NOMIS SEISMOGRAPHS

MINI-GRAPH 7000

OPERATING MANUAL

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Mini-Graph 7000
USER'S MANUAL

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NOMIS Seismographs
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1.0 GENERAL DESCRIPTION

The Mini-Graph is designed for low cost blast vibration monitoring where an immediate on-site printout is not required. It is offered in a small 3.5 lb. package with a display and keyboard for on-site programming. Up to 341 typical 2 to 5 second blast events may be stored in memory. The event summaries may be viewed on the display at any time, and waveforms may be rapidly downloaded and transferred to a DOS file using a portable PC in the field. Communication rates from 1200 to 38.4K baud are available as standard rates. Coupled with an efficient compression routine this allows rapid set-up and download of data via modem or direct to a computer.

The Mini-Graph has selectable sample rates up to 1024 samples/sec (2048 optional) and recording ranges which allow resolution from .005 (.127 mm) up to 20 IPS (508 mm). This combination, coupled with the use of accelerometers for sensors, allows close-in monitoring where both frequency and displacement may be high. Events up to 12 seconds long may be recorded at 1024 samples per second. If set up for shorter record times, the Mini-Graph can take two or more events in succession with only 50 milliseconds of down time between them. Monitoring can be done while a computer is connected, allowing immediate viewing of summary data after the event is stored.

For large monitoring jobs, the set-up of multiple units can be accomplished quickly using provided software for downloading set-up data to one or all units simultaneously. Charging of multi units may be done while connected to a computer. Each unit will operate for approximately 9 days at 1024 samples/sec on its internal battery. A timer mode can extend this to about a month using a 7 hr/day monitoring. Any unit may also be connected to an auto battery or solar cell for unlimited operating time.

The cable mounted, detachable mic allows monitoring of any air born effects at sound pressure levels up to 148 dB. The three component seismic sensor comes mounted within the instrument or as a separate detachable accessory.

The Mini-Graph comes with all required accessories including a windscreen, charger, communication cable, and carrying case. Software is provided for setup, data download via modem or computer, and waveform viewing and printing.

A modem is available for the Mini-Graph which allows operation, setup, and data transfer using the phone system. The data compression routine used in the Mini-Graph increases transmission speed to several times faster than competing instruments. This feature can save time and reduce telephone expense.

2. SPECIFICATIONS
2.0   SPECIFICATIONS

2.1   GENERAL

Data Recorded

One (1) acoustic and three (3) seismic channels.

Frequency Response

2 to 400 hz. (-3 dB. points) at 2048 samples per second.Lower sample rates reduce the high frequency response proportionately. 2 to 250 HZ (-3 dB points) at 1024 samples per second.

Seismic Sensor

Three component mounted within the instrument or available as a separate, detachable accessory. Accelerometers or geophones are available.

Microphone

Ceramic element rated to at least 150 dB.

Memory

Solid state with all summary, setup, and recorded data retained with power off. A lithium backup battery retains data if primary power fails.

Clock

A 24 hr. clock maintains the date and time accurate within 1 minute per month even if primary power fails.

Timer Mode

Allows an instrument to be active only during selected hours on a daily basis.

Display

High contrast LCD has two lines of 40 characters which make setup easy and allows the operator to view operating parameters and summary data.

Keyboard

5 keys for entering setup data and operating commands.

Power on Log

A log of the last 64 on/off cycles is kept in memory to indicate the active monitoring periods. If the timer is used, the log is updated each time it activates.

2. SPECIFICATIONS

2.1 GENERAL (Continued)

Printer Output

A serial input printer, which emulates IBM or Epson modes, may be connected to the unit using an optional cable. Both waveforms and OSM graphs may be printed.

Battery

Internal 6 volt rechargeable.

Operating Time

With a fully charged battery all models will operate from 5 to 10 days at 1024 samples/sec. Longer times may be obtained using the Timer mode or external power from a small solar cell or automobile battery.

External Battery Life

A standard automobile battery will keep the internal battery at full charge for several months at moderate temperature. If the external battery dies, the unit will continue to operate on its internal battery.

Charging

An internal charging circuit allows charging with the supplied plug-in wall mount charger or any 10 to 15 volt DC supply. Power supplies for international use are available.

Operating Temperature

0 to 130 degrees F (-18 to 54 degrees C)

Case

Heavy gauge aluminum for effective electrical shielding and rugged protection. (stainless steel optional) Case is sealed for shallow burial.

Size

Approximately 7.5"x4.5"x2.5". (190 x 114 x 64 mm)

Weight
Aluminum Case

Approximately 3.5 lbs. (1.6 Kg.) without accessories.

2. SPECIFICATIONS

2.1 GENERAL (Continued)

Stainless Steel Case
Adds 2 lbs. (.9 Kg.) above the aluminum case.

Accessories
Approximately 6 lbs. (2.7 Kg.) including the storage case.

Waveform Data
The full waveform signature is stored in solid state memory for up to 300+ events.

Summary Data
Summarized data includes the event time, date, battery voltage, peak measurements (including frequencies), and unit serial number and frequencies.

Sample Rate
Selectable from 1024 samples per second per channel down to 32 samples per second. (2048 optional)

Recording Units
User selectable, English (U.S.) or metric.

Recording Ranges
Seismic
User selectable.
(x8) 0.001 to 2.5 IPS (.0254 to 63.5 MM/S)
(x4) 0.0025 to 5.12 IPS (0.0635 to 130 MM/S).
(x2) 0.005 to 10.0 IPS (0.127 to 254 MM/S).
(x1) 0.01 to 20.0 IPS (.25 to 508 MM/S).
(Ranges must be specified prior to odering)

Optional
Sensitivities of X2, X4, or X8 are available. They reduce the ranges to 1/2, 1/4, or 1/8 the values as shown in the above table.

Acoustic
User selectable. 0.02 to 2.56 millibars (100 to 142 dB) or 0.04 to 5.12 millibars (106 to 148 dB).

Trigger Levels
Seismic
0.02 to 1.14 IPS (0.5 to 28.9 MM/S).

Optional
Lower sensitivities allow trigger levels down to .002

Acoustic
106 to 142 dB or 112 to 148 dB.

2. SPECIFICATIONS

2.1 GENERAL (Continued)

Manual

Allows triggering from the keyboard or by an external input. One unit may be used to trigger one or more additional instruments.

Frequency Response

2 to 250 Hz. (-3 dB points) at 1024 samples/sec. 2 to 150 Hz. at 512 samples/sec. Anti alias filters are provided for both sample rates. 1 Hz low end is optional.

Accuracy

The Mini-Graph is calibrated within 2% at 30 Hz. Frequencies down to 3 Hz are tested to be withing 3% of the 30 Hz. value.

Recording Time

User selectable from 1 to 6 seconds at a sample rate of 2048 samples per second. At lower sample rates, the duration is automatically increased proportional to the amount of decrease in the sample rate.

Cycle Time

At 1024 samples per second, up to 12 seconds of data may be taken with only 50 milliseconds between events. After 12 seconds of data is stored, another event cannot be taken until data has been processed. Processing requires a maximum of 25 seconds.

**Records Stored-
Waveform Mode**

Up to 341 typical coal mine or quarry events.

Calibration Test
Seismic

A dynamic transducer test is performed automatically after each event or manually on command. The test results are stored in the summarized data and may be downloaded as an event.

Acoustic

An electronic test of the microphone is performed with the seismic test and is stored in memory along with the seismic test.

2. SPECIFICATIONS

2.1 General (Continued)

84 Hour Cal Test   In a remote installation, an automatic calibration test occurs if no event has been recorded for 84 hours.

RS232 Serial Port   Data may be downloaded and setup commands may be uploaded directly by computer or remotely by modem.

Baud Rate   Baud rate is selectable from 1200 to 38.4 K.

Modem Capability   The Mini-Graph will work with most modems where AC power is available. For DC operation, an adapter is available to conserve power by powering the modem on and off as required.

3. SET-UP

3.0 GENERAL

The Mini Graph is complete with a keyboard and display to allow setup, test and summarized data viewing on site without a computer. A computer is required however to enter comments which may be stored with each record. The computer may also be used for all functions.

Setup is accomplished by selecting fields on three display screens and then incrementing or decrementing to the desired value. The "Enter" key accepts all values on the screen and advances the display to the next screen. Once set, the values are stored and are implemented each time power is cycled on. Unless changes are required, future jobs will require only installation and plugging in the mic or transducer to enable the power.

3.1 KEYBOARD FUNCTIONS

The keyboard consists of only 5 keys, but allows the user to accomplish all operating functions except entry of comments to be stored with each record. Key combinations are required for some functions.

3.1.1 RESET

Pressing the "Reset" key by itself resets the instrument causing it to start the program from the beginning. In the reset mode, the unit goes thru a stabilization period during which it will not trigger and no setup may be done. It will normally exit reset mode in a few seconds unless the trigger levels are set below the background vibration.

3.1.2 ENTER

The "Enter" function is used to accept all setup parameters as they appear on a screen, and causes the next screen to be displayed.

3.1.3 INCREMENT & DECREMENT

These are single key functions for changing setup parameters after a parameter field has been selected. They also are used to change the summary event number on the Main screen (Screen 4, Page 10) to allow viewing any event in memory. Holding down either key will cause a rapid repeat of the function to allow faster changes.

3. SET-UP

3.1 KEYBOARD FUNCTIONS (Continued)

3.1.4 SELECT FIELD

This function is used to select a parameter field to be changed. Press the "Shift" key and hold it while the "Increment" key is pressed. Brackets on the display will enclose the field which is selected and will move in response to each press on the "Increment" key. As each field is exited the parameter will be accepted as it appears in the field. The "Select Field" function may also be used on the Main screen (Screen 4, Page 10) to toggle between the normal summary screen and a display of the frequencies associated with the summary event selected.

3.1.5 TEST

Holding the "Shift" key and pressing "Enter" will produce a manual calibration test. This function does not have to be used but does allow testing operation during setup or at regular intervals during long term monitoring. If the Mini-Graph is set on a low trigger level or not properly coupled to the ground, it is likely that a trigger will result from pressing the keyboard. Carefully pressing the keys will usually allow this function to be used without the trigger defeat option.

3.1.6 CLEAR

This function may be used in case a problem occurs with the program. This could happen as the result of complete loss of battery power. Press "Enter" and hold it down while "Reset" is pressed and released. Continue to press "Enter" for a few seconds after "Reset" is released. All parameters will be reset to default values and comments will be erased. Stored events will not be erased.

3.1.7 CLEAR DATA

Hold down the "Increment" key and press and release the "Reset" key while continuing to hold the "Increment" key to clear all stored events. The event number will be set to 000 and all summary events will show zeros.

3.1.8 MANUAL TRIGGER

Hold down the "Decrement" key and press and release the "Reset" key. The unit will go through stabilization and display a manual trigger message. The unit can now be triggered only by two methods. Hold "Shift" and press "Decrement" to trigger from the keyboard, or apply a trigger to pin 7 of the female connector on the end of the case.

3. SET-UP

3.2 KEYBOARD SET-UP

3.2.1 TRIGGER DEFEAT

The Mini-Graph normally goes into monitoring mode as soon as the Microphone or the transducer are installed and stabilization is complete. If setup is to be done on site, accidental triggers will almost certainly occur unless the trigger mode is disarmed. This can be done with the trigger disarm switch, or implemented with software when connected to a computer. If a few false triggers are not considered a major problem, the trigger disarm switch is not required.

The trigger disarm switch is located on the mic housing, and is a momentary contact type. The switch is a red button located close the end of the microphone. The Mini-Graph will begin stabilization and should be ready for setup a few seconds after the microphone is plugged in. Press the disarm switch as soon as stabilization is complete. This will allow setup to be completed without causing a trigger. The display, after stabilization, will be in insert mode. One to two minutes after all keyboard activity has ceased, the Mini-Graph will go back to the triggered mode and the display will blank. Pressing the disarm switch again will cause the display to come on and the trigger will be disarmed. The display will also come on to display any event that occurs.

3.2.2 SCREEN DEFINITIONS

The Mini-Graph has 4 basic screens available using the 5 key pad. The first 3 are used to change monitoring characteristics. The main screen (Screen 4) is used to review the event summaries in memory. A 5th screen is also available, which provides additional information to the summary data provided on screen 4. Examples of the 5 screens are shown as follows.

Screen 1

```
BAT 06.5  BAUD 19.2    WRAP ON
A  COMMENTS OFF   AIR  DB  06-10-96  22:54[]
```

Screen 2

```
COPIES 0  MAX RANGES IPS  05.0  DB  148
A TRIGGERS  SEIS 1.14    IPS  AIR  115  DB
```

3. SET-UP

3.2 KEYBOARD SETUP (Continued)

Screen 3
```
PRINTER RANGE  0    SPEED 1      TIMER OFF
A 1024/SEC 004 SEC RECORD  OSM NONE      []
```

Screen 4
```
BAT 06.5   06-09-96  10:34  IPS      002      P
N 00.14T  00.07V  00.07R  124A  00.15VS     A
```

Screen 5
```
   T          V         R       ·   A         002
032.0 HZ   341.0 HZ   73.1HZ     007.0 HZ
```

Screen 1
```
BAT 06.5  BAUD 19.2    WRAP ON
A. COMMENTS OFF   AIR  DB  06-10-96  22:54[]
```

Screen 1 shows the current battery voltage, baud rate, memory configuration, status of the comments, acoustic display mode and the date and time (U.S. Configuration). Each of these fields is accessible using "Select Field". Hold down the "Shift" key and press "Increment" until the brackets surround a field you wish to change. Release the "Shift" key then use "Increment" or "Decrement" to change the settings within the brackets. Using "Select Field" or "Enter" will accept any changes made.

3. SET-UP

3.2 KEYBOARD SET-UP (Continued)

3.2.3 BAUD RATE

Set the Baud rate to the highest your computer will support. All computers tested to date, including old models, have supported 38.4k baud with the Mini-Graph communications software. Setting to a lower rate may be more reliable in some cases, but will slow transmission of data and setup information.

3.2.4 MEMORY WRAP

The Mini-Graph memory can be configured to start from event zero, and STOP taking events when full. The default configuration sets the memory to WRAP ON mode with the newest events writing over the oldest. When the memory is full when set in the WRAP OFF mode, data must be cleared to zero before more events can be stored.

3.2.5 COMMENTS

5 lines of comments may be entered with a computer and stored with each record. From the keyboard it is only possible to view or turn comments ON or OFF. Turning comments OFF saves some memory allowing perhaps one or two extra events to be stored. Selecting ADD in this field allows viewing any stored comments. Comments can only be changed by using a computer. See Chapter 1, Section 1.7 in the **NOMIS Mini-Graph Software for DOS Users Manual and in the Windows Software Users Manual.**

3.2.6 ACOUSTIC DISPLAY UNITS

The acoustic reading is normally displayed in millibars (MB) on the summary screen, but can be set to display decibels (DB). Any event in memory may be displayed either way.

3.2.7 DATE/TIME

Make changes as described above and use "**Select Field**" or "**Enter**" to set. Holding down the "**Increment**" or "**Decrement**" keys will advance the settings at a rapid rate. Pressing "**Enter**" will advance the display to the next screen. Please note the date is entered in U.S. notation i.e. Month/Date/Year.

3. SET-UP

3.2 KEYBOARD SET-UP (Continued)

Screen 2
```
COPIES 0  MAX RANGES IPS  05.0 DB  148
A TRIGGERS  SEIS 1.14    IPS   AIR  115  DB
```

Screen 2 shows the units of measurement, the maximum seismic recording range, the maximum air recording range, vibration trigger level, and air trigger level. Each of these fields is accessible using the "Select Field" option. Press "Increment" or "Decrement" to change the settings within the brackets. Using "Select Field" or "Enter" will accept any changes.

3.2.8 COPIES

The Mini-Graph can be connected to a serial printer which is IBM or EPSON compatible, and can automatically print 1 or 2 copies of any event that occurs even if an operator is not present. If no printer is connected, copies should be set to 0. Manual printing of single records does not require Copies to be set.

3.2.9 UNITS

Use "Select Field" to advance to this field and "Increment" or "Decrement" to toggle between U.S. or Metric. This will have no effect on the data storage, but will change the way data is displayed or printed.

3.2.10 SEISMIC RANGE

The Mini-Graph has three seismic ranges which can be displayed in U.S. or metric units. Use the lowest one that will accommodate the highest velocity level you expect. This will give the best resolution of low level data. The three seismic ranges available are 2.5, 5.0, 10.0, and 20.0 inches per second (63.5, 127, 254, 508 mm per second).

3. SET-UP

3.2 KEYBOARD SET-UP (Continued)

3.2.11 AIR RANGE

The Mini-Graph has two air ranges. Use the lowest one which will accommodate the highest air blast expected. The two Air ranges available are 142 and 148 decibels (dB), maximum.

3.2.12 SEISMIC TRIGGER LEVEL

Set the trigger level above any background noise but below the velocity levels expected. Setting too low may allow false triggers and too high may cause a lost event. Avoid the most sensitive settings unless required by the application. The vibration trigger levels can be set anywhere between .02 through 1.14 inches per second (.05 through 2.89 cm per second).

3.2.13 AIR TRIGGER LEVEL

The air trigger should not be required for normal blast events. If it is used, it should be set as high as practical. Setting too low will produce false events due to wind or noise. The choices for air trigger levels are off and 112 through 148 decibels (dB). Please note that when "off" is used, the Mini-Graph will not trigger on sound, but will record any sound once the unit is triggered by the seismic activity. Press "Enter" to set your selections and advance to the next screen.

Screen 3
```
PRINTER RANGE  0    SPEED 1      TIMER OFF
A 1024/SEC 004 SEC RECORD  OSM NONE      []
```

Screen 3 shows the printer range, timer option, sample rate, and recording time. Each of these fields is accessible using "Select Field". Hold down the "Shift" key and press "Increment" until the brackets surround a field which you wish to change. Release the "Shift" key and then use "Increment" or "Decrement" to change the settings within the brackets. Using "Select Field" or "Enter" will accept any changes made.

3. SET-UP

3.2 KEYBOARD SET-UP (Continued)

3.2.14 PRINTER RANGE

This setting will normally be left on [0] so that the print range will automatically be set by the instrument. In special cases you may want to print with higher or lower amplitudes on a chart. There are 5 possible selections which you will have to choose by experimentation. You may print any event in memory as many times as desired.

3.2.15 TIMER

This field allows the Timer to be Set and turn the instrument ON or OFF. If Set is in this field when "ENTER" is pressed, a new screen will appear which will allow Timer operation to be programmed. It will appear similar to the following example:

>   HOUR TO TURN UNIT · OFF 00 ON 00
>   arrow keys to set hour 0-23, then enter

The cursor may be moved to the "OFF" and "ON" (Using "Select Field" on the 5 key pad) fields where the Arrow keys will allow the operator to set the hour when the unit will start and cease monitoring on a daily basis. When "ENTER" is pressed, the hours are set and Setup Screen #3 returns with the "Timer ON". A typical setup might be: On at 8 and Off at 17, for 9 hours per day recording, 7 days per week. The primary purpose for timer operation is to conserve power and obtain longer operation per charge. It will also reduce the possibility of false triggers.

During time periods outside the Timer ON time, the instrument will not trigger or record events, and instrument current drain is about one sixth of normal. Pressing "RESET" will wake the unit and bring it out of the sleep condition until the next scheduled OFF time.

3.2.16 SAMPLE RATE

This field sets the number of samples each channel takes in a one second period. Set the sample rate to the lowest rate which will resolve the frequencies you expect to record. The Mini-Graph operating current gets lower as the sample rate decreases so longer operating time can be obtained. For most blasting operations do not go below 512 samples per second. This will resolve up to 100HZ data. For very close in

3. SET-UP

3.2 KEYBOARD SET-UP (Continued)

3.2.16 SAMPLE RATE (Continued)

monitoring of large blasts, the 1024 or 2048 sample rate may be required. It will resolve frequencies up to 400 HZ but the total record time drops to 6 seconds for 2048 and battery life will decrease by approximately 30%. The 1024 samples per second should be used most of the time. The range of settings is 32 - 2048 Samples per second.

3.2.17 RECORDING TIME

This field sets the length of time that data will be collected. The range of settings for the recording time is 1 through 384 seconds, depending on the sample rate selected. As previously mentioned the sample rate of 1024 should be used for most blasting. A recording time of 2 or 4 seconds should be used in most cases. The recording time of 4 seconds should be used when the Mini-Graph is located in excess of 2000 feet from the blast. The 4 second recording time will allow the airblast to travel over this distance and be recorded by the Mini-Graph during the four second recording time. Using a 2 second recording time may allow the Mini-Graph to stop collecting data before the airblast arrives. Sound travels at the rate of 1046 ft/sec. This will allow you to calculate the recording time necessary for your particular distance.

3.2.18 OSM

This field determines if an OSM chart will be printed with all three components combined on one chart, printed with separate charts, or not printed.

Screen 4 and Screen 5 - see **3.5 Reviewing Data**

3.3 FIELD INSTALLATION

The Mini-Graph may be sand bagged in place for low level blast monitoring, but spiking into the ground, mounting to a concrete block or burial are preferred methods for better coupling.

3. SET-UP

3.3 FIELD INSTALLATION (Continued)

3.3.1 SPIKING

Press or drive the tripod and spike assembly into the ground until the three points are well buried. This should be done before the spike is attached to the Mini-Graph. Take care not to bend the plate or roughen the bolt head. Install the Mini-Graph over the spike plate so the bolt head fits inside the hole in the bottom of the case. Orient the unit so the arrow on top is pointing toward the blast site. The operator will be looking toward the blast site when the display is properly oriented for viewing. The Connectors will be on the right side of the operator. Press the unit down tight and tighten the two set screws using the supplied Allen wrench.

If setup has been previously done, plug in the microphone and leave the unit to monitor. If setup is required use the Trigger defeat switch to disable the trigger as described under **Setup 3.2.1.**

3.3.2 BURIAL

The Mini-Graph is moisture resistant but should be buried in a well drained area above possible flooding. To protect the case finish it will help to put it in a plastic bag before burial. Dig the hole and install a spike if possible. Install the Mini-Graph as described under Spiking. Connect an external battery or solar cell if long term monitoring is required. Connect the microphone last and bring out all cables so they won't be damaged by local activity. Use a blank 9 pin male plug to keep dirt and moisture out of the auxiliary connector. Putting petroleum jelly in the connector will displace moisture and may improve operating life. If no microphone is desired, the supplied interlock plug may be used to allow operation without the microphone connected.

Press the trigger disable switch so that burial may be completed without a trigger. At least one minute of non-triggering time is available after the switch is pressed. If a long time will be required to bury the unit, it would be best to tape the switch in the down position until installation is complete.

NOTE: For permanent buried installations, the optional external sensor is recommended.

3. SET-UP

3.3 FIELD INSTALLATION (Continued)

3.3.3 MICROPHONE INSTALLATION

The microphone may be installed by any convenient method such as using the mast mount on the side of the case or using the mast spike driven into the ground. It should be out of the weather if possible and covered with the supplied windscreen. If it may be subjected to water, cover it with a loose fitting plastic bag. Plug the microphone into the connector with the male pins and tighten the hold-down screw. Failure to tighten this screw may allow the mic to disconnect or water to enter the connector.

3.3.4 MINI-GRAPH DE-ACTIVATION

False triggers at time of removal are more of a problem than those that occur at start-up. This is because the data processing may be occurring when the microphone is unplugged. This will produce a corrupted event which will slow down or stop the data downloading process later on. It may cause a false event which will show all zeros on the levels. To prevent this, press the trigger disarm switch to disable triggers before unplugging the microphone. In above ground installation the Mini-Graph may be disabled with the "Reset" key before unplugging the microphone.

3.4 OPERATION

3.4.1 STARTING TRIGGERED OPERATION

As soon as the mic or sensor is connected, the Mini-Graph will enter stabilization mode and become active as soon as it completes. A dark bar will show in the lower left of the display if the trigger is disarmed. This will be the case if the trigger was previously disarmed and the unit shut off before it entered the low power mode. In this condition, the Mini-Graph may be setup or interrogated, but can not be triggered. Once setup is complete and no more keyboard activity occurs, the unit will enter the low power monitoring mode within one or two minutes. Should it be necessary to enable the trigger sooner than this, you can clear the unit by pressing "Reset" while holding down "Enter". This will return the unit back to default settings and may require you to redo some setup. The unit will be in a triggerable condition even if you are working on the setup.

3. SET-UP

3.4 OPERATION (Continued)

3.4.2 MANUAL KEYBOARD TRIGGER

Connect the mic and sensor. Press "Reset" and hold "Decrement" until you see the Manual Trigger prompt. Hold down the "Shift" key and press "Decrement" to cause the unit to record for the length of time selected in setup.

3.4.3 EXTERNAL TRIGGER

The External Trigger mode allows the Mini-Graph to be triggered by connecting a momentary switch between pins 5 and 7 of the communication connector. The leads should be short with this simple circuit. If a long cable is required, it is better to use an external voltage of 4 to 12 volts with shielded wire (shield to pin five). The trigger will work with either a high to low, or a low to high change. You must however power up the unit with the trigger circuit connected so that the unit can configure itself for the proper polarity. Contact NOMIS for information on how to use this feature for triggering from sources such as detonations.

3.4.4 ARRAY TRIGGERING

A number of Mini-Graphs may be connected and triggered at the same time by one master unit or an external trigger. Pin 9 of the communication connector outputs a positive voltage when the unit is triggered. If pin 9 of a master unit is connected to pin 7 of other slave units, all will be triggered when the master unit is triggered. In this case all units have pin 5 connected as a common. To prevent unwanted false triggers, the units should be connected using the following procedure:

Power up the master unit by connecting the mic and sensor and allow it to stabilize. Connect the trigger cable to additional units and put them in the Manual trigger mode. If the master unit is powered last it will cause the others to trigger as it goes thru stabilization.

The Mini-Graph can be connected for Array triggering with all units powered from one external power source. The Array may also be connected to a computer or modem to allow Setup and download of each individual unit. The clock on each unit may be synchronized by using the supplied Serial software and the F9 setup mode. The clock accuracy will usually be with in 1 second per day.

Contact NOMIS for information on how to make connections for your specific application.

3. SET-UP

3.4 OPERATION (Continued)

3.4.5 MODEM INSTALLATION

Most modems can be made to work with the Mini-Graph, but cables may have to be made up to adapt to the 9 pin connector. Usually you can adapt using commercially available null modems, gender changers, and connector adapters. Since there are so many types of modems available, it would be advisable to contact NOMIS for recommendations on what to use. Most modems will require AC power to operate and will have to be left on continuously. NOMIS has a DC powered modem available which works on a 12 volt battery and powers down after each use to conserve power.

3.5 REVIEWING DATA

The Mini-Graph allows viewing of any event in memory even while monitoring. If the trigger level is low or the unit is not securely fastened down, false triggers may result from using the keyboard. If a false trigger is not desirable, use the trigger disarm switch or set the trigger levels to maximum. If the unit is in the low power mode, pressing "Enter" will wake it. The display will be on the main screen (Screen 4) and show the summary data of the most current event. The "Increment" and "Decrement" keys may be used to change the event number. As the event number changes the corresponding data for each event is displayed. Frequency information on any event may be obtained by using the "Select Field" key combination ("Shift" and "Increment" at the same time) to toggle between Screen 4 & Frequency screen (screen 5).

Screen 4

BAT 06.5	06-09-96	10:34	IPS	002	P
N 00.14T	00.07V	00.07R	124A	00.15VS	A

Screen 4 is the main screen for displaying recorded data. This screen is always displayed when the unit has been operating and the operator addresses the trigger disarm switch. Screen 4 displays battery voltage, date, time, measurement units, event number, transverse, vertical, radial (longitudinal), airblast, and vector sum results.

3. SET-UP

3.5 REVIEWING DATA (Continued)

Screen 5

T	V	R	A	002
032.0 HZ	341.0 HZ	73.1HZ	007.0 HZ	

Screen 5 displays the frequencies associated with the transverse, vertical, radial (longitudinal), and airblast measurements. The event number is also displayed. The frequency reading is recorded in Hertz.

Viewing the recorded data with the computer is discussed in the **NOMIS Mini-Graph SOFTWARE Manual** under **SET-UP.**

4. CHARGING

4.0 CHARGING

The Mini-Graph systems may be charged using either of two methods. An AC charger is supplied which plugs into the male connector where the mic normally goes. This charger is normally supplied without a connector for use outside the U.S. due to the many types required. This method is used when the Mini-Graph is not being used and AC power is available. Normally an overnight charge will bring the unit up to full charge. Normal operating voltage will be 6.3 to 6.4 volts and the units should not be operated below 6.0 volts. Operating time depends on the sample rate and whether the timer is used. The worst case is 2048 samples per second where operating time is about 5 days.

The second method for charging requires a 12 volt automobile battery or other power source such as a solar cell. It connects to the male connector where the computer normally connects. This method may be used in the field while the unit is operating with the mic connected. The red clip must be connected to the positive terminal of the power source and the black clip goes to the negative terminal. No damage will result if connections are reversed but no charging will take place.

5. MODEM INSTALLATION AND OPERATION

5.0 GENERAL

The modem supplied with the Mini-Graph support baud rates up to 14.4 K baud, but some phone lines may be limited to far less than this. Test the line to see what it supports or check with the phone company. A rate of 9600 is recommended, but with a good connection the higher rates will work and speed up data transfers. If you experience difficulty, lower the baud rate to see if there is an improvement. Each time you try a new baud rate, the Mini-Graph baud rate will also have to be changed. This may require an operator at each end of the communication link until you are able to establish a good connection.

Sometimes communication will not be good enough to allow record transfers at a high rate, but you may be able to do set up on the Mini-Graph. In this case, you can set the Mini-Graph baud rate, within the instrument, to a lower rate from your keyboard and then set the baud rate of the MINI.COM software to the same rate (ALT F3). You will probably lose communication and have to redial, but the new connection will be at the lower baud rate.

When attempting to use the higher rates, set MINI.COM and the Mini-Graph to 19.2 K to talk to the modems at 14.4 K. If you have the high speed version of the modem, it will work up to 28.8 K baud, but the MINI.COM software and Mini-Graph will be set to 38.4K.

The modems supplied with the Mini-Graph use the latest error correction and compression routines which allow increased speed of data transfer. These features may be incompatible with any modems you already own. It is recommended that you use the same type of modem at both ends of the communication link. If your present modem does not work properly with the system, consider replacing it with one similar to the Sportster.

5.1 MODEM SETUP

Most brands of modems may be used with the Mini-Graph on AC power as long as they are properly setup. This will require reading the manual supplied with the modem to learn how to set dip switches or use software commands. Some modems seem to be unreliable especially when different brands are used at the master and remote locations. For this reason we suggest the modems be purchased and tested at our shop before installation in the field.

5. MODEM INSTALLATION AND OPERATION

5.1 MODEM SETUP (Continued)

We recommend the U.S. Robotics Sportster if you wish to purchase your own. It is inexpensive, easy to use, and one of the most common modems available. For AC operation set the dip switches on the back as follows:

1 = down, 2 = up, 3 = up, 4 = down, 5 = up, 6 = up, 7 = up, 8 = down

For other brands of modems, you may have to use software to set the modem for Auto Answer, Echo Off, Ignore DTR, and Result Codes Off.

The cable from the modem to the Mini-Graph can usually be made up using adapters for the connectors along with a null modem. This may not work for all modems, and may require cutting some wires in the cable. In other cases, jumpers may have to be added to the connector. It is best to obtain the modem and cable from NOMIS or contact NOMIS for connection information.

NOMIS supplied modems will come with the proper cable. This cable will allow the normal Mini-Graph charger to be connected at the same time as the modem.

Communication speeds up to 28.8K baud are supported, but many phone lines are still limited to lower rates. Test the lines to see the highest rate they will support, and set the baud rate of the Serial software to this rate. Set the Mini-Graph rate to match. If you see connect rates less than this displayed on your computer screen, you will have to dial again until the connection improves.

When the modem is installed, make certain the phone line has a lightning arrestor connected. Lightning damage is not uncommon for modem installation in the field.

5.2 AC OPERATION

The modems to work with the Mini-Graph may be supplied to work with either AC or DC power. The simplest operation uses the AC adapters supplied with both the modem and the Mini-Graph. For AC operation, a cable is supplied which connects the Mini-Graph to the modem. This cable has three connectors one of which may be used to connect the Mini-Graph charging accessories.

5. MODEM INSTALLATION AND OPERATION

5.2 AC OPERATION (Continued)

Setup the Mini-Graph in the normal manner, with the baud rate at 9600 or other rate you determine will work with the phone line.

Set the Sportster modem dip switches as follows:

1 = down, 2 = up, 3 = up, 4 = down, 5 = up, 6 = up, 7 = up, 8 = down

This will default the modem for Auto Answer, Ignore DTR, Echo Off, and No Result Codes. Software will also configure this, but in the event lightning reprograms the modem, it will automatically reset itself when power is cycled.

Turn off the Mini-Graph, and connect the modem with the supplied cable. Connect the phone line to the outside jack on the modem, and connect the modem power adapter to the round jack. Plug the power adapter in the AC line, and turn on the modem. The lights should flash and stabilize indicating it is operating. If you want the Mini-Graph to charge from AC power, connect it's charger to the 9 pin connector on the adapter cable. Turn on the Mini-Graph and check it for proper setup. If you change the baud rate, reset the Mini-Graph with the modem connected. This allows the Mini-Graph to configure the modem for the proper baud rate.

NOTE: This modem programming feature is available only with Mini-Graph program version 2.47 or higher. Note the program version on your Mini-Graph display as it is powering up. If it is lower than 2.47 contact NOMIS about a program upgrade.

1 = down, 2 = up

5.3 DC OPERATION

For DC operation, the modem is supplied in a sealed metal box with electronics for detecting the phone ring. An internal lightning arrestor and modem power supply are also provided in this box. When not in use, the modem is automatically powered down. This reduces power requirements, so that several months operation can usually be expected with an auto battery. A connector on the box allows operating the modem from AC or DC by using the accessories supplied with the Mini-Graph.

5. MODEM INSTALLATION AND OPERATION

5.3 DC OPERATION (Continued)

Connect the modem to the phone line and connect the ground strap to earth ground. The unit will work without the ground, but is more likely to be damaged by lightning. Connect the communication cable to the Mini-Graph and then to the modem box. Connect the external power source to the modem box female connector. This will power both the modem and Mini-Graph.

Plug in the Mini-Graph sensors which will power it on. Check all setups to be sure they are correct. If you reset the baud rate, reset the Mini-Graph to allow it to configure the modem for the proper baud rate. If your Mini-Graph has a program version older than 2.47, it does not have this modem programming feature. Contact NOMIS for information on an upgrade.

6. PRINTER INSTALLATION AND OPERATION

6.0 GENERAL

A serial printer which emulates IBM or Epson print modes may be connected to the Mini-Graph for printing waveforms and OSM type graphs. A parallel input printer may be used if you install a serial to parallel adapter between the Mini-Graph and printer. A null modem will also be necessary to cross over the RX & TX connections. You may wire a special cable which eliminates the gender changer and adapts to the type of connector used on your printer. This cable may also be supplied by NOMIS if you provide information about your printer.

The printer may be left connected to the Mini-Graph while monitoring in the field. With proper setup, the records will print as the events occur. Most printers are not made to work under conditions that may be found in the field, so this type of operation requires careful installation.

6.1 SETUP SCREENS

The Mini-Graph has five parameters to set for printing. The default settings when the unit is cleared are generally satisfactory for a manual print. If a printer is not in use, be sure the number of copies is set to zero. Although the unit will work however it is set, if the number of copies is not zero, it will attempt to send serial data to a printer each time an event occurs. This will slow data processing and put characters on your computer display if a computer is connected.

6.1.1 BAUD RATE

The baud rate (on the first screen) should be set to match what your printer requires. Usually 9600 baud is a good choice.

6.1.2 COPIES

The second screen has this parameter and it should be set to (0) if no printing is required. If a printer is connected, you may select (1) or (2) and have the records automatically printed as the events occur.

6. PRINTER INSTALLATION AND OPERATION

6.1.3 PRINTER RANGE

The amplitude of the waveforms are controlled by this parameter. The default (0) is probably the only setting you will require. It allows the Mini-Graph to automatically select the range based on the peak amplitudes. In some special cases, it may be advantageous to blow up or decrease the record amplitude. Perhaps you would like all records to be printed at the same scale for instance. Five ranges are available with (1) producing the largest amplitudes.

6.1.4 PRINTER SPEED

This parameter sets the apparent speed of the chart as the wavefrom is plotted on it. The effect is to compress or expand the record to different lengths. In most cases you will want the record to fill one page, and the SPEED will have to be set to the number that works with the record length you have stored. A record of nine seconds may require a (1) setting while a one second record might use a (3). The (4) and (5) settings will print very long records, and would not be used unless you are using a printer with continuous forms. A printer with single sheets will work this way, but it is inconvenient to have the record on several sheets.

6.1.5 OSM CHARTS

This parameter is on screen 3 and may be set for none, combined, or separate. The combined selection puts all three components on one chart, and will print a little faster than the separate selection. The separate selection will produce three individual charts for the three components.

6.2 MANUAL PRINTING

Press "Enter", if required, to advance to the Main screen where the event summary data is displayed. Select the event you wish to print by using the "Increment" and "Decrement" keys. Note the character in the lower right corner. An (S) in this spot indicates that only summary data is left in memory and no waveform can be printed. An (A) in this spot indicates an analog event is in memory and the waveform can be printed. If selected, OSM charts will be printed on a separate page.

Press "SHIFT" and "DECREMENT" and the printer should almost immediately begin to produce a record according to the selected setup parameters.

NOTE: Manual printing can not be performed while in the Manual Trigger mode. Manual Trigger uses the same key combination to cause a trigger.