GeoSonics

SAFEGUARD SEISMIC UNIT

5500

Portable Printing Seismograph With CompactFlash™ Data Card
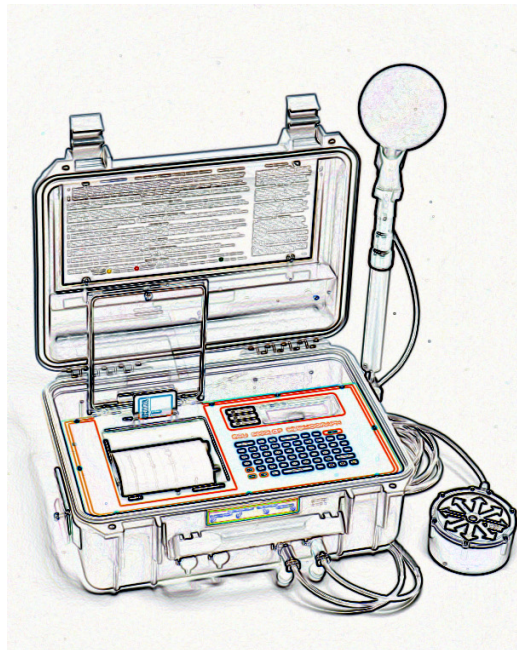
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NOTE: The following manual is applicable for SSU 5500 seismograph operation.

INTRODUCTION

Welcome to the Safeguard Seismic Unit family of seismographs. The SSU 5500 was designed with the user in mind. It has a tough, weather resistant case. The enhanced keypad has large tactile keys for easy on-site setup. Metal quick-lock connectors ensure secure cable connections. It features a facsimile style printer for on-site printouts. External ports allow the case to remain closed during monitoring operations. The low-density geophone (which complies with ISEE recommendations for "equal to or less than" densities), 2 hertz high pass microphone, microphone stand, and all other standard accessories fit easily into the storage compartment.

The full "QWERTY" style keypad makes setup and data retrieval fast and easy. The removable CompactFlash^{TM} card facilitates data transfer to a PC.

The SSU 5500 portable printing seismic monitor has three recording modes – triggered, histogram/continuous, and sustained trigger. The 5500 can record up to 10,000 events on its CompactFlash^{TM} media card regardless of event length. Multiple options are available to the user to customize data collection.

The four-line LCD window not only makes on-site programming easy, it also permits the user to review results in the field before printing. The included Analysis Software can be used for compliance analysis and custom printouts.

Data can be collected in either imperial (US customary) units or metric units. Enabling the timer option will turn the unit on and off at pre-selected times. The timesaving template utility can be used to store often-used setup configurations. The internal lead-acid battery is easily charged using the included AC adapter.

GeoSonics Inc. is a leader in seismograph innovation, manufacturing, and vibration consulting. When designing our equipment user-friendly interfaces, ruggedness, and reliability are not just goals - they are standards.

A NOTE TO OUR USERS:

The GeoSonics Safeguard Seismic Unit family of seismographs is continually evolving. Technological advances and changes in both client needs and regulatory requirements influence hardware and firmware enhancements.

In order to provide our clients with the most up-to-date equipment, GeoSonics has a standing policy to upgrade seismograph firmware to the latest version when we calibrate the seismograph. Please refer to any new documentation included with your seismograph for new features and changes in operating instructions.

QUICK START GUIDE

1. Securely couple geophone to surface.

2. Plug geophone cable into geophone jack. Turn the quick-lock connector clockwise to secure the connection.

3. Extend microphone stand, attach spike, and place microphone stand on the right side of the unit. Insert microphone into the clip. Plug microphone cable into the microphone jack. Turn the quick-lock connector clockwise to secure connection.

4. Press **ENTER/ON** to turn the seismograph on.

5. **Press the [↓] to scroll through startup screens (CF status check, Printing Mode, and Banner**.

6. When the command menu is displayed, press 1 for seismic setup. Make necessary changes.

7. From the command menu, press 3 for text setup. Make necessary changes.

8. From the command menu, press 2 for display data, then 3 for calibration check. If any channels FAIL, check connections and correct problems before proceeding.

9. From the command menu, press 5 for print menu. S**et up** according to printing requirement. Options are NONE for no printing, **SUMMARIZE for** summary (**text only**) **or FULL for summary and graph.**.

10. Press **SCAN** to start collecting data. It takes approximately 15 seconds for the unit to start to record. But, always allow extra time for instrument setups, typically, at least 15 minutes.

11. After recording procedures are complete, press END to exit the SCAN mode.

GETTING STARTED

Components -   The 5500 portable printing seismograph kit consists of the following hardware**:**

> seismograph base unit
> geophone
> microphone
> microphone stand
> windscreen/air ball
> four (4) 3-inch spikes
> AC adapter
> 128mb CompactFlash^{TM} data card with 10,000-event capacity

GeoSonics' Seismic Analysis Software (version 6.3.37) is also included with your unit. Units are typically shipped with the fuse removed. This is done to protect your unit from damage that sometimes occurs during airport tracking scans.

The fuse is easily replaced using the removable fuse holder, however, date and time information will have to be re-entered into your unit once replaced. This is easily accomplished by following the instructions under the UTILITIES heading, option 1 (please see below.)

There are three (3) LED's on the top panel of the seismograph.

> The top LED (Orange) is the status indicator light for the charging circuit. This LED will remain ON when the unit is charging.

> The middle LED (Red) is the status indicator light for the SCAN modes. This light will blink when the seismograph is in the scan mode.

> The bottom LED (Green) is the status indicator light for the printer. This LED will come on whenever the unit is sending data to the printer.

Paper Replacement

1. Release print-head tension by completely raising the gray plastic release lever located at the right end of the print head.
2. Grasp the take-up spool firmly, pushing to the right side of the printer housing while raising the left end of the spool until clear. If still spooled to the paper supply, relieve tension on the take-up spool by rotating it toward the print head. Remove the supply spool in the same manner.
3. Prepare the new roll of paper by tearing or cutting the end of the paper so that it is tapered to a point (inverted V). Position new roll of paper so that it feeds from the bottom of the spool towards the print head.
4. Push paper under print roller until the tapered end juts out over the top. Pull the paper out 10 – 12 inches, then install supply spool on guides.
5. Install removed take-up spool with notched end to the left. Fold the end of the supply paper and slide into the slot located on the take-up spool. Remove any remaining slack by manually advancing the wheel located on the left side of the take-up spool.

Field Setup

(For additional information regarding seismograph set up, refer to the *ISEE Field Practice Guidelines for Blasting Seismographs; Journal of Explosives Engineering, May/June 2000,* available through the International Society of Explosives Engineers)

Location

When choosing the location for your seismograph, the following factors should be considered:

1. The geophone should be placed between the vibration source and the structure to be monitored / protected.
2. Avoid placing the unit under or near high-tension wires or other high voltage transmission devices. Voltage spikes may cause the unit to pre-trigger or malfunction during data collection.
3. Avoid placing the geophone within four (4) feet of a building foundation. Vibration waves may "bounce" off of a foundation and cause erroneous readings.
4. If the location is near other vibration sources, extra caution will be needed when selecting trigger levels.
5. In order to get the most accurate data, the geophone <u>must</u> be securely coupled to the surface. Review the *Geophone Installation* section below.
6. Choose a location where the microphone will not be placed behind a solid surface, such as a brick retaining wall. Solid surfaces block the air overpressure and may result in inaccurate data results.

Geophone Installation

The geophone contains three mutually perpendicular velocity-measuring elements that measure the vibration levels on three planes – longitudinal (back and forth), transverse (side to side) and vertical (up and down). In order for these elements to function properly, the geophone must be in a level orientation. If the geophone is mounted at an extreme angle, or upside down, one or more of the elements will be inoperable. In addition to missing data, this will also cause invalid calibration pulses in the triggered and sustained triggered recording modes. An invalid calibration pulse will render your record invalid in many states. There is a bubble level in the center of the geophone to help the operator ensure that the geophone is installed in the proper orientation.

The geophone must also be properly oriented toward the vibration source. The arrow on the top of the geophone that points away from the cable connection should be pointing toward the vibration source.

TO VIBRATION SOURCE

To obtain accurate data the geophone must be securely coupled to the surface. There has been much debate and discussion in recent years regarding coupling. If accelerations in excess of 0.2 g's are anticipated, some method of external coupling (burial, spikes, anchoring to bedrock, etc.) is essential.   For accelerations less than 0.2 g, other forms of coupling may be acceptable. While some methods are better than others, no one method will work in all cases. Coupling methods may also be combined, such as sandbagging a spiked geophone.

Please note: Obtaining an acceleration reading in excess of 0.2 g DOES NOT mean that your geophone de-coupled and that your reading is inaccurate.

➢ BURIAL

Most experts would agree that burying the geophone is the best way to obtain accurate data. If you plan to bury the geophone, the hole should be at least 8 inches deep. The hole should be large enough so that the cable is not pinched. The bottom of the hole should be level. After the spikes have been attached to the geophone, it should spiked to the bottom of the hole.   Soil, sand, or other loose granular material should be placed and packed tightly around and on top of the geophone until the hole is filled. If the fill material is left loose, you will not have good coupling.   If gravel or a similar type of material is used to fill the hole, the ground vibrations could cause the gravel to "bounce" off the geophone causing high, inaccurate readings.

➢ ANCHORING TO BEDROCK

The geophone may also be attached to stable bedrock using a rock bolt or an adhesive. It is best to have developed a plan for removing the geophone from the surface, before applying any type of adhesive.

➢ SPIKES

If monitoring is to be done on firm soil, spiking the geophone is an excellent coupling method. Three-inch spikes are included with your seismograph. These spikes can be screwed into the bottom of the geophone. After the spikes have been securely attached, use steady pressure on the geophone to push the spikes into the ground.   The geophone should be flush with the ground.

DO NOT hammer the geophone as this may damage sensitive internal electronic components. DO NOT "wiggle" the geophone back and forth. This will make the spike openings larger than the spikes, preventing a secure coupling.

USE STEADY FORCE

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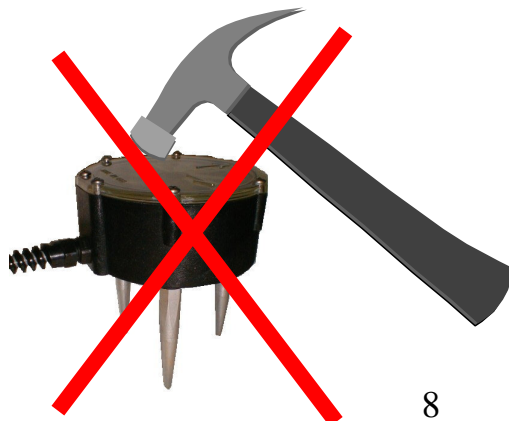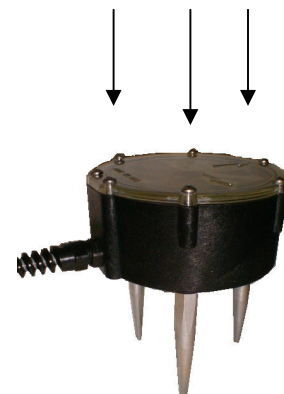
➢ SANDBAGGING

A LIMP, 10 pound sandbag may be draped over the geophone to prevent slippage. The sandbag should be limp enough that it conforms to the shape of the geophone and large enough so that all sides of the sandbag are in contact with the ground.

➢ HARD SURFACE INSTALLATION

Double face (carpet tape) can be used to obtain a secure coupling on a hard surface in many cases. The surface should be flat and free of dirt or other substances that would prevent a secure attachment. Adding a sandbag will decrease the possibility of slippage.

Other coupling methods have proven to be successful under specific conditions. C-clamps and epoxy have all been used to attach geophones to stable surfaces.
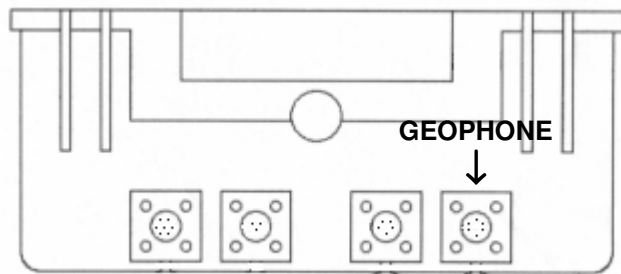

After installing the geophone, insert the connector on the end of the cable into the port labeled **GEOPHONE** on the front of the unit. After inserting the connector into the port, turn the outer locking ring clockwise to complete the connection.

Microphone Installation

The telescoping microphone stand extends to a height of 28 inches. A spike is included which can be screwed into the bottom of the microphone stand so that it can be placed into the microphone holder found on the right side of the unit. After placing the microphone into the clip at the top of the stand, place the airball over the microphone. The microphone should be pointed toward the airblast source.
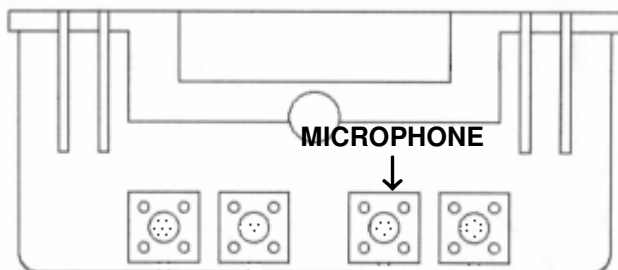
After installing the microphone, insert the connector on the end of the cable into the port labeled **MICROPHONE** on the right side of the unit. After inserting the connector into the port, turn the outer locking ring clockwise to complete the connection.

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MENU OPTIONS / KEYPAD OVERVIEW

The seismograph is programmed using menu driven options displayed in the liquid crystal display window. The full "QWERTY" style keyboard allows the user to communicate with the unit. In addition to the standard character keys, several short-cut keys are included.

END – exits the current setup menu, or exit the scanning mode

CAL- runs a calibration check

SUM – prints a summary of the last five recorded events

SCAN - Sets the unit in scan mode

SFT – shift key for entering text characters displayed on the right side of keys (i.e. !, @)

CTRL - (for future use)

ALT – (for future use)

ENTER/ON – turns unit ON; enter typed text or data

OFF – turns the seismograph off

← **-** backspace key, deletes last typed character

Whenever the characters ▲   or ▼ are visible in the upper right corner of the LCD, the ↑ or ↓ keys may be pressed to view more options.   Pressing the up, down, or end keys <u>before</u> pressing the enter key will stop a recent (i.e. NEW) entry from being saved.

Pressing the SCAN key will cause the unit to start collecting data in approximately twenty (20) seconds. Pressing END will end this process. A stop event will be created when the END key is pressed during scanning modes.

The unit is turned on by pressing and holding the ENTER key until a small line (_) appears in the upper left corner of the display window. After a few seconds, the banner will be displayed.

```
SN:5001 v.0.47  12.7
02/20/01 14:28  TRIG
SEI<0.050>SND<  OFF>
5.0 s TIMER<OFF> Std
```

SN: 9001 - this unit's serial number is 5001
v. 0.47 – the firmware version is 0.47

12.7 – battery voltage is 12.7 volts
02/20/01 – the internal memory date is February 20, 2001*
14:28 – the internal memory time is 2:28 PM
TRIG – the unit is programmed to record in the triggered mode
SEI<0.050> - the seismic trigger is set at 0.050 ips*
SND < OFF> - the air trigger is set to off
5.0 s – the unit will record a five (5) second event
TIMER<OFF> - the timer feature is turned off
std – the unit is set to record using a standard scaling system

* This example, as well as the majority of examples in this manual, is in mm/dd/yy date format
and imperial units. There are menu options to switch to dd.mm.yy date format and metric units.

After the banner has been displayed, the command menu options will be displayed.

The first line of the command menu is <7> = OFF - i.e. pressing the 7 key from this menu will
turn the unit off.

The first three command menu options are

```
1.  Seismic Setup
2.  Display Data
3.  Text Setup
```

Press the ↓ key to go to the next grouping.

```
4.  Timer Setup
5.  Print Reports
6.  Utilities
```

The ↑ and ↓ keys can be used to scroll up and down through the commands.

The next grouping is

```
7.  Turn Off Unit
8.  Display Banner
9.  Templates
```

If you know the option that you want, simply press the appropriate number (from any command
menu display) to go to that sub-menu.

<u>CONFIGURING</u> THE UNIT FOR BASIC DATA COLLECTION

Removable Flash Card Memory Storage

The SSU 5500 seismograph is equipped with a removable CompactFlash™ data card for event storage. The 128mb CompactFlash™ card has a storage capacity of 10,000 events. This is a distinct advantage when monitoring continual blast at the same location for a client as a blast history spanning over years of time that can be recorded and stored on a single compact flash card. In addition, the need to continually download and clear events from the seismograph is virtually eliminated, although, extremely high number of stored events will significantly increase time required to write events to the compact flash.

Differences between 3000 LCP^{Plus} and 5500 Seismographs

Serial Port

There is no serial port on the SSU 5500 because the accessibility of the compact flash card eliminates the need to download data via serial cables.

Firmware

The SSU 5500 is equipped with version 3.84 firmware and up.

Memory

The SSU 5500 is equipped with a 10,000-event memory CompactFlash™ card.

Recording and Transferring data using the CompactFlash™ storage card

1. Inserting and removing the CompactFlash Card - The slot for the CompactFlash™ card is located on the faceplate to the left of the printer compartment. To correctly insert the card, make sure it slides easily into the slot. If the card resists rotate 180 degrees. To remove the card, simply pull the card out. It is recommended that the unit always be turned off unit removing or inserting the flash card.

2. Accessing events and data from the CompactFlash™ card

3. Any Windows® or Linux® systems will accept the card with either a CompactFlash™ card slot or USB slot adapter. USB slot adapters are available at most computer supply stores.

4. Once the card has been inserted in the appropriate slot, the computer should automatically recognize the card.

Using CompactFlash™ with Seismic Analysis

1. Open the program Seismic Analysis version 6.3.37 .

2. To access events on the card, open the drop down menu in the right side of the window and select the CompactFlash™ card. The card should be identified as a mass storage device and be marked as a lettered drive.

3. Events should appear in the window once the card has been selected. Refer to   Seismic Analysis Manual for further instructions regarding event data access and viewing.

The following command options will be discussed in this section: seismic setup, text setup.

The **SEISMIC SETUP** command option is used to set the trigger mode, histogram mode, sustained trigger mode, and the recording units (imperial/metric).

BLAST / SINGLE EVENT RECORDING

The trigger mode is used for single event recording such as a blast event. The length of the record can be set for 1 to 15 seconds. Because of varying sample rates, it is recommended that the sustained trigger option be used for events greater then 5 seconds. The seismograph measures and records peak particle velocity and air overpressures. Frequency information is calculated from this data. Data recorded in the trigger mode produces a waveform event that may be printed, with or without the USBM/OSM or DIN compliance graph. Waveform events may be printed out using the Geosonics Analysis Software. The software can also print velocity, acceleration, and displacement graphs, perform FFT frequency analysis, as well as plot the data on USBM, OSM, or DIN compliance curves.

When the seismograph is in the triggered mode, it continually scans (as often as 2,000 samples per second) for vibrations and/or airblast levels that meet or exceed preset trigger levels. Once the preset trigger level is reached or exceeded, the unit begins to collect data.

Option 1 under the seismic setup menu option is **TRIGGER MODE**. Press **1** to enter the seismic setup menu.

```
1 TRIGGER SETUP     <1>
USE TRIGGER:1=ON  0=OFF
SET: USE TRIGGER
NEW:
```

To enable the trigger mode press **1**.   The unit will respond with USE TRIGGER. Press ENTR.

Press ↓   to go to the seismic trigger setup menu.

NOTE: You may exit the trigger mode setup menu at any time by pressing the END key. You will return to the command options.

```
1 TRIGGER   SETUP  <2>
SEIS TRIG.0.005 – 5.000
SET:     0.050 IN/SEC
NEW:     0.000 IN/SEC
```

A seismic trigger level must be set when the unit is programmed to record in the trigger mode. Once the seismograph is placed into the scan mode, the geophone will continually *scan* for vibration levels that meet or exceed the set trigger level. If you want to keep the value displayed under SET: simply press ↓ to go to the next setup menu. To change the value, type in the new trigger level beginning with the character to the LEFT of the decimal point, press ENTR. The new value will appear as the SET value. Press ↓ to proceed to the next setup menu.

```
1 TRIGGER   SETUP  <3>
AIR TRG        81 – 142
SET:             0 db
NEW:             0 db
```

The seismograph can be set to trigger off airblast levels. Entering 00 can also turn off the air trigger. If the air trigger is turned off and the unit is triggered by ground vibration, the airblast data will still be recorded. Because airblast data is measured by this instrument on a linear scale, it is possible

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that a small gust of wind could trigger the instrument. This could cause one or more false triggers that could result in the memory filling up and the desired data (the blast event) not being recorded.

If you want to keep the value displayed under SET: simply press ↓ to go to the next setup menu. To change the value, type in the new trigger level, press ENTR. The new value will appear as the SET value. Press ↓ to proceed to the next menu option.

```
TRIGGER   SETUP   <4>
RECORDS PER TRIGGER
SET:                  01
NEW:                  01
```

Used in conjunction with multiple events per trigger and should be left at 01 for standard event recording.

```
TRIGGER    SETUP   <5>
RECORD TIME     1 – 15
SET:           5.0 SEC
NEW:           0.0 SEC
```

The seismograph may be programmed in one tenth (1/10) second increments to create 1 to 15 second events. There are several factors to consider when choosing the record length.

1. Air blast travels at a slower rate than does ground vibration. Ground vibration travels up to 10,000 feet per second, depending upon geology and other factors. It reaches the geophone almost immediately after the blast is detonated. Airblasts travel approximately 1100 feet per second under standard conditions. Because of this, allow at least one (1) second for every 900 feet between the seismograph and the blast. Additionally, each triggered event contains from 0.25 to 1.5 seconds of pre-trigger data.

2. The length of each blast event varies. Small shots with only a few delay periods may have only a few tenths of a second duration. A blast shot with tunnel delays may last several seconds. In order to record all blast associated airblast data; allow sufficient time for both the vibration and the airblast from the last delay period to reach the seismograph.

3. Weather conditions such as wind velocity and direction also effect airblast speed.

The following chart may be used as a general reference for selecting record times. This chart is based on a blast where there is no more than 0.5 seconds between the first delay period and the last and where there are no significant adverse wind or sky conditions.

DISTANCE	MINIMUM RECOMMENDED RECORD TIME
300 ft. / 91.44 m	1 second
1,000 ft. / 304.8 m	2 seconds
2,000 ft. / 609.6 m	3 seconds
5,000 ft. / 1524 m	6 seconds
8,000 ft. / 2438.4 m	10 seconds

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If you want to keep the value displayed under SET: simply press ↓ to go to the next setup menu. To change the value, type in the new trigger level, press ENTR. The new value will appear as the SET value. Press END to exit the trigger setup menu or Press ↑ to go back through the previous menu options. Printer options are also listed under the Trigger Setup menu. Use the ↓ or ↑ keys to access printer options

```
PRINT MODE          <6>
1:NONE 2:SUM 3:FULL
SET: SUMMARIZE
NEW: SUMMARIZE
```

Option 6 selects printing mode.
1. NONE: Printer off
2. SUM: Text only prints
3. FULL: Prints text and graphics.

```
GRAPH LENGTH        <7>
1-6: 2.5-25 in
SET: 2.5
NEW: 2.5
```

Option 7 sets the length of graph for each one second of recorded data. See the table on page 21 for available options. Remember that this table represents **one second** of data.

```
OSM/USBM:DIN        <8>
INCLUDE?   1:YES 0:NO
SET:N0
NEW:N0
```

Option 8 allows the user to include an OSM/USBM:DIN graph with the printout.

```
PRINT COPIES        <9>
# OF COPIES?  1...7
SET: 1
NEW: 1
```

Option 9 allows the user to select how many copies of a Triggered event they would like printed out by seismograph on-site. Useable only in Standard Trigger mode and does not work in Sustained trigger mode.

HISTOGRAM RECORDING

The histogram-recording mode is used to monitor longer periods of time. It produces a record with maximum peak particle velocities and associated frequency data for set intervals of time. For instance, the seismograph may be set to record the maximum particle velocity for every 1-minute interval. (Note: the LCD screen will update a minimum of every 10 seconds.) If you record for fifteen minutes, with a 1-minute interval, there will be 15 data points, one for each one-minute interval. Several options for printing the data can be found under command option 5 – PRINT. The Analysis Software can also be used to print this data as well as produce customized histogram charts. Common applications for this mode are pile driving monitoring, dynamic compaction monitoring, and background ambient studies.

Option 2 under the seismic setup option is **HISTOGRAM**. Press **2** to enter this setup menu.

```
HISTOGRAM SETUP     <1>
USE HIST: 1 = ON 0 = OFF
SET :      HIST DISABLED
NEW:            USE HIST
```

To enable the histogram mode press **2**. The unit will respond with USE HIST. Press ENTR.

Press ↓ to go to the histogram setup menu.

NOTE: You may exit the histogram mode setup menu at any time by pressing the END key. You will return to the command options.

```
2 HIST INTERVAL       <2>
1 - 7: 1,2,5,10,15, . . .
SET:     10 SEC
NEW:     10 SEC
```

The histogram interval refers to the time interval for which maximum levels are calculated. 1 = 1 second interval; 2 = 2 second interval; 3 = 5 second interval; 4 = 10 second interval; 5 = 15 second interval; 6 = 30 second interval; and 7 = 1-minute interval.

```
PRINT MODE            <3>
1:NONE 2:SUM 3:FULL
SET: SUMMARIZE
NEW: SUMMARIZE
```

  Option 3 selects printing mode.
   1. NONE: Printer off
   2. SUM: Text only prints
   3. FULL: Prints text and waveform.

Note that the printer is disabled for all histograms with intervals less than 15 seconds.

```
HIST. STYLE           <4>
1: LIST 0: GRAPH
SET:
NEW:
```

Option 4 - allows the user to select the style of histogram printout. The LIST option will provide only the numeric data for the interval. The GRAPH option will print the data in histogram (bar graph) form in addition to the numeric data.

```
HIST. SUMMARY         <5>
SUM. EVERY  0,10-1800
SET:
NEW:
```

Option 5 - sets interval summary of the histogram when printing. (0 = none)

```
PRINT COPIES          <6>
# OF COPIES?  1...7
SET: 1
NEW: 1
```

      Option 6 - allows the user to select how many copies of a Triggered event they would like printed out by seismograph on-site. Used only for Standard Trigger mode.

Press END to return to the command menu or ↑ to go back to the histogram setup menu.

SUSTAINED TRIGGER RECORDING (Multiple record event mode)

The sustained trigger mode is used for producing consecutive trigger events with no data loss between events that can be linked to produce one long time-history event. Once the preset trigger level is met, the seismograph will continue to record a predetermined number of events. Unlike histogram events, these are trigger events that can be analyzed by the Analysis Software to produce OSM/USBM compliance graphs as well as advanced frequency analysis such as FFT.

In addition to setting both the seismic and the air trigger levels, you will need to set the record times for the events and the number of events that you want recorded for each trigger. For

instance, if you want to record 30 seconds of data, you could choose to record six (6) 5-second events. Available record lengths and sampling rates are discussed below.

```
TRIGGER SETUP         <4>
RECORDS PER TRIGGER
SET: 1
NEW: 1
```

Choosing any number other than 1, in Option 4 under the TRIGGER SETUP puts unit into SUSTAINED TRIGGER (or multiple event mode). Events are recorded back to back with no loss of data between events, then analyzed after the last event is recorded.

```
TRIGGER SETUP         <5>
RECORD TIME      1 – 15
SET:          5.0 SEC
NEW:          0.0 SEC
```

Set the record time for EACH event beginning with the number to the left of the decimal point. Press ENTR to set the value; press ↓ to proceed to the next menu option.

The sampling rate is determined by the record length. The frequency range of a record is affected by the sampling rate. The following sampling rates apply to events recorded in the sustained trigger mode as well as standard time history records (triggered events).

RECORD LENGTH	SAMPLING RATE	FREQUENCY RANGE
0.1 – 5.0 seconds	1,000 samples / second	2 – 500 hertz
5.1 – 10.0 seconds	500 samples / second	2 – 250 hertz
10.1 – 15.0 seconds	330 samples / second	2 – 165 hertz

Refer to the specifications in the back of this manual for data regarding maximum number of records/recording capacity.

```
SUSTRIG SETUP        <5>
RECORDS PER TRIGGER
SET:                 05
NEW:                  0
```

HOW ARE SUSTAINED TRIGGER EVENTS RECORDED

Each sustained trigger event includes the same type of data as a trigger event. However, there are several distinctions. When a trigger event is recorded, the seismograph does not return to the scanning mode until the event is analyzed and the results displayed and/or printed. This gap prohibits groups of consecutive, uninterrupted data from being recorded. When the seismograph is programmed to record in the *sustained trigger mode* the data is recorded as a series of events, with no time gaps between the events. The events are not processed until all the events have been recorded. The number of waveform events contained in each series is equal to the *Records per Trigger* set in Trigger option 4. . The summary for these files includes the same information as a triggered event. The full report is also the same with one addition. The sequence number of the event is included on the report, i.e. 2 of 6. When the events are processed, an additional file is created. The sustained summary or *SUSTAIN HEAD* file contains the maximum particle velocities, frequencies, and decibel level over the entire series. The addition of this file results in the total number of files in a series to be equal to the number of waveform events plus one. There is no waveform associated with this file; however, the calibration graph is included. When a sustained summary is printed, no frequency analysis is included on the USBM/OSM or DIN graphs.

<u>RECORDING UNITS</u>

Option <u>3</u> under seismic setup is used to toggle between imperial units (inches/second and psi) and metric units (mm/second and Pascals)

```
RECORD UNITS SETUP
INITS 1.IMP 2.METRIC
SET:   IMPERIAL
NEW:   METRIC
```

To keep the current (set) setup, press END to exit the menu and return to the command options. To toggle to the other record unit, press the appropriate number followed by ENTR. Press END to exit the Seismic Setup command option.

TEXT SETUP

The **TEXT SETUP** command option is used to program the text portion of the header information into the unit. This text information, along with the date and time of the record, and unit serial number, is saved in memory with the data portion of each record – trigger, histogram, or sustained trigger. While not necessary for operation, this information is useful for record keeping purposes. Records printed through the Analysis Software or through the direct print option (optional cable required) will include this information.

Press **3** from the command menu for **TEXT SETUP**.

```
TEXT SETUP          <1>
CLIENT NAME:
ACME CONSTRUCTION CO
_
```

Press 1 in the text setup menu to access the first entry-CLIENT NAME. To keep the current information press ↓ to go to the next menu window. To change this information, enter up to 20 characters using the keypad. Press ENTR. After the new information is displayed, press ↓ to continue with the text setup or END to exit this option.

```
TEXT SETUP          <2>
OPERATION:
ROCK BLASTING
_
```

The next entry is OPERATION. To keep the current information press ↓ to go to the next menu window. To change this information, enter up to 20 characters using the keypad. Press ENTR. After the new information is displayed, press ↓ or ↑ to scroll to other text setup options or END to exit this option.

```
TEXT SETUP          <3>
LOCATION:
SMITH 38 MAIN ST.
_
```

The next entry is LOCATION. To keep the current information press ↓ to go to the next menu window. To change this information, enter up to 20 characters using the keypad. Press ENTR. After the new information is displayed, press ↓ or ↑ to scroll to other text setup options or END to exit this option.

The next entry is DISTANCE. To keep the current information press ↓ to go to the next menu window. To change this information, enter up to 5 numeric characters using the keypad.

```
TEXT SETUP          <4>
DISTANCE:
875 FT.
_
```

Press ENTR. After the new information is displayed, press ↓ or ↑ to scroll to other text setup options or END to exit this option.

```
TEXT SETUP        <5>
OPERATOR:
PHIL B  GEOSONICS
_
```

The next entry is OPERATOR. To keep the current information press ↓ to go to the next menu window. To change this information, enter up to 20 characters using the keypad. Press ENTR. After the new information is displayed, press ↓ or ↑ to scroll to other text setup options or END to exit this option.

```
TEXT SETUP        <6>
COMMENT:
OVERCAST SKIES
_
```

The next entry is COMMENTS. To keep the current information press ↓ to go to the next menu window. To change this information, enter up to 20 characters using the keypad. Press ENTR. After the new information is displayed, press ↑ to scroll to other text setup options or END to exit this option.

Additional Notes - The following two options must be accessed directly from the TEXT SETUP menu.

```
ADDITIONAL NOTES
0.DON'T USE NOTES
1.USE ADD'L NOTES
```

From the TEXT SETUP menu press **7** for ADDITIONAL NOTES. This option allows the user to add up to three (3) lines of text to the record. If **1** is pressed for Use Add'l Notes, the unit will prompt you for the first line of notes.

Enter up to 20 characters using the keypad. Press ENTR. After the new information is displayed, press ↓ to add the second line of text. Press ↓ to scroll to the third and last line of text. Press ENTR. Press END to exit this option. Note that line 3 is typically used to store GPS location which should be entered in the NEMA 0183 format. (i.e., the location N 27° 46.147' W 082° 39.648' should be entered as 2746.147,n,08239.648,w)

PRINTER SETUP [5]

The following command option will be discussed in this section: Print Reports

Several print options are available. The seismograph can be setup to print the summary or the summary and waveform for a trigger event immediately after it is recorded, or in the case of the histogram mode, to print the data after every interval. The unit can also print events stored in memory.

Example of various types of printouts may be found in the appendix.

The waveform scale is adjustable for 0.5 inch/1 second to 5 inches/1 second. The OSM/USBM or DIN graphs may be enabled. The printer may also be programmed to automatically insert page breaks for ease in duplicating your data with a copier.

Press option 5 from the Command Menu.

```
PRINTER REPORTS
1. PRINT SUMMARY
2. PRINT EVENT
3. PRINT SETTINGS
4. BATCH PRINT
5. PRINT CAL TEST
6. SETUP PRINTER
```

In order to set up the desired options for your printouts, select **6** for SETUP PRINTER.

There are four (6) print setup options:

1. PRINT MODE

```
PRINT MODE          <1>
1:NONE 2:SUM 3:FULL
SET: SUMMARIZE
NEW: SUMMARIZE
```

This option selects the printing mode for events.
1. NONE: Printer off
2. SUM: Text only prints
3. FULL: Prints text and waveform.

```
GRAPH LENGTH        <2>
1-6: 2.5-25 in
SET:2.5
NEW:2.5
```

2. GRAPH LENGTH (applies to trigger and sustained trigger events)This option sets the length of graph for each one second of recorded data. The following table summarizes the available options. Remember that this table represents **one second** of data. In order to calculate the length of the printed waveform, multiply per second length by the number of seconds of record time.

Selection Number	Graph Length per Second of Data	
1	.5 in. / 1 cm	(default)
2	1 in. / 2 cm	
3	2 in. / 3 cm	
4	3 in. / 4 cm	
5	4 in. / 5 cm	
6	5 in. / 10 cm	

☛ The shorter the graph length, the lower the print resolution. Short graph lengths may save paper but they also prevent the printed seismogram from being manually read and checked for frequency content or decoupling. If you elect to use a short graph length (< 2 in / 3 cm) it is recommended that you save your event data using the Seismic Analysis Software. This will ensure that further analysis is possible.

Press ENTR after making your selection to save the setting. Press ↓ to go to the next menu option or END to exit the PRINT SETUP MENU and return to the COMMAND MENU.

3. OSM/USBM:DIN

```
OSM/USBM:DIN        <3>
INCLUDE?     1:YES 0:NO
SET:NO
NEW:NO
```

If you have programmed your unit to record using *imperial units* (US customary), press **1** to include the OSM/USBM graph with your waveform. Press **0** to disable this feature. Press ENTR to save the setting. Press ↓ to go to the next menu option or END to exit the PRINT SETUP MENU and return to the COMMAND MENU.

If you have programmed your unit to record using *metric units*, press **1** to include the DIN graph with your waveform. Press **0** to disable this feature. Press ↓ to go to the next menu option or END to exit the PRINT SETUP MENU and return to the COMMAND MENU.

1. HISTOGRAM STYLE

```
HIST. STYLE        <4>
1:LIST 0:GRAPH
SET:LIST
NEW:LIST
```

There are two options for printing histogram events. The LIST option will provide only the numeric data for the interval. The GRAPH option will print the data in histogram (bar graph) form in addition to the numeric data.

Press **1** for the LIST option or **0** for the GRAPH option followed by ENTR to save the entry. Press ↑ to go to previous menu options or END to exit the PRINT SETUP MENU and return to the COMMAND MENU.

5. HISTOGRAM SUMMARY

```
HIST. SUMMARY       <5>
SUM. EVERY   0,10-1800
SET: 10
NEW: 10
```

Option 5 - sets interval summary of the histogram when printing. (0 = none)

6. PRINT COPIES

```
PRINT COPIES        <6>
# OF COPIES?   1...7
SET: 1
NEW: 1
```

This option allows the user to select how many copies of a Triggered event they would like printed out by seismograph on-site. Used only for Standard Trigger mode.

PRINT SUMMARY

```
PRINT SUMMARY
1. ALL
2. LAST FIVE
3. ALL, NO STOP
```

Press 1 in print menu to access PRINT REPORTS, then press 1 to access PRINT SUMMARY

There are three (3) options available from the PRINT SUMMARY menu.

1. All – Pressing **1** for ALL will produce a printout with the summary information from all the events in memory, including the stop events.

2. Last Five – Pressing **2** for LAST FIVE will produce a printout of the summary information from the last five (5) events, regardless of their type. This includes trigger, sustained trigger, histogram, and stop events.
3. ALL, NO STOP – Pressing **3** for ALL, NO STOP will produce a printout of the summary data for all trigger, histogram, and sustained trigger events in memory.

3:FULL (From Instant Print Menu) Press **3** for FULL REPORT, and the seismograph will print the header information, the summary data, the waveform, the compliance graph, if enabled, and the calibration check. After this option is chosen, you will be prompted for the directory number of the event that you want to be printed. Enter this number followed by ENTR.

RETRIEVING / VIEWING DATA ON THE LCD WINDOW

The following command option will be discussed in this section: display data.

The DISPLAY DATA command option is used to display a directory of stored events, a summary (i.e. results) of one or more events, a calibration test, display the banner, view the results of a memory status check, view additional notes information and view the stored GPS location. Keep in mind that information can only be <u>viewed</u> through this option; you cannot change any data through the Display Data command option.

Press 2 from the COMMAND menu to enter the Display Data option.

Press **1** for **Directory**.

```
DIRECTORY        006 ▲

004:TRIG         3144
01/21/01      13:52:30
```

The first line of the DISPLAY window shows DIRECTORY 006 indicating that this is the information for memory event # 006. The directory entry for the most recently recorded event (the last one in memory) is displayed first. The example shown at the left is for seismic event # 004, recorded in the trigger mode; the byte size is 3144; it was recorded on January 21, 2001 at 1:52.30 PM.

► The term *memory event* refers to the storage area in the memory of the CompactFlash^{TM} card in the seismograph. The term *data collection event* refers to the number assigned to a trigger, histogram, or sustained trigger event where data has been collected and saved in memory. When data collection events are downloaded through the Analysis Software, the event number becomes a part of the filename. Typically when the term *event* is used, it is referring to a data collection event.

Other examples of display windows for this option:

```
DIRECTORY        004 ▲▼

002:HIST         7344
01/19/01      08:52:00
```

This is memory event four. Event 002 is a histogram event, 7344 bytes, recorded on January 19, 2001. The start time of the event is 8:52 AM.   The time assigned to a histogram event is always the START time.

```
DIRECTORY          003 ▲▼

000:STOP            512
01/18/01       15:21:00
```

This is memory event three. This is a STOP event. Because stop events contain no vibration or airblast data, they are not assigned data collection event numbers. All stop events take 512 bytes of memory. This stop event occurred on January 18, 2001 at 3:21 PM. A stop event is written to memory every time the unit is taken out of the trigger scan mode.

```
DIRECTORY      002 ▲▼


002:SU TRIG     4258
01/18/01       09:04:00

```

This is event memory 002. This is a sustained trigger event, 4258 bytes, recorded on January 18, 2001 at 9:04 AM.

```
DIRECTORY          001  ▼

000:TMPL           2772
01/18/01       09:14:00
```

This window shows that a template is stored in memory event 001. It was stored in memory on January 18, 2001 at 9:14 AM. Templates are discussed under command option 9: TEMPLATES.

The ►   and ►characters in the upper right corner of the window indicate if more directory entries are available by pressing ↑ or ↓.

Option 2 – SUMMARY   This option is used for viewing event results**.**

Press **2** for Summary. The results for the most recent event are displayed. Following are sample display windows. Note that it takes a little time to read summary out of the compact flash and the display will be delayed until the summary has been retrieved. Also, maximum number of summaries for display is 56 records.

```
SUMMARY  R 1.32   007
▲  ▼
002    076   L0.13, 225.0
01/22       T1.05,  64.3
15:09       V0 31  115 7
```

This summary display is for a trigger or sustained trigger event. The event number is 002. The event was recorded on January 22 at 3:09 PM.   R (resultant) = 1.32 ips; V (vertical) = 0.13 ips @ 225 Hz.; L (longitudinal) = 1.05 ips @ 64.3 Hz.; T (transverse) = 0.31 ips @ 115.7 Hz; air overpressure is 76 decibels.

```
SUMMARY    HIST   009
▲  ▼
004    078   L0.25,  20.8
01/23       T0.51,  21.3
13:03       V0 25    5 8
```

This summary display is for a histogram event. The event number is 004. The histogram's start time was 1:03 PM on January 23. V (vertical) = 0.25 ips @ 20.8 Hz.; L (longitudinal) = 0.51 ips @ 21.3 Hz.; T (transverse) = 0.25 ips @ 5.8 Hz. Air overpressure was 78 decibels.

☛ Stop events are not displayed through the DISPLAY SUMMARY option.

Option 3 is Calibration Test. This option is used to check for proper communication between the geophone elements and microphone element and the seismograph base unit. After the geophone

has been installed on the surface and the geophone and microphone cables have been properly connected to the base unit, press **3**. The unit will go through a self-test. If all channels are functioning, the following window will be displayed.

```
CALIBRATION TEST
Last Cal. 01/20/01
S———— L————T————V———
PASS    PASS    PASS    PASS
```

The second line of the display shows the date of the last calibration service. If any of the channels show a FAIL message, that channel(s) is not working properly. Check the following.

1. Make sure that the cables are securely inserted into the appropriate port. Make sure that the quick-lock connectors have been tightened.

2. If any of the geophone channels, L, T, V, show FAIL, check the geophone to make sure that it has not been installed at an acute angle or upside down.

3. If the calibration test is still showing FAIL, disconnect the cables and check to make sure that the connector pins are clean and dust/mud free. Clean the pins if necessary, and reconnect.

4. If one or more channels are still showing FAIL, contact the GeoSonics Service Department.

Press END to exit this option.

Option 4 allows the user to review the BANNER information. This is the same information that is displayed when the unit is first turned on. This option is useful to check voltage levels, as well as changes to the date, time, recording mode, trigger levels/recording interval, and timer on/off. Press END to exit this menu and return to the command menu.

Option 6 displays the ADDITIONAL NOTES information currently in memory. Press END to exit this window and return to the command menu.

Option 7 displays the GPS Location information currently in memory. If no GPS information is available, an N will appear in the window. Press END to exit this window and return to the command menu.

TIMER SETUP

The following command option will be discussed in this section: Timer Setup

The TIMER SETUP option is used to put the seismograph in, and exit from, the scan mode at predetermined times. The timer is useful in conserving battery power during extended, unattended monitoring periods. By having the seismograph turn off during "down" times (such as overnight or weekends), memory space is not taken up by unwanted data.

It is highly recommended that the proper date and time be programmed into the unit <u>before</u> setting the timer options. It is also recommended that the seismic setup and text options have been entered before setting the timer options.

☞ Previous seismograph versions may have referred to this feature as the *alarm option*.

```
TIMER SETUP           ▼
1. Timer Mode  ON/OFF
2. One Time / Daily
3. Set Wake Up
```

The timer setup option is accessed by pressing **4** from the command menu.

There are four (4) menu items under TIMER SETUP.
1. Timer Mode ON /OFF – This option is used to turn the timer mode on or off.

```
TIMER SETUP    <1>
TIMER   1:ON 0:OFF
Set: OFF
New: ON
```

This option enables or disables the timer. To change from the current setting, press the appropriate number, followed by ENTR. After the change has been entered, press END to exit the timer setup option or ↓ to proceed with additional options / setup commands.

```
TIMER SETUP    <2>
MODE 1:DAILY 2: ONCE
Set: DAILY
New: DAILY
```

This option allows the user to choose between two (2) on/off modes.
1: Daily – The wake up and sleep cycles will be repeated every day until the timer is turned off.

2. Once – The unit will turn on at the pre-programmed wake up time and turn off at the pre-programmed sleep time. The cycle will not repeat.

After the timer on/off mode has been selected and the ENTR key has been pressed to set the selection, press ↓ to proceed with timer setup or END to exit the timer setup option.

```
TIMER SETUP    <3>
WAKEUP TIME &   DATE:
Set: 00/00/00   00:00
New: 01/22/01   08:00
```

This option sets the wake up time. The wake up time tells the unit when it is to enter the **SCAN** mode and start collecting data. After entering the appropriate data and pressing ENTR to set the information, press ↓ to proceed with timer setup options or END to return to the command menu.

```
TIMER SETUP    <4>
SLEEP  TIME &  DATE:
Set: 00/00/00   00:00
New: 01/22/01   16:00
```

This option sets the sleep time. The sleep time tells the unit when it is to exit the **SCAN** mode and stop collecting data. After entering the appropriate data and pressing ENTR to set the information, press END to return to the command menu or ↓ to cycle back to the Timer ON/OFF proceed with timer setup options.

EXAMPLE SETUPS

Desired monitoring period: Start scanning this afternoon at 1:30 PM and stop scanning at 4:00 PM.
         SETUP – Set the mode for ONCE
         Set the WAKE UP date and time for 01/01/01 13:30

25

Set the SLEEP date and time for 01/01/01 16:00

Desired monitoring periods: Start recording tomorrow morning at 7:00 AM, record until 5:00 PM. Monitor during this time period every day.

SETUP – set the mode for DAILY
Set the WAKE UP date and time for 01/02/01 07:00
Set the SLEEP date and time for 01/02/01 17:00

NOTE: Every time the unit exits the scan mode, a stop event will be created.

UTILITIES

MEMORY MAINTENANCE / SPECIAL SETUPS / ADVANCED SETTINGS

The following command option is discussed in this section: Utilities

The Utilities option is used to set the seismograph's internal date and time, set the event number, change communications port settings, set special alarms, enable password protect, change advanced settings, set the display default, and process sustained trigger events.

Set Clock / Date

Option 1 – **Set Clock / Date** is used to set the internal clock as well as select the date format.

```
SET CLOCK/DATE
1. Set Time
2. Set Date
3. Date Format
```

To change the time, press **1**.

```
CLOCK/DATE      <1>
SET TIME:
Set:    15:37:39
New:    16:00:00
```

Time is entered using a 24-hour format HH:MM:SS. Enter the six numeric characters for the current time, and press ENTR.
☛ Enter 8:00 AM as 08:00:00; enter 8:00 PM as 20:00:00.

Press ↓ to proceed to the Set Date Option or END to return to the command menu.

```
CLOCK/DATE      <2>
SET DATE:
Set:    01/22/01
New:    01/23/01
```

To change the date, press **2**. The default date format is mm/dd/yy. Unless you have changed the date format using option 3 of this menu, enter the 6 characters of today's date using the mm/dd/yy format. If you have switched to the other date format, enter the date using the dd.mm.yy format.

☛ Remember to use two numeric characters for each field, i.e. use 01, not 1, for January.

Press ↓ to proceed to the Date Format Option or END to return to the command menu.

```
CLOCK/DATE       <3>
FORM 1:m/d/y  2:d.m.y
Set:     M/D/Y
New:     D.M.Y
```

To change the date format, press **3**. Select the new format by pressing **1** or **2**. Press ENTR to save the new option. Press END to return to the command menu.

Set Event Number

Utility option 2 may be used to set the next event number. Event numbers, which are assigned to all data collection events, are assigned consecutively beginning with 001. The default settings of the seismograph will reset the starting event number to 001 every time the memory is erased. At any time, you may choose to set the event number to any number from 01 – 999.

```
UTILITIES
NEXT EVENT NUMBER:
Set:  03
New:   0
```

Press **3** from the Utilities menu. The number currently assigned to the next data collection event is displayed. To reset the event number, enter the two-digit number followed by ENTR. Press END to return to the command menu.

Special Alarms

Utility option 3 is used to set the Special Alarm parameters.

☞ This feature is designed for use with optional, external alarm devices.

The special alarm feature allows the user to set a secondary trigger level for all recording modes – trigger, histogram, and sustained trigger. This can be either a seismic or a sound trigger. Two (2) alarms are available should the user desire to set one for seismic and one for sound. Both alarms can be set for seismic trigger or sound trigger if desired.

For Trigger and Sustained Trigger Recording:

Once the primary trigger (as set under SEISMIC SETUP) level is reached, the unit will begin to record data. If one or both of the special alarm trigger levels are reached, a signal will be sent from the seismograph to a special external warning device connected to the seismograph. The external device will "alarm" the user that the special alarm trigger level has been reached. For additional information on alarm devices, refer to the documentation accompanying the external alarm device.

For Histogram Recording:

The seismograph will measure and record data as programmed through the SEISMIC SETUP option. If one or both of the special alarm trigger levels are reached, a signal will be sent from the seismograph to a special external warning device connected to the seismograph. The external device will "alarm" the user that the special alarm trigger level has been reached. For additional information on alarm devices, refer to the documentation accompanying the external alarm device.

TO SET THE SPECIAL ALARMS

Press **3** from the Utilities menu.

```
SPECIAL ALARMS
1. Alarm1 On/Off
2. Alarm1 Trigger
3. Alarm1 Hold Time
```

Press **1** to turn Alarm 1 on or off.

```
SPEC'L ALARM <1>
ALARM1   1:ON  0:OFF
Set:  OFF
New:   ON
```

Press **1** to set special alarm 1 to ON. Press ENTR. Press ↓ to continue with the setup process or END to return to the command menu.

```
ALARM1 SOURCE <2>
0.SEISMIC
1.SOUND
```

The next option is for selecting a seismic trigger or a sound trigger. The ALARM1 T window will be displayed. Allowable entry ranges are as follows:
SEISMIC – 0.005 – 5.000 ips (0.13 – 127.0 mm)
SOUND – 100 – 140 dB

After entering the desired trigger level, followed by ENTR, the ALARM1 HOLD window will be displayed.

```
SPEC'L ALARM <3>
ALARM1 HOLD    5-300
Set:         20 sec
New:          0 sec
```

The alarm hold setting tells the seismograph how long the signal should be sent to the external device before re-setting itself. Set the hold time followed by ENTR. Press ↓ to continue to the Alarm 2 setup menus or END to return to the command menu.

►As an example, consider the following setup. Record mode - histogram mode; special alarm seismic trigger - 0.50 ips; hold time – 20 seconds. If the seismograph detects a vibration level that exceeds 0.50 ips seconds, the alarm will reset 20 seconds after the alarm was first triggered. If the vibration lasts beyond the 20-second hold time, the alarm will re-trigger within one (1) second.

Alarm 2 is set in the same manner as alarm 1.

Advanced Options

Option 4 of the Utilities menu accesses the Advanced Options.

Four features are available through the advanced setup – configuration, trigger filter, show date/time, and ask for printer.

```
ADVANCED SETUP:
ENTER PASSWORD:
```

In order to access the advanced setup features, you must first enter your password. This four-digit number was supplied with the documentation included with your unit. After entering the password, press ENTR.

► If you have misplaced your access code, contact the GeoSonics Service Department. You will need to supply the unit's serial number as well your company name in order to obtain this information.

Configuration / Alternate Scaling

```
CONFIGURATION        <1>
0:STD  1:ALT
SET:
NEW:
```

The first option under the advanced menu is CONFIGURATION. The configuration feature allows the seismograph to have an alternate scaling system programmed into the unit. The alternate scaling configuration is an optional feature that must be installed by an authorized GeoSonics service technician. This alternate scaling system was designed for use with special sensor devices, such as 10X and 100X amplifiers and hydrophones. The alternate scaling system can be enabled by selecting option 1 from the Configuration menu, followed by ENTR. When the banner is displayed, the enabled scaling system notation (std = standard; alt = alternate) is displayed in the lower right corner of the window.

Trigger Filter

```
TRIGGER FILTER       <2>
1…4 SAMPLES
SET:4
NEW:4
```

The second option under the advanced menu is TRIGGER FILTER. When the seismograph is set to record in either of the trigger modes, the unit continuously scans and measures seismic or sound levels. The sampling rate varies from 330 to 1,000 samples per second. Under the default setting of 4 samples, in order for the unit to trigger, the trigger level must be exceeded four (4) times within a 4 millisecond time frame (based on 1,000 samples per second). Requiring four (4) samples above the trigger level before triggering the unit helps to prevent false triggers due to electronic interference.

Using the TRIGGER FILTER option, the seismograph can be set to trigger after only 1, 2, or 3 samples over the trigger level. Enter the desired sample limit followed by ENTR. Press END to exit the Advanced Options menu or ↑ or ↓ to move to the next option.

When the seismograph is first powered on, there are three (3) optional window displays that can be toggled on or off. These displays can be turned ON/OFF in the advanced options menu.

The SHOW DATE/TIME option allows the user to disable the DATE / TIME being displayed every time the unit is turned on.

```
SHOW DATE/TIME?
0:NO  1:YES
SET:YES
NEW:YES
```

The ASK FOR PRINTER display option allows the user to disable the printer before entering the command menu.

```
ASK FOR PRINTER?
0:NO  1:YES
SET:YES
NEW:YES
```

Process Events

```
PROCESS EVENTS?
0:NO 1:YES
SET:NO
NEW:NO
```

Utility option 9 is PROCESS EVENTS. This command will process sustained trigger events so that they may be downloaded. Once this option is selected, all unprocessed sustained trigger events in memory will be automatically processed.

TEMPLATES

Press 9 in the command menu to access TEMPLATES
The following command option is discussed in this section: templates.

Six template storage locations are available to the seismograph user. The template feature is a timesaving option for saving setups. After the text and seismic setup information has been programmed into the seismograph, it can be saved as a template. The next time that set of information is needed, instead of reentering all of the information, the template can be recalled.

USE THE FOLLOWING STEPS TO SAVE A TEMPLATE

1. Enter the seismic and text information as described under *PROGRAMMING THE UNIT FOR BASIC DATA COLLECTION.*

2. From the command menu, press **9** for Templates. The third menu window, which can be accessed by pressing ↓ twice, shows option 7 – SAVE TEMPLATE

```
SAVE A TEMPLATE    ▼
1. <template 1>
2. <template 2>
3. <template 3>
```

After choosing option 7, the names of the currently saved templates are shown. (Press ↓ to view locations 4 – 6.) If a template register is empty, or if a name was not assigned to a template, it will be listed as <template #>. Choose a template location by pressing the appropriate number.

```
TEMPLATE <4>
ENTER NAME
   <template 4>
```

3. Enter a name for the template using the alphanumeric keypad. Press ENTR to save; press END.

USE THE FOLLOWING STEPS TO USE (RECALL) A TEMPLATE

1. From the command menu, press **9** for Templates
2. The template names for locations 1 – 6 are listed.
3. Press the appropriate number for the template that you wish to use.
4. Changes to the seismic or text data <u>can be made</u> using the seismic setup and text setup options. The new information will not be saved to the *template* unless the template is re-saved.

EXAMPLE: A quarry operator has two main recording locations, depending upon the blast location within the pit. He saves the setup information for the Smith residence in template 1 under *SMITH*. He saves the setup information for the Jones residence in template 2 under *JONES.*   Because the distance and comments change for each blast, after the operator has chosen the appropriate template, he goes into the text setup to enter these two items. After the monitoring has been completed, he does not re-save the template. The original setup data remains stored, but the distance and comment information that was edited for the last shot is not saved in the template.

EXAMPLE: An engineer at a large construction site must split his time between monitoring blasting and monitoring pile driving. He sets up one template for the trigger recording mode and another template for the histogram recording mode.

ADDITIONAL COMMANDS

The following command options are summarized in this section: turn off unit, display banner.

Pressing **7** from the command menu will cause your unit to power down and shut off.

Press **8** from the command menu to display the current banner. This option is useful for checking the battery voltage and verifying changes to the seismic setup.

USING THE CompactFlash^{TM} DATA CARD

Removable Flash Card, High Event Capacity
The SSU 5500 seismograph is essentially an LCP ^{plus} equipped with a removable CompactFlash digital media card for event storage. The 128mb CompactFlash card has a storage capacity of 10,000 events. This is distinctly advantageous when monitoring continual blasts at the same location for a single client as a blast history spanning a long period can be recorded and stored on a single compact flash card

Differences between 3000 LCP^{Plus} and 5500 Seismographs
The SSU 3000 LCP^{Plus} and 5500 are nearly identical instruments regarding function and design. The SSU 5500's most notable differences are listed below;

Serial Port

There is no serial port on the SSU 5500 LCP + because the accessibility of the compact flash card eliminates the need to download data via serial cables.

Firmware

The SSU 5500 is equipped with version 3.84 firmware or higher.

Memory

The SSU 5500 is equipped with a 10,000-event memory CompactFlash™ card.

Recording and Transferring data using the CompactFlash™ storage card

1. Inserting and removing the Compact Flash Card

The slot for the CompactFlash™ card is located on the faceplate to the left of the printer compartment. With the SSU 5500 powered off, correctly insert the card by making sure it slides easily into the slot. If the card resists rotate 180 degrees and retry. To remove the card, simply pull the card out. NEVER REMOVE OR INSERT THE CARD WITH THE SEISMOGRAPH POWERED ON doing so may result in data loss.

2. Accessing events and data from the CompactFlash™ card

3. Any Windows® or Linux® system will accept the card with either a CompactFlash™ card slot or USB slot adapter. USB slot adapters are available at most computer supply stores.

4. Once the card has been inserted in the appropriate slot, the computer should automatically recognize the card.

Using CompactFlash™ with Seismic Analysis

1. Open the program Seismic analysis. Note: Only the latest version 6.3.37 or higher of Seismic Analysis is compatible with the SSU 5500's CompactFlash™ card.

2. To access events on the card, open the drop down menu in the right side of the window and select the CompactFlash™ card. The card should be identified as a mass storage device and be marked as a lettered drive.

3. Events should appear in the window once the card has been selected. Refer to the Seismic Analysis manual (available online at www.geosonics.com) for further instructions regarding event data access and viewing.

4. Deleting events- Events are deleted by reformatting the CF card in the PC. Always use the FAT or FAT16 format when reformatting the card to erase all events and folders. Never used FAT32 to format card as the seismograph will not be able to write to it and a write error will occur. They may also be removed by deleting or cutting the data folder from the flash card.

 It should also be noted that the more events there are on the card, the longer it takes the instrument to store the event. For example, if you have 400 or 500 events on a card and the unit writes out a new event, it will take approximately 30 seconds from the time the event has been recorded before the unit is ready to take another event, (approximately 17 seconds to analyze and 7 seconds to write to the card). If the card has 5,000 or so events already stored, it can take up to a minute to write out the event.

Re-initializing Instrument RAM and compact flash card- The compact flash card may also be erased and the instrument's internal memory re-initialized from the utility menu as follows.

   1. At the Utility Main Menu, press [0] and the follow screen should be displayed-

FORMAT CARD? 0: NO 1: YES 2: CANCEL

Press [1] to format compact flash and instrument RAM. Display will advance to next menu.

FORMAT CARD? 0: NO 1: FORMAT CARD 2: AND FILL WITH ZEROES

Press [1] again to format card and memory. Press [2] to format card and fill internal memory with zeros. (This is recommended only for use during instrument programming and maintenance.)

The unit will process the formatting and return to the main command menu after completion.

APPENDIX A

SPECIFICATIONS

TRIGGER MODES

Seismic	Resolution:	0.0025 in/sec (0.06 mm/sec)
	Printout graph time scaling:	From 0.5 to 5 inches for 1 second (5 second recording)
	Range:	5.120 in/sec (130 mm/sec) (other ranges available)
	Frequency Response Range:	2 – 250 Hz (3 dB), 2 – 1000 Hz (Nyquist)
	Sampling Rate:	Up to 2000/sec/channel
	Record Time:	1 – 15 seconds
	Accuracy:	5% within one year (multi-point calibrated within 3%)
	Calibration:	Internal dynamic
Sound	Range (linear):	78 – 138 dB (optional 154 dB and 174 dB ranges available
	Frequency Range (3dB):	2 – 250 Hz (3dB), 2 – 1000 Hz (Nyquist)
	Accuracy:	5% within one year (multi-frequency calibrated)
	Calibration:	Internal electronic
Sustained Trigger	Multiple record / real time:	Up to 252 seconds of full waveform data (up to 17.2 minutes available with additional memory)

HISTOGRAM MODE

	Recording intervals:	Selectable – 1,2,5,10,15,30 seconds and 1 minute
	Printout, list:	Highest peak particle velocity and frequency for each channel during selected interval. (Summary every 30 intervals with peak record and time of peak)
	Printout, graph:	Histogram (bar graph) of highest PPV during interval plotted with peak record value; time and date listed every 30 intervals
	Seismic resolution:	0.0025 in/sec (0.06mm/sec)
	Range:	5.120 in/sec (130 mm/sec) (other ranges available)
	Printout:	Maximum overpressure which occurs during each one minute period
	Sound resolution:	1 dB

GENERAL

- 42 column linehead printer with motor-driven paper take-up; up to 140 events printed per roll of paper
- Weight: 22.7 lbs. (10 kg)
- Dimensions: 16 x 13 x 6.75 in (41 cm x 33 cm x 17 cm)
- Operating Temperature: 0 – 130° F (-18 – 55° C)

APPENDIX B

TRIGGER MODE CAPACITIES

With the advent of the removable compact flash card, memory capacity is no longer an issue. For example, if a quarry was to blast 3 times a week and recorded every shot, it would take them 19 years to fill up the flash card if they never erased it.

SUSTAINED TRIGGER RECORDING CAPACITIES

The following data is based on a **100% FREE** memory.

The total sequential recording time available is dependent on the record time set and is as shown below.

Record Length	Max Number of Records	Max Recording Capacity
1 second	71	71 seconds
5 seconds	17	85 seconds
10 seconds	17	2.8 minutes
15 seconds	17	4.2 minutes

Note that after of these recordings a stored to the compact flash, the recording cycle will be repeated for each trigger and processed until the END button is pressed. As to card capacity, if you were recording 5 second records with 5 records per trigger, you could record a total of 1666 sustained trigger records of 25 seconds each.

Sampling Rates during Sustained Trigger Operation: Depending upon data recording requirements, sampling rates may need to be considered as well as total recording times. The sampling rate also affects the frequency range. Sampling rates for this mode are fixed as follows:

Record Length	Sampling Rate	Frequency Range
Up to 5.0 seconds	1,000 samples per second	2 – 500 hertz
5.1 to 10 seconds	500 samples per second	2 – 250 hertz
10.1 to 15 seconds	330 samples per second	2 – 165 hertz

NOTE: When Sustained Trigger operation is interrupted by pressing the END key, events will be processed which may take a considerable amount of time to accomplish (several minutes).

SAMPLE PRINTOUTS

```
            SN:0000 (00.30)
           WAVEFORM REPORT

Date & Time......... 02/06/00 18:56:15
Event Number........      3

Client.............. ACME BLASTING
Operation........... NORTH QUARRY
SSU Location........ JONES RES.
Distance to Source.. 1500 ft
Operator............ JOE B.
Comments............ RAIN

Recording Time......   5.0 s

Triggers (seismic).. 0.050 in/s
          (sound)....  OFF

SUMMARY       --L--   --T--   --V--
PPV...........  0.098  0.105   0.128 in/s
PD............   1.79   2.26    0.91 (.001")
PPA...........  0.039  0.039   0.039 g
FRQ...........   8.3    8.8    27.8 Hz

Resultant PPV.......  0.130 in/s
Peak Sound..........   128 db
                      .0073 psi

WAVEFORM GRAPH

Data Scale (seismic)... 0.320 in/s
Data Scale (air).......   130 db (.0091 psi)
Graph Scale............ 1 s = 1 in
Time Scale per mark.... 100 ms
```

Waveform Report

Seismograph's serial number and firmware version

Header Information

5 second record time

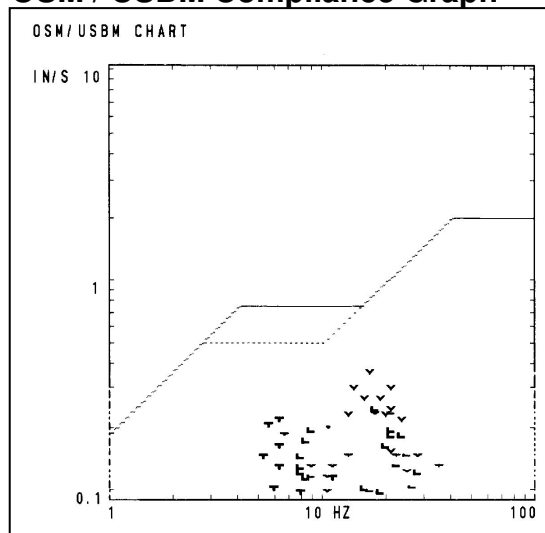Trigger levels: seismic – 0.05 ips
Sound / Air – off

Summary Data:
PPV – peak particle velocity; PD – peak displacement;
PPA – peak particle acceleration; FREQ – frequency;
L – longitudinal; T – transverse; V – vertical, db –
decibel; psi – pounds / square inch

Graph scale information

```
     L       T       V       S
```

```
DYNAMIC CALIBRATION CHECK
     L       T       V       S
```

Calibration test graph

C

OSM / USBM Compliance Graph

```
OSM/USBM CHART

IN/S 10



      1




    0.1
         1              10 HZ           100
```

The peak particle velocity (in/sec) is plotted on a logarithmic scale along the Y-axis. The frequency (hertz) is plotted on a logarithmic scale on the X-axis.
L represents a data point on the longitudinal channel.
T represents a data point on the transverse channel.
V represents a point on the vertical channel.

STOP EVENT

```
GEOSONICS INC

        SAFEGUARD SEISMIC UNIT 3000 L/C P
              SN:0000 (00.30)
                 STOP EVENT

Date & Time......... 02/00/00 22:22:59
Event Number........      0

Client............... ACME BLASTING
Operation............ NORTH QUARRY
SSU Location........ JONES RES.
Distance to Source.. 1500 ft
Operator............. JOE B.
Comments............ RAIN

SHAKETABLE CALIBRATED.. 00/00/00 00:00:00
BY  GeoSonics, Inc.
      Box 779
      Warrendale, PA 15095 U.S.A.
      724.934.2900, 724.934.2999 (fax)

          1 02/00/00 22:22:50
          1 02/00/00 22:22:59
          0 event(s) over trigger
          0.050 in/s OFF
```

seismic trig.   sound/air trig.

A trigger mode stop event includes header and banner information.

Scan start time
Scan exit time
# of events over trigger level(s)

D

BATCH REPORT

```
GEOSONICS INC

       SAFEGUARD SEISMIC UNIT 3000 L/C P
              SN:0000 (00.30)
              SETUP INFORMATION

Date & Time......... 02/05/00 00:03:50
Battery Voltage..... 12.6
Software Version.... 00.30
Memory Size (k)..... 512
Calibration Date.... 00/00/00 00:00:00
BY GeoSonics, Inc.
      Box 779
      Warrendale, PA 15095 U.S.A.
      724.934.2900, 724.934.2999 (fax)


Owner Info.........
                    NOT_IMPLEMENTED


Next Event Number...   2

Client.............. ACME BLASTING
Operation........... NORTH QUARRY
SSU Location........ JONES RES.
Distance to Source..   458 m
Operator............ JOE B.
Comments............ RAIN


Record Type......... WAVEFORM
Recording Time......   5.0 s

Triggers (seismic)..  1.27 mm/s
         (sound)....  OFF

Hist. Mode Interval.  1 min
Hist. Mode Samples..  5

Clock Timer......... OFF
Sleep Date & Time... 00/00/00 00:00:00
Wake Up Date & Time. 00/00/00 00:00:00

Trigger Alarm 1.....  ON
          Level.......  1.27 mm/s
          On Time.....  20 s

Trigger Alarm 2.....  ON
          Level.......    76 db
          On Time.....  20 s

Serial Baud Rate....  9600
Serial Flow Control.  XON/XOFF
Modem Init String...
Modem Dial String...

Include OSM/USBM....  YES
Use Page Breaks.....  YES
Histogram Style.....  GRAPH
Use Password........  NO
Keep Display On.....  NO
Idle Time Out.......  300 s
```

Banner information

Calibration information

Next event number

Header information

Recording mode
Record time

Trigger levels

Histogram setup

Timer settings

Alarm 1 settings

Alarm 2 settings

Modem settings

Print setup

LCD display time-out ON / OFF
Power down time-out

-END-

E