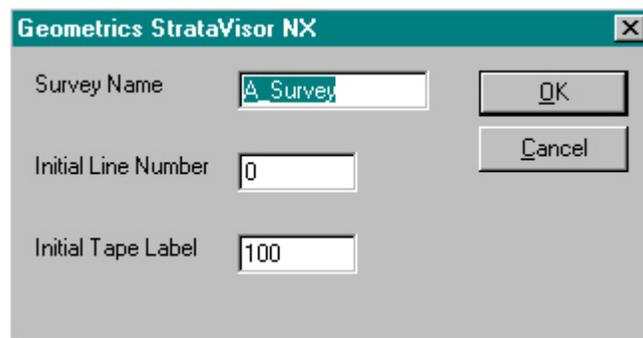
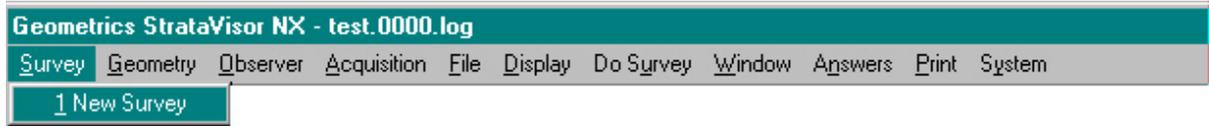
System menus are used for general operating and test functions.

Experiment with the system. The complete menu structure is listed on the following pages. Many secondary menus have a status indication, which identifies the current setting.

The current settings in the following examples are representative. The actual menus will display many other alternatives.

Survey

New Survey



The **Survey** menu is used to provide a name for the survey, an initial line number, and if writing to tape, an initial tape number. 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. 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 system switches to a new tape (automatically if more than one tape drive is installed), the tape 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.

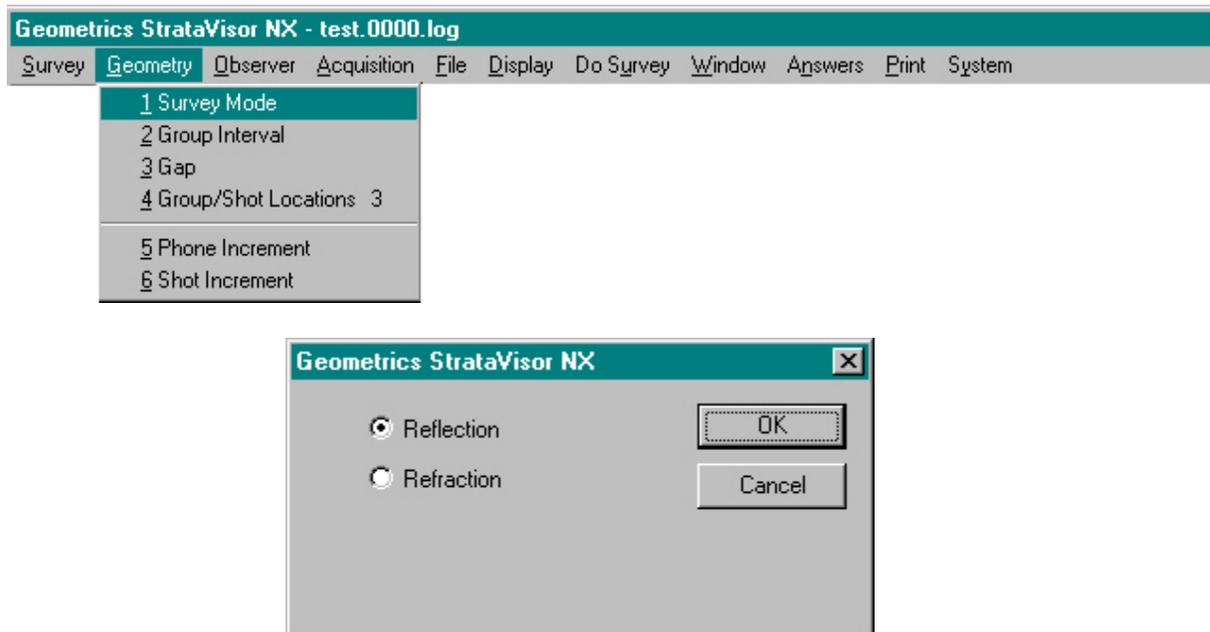
Geometry

Geometry is a collection of menus used to annotate the seismic data with the locations of the geophones and seismic source. The SEG-2 standard provides space in the header for 3-dimensional coordinates (X, Y, and Z) for the energy source and each geophone group.

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

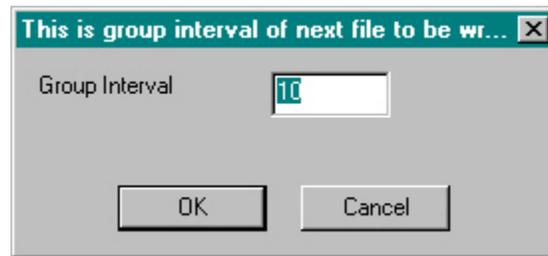
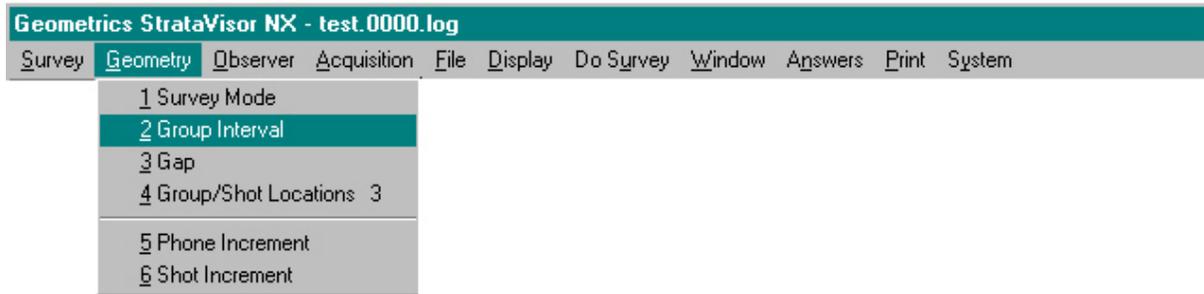
This information will be attached to the data when the file is saved to disk. If a file is read from memory, the geometry settings on the LCD display will continue to indicate the current instrument settings, not the data read from disk. However, the information read from the disk file can be printed on the paper records. Proper use of these capabilities will label each file with the geophone geometry and source location.

Survey Mode



The **Survey Mode** you choose will affect the response of the anti-alias filter, and it will have subtle effects on program operation (for instance, the **Gap** setting only applies for reflection surveys; if **Refraction Mode** is selected, **Gap** will be grayed out).

Group Interval



The **Group Interval** is the distance between geophones or groups of geophones. Units are set in the **System** menu. If you are working in stations (i.e., one station equals x feet or meters), then the units you set are irrelevant. *Be aware, however, that the functions in the **Answers** menu require units of feet or meters.* If you intend to use these functions, you must base your coordinates in one of these two units.

Group/Shot Locations

This is geometry of next file to be written

Shot location

10.00
▲ 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Channel	1	2	3	4	5	6
Interval	<input type="text" value="10.00"/>					
Position	<input type="text" value="10.00"/>	<input type="text" value="20.00"/>	<input type="text" value="30.00"/>	<input type="text" value="40.00"/>	<input type="text" value="50.00"/>	<input type="text" value="60.00"/>
Gain	<input type="text" value="48dB"/>					
Use	<input type="text" value="DATA"/>					
Freeze	<input type="text" value="NO"/>					

ENTER NEW SHOT LOCATION,
USE UP/DOWN TO MOVE FIELDS
PRESS ENTER KEY WHEN DONE

(In Feet)

This is a map of the geophone locations and current shot point location, with coordinates and group intervals listed. You also have access to gains, channel use, and channel freeze from this menu. However, we will only discuss geometry attributes here.

Use the arrow keys to move up and down, and use the tab or “*” key to move from field to field within a category. Regardless of the number of channels, only the positions of six channels are displayed at a time. To view a different segment of the geophone spread, simply tab to the right (or if using a mouse, use the scroll bar). You will see the channel numbers change accordingly. To change any of the numbers, just position the cursor over it, key in a new number, and press **ENTER** or any arrow key except the left arrow key. Note that pressing **ENTER** will also cause you to exit from this menu. Pressing an arrow key will cause the entry to be accepted and leave the menu open.

Note that the group interval is set to whatever number was entered in the **Group Interval** dialog box discussed above. However, you now have the flexibility to edit individual group intervals – this need not be constant throughout the spread. You may also edit the actual geophone positions. Practice changing the group interval and geophone positions to gain familiarity.

If you know the coordinate of your shot, you may enter it next to **Shot Location**. The shot point location can also be set by positioning the cursor over the shot point location field and using the left and right arrow keys. The shot will be moved in increments equal to the entered group interval. This is useful in that it doesn't require the actual coordinate of the shot to be known, just its location with respect to the geophones. You may know you want the shot between geophones 5 and 6, but you may not know the actual coordinates of that position. Move the cursor as close to that position as possible, and then fine-tune it based on the positions shown for the relevant geophones.

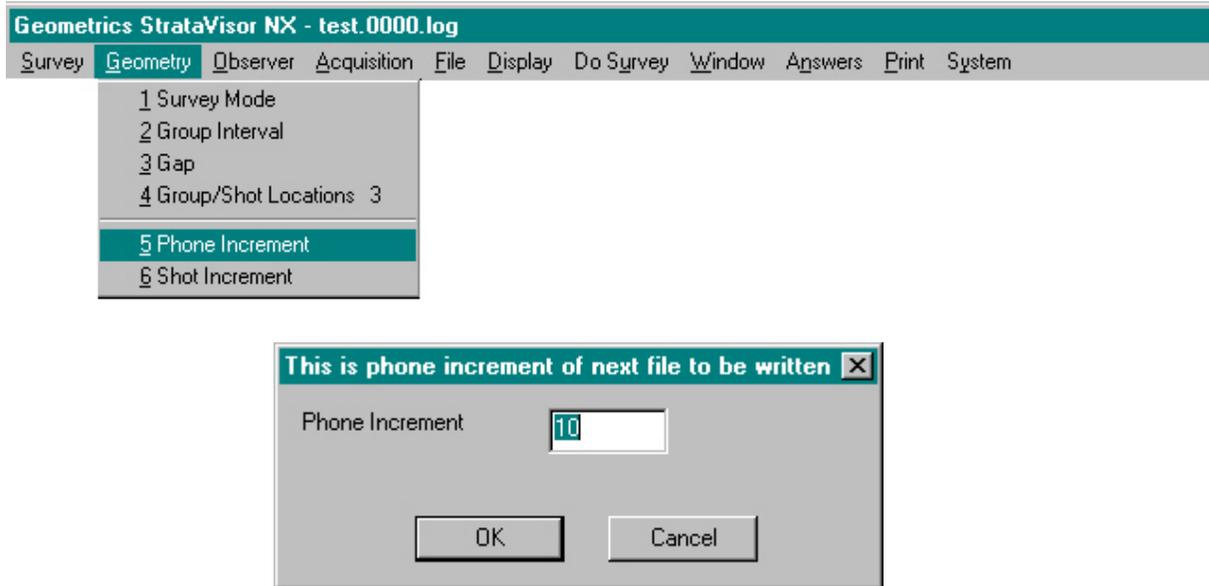
The message at the top of the dialog box indicates what the parameters are for. If you read in a previously taken record, the message will change to:

This Is Geometry Of Last File Read In

When you clear the data in order to take a new record, the geometry settings will revert to the settings for new data.

Once you have the geometry set, tab to **OK** and press **ENTER**.

Phone Increment



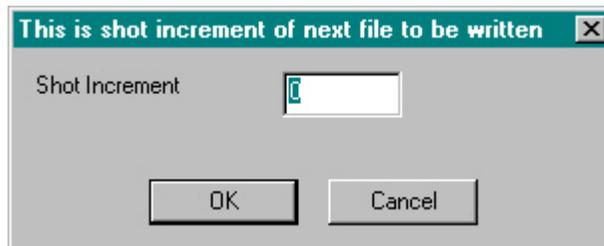
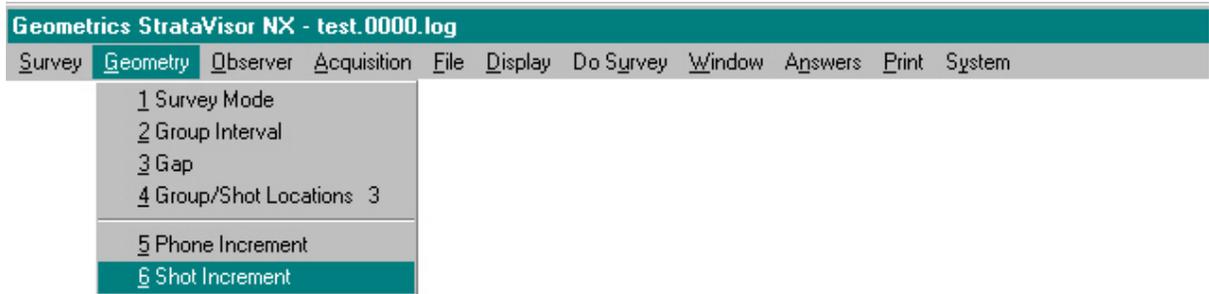
The **Phone Increment** is the physical distance that you wish to move or “roll” the active portion of the geophone spread. For instance, when conducting a common-depth-point (CDP) reflection survey, normal procedure is to lay out a spread of geophones, connected to the seismograph via a roll switch. The number of geophones on the ground is larger than the number of channels in the seismograph, and the roll box controls which geophones are active (i.e., connected to the seismograph) at any given time. After each shot, the source and *active* segment of the geophone spread are “moved up”. No geophones or cables are actually moved physically, but the geophones that are now connected to the seismograph are different than before. Example: when the first shot is recorded, ground stations 1 through 24 (out of a total of, say, 48) are connected to channels 1-24 on the [24-channel] seismograph. Then, the shot is moved up (generally by a distance equal to the group interval), and the active portion of the spread is also moved up using the roll switch. For the second shot, ground stations 2 through 25 are now connected to channels 1-24 on the seismograph. For the third shot, you are recording from ground stations 3 through 26, and so on.

Setting the shot and geophone increment appropriately will allow the seismograph to keep track of shot and geophone coordinates automatically, precluding the need for the operator to update this data after each shot. This is very useful, particularly in production seismic surveying.

In practice, any sequence will be interrupted eventually. In that case, just enter the correct values for the line geometry before saving the file. If the geometry changes (different group interval for example), just update the information.

If the **Phone Increment** is set to zero, the spread coordinates will be static, and any changes must be done manually in the **Group/Shot Locations** menu. For most refraction work, you should set the phone and shot increment to zero.

Shot Increment

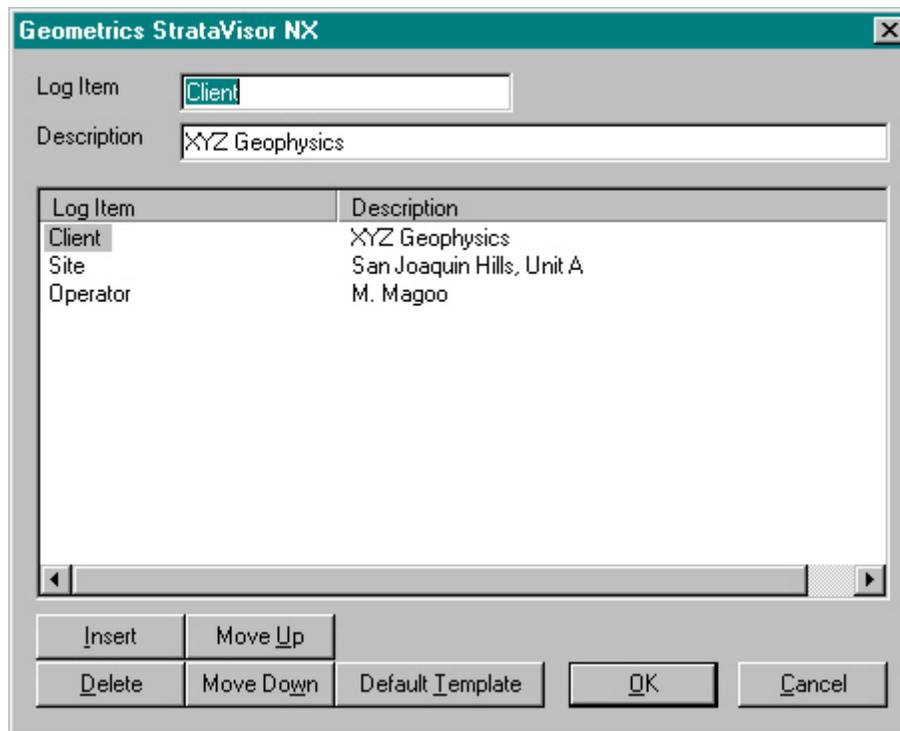
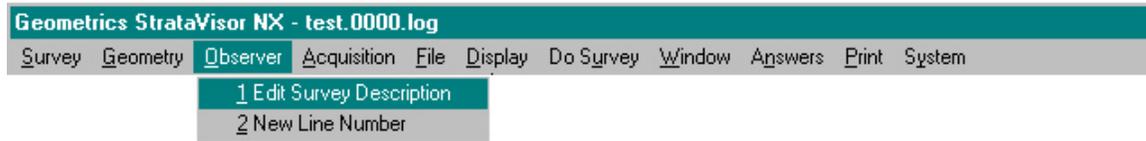


Shot Increment is the physical distance between subsequent shot points. See above discussion on **Geophone Increment**.

Observer

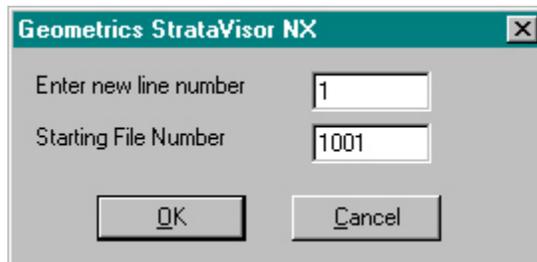
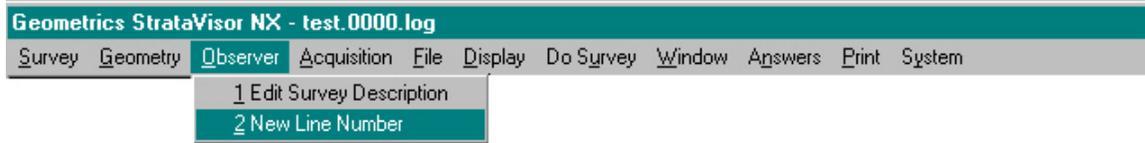
The **Observer** menu allows you to enter basic information about the survey: who the client is, the job #, site name, etc. This is also where you update the line number if you start a new "line" within a survey.

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. Obviously, you need an external keyboard to take full advantage of this feature.

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 parallel refraction lines. They may be end-to-end or side-by-side. 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 effected. If you elect to change the line number, you will also be given the opportunity to update the file number if you wish. 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. The StrataVisor will not allow existing files to be overwritten -- you will be warned in this eventuality.

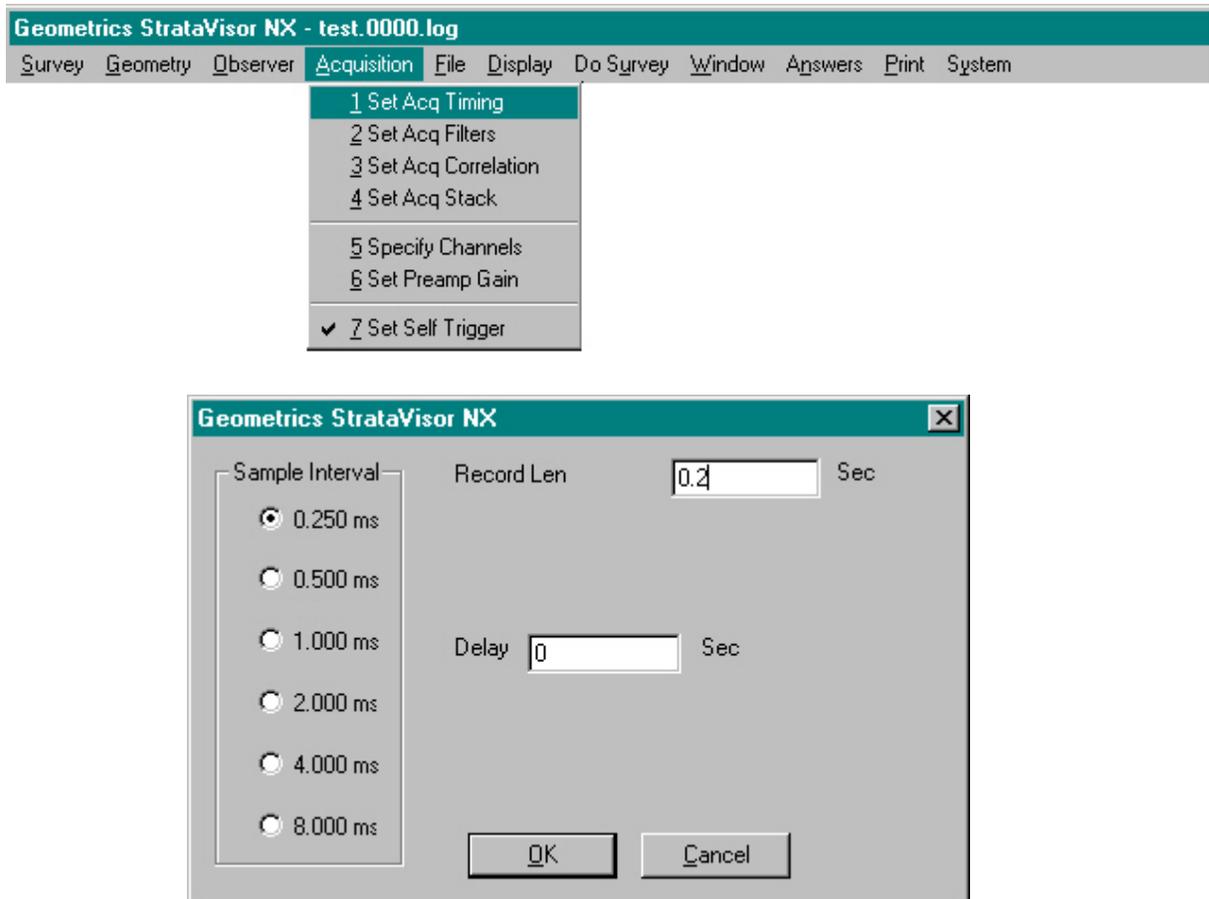
Acquisition

This set of menus contains the acquisition parameters, those variables which effect how the data is collected.

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.

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.

Acquisition Timing



A seismic signal 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 interval between data samples.

The sample interval is selected to match the scale and type of the survey. Smaller sample intervals (faster sample rates) should be used for short surveys in hard materials (such as rock and concrete). Slower sample rates are used for long refraction surveys and reflection surveys where events of interest arrive late in time.

The *Record Length* is the length of the final record in seconds. This is the amount of time the system listens for signals 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. The StrataVisor™ comes standard with enough memory for 16,000 samples/trace, and 128,000 samples/trace are available as an option. There is an interplay between record length (in units of time) and sample interval. For a given record time, the smaller the sample interval, the greater the number of samples per trace. Conversely, for a given sample interval, the longer the record time, the greater number of samples per trace. You will be notified if the parameters you choose exceed the maximum allowable number of samples.

It is good practice to record only as long and/or sample only as tightly as necessary to accomplish the goals of the survey. Each sample uses 4 bytes of storage capacity, and this can add up quickly. Large data files can be cumbersome to work with, so you should take care to keep them as small as possible. This is especially important if you are transferring data via floppy disks. The appropriate parameters depend on the type and goal of the survey. Contact the factory if you need guidance.

Delay is 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, and surveys where there is a significant offset from the first geophone. Use of the delay allows the use of less memory and/or a faster sampling rate in these cases.

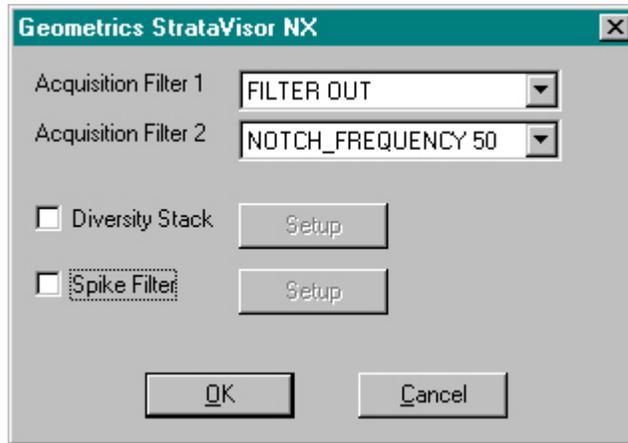
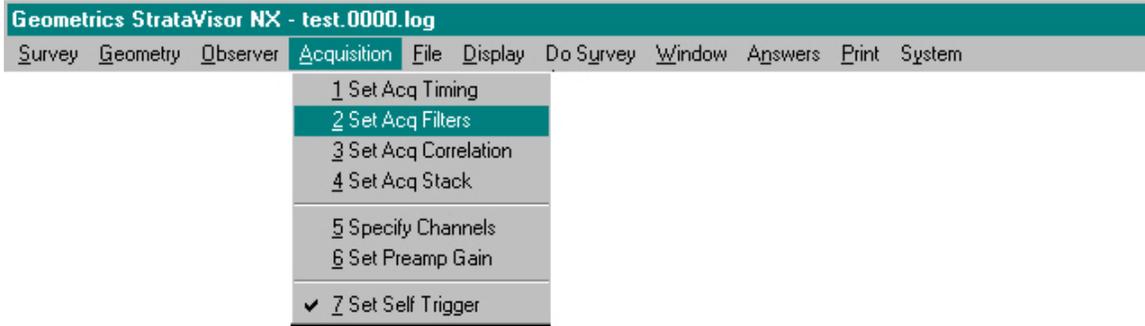
Creative use of the delay function can also allow effectively longer records for special situations. Data can be collected with no delay, followed by one or more records with a delay set to the length of the previous record, resulting in multiple records that can be merged together in processing to make a composite record much longer than that supported by the system's total memory.

Because the system always stores 4096 [continuously refreshed] samples in memory, you can display a portion of the record before “time zero” (trigger time). This is useful with some sources with uncertain timing. Just enter a negative number to record pre-trigger data. It also helps the first-break picking program work better, giving the near phones more history to include in the computation.

The amount of delay will be added to the time lines on the screen and on the plotted record. Thus the timing information in the display and plotted record automatically incorporates any delay used.

Acquisition Filters

The StrataVisor™ provides real-time digital filters, which operate on the data as it is acquired. These filters operate much like analog filters in that data is filtered before going into memory. Thus, once these filters are used, the raw data cannot be recovered. This is different than the similar filters provided in the **Display** menu.



You may set two separate filters (Acquisition Filter 1 and Acquisition Filter 2). The filter choices are the same in each. To see the available filters, tab to either one and use the up/down arrow keys. You will see a range of FILTER OUT, LOW-CUT, NOTCH, and HIGH-CUT filters. FILTER OUT is used to bypass the filter for non-filtered data. This is the preferred setting for most surveys, especially since the display filter can be used for a similar purpose (the display filter can be altered and reversed, providing more flexibility in use). All acquisition filters have attenuation slopes of 24 dB/octave.

There are cases where acquisition filters are preferable to display filters. Most often this involves the notch filters. For instance, if you are correlating and you are picking up 60-cycle noise from nearby power lines, it is best to set an acquisition notch filter in order to filter the pilot before correlating.

Low-cut filters are commonly used to remove low frequency seismic noise (from traffic or wind in trees) to make the first arrivals relatively stronger, and also to filter out surface waves in reflection surveys.

A *notch* filter is a narrow band filter designed to reject certain frequencies, normally those of power lines. The choices are 50, 60, 150 and 180 Hz. These correspond to the power line frequencies (and the third harmonic from 3-phase power lines). Use the one appropriate to your locality.

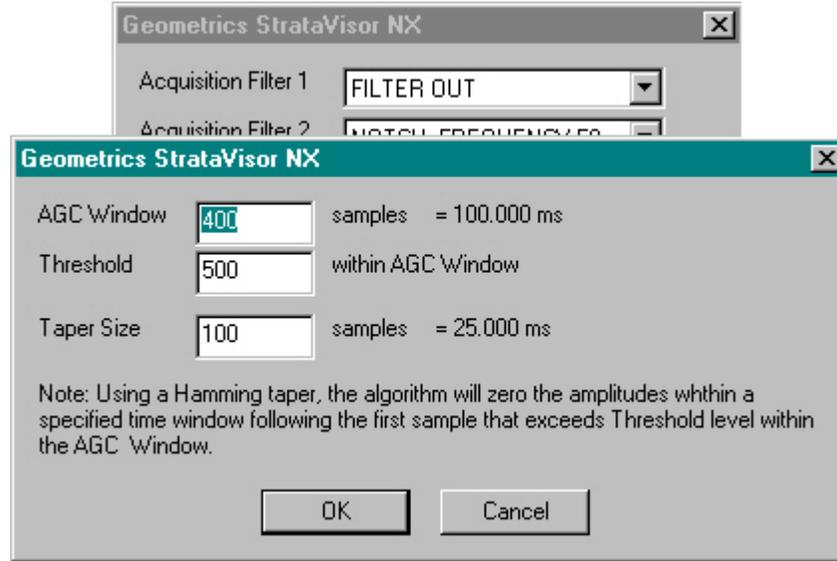
High-cut filters reject high frequencies. They are commonly used to remove some wind noise and certain types of machinery.

Note that some high cut filter selections may be automatically removed from the menu when sample intervals are slower than 500 μ sec. This is to avoid conflict with the anti-alias filter.

Acquisition Filter 1 operates identically to *Acquisition Filter 2*. It can be used to provide an additional filter function, such as the combination of low-cut and notch. It may be set to a different or the same type and frequency. If set identically, the filters will cascade and the resulting filter slope will be doubled to 48 dB/octave.

Two additional types of filters are available. The first is *Diversity Stack*. This function is a type of real-time automatic gain control, designed to help suppress certain types of noise. It is often used in swept-source surveys, when record lengths are long and there is much activity along the geophone spread during recording.

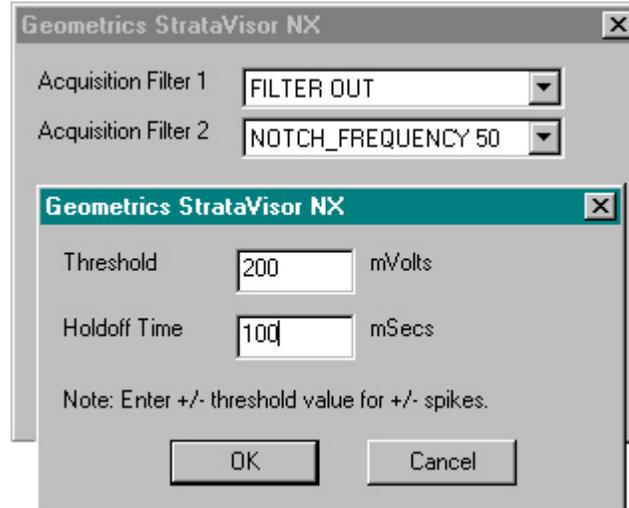
Enabling this function and pressing **Setup** brings up the following window:



There are three parameters that control the characteristics of the diversity stack filter.

Spike Filter is required when using a pseudo-random source such as the Mini-Sosie. In this type of survey, a sensor, usually a heavily-damped geophone, is placed on the base plate of the source. The response from this sensor is transferred to channel 1 as a pilot trace (see discussion of correlation below). When using a pseudo-random source, the idea is to cross-correlate the raw data against a comb-function resulting from the generation of a single-sample spike each time the source makes contact with the ground. In reality, any geophone or accelerometer will tend to ring. The spiking filter is designed to collapse the ringing response of the sensor into a single-sample spike before the pilot is correlated against the raw data.

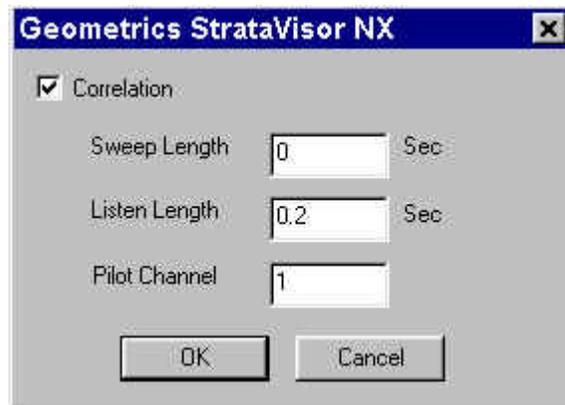
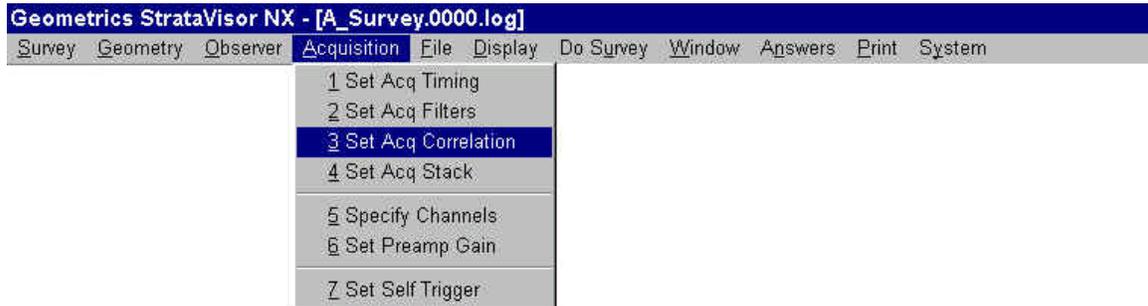
Enabling the *Spiking Filter* will bring up the following menu:



There are two parameters that must be set. The *Amplitude Threshold* represents the minimum amplitude in millivolts to consider as a candidate for spiking. When the base plate strikes the ground, the first peak from the pilot geophone is generally the largest. The amplitude of this event can be estimated by activating the source and noting the maximum amplitude on channel 1. By setting the threshold slightly lower than the maximum amplitude, you are effectively telling the algorithm to ignore anything smaller than this.

The second parameter that must be set is the *Holdoff Time*. This parameter tells the algorithm the *minimum* time between impacts. Although the time between impacts will vary significantly (this is where the randomness of the source comes in), there will be a minimum time between impacts. This can be determined by recording and printing the pilot signal. Each impact should be readily apparent, and you should determine the minimum time in milliseconds between impacts. Setting the holdoff time slightly larger than this will, in conjunction with the amplitude threshold, prevent ringing peaks from being treated as impacts and spiked by the spiking algorithm.

Correlation



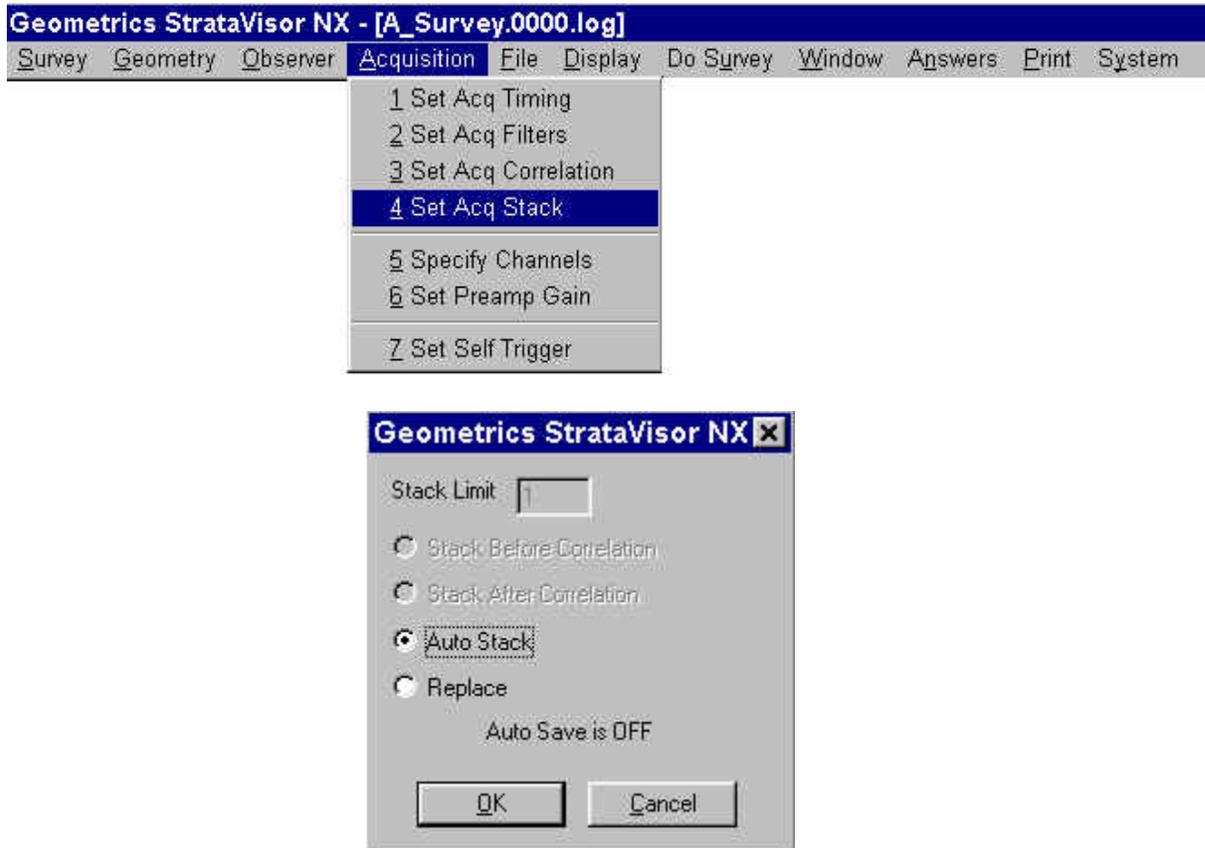
Correlation is used when using a long-duration source such as the Mini-Sosie or a vibrator. There are three parameters to set:

The *Sweep Length* refers to the time between activation and deactivation of the source -- the length of time the source is active for each acquisition.

The *Listen Time* is the length of time the seismograph will record after the source is stopped. This will be the length of the final record after it is correlated against the pilot.

The *Pilot Channel* refers to the channel the pilot signal from the source is recorded on. This is generally channel 1, as this is the channel that is wired to the pilot input. Whichever channel the pilot signal is recorded on, it must be designated as a PILOT channel in the **Specify Channels** menu. For a further discussion of correlation, see the Chapter (Advanced Features).

Stacking



If correlation is enabled, you must decide whether to *Stack Before Correlation* or *Stack After Correlation*. If you stack the data before correlation, data from each acquisition will be summed before the correlation is applied. If you stack the data after correlation, the correlation is done on each individual stack, and then they are summed together. See Chapter 4 (Advanced Features) for further discussion on stacking correlated data.

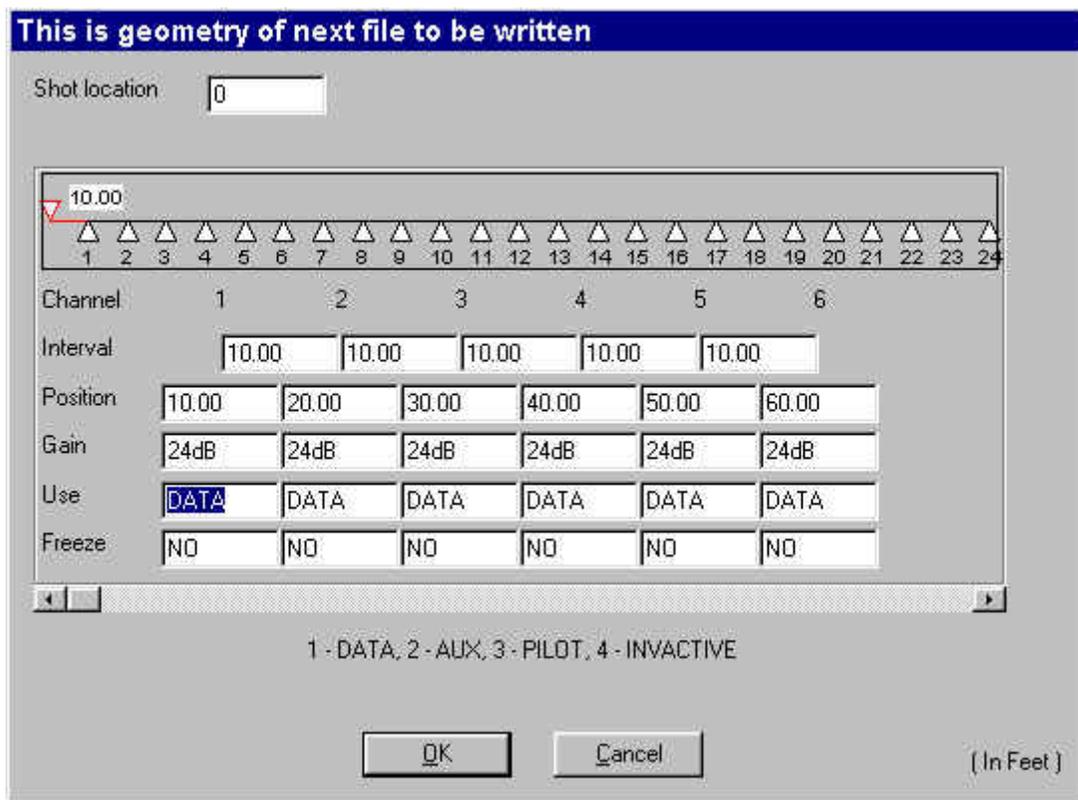
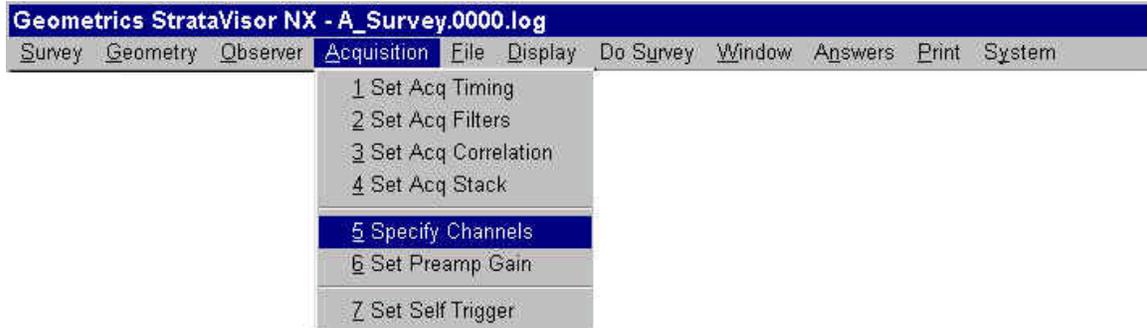
If correlation is not enabled, the two parameters discussed above will not be available for selection.

If *AutoStack* is enabled, the seismograph will stack each subsequent record to the previous automatically. If *AutoSave* is also enabled (see the **Storage Parameters** menu), the system assumes you are in a production mode, and after the *Stack Limit* is reached, the file is saved, the next record automatically replaces the previous stacked record, and the stack count is set back to 1. This is most useful in production reflection surveys where the number of stacks per shotpoint is constant.

In general, it is best to use the *AutoSave* function when doing vibratory sources. If you are stacking before correlating, the system will correlate the data when the *Stack Limit* is reached, whether *AutoSave* is enabled or not.

Some applications, such as surface and downhole shear wave surveys, may require creative use of the stack modes. Data may be manipulated, printed, and saved at any point. Experiment with the stack modes to learn their capabilities.

Specify Channels

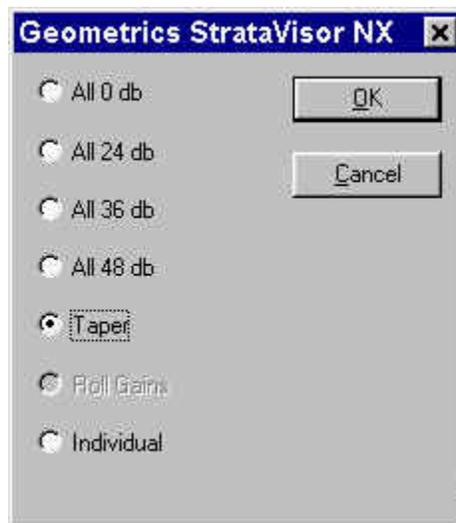
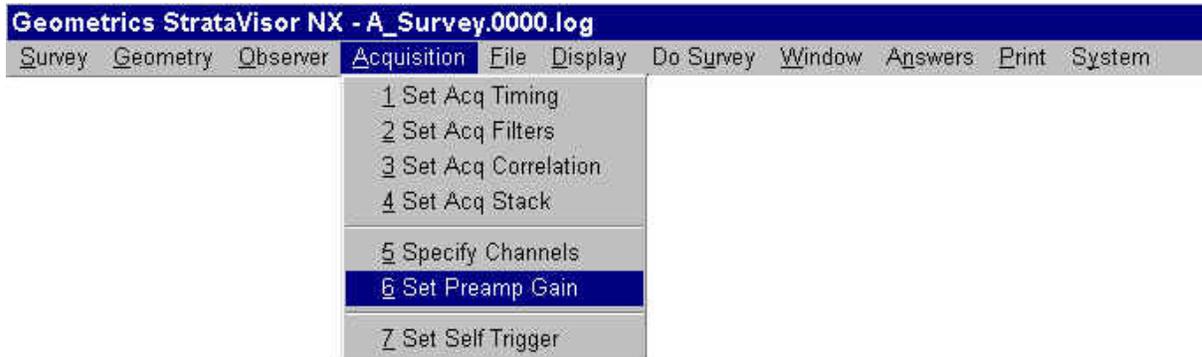


Specify Channels is used to select use of each channel. In some surveys (particularly borehole), less than the maximum number of channels may be used. This option allows the operator to disable unused channels, reducing the amount of disk or tape space required to store a file, and allowing room for more files on a disk or tape.

In addition to *Inactive*, channels may be labeled as *Pilot*, *Aux* or *Data* channels. *Data* channels will be correlated, if correlation is selected, while auxiliary (*Aux*) channels will not be correlated. If correlating, the *Pilot* channel will be correlated with itself, producing an autocorrelation trace.

To change a channel designation, move the cursor to that channel and press the appropriate number (1,2,3, or 4). Pressing either 1 or 4 (*Data* or *Inactive*) will set that channel and all of the channels to the right of it to either *Data* or *Inactive*.

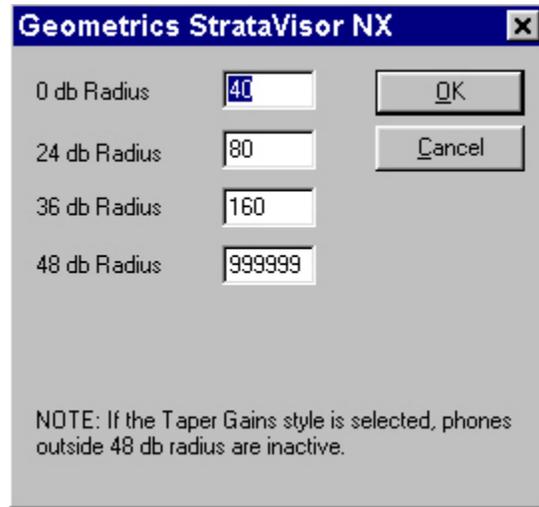
Preamp Gains



The StrataVisor™ has analog **Preamp Gains** that must be set. Channel gains are set in pairs. Therefore, channels 1 and 2, 3 and 4, 5 and 6, etc. will always be set to the same gain. If you set channel 1 to 48 dB, channel 2 will automatically be set to 48 dB and vice versa.

Generally, you should try to set the gains as high as possible without saturating the A/D, causing clipping. Clipping is not an issue in refraction or downhole surveys in which only first breaks are of interest, but it must be avoided in seismic reflection and other surveys where the full waveform is important. Clipped channels will be shown in red on the screen for easy identification. Note that electronic clipping is different from display clipping, which can be enabled in the **Display** menu.

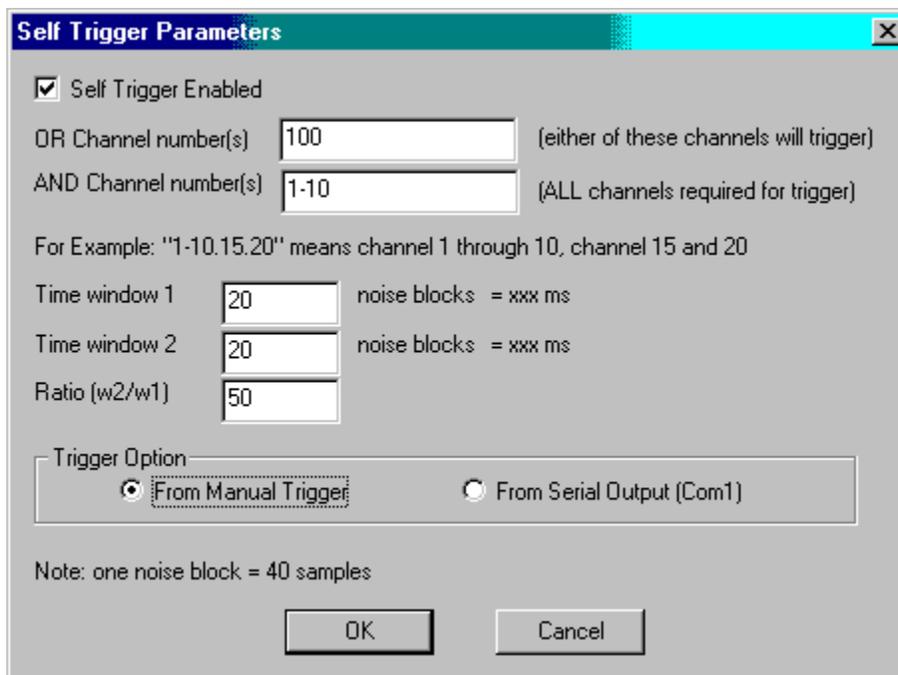
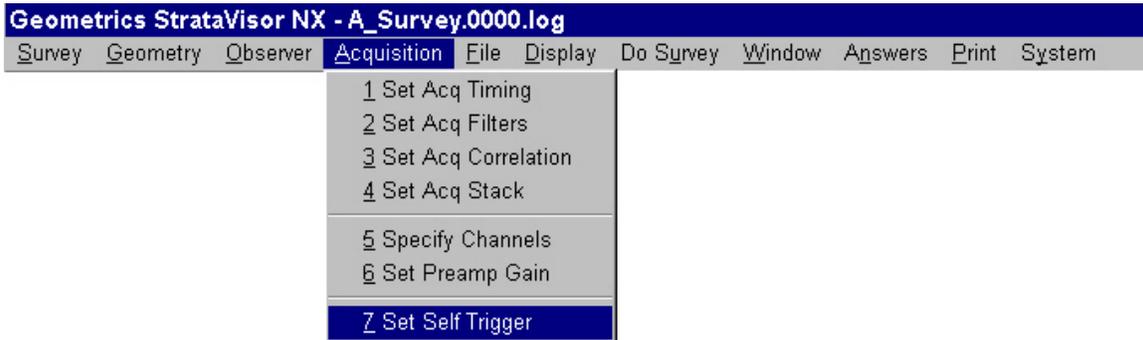
If you choose *Taper* to set a tapered gain (which you can accomplish by setting the gains individually, albeit with more effort), you will be presented with the following menu:



You must indicate the *Radius* or distance between the shot and the farthest reach of each gain setting. For instance, in the example above, all stations within 40 ground units (feet, meters, stations, etc.) on either side of the shot will be set to 0 dB. All stations farther than 40 up to and including 80 units from the shot will be set to 24 dB. All stations beyond 80 up to and including 160 will be set to 36,dB, and the rest will be set to 48 dB.

As mentioned above, this can obviously be accomplished by setting gains individually. This is fine provided that the distance between the shot and the geophone spread is intended to remain constant, as in a standard end-on CDP reflection survey. However, if you are conducting a split-spread survey, or if you intend to shoot *through* the active spread (i.e., by moving the shot within the active spread while the position of the active spread remains static), you should use the *Taper* option. This signals the seismograph that you want to keep the center of the gain taper coincident with the source. As the source moves, the gains will be adjusted accordingly to maintain the above relationship. If gains are set individually, they will remain static regardless of where the source is.

Self Trigger



The **Self Trigger** option is available for monitoring purposes. It allows you to monitor one or more channels for a seismic event. If an event meeting your criteria occurs on any (or all) of the designated channels, the seismograph will trigger and record the data.

The event detection algorithm works as follows: on each designated monitoring channel, noise samples are gathered from the data stream. Average RMS values of the noise are calculated for two contiguous time windows. If the ratio of the average energy in Window 2 divided by the average energy of Window 1 is more than a certain threshold, an "event" is detected by that particular channel.

The lengths of Window 1 and Window 2 are selected by the user, as is the threshold ratio required for an event. Window 2 covers the most recently acquired data. Window 1 covers data prior to that. The windows do not overlap. A more detailed description of how an event is identified is given later.

Checking the *Self Trigger Enabled* box will enable event detection triggering. The system can be configured to trigger if a **single** channel receives an event, or if **all** of a set of channels receive an event simultaneously.

The *OR Channel numbers* will set the channels for which, if an event is detected in **any one** of the specified channels, the StataVisor will trigger.

The *AND Channel numbers* sets the system such that an event must be detected on **all** of the monitoring channels in order for the StrataVisorTM to trigger.

If some *OR channels* and some *AND channels* are specified, the system triggers if **any one** of the OR channels are detected, *or* if **all** of the AND channels are detected.

Time window 1 specifies the length of the first (earlier) time window. The unit of time length is *Noise Blocks*, which is 40 times the sample interval. The string to the right of the entry ("=xxx ms", in the above picture) will tell you how long this is in milliseconds when a value is entered.

Time window 2 specifies the length of the second (most recent) time window.

The *Ratio* is the threshold value for the average RMS noise in Window 2 divided by that in Window 1 required for an event. The larger the ratio, the larger the event must be in order to cause a trigger.

There are two methods of triggering the seismograph when an event is detected. If you choose *From Manual Trigger*, the seismograph will be triggered as if you chose **Manual Trigger** from the **System** menu. However, you should be aware that the manual trigger function triggers the system via software, one acquisition board at a time. The result is that there is a slight time-delay between each 12-channel block. In a 12-channel system it will not matter, but in a larger system it may, depending on the goals of the survey. The manual trigger function was designed mainly for taking noise records, where slight timing differences are of little import.

If it is important that all channels are triggered simultaneously, or if you are using multiple systems, you should choose *From Serial Output*. In this case, when an event is detected, a character will be sent to the serial port on the seismograph[s]. This can in turn be fed to the trigger input on the seismograph[s], causing all boards on all seismograph[s] to be triggered simultaneously. You will need to obtain or make a special cable to connect the RS-232 to the 3-pin Bendix trigger input.

In the case of multiple seismographs, you will need a special self-trigger box (available from Geometrics) to ensure that they all trigger at the same time. In this case, the RS-232 output from each seismograph is connected to the trigger box, which is then connected to the trigger input of each seismograph. The trigger box may be set to trigger **all** seismographs simultaneously if **any one** seismograph receives an event, or to trigger **all** seismographs simultaneously only if **all** seismographs make the decision to trigger (within an adjustable period of time of each other). Please consult the factory if you intend to use the self-trigger option with multiple units.

*Note: in the self-trigger mode, you are using the event you are interested in recording to trigger the seismograph. Therefore, whether you are using one or more seismographs, it is generally advisable to use a negative trigger delay in order to ensure that the onset of the event is recorded. Otherwise you risk missing some of the desired data. Also, in most monitoring applications, **AutoSave** should be enabled and the **Stack Limit** should be set to 1.*

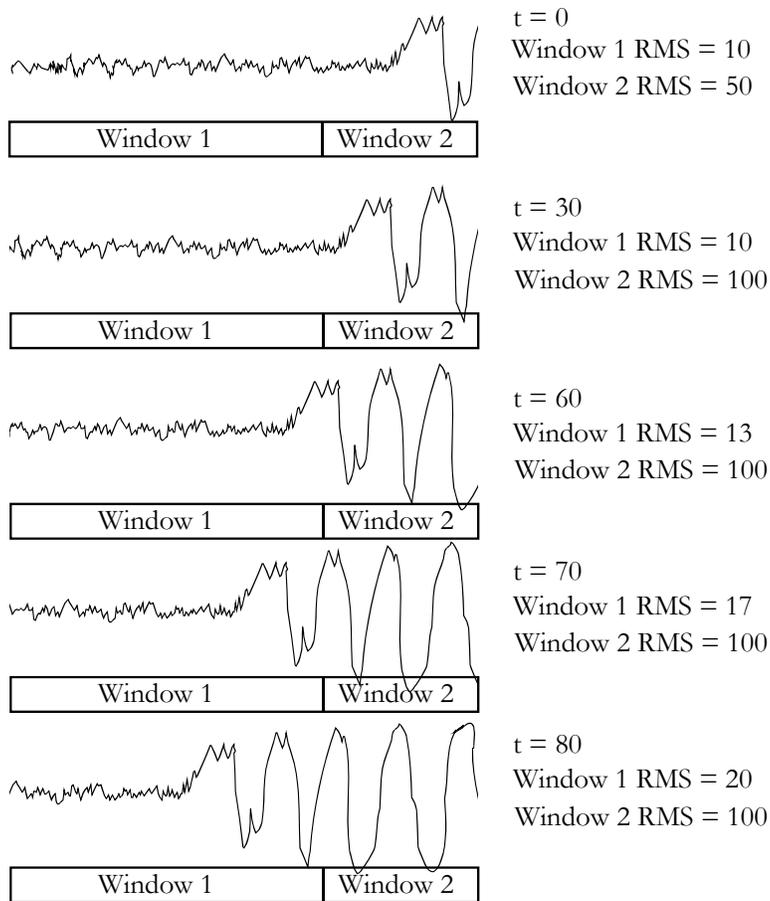
Self-trigger Algorithm - Detailed Description

The RMS calculation for each time window takes place after every 41 noise samples arrive (one "noise block"). This is why the time windows are chosen to be a certain number of noise blocks in length. This reduces the calculation burden on the system.

In other words, after each 41 samples arrive, the system calculates the ratios of the RMS values for the two time windows for each channel specified in the dialog box. It then loops through these values, considering whether the ratios are greater than the threshold or not. If any **one** of the OR channels have a larger ratio than the threshold, the system triggers. In addition, the system will trigger if **all** of the AND channels have a greater ratio than the threshold at that moment.

The system does not have a direct setting for considering how long to hold in memory the fact that an AND channel was triggered. Some memory is required, however, since it is unlikely that an event will be exactly simultaneous on each of the AND channels. However, the fact that the event slides through the time windows means that a particular event will be detected by a particular channel for certain length of time. Thus, the system does allow for delay between the channels by adjusting the length of the time windows. The following discussion provides further explanation of this time slippage.

The sequence of sketches below indicates the arrival of an event. As time progresses, the values stored in memory shift accordingly, as the sketches show:

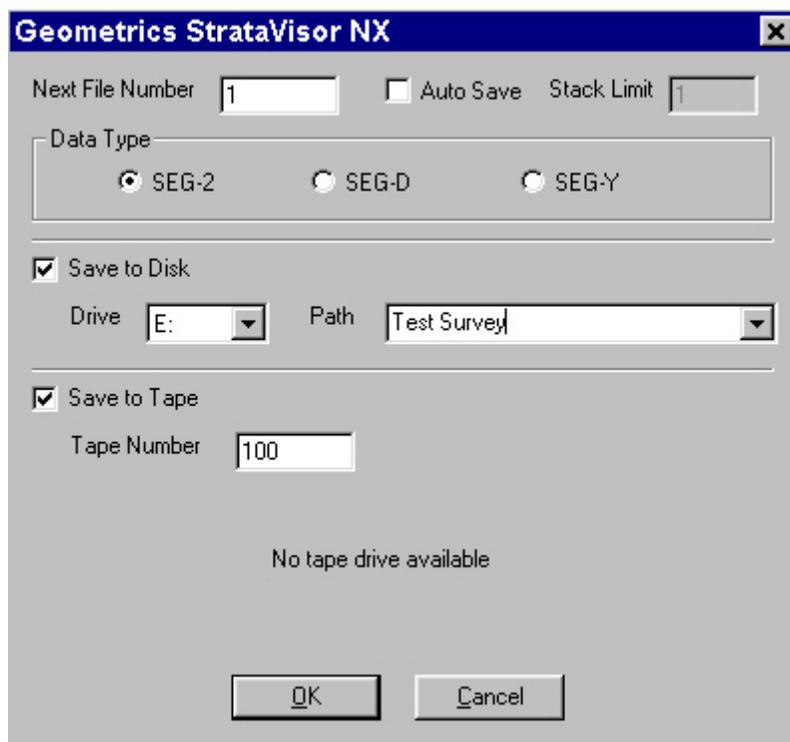
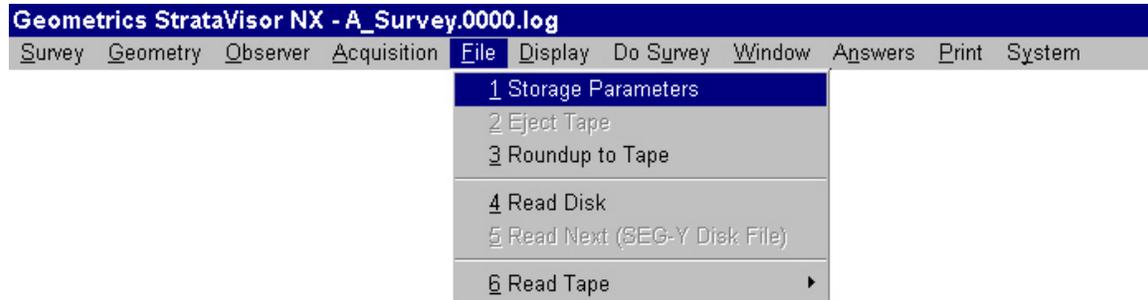


If the threshold is set at 5, then this channel will detect the event at $t=0$. The event will remain detected at $t=30$, $t=60$, $t=70$, and $t=80$. After that, the ratio will drop below the threshold, and the event will no longer be detected.

If several channels are to be ANDed to determine whether to trigger the seismograph, this sliding of the event past the time windows provides the memory required so that even when the event arrives at different channels at different times, at some time all of the channels will still be in a triggered state, and the system will trigger. The length of time over which this will occur is determined by the lengths of the time windows.

File

Storage Parameters



The **Storage Parameters** menu allows you to set up how and where to store the data.

Next File Number is the name of the next file to be saved to disk. This can be up to nine characters, and will automatically increment each time a file is saved. The file extension will depend on the data format, discussed below. *Note: The file number should be a numerical integer, not alphanumerical.*

If *AutoSave* is enabled, you will be prompted for the *Stack Limit*. The data will be saved automatically when the stack count is reached. The first stack after saving will replace the prior record in memory and the stack count will be automatically set back to 1. In production shooting, *AutoSave* can along with *Shot Increment* and *Geophone Increment* can allow automated "hands off" operation.

*Note: **Stack Limit** also applies when stacking **before** correlation in a vibrator survey. This is true whether **AutoSave** is enabled or not. If both **AutoSave** and **Stack Before Correlate** are enabled, it is assumed that you wish to save immediately after the record is correlated, i.e., the **Stack Limit** applies to both correlation and saving of the data.*

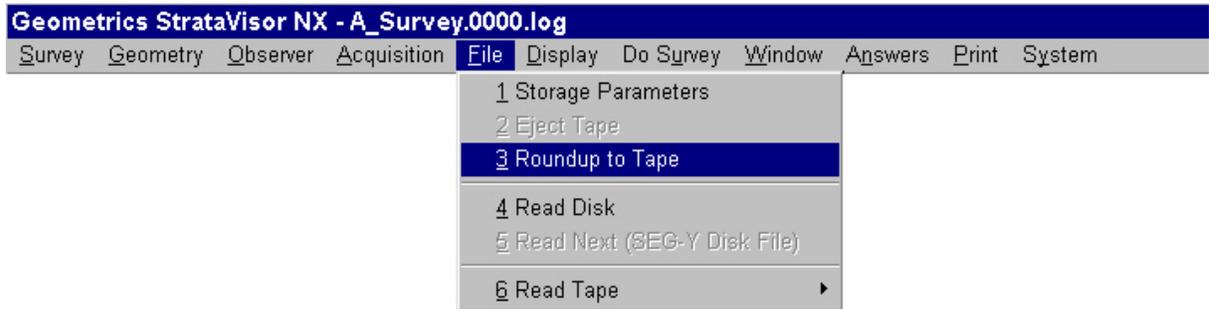
In many types of surveys, particularly refraction, the stack count is often variable. In this case, *AutoSave* is generally not used. Instead, the data are saved manually using the *Save* command in the **DoSurvey** menu. *Note: if using manual save, the data acquired prior to saving are not replaced by the next stack, and the stack count is not reset to 1. After saving, you must clear the data manually before moving the shot and continuing.*

Data Type determines which of the three standard formats the will be saved in. In general, if saving to disk, SEG-2 is a likely choice as this is the standard set in the mid 80's for portable seismographs. It is designed for hard drive storage of seismic data. If you are writing to tape, SEG-D or SEG-Y may be a better choice. What you choose should be compatible with the processing software you intend to use. A further discussion of each format is provided in a later chapter.

If you enable *Save to Disk*, you should indicate the *Path* or folder you would like the data to be saved in.

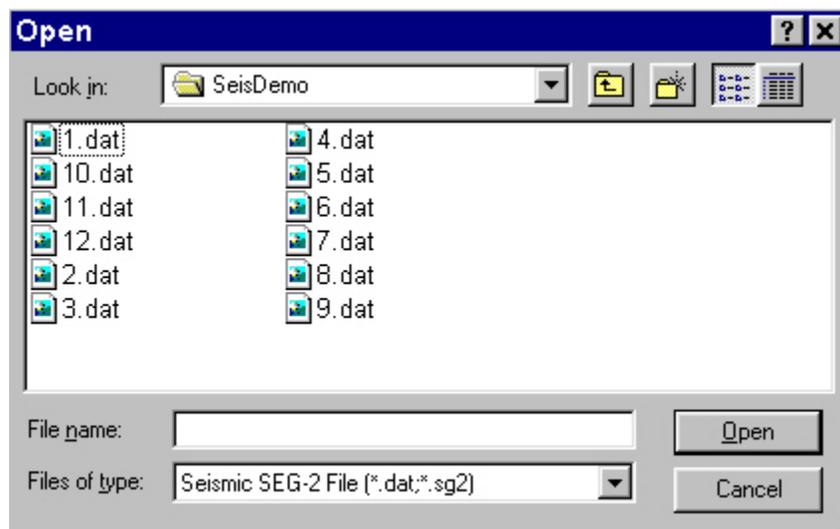
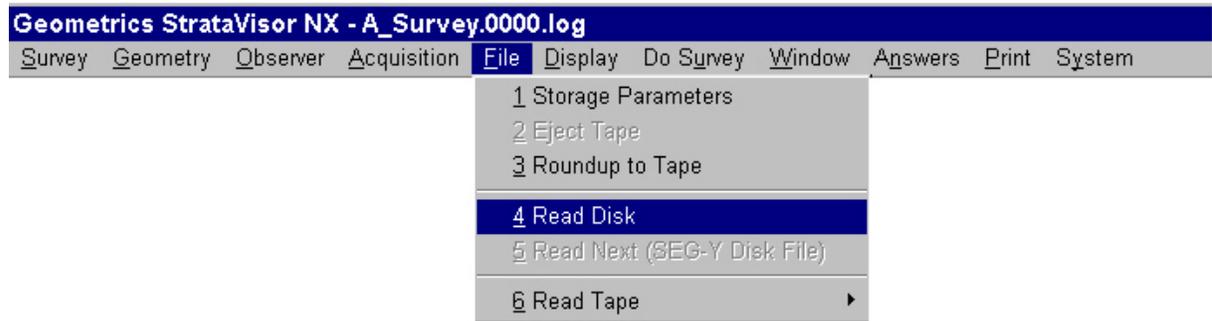
If you intend to *Save to Tape*, the tape drive must be plugged in to the SCSI port and powered up before you boot the seismograph. Indicate the *Tape Number* of the first tape. The tape number that each shot record is saved to will be indicated in the survey log, and if you end up storing data on more than one tape, this is useful in finding individual shot records later. This number should be updated whenever you change tapes.

Roundup to Tape



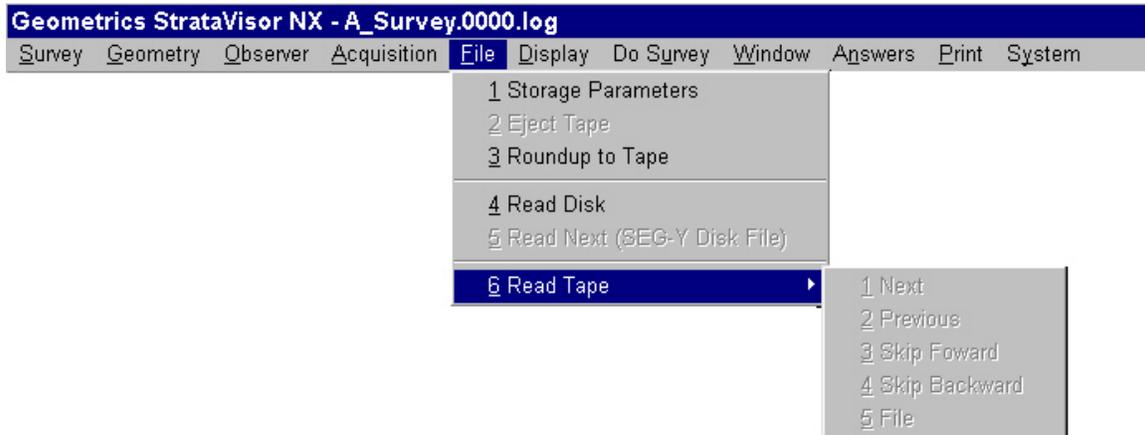
Roundup to Tape is used to transfer data from the hard drive to tape. Choosing this option will automatically transfer all of the data from the current folder to the tape drive. *Note: unlike the DOS version of Roundup included with the StrataView, this version of Roundup does NOT change the data format. Data is transferred to tape in whatever format it was saved in.*

Read Disk



The **Read Disk** function allows you to read previously stored data into memory for display on the StrataVisor™ screen. Simply choose the path and filename of the file you want to see and press **OPEN**.

Read Tape



The **Read Tape** function allows you to read data from the tape back in to memory for display on the StrataVisor™ screen.

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.

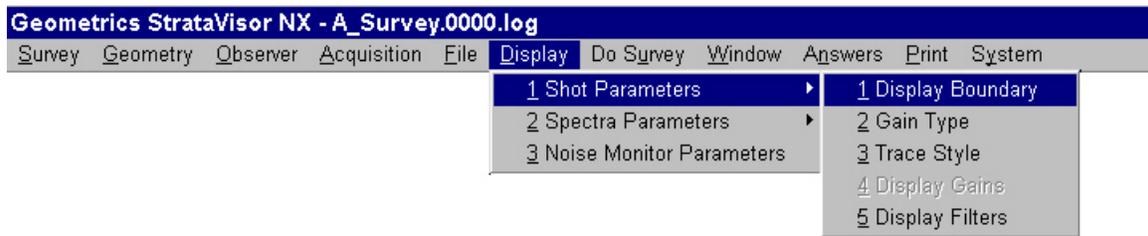
File allows you to seek a user-specified record on the tape.

Display

The **Display** menu is for controlling how data is displayed on the StrataVisor. None of the settings in this menu have any effect on the data itself. All settings affect data display only. You may control the display characteristics of the shot, spectra, and noise data from this menu.

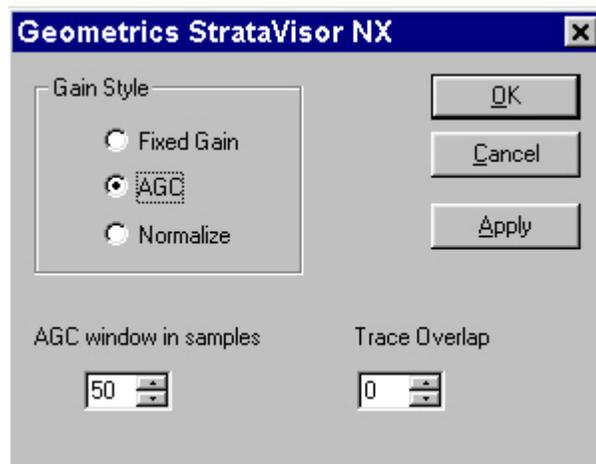
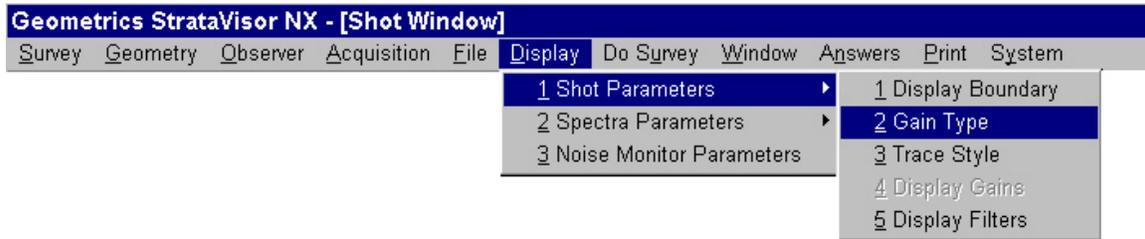
Shot Parameters

Display Boundary



The **Display Boundary** menu allows you to determine how much of the total record is actually displayed and printed. You are under no obligation to display the entire record. The function of these settings should be self-evident.

Gain Type



There are three **Gain Types** 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 or automatic gain control strives to equalize the amplitudes of early as well as late events in the seismic trace. This gain style is very useful in display seismic reflection data. The trace scale factor is adjusted continuously during the record to normalize 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 16 and 500. 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. The AGC algorithm in the StrataVisor™ is the type commonly referred to as "digital AGC", which uses data in advance of the particular sample. Thus, it will look ahead and reduce the

gain before a large signal. 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.

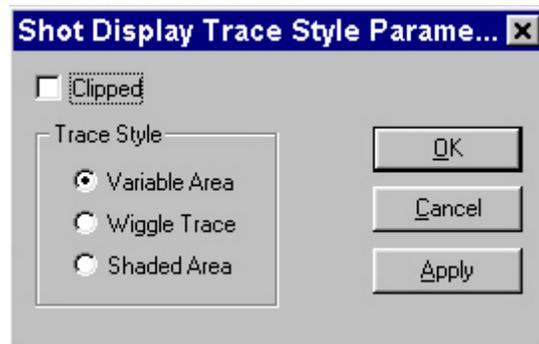
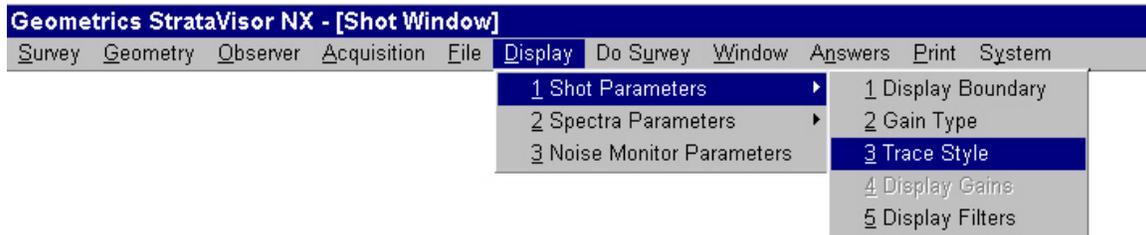
To control the *overall* trace amplitudes when using AGC, you must specify a *Trace Overlap*. This is simply a scale factor, applied after the AGC is performed, that determines the display gain of each trace expressed in terms of how much the traces overlap each other. It is similar to **Display Gains** (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.

Again, 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 divides the entire trace 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.

Trace Style

The StrataVisor™ offers six different **Trace Style** options: *Variable Area*, *Wiggle Trace*, *Shaded Area*, and *Clipped* versions of each.



In *Variable Area*, the positive excursions are shaded in black. This improves the operator's ability to identify reflections and other events when adjacent channels are compared.

Wiggle Trace displays the data in the traditional wiggle trace line format, often better for picking first arrivals.

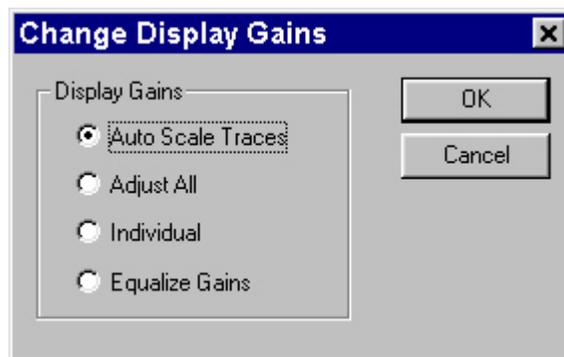
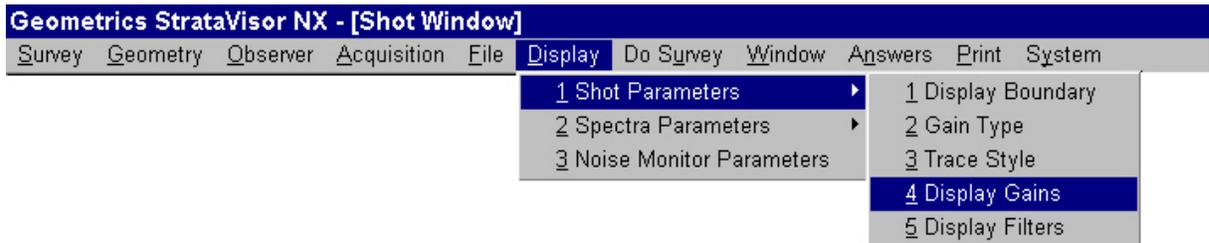
Shaded Area is similar to variable area, except that the positive excursions are shaded in gray scale instead of solid black. The traces themselves are black, and can be seen as they pass through the gray shading.

If *Clipped* is enabled, the trace excursions are limited to prevent overlap between adjacent traces. The waves will have flat tops instead of the normal curves. Clipping reduces confusion on the record, preventing adjacent traces from obscuring the first breaks.

Experiment with the various trace styles to gain familiarity.

Display Gains

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



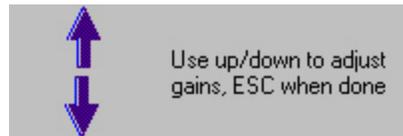
Auto Scale Traces automatically selects the trace size values to display the data on the screen. The **Fixed Gain** style is most often used in seismic refraction surveys, so this function attempts to set the trace sizes in order to best display the first breaks. With a new record, this function will 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 excursions on the screen and plotter. 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 + or - 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 display is set to **Fixed Gain**,

the trace excursions and trace size factor can be used to compare true amplitudes at the input. Thus, it is possible to measure attenuation and vibration levels with the StrataVisor™.

When *Adjust All* is chosen, the following will be displayed in the upper left-hand corner of the shot record:



Each press of an up/down arrow key will increase/decrease the display gain of each channel by 3 dB.

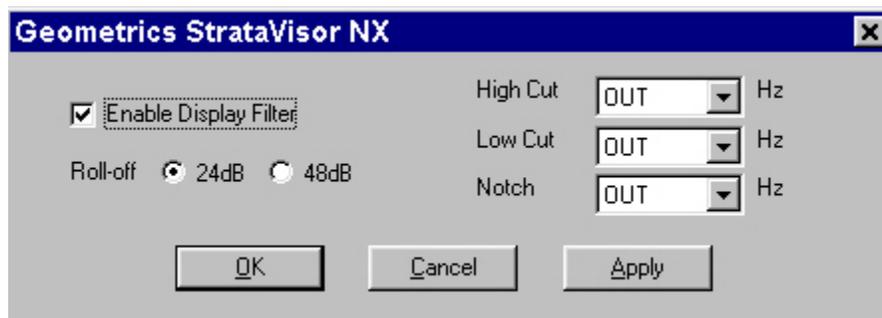
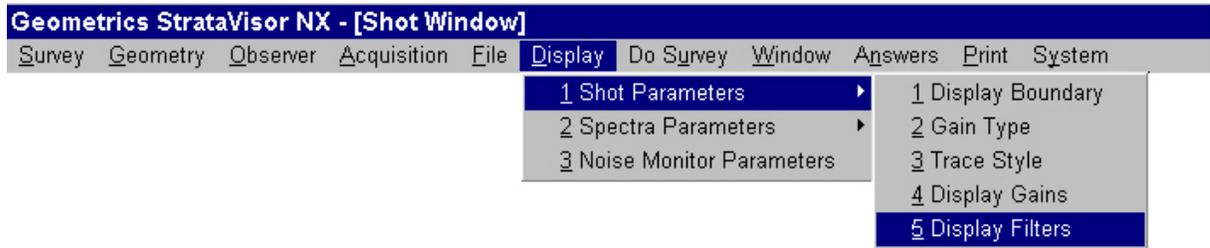
When *Individual* is chosen, the following will be displayed in the upper left-hand corner of the shot record:



In this case, the left/right arrows are used to move from channel to channel. The number of the channel currently under control is displayed, 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.

Display Filters

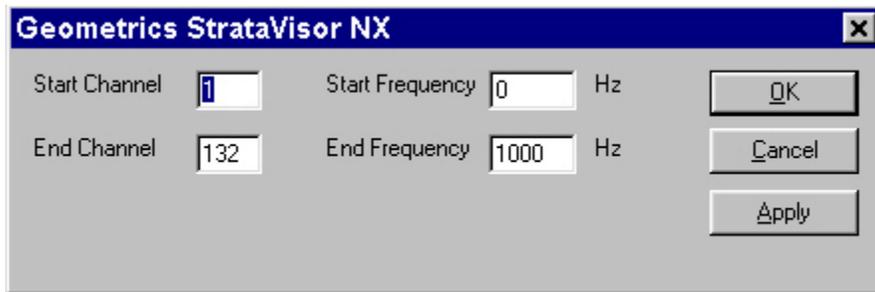
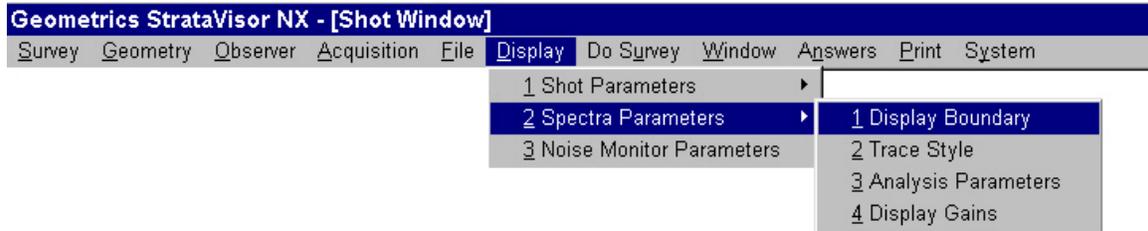


The StrataVisor™ is equipped with digital display filters. Unlike the acquisition filters in the **Acquisition** menu, **Display Filters** act only on the data display, and do not affect the data stored to tape or disk. Operation and effect are identical to those of **Acquisition Filters**, except that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

Spectra Parameters

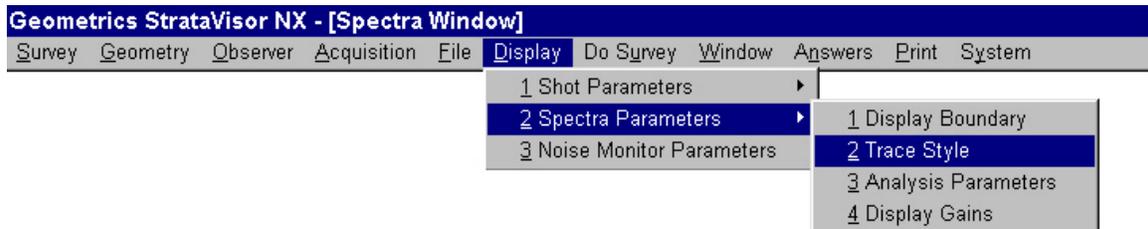
The StrataVisor™ provides spectral analysis of all or a contiguous subset of channels. This can be a very useful QC tool.

Display Boundary



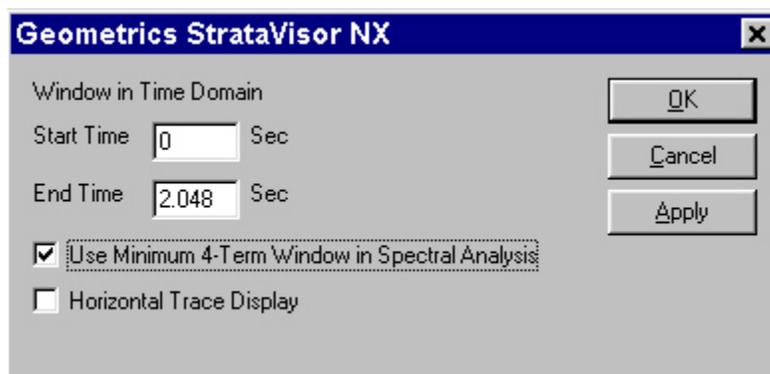
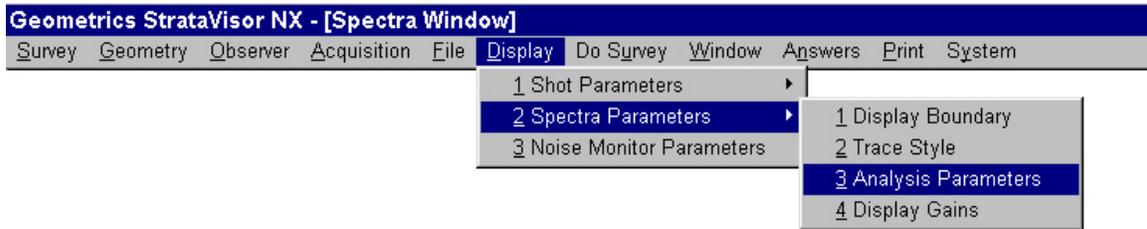
Setting the **Display Boundary** is similar to that for the **Shot Parameters** window. You provide a beginning and ending channel, but rather than supplying a beginning and ending time, you provide a beginning and ending *frequency*.

Trace Style



Setting the **Trace Style** is identical to that for the **Shot Parameters** window.

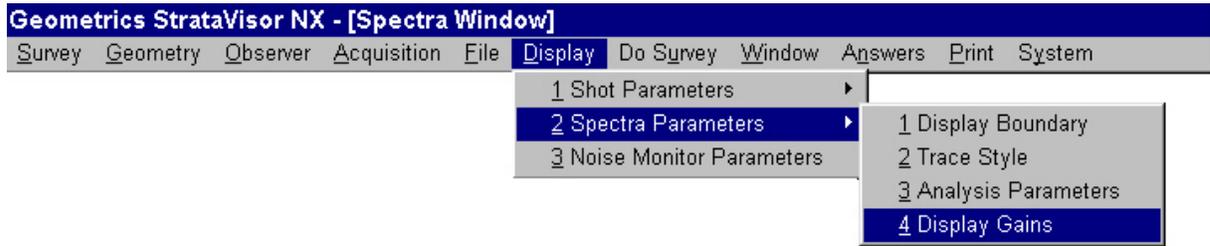
Analysis Parameters



The **Analysis Parameters** dialog box allows you to set the time window of the seismic traces for which you would like to compute the frequency spectrum.

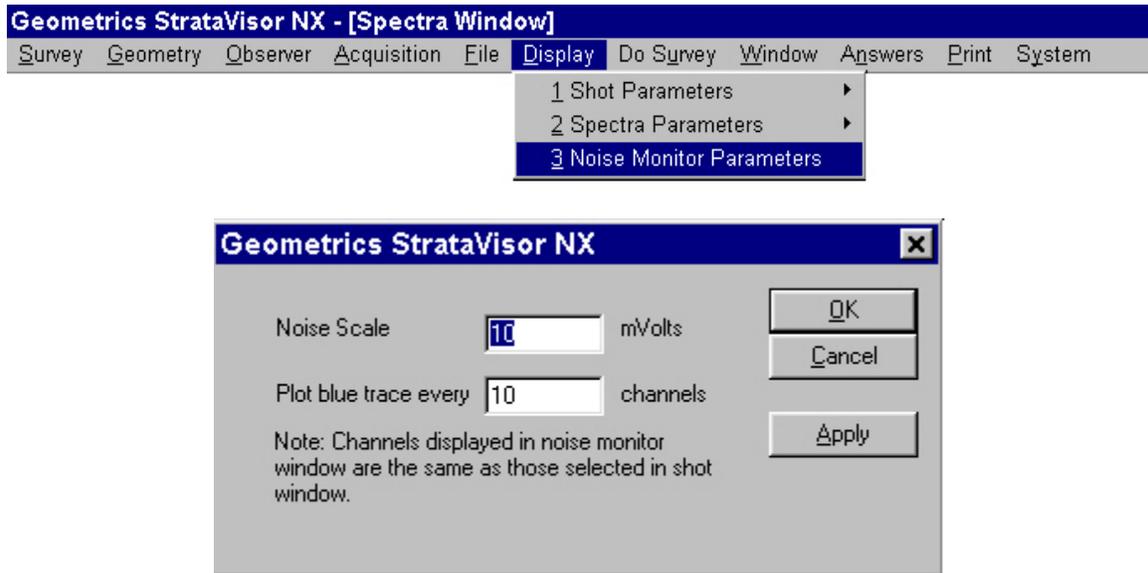
You may choose to plot the spectrum display either vertically or horizontally.

Display Gains



Display Gains are identical to those in the **Shot Parameters** menu. The gain style in the spectra display is always fixed gain.

Noise Monitor Parameters



The **Noise Monitor Parameters** dialog box allows you to control the way noise is displayed in the noise monitor screen. 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 and down arrow keys. The scale can be viewed in the upper left corner of the noise monitor.*

For systems with large numbers of channels, you may prefer to show each n^{th} 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 zero in this field.

Do Survey

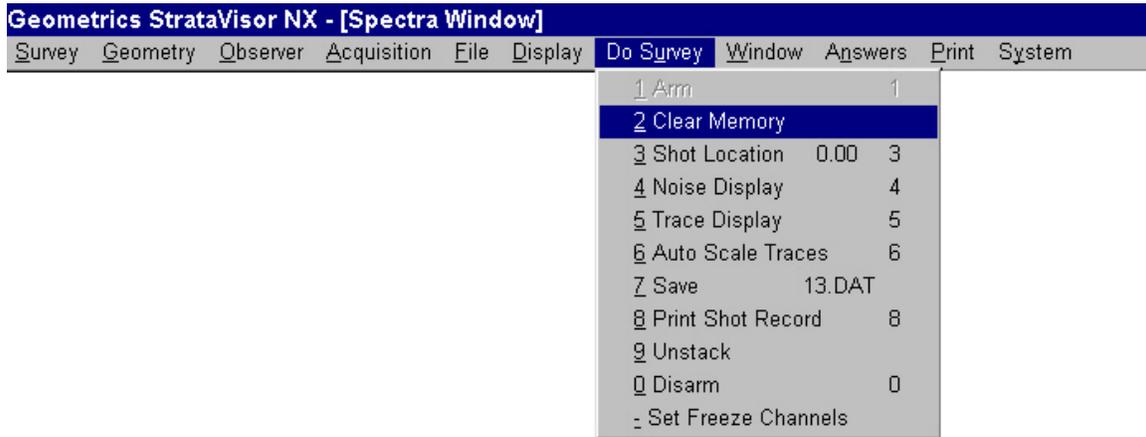
Once the system is set up, most of your interaction with the seismograph will be via the **Do Survey** menu. This is the menu that appears by default whenever you press the **MENU** key. Some items, such as **Shot Location** and **Auto Scale Traces**, are redundantly located here for convenience. Note that many of the selections in this menu have an associated "hot key" (the number to the right of the selection). You may activate any of these from outside the menu system by pressing the appropriate hot key.

Arm



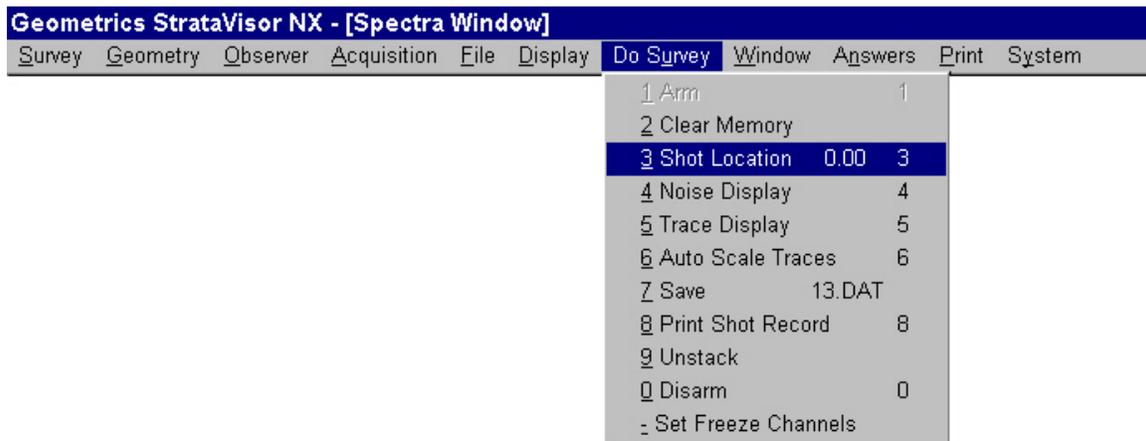
The seismograph must be armed in order to respond to a trigger signal and record data. The ready status of the system is always displayed in the lower left-hand corner of the shot window. If it says "Disarmed", you must **Arm** the system before recording data. You may set the system to manual or auto arm (see discussion on the **System** menu).

Clear Memory



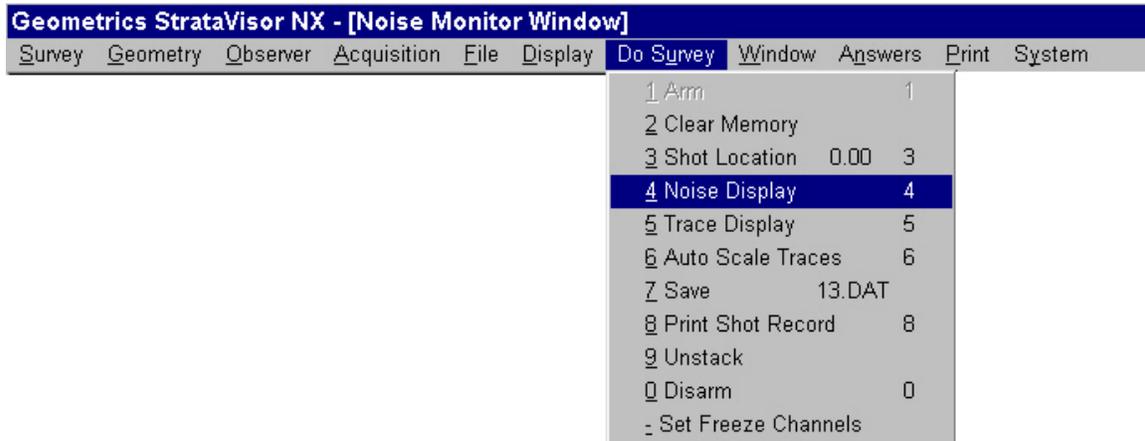
Clear Memory will erase the current shot record from *memory*. It has no effect on data stored on the hard drive. If you attempt to clear the memory before saving the data, you will be warned that the data is about to be lost. It is generally illogical and potentially harmful to change certain parameters between stacks. As such, certain parameters, such as those in the **Acquisition** menu, require clearing the memory before they can be accessed. If you attempt to change one of these parameters while data is in memory, you will be prompted to clear the memory first.

Shot Location



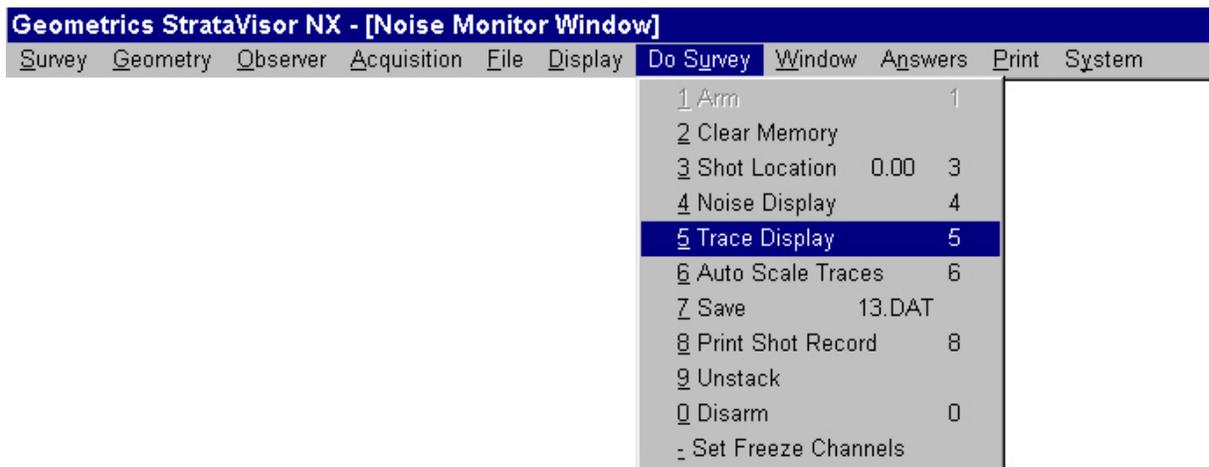
Shot Location is redundantly located in the menu for convenience. It is also located in the **Geometry** menu. Use it to update the shot location after each shot. If you have set the **Shot Increment** to a non-zero number (in a production reflection survey, for example), then the shot location will be updated automatically each time a file is saved.

Noise Display



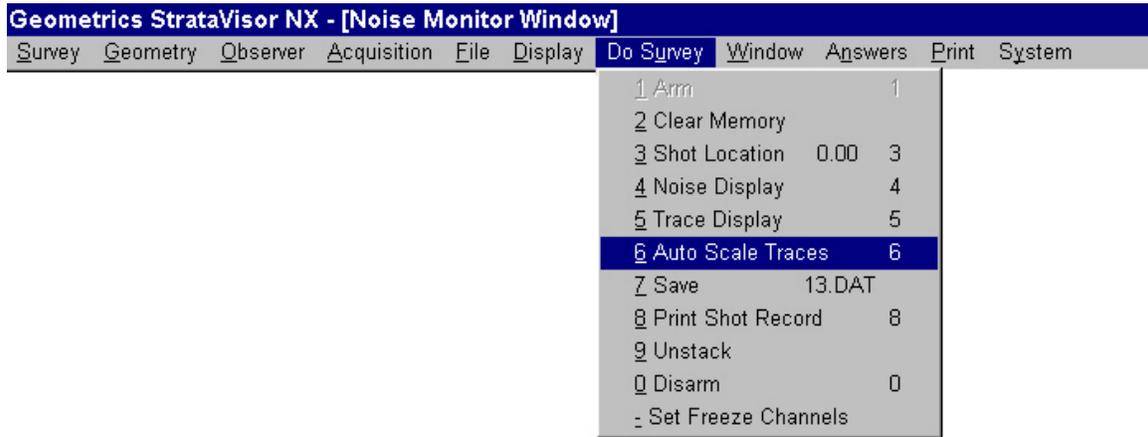
Choosing **Noise Display** will maximize the noise monitor window. No other windows will be visible.

Trace Display



Choosing **Trace Display** will maximize the shot record. No other windows will be visible.

Auto Scale Traces



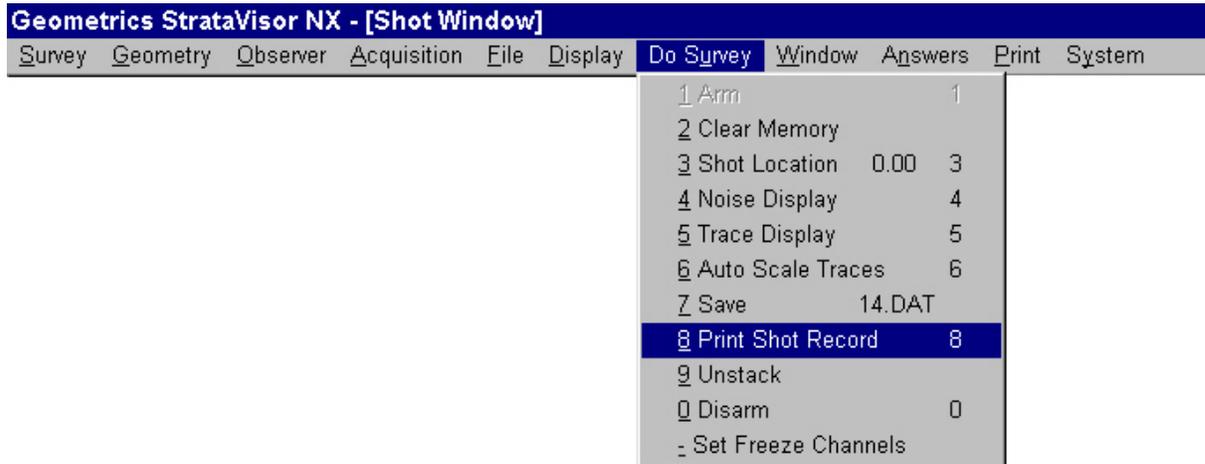
Like **Shot Location**, **Auto Scale Traces** is redundantly located for convenience. It is also available in the **Display** menu.

Save



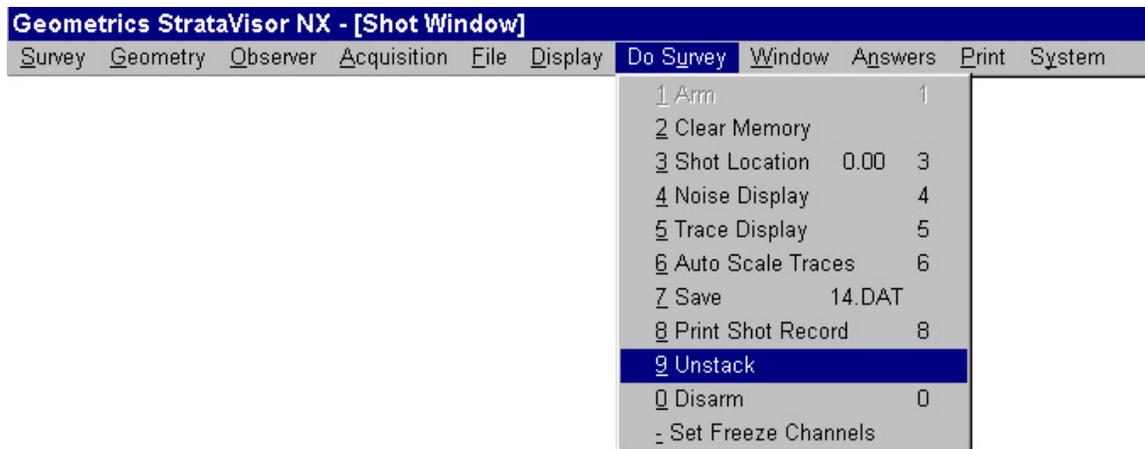
Unless **AutoSave** is enabled, you must manually **Save** each record you wish to keep. *Note that there is a subtle difference in operation depending on whether you are saving data manually or automatically. In **AutoSave** mode, once the stack limit is reached, the data will be saved, and the next 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 the **Storage Parameters** menu for further discussion of the **AutoSave** feature.*

Print Shot Record



Print Shot Record simply prints the shot record in memory. This can be new data or data that have been read from the hard drive. The data will be plotted according to the parameters set in the **Display** and **Print** menus. You may abort a print operation by pressing the **CLR** key.

Unstack



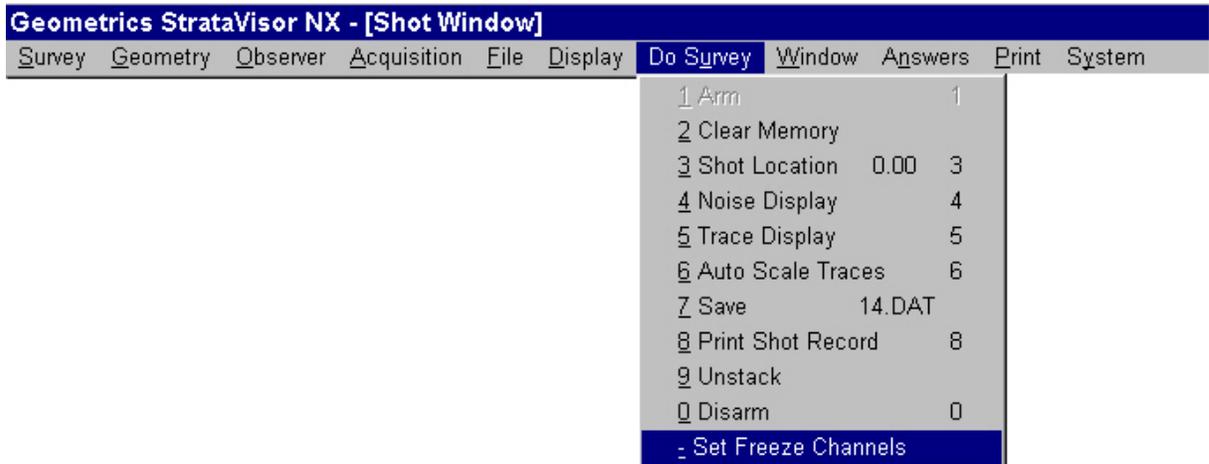
The **Unstack** option allows you to remove the most recent stack from the record. For instance, if you have swung the hammer five times, you may remove the fifth stack. Simply choose **Unstack**, and the stack count will be decremented by one. You may remove only the most recent stack.

Disarm



Choosing **Disarm** will disarm the system, and it will ignore further triggers until rearmed.

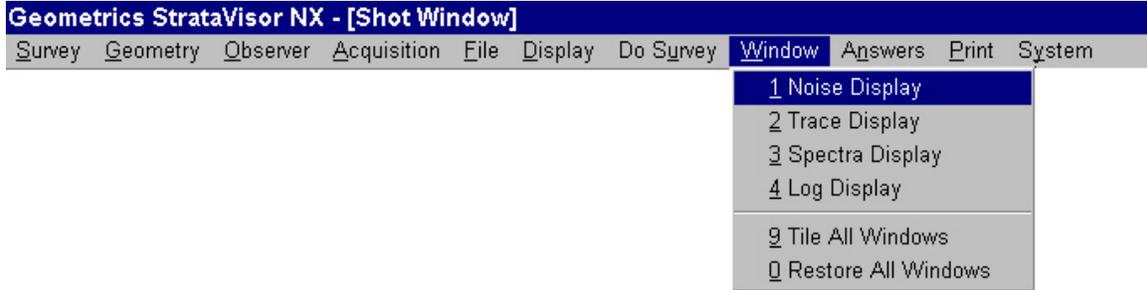
Freeze Channels



Freeze Channels is a data protect function. When a channel or group of channels are "frozen", they are protected against further stacking, and also will not erase if the memory is cleared. When working in noisy conditions, channels with good data can be frozen to protect them while the remaining channels receive extra effort.

Window

The **Window** menu allows you to control the configuration of the windows on the screen:



Choosing **Noise Display** will provide a full-screen display of the Noise Monitor window.

Trace Display will display the Shot Record.

Spectra Display will display the spectral analysis window.

Log Display will display the survey log.

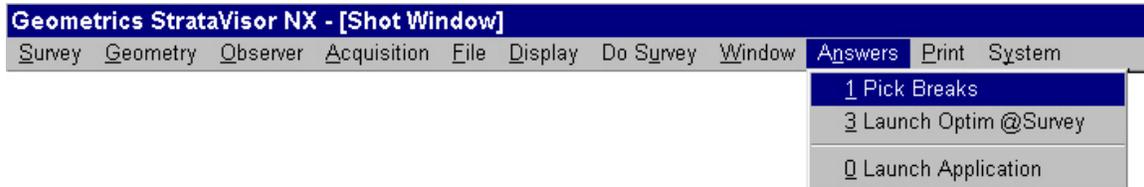
Tile All Windows will display the Noise Monitor, Shot Record, Spectra, and Survey Log in a standard Windows™ tiled format.

Restore All Windows will return the screen configuration to your custom settings.

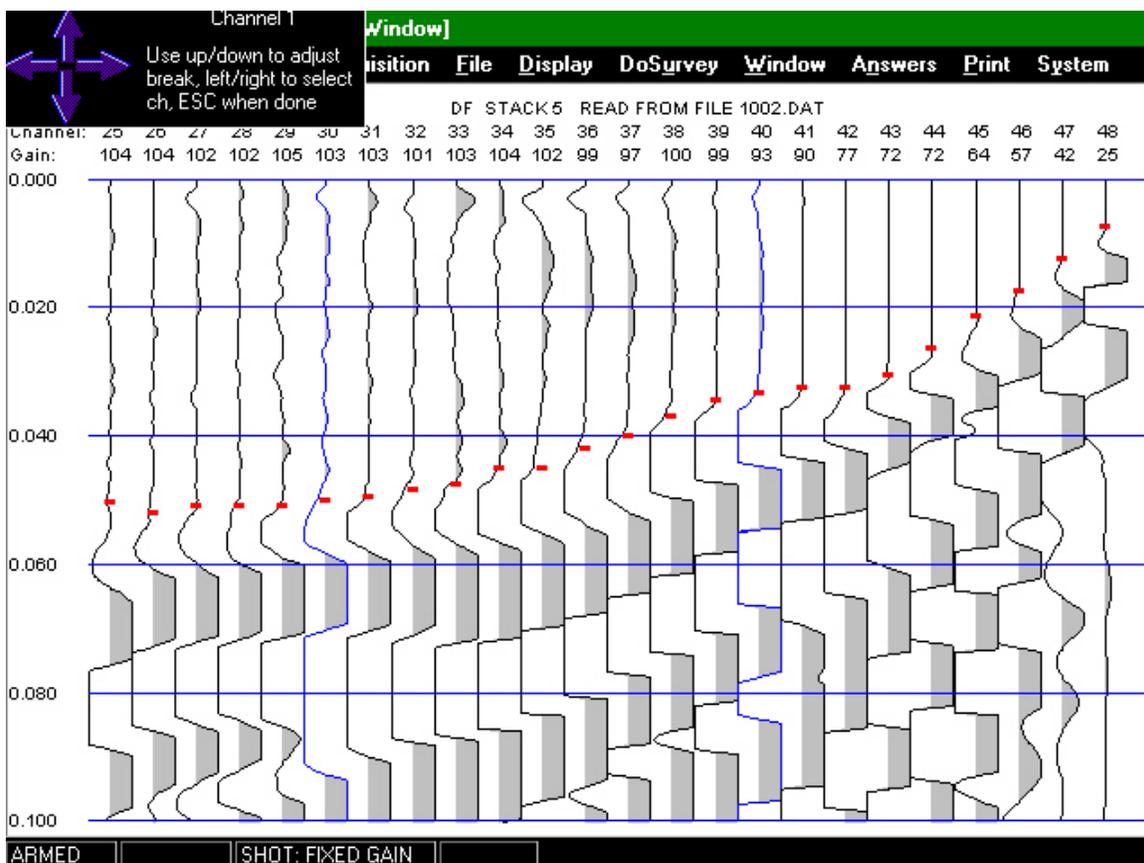
Answers

The **Answers** menu provides refraction interpretation tools. Also, you may run third-party software from here. Remember, in order to use the utilities in this menu, you must keep an accurate accounting of your survey geometry at all times.

Pick Breaks



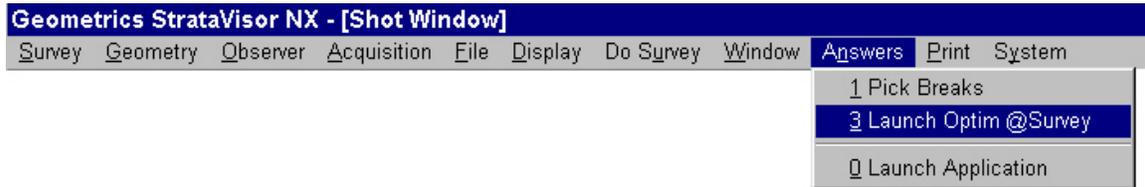
The **Pick Breaks** utility will assist in picking the first-arrivals on a refraction record in memory, either newly-acquired or read from the hard disk. Upon selecting this item, the picking software will attempt to pick the first breaks automatically, and you should see something akin to the following:



The ability of the first-break picker to accurately determine first-arrival times depends on the same thing you do: data quality. The better the data, the better the algorithm will perform. If it has trouble with a particular trace, you will be prompted to pick that trace manually. Based on your input, it will attempt to pick the rest of the traces in the record. Depending on data quality, it may do a poor job in some cases. However, once it has been through all the traces, control will be returned to the user, and the arrival times may be adjusted manually.

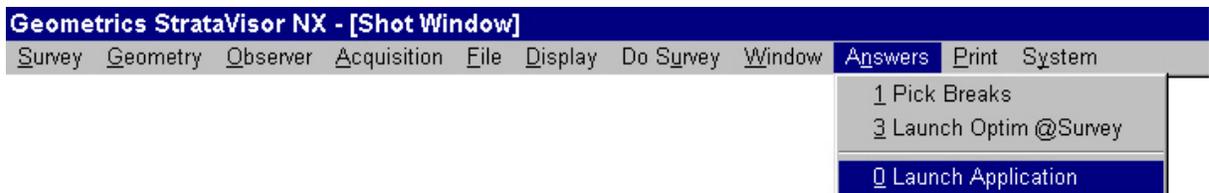
The purpose of the first break picker is to *facilitate* the process, not to substitute for human interaction. Determining accurate first breaks is a crucial step in the interpretation process, and the quality of the final product depends greatly on this step. With high-quality data, you will find this utility to be most useful; with poor data it will require much more human intervention. Regardless of data quality, you should never blindly accept the results; always double check to make sure the first breaks make sense.

Launch Optim@Survey



Launch Optim@Survey will start the Optim refraction package. See the Optim manual for a discussion of the operation of this software.

Launch Application

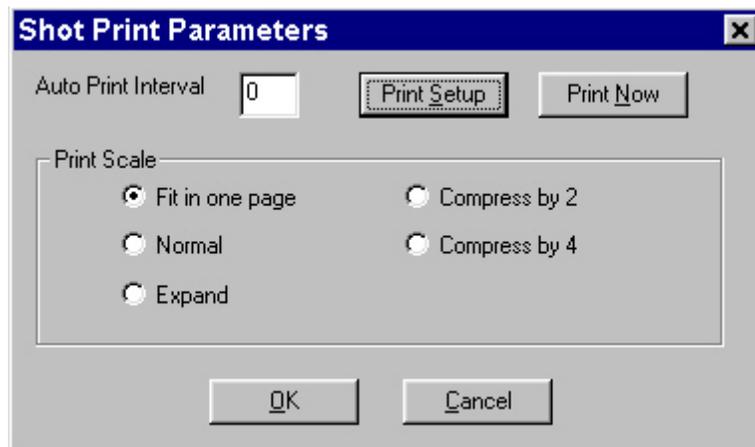
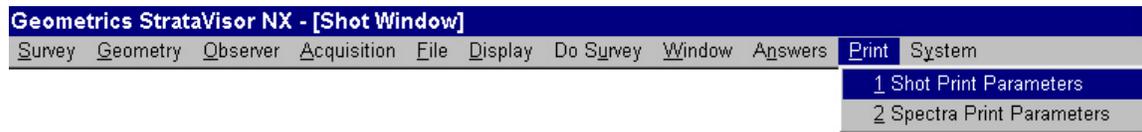


Launch Application will activate the WindowsTM Run menu and allow you to launch a WindowsTM-compatible third-party application.

Print

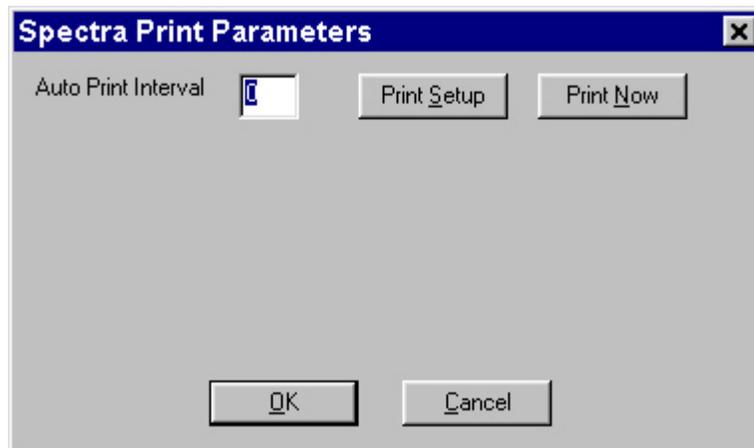
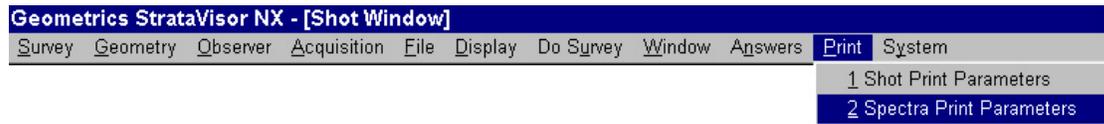
The Print menu allows you to set up the printing parameters for the shot and spectra records.

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 **Do Survey** menu).

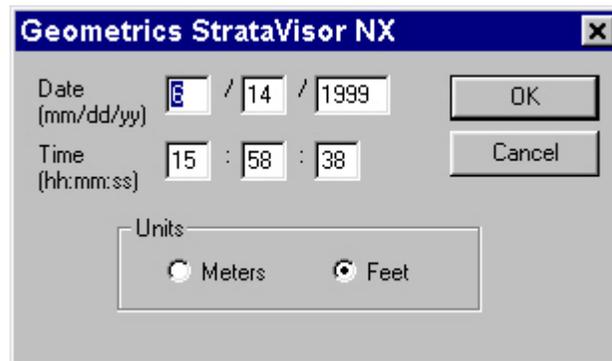
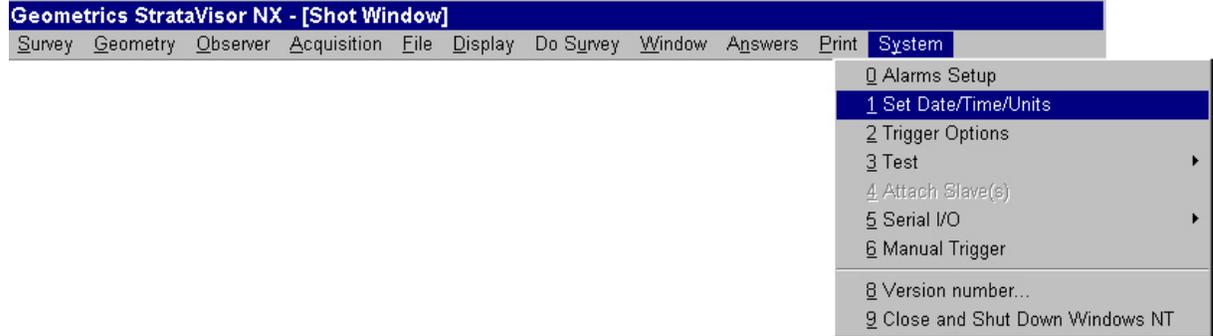
Spectra Print Parameters



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

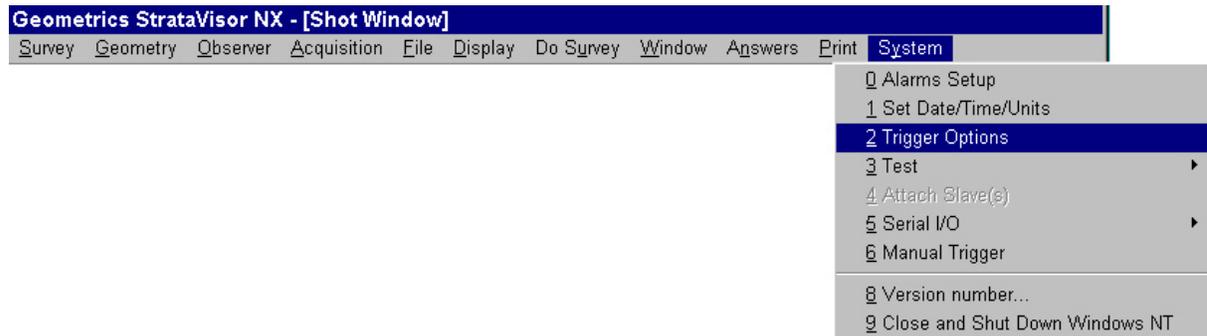
System

Set Date/Time/Units



Set the Date, Time, and Units in the **Date/Time/Units** menu.

Trigger Options



Use the **Trigger Options** menu to set the *Trigger Holdoff* and the *Arm Mode*. The trigger holdoff sets the minimum time between triggers, and is used to guard against false triggers. The system will ignore any triggers arriving within the trigger holdoff time of the last trigger. For instance, if the system is triggered and the holdoff time is set to two seconds, the system will not respond to subsequent triggers until two seconds have passed.

There are two arm modes. If *Auto* is selected, the system will automatically rearm itself after each shot. In *Manual* mode, the system must be manually armed after each shot. In most production work, particularly when using a vibrator, auto mode is usually best. It is also preferable when using explosives, as it is better to get a false trigger than to forget to arm the system and miss a shot. Manual arm mode is most useful when working near power lines or other potential sources of annoying false triggers.

Test

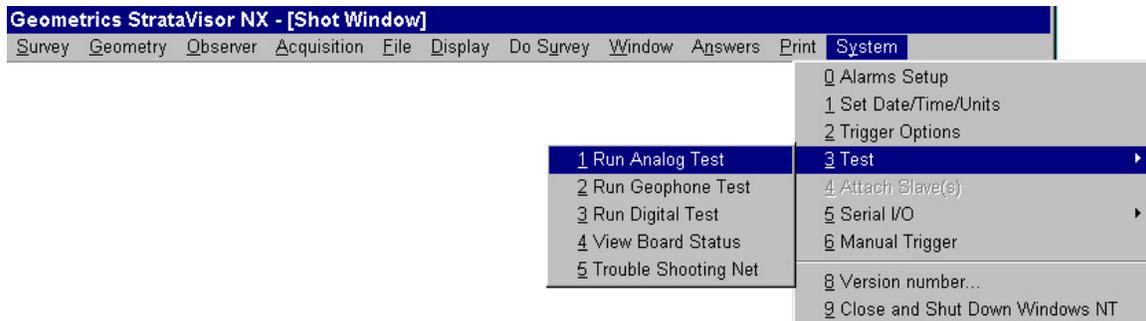
The StrataVisor™ provides several types of tests for ascertaining proper function of the system.

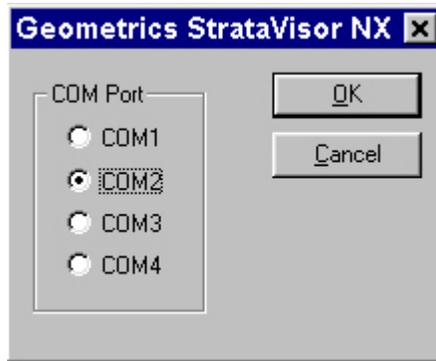
Analog Test

The *Analog Test* provides the most thorough test of the system, and requires a separate test box (TB-1 or TB-2; portable TB-1 shown in Figure 3.1). The test box provides a high a high-quality analog signal to the seismograph, which the seismograph digitizes. The resultant digital record is then subject to a suite of rigorous tests to ensure that the system is meeting published specifications.

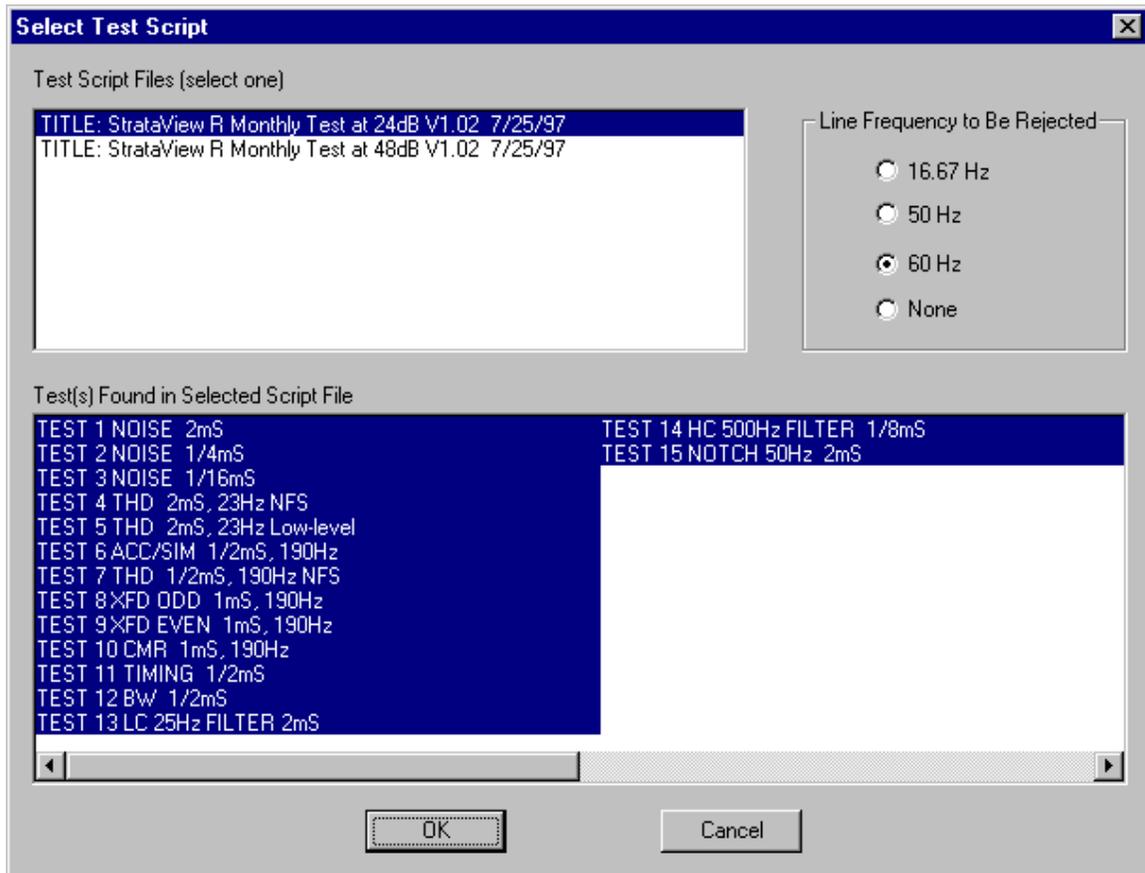


Figure 3.1 - The TB-1 Portable Testbox.



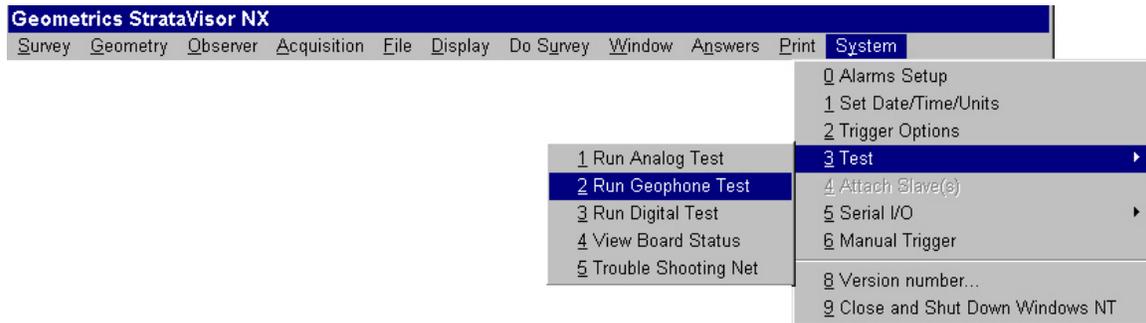


Choosing *Analog Test* will result in the above dialog box. Once you indicate the communications port the test box is plugged in to, you will be asked which test suite you would like to run:



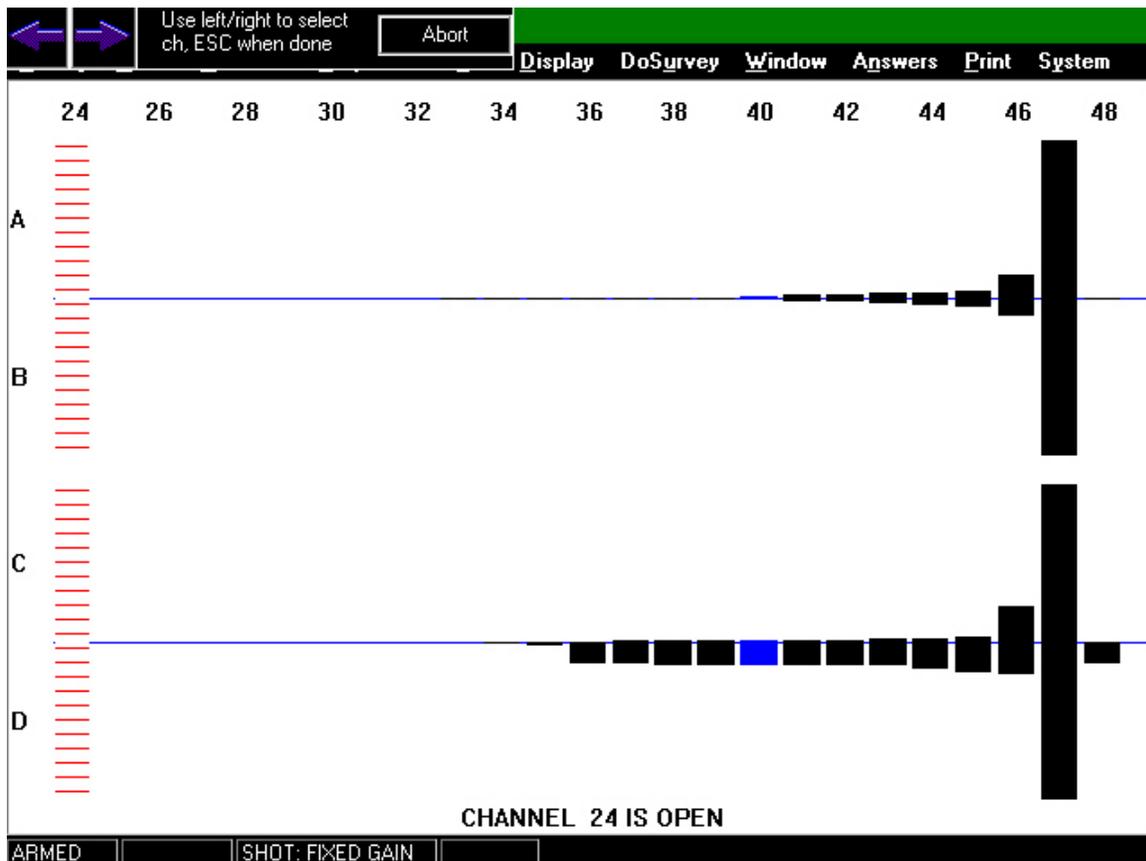
From that point on, testing is driven by software and is automatic. When complete, the seismograph will print a report of the test results. For a more complete discussion on analog testing, see Chapter 4 (Advanced Features).

Geophone Test



The StrataVisor™ is capable of sending a voltage pulse out the geophone inputs to evaluate geophone performance and to test for cable problems. The resulting waveform is captured and analyzed by the StrataVisor™ for the operator to take corrective action. The test is repeated continuously at 2-second intervals to monitor changes in line conditions to see if the corrective action has been successful.

Beginning the geophone test will display the following window:



Two types of analysis are performed on the recorded waveforms from the line pulse test, and are shown graphically as two sets of bar graphs on the StrataVisor™ display. The first test (shown by bar graphs A and B) is known as the ‘match’ test and the second test (graphs C and D) is the ‘noise’ test.

The analysis begins by first calculating a ‘median’ response of the captured waveform. After eliminating data from obvious open or shorted traces, a relative measure of how the median response compares with each trace is presented in the top bar graph (A). The standard deviation of the last 5 tests is shown in the inverted bar graph directly underneath (B).

The noise test is performed by creating a first derivative median trace, and comparing it to the other traces in a similar fashion. The results of each test are presented in the top graph of the bottom set of bar graphs (C). The standard deviation of the last 5 tests is shown in an inverted bar graph directly underneath (D).

Open geophones or cable breaks are shown as dashed bars. Bad or noisy phones show responses on either the match (top set) or noise (bottom set) of bar graphs. Sticking or broken phones in strings of geophones are more subtle and show up more clearly in the deviation (inverted B or D) bar graphs.

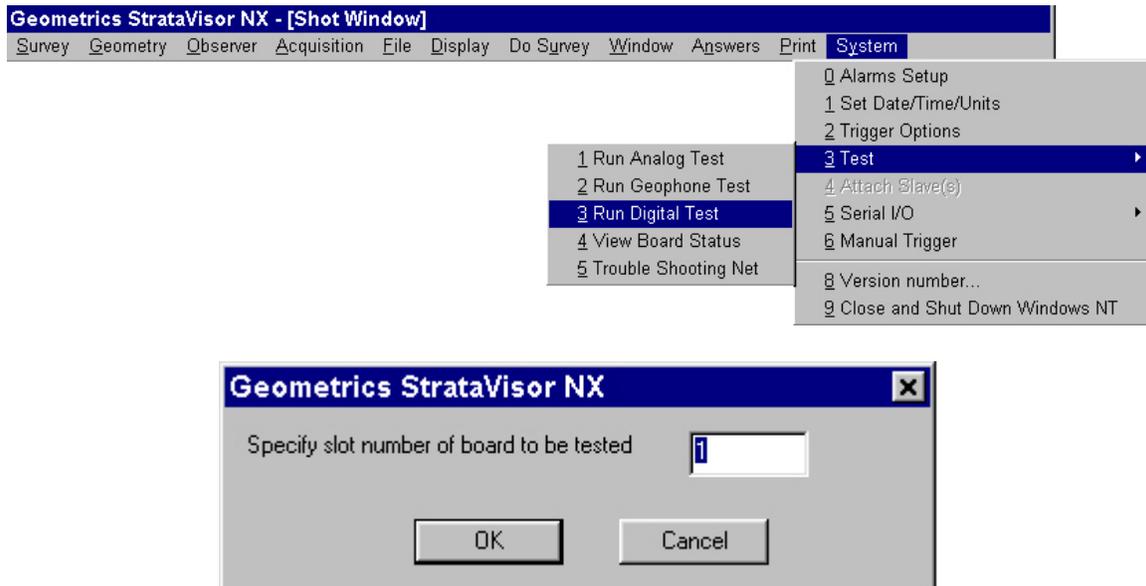
A dialog line is shown at the top of the graph with the match and noise values for each channel. Using the left and right arrow keys moves between individual channels and displays the corresponding analysis.

The test is terminated when the **CLR** key is pressed, and the operator can then print a hardcopy of the results by pressing **ENTER** or abort by pressing **CLR** again.

The StrataVisor™ display then shows the trace data from the last test, which can be scaled and printed for visual inspection of geophone impulse response.

Some experience may be necessary to recognize faults and bad geophones. Note that this is a relative technique and does not provide quantitative information about geophones. This is not possible due to differing line lengths and geophone configurations. Suspected bad strings and cables can be located with the StrataVisor™ line test and then verified quantitatively with a certified geophone testing instrument. Note also that the statistical analysis identifies geophones that are *different* from the average; that doesn't necessarily mean a geophone is bad. A perfectly-functioning 40 Hz geophone would therefore be flagged by this test if the rest of the geophones in the line are 14 Hz.

Digital Test



The *Digital Test* is a simple test of the acquisition boards to determine whether they are functioning or not. This utility is not intended as a go/no-go test of the system. It should only be used to isolate suspected problems with one of the acquisition boards.

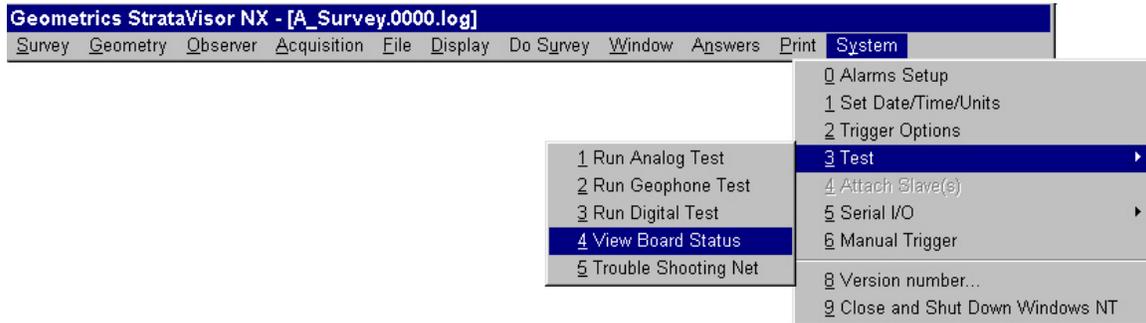
Either disable external triggers from happening, or remove the trigger cable from the StrataVisor. Specify the slot number of the board to be tested (see *View Board Status*, below) and press OK. A report similar to the following will be displayed:

```
24-BIT ACQUISITION BOARD FUNCTIONAL TEST PROGRAM   Version
1.25 (2/99)
Slot: 1; I/O base address: 1000; VRAM base address:
08000000
OMNI: 01E0, if installed
EISA access of VRAM seems OK.
EISA access of DSP ports seems OK.
DMA access of DSP internal SRAM seems OK.
DMA access of DSP external SRAM seems OK.
0-wait-state DMA access of DSP external SRAM seems OK.
DMA access of DRAM part of VRAM seems OK.
VRAM refresh seems OK.
ADC cycling and SYNC seem OK.
All sampling rates seem OK.
SOS data tagging seems OK.
SOR data tagging seems OK.
Digitization of grounded signal seems OK.
```

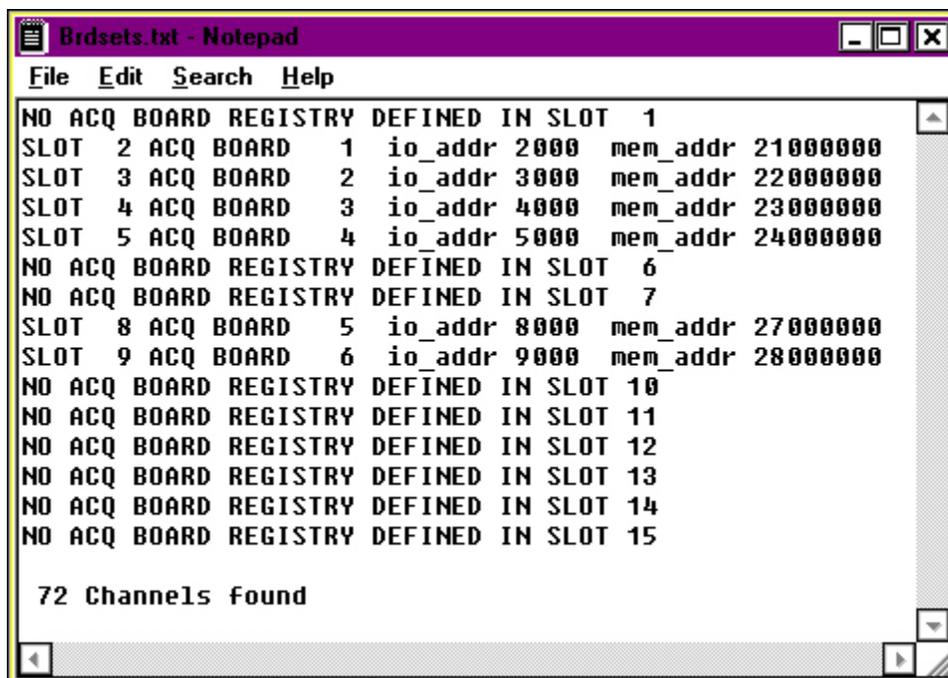
Digitization of un-terminated signal at 0dB seems OK.
Digitization of un-terminated signal at 48dB seems OK.
Digitization of input step seems OK.

Note: You should only use this utility if board problems are suspected. Occasional failures of some of the tests are normal due to random variation in the measurements.

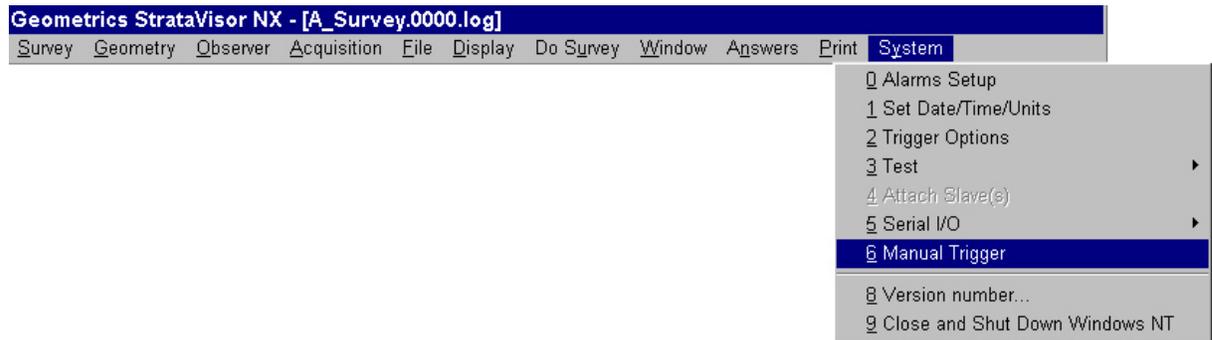
View Board Status



The *View Board Status* utility will identify what type of board is in a particular slot. This is useful if you intend to run the digital test described above. You simply enter the slot number you wish to test, and the system will report the type of board in that slot. A sample report is provided below.

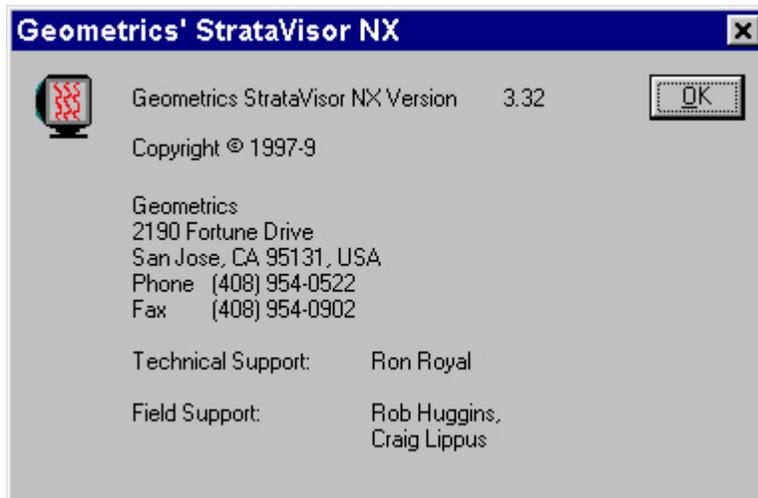


Manual Trigger



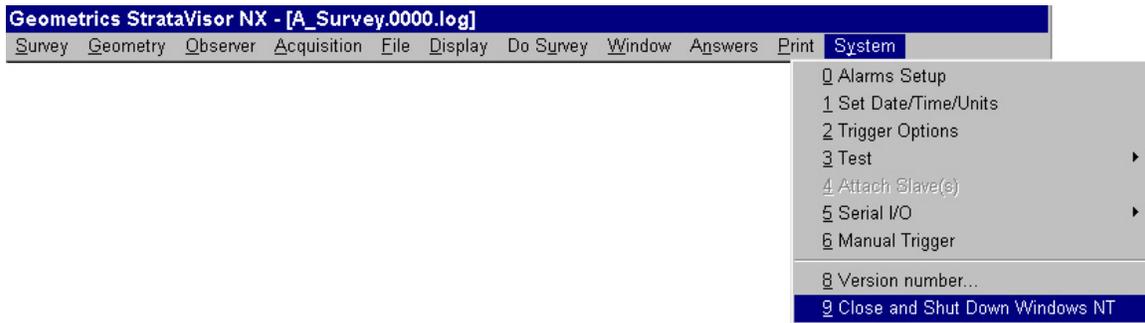
The *Manual Trigger* utility is used to trigger the instrument internally, without the need for an external trigger source. This is useful for testing or recording background seismic noise. The manual trigger is almost never used to record real seismic data, since analysis depends on exactly synchronizing the seismograph with the energy source.

Version Number



Selecting *Version Number* displays the above window. When reporting software problems, please be able to supply the software version number.

Close and Shut Down Windows™ NT



Close and Shut Down Windows NT will close the StrataVisor™ software and go through the normal Windows™ shut-down procedure. It is best to wait until this process is complete before turning off the power. Failure to do so could result in boot-up problems in your next session, and a keyboard may be required to answer the Windows™ prompts.

Chapter 4. Advanced Features

The StrataVisor™ Correlator

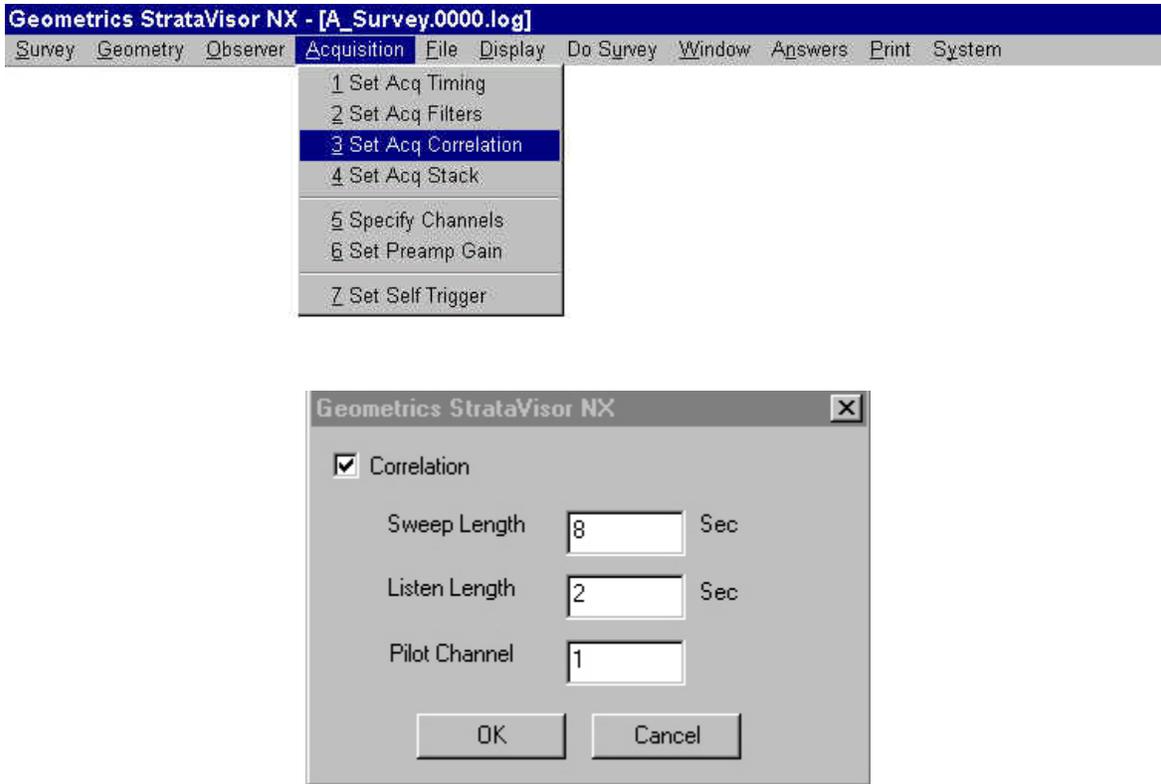
Data recorded with a swept vibrating source must be cross-correlated with the pilot or input signal in order to produce an interpretable record. The StrataVisor™ is equipped with a correlator that accomplishes this automatically and efficiently before the data is written to disk. When summing multiple shots, data can be correlated either before or after stacking.

Provisions must first be made to provide the StrataVisor™ with the input sweep from the vibratory source. The point of entry on the StrataVisor™ is the BNC connector (circular connector approximately 1 cm in diameter) to the right and below the keypad (don't confuse this with the BNC near the trigger input, which is used for the network connection). Throwing the toggle switch to the appropriate position will route the pilot signal to channel 1. Alternatively, you may wire up any desired channel to be your pilot signal. See wiring diagrams in Chapter 5 for proper wiring for your instrument.

Next, you must indicate which channel contains the pilot signal. This is done in the **Acquisition/Specify Channels** menu, as indicated in Chapter 3. Only one channel may be considered to be the pilot.

Note: To achieve the best results possible, the amplitude of the input signal should be just below the clipping threshold of the recording system. Adjust the amplitude of the pilot until it clips, then reduce the amplitude so it is just below full scale. Several test shots (with correlator disabled) may have to be taken to ensure settings are correct. Alternatively, if changing the amplitude of the pilot is difficult, you may adjust the preamp gain of the pilot channel to ensure that it does not clip. If you have difficulty, contact the factory for details on interfacing vibratory sources with the StrataVisor™.

Once you have successfully interfaced the pilot with the StrataVisor™, you must set up the correlator.



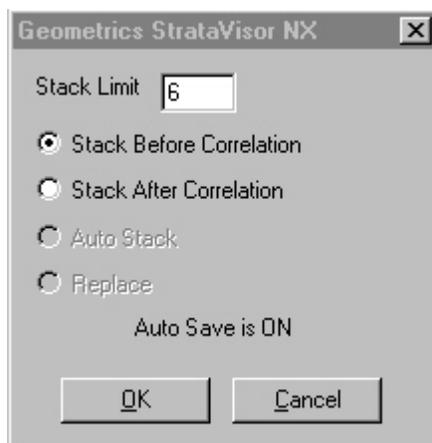
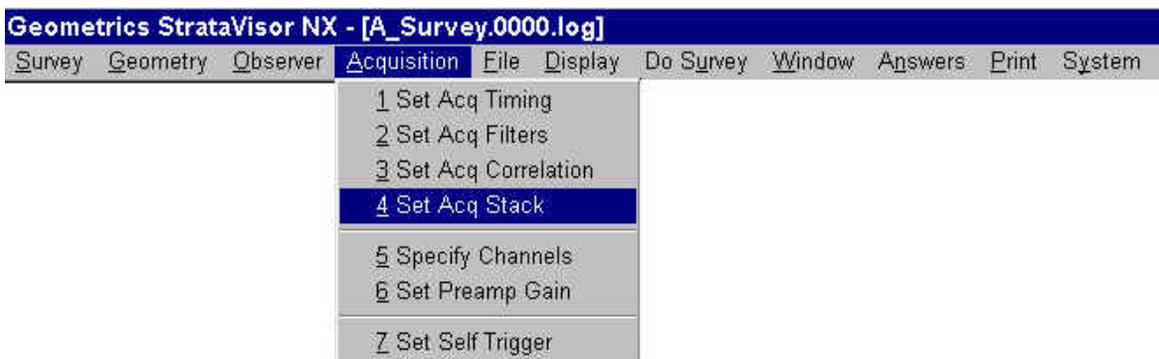
Select **Correlation** in the **Acquisition** menu to reveal the above dialog box. The *Sweep Length* is the length of time in seconds that the source will take to sweep from its beginning frequency to the ending frequency. *Listen Time* refers to the amount of time the seismograph will continue to record after the sweep has been completed (the seismograph begins recording at the start of the sweep). The seismograph records for a time equal to the sum of the *Sweep Length* and *Listen Length*. The final record length, after correlation, will be equal to the *Listen Length*.

If you intend to stack several sweeps per shotpoint, you must decide whether to stack before or after correlation. Each has its advantages and disadvantages.

If the source is phase-compensated and consistent, it is generally preferable to stack the data before correlating in order to attain the fastest production rate possible (only one correlation operation per shotpoint). In this case, the system will correlate against the pilot signal recorded during the last sweep in the stack. The underlying assumption is that all of the pilot signals are identical.

If the source is not phase-compensated, each pilot signal may be slightly different, and you may want to correlate before stacking. In this way, you are not assuming that each pilot is identical. The downside is that you must correlate each sweep, and your production rates will be negatively impacted, albeit slightly. It is generally advisable to conduct a test prior to your first survey with a given source to determine which method is appropriate. Most large vibrators are phase-compensated and generally deliver a consistent pilot.

In the **Acquisition** menu, choose **Stacking**:



Generally, when using a swept source, you will use a fixed number of sweeps (stacks) per shot point once you get into production mode. As such, the *AutoSave* feature is almost always used in vibrator surveys (see the **File/Storage Parameters** menu). When the *Stack Limit* is reached, the system automatically saves the data, increments the shot record, shot point location, active spread location, and resets the stack count in preparation for the next shot. This allows very rapid, "hands off" operation, and the seismograph can keep up with even the fastest sources.

If you intend to stack before correlating, the system must know how many stacks to do before correlating the data. This makes the *Stack Limit* relevant even if not in *AutoSave* mode. How many stacks you do will depend on site conditions; you will want to conduct some tests to determine the appropriate number.

Note that it is not necessary to correlate vibratory data in the field. Some practitioners prefer to record raw data along with a pilot and then correlate later in processing. This can be accomplished by simply disabling correlation and setting your recording parameters appropriately. If you are using a vibrator with an inconsistent pilot (with which you would stack after correlating, if correlating in the field), and you do not want to use the same pilot to correlate each stack, *you must record each sweep as a separate record, and stack in processing, after correlating each stack with its own sweep.*

External Storage Media

The StrataVisor™ can be interfaced with numerous external storage media types. It can write data to most SCSI tape drives, including 4mm DAT, 8mm Exabyte, DLT, 3480, 3490, and 3590. Simply plug the SCSI interface cable into the SCSI connector on the StrataVisor™, turn on the tape drive, and boot the seismograph. The tape drive will be recognized automatically. You may either write to tape in real time (by enabling *Save to Tape* in the **File/Storage Parameters** menu), or after the survey by using the **Roundup** utility to transfer the data from hard disk to tape. You may save data to tape and disk simultaneously by enabling both functions.

In addition to tape drives, the StrataVisor™ will support any other Windows^{NT} compatible device, including JAZZ drives, ZIP drives, and external SCSI hard drives. These items will be recognized by the system as disk drives on boot-up, and will be available as a path. Contact Geometrics for assistance with external storage media.

Marine Surveys

The StrataVisor™ seismic system is engineered to provide good performance for both small and large marine surveys. Special software features permit continuous recording to internal hard disk or external mass storage, like large hard drives or magneto-optical devices. An optional controller package permits 24-hour operation by managing numerous SCSI storage devices.

Small Scale Engineering Surveys

Marine surveys collect great amounts of data, as there is often only 2 seconds between shots. For example, a 24-channel record with 2000 data samples per channel is about 200 Kbytes. Therefore a 24-channel survey with 5-second shot intervals would collect about 140 megabytes of data in an hour!

The StrataVisor™ seismograph can be used as a marine recording system without additional hardware or software, provided that the lines are short and there is time for data to be transferred to a mass storage device between lines.

Larger 24-Hour Continuous Surveys

Larger marine seismic surveys are often operated for 24 hours each day to justify the high vessel and crew costs. When combined with the CNT-1 Marine Controller, StrataVisor™ becomes a full-featured marine recording system. The CNT-1 coordinates a multitude of marine acquisition activities, allowing for extremely rapid data acquisition while providing numerous QC features including alarms, brute stack, common offset gather, and sea-state monitor. It can manage up to six tape drives simultaneously, automatically switching when one gets full or fails. Data can be written to two tapes simultaneously, creating an instant backup.

Marine survey seismic systems are one of the custom configuration options that Geometrics can offer with the StrataVisor™. Please contact the factory to discuss your particular application, and to receive a data sheet describing the CNT-1 Marine Controller.

Analog Testing with the Geometrics Test Box

The optional Test Oscillator is available to provide confirmation of the StrataVisor™ performance. Some clients, most notably the U.S. Government, require the seismograph to be tested prior, during, and after a seismic survey in order to provide that it is meeting published specifications. The oscillator provides a known, high-quality analog sine wave to the seismograph, which digitizes and records the signal. A series of customizable tests are conducted automatically, and the results are provided in a printout. The test data can be sent to an independent testing house for independent verification.

The test box comes in both a portable and rack-mount configuration. Operation is identical. The portable test box is shown in Figure 3.1. The following discussion focuses on the rack-mount version, but most of it applies to the portable version as well.

The TB-2 Rack-Mount Test Oscillator

The TB-2 test system is specially designed to work with rack-mounted StrataVisor™ seismographs. It has the following features:

- Completely automatic operation with StrataVisor™ seismograph.
- Script files allow custom configuration
- Low noise, low distortion.
- Pass-through mode. You do not have to disconnect the geophone cables from the panel connectors to run a self-test. The geophones are connected to the test box, and the test box will either connect the test signals to the StrataVisor™, or pass-through the geophone signals.
- Tests up to 132 channels.

Installation

The TB-2 is designed to be mounted in a standard instrument rack directly above the StrataVisor™ seismic acquisition unit that it serves. The Test System itself requires 7" of vertical rack space. Refer to Figure 4.1 for additional clarification of the following procedure.

If this installation is a retrofit to a StrataVisor™ acquisition unit that is already installed, first remove the existing geophone connector panel and disconnect its cables from the acquisition unit.

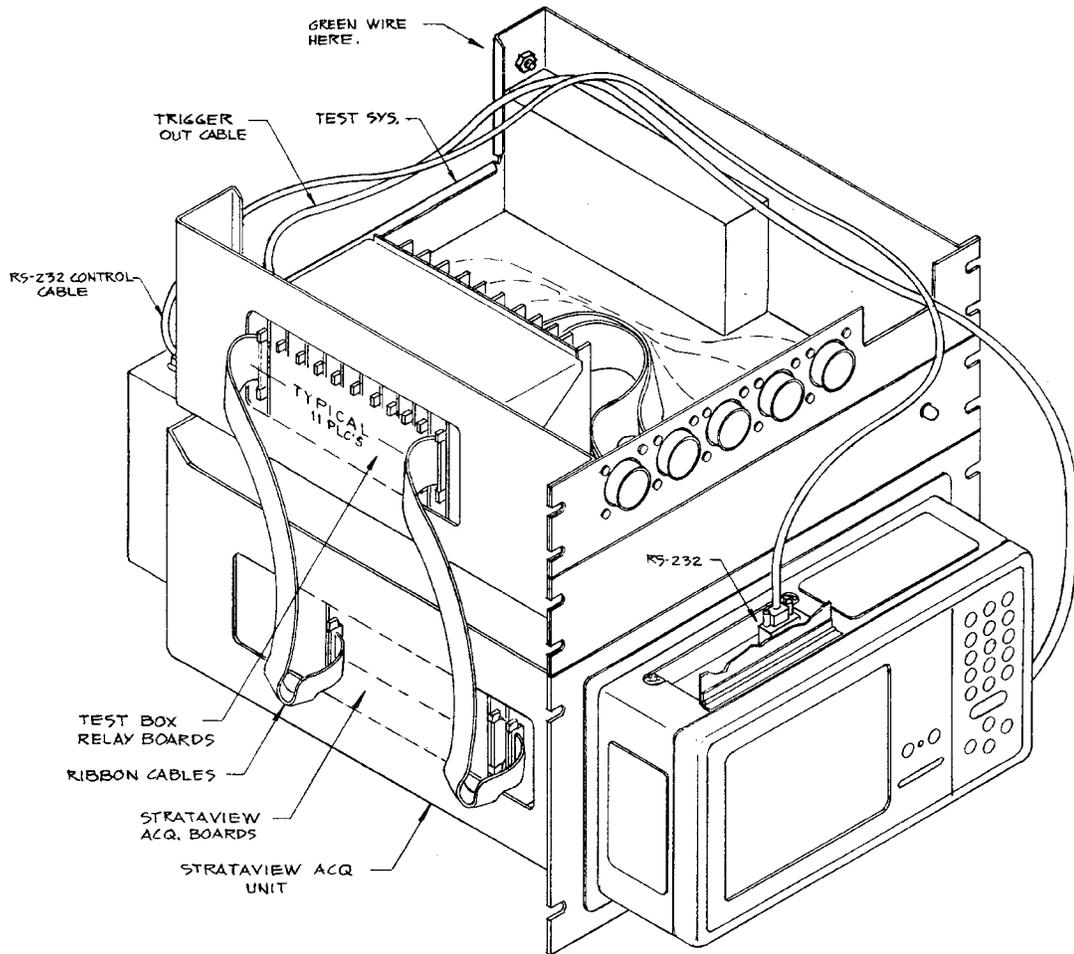


Figure 4.1 - TB-2 Test System Installation. The figure shows the positioning of the test system over the StrataVisor™ seismograph.

Mount the test system to the front rails of the rack directly above the StrataVisor™ acquisition unit using six flathead screws, three on each side.

Use the several ribbon cables provided to connect each StrataVisor™ acquisition board to the test system relay board directly above. You may also refer to the channel labels above the relay boards and near the acquisition boards. If there should exist more relay boards than acquisition boards, leave the extra relay boards at the back of the test system unconnected. Be sure that all cables are securely mated at both ends. Each cable header locking ejector should snap in place behind its mating cable connector.

Mount the 3 1/2" panel with the power indicator over the lower half of the front of the test system. Mate the power indicator cable connector with cable header labeled J11 on the horizontal printed circuit board of the test system.

Position the geophone connector panel either at the front or the rear of the rack to allow connection of its cables to the input side of the relay boards. The cables connected to the geophone connectors are connected to the appropriate relay board on the test box. Both the cables and relay boards are labeled with the channel numbers. Check that all connections are secure. Then mount the connector panel itself to the rack frame. Take precaution that the signal cables are kept away from the AC power lines and power supply, which are a potential source of noise contamination.

Next, make the other electrical connections as follows (see Figure 4.2):

- Connect the RS-232 cable and trigger cable. As indicated in Figure 4.1, connect the RS-232 cable from the CNT-1 to the connection marked RS-232 Control Input.
- Connect the Trigger Output of the Test System to the Trigger Input on the StrataVisor™.
- Connect the Trigger Input on the Test System to your trigger source. This signal will be passed-through to the seismograph when you are taking shots.
- Connect the ground wire from the lug indicated on Figure 4.1 to the ground connection on the rest system.

Note: If the power to the test system is turned off, the geophone and trigger signals will automatically be sent through the test system to the StrataVisor™.

If the seismic test system needs to be removed for some reason, you must connect the cables indicated by the letter A directly to the corresponding acquisition board.

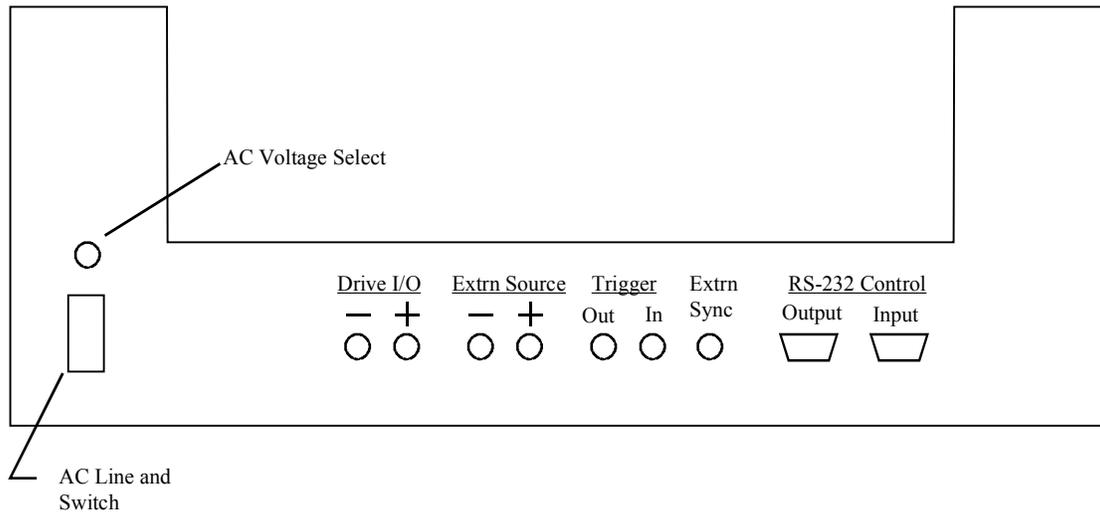


Figure 4.2 - Back Panel of the TB-2 Test System showing electrical connections.

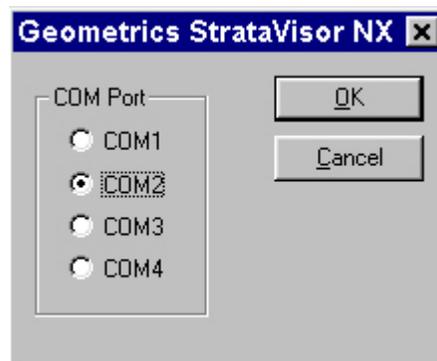
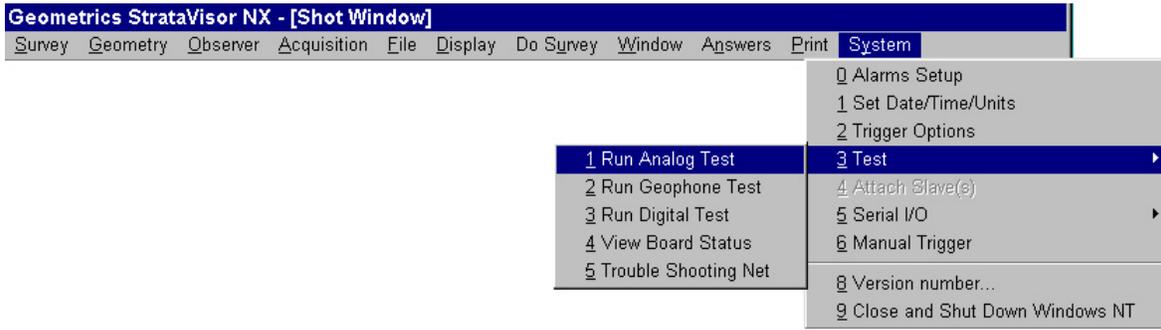
Multiple Test Systems

If the system consists of more than 132 channels, multiple test boxes must be used. The test boxes are connected in a daisy chain manner as follows:

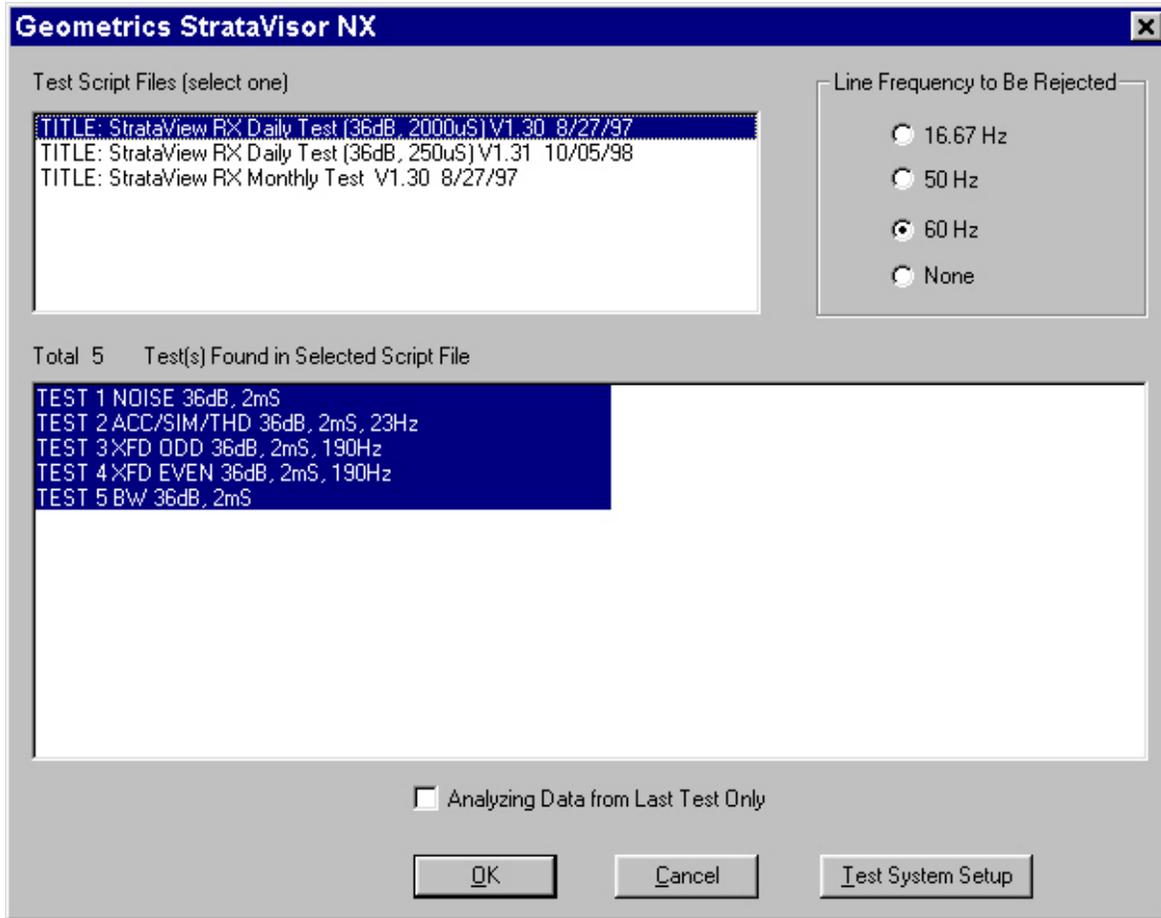
- Connect an RS-232 cable (no null modem) from the CNT-1 serial port to the connection marked RS-232 Command Input on the first Test System.
- Connect an RS-232 cable (no null modem) from the RS-232 Command Output of the first Test System to the RS-232 Command Input of the second Test System.
- Connect the Trigger Output of the First Test System to the Trigger Input on the StrataVisor™.
- Connect the Trigger Input of the first Test System to the trigger Output of the second test system.
- Connect the Trigger Input on the second Test System to your trigger source.
- Connect the ground wires to the respective StrataVisors.
- Connect the Drive I.O + of the two test boxes to each other with a BNC cable
- Connect the Drive I.O - of the two test boxes to each other with a BNC cable

Running a Test

Re-start the StrataVisor™ program. Open a survey, and select **System/Test/Analog Test**:



Indicate the appropriate communications port. You should then see a list of the available test suites:



The top window lists the test suites available. In this case, there are three tests: a daily, weekly, and monthly. In general, the daily test is less extensive than the weekly, and the weekly is less extensive than the monthly. The bottom window displays the test in the highlighted test suite. These test suites are completely customizable. Contact Geometrics for assistance if you need assistance in designing a custom test suite to meet your specific purposes.

Choose the test suite you wish to run. The test system will take over from here. When completed, a summary version of the test report will be listed in the log file. A longer report, detailing full test results, is saved on the hard disk.

File Locations

Test files are saved in the directory D:\TEST_DIR. The long report is named LONG.RPT and the short report is named SHORT.RPT. This is also where the actual data files are stored. All files (data and report files) are overwritten each time the test is run, so save them in a different directory if you wish to preserve previous test results.

Test Description

The following is a description of the tests performed. The tests on your system may vary from the examples shown here.

TEST 1 NOISE 48dB, 2ms

Measures the DC offset and AC RMS noise with the input connections terminated.

48 dB gain, 2 ms sampling rate.

Limits: DC offset less than 0.40uV, AC RMS less than 1.0 uV.

TEST 2 NOISE 48dB, 1/4ms

Same as test 1.

48 dB gain, 1/4 ms sampling rate.

Limits: DC offset less than 0.40uV, AC RMS less than 1.5 uV.

TEST 3 NOISE 0dB, 1/4ms

Same as test 1.

0 dB gain, 1/4 ms sampling rate.

Limits: DC offset less than 200 uV, AC RMS less than 35 uV.

TEST 4 NOISE 0dB, 2ms

Same as test 1.

0 dB gain, 2 ms sampling rate.

Limits: DC offset less than 100 uV, AC RMS less than 6.3 uV.

TEST 5 THD 0dB, 2ms, 23Hz

Measures total harmonic distortion by applying an 23 Hz input signal.

0 dB gain, 2 ms sampling rate.

Limits: Less than 0.001 percent.

TEST 6 THD 48dB, 2ms, 23Hz

Same as test 5.

48 dB gain, 2 ms sampling rate.

Limits: Less than 0.005 percent.

TEST 7 ACC/SIM 48dB, 1ms, 23Hz

Measures gain accuracy and gain and phase similarity by applying a 23 Hz input signal. Gain accuracy is the absolute accuracy of each channel. Gain and phase similarity are the difference between the measured amplitude of a particular channel with the median amplitude measured by all the channels.

48 dB gain, 1 ms sampling rate.

Limits: Gain accuracy, 3.0%. Gain similarity, 1.0%. Phase similarity, 0.88 deg.
 TEST 8 ACC/SIM 36dB, 1ms, 24Hz
 Same as test 7.
 36 dB gain, 1 ms sampling rate.
 Limits: Gain accuracy, 3.0%. Gain similarity, 1.0%. Phase similarity, 0.88 deg.
 TEST 9 ACC/SIM 24dB, 1ms, 24Hz
 Same as test 7.
 24 dB gain, 1 ms sampling rate.
 Limits: Gain accuracy, 3.0%. Gain similarity, 1.0%. Phase similarity, 0.88 deg.
 TEST 10 ACC/SIM 0dB, 1ms, 24Hz
 Same as test 7.
 0 dB gain, 1 ms sampling rate.
 Limits: Gain accuracy, 3.0%. Gain similarity, 1.0%. Phase similarity, 0.88 deg.
 TEST 11 THD 0dB, 1/2ms, 190Hz
 Measures total harmonic distortion by applying a 190 Hz input sine wave.
 0 dB gain, 1/2 ms sampling rate.
 Limits: 0.001 percent.
 TEST 12 XF ODD 0dB, 1ms, 190Hz
 Measures crossfeed rejection from odd to even channels, by applying a 190 Hz
 input signal.
 0 dB gain, 1 ms sampling rate.
 Limits: 110 dB
 TEST 13 XF EVEN 0dB, 1ms, 190Hz
 Measures crossfeed rejection from even to odd channels, by applying a 190 Hz
 input signal.
 0 dB gain, 1 ms sampling rate.
 Limits: 110 dB
 TEST 14 XF ODD 48dB, 1ms, 190Hz
 Same as test 12.
 48 dB gain, 1 ms sampling rate.
 Limits: 110 dB
 TEST 15 XF EVEN 48dB, 1ms, 190Hz
 Same as test 13.
 48 dB gain, 1 ms sampling rate.
 Limits: 110 dB
 TEST 16 CMR 0dB, 1ms, 190Hz
 Measures common mode rejection by applying a 190 Hz input signal.
 0 dB gain, 1 ms sampling rate.
 Limits: 70 dB
 TEST 17 CMR 48dB, 1ms, 190Hz
 Same as test 16.
 48 dB gain, 1 ms sampling rate.
 Limits: 90 dB
 TEST 18 TIMING 24dB, 1/2ms

Measures timing accuracy by applying a delayed pulse.

24 dB gain, 1/2 ms sampling rate.

Limits: 500 us.

TEST 19 BW 24dB, 2ms

Measures bandwidth by applying an input pulse signal.

24 dB gain, 2 ms sampling rate.

Limits: Lower 3dB freq 0.1 to 0.5 Hz. Upper 3dB 200 to 210 Hz.

TEST 20 LC 25Hz FILTER 24dB, 2ms

Checks the 25 Hz Low Cut acquisition filter function, using an input pulse signal.

24 dB gain, 2 ms sampling rate.

Limits: Lower 3dB freq 24.375 Hz to 25.625 Hz.

TEST 21 HC 250Hz FILTER 24dB, 1ms

Checks the 250 Hz High Cut acquisition filter function.

24 dB gain, 2 ms sampling rate.

Limits: Upper 3dB frequency 241.800 Hz to 254.200 Hz.

TEST 22 NOTCH 50 Hz 24dB, 2ms

Checks the 50 Hz Notch acquisition filter function.

24 dB gain, 2 ms sampling rate.

Limits: 3dB width less than 20.0 Hz, Upper 40dB freq > 50.25 Hz, lower 40 dB frequency less than 49.75 Hz,

OUTPUT FILES

Short Form

The following is an example of the short form which is printed at the completion of the tests (tests on individual systems may vary):

TEST REPORT

DATE: 27/JUN/96 TIME: 15:12:21 INSTRUMENT SERIAL NO. 654321

TITLE: StrataVisor RX Monthly Test V1.20 6/27/96

TEST 1 NOISE 48dB, 2mS

DC OFFSET SPECIFICATION (< 0.00040 mV)

PASSED

AC RMS SPECIFICATION (< 0.00100 mV)

PASSED

TEST 2 NOISE 48dB, 1/4mS

DC OFFSET SPECIFICATION (< 0.00040 mV)

PASSED

AC RMS SPECIFICATION (< 0.00150 mV)

PASSED

TEST 3 NOISE 0dB, 1/4mS

DC OFFSET SPECIFICATION (< 0.20000 mV)

PASSED

AC RMS SPECIFICATION (< 0.03500 mV)

PASSED

TEST 4 NOISE 0dB, 2mS

DC OFFSET SPECIFICATION (< 0.10000 mV)	PASSED
AC RMS SPECIFICATION (< 0.00630 mV)	PASSED
TEST 5 THD 0dB, 2mS, 23Hz	
HARMONIC DISTORTION SPECIFICATION (< 0.00100 %)	PASSED
TEST 6 THD 48dB, 2mS, 23Hz	
HARMONIC DISTORTION SPECIFICATION (< 0.00500 %)	PASSED
TEST 7 ACC/SIM 48dB, 1mS, 23Hz	
GAIN ACCURACY SPECIFICATION (< 3.00000%)	PASSED
GAIN SIMILARITY SPECIFICATION (< 1.00000%)	PASSED
PHASE SIMILARITY SPECIFICATION (< 0.88000 DEGREE)	PASSED
TEST 8 ACC/SIM 36dB, 1mS, 23Hz	
GAIN ACCURACY SPECIFICATION (< 3.00000%)	PASSED
GAIN SIMILARITY SPECIFICATION (< 1.00000%)	PASSED
PHASE SIMILARITY SPECIFICATION (< 0.88000 DEGREE)	PASSED
TEST 9 ACC/SIM 24dB, 1mS, 23Hz	
GAIN ACCURACY SPECIFICATION (< 3.00000%)	PASSED
GAIN SIMILARITY SPECIFICATION (< 1.00000%)	PASSED
PHASE SIMILARITY SPECIFICATION (< 0.88000 DEGREE)	PASSED
TEST 10 ACC/SIM 0dB, 1mS, 23Hz	
GAIN ACCURACY SPECIFICATION (< 3.00000%)	PASSED
GAIN SIMILARITY SPECIFICATION (< 1.00000%)	PASSED
PHASE SIMILARITY SPECIFICATION (< 0.88000 DEGREE)	PASSED
TEST 11 THD 0dB, 1/2mS, 190Hz	
HARMONIC DISTORTION SPECIFICATION (< 0.00100 %)	PASSED
TEST 12 XF ODD 0dB, 1mS, 190Hz	
CROSS TALK REJECTION SPECIFICATION (> 110.00 dB)	PASSED
TEST 13 XF EVEN 0dB, 1mS, 190Hz	
CROSS TALK REJECTION SPECIFICATION (> 110.00 dB)	PASSED
TEST 14 XF ODD 48dB, 1mS, 190Hz	
CROSS TALK REJECTION SPECIFICATION (> 100.00 dB)	PASSED
TEST 15 XF EVEN 48dB, 1mS, 190Hz	
CROSS TALK REJECTION SPECIFICATION (> 100.00 dB)	PASSED
TEST 16 CMR 0dB, 1mS, 190Hz	
COMMON MODE REJECTION SPECIFICATION (> 70.00 dB)	PASSED
TEST 17 CMR 48dB, 1mS, 190Hz	
COMMON MODE REJECTION SPECIFICATION (> 90.00 dB)	PASSED
TEST 18 TIMING 24dB, 1/2mS	
TIMING SPECIFICATION (ABSOLUTE DEVIATION < 500.00 usec)	PASSED
TEST 19 BW 24dB, 2mS	
LOWER CORNER FREQ SPEC AT 3 dB (> 0.100 Hz & < 0.500 Hz)	PASSED
UPPER CORNER FREQ SPEC AT 3 dB (> 200.000 Hz & < 210.000 Hz)	PASSED

```

TEST 20 LC 25Hz FILTER 24dB, 2mS
LOWER CORNER FREQ SPEC AT 3 dB ( > 24.375 Hz & < 25.625 Hz )      PASSED

TEST 21 HC 250Hz FILTER 24dB, 1mS
UPPER CORNER FREQ SPEC AT 3 dB ( > 241.800 Hz & < 254.200 Hz )    PASSED

TEST 22 NOTCH 50Hz 24dB, 2mS
NOTCH FILTER SPEC AT 3 dB (WIDTH < 20.000 Hz)                    PASSED
NOTCH FILTER SPEC AT 40 dB (UPPER > 50.250 Hz & LOWER < 49.750 Hz) PASSED

TEST RESULT                                                         ALL TESTS PASSED

```

Long Form

The long form report is automatically saved on the disk. It is too long to show here, but it gives the exact measurements for each channel.

Open the Test Files (D:\Test_Dir) folder on the NT desktop. Double click on the name of the long or the short report file.

If the System Fails Any Tests

There are many situations which might cause some of the tests to fail. The first thing to check is that the cables are securely connected. Disconnect, clean and reconnect the cable connections. Clean cable connections are particularly important for the common mode rejection test. The grounding cable is also particularly important for common mode tests. Without it, the reports will indicate untrue, exceptionally good, results.

Occasional statistical variations may cause a channel to fail the specifications slightly. Repeated testing can assure that the channel is indeed performing properly if it passes the great majority of repeated tests. Consistent failures indicate a need to replace the corresponding acquisition board.

Too much AC line pickup is another possible cause for erroneous results. Make sure AC power cords are as far as possible from the unit. Try disconnecting any AC-powered instruments nearby (monitors, printers, tape drives, etc.), and run the seismograph from a battery, if necessary.

Also make sure that digital cables, such as the RS-232 cable, are not routed near to the signal cables. Other situations that can cause failures of certain tests are: power voltage variations, ground loops, temperature extremes or variations, mechanical shocks, or excessive humidity.

The system may report certain error messages regarding communications with the test system console. In this case, check the connection of the RS-232 cable

The test box itself may be suspected to be malfunctioning if all the channels show degraded performance. If cabling or internal relays malfunction, swapping the signal cable connections between the StrataVisor™ and the test system relay boards, and repeating the test will show a migration of the failures. You may also try swapping the relay boards on the test system if they are suspected of failing.

Note: When contacting Geometrics to report testing problems, please be prepared to communicate the long form report that illustrates the problem. This will help our engineers spot the source of the failure.

Adjustment for Test Oscillator Stability

This section will be useful if you receive the error message “Test Oscillator Not Stabilizing. Adjustment Required.” These adjustments are performed on the Test System motherboard.

The Test Signal Oscillator is a Wein Bridge type that uses a photo-modulator (component PM1) to control its amplitude. The use of a photo-modulator allows a very low distortion output, however its behavior is somewhat temperamental. Its characteristics are very non-linear, very temperature dependent (which is the reason for the temperature-compensating thermistor bonded to the top of it), and even dependent on its history (i.e., whether or not it has been activated recently).

For orientation, view the board such that the serial and BNC connectors are up, or away from you. Locate on the board R26 (the small blue rectangular object with a screw head projecting, in the upper-right portion of the board), TP23 (a terminal post near the large cylindrical object in the center-right portion), and AGND (at the end of C14, another large cylindrical object at the bottom-right). TP23 is the control voltage for PM1, and R26 is the adjustment potentiometer for the control voltage. The feedback loop attempts to adjust automatically for any variations in PM1, but can only do so within its control range. The control voltage is nominally set to about 1.2 Volts at 25C for best results. When warm, the control voltage must be higher, when cold a little lower. But also, if the oscillator has been off for days or weeks, the required control voltage is lower, and if it has been on recently for some time, the control voltage needs to be higher. Therefore, the task is to set R23 for the control voltage that best accommodates all the variations that PM1 may experience.

Perform the following adjustment when the message “Test Oscillator Not Stabilizing. Adjustment Required.” is showing on the CNT-1. Do not press OK on the CNT-1 until the adjustment is completed.

Procedure: Monitor the voltage at testpoint TP23 relative to the AGND ground point, using an oscilloscope (or voltmeter if an oscilloscope is not available). The goal is to have the voltage at TP23 steady at about 1.2V DC with relatively no AC voltage. When making adjustments to R26, remember that the response at TP23 is slow and delayed, so gradual changes to R26 with sufficient time for TP23 to respond are better than attempting a rapid adjustment. If the voltage at TP23 reads greater than 1.2V, turn the R26 adjustment screw clockwise. If it is too low, turn it counter-clockwise. If it is far out of adjustment, there may be an AC component to the voltage, making a voltmeter reading jump around somewhat, and there may be no detectable effect on TP23 from adjusting R23 until several revolutions have been made. The procedure is complete when the desired voltage is obtained.

Chapter 5. Hardware

Equipment and Accessories for Operation

It takes several peripheral accessories to conduct a seismic survey. Besides the seismograph, you will need a power source, geophone cables, geophones, an energy source, plus a few minor items. Specific items vary considerably depending on the survey. Because of the potential variations, only a minimum of the required accessories are supplied with the basic instrument. The remaining accessories may have been ordered with your system as options, or you may have intended to supply your own. Most seismographs have a high degree of interchangeability in accessories (particularly geophones and cables), and you may be using equipment you already own. The shipping documents should be checked to confirm the items supplied as standard equipment and those ordered as optional accessories.

Power

The StrataVisor™ portable system operates from a nominal 12 volts DC. This may be a rechargeable battery pack, a standard automotive battery, 12-volt vehicle power, or an AC-powered, 12-volt DC supply. Current drain of the StrataVisor™ varies depending on the number of channels and the options installed. The small systems draw about 8 amps, increasing with the number of channels and installed options to nearly 20 amps for the largest systems. Additional power is required for short intervals when the printer is running. The power source selected should be sufficient for a day in the field.

A general purpose power cord with clip connectors is provided with the system. Connect the seismograph to the power source tightly; momentary loss of power will cause the loss of any data in memory and possibly interfere with disk operations.

An optional rechargeable battery is available which will provide approximately 1/2 day of operation in cyclic use. The battery pack is supplied with an appropriate power cord to connect to the 3-pin Cannon plug on the seismograph. Also available with the rechargeable battery is a 110/220 volt AC-powered battery charger. Before using this charger, check and see that the proper AC voltage is selected on the switch. The Geometrics charger is designed to be connected continuously to the battery. The system will charge at a high rate until the battery is charged, then switch to a standby voltage. A light on the charger indicates when the rate switches to trickle charge, which also means the battery is charged. Charging will take several hours.

Rack mount systems operate from 110/220 AC power, 50/60 Hz. Power should be carefully regulated and free from voltage spikes and sags. Appropriate grounding is necessary.

The Energy Source

Energy source, when used in a seismic context, means a source of seismic energy; something to introduce elastic waves into the ground. There must be a means of synchronizing the energy source with the seismograph, or more specifically, triggering the seismograph when the energy source is activated. Energy sources come in a wide variety of explosive and mechanical types.

A sledgehammer is the most common energy source for shallow surveys. It is popular because it is lightweight, portable, low cost, repeatable, and safe. Its only serious limitation is its limited depth range, although it compares favorably in this respect with a number of less portable and more costly devices. Signal enhancement, or stacking seismographs (including the StrataVisor™) were developed for use with a sledgehammer. The energy from several hammer blows may be stacked into memory to increase the survey depth range.

The sledgehammer is synchronized with the seismograph by an impact-sensitive "hammer switch", taped to the handle and connected directly to the trigger connector on the seismograph. An extension cable may be used to allow the sledgehammer to be located away from the seismograph. An aluminum or steel plate (approximately the same weight as the hammer) is placed on the ground for the hammer to impact. This "striker plate" provides more efficient coupling and more precise triggering.

Explosives, such as dynamite and its derivatives, are an excellent and widely used energy sources. Optional blasters, such as the Geometrics HVB-1, are available with the StrataVisor™. The blaster provides a high voltage to detonate the blasting cap and also sends a signal to trigger the seismograph at "zero time".

Other sources which may be used with the StrataVisor™ include weight drops, shotgun-type devices (such as the "Betsy" seisgun), electro-mechanical sources, vibrators, air guns, and most other types of seismic energy sources which can be synchronized in some manner with the StrataVisor™. There are a number of ways to synchronize an energy source:

- a) If the source operates with a sharp impact, the standard hammer switch can be used (examples: sledgehammer, shotgun, accelerated weight drop, land air gun).
- b) If the source is activated with electrical energy, the seismograph can usually be synchronized with the same electrical device (examples: blasting caps, electric shotgun shells, sparker, boomer, piezoelectric transducer). Some devices have an imprecise mechanical delay and may require a device to sense the actual vibration and provide an analog record (examples: marine or borehole air guns, water gun). In that

case, the vibration sensor should be connected to one of the signal channels. Set the seismograph delay to a negative number to record a short portion of the record prior to the trigger. This will allow recording of the whole signature from the sensor to verify and correct for exact zero time.

- c) Some sources can be synchronized by placing a standard geophone (connected to the seismograph trigger input) near the source (examples: weight drop, explosives using a blaster without a trigger signal, explosives with chemical fuses). Obviously any source may be synchronized with this method, but the timing may be a little less precise. Since the geophone will not be located at exactly the point of impact, there will be some delay between the impact time and the trigger. Try and keep this delay (distance) constant.
- d) If you find yourself with a broken hammer switch or in need of even higher trigger accuracy than the hammer switch can provide, you can trigger on a contact closure by taping one trigger wire lead to the hammer head and the other to the striker plate. A contact closure (which is exactly what the hammer switch provides) will occur when the hammer strikes the plate, and this will cause the seismograph to trigger.

Remember that the seismograph can be triggered by a contact open as well as a closure. If you have an explosive with an imprecise detonation time (such as firecrackers or "zero delay" blasting caps), the seismograph can be triggered by wrapping a small wire around the explosive device (connected to the start input on the seismograph). It will break contact at the time of detonation. *If you use this method, it is recommended that you set the system to **Manual Arm** mode, so that the system automatically disarms itself immediately after the charge goes off.* Otherwise you may get false triggers after the initial detonation, as the trigger wire leads may come in contact with each other.

Geophone Cables

A geophone cable is a multi-conductor cable with connectors molded at intervals along the cable. The geophones will have connectors which mate with those on the cable. One common type is the wire-wrap takeout, which looks like a coil spring molded into the cable. The mating connector used on the geophone is a clip with a colored insulator. The takeouts and clips are different widths and colors to encourage the use of the same polarity each time the geophone is connected.

Waterproof connectors are also available from the geophone and cable manufacturers. These are preferred in wet locations despite their higher cost and complexity.

Cables for Refraction Surveys

There is a standard cable used for refraction surveys, consisting of 12 geophone connections (called "takeouts") at selected intervals. Each end has some additional lead-in cable and a 27-pin connector (Cannon type NK-27-21C). The cable is "double-ended", constructed so that it is reversible and identical from either end. The takeout closest to the connector is wired to channels 1 and 2, while the farthest is wired to channels 23 and 24. If the instrument is connected to the opposite end of the cable, the takeout that was previously the farthest away is now wired to channels 1 and 2 on that connector.

Two of these cables are used with a 24-channel StrataVisor™. The seismograph is located in the center of the line, and the two input connectors are wired so that the takeouts closest to the instrument are connected to channels 12 and 13. A similar pattern is followed for the StrataVisor™ NX48 and NX60, with two connectors, each wired to half of the channels.

Cables for Reflection Surveys

Reflection surveys differ in that continuous, overlapping surveys are usually conducted along a line. The data is processed on a computer to produce an uninterrupted cross section. In shallow exploration, these surveys fall into two types: common offset gathers (COG, or "Optimum Window") and common midpoint surveys (also called CMP, common depth point or CDP surveys).

Standard refraction cables are used for "optimum window" or "common offset gather" reflection surveys.

CDP surveys are a little more complex. Shots are fired along a line by moving the shotpoint and active portion of the geophone spread just a short distance each time. Rather than physically moving the geophones and cables each time, two, three, or four 12-takeout refraction cables, or a special cable (called a CDP cable) is used.

A roll switch is also required for CDP surveys. A roll switch is a multi-input, multi-channel switch that can select a group of geophones from a longer array, and then move that active group along the ground by electrically adding new geophones on one end and dropping geophones off the other end as the energy source is moved along the ground. The output cable of the roll switch will need the appropriate connectors to mate with the input connector on the seismograph.

Geophones

The moving-coil geophone is the basic vibration sensor. The coil and its support spring make a pendulum with a natural frequency, and this is specified for all geophones. Frequency is measured in cycles-per-second, called Hertz and abbreviated Hz. The output of the geophone is reasonably flat in responding to earth vibrations with a frequency higher than the natural frequency of the geophone. The geophone is less sensitive to vibrations with frequencies lower than its natural frequency. The sensitivity decreases (or rolls off) at -12 dB/octave below the natural frequency. Thus, for a 40-Hz geophone, the sensitivity at 20 Hz will be 1/4 the sensitivity at 40 Hz. Geophone manufacturers provide data sheets with response curves for each type of geophone.

The geophone is a pendulum, and left to its own devices will oscillate at its natural frequency. Internal friction will damp these oscillations somewhat, but additional damping is normally required. The published data sheets show the response curves with various levels of damping (the oscillation is shown as a peak near the natural frequency). A geophone is damped by connecting a resistor across its output terminals; the preferred resistor values are shown on the data sheet. Some seismographs have an input circuit with a low resistance, and geophones purchased for such instruments may not have damping resistors installed. The StrataVisor™ has a relatively high input resistance (20,000 ohms) and geophones purchased for use with the StrataVisor™ should be ordered from the manufacturer with the damping resistor installed (these can also be added later by soldering the proper value low-noise resistor across the terminals). An incorrectly damped geophone is not a disaster, the result is a boosted signal near the natural frequency, but proper damping is good practice. A properly damped geophone will have a lower output voltage because the resistor attenuates the signal.

The desired seismic information is generally called "signal". Undesirable vibrations (from wind, vehicle traffic, airplanes, surface waves, machinery) are called "noise". Improving the signal-to-noise ratio is an ongoing effort in seismic exploration. Geophone frequencies are chosen to provide adequate signals at the frequencies found in the seismic data, and preferably not at the frequencies of the noise signals (where the two are different).

Much noise tends to be low frequency (because low-frequency vibrations travel further through the ground). For shallow surveys, seismic signals tend to have a much higher frequency and a geophone with a natural frequency around 14 Hz is a good compromise.

In shallow reflection surveys, most of the problems come from large, low-frequency surface waves. Thus, it has been common to use 100-Hz geophones to filter the surface waves. Obviously, having a wide selection of geophones available is not only inconvenient, it is quite costly. The StrataVisor™ seismograph, with its high dynamic range, can compensate for most of these problems and you can normally compromise on

one good set of 14-Hz to 40-Hz wideband geophones. The seismograph's selectable lowcut filters can quickly be set in the field to the best frequency to fit the situation. Furthermore, with its 24-bit A/D converter, the StrataVisor™ will record data with sufficient resolution that digital filtering can be used later to extract signals from noise. Guidelines and compromises that were appropriate to 8-bit refraction seismographs do not apply to the StrataVisor™.

Geophone groups are sometimes used for reflection surveys. A group is a collection of geophones, wired together in series and/or parallel, connected to a single channel on the seismograph. They are spread out on the ground in an array chosen to attenuate surface waves and reinforce waves arriving vertically. Geophone groups are widely used for deep reflection surveys but are less desirable for shallow reflection surveys. The wavelengths of the surface waves in shallow surveys are too long for practical spatial filtering with geophone groups, although using 2 or 3 phones in a small group can attenuate the effects of the sound of the shot detonating.

The StrataVisor™ Seismograph

Specifications and features of the StrataVisor™ are described in Appendix A. Operation was discussed in Chapters 1 and 2. This section is intended to provide background information on the StrataVisor™ seismograph, as well as specific hardware details.

Display

The StrataVisor™ comes standard with a black and white liquid crystal display (LCD). An optional color LCD is also available. Both are easy to see in daylight. If you have a black and white display, a backlight is provided to allow viewing in subdued light or nighttime. The control to turn the backlight on and off is located in the **Display** menu. Also with the black and white display, some darkening of the screen may occur in hot weather and bright sunlight, caused by thermal heating. This can be compensated for by adjusting the contrast control, but it will help to shade the seismograph (always a good practice in high temperatures). Shading will be more effective if you do it before the display gets dark. Do not use the backlight in the hot sun; it has no effect except to use power and generate extra heat.

If you have a color display, the backlight is always on, and there are no contrast controls. The color display is generally not effected by thermal heating, but it is still good practice to keep it shaded from the hot sun.

Printer

Loading Paper

To load paper into the printer, tilt open the cover (released by pressing the two latches on either side). Remove the empty reel and two plastic end plates from the retaining guides. Insert the end plates into the new paper roll and snap the new roll into the retaining guides. The paper roll should be oriented with the loose end between the printer and the paper roll, curled upward. The printer has a small lever on its front edge which clamps and releases the paper. Move it to the free position, insert the loose end into the slot in the center of the printer (see Figure 5.1),

and feed it through the rollers. Leave enough paper protruding to conveniently feed the loose end through the slot in the instrument case. Center the paper and move the paper release to the clamp position.

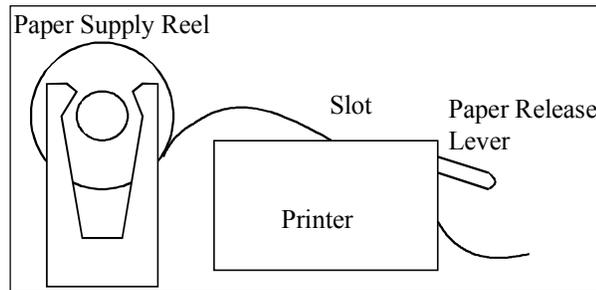


Figure 5.1 - Loading paper in printer.

Print a sample record. Adjust the paper if not centered. If the plotted records are blank, then check to see if the paper is upside down. Turn the paper supply reel over so it feeds into the printer the proper way. These instructions are also on the inside of the instrument panel.

The Print Header

The plotted record is annotated with a header, which includes information about the line and the data. Examples of the print header appear in Chapter 1.

The header will identify the source and status of the data. Raw unsaved data is identified as "UNSAVED STACKED DATA". If the data has been written to disk, the message will say "SAVED AS FILE xxxxx.DAT". Data read from a file is labeled "READ FROM FILE xxxxx.DAT". Thus, it is good practice to make paper copies of the record after, rather than before, saving the file to disk. Then, the copies can be matched with a particular file later.

The remaining parameters listed on the print header match similar descriptors on the display and menu. The channel numbers and trace sizes are listed below the descriptors. Time lines are provided at approximately 1 cm intervals, with every tenth line accented and labeled. Thus, the physical interval between the time lines is kept at a convenient spacing for picking arrival times.

Note that the print header is the only reliable source of line geometry for data retrieved from disk, since the LCD will display the current instrument settings, not the information for the file read from the hard disk.

Data Acquisition and Sampling

All modern seismographs are digital. They operate by digitizing the amplified seismic signal with an analog-to-digital converter. This digital signal is then stored in a semiconductor memory, where it can be viewed on a display, plotted on a paper record, or stored on some device for later use.

In digitizing, the seismic signal is broken up into different levels (or amplitudes) with a number assigned to each level. The number of bits used by the A/D converter is the measure of the number of levels. On traditional refraction seismographs, an 8-bit converter is commonly used. That means that there are 2^8 or 256 different levels available. Since seismic signals are either positive or negative, one bit is assigned to indicate the polarity, and the signal can range from -128 to +127 levels.

A signal that is too small to make the transition between levels will not be digitized (except that noise often will add enough random signal to make the transitions happen). The signal can also be too large and exceed either -128 or +127. When that happens the reconstructed waves have flat tops and are said to be "clipped" (clipping can also occur in the amplifier, or the memory of an 8-bit seismograph during stacking). This is not the same as the clipping that occurs when the *Trace Style* is set to "clipped" – this is a display option and does not affect the actual data. Generally, electronic clipping can be identified as irregular distorted waveforms, not perfectly flattened ones. In refraction surveys, one generally doesn't care too much about clipping, since first breaks are all that is important. However, in surveys where the entire wave form is important, particularly reflection surveys, clipping must be avoided (see Chapter 3 for a discussion of clipping).

In a seismograph, the amplifier gains must be adjusted to keep the signal significantly larger than the minimum quantization level, but less than the full-scale value. This is not a major problem in refraction surveys, since the first arrivals are easily identified and adjustments made based on the record appearance (although there is a tendency for new users to mistakenly identify the larger surface waves as first arrivals).

The principle difference between the StrataVisor™ and previous seismographs is in the quality of the digitizer. The StrataVisor™ has a 24-bit A/D converter, which quantizes the signal in 2^{24} or 16 million steps. Thus, there is extra resolution and dynamic range to allow the system to handle large and small signals simultaneously. Once the data is digitized, it is stored in memory in a 32-bit word. This is transparent to the user, although it is worth noting that having this many bits ensures that you will never saturate by stacking too many signals.

The digitizing of the signal does not take place continuously, but at regular intervals, called the "sampling interval" or sampling rate. Practical considerations dictate that a limit be put on the total number of samples taken. The sample rate is chosen so that the total seismic record fits within the memory. The StrataVisor™ has a larger than normal memory, and the operator may elect to not use all the memory available.

Consider a refraction line 5,000 ft (1,500 m) long. Unless the overburden is unusually deep, there should be bedrock velocities of around 10,000 ft/sec (3,000 m/s) and the average velocity should be above 5,000 ft/sec (1,500 m/s). Thus it will take about 1 second to travel from the shotpoint to the last geophone. With a memory length of 4096 samples, a sample interval of 0.250 milliseconds will provide a record long enough to capture all the arrivals of interest.

Most users will find that although 0.25 msec sampling provides more data than is necessary to accurately determine the time of the first arrivals, it is an appropriate sample rate when plotting and manually picking first arrivals on the StrataVisor™ printer. An experienced user employing either the StrataVisor™ automated first break picking software or a separate computer program would be quite happy with 1024 samples, with a sample rate selected to put the furthest geophone's first arrival at around the midpoint of the record (0.5 ms sampling would give you a total record length of 512 ms with 1024-sample memory length). It is generally quite easy in the field to repeat a shot, so feel free to experiment. It is important in refraction surveys to use a sample rate fast enough to spread the first arrivals away from the first part of the record.

Reflection surveys are different, since the important information is contained in the entire record. A longer record may be desirable, combined with faster sample rates. A good reflection record is likely to have the first arrivals close to the zero time on the plot, so that the refractions are hard to precisely "pick".

One of the benefits of the StrataVisor™ seismograph is that the operator can afford to use a little faster sample rate or a little longer memory than needed, save the records on disk, and then pick the arrivals later with flexibility in the display and print scale factors. It is a measure of the sophistication of the StrataVisor™ that it is actually much easier to operate than a traditional seismograph.

Triggering

The StrataVisor™ can be triggered in a variety of ways. Almost any type of signal can be used successfully, including a contact closure, contact open, saturated NPN transistor, logic pulse, positive voltage or negative voltage. The standard hammer switch or optional blaster are preferred.

Any standard geophone with a suitable connector (Bendix PT06A-8-3P[SR], Geometrics part number 21-206-003) may be used for triggering. A suitable geophone with connector installed is available from Geometrics as part number 23197-01. The standard 91-meter (300-ft) hammer switch extension cable (Geometrics part number 23219-01) may be used to locate the trigger geophone away from the instrument. The sensitivity should be adjusted so that ambient vibrations from personnel or the energy source handling do not trigger the system. Locate the geophone as close as possible to the shot point to minimize timing errors (velocities in the near surface material are likely to introduce delays on the order of 1 ms/ft or 3 ms/m). Be consistent with the spacing between the geophone and shotpoint so that timing errors remain more or less constant.

When using a contact open (such as breaking a wire with an explosive), remember that making the initial connection will trigger the seismograph if it is armed at the time, and the memory should be cleared before firing the shot.

When interfacing external electronic devices, it is good practice to isolate the ground connection between the StrataVisor™ and the external device. Connecting multiple instruments to a common ground often leads to electrical interference, called a "ground loop". Consult the factory for assistance if problems appear when interfacing such devices to the StrataVisor™.

Environmental Considerations

The StrataVisor™ is designed to operate over a wide temperature range, but these limits may be exceeded in the field. Extra effort may be required when operating in very hot or cool temperatures.

In hot weather, shield the system from direct sunlight. Be sure and turn off the display backlight (if equipped) to help keep the display cool. Do not store disks in the sun or in closed vehicles.

In cold weather, it may be necessary to wait a few minutes while the system warms up from internal heating. In extreme cold, the system can be mounted in an insulated box. Keep your spare disks in a warm place so they will be ready for use when needed. Turn on the display backlight (if equipped) to heat the liquid crystal display, and wrap the instrument with insulating material to retain the heat.

The portable StrataVisor™ is designed for use in a light rain, but only in the vertical position. Operating in a horizontal position or in heavy wind and rain may get the interior wet and damage the instrument. Fortunately, seismic surveys are not normally conducted in such weather; the wind and rain noise obscure the seismic signal. Put your instrument in the vehicle or dry place if the rain exceeds a light mist.

The StrataVisor™ is not designed for use in explosive atmospheres. Both the power switch and an internal relay may spark when actuated.

Connector Wiring

Geophone Connector

On 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 Table 5.1 for the pin assignments.

The 24-channel system has two of these connectors. The two 27-pin connectors are wired so that when two standard, double-ended spread cables are used with the system, the nearest two geophones will be connected to channels 12 and 13.

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 48 and 60-channel StrataVisor™ seismographs use a pair of 61-pin Bendix connectors. The mating connector is Bendix PT06-24-61S(SR) or an equivalent connector from another manufacturer. The wiring scheme is shown in Table 5.2.

Power Connector

The power connector 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).

<u>Pin</u>	<u>Use</u>
1	+12 Volts
2	common
3	not used

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).

<u>Pin</u>	<u>Use</u>
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.

Geophone Connector Pin Assignments for Wiring Table for 12 and 24-channel StrataVisor™ Seismographs

StrataVisor™ NX12		StrataVisor™ NX24	
Pin	Connector 1	Connector 1	Connector
<u>2</u>			
1	+1	+13	+12
2	- 1	- 13	- 12
3	+2	+14	+11
4	- 2	- 14	- 11
5	+3	+15	+10
6	- 3	- 15	- 10
7	+4	+16	+ 9
8	- 4	- 16	- 9
9	+5	+17	+8
10	- 5	- 17	-8
11	+6	+18	+7
12	- 6	- 18	- 7
13	+7	+19	+6
14	- 7	- 19	- 6
15	+8	+20	+5
16	- 8	- 20	- 5
17	+9	+21	+4
18	- 9	- 21	- 4
19	+10	+22	+3
20	- 10	- 22	- 3
21	+11	+23	+2
22	- 11	- 23	- 2
23	+12	+24	+1
24	- 12	- 24	- 1
25	nc	nc	nc
26	nc	nc	nc
27	GND	GND	GND

Note: Bold numbers in left-hand column refer to pin numbers. All other numbers refer to the seismograph channel. Each channel has two inputs, the first pin connected to + input, second to - input.

Table 5.1 - Pin connector assignments for 12-24 channel StrataVisor™.

**Geophone Connector Pin Assignments for 48 and 60-channel
StrataVisor™ Seismographs**

Pins	StrataVisor™ NX48		StrataVisor™ NX60	
	Connector 1	Connector 2	Connector 1	Connector 2
A/B	24	25	24	37
C/D	23	26	23	38
E/F	22	27	22	39
G/H	21	28	21	40
J/K	20	29	20	41
L/M	19	30	19	42
N/P	18	31	18	43
R/S	17	32	17	44
T/U	16	33	16	45
V/W	15	34	16	46
X/Y	14	35	14	47
Z/a	13	36	13	48
b/c	12	37	12	49
d/e	11	38	11	50
f/g	10	39	10	51
h/i	9	40	9	52
j/k	8	41	8	53
m/n	7	42	7	54
p/q	6	43	6	55
r/s	5	44	5	56
t/u	4	45	4	57
v/w	3	46	3	58
x/y	2	47	2	59
z/AA	1	48	1	60
BB/CC	nc	nc	25	36
DD/EE	nc	nc	26	35
FF/GG	nc	nc	27	34
HH/JJ	nc	nc	28	33
KK/LL	nc	nc	29	32
MM/NN	nc	nc	30	31
PP	GND	GND	GND	GND

Note 1. Numbers in this table refer to the seismograph channel. Each channel has two inputs, the first pin connected to + input, second to - input.

Note 2. Pins BB through NN are not used StrataVisor™ NX48.

Table 5.2 - Pin connector assignments for 48-60 channel StrataVisor™.

Maintenance and Trouble Shooting

Look outside the seismograph first; most field failures are related to external devices. These can usually be corrected by the operator.

Power

The most common problem is power failure, normally a discharged battery. The front panel has a series of lights which constantly display the battery voltage. The lights are not dependent on the internal power supply or computer, so they will function even in case of an equipment fault. Monitor the battery voltage during field operations. When the voltage drops below 10 volts, little operating time is left and every effort should be made to complete the survey as soon as possible. Become familiar with the pattern that the lights follow, so that you can anticipate battery discharge.

A battery will deteriorate in storage unless it is charged regularly. If charged monthly, the battery should retain its capacity for years. A failing battery will show decreased operating life, and will charge up in less time.

With the clip-type power cable, a vehicle battery can be used to operate the system. If the polarity is reversed, the system will not operate. However, the StrataVisor™ is protected from damage due to polarity reversal.

If the system shows symptoms of power failure, check the fuse located under the front panel near the printer.

External Keyboard Problems

Not all keyboards work the same. If the system doesn't respond to your keyboard, try plugging it in both before and after booting the system. If that doesn't work, try a different keyboard. On some compact keyboards, some of the letter keys double as numerical keys if the NUMLOCK is on. When connected to the StrataVisor™ on boot-up, NUMLOCK is sometimes enabled automatically.

Sensor Problems

If the geophone test (see Chapter 3) shows an open channel, check to see that the geophone is properly connected. If so, try substituting a different geophone. If this does not correct the problem, then the cable is suspect. Sometimes, a cable that is faulty from one end will work properly when reversed.

Print Problems

If the printer will not print, open the top of the seismograph and make sure that the paper is properly installed and that the release lever is in the correct position (see diagram under lid, or Figure 5.1). Check to see if the printer cable is plugged into the printer port next to the keyboard connection. Also, check the cable at the back of the printer for proper seating. If the printer scrolls out blank paper, the paper is probably installed backwards (it is thermal paper and only sensitive on one side).

Trigger Problems

If the system will not trigger, try using the manual trigger in the test function to see if the system triggers that way. Then, try triggering with the hammer switch without the hammer switch extension cable connected. Substitution (of another hammer switch) can be used to test for a defective hammer switch. Triggering can also be tested by shorting pins A and B of the trigger connector with a small piece of wire (a paper clip works well). If that works, then the problem is generally external to the instrument. The voltage between pins A and B should be between 4-5 volts DC.

If false triggering occurs only with a trigger extension cable or with networked systems, try grounding the system to earth ground using the ground lug located near the trigger connector. Also, try to use coaxial cable or twisted pair wires for the trigger extension. Be sure the voltage between pins A and B on the trigger connector is 4-5 volts DC.

If trigger noise appears on seismic records, try grounding the system and using coaxial trigger cable. Also, effort should be made to keep the trigger wire away from the geophone cable to prevent cross feed. If the trigger line must intersect the geophone spread, it should do so at a right angle.

Chapter 6. File Storage and Data Handling

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 used are SEG-2, SEG-Y and SEG-D, 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 the StrataVisor™. 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 and SEG-D formats used in the StrataVisor™.

¹Pullan, 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.

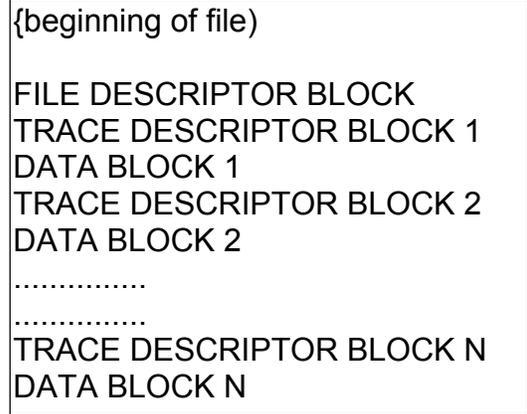
²SEG Subcommittee on Field Tape Standards, Digital Field Tape Format Standards - SEG-D, REVISION 1: Geophysics, Vol. 59, No. 4, April, 1994, pp. 668-684.

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 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 80486 processor used in the StrataVisor™. 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.

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 co-ordinate, 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.

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.

The next twenty bytes (bytes 13 through 31) are a series of 00's. 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.

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.

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.

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 was 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 was 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.

Key Words Used in Trace Descriptor Blocks

CHANNEL_NUMBER

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

DELAY

The 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:

$$\text{input voltage due to one shot} = \text{data point} * \text{DESCALING_FACTOR} / \text{STACK_COUNT}$$

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.

HIGH_CUT_FILTER

The HIGH_CUT_FILTER values are positive decimal integer 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 integer 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).

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
000000	55 3A 01 00	10 02 18 00	01 00 00 01 0A 00 00 00 U:.....
000010	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000020	30 03 00 00	7C 24 00 00	C8 45 00 00 14 67 00 00 0...|\$.E.g..
000030	60 88 00 00	AC A9 00 00	F8 CA 00 00 44 EC 00 00 `.....D...
000040	90 0D 01 00	DC 2E 01 00	28 50 01 00 74 71 01 00 .....(P..tq..
000050	C0 92 01 00	0C B4 01 00	58 D5 01 00 A4 F6 01 00 .....X.....
000060	F0 17 02 00	3C 39 02 00	88 5A 02 00 D4 7B 02 00 ....<9...Z...{.
000070	20 9D 02 00	6C BE 02 00	B8 DF 02 00 04 01 03 00 ...l.....
000080	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000090	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
0000A0	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
0000B0	00 00 00 00	00 00 00 00	00 00 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	00 00 00 00	00 00 00 00 00 00 00 00
0000E0	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
0000F0	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000100	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000110	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000120	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000130	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000140	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000150	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000160	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000170	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000180	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000190	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
0001A0	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
0001B0	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
0001C0	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
0001D0	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
0001E0	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
0001F0	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000200	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000210	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000220	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000230	1F 00 41 43	51 55 49 53	49 54 49 4F 4E 5F 44 41 ..ACQUISITION_DA
000240	54 45 20 31	32 2F 44 45	43 2F 31 39 39 36 00 1C TE 12/DEC/1996..
000250	00 41 43 51	55 49 53 49	54 49 4F 4E 5F 54 49 4D .ACQUISITION_TIM
000260	45 20 31 35	3A 35 34 3A	31 32 00 29 00 49 4E 53 E 15:54:12.)_INS
000270	54 52 55 4D	45 4E 54 20	47 45 4F 4D 45 54 52 49 TRUMENT GEOMETRI
000280	43 53 20 53	74 72 61 74	61 56 69 65 77 58 20 30 CS StrataVisorX 0
000290	30 30 30 00	19 00 54 52	41 43 45 5F 53 4F 52 54 000...TRACE_SORT
0002A0	20 41 53 5F	41 43 51 55	49 52 45 44 00 0D 00 55 AS ACQUIRED...U
0002B0	4E 49 54 53	20 46 45 45	54 00 70 00 4E 4F 54 45 NITS FEET.p.NOTE
0002C0	20 0A 20 42	41 53 45 5F	49 4E 54 45 52 56 41 4C . BASE_INTERVAL
0002D0	20 31 30 2E	30 30 20 0A	20 53 48 4F 54 5F 49 4E 10.00 . SHOT_IN
0002E0	43 52 45 4D	45 4E 54 20	30 2E 30 30 20 0A 20 50 CREMENT 0.00 . P
0002F0	48 4F 4E 45	5F 49 4E 43	52 45 4D 45 4E 54 20 30 HONE_INCREMENT 0
000300	2E 30 30 20	0A 20 41 47	43 5F 57 49 4E 44 4F 57 .00 . AGC WINDOW
000310	20 30 20 0A	20 44 49 53	50 4C 41 59 5F 46 49 4C 0 . DISPLAY_FIL
000320	54 45 52 53	20 30 20 30	20 0A 00 00 00 00 00 00 TERS 0 0
000330	22 44 4C 01	00 20 00 00	00 08 00 00 02 00 00 00 "DL..
000340	00 00 00 00	00 00 00 00	00 00 00 00 00 00 00 00
000350	13 00 43 48	41 4E 4E 45	4C 5F 4E 55 4D 42 45 52 ..CHANNEL_NUMBER
000360	20 31 00 0E	00 44 45 4C	41 59 20 30 2E 30 30 30 1...DELAY 0.000
000370	00 21 00 44	45 53 43 41	4C 49 4E 47 5F 46 41 43 .!.DESCALING_FAC

```

000380 54 4F 52 20 33 2E 34 31 37 30 30 30 45 2D 30 30 TOR 3.417000E-00
000390 36 00 13 00 46 49 58 45 44 5F 47 41 49 4E 20 34 6...FIXED_GAIN 4
0003A0 38 20 44 42 00 10 00 4C 49 4E 45 5F 49 44 20 30 8 DB...LINE_ID 0
0003B0 30 2D 30 30 00 15 00 4C 4F 57 5F 43 55 54 5F 46 0-00...LOW_CUT_F
0003C0 49 4C 54 45 52 20 30 20 30 00 14 00 4E 4F 54 43 ILTER 0 0...NOTC
0003D0 48 5F 46 52 45 51 55 45 4E 43 59 20 30 00 16 00 H_FREQUENCY 0...
0003E0 52 41 57 5F 52 45 43 4F 52 44 20 31 30 30 31 2E RAW_RECORD 1001.
0003F0 44 41 54 00 1B 00 52 45 43 45 49 56 45 52 5F 4C DAT...RECEIVER_L
000400 4F 43 41 54 49 4F 4E 20 31 30 30 2E 30 30 00 1A OCATION 100.00..
000410 00 53 41 4D 50 4C 45 5F 49 4E 54 45 52 56 41 4C .SAMPLE_INTERVAL
000420 20 30 2E 30 30 30 32 35 00 10 00 53 4B 45 57 20 0.00025...SKEW
000430 30 2E 30 30 30 31 36 37 00 17 00 53 4F 55 52 43 0.000167...SOURC
000440 45 5F 4C 4F 43 41 54 49 4F 4E 20 30 2E 30 30 00 E_LOCATION 0.00.
000450 0A 00 53 54 41 43 4B 20 31 00 1D 00 4E 4F 54 45 ..STACK 1...NOTE
000460 20 0A 20 44 49 53 50 4C 41 59 5F 53 43 41 4C 45 . DISPLAY_SCALE
000470 20 31 32 30 20 0A 00 00 00 00 00 00 E3 00 00 00 120 .....
000480 12 00 00 00 23 00 00 00 D2 FF FF FF F8 FE FF FF ....#.....
000490 37 FF FF FF 1A 00 00 00 CD 00 00 00 AC 00 00 00 7.....
0004A0 36 00 00 00 38 00 00 00 24 00 00 00 D0 00 00 00 6...8...$.....
0004B0 30 01 00 00 2D 00 00 00 26 FF FF FF 42 FF FF FF 0...-...&...B...
0004C0 6C 01 00 00 A0 01 00 00 19 00 00 00 EB 00 00 00 l.....
0004D0 65 00 00 00 60 FF FF FF 2D FF FF FF E0 FE FF FF e...`...-.....
0004E0 2B 00 00 00 D5 00 00 00 E1 FF FF FF 28 FF FF FF +.....(....
0004F0 8E FF FF FF 7B FF FF FF B1 FF FF FF 53 00 00 00 ....{.....S...
000500 90 FF FF FF 76 FF FF FF B5 FF FF FF EE FE FF FF ....v.....

```

data from trace 1 continues

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 traces 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.

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.l...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 DE 0A 39 5A 8F E2	..\...uo6.....9Z..

data from trace 1 continues

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  xxxxxxxxx
Number 6:  SAMPLE INTERVAL xxxxxxxxx usec  RECORD LEN  xxxxxxxxx
Number 10: FILTERS  LOW CUT  xxxx HZ  HIGH CUT  xxxxxxx 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.

Storage Capacity

The number of files which can be stored on a disk drive varies with the amount of memory 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) * (number of bytes in a data word), then add some for the header information (approximately 700 bytes for the file header and $N \times 600$ bytes for the trace headers).

The amount of memory 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	Files/1.44 Mb Floppy	Files/100 Mb Hard
12	2048	106K	12	940
12	4096	204K	7	490
12	8192	394K	3	250
12	16396	794K	1	125
24	2048	212K	6	470
24	4096	410K	3	240
24	8192	800K	1	125
48	2048	423K	3	230
48	4096	816K	1	120
48	8192	1600K	0	60
60	2048	528K	2	190
60	4096	1020K	1	100

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. See Chapter 4 (Advanced Features) for a discussion of data transfer options.*

In general, the very long records will only be used with a vibrator source. Once the data is correlated, the resultant file will be much shorter.

Support Disks

The StrataVisor™ comes with disks called "Support Disks". These include programs and data used to support the system. The seismic program is included, along with sample data, and some additional files. The latest revisions to the software, format, and operating instructions will be found here.

Geometrics has sample data sets for refraction and reflection surveys available on request.

Loading the seismic program

The operating software of the StrataVisor™ is stored on hard disk drive C:. The software is normally resident in the system and will be loaded automatically by the autoexec.bat file to configure the system as a seismograph. This software may also be loaded from drive A: in the case of a failure or, more commonly, to update the system software.

To load the new software, simply insert the support disk and follow the instructions on the label. Further information can be found in the "Readme" file on the disk.

Chapter 7. Hardware Troubleshooting

Internal System Problems

If you are comfortable working on your personal computer (that is, installing circuit boards and disk drives), then you should be qualified to perform simple repairs on the StrataVisor™. Alternatively, a local computer service center may be able to assist you with some problems in an emergency.

On rare occasions, the StrataVisor™ software on the hard disk may become corrupted. Symptoms include a blank display or a message on the screen after the power up sequence instead of seismic traces. If this happens, try and re-load the system software from the disk supplied with the seismograph. Simply insert the support disk in the floppy drive and follow the instructions on the label.

For repair discussion purposes, the StrataVisor™ can be broken into two functional blocks. These will be called the "seismograph" and the "computer" for convenience, although they are closely integrated.

The seismograph portion consists of a multipurpose OMNI board and one to six (eleven if a rack-mount system) acquisition boards. These boards are of dense, surface-mount construction and do not contain any parts which can be serviced in the field. Repair of these boards not only requires specialized training and familiarity with the details of the system, but also special tools for working on surface-mount products. Do not try and repair either of these boards. If you have a problem, return the unit to the factory or substitute a new board if you purchased the optional spares kit.

There is also a power supply board (located in the very bottom of the unit) which provides the multiple DC voltages required by the system. There are five light-emitting diodes located on the power supply to monitor the output voltages. All these lights should be lit if the power supply is working properly (although the fault could be located on another board). The power supply circuit boards can be serviced by authorized Geometrics service facilities.

The computer part of the system consists of selected components used in the manufacture of standard personal computers. These include the CPU board with memory, the 3 1/2-inch disk drive, and an IDE hard drive. These components are not normally serviced, because the cost of repair exceeds their purchase price, and problems are fixed by substitution. If you purchased a standard spares kit, these components will be available for immediate replacement. Otherwise, you may be able to purchase them locally.

StrataVisor™ Rack Mount Chassis

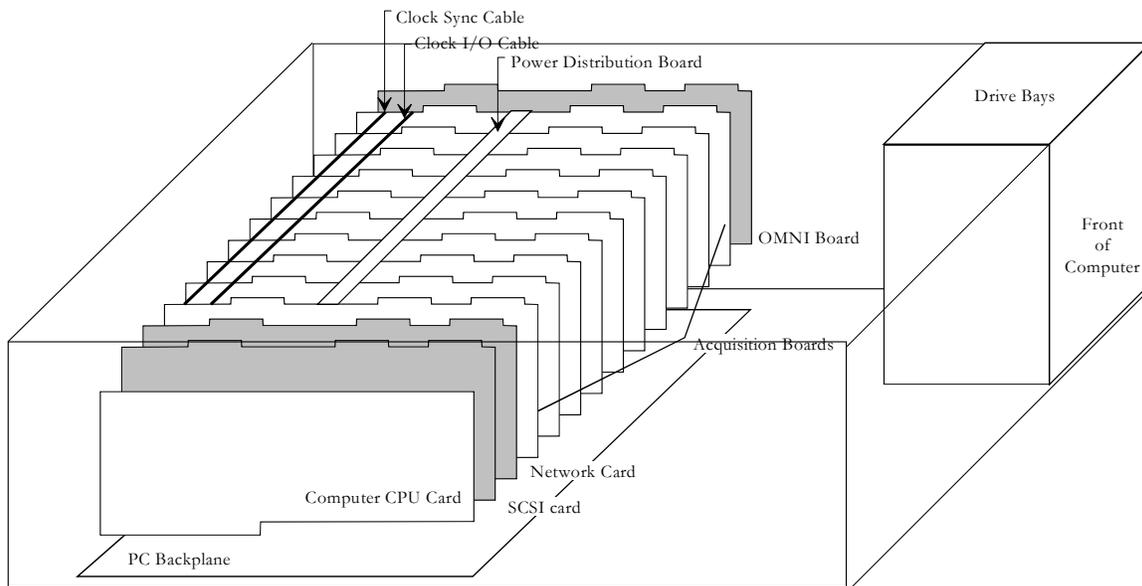


Figure 7.1 - StrataVisor™ Rack Mount System.

StrataVisor™ Portable Chassis

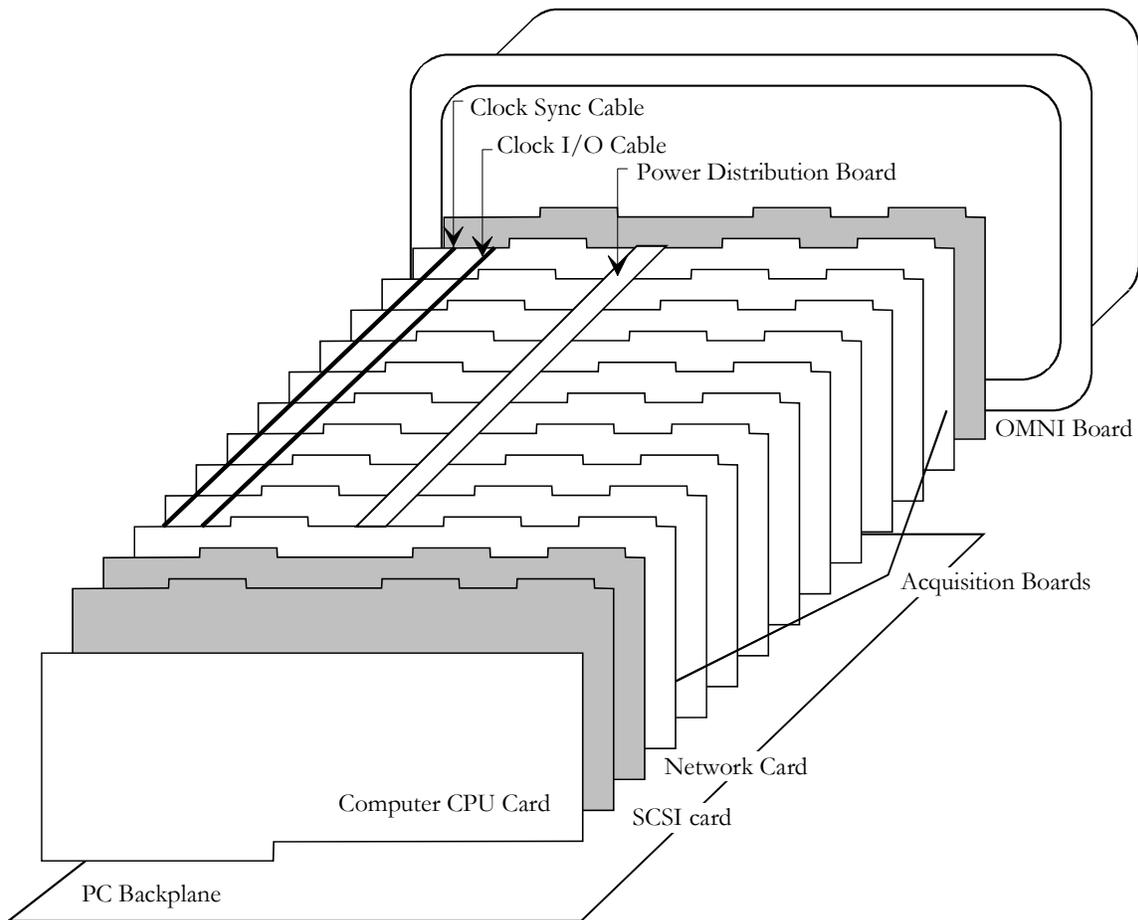


Figure 7.2 - Portable StrataVisor™ System.

The StrataVisor™ consists of the following major boards:

OMNI Board. This board contains the IDE hard drive controller, LCD and VGA video controller, floppy drive controller, key panel circuitry, and trigger circuitry.

Acquisition Boards. These boards perform the actual signal amplification and digitization.

Network Card (optional). This is an off-the-shelf 3COM network card, mounted to a fiberglass card holder. The connector has been modified to fit into the physical constraints of the StrataVisor™. **SCSI Card.** This is an off-the-shelf Adaptec SCSI controller, also mounted to a fiberglass card holder.

Computer Card. This is a purchased single board computer card, manufactured by DTI.

PC Backplane. This is also purchased from DTI.

The picture below shows the StrataVisor™ chassis before any disassembly:

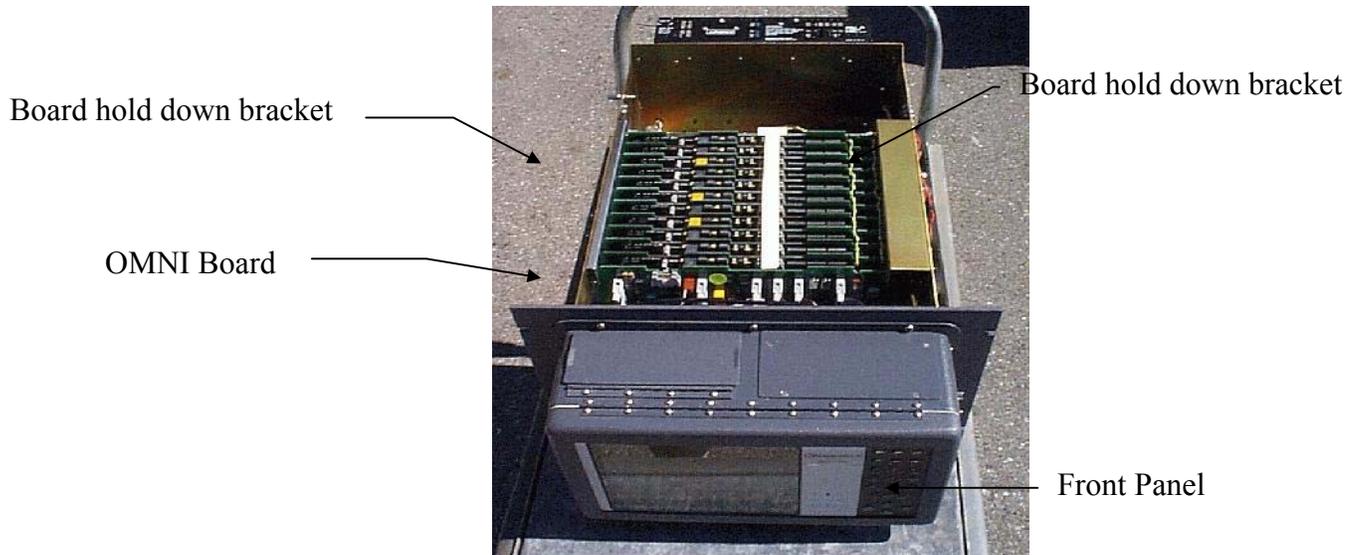


Figure 7.3 - Front View of Rack-mount StrataVisor™ Chassis.

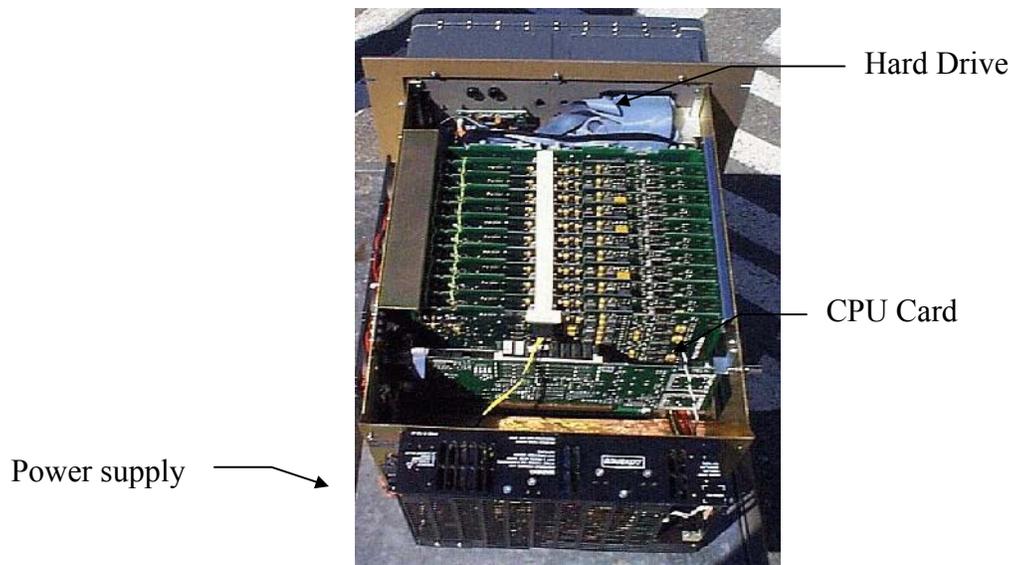


Figure 7.4 - Rear View of Rack-mount StrataVisor™ Chassis.

Troubleshooting

Overview

There are several steps to be followed to isolate the cause of a problem. One should, of course, always start with the easiest checks, and proceed further to the more complicated.

First, check the software settings. These settings are described in more detail in the Chapter 3 (Interactive Menus).

Second, check the ERROR.LOG file located in the D:\GEOMETRICS directory on the StrataVisor™. More detail is given on this file later. This file will often point to the offending acquisition board, if such is the case.

Second, if PC boards have been exchanged or moved, check the jumper settings of all the boards in the system. The software may become very confused if the settings are not correct and generate error messages that have nothing to do with the actual problem.

Third, carefully reseat all of the boards in the system. Pull each board out and firmly replace it in the backplane slot. Check all cable connections as well. Again, this is best done by disconnecting and firmly reconnecting every cable. If the software is crashing or memory problems are otherwise suspected, you should also reseat the memory SIMMS on the computer card. **DO THIS VERY CAREFULLY**, as the pins are exceedingly fragile.

Fourth, try swapping or replacing suspected boards. Be sure to modify the jumper settings correctly. There is nothing that can be done to repair a bad acquisition board in the field. Geometrics strongly suggests that spares be on hand.

Symptoms

This section mentions some problems that may be encountered and what component might be responsible. More detail on troubleshooting particular components will be found in the next section.

Acq Unit reports X channels when Y channels are expected

This message appears in a dialog box when the StrataVisor™ program is initializing. The number of channels expected ('Y') is set in the Configure / Hardware menu. The number of channels reported ('X') is set by the Acquisition Device Registry Setup program.

System won't boot

Since the StrataVisor™ is a normal PC compatible running the NT operating system, it will go through the usual NT boot procedure. Most errors such as a bad floppy drive, bad hard drive, etc., will be indicated by messages as the system goes through its self-checks. Check the CMOS settings (refer to the later section) first if any problems are noted.

Make sure the power is plugged in and the power supply is working.

Make sure the display is functioning properly. You should hear the characteristic sounds of the hard drive if the system is booting. Plug in an external monitor if you are not sure.

StrataVisor™ software reports errors or crashes repeatedly

This can be caused by incorrect jumper settings on an acquisition board, failure of an acquisition board, or by CPU Board problems. If these problems persist, please refer to the appropriate section.

This symptom may also be caused by incorrect setting of the network or SCSI card. Refer to the Troubleshooting chapter for the correct settings of those cards.

Make sure all the boards are properly seated before working further to isolate the cause of this problem.

Some analog traces are dead or noisy

First, swap the external input connectors to see if the problem moves to a different channel. This would indicate external cable or phone problems.

A set of 12 channels are all dead or noisy

Follow the signal path from the front panel connectors, to the relay boards on the Test System, then to the acquisition board. Make sure cables are connected properly. If noise is the problem, shift the cabling to see if that changes the nature of the noise. This would indicate an external noise source too near the cabling.

Next, swap the cables between the Bendix connectors and the relay boards. If the problem now changes to a different set of channels, then those cables are the source of the problem.

Finally, try swapping the cables between the Test System relay boards and the acquisition boards. First, swap the ends connected to the relay boards. If the problem now shifts channels, then the relay board is bad. If not, swap the ends nearest the acquisition board. If the problem now shifts channels, then that cable is bad.

If the problem is still on the same set of channels through out all this swapping, then it is likely that the acquisition board is bad. Replace it if a spare is available, referring to the section below on the acquisition boards.

System fails one or more analog performance tests

First, rerun the tests a few times to see if the problem is a statistical problem. Due to the random nature of the noises being measured, and the finite time intervals over which the measurements are taken, a channel will occasionally fail a test. This should be considered normal if it is infrequent. Please refer to the section on running tests in the Seismic Controller User's Guide gives more details.

Consistent failures of a certain channel, or especially all channels of a certain acquisition board, indicate a more serious problem. Refer to the section above on noisy channels to check if the problem is in cabling or the acquisition board.

"Test oscillator not stabilizing. Adjustment required. "

Please refer to the section on adjusting the test oscillator Chapter 4(Advanced Features).

Components

CMOS Settings

The only setting that is not the normal default setting is the keyboard detect setting. Set this to ignore keyboard errors on startup if you see the message "Keyboard not found" on boot up. The key panel of the StrataVisor™ does not emulate an actual keyboard during this power on testing.

Hard Drive

A bad hard drive is usually indicated by the message "HDD Failure" or something similar on boot up. This may be caused by a bad OMNI board or a bad hard drive. Replace the OMNI board first, as this is easiest. If problems persist, replace the hard drive. The software will then need to be re-installed from the back up floppies. Refer to the Seismic Controller User's Guide for installing software.

Commonly available software (such as Norton Utilities) may be used to diagnose or fix many hard drive problems.

Floppy Drive

Floppy drive errors may be caused by a bad OMNI board or a bad floppy. Replace the OMNI board first as this is easiest. Then replace the floppy drive if necessary.

A spare floppy drive can be plugged in without removing the mounting screws from the existing floppy drive. Simply remove the ribbon and power cables and plug them into the spare drive. Make sure the new drive does not short itself against any conductive material. If the floppy drive is now seen by the system, you can then replace the drive.

CPU Board

First, check that the fan on the top of the CPU is operating. Random software crashes may be caused by an over-heated CPU.

A bad memory SIMM will also cause random crashes. The memory test that occurs on power up is virtually useless in actually detecting memory errors. Its purpose is only to tell DOS how much memory is actually present in the system. Do not think that the memory is good simply because it passes the power on test (the power on test should, however, reflect the correct amount of memory). First, reseal all the memory SIMMS. Do this very carefully, as the pins are very fragile. If random crashes persist, replace all memory SIMMS (they are not expensive), or the entire CPU board.

Acquisition Board Problems

You may suspect an acquisition board problem if the following symptoms occur:

1. System reports acquisition board error when booting. Which board has a problem will be mentioned.
2. All traces are dead on a particular board.
3. System hangs repeatedly without other explanation.

Consult the file `ERROR.LOG` in the `D:\GEOMETRICS` directory. Many types of errors are logged in that file, which will indicate which board is having a problem.

If a spare acquisition board is available, replace the offending board with the spare. See the section below on replacing an acquisition board. Refer to the section. "Identifying the correct acquisition board" to identify which board is having the problem

If no spares are available, try swapping two acquisition boards. Be sure to change the jumper settings on each board if necessary. If the problem follows a particular board, you can be sure that board needs replacement.

If the error occurs on the same logical board number, then the problem is either in the software setup, or the backplane slot. If not all slots are used, then move the boards so that

the bad slot is not used. Acquisition boards may be in any slot of the backplane. The software will search for board from the lowest logical slot number to the highest, and number them in the order it finds them. If you are sure that the software is set up correctly and there are no free slots, then the backplane will need to be replaced. This is a job best left to a factory-trained person.

Identifying the Correct Acquisition Board

The acquisition boards are numbered by the software according to the backplane slot number in which they are found. Acquisition boards are numbered in order, from 1 to N, starting with the lowest slot number. Slots may be left unused anywhere in the system.

For example, the acquisition board in the lowest slot number will be board number 1, and contain channels 1-12. The acquisition board in the next lowest slot number will be board 2, etc. If a board is missing, or has failed in a manner such that it is invisible to the software, it will not be numbered. The acquisition board numbering will always be continuous.

This is a very important point. If you remove acquisition board 1, for example, channels 1-12 will not go missing. Rather, all the boards will drop a number. The input that previously was called channel 13, for example, will now be reported as channel 1 by the software. There will, of course, be 12 fewer channels in total; they will still start with number 1.

The other important issue is that the slots of the backplane are not numbered sequentially by position on the backplane. Please refer to the diagram below. The slots are labeled on the backplane itself, but the numbers are difficult to read when the chassis is full of boards.

Slot numbering of backplane. On the Portable chassis, the CPU board slot is mounted toward the power supply, the OMNI board nearest the LCD panel. On the rack mount computer chassis, the CPU board is on the left, when viewed from the front of the computer.

Slot	Board
13	OMNI Board
6	
12	
5	
11	
4	
10	
3	
9	
2	
8	
1	
7	
CPU	CPU Card

The top of the table represents the front of the backplane (the side nearest the LCD panel). Slots may be left empty anywhere in the system if not all are needed. The CPU board must go in the very bottom slot. The OMNI board needs to be the front-most board so the cables may reach it. Note that if not all slots are used, the OMNI board does not need to be in slot 13.

Board Numbering for 132 channel system:

Slot	Board	Channels
13	OMNI Board	
6	Acquisition Board 6	61-72
12	Acquisition Board 11	121-132 or AUX: 129-132
5	Acquisition Board 5	49-60
11	Acquisition Board 10	109-120
4	Acquisition Board 4	37-48
10	Acquisition Board 9	97-108
3	Acquisition Board 3	25-36
9	Acquisition Board 8	85-96
2	Acquisition Board 2	13-24
8	Acquisition Board 7	73-84
1	Acquisition board 1	1-12
7	Network Card	
CPU	CPU Card	

Board Numbering for 120 channel system with SCSI Card:

Slot	Board	Channels
13	OMNI Board	
6	Acquisition Board 5	49-60
12	Acquisition Board 10	109-120
5	Acquisition Board 4	37-48
11	Acquisition Board 9	97-108
4	Acquisition Board 3	25-36
10	Acquisition Board 8	85-96
3	Acquisition Board 2	13-24
9	Acquisition Board 7	73-84
2	Acquisition Board 1	1-12
8	Acquisition Board 6	61-72
1	SCSI Card	
7	Network Card	
CPU	CPU Card	

The position of the Network and SCSI cards may be interchanged.

Repair and Replacement

Replacing the OMNI Board

To replace the OMNI board, perform the following steps:

1. Remove the brackets holding the Omni Board in place.
2. Remove the Power Distribution PCB and the Clock and Clock Sync cables.
3. Remove the ribbon cables from the OMNI board. Spread the levers of the card edge connector wide to facilitate sliding the connector past the chassis.
4. Carefully lift the OMNI board loose from the EISA slot and remove it. Lift with even pressure on each side.

Installation is the reverse of removal. Be sure to set the jumpers properly before installing. Refer to page 14 if you lose track of which ribbon cable goes to which connector. Also, make sure that the PCB is held in place by the slotted bracket deep inside the chassis near the geophone ribbon cables.

OMNI Board Jumper Settings

Please refer to the diagram below of the Omni board.

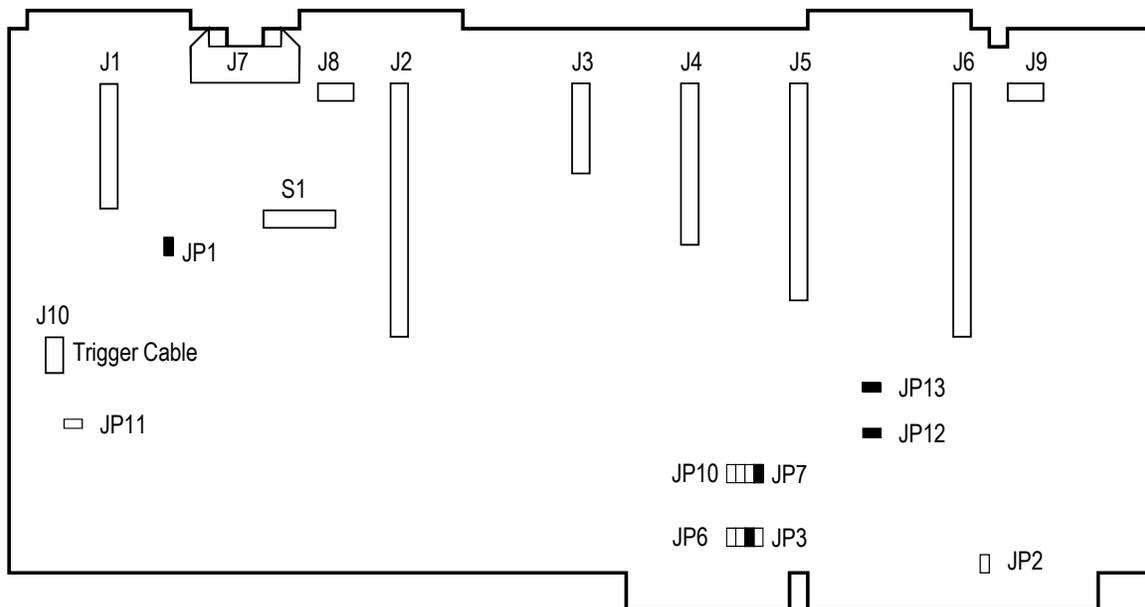


Figure 7.5 - Schematic of OMNI board.

Omni Board Jumper LK3 - 6

These jumpers set the IRQ used by the trigger of the seismograph. This should normally be set to IRQ 11.

Jumper	IRQ
JP3	IRQ 10
JP4	IRQ 11
JP5	IRQ 12
JP6	IRQ 15

All of the acquisition boards in the system must be set to the same IRQ as the OMNI board. This IRQ may not conflict with any other used by the system.

Omni Board Jumper LK7 - 10

These jumpers set the IRQ used by the seismograph keypad. This should normally be set to IRQ 10.

Jumper	IRQ
JP7	IRQ 10
JP8	IRQ 11
JP9	IRQ 12
JP10	IRQ 15

Other Jumpers

The rest of the jumpers must be installed as follows:

Jumper	Function	Position
JP1	VGA Bios enable	Installed
JP2	IDE IOCHRDY	Not installed
JP11	Trigger cable shield	Not installed
JP12	IDE drive enable	Installed
JP13	Floppy drive enable	Installed

S1 Position

This sets the VGA panel configuration. It must be set to 00111110 (0 = OFF):

Switch:	1	2	3	4	5	6	7	8
Position:	0	0	1	1	1	1	1	0

Omni Board Cable Wiring

Most of the ribbon cable connectors are a different size, so it is easy to identify which is which. Be very careful, however, as the IDE connector (J6) and the front panel cable (J2) are the same size. The IDE cable plugs directly to the hard drive, while the front panel cable passes through Cable Slot A, as indicated below.

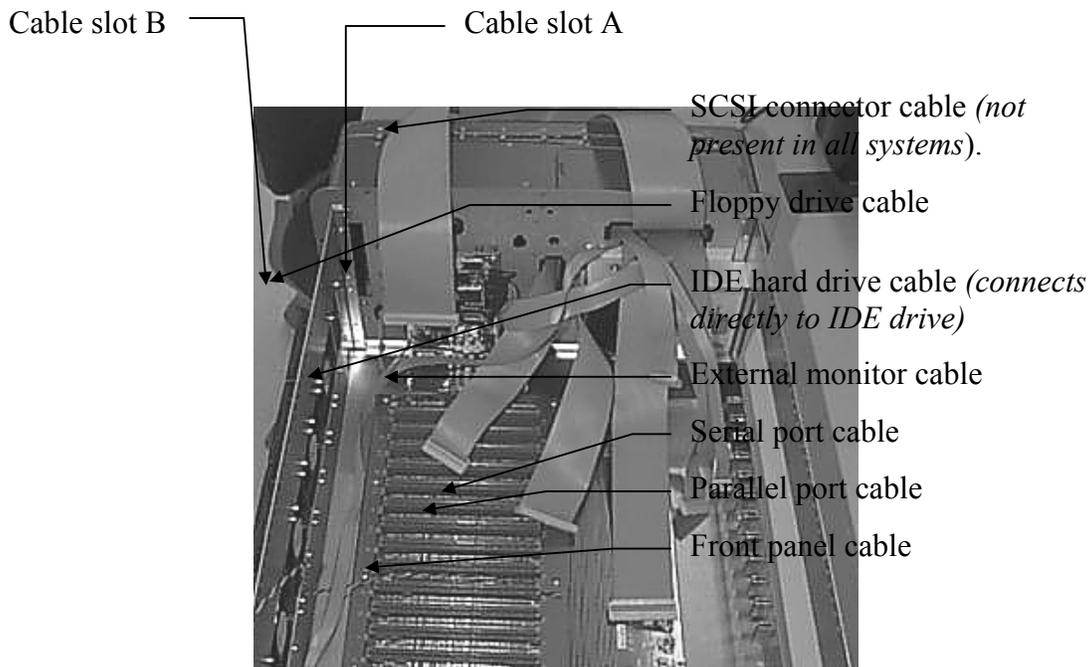


Figure 7.6 - Cables to be connected to Omni Board.

Connector	Connect To
J1	External monitor connector.
J2	Front panel interface
J3	Serial port panel connector
J4	Parallel port panel connector
J5	Floppy drive
J6	IDE hard drive
J7	Power Distribution PCB
J8	Speaker port on the motherboard
J9	Not Used
J10	Trigger cable.

Replacing an Acquisition Board

To replace an acquisition board, follow the following steps:

1. Remove the brackets holding the acquisition board in place
2. Remove the Power Distribution PCB and the Clock and Clock Sync cables.
3. Remove the Geophone ribbon cable. Spread the levers of the card edge connector wide to facilitate sliding the connector past the chassis.
4. Gently lift the acquisition board loose from the EISA slot and remove the board.

Installation is the reverse of removal. Be sure to set the jumpers properly before installing the acquisition boards. Also, make sure that the PCB is held in place by the slotted bracket deep inside the chassis near the Geophone Ribbon cables.

Each PC board needs to be fully seated. Check the alignment of all the PC boards to make sure they are even and of the same height.

Acquisition Board Jumper Settings

Please refer to the picture below of the StrataVisor™ NX acquisition board.

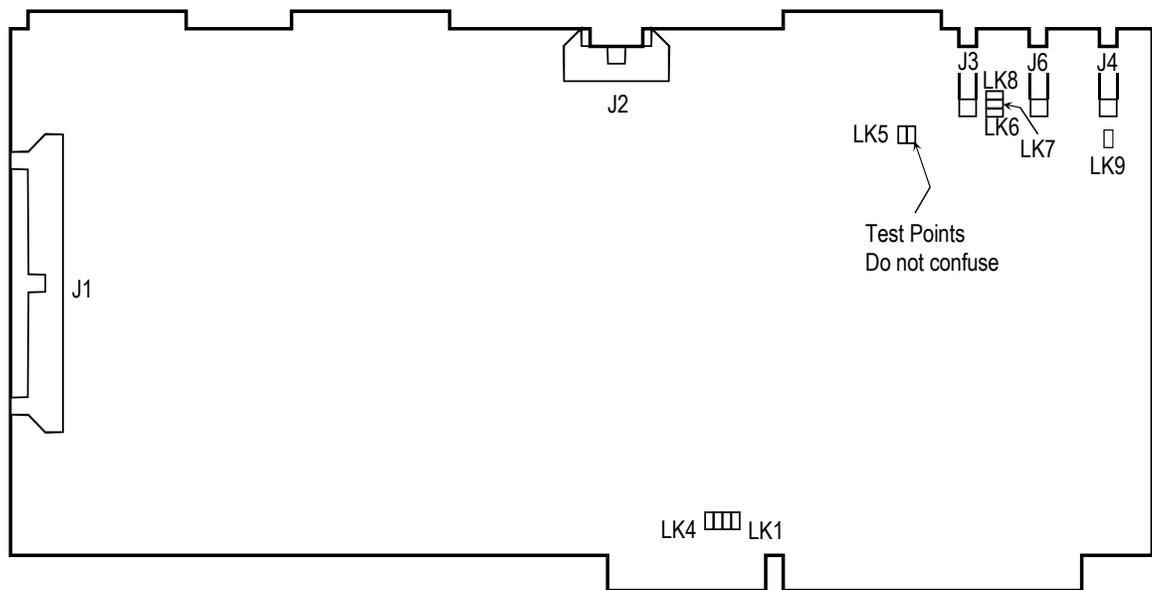


Figure 7.7 - Acquisition board jumper settings.

Jumper LK1-4

These jumpers set the IRQ used by the trigger of the seismograph. This should normally be set to IRQ 11.

Jumper	IRQ
LK1	IRQ 10
LK2	IRQ 11
LK3	IRQ 12
LK4	IRQ 15

All of the acquisition boards in the system must be set to the same IRQ. The OMNI board of the system must be also be set to the same IRQ. This IRQ may not conflict with any other used by the system.

Other Acquisition Board Jumpers

LK5 LK6 LK7	The front acquisition board of the seismograph must have all three of these jumpers installed. All other boards will not have any of these jumpers installed. The front acquisition board is the one nearest the LCD panel. It does not necessarily mean logical board 1 (ch. 1-12).
LK8	The last acquisition board of the seismograph must have this jumper installed. All other boards will not have this jumper installed. The last acquisition board is the one nearest the power supply at the rear of the chassis.
LK9	One board must have this jumper installed. This should be one of the boards near the middle of the seismograph. Only one board will have this jumper installed.

Acquisition Board Cable Wiring

Connector	Connect To
J1	Geophone Ribbon Cable.
J2	Power Distribution Board. Carefully connect, so as not to bend the connector pins or the nearby capacitors. Be Very Careful!
J3	Clock Cable.
J4	Clock Sync Cable.
J6	This is not used. Do not confuse with J3 or J4 when wiring those cables.

Appendix A. Specifications

Analog to digital conversion: 24 bit, high-dynamic range Sigma-Delta A/D converter.

Dynamic range: Greater than 120 dB at 8 ms sampling rate and 0dB preamp gain.

Noise: Less than 0.5 μ V RMS at 2 ms sampling rate and 48 dB preamp gain at 25 degrees C.

Harmonic distortion: Less than 0.001% at 20 Hz. Less than 0.05% at 500 Hz.

Common mode rejection: Greater than 100 dB at 48 dB preamp gain, 75 dB at 0 dB preamp gain (both at 100 Hz).

Preamp gains: 0, 24, 36, 48 dB, selectable from menu on a channel-pair basis.

Maximum input signal: 4.72 V peak at 0 dB preamp gain.

Input impedance: 20K ohms parallel with 0.022 μ F, differential. 10K to ground from either input.

Anti-alias Filters: Zero-phase digital anti-alias filter automatically selected for each sample rate. -3dB corner frequency at 82 % of Nyquist frequency, down 130 dB at Nyquist.

Crossfeed: Less than -115 dB at 100 Hz at 48 dB preamp gain.

Stacking Trigger Accuracy: $\pm 1/128$ of the sampling interval.

Timing accuracy: 100 ppm.

Signal Filters: Four filters are available for improving seismic signal-to-noise ratio, both *during* and *after* acquisition.

Two filters can operate during acquisition as part of the digital processing sequence using floating point calculations with a 24-bit mantissa and an 8-bit exponent. Two additional post-acquisition filters operate on records stored in memory, and resultant waveforms may be displayed on the screen, plotted on paper, and processed. When the data is saved on disk, the original record is saved, not the post-acquisition filtered version.

Highcut: Selectable at 250, 500, or 1000 Hz and Out, Butterworth, attenuation slope of 24 or 48 dB/octave, excluding corner frequencies greater than one-half the Nyquist frequency.

Lowcut: Selectable at 10, 15, 25, 35, 50, 70, 100, 140, 200, 280, 400 Hz and Out, Butterworth, attenuation of 24 or 48 dB/octave, excluding corner frequencies greater than one-half the Nyquist frequency.

Notch: Selectable at 50, 60, 150, 180 Hz and Out, with the 50-dB rejection bandwidth 2% of center frequency.

Sample rates: Samples data at 4000, 2000, 1000, 500, 250, 125, or 62.5 samples per second (250, 500, 1000, 2000, 4000, 8000, or 16,000 μ sec).

Record length: Selectable up to 16,000 samples/trace standard, up to 64,000 samples/trace available. Time duration of record is the record length times the sample interval, e.g. 20K at 2 ms = 40 seconds.

Delay: Record initiation may be postponed from 0 to 9.999 seconds in 1 msec increments.

Pre-trigger data: Data is acquired continuously and system will acquire, display and save some portion of the record prior to the actual zero time trigger. Amount of pre-trigger data is menu selected in milliseconds, limited to a maximum of 4,096 samples.

Trigger: System will trigger from a hammer switch, contact closure, contact open, saturated NPN transistor, or positive or negative voltage. Minimum interval between successive triggers and trigger sensitivity are adjustable from the menu. Event-detection trigger available for monitoring applications.

Stacking: Data from repetitive shots is digitally summed into a 32-bit register, allowing thousands of stacks without clipping. Stack options include: autostack, whereby each shot is automatically added to the previous; and preview, whereby the current record is displayed and either accepted (stacked) or rejected by the user. The most recent stack can be removed using the unstack option. Stacking polarity can be reversed for shear wave enhancement. If autosave is enabled, record will be saved after a user-specified number of stacks.

Memory Freeze: Operator can select individual or groups of channels to protect them from further stacking or erasure.

Correlation: Built-in correlator for use with swept vibratory or pseudo-random sources. Will correlate a 12-channel record with length of 12K in 2.0 seconds, or 64K in 10 seconds. Will correlate a 60-channel record with length of 12K in 3.8 seconds, or 64K in 20 seconds. Listen time and final record length independently selectable.

Marine surveys: When combined with the CNT-1 Marine Controller, the StrataVisor is a full-featured marine system. Contact factory for details.

Number of channels: The StrataVisor™ is available with 12, 24, 36, 48, 60 or 72 channels in the portable console. The rack-mount option can be configured to 120-channels plus auxiliary channels.

Networking capability: Multiple StrataVisor™ seismographs, both portable and rack-mount, may be connected via high-speed network to construct systems with large numbers of channels. One unit is selected as the master, and will remotely control all the systems on the network. All data is displayed on the master unit and saved to the master hard drive or SCSI device. Additionally, StrataVisors can be networked to a separate PC for real-time data processing and QC.

Display: 500 Lumens, daylight-visible color liquid crystal display, VGA compatible, 800 x 600 dots, 16 x 21 cm. viewing area. Displays data in wiggle trace, variable area, gray-scale variable area, clipped wiggle trace or clipped variable area. Also displays cursor time lines for picking events on the record.

Display Gains: Data may be displayed in fixed gain, normalized, or with automatic gain control. AGC is digital, with a moving window that looks ahead to compensate for first breaks. Window length is operator selected to adjust AGC time constant.

Internal Plotter: 11-cm wide, 640-dot high-resolution thermal plotter, plots seismic data in same formats as display, with annotated time lines and record header with acquisition parameters. System will also drive external Windows NT-compatible plotters and printers. Consult factor for recommended devices.

Noise monitor: Continuous, full-waveform waterfall display or standard bar-graph style.

Data storage: 3 1/2-inch, 1.44-Mbyte DOS-compatible floppy disk and a ruggedized 4-Gbyte hard disk. Data stored in the SEG-2, SEG-Y or SEG-D standard format for use by processing houses and third party software. Data is stored in 32-bit fixed point. True amplitudes are preserved. Does 32-bit fixed apply in SEG-D and SEG-Y?

Survey geometry: Operator can input coordinates or geometry of survey line, and data will be stored in file header and used in QC programs. Shot/geophone coordinates can be automatically incremented in production shooting situations.

SCSI interface: Allows data storage on external devices.

Computer: Internal IBM-compatible, Pentium- based. Memory depends on number of channels; up to 512 Mbytes available. Includes 3 1/2-inch floppy and 4 Gbyte hard disk, color LCD VGA display, and connectors for external VGA color monitor, keyboard, parallel

printer, RS-232, network and SCSI. External accessories are standard commercial types (not supplied with system unless ordered as an option).

Processing: The seismograph has built-in QC software including first break picking, T-D plotting, refraction interpretation, synthetic reflector modeling, reflector curve fitting, and normal moveout corrections. All of these are accessible from the keypad and do not require exiting the seismic program. In addition, third-party software packages are available to do field VSP QC processing, final VSP processing, reflection processing, and others. Programs written for DOS-based systems will normally run on the StrataVisor™ system.

Clock: System clock, with time of day and date, stored in file header with record.

Power: Portable system operated from a nominal 12 volts DC from a power supply, rechargeable battery pack, or vehicle battery. Current drain ranges from 8 amps for a 24-channel system to roughly 15 amps for a 60-channel system. Rack-mount systems operate from standard 110/220 VAC mains power or generator.

Physical: Weight 16 kg for 24-channel system, 17 kg for 60-channel system, dimensions 43 x 25 x 46 cm.

Environmental: Portable operates from 0 to 50 deg C. Weatherproof with cover on, will operate in light rain in vertical position with cover removed. Rack mount systems must be sheltered appropriately.

Connectors: 12 and 24-channel units use standard NK-27-21C geophone input connectors, larger systems use 61-pin Bendix connectors. Computer connectors are IBM AT compatible.