

SAFEGUARD

SEISMIC

UNIT

3000

LCP *plus*

Portable Printing Seismograph



GEOSONICS INC
WARRENDALE PA, USA
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INTRODUCTION

Welcome to the Safeguard Seismic Unit family of seismographs. The SSU LCP^{plus} was designed with the user in mind. It has a tough, weather resistant case, a full *QWERTY* style keyboard which makes programming and data retrieval fast and easy, metal quick-lock connectors to ensure secure cable connections and a facsimile style printer for on-site printouts. The 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 SSU 3000 LCP^{plus} portable printing seismic monitor has four recording modes – triggered, histogram/continuous, sustained trigger, and dual mode. Events up to 252 seconds in length can be recorded. 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. A serial port (serial to USB cable included) allows the seismograph to be connected to a PC for easy data transfer. The included Analysis.NET Software can be used for compliance analysis and custom printouts.

Data can be collected in either imperial (US customary) units or metric units. The non-volatile internal memory can store up to 100, 1 – second events. 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 in 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. After the unit does a self-check, the *Printing Mode* screen will be displayed. Make any necessary changes.
6. When the **COMMAND** menu is displayed, press 1 for *Recorder Setup*, then 1 for *Recording Mode*. 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 Test*. If any channels **FAIL**, check connections and correct problems before proceeding.
9. Press **SCAN** to start collecting data. Allow approximately 25 seconds for the unit to start to record.
10. After recording procedures are complete, press **END / ESC** to exit the **SCAN** mode.

Quick Setup Reference Guide

Recording mode, settings:

Triggered Mode – see page 12

Histogram Mode – see page 15

Sustained Trigger Mode – see page 19

Dual Monitor Mode – see page 20

Text Setup – see page 26

Printer Setup – see page 31

GETTING STARTED

Components

The 3000LCP ^{plus} portable printing seismograph consists of the following hardware:

- seismograph base unit / carrying case
- geophone
- microphone
- microphone stand
- windscreen/airball
- three (3) 3-inch spikes with external threads (for use with geophone)
- one (1) 3-inch spike with internal threads (for use with microphone stand)
- AC adapter
- PC communication cable
- USB to serial adapter cable

GeoSonics' Seismic Analysis.NET Software is also included with your unit. Units are typically shipped with the fuse removed. This is done to protect your unit from damage that may occur during airport or delivery tracking scans.

The automotive-type fuse is easily replaced by seating it in its socket (which is located in the printer compartment). However, date and time information will have to be reentered into your unit once the fuse is replaced. This is easily accomplished by following the instructions under UTILITIES, option 1 (page 38).

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



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



The middle (**RED**) LED is the status indicator light for the SCAN modes. This light will blink when the seismograph is in the scan mode or doing a calibration check.



The bottom (**GREEN**) LED 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*:

http://www.isee.org/media/pdf/FieldPracticeGuidelinesRev03_01_10.pdf

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 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 must 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 which 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 your events to have invalid calibration pulses. 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 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 acceleration 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 be 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.

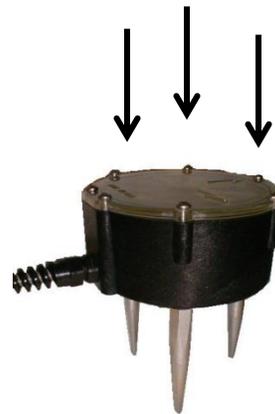
ANCHORING TO BEDROCK

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



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

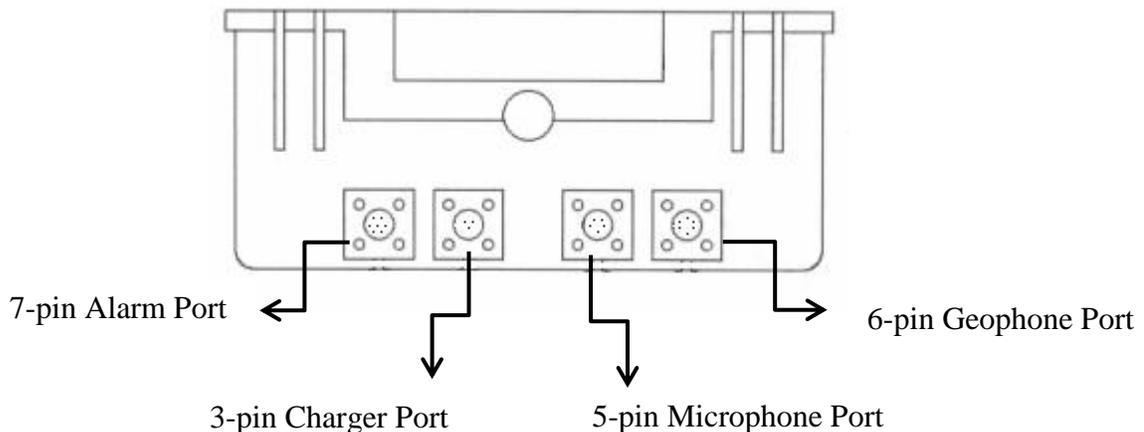
Double face (carpet tape) can be used to obtain a secure coupling on a hard surface in many cases. The surface should be flat and free of dirt or other substances that would prevent a secure attachment. Adding a sandbag will decrease the possibility of slippage. Other coupling methods have proven to be successful under specific conditions. C-clamps and epoxy have all been used to attach geophones to stable surfaces.

GEOPHONE INSTALLATION

After installing the geophone in its recording location, 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 assembly in its recording location, insert the connector on the end of the cable into the port labeled **MICROPHONE** on the front of the unit. After inserting the connector into the port, turn the outer locking ring clockwise to complete the connection.



MENU OPTIONS / KEYBOARD OVERVIEW

The seismograph is programmed using menu driven options displayed in the liquid crystal display. Data entry is accomplished through the QWERTY keyboard.

In addition to the standard character keys, several short-cut keys are included.

END/ESC exits the current setup menu, or exits the scanning mode

CAL prints a calibration test

SUM prints a summary of the last five recorded events

PRINT Prints a summary of the last five recorded events and proceeds to the *Print Reports* menu.

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 (set) typed text or data

OFF turns the seismograph off

← backspace key, deletes last typed character when programming the unit; advances paper when the **COMMAND** menu is active.

Pressing the up, down, or end keys before pressing the enter key will stop a recent (i.e. NEW) entry from being saved. Pressing the **SCAN** key (from the **COMMAND MENU**) will cause the unit to start collecting data in approximately twenty (20) to sixty (60) seconds depending upon the recording setup. Pressing **END** will end this process. A stop / check event will be created when the **END** key is pressed during scanning activities.

The unit is turned on by pressing and holding the **ENTER / ON** key until a small line (_) appears in the upper left corner of the display window.

After a few seconds, the **CHECK** screen will appear. This screen provides a quick overview of basic information.

This CHECK screen provides the following information:

```
CHECK
Fr 04/12/13 13:24:29
21 records 89 % free
```

The seismograph's current date setting is Friday, April 12, 2013. The time setting is 1:24:29* PM. There are 21 records (including check events) in the unit's internal memory with 89% of the memory free and available for data recording.

This screen will be displayed for approximately 10 seconds and will then be replaced by the *Print Mode* screen.

```
PRINT MODE
1:NONE 2:SUM 3:FULL
Set: DISABLED
New: FULL DETAIL
```

If you wish to keep the current setting, press ↓ to go to the next menu. If you wish to change the setting press to appropriate number followed by ENTER.

- 1 – NONE: event data will not be printed during data collection
- 2 – SUM: event summaries will be printed during data collection
- 3 – FULL: full detail events will be printed during data collection

For more information on printer settings please refer to page 31.

Next, the BANNER screen will be displayed.

```
SN:5291 0509xp 12.8 v
04/12/13 16:19 TRIG
SEI <0.100> <SND OFF>
5.0s TIMER <OFF> STD
```

SN: 5291 - this unit's serial number is 5291
0.495xp – the firmware version is 0.509xp
12.8 – battery voltage is 12.8 volts
04/12/13 – the internal memory date is April 12, 2013*
16:19 – the internal memory time is 4:19 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

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. Recorder Setup

* 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.

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.

Recorder Setup / Modes

Your SSU 3000 has four available recording modes: Trigger, Histogram, Dual Mode and Sustained Trigger. These modes have been designed to provide the user with multiple recording options to satisfy a wide range of vibration and airblast monitoring and recording situations. It is recommended that all users acquaint themselves with the capabilities (and limitations) of each of the recording modes.

TRIGGER MODE

Press **1** from the COMMAND screen for *Recorder Setup*.

Press **1** from the RECORDING SETUP screen for *Recording Mode*.

The *trigger mode* is designed for single event recordings of 15 seconds or less, such as blast events. (Due to changes in the sampling rate it is not recommended for events longer than 5 seconds. Please refer to the *Sustained Trigger mode*, page 19.)

In the trigger mode the seismograph measures and records peak particle velocities and air overpressures. Frequency information is calculated from this data. In addition to generating on-site printouts using the seismograph's printer, the information recorded in the trigger mode may be used to generate customized reports using the GeoSonics Analysis.NET Software. The software can print velocity, acceleration, and displacement graphs, perform FFT frequency analysis, as well as plot the data on expanded USBM, OSM, or DIN compliance curves.

When the seismograph is in the triggered mode, it continually scans (at a rate as high as 2,000 samples/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.

```

RECORDING MODE
0:DM 1:TRG 2:HST 3:S
SET: HISTOGRAM
NEW: TRIGGER
    
```

To enable the trigger mode press **1**. The unit will respond with **NEW: TRIGGER**. Press **ENTER**.

```

RECORDING MODE
0:DM 1:TRG 2:HST 3:S
SET: TRIGGER
NEW: TRIGGER
    
```

Press **↓** to go to the *SEISMIC TRIGGER SETUP* menu.

NOTE: You may exit trigger mode setup menu at any time by pressing the **END/ESC** key.

```

1 TRIGGER SETUP <1>
SEIS TRIG.0.050 - 5.000
SET:          0.050 in/sec
NEW:          0.040 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 **ENTER**. The new value will appear as the **SET** value. Press **↓** to proceed to the next setup menu.

```

TRIGGER SETUP <2>
AIR TRG      81 - 142
SET:         0 db
NEW:         132 db
    
```

The seismograph can be set to trigger off airblast levels. Entering 0 will 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 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 (i.e. the blast event) not being recorded.

If you anticipate a high airblast level and very low ground vibrations, then the air trigger should be enabled. Use caution in setting a low-level air trigger to avoid false triggers.

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 ENTER. The new value will appear as the SET value. Press ↓ to proceed to the next menu option.

TRIGGER SETUP <4>	
RECORD TIME	1 - 15
SET:	5.5 SEC
NEW:	5.0 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. The longer the record length, the more memory space it requires. The (standard) internal memory has a maximum capacity of 100 1-second events. Airblast travels at a much slower speed than does ground vibration. Ground vibrations 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 1090 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 affect 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 second between the first delay period and the last and where there are no significant adverse wind or sky conditions.

DISTANCE	<u>MINIMUM</u> 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

The sampling rate is determined by the record time. The frequency range of a record is affected by the sampling rate. The following sampling rates apply to events recorded in the triggered, sustained trigger, and dual modes.

RECORD LENGTH	SAMPLING RATE	FREQUENCY RANGE
1.0 – 2.5 seconds	2,000 samples / second	2 – 1,000 hertz
2.6 – 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 information regarding maximum number of records/recording capacity. It is also recommended that users consult local and state regulations for frequency related instrumentation requirements.

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 record time, press **ENTER**. The new value will appear as the **SET** value. Press **END/ESC** to exit the trigger setup menu or press ↓ to go to the next screen.

The next option (which is also accessible through the *Setup Printer* up menu, see page 32) allows you to enable or disable the printing of the OSM/USBM (imperial, i.e. in/sec) or DIN (metric, i.e. mm/sec) graph if the *full detail* printer mode is enabled. Select **1** for YES; **0** for NO; followed by **ENTER**.

Press **END/ESC** to exit the trigger setup menu or press ↓ or ↑ to go back through the previous menu options.

To place the unit in the **SCAN** mode – press **SCAN**

The seismograph will begin scanning vibration levels within 30 - 60 seconds. The RED LED status light will blink once approximately every 10 seconds during *trigger mode* operation.

To end data collection press **END/ESC**

HISTOGRAM RECORDING

Press 1 from the **COMMAND** screen for *Recorder Setup*.

Press **1** from the RECORDING SETUP screen for *Recording Mode*.

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. In addition to on site printouts (if desired) the Analysis.Net Software can 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.

```

RECORDING MODE
0:DM 1:TRG 2:HST 3:S
SET:  TRIGGERED
NEW:  HISTOGRAM
    
```

To enable the histogram mode press **2**. The unit will respond with NEW: HISTOGRAM. Press ENTER.

```

RECORDING MODE
0:DM 1:TRG 2:HST 3:S
SET:  HISTOGRAM
NEW:  HISTOGRAM
    
```

Press ↓ to go to the *HISTOGRAM SETUP* menus.

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

```

HIST INTERVAL
1: sec., 2: min -
SET: seconds scale
NEW: minutes scale
    
```

There are two (2) **time interval** menu screens. The first screen (shown here) is used to set the time unit that will be employed when the interval is set on the next screen. The following table lists the available interval times.

Screen two setting	Screen one setting set to 1 – sec.	Screen one setting set to 2 – min
1	1 second	1 minute
2	2 seconds	2 minutes
3	5 seconds	5 minutes
4	10 seconds	10 minutes
5	15 seconds	15 minutes
6	30 seconds	30 minutes
7	1 minute	1 hour

Select **1** for seconds or **2** for minutes in the first screen. Press **ENTER**. After the desired setting is set, press ↓ to access the second histogram interval screen. A <s> or <m> will appear at the end of the first line to indicate whether the unit is set for a *second* or *minute* interval.

HIST INTERVAL <s> 1 – 7: 1, 2, 5, 10, 15, . . . Set: 15 sec New: 1 min

Press 1, 2, 3, 4, 5, 6, or 7 to set the desired recording interval based upon the above table.

When recording in the histogram mode, there is a maximum of 2,500 intervals that can be saved in each event file. If the record length is set for 2,500, the data will be written to an *HIST* event after 2,500 intervals and a new *HIST* file will be begun.

The maximum record length may be changed to customize the length of the records. For instance, if the recording interval is set for 1 minute and the record length is 1440, a new file will begin every 24 hours.

NOTE: up to 2 minutes of record time will be missed every time a record is written and a new one is begun.

The following examples are provided to assist users who desire specific record (file) lengths.

Recording Interval	Record Length	Maximum File Length
1 second	1800	30 minutes
15 seconds	1920	8 hours
5 minutes	12	1 hour
30 minutes	48	24 hours
1 hour	168	7 days

To calculate the desired record length in hours:

$$(\text{\# of interval recordings per minute}) \times 60 \times (\text{desired \# of hours per event}) = \text{record length}$$

To calculate the desired record length in days:

$$(\text{\# of interval recordings per hour}) \times 24 \times (\text{desired \# of days per event}) = \text{record length}$$

HIST MAX LENGTH RECORD LENGTH 1 – 2500 SET: 1440 NEW: 1440

Press **ENTER**. After the desired setting is set, press ↓ to access the histogram summary menu.

HIST SUMMARY	
SUM. EVERY	0, 10 – 1800
Set:	10
New:	0

Users who enable the print mode during histogram recording operations can choose how often a summary is printed. If **0** is selected, no summary data will be printed until the end of recording operations. If **10** is selected, a summary will be printed after each 10 interval recordings, i.e, after 5 minutes (300 seconds) for 30-second intervals or 10 minutes for 1-minute intervals.

NOTE: For recording intervals of 10 seconds or less, the printer is disabled during recording operations. After the seismograph is placed in the **SCAN** mode, the histogram’s record start time and date as well as the interval length (1, 2, 5, or 10 seconds) is printed. No additional information will be printed until monitoring activities are ended by pressing the **END/ESC** key. The printer will then print summary data for the event. In order to obtain a printout of the interval data (including the text header information) you may either print the event using the *Print* menu (see page 31) or download the data to your PC and use the Analysis.Net Software to create a customized report.

Press ↓ or ↑ to cycle through the options again or **END/ESC** to exit histogram setup.

NOTE: When the seismograph is writing the event data to memory (at the end of an event), it is unable to monitor and record data. For recording intervals less than 60 seconds, data recording will resume within one (1) minute. For recording intervals of 1 minute or longer, data recording will begin within two (2) minutes, but always at the start of a minute, i.e. when the seismograph’s internal clock is HH:MM:00.

To begin to record data – press **SCAN**

Date collection will begin within two (2) minutes. The RED LED status light will blink twice (rapidly) approximately every 10 seconds during histogram mode data collection. If the display is active, interval readings will refresh approximately every 10 seconds.

 Users of seismographs employing firmware versions prior to 4.98* should refer to Appendix D (page 48) for instructions on the proper procedures for ending histogram recording. Failure to follow the instructions in Appendix D may result in loss of data.

For seismographs with firmware version 4.98 and above*:

If the LCD has timed out, press **ENTER/ON** to ‘awaken’ the LCD.

Press **END/ESC** to end data collection.

* If you do not know the firmware version of your unit, refer to page 46.

SUSTAINED TRIGGER RECORDING

The sustained trigger mode is used for producing consecutive trigger events with no data loss between events. These events can then be linked to produce one long time-history event using the analysis program. 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 waveform, OSM/USBM and various international compliance graph printouts; advanced frequency analysis such as FFT can also be performed on these event files.

In addition to setting both the seismic and the air trigger levels, you will need to set the record times for the individual 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 on the following page..

Please refer to **TRIGGER SET UP** (see page 12) for information on Trigger Setup screens 1 – 2. **Do not exit the sustained trigger setup until the records per trigger has been set.**

```
SUS TRIG SETUP    <3>
RECORDS PER TRIGGER
SET: 2
NEW: 3
```

Choose the number of consecutive events (2 - 15) that you want to be recorded every time the unit is triggered. (If the ‘records per trigger’ is set to 1, the unit will set itself to the *triggered mode*.) Events are recorded back to back with no loss of data between recordings. The data is then processed

after the last event is recorded.

```
SUS TRIG SETUP    <4>
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 **ENTER** to set the value; press ↓ to review current settings or **END** to exit this menu.

The sampling rate is determined by the record time of each (individual) record. The frequency range of a record is affected by the sampling rate. The following sampling rates apply to events recorded in the triggered and sustained trigger mode.

RECORD LENGTH	SAMPLING RATE	FREQUENCY RANGE
1.0 – 2.5 seconds	2,000 samples / second	2 – 1,000 hertz
2.6 – 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. It is also recommended that users consult local and state regulations for frequency related instrumentation requirements.

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. 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 SUS TRG option 3. 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, associated 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.

DUAL MONITOR MODE

The dual monitor mode utilizes both trigger and histogram style event recording. The unit continuously records in the histogram mode until ground vibrations and/or airblast levels reach or exceed preset trigger levels at which point the unit *switches* to the trigger mode and records a trigger event. After processing the data the unit will return to the histogram mode. This mode enables the operator to continuously record low-level background data while still being able to record significant vibration events in the triggered mode. Please note that when recording in the *Dual-Mode*, no frequency data is computed or recorded with the histogram data. In order to collect histograms with the associated frequency data use the HISTOGRAM mode.

DUAL MODE SPECIFICS

- #*** When the unit is triggered, the data from the current interval is lost with the exception of the data that will be incorporated into the pre-trigger portion of the trigger event, (i.e., 0.5 seconds for a 5 second record).

- #*** Histogram records are saved in the seismograph with an HST-F extension.

When the seismograph is in the *Dual Monitor Mode* it only records maximum interval data for complete intervals. As an example, if you have the seismograph to record in 30-minute intervals and the scan mode is active for one hour and 22 minutes (82 minutes) your event will have two (2) interval readings covering the first hour, but no recorded data for the last 22 minutes.

Similarly, if an interval is interrupted by a trigger event, the partial interval that preceded the trigger will be written as an event, but will not contain any vibration data. For example, if you have programmed your unit to record in 1-hour intervals and a trigger event occurs 58 minutes after placing the seismograph in the scan mode, an HST-F event will be written to memory for the first 58 minutes, but will not contain any vibration data. The unit's interval timer will start over after the trigger event is processed and (if not interrupted) will produce an interval record for the next 1-hour time period.

When downloading data through the Analysis.NET software, be sure to save the *check* event created when the unit exited the scan mode. It will provide verification of beginning and end times of the entire scan period as well as the number of trigger events.

Press **1** from the **COMMAND** screen for *Recorder Setup*.

Press **1** from the **RECORDING SETUP** screen for *Recording Mode*.

```
RECORDING MODE
0:DM 1:TRG 2:HST 3:S
SET: HISTOGRAM
NEW: DUAL MODE
```

To enable the Dual Mode, press **0**. The unit will respond with **NEW: DUAL MODE**. Press **ENTER**.

```
HIST INTERVAL
1: sec., 2: min
SET: seconds scale
NEW: minutes scale
```

Press **↓** to go to the *HISTOGRAM INTERVAL* screen.

There are two (2) **time interval** menu screens. The first screen (shown above) is used to set the time-unit that will be employed when the interval length is set on the next screen. The following table lists the available interval times.

Screen two setting	Screen one setting set to 1 – sec.	Screen one setting set to 2 - min
1	1 second	1 minute
2	2 seconds	2 minutes
3	5 seconds	5 minutes
4	10 seconds	10 minutes
5	15 seconds	15 minutes
6	30 seconds	30 minutes
7	1 minute	1 hour

Select **1** for seconds or **2** for minutes in the first screen. Press **ENTER**. After the desired setting is set, press ↓ to access the second histogram interval screen. An <s> or <m> will appear at the end of the first line to indicate whether the unit is set for a second or minute interval.

DUAL INTERVAL <s> 1 – 7: 1, 2, 5, 10, 15, . . . Set: 15 sec New: 1 min

Press 1, 2, 3, 4, 5, 6, or 7 to set the desired recording interval based upon the above table. In this example the **7** was pressed which results in a 1-minute interval.

Press ↓ to go to the *DUAL MAX LENGTH* screen.

When recording in the histogram mode, there is a maximum of 2,500 intervals that can be saved in each event file. If the record length is set for 2,500, the data will be written to an HST-F event file after 2,500 intervals and a new HST-F file will be begun.

The maximum record length may be changed to customize the length of the records. For instance, if the recording interval is set for 1 minute and the record length is 1440, a new file will begin every 24 hours.

NOTE: up to 2 minutes of record time may be missed every time a record is written and a new one is begun.

The following examples are provided to assist users who desire specific record lengths.

Recording Interval	Record Length	Maximum File Length
1 second	1800	30 minutes
15 seconds	1920	8 hours
5 minutes	12	1 hour
30 minutes	48	24 hours
1 hour	168	7 days

To calculate the desired record length in hours:

$$(\text{\# of interval recordings per minute}) \times 60 \times (\text{desired \# of hours per event}) = \text{record length}$$

To calculate the desired record length in days:

$$(\text{\# of interval recordings per hour}) \times 24 \times (\text{desired \# of days per event}) = \text{record length}$$

Remember that a new histogram file will begin after each seismic trigger event.

```
DUAL MAX LENGTH
RECORD LENGTH 1 – 2500
SET: 1440
NEW: 1440
```

Enter the desired maximum record length. Press **ENTER**. After the desired setting is set, press **↓** to proceed to *DUAL SEISMIC* setup.

NOTE: When the seismograph is writing the event data to memory (at the end of an event), it is unable to monitor and record data. For recording intervals less than 60 seconds, data recording will resume within one (1) minute. For recording intervals of 1 minute or longer, data recording will begin within two (2) minutes, but always at the start of a minute, i.e. when the seismograph's internal clock is HH:MM:00.

```
DUAL SUMMARY
SUM. EVERY 0, 10 – 1800
Set: 0
New 10
```

Users who enable the print mode during histogram recording operations can choose how often a summary is printed. If **0** is selected, no summary data will be printed until the end of recording operations. If **10** is selected, a summary will be printed after each 10 interval recordings, i.e. after 5 minutes (300 seconds) for 30-second intervals or 10 minutes for 1-minute intervals.

NOTE: For recording intervals of 10 seconds or less, the printer is disabled during recording operations. After the seismograph is placed in the **SCAN** mode, the histogram's record start time and date as well as the interval length (1, 2, 5, or 10 seconds) is printed. No additional information will be printed until monitoring activities are ended by pressing the **END/ESC** key. The printer will then print summary data for the event. In order to obtain a printout of the interval data (including the text header information) you may either print the event using the

Print menu (see page 31) or download the data to your PC and use the Analysis.NET Software to create a customized report.

Press ↓ or ↑ to cycle through the options again or **END/ESC** to exit histogram setup.

NOTE: When the seismograph is writing the event data to memory (at the end of an event), it is unable to monitor and record data. For recording intervals less than 60 seconds, data recording will resume within one (1) minute. For recording intervals of 1 minute or longer, data recording will begin within two (2) minutes, but always at the start of a minute, i.e. when the seismograph's internal clock is HH:MM:00.

DUAL SEISMIC	
SEIS TRIG.0.050 - 5.000	
SET:	0.050 in/sec
NEW:	0.040 in/sec

A seismic trigger level must be set when the unit is programmed to record in the dual mode. Once the seismograph is placed into the scan mode, the geophone will continually *scan* and record vibration levels in the histogram mode. Once vibrations or air overpressures meet or exceed

the set seismic and/or air trigger level(s) it will switch to the trigger mode. 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 ENTER. The new value will appear as the SET value. Press ↓ to proceed to the next setup menu.

DUAL AIR TRG	
AIR TRG	81 – 142
SET:	132 db
NEW:	0 db

The seismograph can be set to trigger off airblast levels. Entering 0 will turn the air trigger OFF. If the air trigger is turned off and the unit is triggered by ground vibration, the airblast data will still be recorded (in both the histogram and trigger modes). Because airblast data is measured by this instrument on a linear scale, it is

possible that a small gust of wind could trigger the instrument. This could cause one or more false triggers.

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 ENTER. The new value will appear as the SET value. Press ↓ to proceed to the next menu option.

DUAL REC TIME	
RECORD TIME	1 - 15
SET:	5.5 SEC
NEW:	5.0 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. The longer the record length, the more memory space it requires. The (standard) internal memory has a maximum capacity of 100 1-second events. Airblast travels at a much slower speed 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 1090 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. While the seismograph will return to the histogram mode following the recording and processing of the trigger event, remember that the processing time does take several seconds. An airblast from a distant event could still be missed before the unit begins to scan in the histogram mode.

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 and airblast associated with the trigger event, 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.
7. Record length also affects the frequency range of the seismograph. Please refer to page 19 for more information.

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 second between the first delay period and the last and where there are no significant adverse wind or sky conditions.

DISTANCE	<u>MINIMUM</u> 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

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 record time, press ENTER. The new value will appear as the SET value. Press ↓ to access the next menu.

OSM/USBM; DIN
 INCLUDE? 1: YES 0: NO
 Set: NO
 New: YES

The next option (which is also accessible through the print set up menu, see page 33) allows you to enable or disable the printing of the OSM/USBM (imperial, i.e. in/sec) or DIN (metric, i.e. mm/sec) if the *full detail* printer mode is enabled. Select **1** for

YES; 0 for NO; followed by ENTER.

Press **END/ESC** to exit the dual monitor setup menu or press ↓ or ↑ to go back through the previous menu options.

To place the unit in the SCAN mode – press **SCAN**

Data collection will begin within 2 minutes. The RED LED status light will blink (rapidly) three times approximately every 10 seconds during histogram mode data collection and will glow steady when the unit is triggered and it is recording data in the trigger mode. Following a trigger event, the seismograph will process the data and will return to the histogram mode.

To end data collection press **END/ESC**

A word of caution regarding print options when monitoring in the dual monitor mode: When the seismograph is printing it exits the scan mode. Programming your unit to print full detailed records is not recommended. It is suggested that you either disable the printer or use the summarized option. If a more detailed printout is desired download the data to your PC and use the Analysis.NET software to create a customized report.

Recording Units

Option 2 under RECORDING SETUP, *Recording Units*, is used to toggle between imperial units (inches/second and psi) and metric units (mm/second and Pascals)

```
SET UNITS
UINITS 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 recording unit, press the appropriate number followed by ENTER. Press END to exit and return to the COMMAND screen.

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, dual mode, or sustained trigger. While not necessary for operation, this information is useful for record keeping purposes. Records printed through the Analysis.NET Software will include this information. **THIS INFORMATION CANNOT BE CHANGED OR EDITTED AFTER THE DATA IS RECORDED. THIS IS TO PROTECT USERS FROM ALLEGATIONS OF RECORD TAMPERING.**

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

(See page 34 for Command Option 2: Display Data.)

Screens 1 – 6 are used to enter the basic header information that will be included with your seismic data if you print a summary or full detail report on the seismograph or download and print your event through the Analysis.NET Software.

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

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

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 keyboard. Press ENTER. 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:
JOHN S. 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 keyboard. Press ENTER. 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 COMMENT. To keep the current information press ↓ to go to the next menu window. To change this

information, enter up to 20 characters using the keyboard. Press **ENTER**. After the new information is displayed, press **↑** to scroll to other text setup options or **END** to exit this option.

NOTE: *Additional Notes* and *Acquire GPS* menu options must be accessed by selecting **7** (Additional Notes) or **8** (Acquire GPS) from the *Text Menu* setup screen.

Option **7** under the Text Setup menu is ***Additional Notes***.

ADDITIONAL NOTES 0: DON'T USE NOTES 1. USE ADD'L NOTES OVERCAST SKIES
--

This option allows the user to add up to three (3) lines of text or two (2) lines of text and an acquired GPS location to the record. **USE ADD'L NOTES** must be enabled in order to use the **ACQUIRE GPS** feature. **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 keyboard. Press **ENTER**. 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. If you intend to add a GPS location to your event, leave line 3 blank. Press **ENTER**. Press **END** to exit this option.

Option **8** under the Text Setup menu is ***GPS Location***.

- **USE ADD'L NOTES** (option 7 above) must be enabled in order to use the **ACQUIRE GPS** feature.

From the Text Setup menu, press **8**.

GPS LOCATION _ 1. ACQUIRE GPS 2 ERASE GPS
--

This option is for users of GPS systems with NEMA 0183 output capabilities to interface their seismograph with the GPS unit and have the location automatically entered into their record. This information will be entered into line 3 of **Additional Notes**.

To save the current information, press **END** to exit the menu.

To acquire a new location, connect your GPS unit to the seismograph, making sure that it is turned ON; press **1** for **ACQUIRE GPS**. If the seismograph receives a signal from the GPS device, the location data will be added to the record. If no signal is received, a **BAD** or **NO RESPONSE** message will be displayed and you will be returned to the GPS menu.

To erase the data stored in the GPS location without acquiring a new location, press **2** to erase the data.

Timer Setup*

From the COMMAND menu press **4** – **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) memory space is not taken up by unwanted data.

It is highly recommended that the proper date and time be programmed into the unit before setting the timer options. It is also recommended that the recording setup and text options have been entered before setting the timer options. It is suggested that the timer function be enabled at least 30 minutes prior to the desired ‘awake’ time.

```
TIMER SETUP
1. Timer Mode On/Off
2. One Time / Daily
3. Set Wake Up
```

There are four (4) menu items under **TIMER SETUP**. (The fourth option – *Set Sleep* may be accessed directly from this screen by pressing **4** or arrowing down and pressing **4**.)

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 **ENTER**. After the change has been entered, press **END** to exit the timer setup option or ↓ to proceed with additional options / setup commands.

This option allows the user to choose between two (2) on/off modes.

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

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.

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

After the timer on/off mode has been selected and the ENTER 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: 03/22/13 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 ENTER to set the information, press ↓ to proceed with timer setup options or END to return to the command menu. **(If programming for a Daily cycle, enter zeroes for the date until you reach the time field.)**

Note – If you are setting the seismograph to record in either the histogram or dual mode using a *minutes* interval setting, set your wakeup time two minutes prior to the desired wakeup time. This is necessary because the seismograph requires a few seconds to ‘wake up’ and *minutes* recordings always start at the beginning of a minute, i.e. when the internal clock’s time is HH:DD:00. Also, allow an additional minute if the print mode is set to *Summarized* or *Full Detail* to allow for the seismograph to print header and graph scaling information.

```
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 ENTER 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. **(If programming for a Daily cycle, enter zeroes for the date until you reach the time field.)**

EXAMPLE SETUPS

Desired monitoring period: Start scanning this afternoon (3/3/13) 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 03/03/13 13:28

Set the SLEEP date and time for 03/03/13 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 00/00/00* 06:58

Set the SLEEP date and time for 00/00/00* 17:00

*When using the **daily** setting, **do not** enter a wake up or sleep date.

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

PRINTER SETUP

Several print options are available. The seismograph can be programmed to print the summary or the summary and waveform for a trigger event immediately after it is recorded. There are numerous settings for histogram recording as well. The unit can also print events stored in memory. Example of various types of printouts may be found in the appendix.

From the COMMAND menu, press **5** for *Printer*.

Option 1 *Print Summary*

The *Print Summary* option is used to print a listing of the events (including peak readings) currently in memory. This is useful for identifying the directory number of an event that you desire to print.

There are three (3) available options.

```
PRINT SUMMARY
1 All
2 Last Five
3 All, NO STOP
```

The *All* option will print a listing of all events in memory.
The *Last Five* option will only print the five most recent events.
The *All, NO STOP* option will print all data collection events.
Stop / check events will not be printed.

Option 2 - *Print Event*

The *Print Event* option is used to print an event from memory. Regardless of the print mode setting, one, full detail report will be printed using the settings chosen under option 5 (see page 31).

```
PRINT EVENT
DIRECTORY NUMBER
- 01
  23
```

Enter the directory number for the event that you wish to print followed by **ENTER**.

Option 3 – *Print Settings*

The *Print Settings* option is used to create a printout of the settings currently in your seismograph, including text (header) information, recording mode, timer and alarm settings, serial port settings, as well as print settings.

Option 4 – *Batch Print*

The batch print option is used to print ALL events, ALL reports or both, with a few key strokes.

BATCH PRINT 1. ONLY Events 2. NO Events 3. Print All

Press **1** to print ALL events currently in memory. (This operation may be aborted by pressing **END/ESC**.)

Press **2** to print out ALL reports - settings, template and summary.

To print all events and all reports, press **3**.

Option 5 – *Print Cal Test*

Use the print *cal test* to run a calibration check and print a calibration report.

Option 6 – *Printer Setup*

The printer setup menu provides many options to customize your event reports. Regardless of the option chosen, the data will be stored in memory and can be printed on the seismograph at a later time or downloaded and printed using the Analysis.NET software.

There are six (6) print setup options: Print Mode, Print Length, OSM/USBM;DIN option, Histogram Style, and Print Copies.

PRINT MODE

The *Print Mode* option sets what, if any, report is printed during recording operation. There are three (3) options.

None or disabled – if this option is selected, the printer is disabled during recording operations. Summary data will be displayed on the LCD (if active).

Summarized - if this option is selected, summarized data will be printed during data collection. For triggered events (triggered, sustained trigger, and dual mode) this includes the scan start time, header information, summary data, and check event information. For histogram events, including dual mode recording, this includes the header information, and summary data (if selected).

Full Detail – if this option is selected, in addition to the information provided for a summary report, the waveform graph will be printed for triggered events, and interval data will be printed for histogram events for intervals of 15 seconds or longer. See page 18 for information regarding shorter interval lengths.

PRINT LENGTH (applies to trigger, including dual mode, and sustained trigger events). There are six (6) graph length settings. The *length* associated with each setting, i.e. 1 = 2.5 in, 2 = 5.0 in, etc. corresponds to the printed graph length of a 5, 10, or 15 second record time. Print lengths for other recording times will be proportionate to the stated lengths. As an example, an 8 second record time with a graph length setting of 2 (5.0 in.) will be 4 inches in length, or 80% of the 5-inch length of a 10 second record. The minimum graph length is 1 inch (2.3 cm).

The following table summarizes the graph length settings.

SETTING	IMPERIAL (in/sec)	METRIC (mm/sec)
1	2.5	5
2	5.0	10
3	8.0	20
4	10.0	30
5	12.0	40
6	25.0	50

* 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 (< 10 in / 30 cm) it is recommended that you save your event data using the Analysis.Net Software. This will ensure that further analysis is possible.

Press ENTER 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.

OSM/USBM:DIN (applies to trigger, including dual mode, and sustained trigger events). 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 ENTER 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. See page 63 for sample printouts.

HISTOGRAM STYLE (applies to histogram, including dual mode). 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. Press **1** for the LIST option or **0** for the GRAPH option followed by ENTER to save the entry. Press ↓ to go to the next menu option or END to exit the PRINT SETUP MENU and return to the COMMAND MENU. See Appendix H for sample printouts.

HISTOGRAM SUMMARY (applies to histogram, including dual mode). The seismograph can be programmed to print a summary after each grouping of ten or more intervals. To disable this feature, press 0; to enable this feature select a grouping size from 10 – 1800.

PRINT COPIES (applies to triggered and dual monitor triggered events during data collection only) You may choose to have up to seven (7) copies of the event printed every time the seismograph is triggered.

DISPLAY DATA (retrieving / viewing data on the LCD window)

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 viewed 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.

Display Option 1 - **Directory**

The Directory information for the most recently recorded event (a check event) is displayed first. Use the ↑ to access other events.

```
DIRECTORY 041
022: TRIG 11058
         04/23/13 14:50:15
```

In this example:

041: The directory number. This is the number that will need to be entered to print the event.

022: This is the unit's internal file number.

TRIG: This is a triggered event

11058: The event's file size in bytes.

04/23/13: The event was recorded on April 23, 2013.

14:50:15 The event (start) time is 2:50:15.

HOW ARE EVENTS NAMED – All files, including *data collection events* (data recorded in the triggered, histogram, sustained trigger, or dual mode), check events and template files are assigned an internal file number. Directory numbers are assigned to all *data collection events*, but not to check or template files.

When data collection events are downloaded through the Analysis.NET software, the event number and the file number become a part of the filename. Typically when the term *event* is used, it is referring to a data collection event.

There are six (6) types of files that may appear in the directory.

A **TRIG** is a triggered event recorded in the triggered or dual monitor mode.

An **HIST** histogram event recorded in the histogram mode.

A **SUTRG** is a trigger event recorded in the sustained trigger mode.

An **HST-F** is a histogram event recorded in the dual monitor mode.

A **CHECK** file (which includes calibration check data) is a file written to memory every time the unit exits one of the recording modes. Because check events contain no vibration or airblast data, they are not assigned data collection event numbers. All check files take 992 bytes of memory.

The **TMPL** file contains the information for one or more templates.

Display Data option **2 – Summary** will display the summary data for individual events.

SUMMARY	R0.435	034
008 105	L0.063,	9.4
3/20	T0.430,	6.4
11:10	V0.045,	5.8

For *Triggered* events, including those recorded in the Dual Mode:

034 – directory number

008 – file number

105 – peak airblast reading in dB (or Pa)

3/20 – month and date of event

11:10 – time of event

R0.435 – RPPV* = 0.435 ips (or mm/sec)

L, T, V – longitudinal, transverse, vertical readings in ips (or mm/sec) @ hertz (cycles per second)

For *Sustained Triggered* events:

SUMMARY	SUTRG	009
047 076	0.063,	9.4
3/21	T0.430,	6.4
10:36	V0.045,	5.8

009 – directory number (this will be unique for each record per trigger)

047 – file number (each record per trigger event will have the same event number)

076 – peak airblast reading in dB (or Pa)

3/21 – month and date of event

10:36 – time of event

L, T, V – longitudinal, transverse, vertical readings in ips (or mm/sec) @ hertz (cycles per second)

* RPPV = Resultant Peak Particle Velocity

For *Histogram* events recorded in the histogram mode:

SUMMARY HIST 005			
046	076	L0.020,	7.0
3/21		T0.103,	7.9
10:28		V:060,	9.4

005 – directory number
046 – event number
076 – peak airblast reading in dB (or Pa)
3/21 – month and date of event
10:28 – start time of event
L, T, V – longitudinal, transverse, vertical readings
in ips (or mm/sec) @ hertz (cycles per second)

Press **END/ESC** to exit this option.

Display Data Option 3 – Calibration Test:

The calibration test is used to check for proper communication between the geophone and microphone elements 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. 03/15/13			
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 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/ESC** to exit this option.

Display Data Option 4 – **Banner**. This is the same information that is displayed when the unit is first turned on. It is also available by pressing **8** from the COMMAND menu.

```

SN:5291 0509xp 15..3v
03/08/13 13:25 TRIG
SEI<0.050>SND< OFF>
5.0s TIMER <OFF> STD

```

SN: 5291 - this unit's serial number
 0496xp – the unit's firmware version
 15.3 – battery voltage is 15.3 volts
 03/08/13 – the internal memory date is March 8, 2013
 13:25 – the internal memory time is 1:25 PM
 TRIG – the unit is programmed to record in the trigger 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

Press **END/ESC** to exit this option.

Display Data Option 5 – Memory Status:

```

DISPLAY MEMORY
E || _ _ _ _ _ _ _ _ _ _ F
Events in Memory      20
Free space            87%

```

This option shows the memory status of the seismograph in both a numeric and graphical format.

Press **END/ESC** to exit this option.

Display Data Option 6 - Additional Notes:

This option will display the information currently in the Additional Notes field, including the acquired GPS location (if enabled). To erase or edit these fields see page 28.

Press **END/ESC** to exit this option.

Display Data Option 7 – GPS Location:

This option will display the GPS location currently stored in the unit. Although the GPS location is stored in Line 3 of Additional Notes, ONLY GPS data will be displayed on this screen.

Press **END/ESC** to exit this option.

UTILITIES

MEMORY MAINTENANCE / SPECIAL SETUPS / ADVANCED SETTINGS

The *Utilities* option is used to set the seismograph's internal date and time (including time format and time zone code), erase the memory, set the event number, set special alarms, change advanced settings, and set the display default.

Press **6** – **UTILITIES** from the **COMMAND** menu.

```
UTILITIES
1. Set Clock / Date
2. Erase Data
Set Event Number
```

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 **ENTER**.

* Enter 8:00 AM as 08:00:00; enter 8:00 PM as 20:00:00.

Press **END/ESC** to exit this option or -

Press ↓ (or press **2** from the **SET CLOCK/DATE** menu) to proceed to the *Set Date Option*.

```
CLOCK/DATE <2>
SET DATE:
Set: 02/22/13
New: 03/23/13
```

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 **END/ESC** to exit this option or -

Press ↓ (or press **3** from the **SET CLOCK/DATE** menu) to proceed to the *Date Format Option*.

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

Select the new format by pressing **1** or **2**. Press **ENTER** to save the new option.

Press **END/ESC** to return to the command menu or -

Press ↓ (or press **4** from the SET CLOCK/DATE menu) to proceed to the *Time Zone Code* menu option.

TIME ZONE CODE
0, 1 – 51
Set: 0 unspecified
New: 11 UTC-4

The Time Zone Code feature was designed for users who employ seismographs in multiple time zones and access and transfer their data through remote communication. This setting is not required and may be left *unspecified* (setting = 0) with no effect on your recorded data.

Please see page 47 for more information on the use of this feature.

After all desired changes have been made, press **END/ESC** to exit and return to the COMMAND menu.

Option **2** from the UTILITIES menu is **Erase Data**.

PLEASE NOTE: Erasing the memory will delete ALL event data from the seismograph. **THERE IS NO WAY TO RECOVER DATA THAT HAS BEEN ERASED.** Also, there is no way to erase select data from the memory. It is suggested that users download event data using the GeoSonics Analysis.NET Software (supplied with your seismograph or available for download at: <http://www.geosonicsvibratech.com/seismic-analysis-software.html>) on a regular basis to avoid placing a seismograph in the field with insufficient available memory space to record the desired data.

The *Erase Data* option will erase event data only; setup data, including recorder setup, text, additional notes (including GPS location), and template information will not be erased.

ERASE MEMORY?
0. NO
1. YES, ERASE ALL

To erase ALL events in memory, press **1** for YES.

CONFIRM ERASE ALL?
0.NO
1.YES, ERASE ALL

You will be asked to confirm. Press **1** for YES, ERASE ALL

```
RESET EVENT NUMBER?
0. NO
1. YES
```

You will be asked if you want to reset the event number. To reset the event number to 01, press **1** for YES or **0** for NO.

Press **END** to return to the **COMMAND** menu.

Option 3 - Set Event Number

Utility option **3** may be used to set the next event number. Event numbers, which are assigned to all data collection events, are assigned consecutively beginning with 01. At any time, you may choose to set the event number to any number from 01 – 999.

```
UTILITIES
NEXT EVENT
NUMBER:
Set: 03
New: 15
```

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 or three-digit number followed by **ENTER**.

Press **END/ESC** to exit and return to the **COMMAND** menu.

Special Alarms – UTILITIES option 4

Utility option **4** 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, sustained trigger, and dual mode. 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, Sustained Trigger, and Dual Mode 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.

❖ DUAL MODE SPECIFICS

If the seismograph is programmed to record in the Dual Mode, histogram recording will begin as soon as the unit is placed into **SCAN**. It is important to remember that the seismic and air trigger settings which activate a triggered event are independent of the alarm triggers. If the *Special Alarm* triggers are set at lower levels than the triggers set under *Recorder Setup* the external warning device could activate without a trigger event being generated or vice versa. To program the seismograph to generate a trigger event every time the external alarm is activated, set the *Recorder Setup* trigger levels to the same value(s) as the *Special Alarm* trigger value(s).

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 **4** 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 **ENTER**. 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. Press **0** to set a seismic (ground) trigger or **1** to set a sound (air) trigger.

```
SPEC'L ALARM <2>
ALARM1 T 0.005 – 5.000
Set:    0.050 in/sec
New:    0.075 in/sec
```

The ALARM1 T (alarm trigger) 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 ENTER, 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 (in seconds) the signal should be sent to the external device before re-setting itself. Set the hold time followed by ENTER. Press ↓ to continue to the Alarm 2 setup menus or END to return to the command menu.

- ❖ As an example, consider the following setup. Recorder 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, a signal will be sent to the external warning device; 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.

Option 5 - Advanced Options.

Four features are available through the advanced setup – *Scan on Timeout*, *Configuration*, *Trigger Filter*, *Show Date/Time*, and *Always Show GPS*.

```
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 ENTER.

- ❖ 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.

```
SCAN ON TIMEOUT <1>
SCAN ON TIMEOUT?
Set: No
New: Yes
```

If the *Scan on Timeout* is set to **YES** and there are no keyboard entries for a period of four (4) minutes, the seismograph will enter **SCAN**. To set to YES, press <1>; to set to NO, press <0>.

Configuration / Alternate Scaling

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

The next 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 ENTER. 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 any of the trigger modes, the unit continuously scans and measures seismic and sound levels. The sampling rate varies from 330 to 2,000 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 a 1,000 sample per second setting). Requiring four (4) consecutive 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 ENTER. 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 two (2) optional window displays that can be toggled on or off. These displays can be turned ON/OFF in the *Advanced Options* menu.

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

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

ALWAYS SHOW GPS?
<5>
0: NO 1: YES
SET: YES
New: YES

The ALWAYS SHOW GPS? display option is for GPS users. If this option is enabled, the seismograph will query the user regarding acquiring or erasing GPS coordinates every time the unit is turned on.

Display Default

UTILITIES option **6** is *Display Default*. When your seismograph is shipped to you, the display default is set to ON. Once the unit is placed into the scan mode, the LCD will go to *sleep* (blank) after a period of 4 minutes without any keyboard entries. This reduces the power drain on the battery and extends recording time. It will continue to collect data. Simply press ENTER to *wake up* the screen.

To disable this feature, press **0**.

TEMPLATES

Press **9** in the COMMAND menu to access *TEMPLATES*

Six template storage locations are available to the seismograph user. The template feature is a timesaving option for saving setups. After the text setup, recorder setup, and print settings, have all been programmed into the seismograph it can be saved as a template. The next time that set of information is needed, instead of re-entering all of the information, the template can be recalled. The template will also save the date format, recording unit setting, and default display settings as well.

USE THE FOLLOWING STEPS TO SAVE A TEMPLATE

1. Enter the recorder setup, text, and printer information as described under *Recorder Setup* (page 12), *Text Setup* (page 26), and *Setup Printer* (page 31).
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>

Enter a name for the template using the keyboard. Press ENTER to save; press END to exit menu.

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 recorder setup, text data and/or printer settings can be made using the appropriate menu. The new information will not be saved to the *template* unless the template is re-saved. **NOTE:** In order to save changes to a previously saved template you must re-enter the template name.

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 her time between monitoring blasting and monitoring pile driving. She sets up one template for the trigger recording mode and another template for the histogram recording mode.

ADDITIONAL COMMANDS

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.

APPENDIX A

STATUS INDICATOR LIGHTS

The **RED** LED found on the top panel of the seismograph indicates the scanning / processing status of the seismograph.

LED blinks ONCE every 10 seconds	Unit is scanning in the Trigger or Sustained Trigger Mode.
LED glows steady	Unit has triggered and is collecting data in the Triggered, Sustained, or Dual Mode
LED blinks TWICE (rapidly) every 10 seconds	Unit is collecting data in the Histogram Mode
LED blinks THREE times (rapidly) every 10 seconds	Unit is collecting data in the Dual – Histogram Mode.
LED shows no activity while the unit is in the Trigger, Sustained Trigger, or Dual Mode	The unit was triggered and is now processing data. It will return to SCAN following the processing procedure.

The **YELLOW** LED is a status indicator light for the charging circuit. This light will glow steady when the unit is charging.

The **GREEN** LED is the printer status light. This light will glow steady when data is being sent to the printer.

APPENDIX B

USING THE UTC TIME ZONE CODE

The Time Zone Code number is used to designate the local time zone. The Time Zone Code is set through the seismograph's Utilities → Set Clock /Date menu option. Utilizing this option ensures that reports will be printed with respect to the local time zone in which they are recorded.

When using this feature, you must set the seismograph's time to UTC time.

Example: If your seismograph is located in the Eastern Standard Time Zone, you are five (5) hours behind UTC. Therefore, you would need to **ADD** five hours to the local time to obtain UTC, i.e.- if local time is 1300hr, EST, set unit time to 1800 or (UTC-5). If it were Eastern Daylight Savings time (EDT), it would be set 1700 or (UTC-4).

CODE	TIME ZONE	CODE	TIME ZONE	CODE	TIME ZONE
0	undefined	18	UTC +1	36	UTC +10
1	UTC -12	19	UTC +2	37	UTC +10:30
2	UTC -11	20	UTC +3	38	UTC +11
3	UTC -10	21	UTC +3:30	39	UTC +11:30
4	UTC -9:30	22	UTC +4	40	UTC +12
5	UTC - 9	23	UTC +4:30	41	UTC +12:45
6	UTC - 8	24	UTC +5	42	UTC +13
7	UTC - 7	25	UTC +5:30	43	UTC +13:45
8	UTC - 6	26	UTC +5:45	44	UTC +14
9	UTC - 5	27	UTC +6	45	US/Aleutian
10	UTC - 4:30	28	UTC +6:30	46	US/Alaskan
11	UTC -4	29	UTC +7	47	US/Pacific
12	UTC - 3:30	30	UTC +7:30	48	US/Mountain
13	UTC - 3	31	UTC +8	49	US/Central
14	UTC - 2:30	32	UTC +8:30	50	US/Eastern
15	UTC -2	33	UTC +8:45	51	US/Atlantic

APPENDIX C

IMPORTANT NOTE REGARDING ENDING HISTOGRAM RECORDINGS FOR FIRMWARE PRIOR TO 4.98

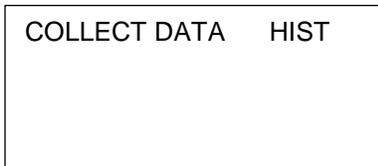
If the LCD display has timed out, you will first need to press **ENTER** to 'awaken' the LCD. **DO NOT** end the histogram record until the seismograph displays a set of interval readings. Pressing **END** before the next set of readings is displayed will prevent the histogram event data from being written to the internal memory. This may also result in the seismograph's internal date and clock being reset to 00/00/00 and 00:00:00.

PROPER KEYSTROKE PROCEDURE TO PREVENT DATA LOSS:



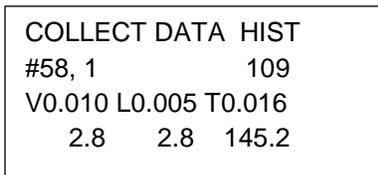
LCD screen has timed out and is blank.

Press **ENTER / ON** to 'awaken' LCD.



Do NOT end the recording.

Wait until -



interval data is displayed. It is now safe to

Press **END/ESC** to end data collection.

APPENDIX D SPECIFICATIONS

GENERAL SPECIFICATIONS & OPTIONAL ACCESSORIES:

- | | |
|---|---|
| <ul style="list-style-type: none"> ☛ Four-line by 20-character LCD for on-site data display and programming. ☛ Full QWERTY-style keyboard with shortcut buttons. ☛ 42 column facsimile-style printer. ☛ Heavy-duty twist-lock metal cable connectors. ☛ Internal, rechargeable lead acid batteries. ☛ Flexible interface and extensive options available for custom configurations. ☛ Two (2) independent threshold alarm output ports. ☛ External geophone meets ISEE density recommendations. ☛ Toughest weather resistant structural case on the market. ☛ Six (6) template locations for recurring set up data. ☛ Imperial and metric operation. ☛ Standard Analysis.NET and compliance software included | <ul style="list-style-type: none"> ☛ Designed & manufactured in the USA. ☛ 2-Hz. High-pass microphone ☛ Weight: 22.2 lbs. (10.1 kg) ☛ Dimensions: 16 x 13 x 6.75 in (41 x 33 x 17 cm). ☛ Operating Temperature: 0 to 130° F (-18 to 54° C). ☛ One (1) year warranty on parts and labor. ☛ Extended warranties and service contracts also available. <p style="text-align: center;">OPTIONAL ACCESSORIES</p> <ul style="list-style-type: none"> ☛ Hydrophones (instrument modifications required). ☛ Accelerometers to 50 g's or higher (instrument modifications required). ☛ Amplifiers (10x-100x). ☛ Optically isolated dual alarm control for dialers, pagers and remote alarm notifications. ☛ Advanced seismic analysis software package. |
|---|---|

Seismic Trigger: Resolution: 0.0025 in/sec. (0.06 mm/sec.).
Printout graph time scaling: From 0.5 to 5 inches (5 – 50 mm) per 1 second of record time

TRIGGER MODES

Seismic	Resolution: 0.0025 in/sec (0.06 mm/sec) 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: ± 10% or 1 dB within one year (multi- frequency calibrated)	
Sound	Calibration: Internal dynamic Range (linear): 78 – 142 dB (other ranges available) Frequency Range (3dB): 2 – 250 Hz (3dB), 2 – 1000 Hz (Nyquist) Accuracy: 5% within one year (multi-frequency calibrated)	
Sustained	Calibration: Internal electronic	Consecutive waveform recordings up to 4.2 minutes

HISTOGRAM MODES

Recording intervals:	Selectable – 1,2,5,10,15,30 seconds; 1, 2, 5, 10, 15, 30, 60 minutes
Seismic resolution:	0.0025 in/sec (0.06mm/sec)
Range:	5.120 in/sec (130 mm/sec) (other ranges available)
Sound resolution:	1 dB

APPENDIX E

TRIGGER MODE CAPACITIES

Memory capacity options: Typically, the GeoSonics’ 3000LCP^{plus} seismograph is supplied with a “Standard Memory” option with a capacity of approximately 50 5-second trigger events. Two additional options are available for increased storage capacity. The *Extended Memory* option increases the event storage to approximately 100 typical events and the *Maximum Memory* option, which has a capacity of approximately 200 typical events.

Whether recorded in the triggered, sustained trigger, or dual mode, each 5-second, trigger event (uncompressed) contains 30,992 bytes. However, the total record capacity is dependent on the efficiency of the data compression that is applied during the event processing.

Compression reduces the number of bytes stored. The degree of compression is dependent on the complexity and levels of data recorded as well as ambient noise and vibration levels. Under the worst case scenario, the compression can be as low as 2:1. Under normal recording conditions, the average data compression generally observed is 4:1. Under ideal conditions, compression levels as high as 7:1 have been observed.

The following table provides typical guidelines on event storage based on various conditions.

COMPRESSION RATIO	MEMORY TYPE	TOTAL RECORD CAPACITY
Compression Ratio- 2:1 (worst case scenario)	Standard Memory	30 events
	Extended Memory	62 events
	Maximum Memory	126 events
Compression Ratio – 4:1 (average)	Standard Memory	61 events
	Extended Memory	124 events
	Maximum Memory	253 events
Compression Ratio – 7:1 (best case scenario)	Standard Memory	107 events
	Extended Memory	217 events
	Maximum Memory	442 events

APPENDIX F

HISTOGRAM MONITOR RECORDING CAPACITIES

The continuous mode (including the dual mode) records peak particle velocity data for the three (3) ground channels as well as linear air overpressure levels. There are thirteen (13) available recording intervals. The interval chosen affects the amount of total recording capacity.

Interval selection can have a dramatic effect on capacity. For example, a unit with the **standard** memory option with the record interval set to 1 second, would record for only 10 hours before running out of storage space. With the interval set to 1 minute, the same unit will record for 24 days before filling the memory.

The table below lists the **histogram recording mode** recording capacity for additional intervals and available memory-type choices.

Recording Interval	Recording Capacity
1 second	10 hours
2 seconds	20 hours
5 seconds	51 hours
10 second	4 days
15 seconds	6 days
30 seconds	12.5 days
1 minute	24 days
2 minutes	50 days
5 minutes	127 days
10 minutes	240 days
15 minutes	360 days
30 minutes	750 days
1 hour	1440 days

Extended Memory cards have approximately two (2) times the recording capacity of a standard card. *Maximum Memory* cards have approximately four (4) times the recording capacity of a standard card.

ADDITIONAL MEMORY CONCERNS

The seismograph's firmware has a total allocation of 999 directory events. An individual histogram event contains a maximum of 2500 intervals (see page 17). Every time a completed event is written to memory, the seismograph will also write a check event to the memory. Each check event requires 992 bytes of memory space; this is generally not considered when computing available capacity but they can affect total event storage.

APPENDIX G

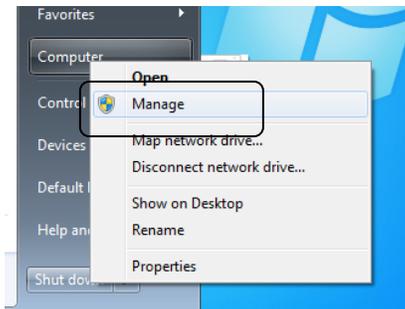
3000 USB-Serial Port Controller & USB to Serial Converter Cable

Data recorded on your 3000 model seismograph may be downloaded to a Windows-based PC for further analysis, in order to print customized reports, as well as for archival purposes. The software also provides a communication platform for programming your unit. If your PC does not have a 9-pin serial port you will need to use the USB – Serial Port Adapter supplied with your seismograph in order to access the power of the Analysis.NET software.

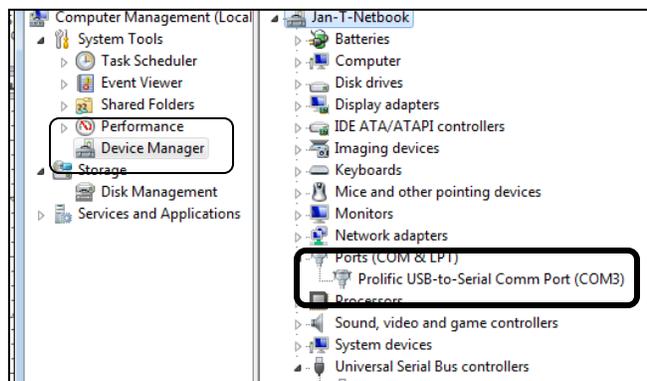
First, you will need to install the Cables to Go® device driver software that came with your seismograph. Insert the CD into your drive and follow the on screen instructions.

Installing the USB to Serial Converter cable and 3000 USB-Serial Port Controller:

1. Attach the USB to serial cable to the Serial Port Adapter making sure to connect it to the adapter cable identified as *USB Adapter*.
2. Connect the seismograph to your PC using the USB-Serial Port cable assembly.
3. Press and hold the Port Status button on the 3000 USB Port Adapter until the *Port Status* light comes on.
4. If you do not know the Com Port (number) associated with the software identified during installation, you can find it by the following steps. (Cable must be attached and active – *Status Port* light is illuminated.)

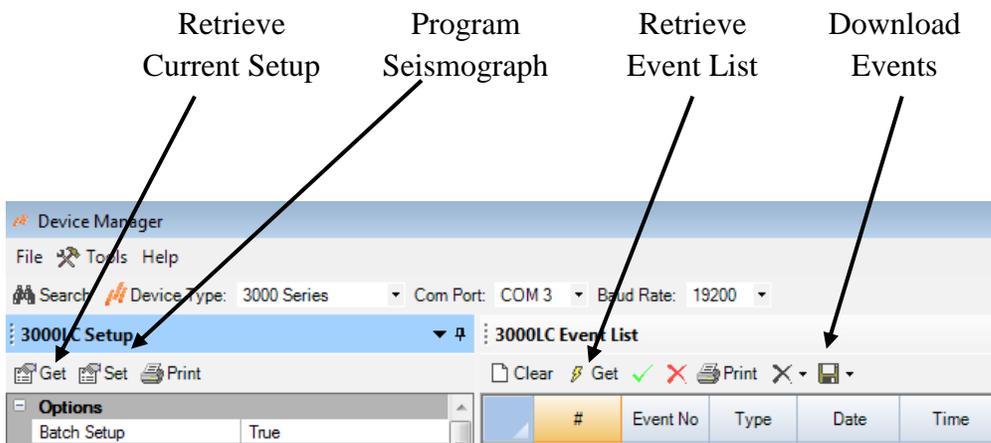


Start → Computer; right click – Manage → Device Manager

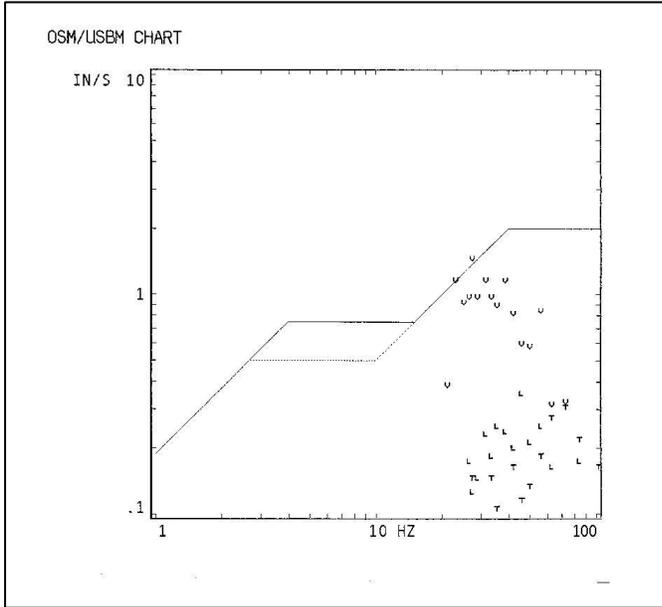


You will see *Prolific USB-to-Serial Comm Port*. The COM number next to it is the one you will need to choose when connecting to the seismograph with Analysis.NET.

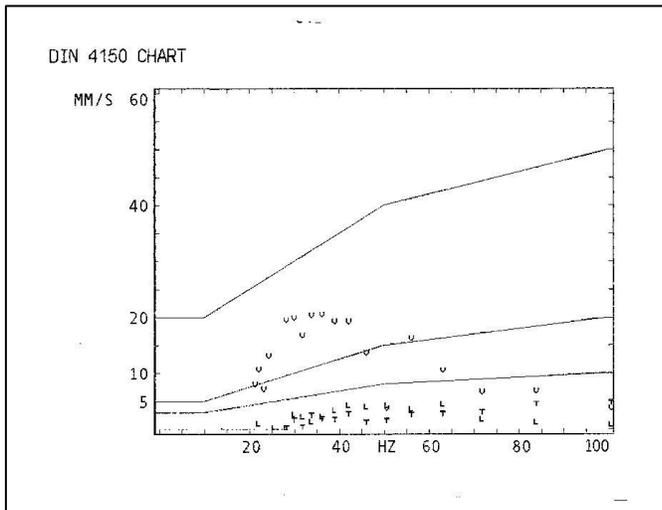
5. If you have not yet installed the Analysis.NET software, you will need to do so with the CD supplied or go to <http://www.geosonicsvibratech.com/seismic-analysis-software.html>.
6. Open Analysis.NET and click Device Manager. Set the “Com Port:” to the number found under Ports (Com & LPT).
7. Set the “Baud Rate” to 19200.
8. Go to Tools and select “Open Port (Toggle DTR)”.
9. You may now:



Compliance Graphs
(from full detail, triggered event reports)



OSM / USBM Chart
(Imperial recording units)



DIN 4150 Chart
(Metric recording units)

Full Detail Histogram Report – Graph Option
(Summary every 10 intervals)

HISTOGRAM SCAN STARTING 05/13/13 10:03:52
Hist. Mode Interval. 30 sec (1440 samples)

GEOSONICS INC

SAFEGUARD SEISMIC UNIT
SN:5291 (05.00)
HISTOGRAM REPORT

Date & Time..... 05/13/13 10:04:30]
Event Number..... 33]

Start Date and Time of event

Client..... ABC Blasting]
Operation..... New Const.]
SSU Location..... 359 Northgate]
Distance to Source.. 1000 ft]
Operator..... Joy G.]
Comments..... vib roller]
Additional Note..... Add'l Note]
Sample Record]

Text / Header Information

Hist. Mode Interval. 30 sec
Hist. Mode Samples.. 1440

FULL SCALE: 5.120 in/s, 142 db

Monday, 05/13/13 10:05:00 --	0.758 in/s,	35.7 HZ
Monday, 05/13/13 10:08:00 --	82 db	
Monday, 05/13/13 10:09:30		
Monday, 05/13/13 10:09:30 --	0.188 in/s,	10.9 HZ
Monday, 05/13/13 10:11:30 --	102 db	
Monday, 05/13/13 10:14:30		
Monday, 05/13/13 10:15:30 --	0.368 in/s,	17.2 HZ
Monday, 05/13/13 10:17:00 --	92 db	
Monday, 05/13/13 10:19:30		

Interval Data:

Graph – Max PPV and dB / interval

Summary every 10 (user-selectable) intervals

PEAK SUMMARY
0.263 in/s 05/13/13 10:22:30
100 db 05/13/13 10:22:30

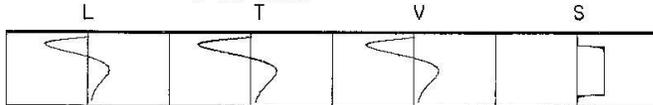
SUMMARY --L-- --T-- --V--
PPV..... 0.200 0.225 0.758 in/s
FRQ..... 41.7 71.4 35.7 Hz

Peak Sound..... 102 db
 .0004 psi

Peak readings for final (partial) interval*

Summary Data for entire event

DYNAMIC CALIBRATION CHECK



Calibration Information
(typically required by regulation)

SHAKETABLE CALIBRATED.. 04/30/13 00:00:00
BY GeoSonics, Inc.
359 Northgate Drive
Warrendale, PA 15086 U.S.A.
724.934.2900, 724.934.2999 (fax)

END OF SCAN - 05/13/13 10:23:50

33 05/13/13 10:04:05
34 05/13/13 10:23:47
1 event(s) over trigger
0.050 in/s 126 db

Full Detail Histogram Report – List Option

(Summary every 10 intervals)

HISTOGRAM SCAN STARTING 05/13/13 10:49:34
 Hist. Mode Interval. 30 sec (1440 samples)

GEOSONICS INC

SAFEGUARD SEISMIC UNIT
 SN:5291 (05.00)
 HISTOGRAM REPORT

Start Date and Time of event

```

Date & Time..... 05/13/13 10:50:30
Event Number..... 35

Client..... ABC Blasting
Operation..... New Const.
SSU Location..... 359 Northgate
Distance to Source.. 1000 ft
Operator..... Joy G.
Comments..... vib roller
Additional Note..... Add'l Note
Sample Record
  
```

Text / Header Information

Hist. Mode Interval. 30 sec
 Hist. Mode Samples.. 1440

Interval Data:

```

X TIME---- L:MAX,HZ---- T:MAX,HZ--- V:MAX,HZ--- S:MA
Monday, 05/13/13 10:51:30 -- 0.323 in/s, 31.3 HZ
Monday, 05/13/13 10:51:30 -- 84 db
Monday, 05/13/13 10:55:30
Monday, 05/13/13 10:59:30 -- 0.115 in/s, 12.5 HZ
Monday, 05/13/13 10:56:00 -- 100 db
Monday, 05/13/13 11:00:30
Monday, 05/13/13 11:02:30 -- 0.275 in/s, 7.6 HZ
Monday, 05/13/13 11:03:30 -- 87 db
Monday, 05/13/13 11:05:30
Monday, 05/13/13 11:08:30 -- 0.443 in/s, 35.7 HZ
Monday, 05/13/13 11:08:30 -- 86 db
Monday, 05/13/13 11:10:30
  
```

List – Max PPV and dB / interval

Summary every 10 (user - selectable) intervals

Peak reading for final (partial) interval* (this data will not be written to the event file)

```

PEAK SUMMARY
0.033 in/s      05/13/13 11:11:00
86 db          05/13/13 11:11:00
  
```

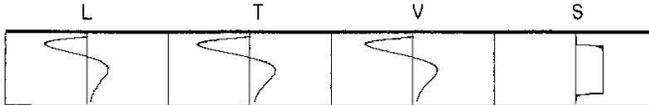
Summary Data for entire event

```

SUMMARY      --L--  --T--  --V--
PPV..... 0.275 0.205 0.443 in/s
FRQ..... 7.6 7.1 35.7 Hz

Peak Sound..... 100 db
                .0003 psi
  
```

DYNAMIC CALIBRATION CHECK



Calibration Information
 (typically required by regulation)

```

SHAKETABLE CALIBRATED.. 04/30/13 00:00:00
BY GeoSonics, Inc.
359 Northgate Drive
Warrendale, PA 15086 U.S.A.
724.934.2900, 724.934.2999 (fax)
  
```

END OF SCAN - 05/13/13 11:12:01

```

35 05/13/13 10:49:47
36 05/13/13 11:11:58
1 event(s) over trigger
0.050 in/s 126 db
  
```



Print Reports → Print Summary → ALL

		GEOSONICS INC		SAFEGUARD SEISMIC UNIT SN:8500 (05.01)			
Directory #		DIR	EVENT #	DATE	TIME		
Template File		L:MAX	T:MAX	V:MAX	S:MAX		
		001	TMPL	00/00/00	00:00:43		
		002	HIST	10 05/08/13	15:34:00		
				0.063, 62.5	0.158, 9.3	0.175, 62.5	79
		003	CHECK	05/08/13	15:57:58		
		004	TRIG	11 05/08/13	16:03:01		
				0.013, 14.3	0.025, 8.8	0.033, 55.6	78
Histogram Event-		005	CHECK	05/08/13	16:03:30		
Histogram Mode		006	HIST	12 05/09/13	11:35:15		
				0.008, 0.4	0.008, 13.9	0.030, 10.0	76
		007	CHECK	05/09/13	11:54:36		
		008	SUTRG	13 05/13/13	10:33:14		
				0.388, 8.8	0.315, 50.0	1.548, 55.6	76
		009	SUTRG	13 05/13/13	10:33:14		
				0.240, 8.9	0.260, 50.0	1.260, 10.6	78
		010	SUTRG	13 05/13/13	10:33:14		
				0.293, 13.2	0.278, 45.5	1.528, 35.7	76
Sustained		011	SUTRG	13 05/13/13	10:33:14		
Trigger Events				0.388, 8.8	0.315, 50.0	1.548, 55.6	78
		012	SUTRG	14 05/13/13	10:35:08		
				0.055, 7.8	0.040, 9.6	0.020, 4.6	76
		013	SUTRG	14 05/13/13	10:35:08		
				0.005, 21.7	0.008, 10.4	0.013, 27.8	76
		014	SUTRG	14 05/13/13	10:35:08		
				0.005, 10.0	0.008, 13.5	0.010, 45.5	76
		015	SUTRG	14 05/13/13	10:35:08		
				0.055, 7.8	0.040, 9.6	0.020, 4.6	76
Histogram Event-		016	CHECK	05/13/13	10:37:28		
Dual Mode		017	HST-F	15 05/13/13	10:39:10		
				0.008	0.013	0.020	78
		018	TRIG	16 05/13/13	10:41:14		
				0.453, 6.1	0.723, 6.8	0.243, 50.0	78
		019	HST-F	17 05/13/13	10:41:40		
				0.035	0.023	0.023	78
		020	CHECK	05/13/13	10:42:24		

SSU 3000LCP *plus* Menu Options

1 Recorder Setup

1. RECORDING SETUP

Recording Mode
0:DM 1: TRG 2:HST 3:S

⚡ 0 DM - DUAL MODE

HIST INTERVAL
DUAL INTERVAL
DUAL MAX LENGTH
DUAL SEISMIC
DUAL AIR TRG
DUAL REC TIME

⚡ 1 TRIGGER SETUP

SEIS TRG 0.005 – 5.00 <1>
AIR TRG 81 – 142 <2>
RECORD TIME 1 – 15 <3>

⚡ 2 HIST SETUP

HIST INTERVAL – 1:sec, 2
min <1>
HIST INTERVAL
HIST MAX LENGTH
HIST SUMMARY 0, 10 -
1800

⚡ 3 S - SUSTAINED TRIGGER

SEIS TRG
AIR TRG
RECORDS PER TRIGGER
RECORD TIME 1 - 15

2. Recording Units - 1:IMP 2:METRIC

2 Display Data

Directory
Summary
Calibration Test
Banner
Memory Status
Additional Notes
GPS Location

3 Text Setup

Client Name
Operation
Location
Operator
Comment
Add'l Notes
Acquire GPS

4 Timer Setup

Timer Mode On / Off
One Time / Daily
Set Wake Up
Set Sleep

5 Print Reports

Print Summary
All
Last Five
All, NO STOP
Print Event
Print Settings
Batch Print
ONLY Events
NO Events
Print All
Print Cal Test

5 Print Reports (con't)

Setup Printer
Print Mode
None
Summarized
Full Detail
Print Length
OSM/USBM; DIN
Hist. Style
List, Graph
Hist. Summary
Print Copies

6 Utilities

Set Clock / Date
Set Time
Set Date
Date Format - FORM 1: m/d/y 2: d.m.y
Time Zone Code - 0, 1 – 51
Erase Data
Set Event Number
Special Alarms – SPEC'L ALARM
Alarm1 On/Off
Alarm2 On/Off
Alarm2 Trigger
Advanced Options
SCAN ON TIMEOUT? y/n
CONFIGURATION - 0 STD, 1: ALT
TRIGGER FILTER 1..4 SAMPLES
SHOW DATE / TIME?
ALWAYS SHOW GPS?
ASK FOR PRINTER?
Display Default - 1: ON, 0: OFF

7 Turn Off Unit

8 Display Banner

9. Templates

<template 1> . . . <template 6>
SAVE TEMPLATE