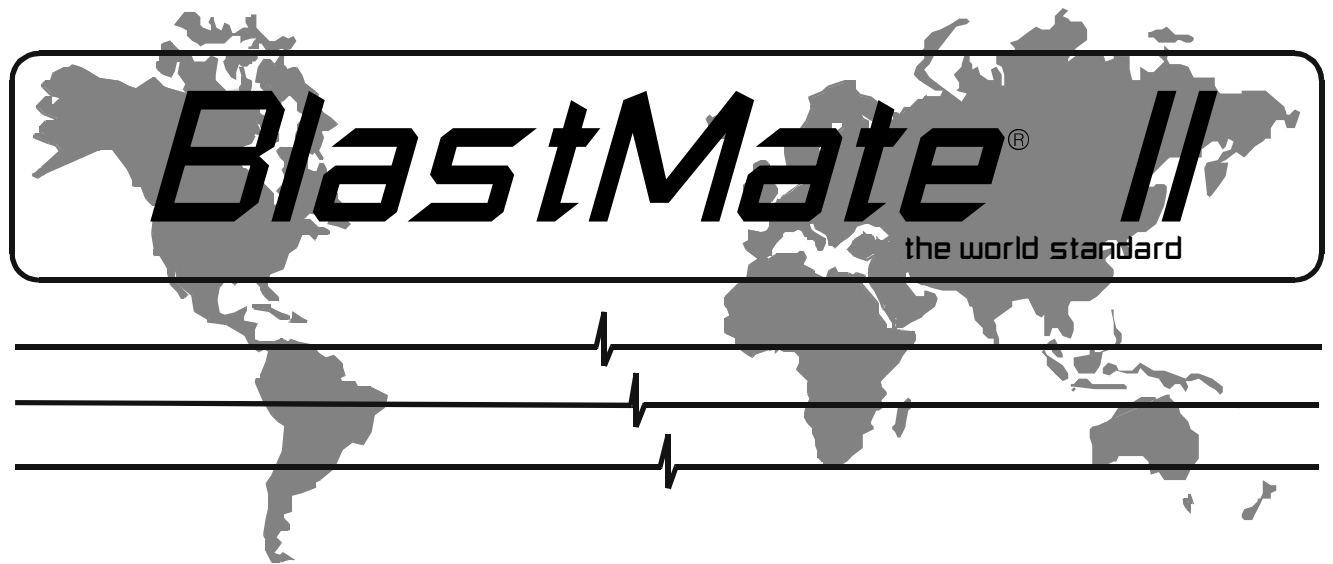




BlastMate® II Operator Manual

DS-477/677



Certified to the ISO 9001 Quality Standard

Instantel Inc.

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Customer Support:

Instantel is represented by a network of qualified dealers throughout the United States, Canada, and Internationally. For further information, including product literature and the location of the dealer nearest you, contact Instantel.

- Extensive dealer network.
- Comprehensive application support.
- In-depth user documentation.
- For technical support, call 1-613-592-4642 or e-mail the event to bmservice@instantel.com

For sales and applications support, contact Instantel and ask for BlastMate II sales. For technical assistance and after sales support, contact Instantel and ask for Technical Support.

Warranty:

Each BlastMate is shipped with velocity sensors, microphone, microphone stand, cables, batteries, charger, and user manual. Except for batteries, it carries a 365 day or 12 month parts and labor warranty against manufacturing defects. If, during the warranty period, a unit fails to perform in accordance with Instantel's published specifications, it will be repaired or replaced free of charge. This warranty is void if the equipment has been dismantled, altered or abused in any way. Authority to return the unit(s) must be obtained from Instantel prior to shipment. Shipping charges to Instantel's plant will be paid by the buyer and those for return will be paid by Instantel.

The above warranty does not include any implied warranty of functionality for a particular purpose. Instantel assumes no responsibility for damages of any description resulting from the operation or use of its products. Since it is impossible to anticipate all of the conditions under which its products will be used, either by themselves or in conjunction with other products, Instantel cannot accept responsibility for the results unless it has entered into a contract for services which clearly define such an extension of responsibility and liability.

Instantel retains the right to change any specifications without notice as legislative, engineering and manufacturing conditions may warrant.

Warning:

This is an electronic instrument. Although it has been designed for field use, it contains sensitive components which cannot be expected to withstand the same stress and shock as heavy machinery. It contains a microcomputer and solid state memory, both of which may be made inoperative by severe radio interference. The use of transmitting equipment in the immediate vicinity of the unit should be avoided. Evidence of negligence in the care or handling of the instrument may void the manufacturer's warranty. The BlastMate II contains no serviceable parts. The unit should be returned to an authorized Instantel service center for service. Any attempt to service the BlastMate II will void any and all warranties offered by Instantel. Service enquiries should be made via your dealer.

EC Warning:

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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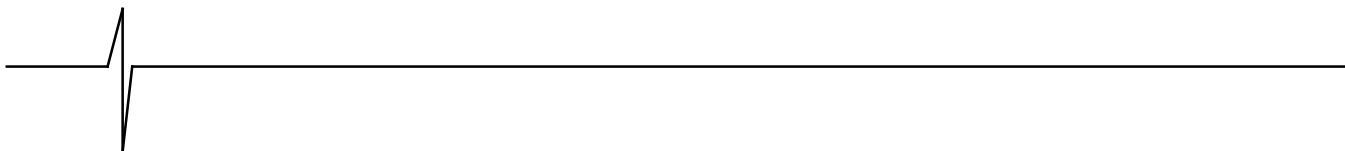
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Thank You . . .

Thank you for purchasing Instantel's BlastMate Series II monitor. You will find it the most reliable and easy-to-use seismograph available. If this is your first Instantel seismograph, welcome to the new World Standard set by Instantel. If this seismograph adds to your existing fleet, congratulations! you will find the many features simple to use and offer you powerful control over your monitoring operations.

Before You Begin

Before you begin using your new BlastMate II, please complete the following. It only takes a few minutes of your time and ensures your monitor is ready for operation and that you become part of Instantel's Product Support Program.

Important information appears within the BlastWare III software Readme file. Install the BlastWare III software then read this file for additional information. See the BlastWare III Operator Manual for installation instructions.

Check the Package Contents

Please check that you received all the parts identified on your shipping invoice. Remember to keep your shipping box because it was designed to safely ship your monitor. It is an important component of what you have just purchased.

Record the BlastMate II Identification Numbers

Record the following identification numbers for future reference.

IDENTIFICATION NUMBERS	
Model Number	
Monitor Serial Number	
Monitor Software Version Number	
Standard Transducer Serial Number (If applicable)	
Microphone Serial Number	
Dealer Name	
Date Purchased	

Check Your Local Electric Power Supply

Every BlastMate II comes with a 120 VAC 60 Hz input AC adapter providing 10 to 14 VDC, 500 mA output. An optional 220 VAC adapter is available. Check with your local power utility to ensure the supplied electric power may be used with the BlastMate II. Your dealer may have

already supplied an optional AC adapter. If not, contact your dealer and ask about the optional AC Adapter.

Note to Our Customers in India and Other Countries

Due to large power fluctuations found in countries including India, please use a voltage stabilizer and a 220 V AC Adapter to provide 10 - 14 VDC @ 500 mA to power the monitor.

Charge the Battery

Before you use the BlastMate II, charge its battery for at least 24 hours. Although Instantel ships every BlastMate II fully charged, it is a good idea to top up the battery's charge before use. Install the 5 amp/250 Volt fast blow fuse. Use a similar type fuse for replacements. To check the battery charge, turn the BlastMate II on and press the BATTERY LEVEL key.

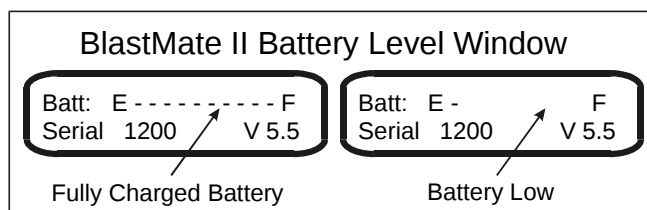


Figure 1 Battery Level Indicator.

To charge the battery, plug the AC adapter into the PWR connector located at the front of the BlastMate II. Plug the other end into a 120 VAC 60 Hz electrical outlet. The charging light located under the carrying handle indicates the battery is being charged.

WARNING: Open the monitor's lid to ensure adequate battery ventilation during charging. Always charge in a well ventilated area.

Do not allow the battery to become discharged and left in a discharged state for any extended period of time. Allowing the battery to become discharged may cause permanent damage to the battery.

You can operate the BlastMate II while it is being charged. Try the Basic Tutorial, Chapter 2, for a quick and easy lesson on how to record events.

Check the Monitor's Memory

When the BlastMate II is turned on, a series of start-up messages appear in the display, including the Memory Level Window, shown in the illustration below. This window displays the total amount of memory, the percentage of memory available, and the number of events recorded. When the memory is empty, you can record events. When the memory is full, the memory has stored the maximum number of events and cannot store more events until you delete the stored events.

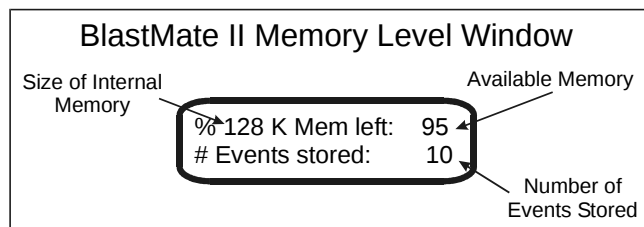


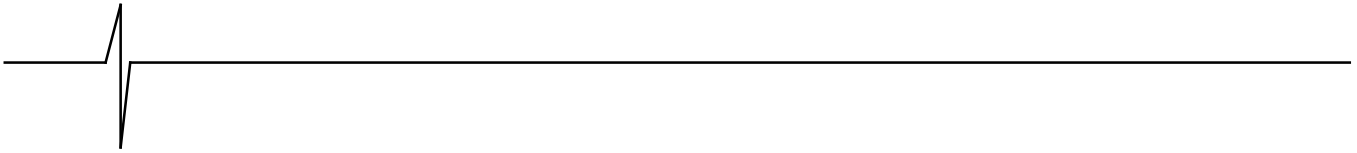
Figure 2 Memory Level Window.

Complete and Return Your Registration Card

Instantel offers a comprehensive Product Support Program. You receive a one year warranty, product support, and product updates. You also receive free software upgrades for the BlastMate II and the BlastWare III software programs for the first year. All you have to do is complete the registration card included with your BlastMate II and return it to Instantel by mail or facsimile within thirty (30) days of purchasing your new monitor.

Handling Precautions

- **Handle All Components with Care.**
- **Keep the BlastMate II On Charge.**
Batteries cannot be over-charged when using the charger supplied but can be irreparably damaged by leaving them in a discharged state. They should be charged when fewer than five graph bars appear in the LCD and *must* be charged when the unit beeps.
- **Disconnect the Battery if Storing the BlastMate II.**
If storing for prolonged periods of time, disconnect the battery. Recharge the battery every six months for twenty four hours.
- **Always Hold a Cable by its Connector.**
Do not hold the cord to pull on a connector when connecting or disconnecting it.
- **Never Force a Connector.**
Always align the connector to the port before inserting.
- **Use Only the Supplied Cables to Connect the BlastMate II to a Personal Computer.**
Use only the BlastMate to PC connecting cable (p/n 712A2301).
- **Never Connect or Disconnect Cables Without First Turning Off the BlastMate II and Your Computer.**
- **Do Not Drop the BlastMate II or Submerge it in Liquids.**
The BlastMate II is rugged and designed to withstand normal wear and tear. The BlastMate II is splash resistant designed to withstand temporary exposure to drops of water. It is not waterproof and should not be immersed in water. Immersing the monitor or installing the monitor where standing water may accumulate may damage the monitor.
- **Do Not Drop the Microphone or Otherwise Subject it to Impact.**
The microphone can be damaged if the microphone is handled roughly.
- **Keep Computer Disks Away from the Transducer.**
The geophones inside the transducers contain magnets that could erase the data stored on computer disks.
- **Clean the BlastMate II Periodically.**
Vacuum dust, dirt, and sand from the BlastMate II. Use alcohol to remove stains. Do not use paint thinners and ketone solvents. These may damage the BlastMate II.
- **Keep the Printer Cover Closed to Keep Out Dirt and Moisture.**
Dirt and moisture can accumulate over time and affect printer performance.
- **Remove the Printer Pen and Cap It when Not in Use.**
- **Do Not Manipulate the Paper Roller By Hand.**
- **The Warranty Is Void if You Oil or Grease Any Part of the Plotter.**



- **Do Not Attempt to Use Pens or Paper Not Designed for the Plotter.**
- **New Pens Should Be Rubbed on Paper to Start the Ink Flowing Prior to Inserting them in the Printer.**

BlastMate II Condensed Instructions

1. Set and level geophone and connect the cable.
2. Set up microphone and connect the cable.
3. Verify that the pen is OK.
4. Turn on unit by depressing the ON/OFF key.
5. Watch messages for battery and sensor status, correct time and date.
6. You may verify setups by pressing R.
7. Press M to enter MONITOR mode.
8. After an event capture, the unit performs a Sensorcheck and “TESTING SENSORS” is displayed on the LCD.
WARNING: After a blast do not touch the unit until the message “Performing ANALYSIS” appears.
9. If accidentally triggered before a blast, press ABORT and when the message “PRESS ‘M’ TO MONITOR” appears go back to step 7.
10. When finished, turn off the unit. Disconnect and stow cables, geophone and microphone.

Conventions Used throughout this Manual

The following typographical conventions appear throughout this manual.

- | | |
|------------------|---|
| Bold type | This type tells you which BlastMate II keys to press. For example, when you see ABORT key, it means press the ABORT key located on the BlastMate II keyboard. |
| Window | This word, when capitalized, refers to a message window appearing on the BlastMate II display. For example, when you see Main Window, it refers to the following display: |

Press ‘M’ to MONITOR
R=Review S=Stest

1. INTRODUCTION

The BlastMate Series II has a proven track record as the industry's most reliable blast monitor. Rugged, flexible, and easy to use, the DS-477/677 offers all the functions you need in an intuitive format that makes it easy even for the first time operator to quickly setup and record an event.

This manual is divided into sections. The first section is a tutorial for the new user. Follow this tutorial to record your first event. The section describes basic functions with illustrative examples to lead you through. The following section offers a detailed explanation of the operation of the monitor. The last sections provide reference and maintenance information, and extensive troubleshooting support, followed by supporting information in the Appendix.

1.1. BlastMate II Models

The BlastMate Series II monitors include two models based on the number of events that can be stored. The DS-477 can store up to 40 one-second full waveform events, and includes an external standard transducer and microphone. The DS-677 offers a 300-event memory capacity, along with the same accessories as the DS-477. Both models offer the level of performance and ease-of-use you expect from Instantel monitors.

1.2. Key Features

The BlastMate II offers a range of useful features. The following table gives a small sampling. Please see the specifications located in the Appendix of this manual for a complete list.

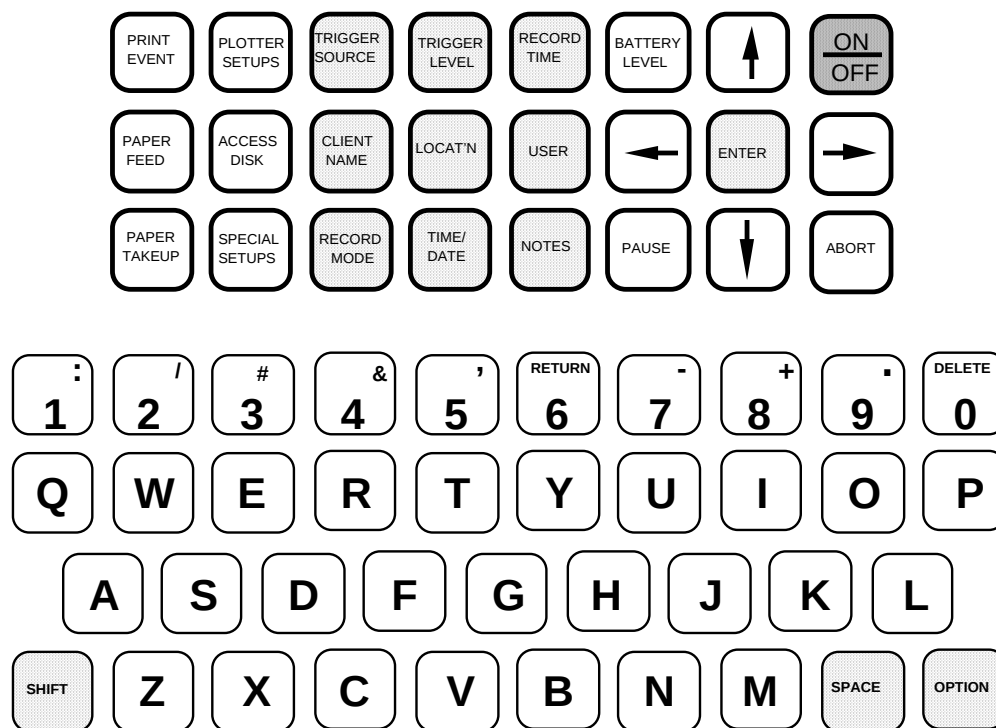
- **One Year Warranty** – full one year no nonsense parts and labor warranty on the monitor.
- **40 or 300 Full Waveform Event Capacity** – 40 (DS-477) or 300 (DS-677) event capacity.
- **High Resolution Printer.**
- **Personal Operation** – complete ability for you to define how the monitor operates. Anything you do not need disappears and does not get in the way, yet is immediately available when you need it.
- **Multiple Record Modes** – offer you unlimited flexibility during monitoring operations: single event, continuous, auto record, programmed start/stop, and manual.
- **Full Waveform Event Analysis** – full field analysis of the event including peak particle velocity (PPV), peak air (sound) pressure, peak vector sum (PVS), peak acceleration, and peak displacement.
- **National Frequency Analysis Standards** – Compliance data can be generated for the USBM/OSMRE standard (USA) and the DIN 4150 standard (Germany), and a range of other international standards.
- **Full PC Compatibility** – to archive, print, and perform analysis and process capabilities with the BlastWare III software.
- **1024 Sample Rate** – the 1024 sample rate ensures accuracy for high frequency blast performance analysis.
- **On-line Help** – informative, context sensitive help guides you through all operations.
- **Rugged Design** – Series II exceeds the field test for rugged, durable design with a fully sealed top panel, non-corrosive industrial grade connectors, and sealed electronics, all packed in a single rugged case. Instantel monitors have been buried; rolled off trucks; thrown down mine drifts by air blast; hit with flyrock; run over by backhoes; and have survived in working order.

1.3. Accessories

Instantel's complete line of BlastMate II accessories offer you the control and flexibility to monitor all types of events.

- **Extra Event Memory** – 300 event memory (converts the DS-477 to the DS-677)
- **External Standard Transducer** – 2 to 250 Hz frequency response.
- **Uniaxial Geophone** – horizontal and vertical models.
- **Hydrophone Sensor** – underwater sensor with 200 ft. (60 m) cable.
- **Transducer Leveling Plate** – with adjustable leveling feet and integrated bubble level. Used to mount the standard transducer to a wall or ceiling as well as ground installations.
- **Remote Alarm** – self contained remote alarm indicator complete with high power auxiliary drive capability for external sirens and other alarms.
- **DS 20 Wire Trigger** – a wire, broken by an explosion, transmits a signal to trigger the BlastMate II to start recording.
- **120 VAC and 220 VAC Adapter** – connect the BlastMate II to your local electrical power supply.
- **Auto / 12 V Adapter** – connect the BlastMate II to your vehicle's 12 volt power supply or a 12 volt battery for remote installations.
- **Extension Cable** – general purpose extension cable to connect transducers, microphones, and a personal computer. Available in standard and custom lengths.
- **Null Modem Cable** – for modem communication between the monitor and a computer.
- **Accessory Case** – carry BlastMate II accessories in a hard case, similar to the BlastMate Series II case. Removable foam accommodates your accessories.

1.4. The BlastMate II Keyboard



AUX PWR GEO MIC

Figure 1-1 BlastMate Keyboard and Relative Position of External Connectors.

Notes:

2. BASIC TUTORIAL

In this tutorial, you will learn how to turn on and setup the BlastMate II to record an event and then print an Event Summary Report. Follow this tutorial to practice event monitoring. You can also use it as a guide when recording actual events.

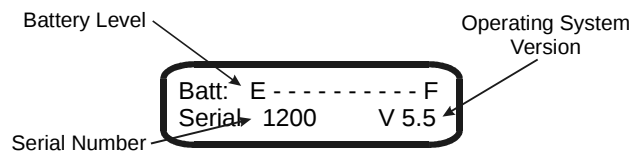
Step 1: Install the BlastMate II

Unpack your the BlastMate II. Attach the ground spikes to the standard transducer. Point the standard transducer in the direction of the event. For this tutorial, point it away from yourself. Press on the top of the standard transducer to force the ground spikes fully into the ground. Using a level, check that the standard transducer is level. Attach the standard transducer cable to the GEO connector on the front of the BlastMate II. Screw the microphone stand sections together and attach the microphone to the stand. Aim the front of the microphone towards the event. In our case, aim it away from yourself. Insert the microphone stand into the holder located on the front of the BlastMate II keeping it in an upright position. Attach the microphone cable to the MIC connector located on the front of the BlastMate II.

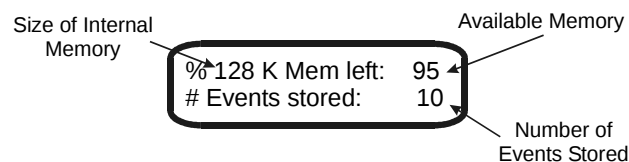
Step 2: Turn the BlastMate II On

Press and hold the red **ON/OFF** key, located on the BlastMate II keyboard, until you hear a beep. A series of Start Up Message Windows appear, showing the battery level, amount of installed memory, and other information on the BlastMate II. The windows appear in the following order.

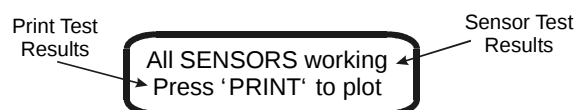
1. Battery level, unit operating system version, and serial number. Make sure the battery is fully charged. If it is not, connect the AC adapter and recharge the unit.



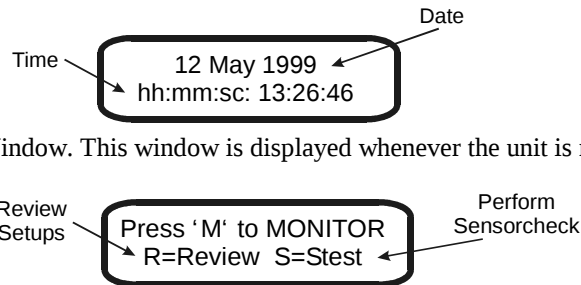
2. Internal memory size, available memory and number of events currently stored. Make sure that there is enough memory to record an event. If memory is full, you must first download events to your PC and then erase the events stored in memory.



3. Results of sensor test, and print test results prompt. If the "All SENSORS working" message does not appear, check to make sure the transducer and microphone are properly connected and oriented.



4. Current date and time. You'll learn how to change the date and time later in this tutorial.



5. BlastMate II Main Window. This window is displayed whenever the unit is ready to monitor.

Step 3: Review Setups

Before we begin, let us review the current BlastMate II setups. To review setups, press the **R** key. The Review Setups Window appears. Press the **R** key again to display the current setups or press the **PRINT EVENT** key to print a list of the setups. While the setups are scrolling by, they may be stopped or resumed by pressing the **PAUSE** key.

Step 4: Change the BlastMate II Setups

After reviewing the setups, you will likely want to change some. For this tutorial, we will change the record mode, trigger source, trigger levels, record time, the time, and the date. To change these setups, follow the steps below.

a) Change the Record Mode

The BlastMate II has four record modes: Single Shot, Continuous, Manual and Strip-Chart. We want to change the record mode from single shot to continuous. Single shot record mode records one event and stops. In continuous record mode, the BlastMate II records multiple events until you stop monitoring or the monitor runs out of memory.

To change the record mode, press the **RECORD MODE** key with the Main Window displayed. Press the **Up** or **Down Arrow** key to scroll through the Recording Mode Windows until **RECORD: CONTINUOUS** appears. Press the **ENTER** key to select this record mode. The BlastMate II is now set to record in the continuous record mode.

Once you have selected the record mode, another message window appears prompting you to choose to save full event waveform data or only summary data. For this tutorial, opt to record full event waveform data. Press the **Up** or **Down Arrow** key until the message **Save ALL DATA** appears, then press the **ENTER** key.

b) Choose a Trigger Source

By choosing a trigger source, you set the BlastMate II to trigger and start recording on either ground vibrations, measured by the standard transducer or sound pressure, measured by the microphone. The trigger source may be the standard transducer, microphone, or both the standard transducer and microphone.

To choose a trigger source, press the **TRIGGER SOURCE** key with the Main Window displayed. Use the **Up** or **Down Arrow** key to scroll through the Trigger Source Windows until **GEO/MIC** appears. Press the **ENTER** key to select this trigger source.

c) Set the Trigger Levels

The BlastMate II uses a trigger level, chosen by you, to automatically start recording when an event's activity exceeds this preset level. For our purposes, we will set an arbitrary trigger level for the standard transducer and the microphone.

To set the trigger level, press the **TRIGGER LEVEL** key when the Main Window is displayed. Set the Geo trigger level to 3.0 mm/s using the **Left Arrow** key to move the cursor and the **Up Arrow** key to change the trigger level number. Press the **ENTER** key to save your setting. The Mic trigger level window appears. Set the Linear Mic trigger level to 100 dB using the **Left Arrow** key to move the cursor and the **Up Arrow** key to change the trigger level number. Press the **ENTER** key to save your setting.

d) Set the Record Time

In the single shot or continuous record modes, you must set the record time for recording the event. You can set either a fixed record time or use the AUTO setting (the BlastMate II continues to record event activity as long as that activity remains above the trigger level). We will set a fixed record time of two seconds.

To set the record time, press the **RECORD TIME** key when the Main Window is displayed. Press the **Up** or **Down Arrow** key to enter a record time of two seconds. Press the **ENTER** key to save this setting.

e) Set the Current Time

The BlastMate II uses the twenty four hour time format (e.g. 23:55:23). To set the time, press the **TIME/DATE** key when the Main Window is displayed. Use the **Right** or **Left Arrow** key to move the cursor and the **Up** or **Down Arrow** key to set the current time. Press the **ENTER** key to save your setting.

f) Set Today's Date

The BlastMate II uses the Day/Month /Year date format (e.g. 12 May 1999). To set the date, press the **TIME/DATE** key when the Main Window is displayed. Press the **ENTER** key to display the date window. Use the **Right** or **Left Arrow** key to move the cursor and the **Up** or **Down Arrow** key to set today's date. Press the **ENTER** key to save your setting.

Step 5: Record Events

At this point, you are ready to record events. Press the **M** key to begin monitoring. To record an event, clap your hands once in front of the microphone. The BlastMate II beeps indicating an event's activity has exceeded the trigger level. BlastMate II then returns to the monitoring mode ready to record another event. Now bump the standard transducer. Again, the BlastMate II beeps. Press the **ABORT** key to stop monitoring.

We have just recorded two events and stored them in the BlastMate II memory. In the next steps, we view these events and print their Event Summary Reports.

Step 6: View the Events

Let us view the events we just recorded. From the Main Window, press the **PRINT EVENT** key. Press the **ENTER** and **Up** or **Down Arrow** keys to display the most recently recorded event. In our tutorial, this is the one we triggered by bumping the transducer. Next, press the **Up** or **Down**

Arrow key to display the event we recorded caused by clapping our hands in front of the microphone. We would like to print all the events stored in the BlastMate II at once, so we will follow the next step to print the events.

Step 7: Print the Events

After viewing the events, let's print copies of each event to obtain their Event Summary Reports. From the Main Window, press the **PRINT EVENT** key. Press the **Up** or **Down Arrow** key to scroll through the windows until Plot all EVENTS appears. Press the **ENTER** key to print all events. The display shows which event is currently printing.

Step 8: Turn the BlastMate II Off

We are finished with the BlastMate II after printing the Event Summary Reports, so let's turn it off. Press the **ABORT** key to return to the Main Window. Press and hold the **ON/OFF** key until the display disappears. The BlastMate II is now turned off.

Step 9: Interpret the Event Summary Report

The Event Summary Report provides important information about an event. Many areas of the report can be custom designed including the report's title using the BlastWare III software; see the software operator manual for further information. You can also choose which information appears on the Event Summary Report including the BlastMate II setup information, waveform printing, frequency plots, and Sensorcheck results. See page 3–18 for more information.

Congratulations! you are now a BlastMate II User.

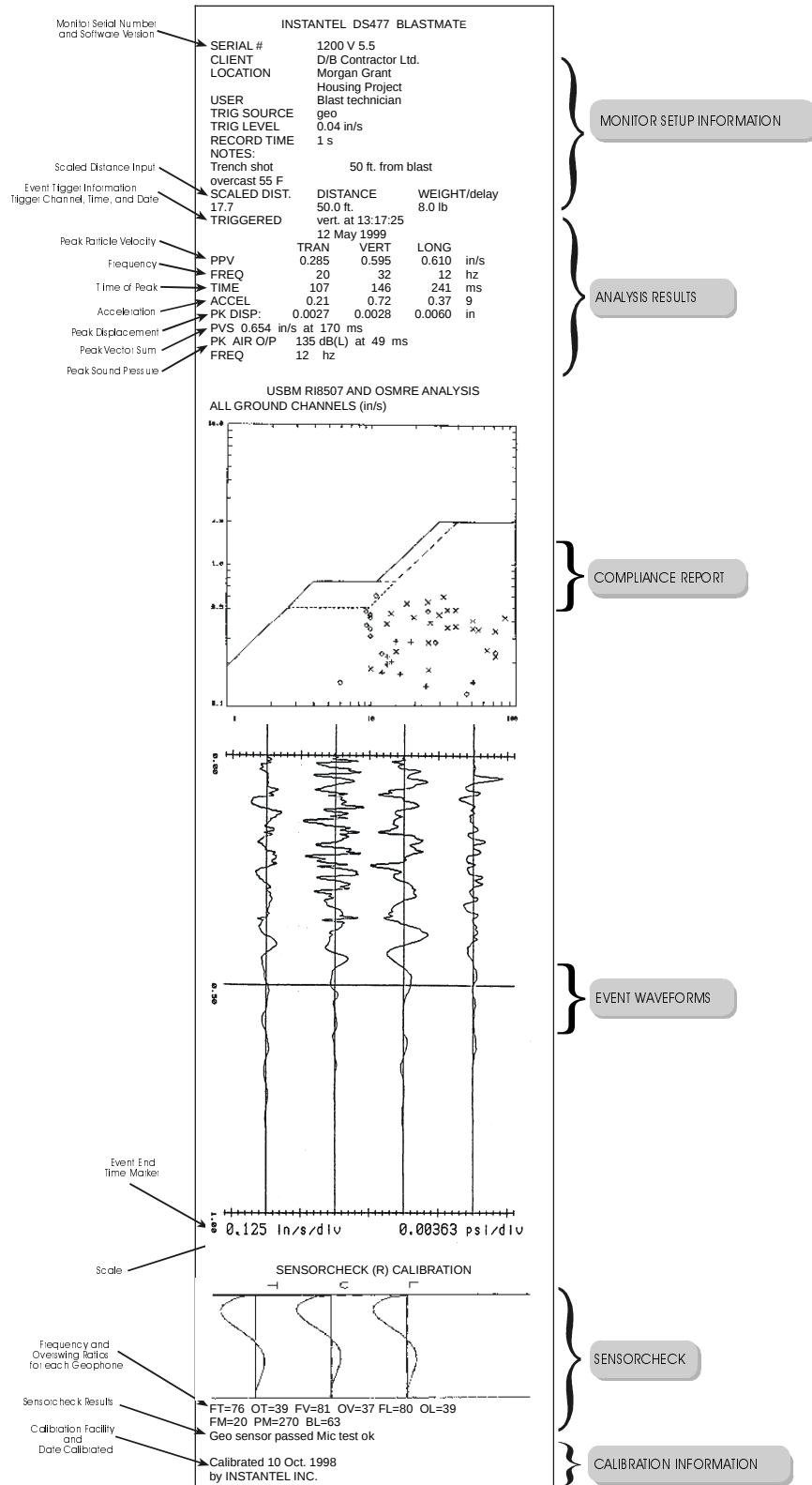


Figure 2-1 BlastMate II Event Summary Report.

Notes:

3. SETTING UP THE UNIT

This chapter provides instructions to install and setup the BlastMate II.

3.1. What is Event Monitoring?

Event monitoring measures both ground vibrations and air pressure. The monitor measures transverse, vertical, and longitudinal ground vibrations. Transverse ground vibrations agitate particles in a side to side motion. Vertical ground vibrations agitate particles in an up and down motion. Longitudinal ground vibrations agitate particles in a forward and back motion progressing outward from the event site. Events also affect air pressure by creating what is commonly referred to as “air blast”. By measuring air pressures, we can determine the effect of air blast energy on structures, measured on the Linear “L” scale, or as perceived by the human ear, measured on the “A” Weight scale. The “C” weight scale corresponds to the response of the human ear at higher sound levels.

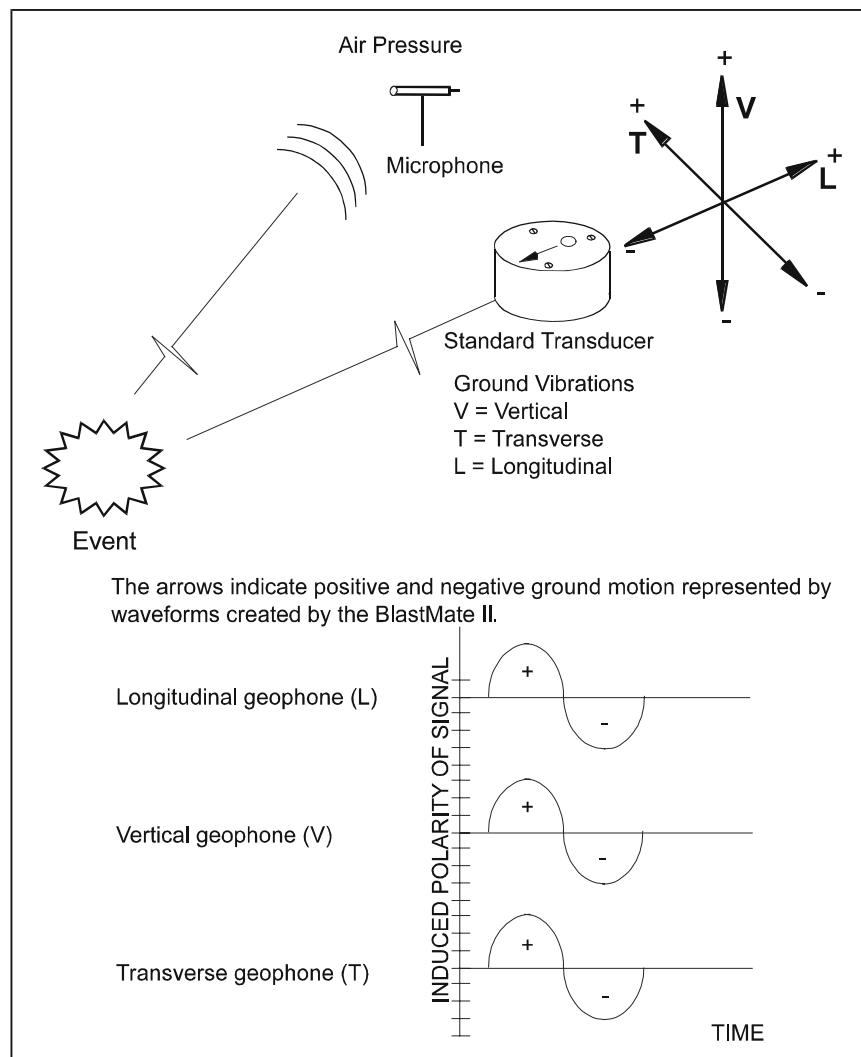


Figure 3-1 How the BlastMate II Monitors Events.

3.2. Installing the Standard Transducer

The following sections apply to the standard transducer as supplied by InstanTel. The sections illustrate coupling methods recommended by InstanTel. Your particular monitoring activities may employ one or a combination of all of the following methods. You may even devise your own coupling method for a specific application. It is important for you to couple securely to ensure reliable monitoring results.

The following sections provide example installation methods. For wall and ceiling installations, refer to the Reference chapter. Other methods may be used if they satisfy the following requirements.

1. Arrow Pointed in Direction of the Event

The arrow on the top of the standard transducer must be pointed in the direction of the event to ensure the geophone sensors, located inside the standard transducer, remain in their natural axis.

2. Level Installation

The standard transducer must be mounted level. An optional leveling plate is available with three leveling feet and an integrated bubble level indicator.

3. Securely Coupled to the Surrounding Surface

The standard transducer must be securely coupled to the surrounding surface. The surface must be compact with no loose or soft material close to the standard transducer. Coupling is critical for reliable and accurate monitoring results. Insufficient coupling allows the standard transducer to move independently of the surrounding surface resulting in distorted, often higher, monitoring results.

Coupling methods depend upon the type of surface with no single method applicable to all types. It is up to you to check the surface and mount the standard transducer with sufficient coupling to ensure reliable monitoring results.

4. BlastMate II Protected from Water

The BlastMate II is splash resistant and designed to withstand temporary exposure to rain. It is not waterproof and should not be immersed in water. Immersing the monitor or installing the monitor where standing water may accumulate may damage the monitor.

3.2.1. Soft Surface Installations

Always install and use the ground spikes provided with the standard transducer. For the best coupling, bury the standard transducer.

a. Using the Ground Spikes

Screw the three ground spikes into the bottom of the standard transducer and tighten. Point the arrow located on the top of the standard transducer in the direction of the event. Press on the top of the standard transducer to push the spikes fully into the ground. Check the standard transducer to ensure it is securely in place and level. Press the S key to run Sensorcheck.



Figure 3-2 Installing the Standard Transducer using the Ground Spikes.



Figure 3-3 Final Installation with Ground Spikes Pushed Fully into the Ground.

b. Burying the Standard Transducer

You can bury the standard transducer to couple it to the ground and prevent movement. The ground must be hard and compact with no loose material between the standard transducer and the compact ground material. Dig a hole from four inches (10 cm) to six inches (15 cm) deep. Attach the ground spikes to the standard transducer. Position the standard transducer in the hole with the arrow pointing toward the event. Press the ground spikes fully into the ground. Level the standard transducer. Compact the material around the standard transducer while back filling to securely couple to the surrounding ground material. Press the S key to check your sensors using Sensorcheck.

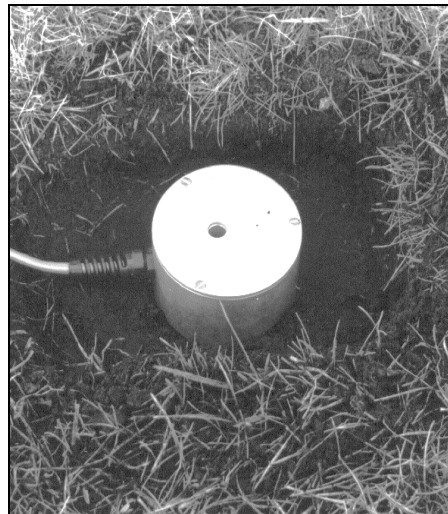


Figure 3-4 Burying the Standard Transducer.



Figure 3-5 Fill In and Pack the Material around the Standard Transducer.

3.2.2. Hard Surface Installations

For hard surface installations, such as rock, concrete or solid ice, the preferred installation method bolts the standard transducer to the surface. A second method, for very low level velocities only, uses a sandbag placed over the standard transducer.

a. Bolting the Standard Transducer

A standard transducer may be bolted to a surface alone or with the aid of the optional leveling plate. Position the standard transducer with leveling plate, if attached, on the surface and mark the position of the mounting bolt. Use a 3/8 inch (9.5 mm) bolt or threaded rod. Mount the bolt according to the manufacturer's instructions. Slide the standard transducer, and leveling plate, over the bolt. Slide a 3/8 inch (9.5 mm) washer and a 3/8 inch (9.5 mm) lock washer over the bolt. If using the leveling plate, level the standard transducer using the leveling feet and integrated bubble level. Tighten the retaining nut to finish the installation. Press the **S** key to check your sensors using Sensorcheck.



Figure 3-6 Bolting the Standard Transducer to a Surface.

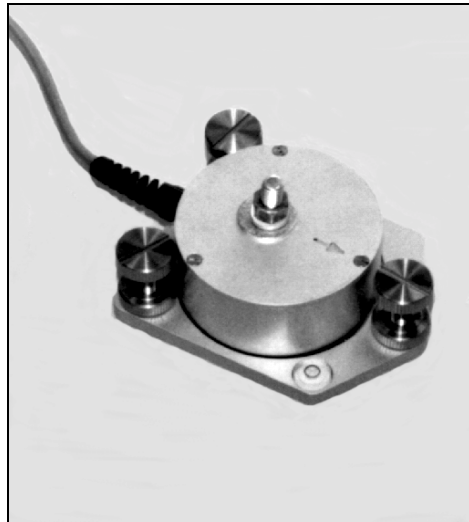


Figure 3-7 Bolting the Standard Transducer to a Surface using the Leveling Plate.

b. Sandbagging – For Very Low Velocity Levels Only

Use this method for installations where velocity levels remain very low. The sandbag must be of sufficient size to cover the entire standard transducer and lay on the surrounding surface around the standard transducer. A sandbag should contain at least 25 pounds (12 kg) of sand or 1/4" washed gravel. The optional leveling plate can be used with the method. Press the **S** key to check your sensors using Sensorcheck.

3.3. Installing a Microphone

Instantel microphones come with a sectional three foot (one meter) mounting stand. Screw the three mounting stand pieces together. Locate the mounting stand at the point of interest. The mounting stand may be inserted into the support bracket located on the front of the BlastMate II or it can be pressed into the ground. Check that the stand is firmly positioned and installed upright. Insert the microphone into the mounting bracket on the top of the stand. Point the microphone in the direction of the event. An optional microphone windscreen is available to reduce false

triggering caused by wind. Connect the microphone cable to the BlastMate II. Press the **S** key to check your microphone and the microphone connection.

WARNING: Handle the microphone with care. Dropping the microphone or otherwise subjecting it to impact may damage the microphone element.

3.4. The BlastMate II Keyboard

The integrated keyboard offers convenient access to all the BlastMate II operations using its sixty three keys. The BlastMate II provides a confirmation beep when a key is pressed. Refer to the keyboard diagram located in Chapter 1.

You can change the BlastMate II setups using the keyboard or using a personal computer running the BlastWare III software. This section outlines the procedures to change the setups using the BlastMate II keyboard. For information on how to change the setups using a personal computer, refer to the BlastWare III Operator Manual (p/n 714U0301) that came with your unit.

3.4.1. ON/OFF Key

The **ON/OFF** key turns the BlastMate II on or off. To turn the BlastMate II on, press and hold the **ON/OFF** key until the unit beeps once. To turn the BlastMate II off, display the Main Window and then press and hold the **ON/OFF** key until the unit beeps twice.

When turning on the BlastMate II, you can display the Main Window immediately by pressing the **ON/OFF** and **ABORT** keys at the same time.

3.4.2. Arrow Keys

The four arrow keys move you through the BlastMate II menus from one window to the next. Inside windows, the keys move the position of the cursor and change the value of the settings in the window.

3.4.3. ENTER Key

The **ENTER** key scrolls through the BlastMate II windows, selects windows, and saves your settings.

3.4.4. ABORT Key

The **ABORT** key allows the user to escape from activities before they are completed. You might use it, for example, to terminate recording after a false trigger, cancel a printout, or whenever you have changed your mind after having initiated a function.

When you press the **ABORT** key, you are usually returned to the previous message window level; in most cases this means the Main Window. Aborting while printing is in progress causes the phrase "Abort by user" to be printed.

If the **ABORT** key is pressed while turning the unit on the startup messages (except battery level) will be bypassed to save time.

3.4.5. BATTERY LEVEL Key

The **BATTERY LEVEL** key displays the battery status message with a bar graphs indicated the remaining charge. It is a good practice to always recharge the unit before moving it into the field.

Battery Level

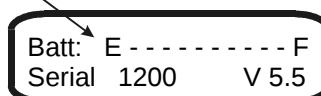


Figure 3-8 Battery Level Window.

3.4.6. PAUSE Key

There are occasions when it is convenient to pause to change pens or to correct paper alignment during a plot. The **PAUSE** key both stops and restarts printing. It may also be used to interrupt a message display sequence when reviewing setups.

3.4.7. R Key (Review Setups)

Reviewing the BlastMate II setups scrolls you through its current settings. This provides you with the opportunity to check the setups without having to enter each setting's individual window.

To review the setups, press the **R** key. The current setups scroll past on the BlastMate II display. You can pause the display by pressing the **PAUSE** key. To continue the review, press the **PAUSE** key again. The order of the display sequence is given in the chart below.

If the **PRINT EVENT** key instead of **R** is pressed, the unit will print the setups. Time can be saved by printing the setups before monitoring (but in monitor mode "PRINT setup info" must be disabled under PLOTTER SETUPS).

After all messages have been displayed the Main Window returns.

Strip-chart Record Mode	Single-shot and Continuous Record Modes	Manual Record Mode
GEO RANGE	TRIGGER SOURCE	RECORD TIME
MIC RANGE	TRIGGER LEVEL	CLIENT NAME
INTERVAL	RECORD TIME	LOCATION
CLIENT NAME	CLIENT NAME	USER NAME
LOCATION	LOCATION	NOTES (if entered)
USER NAME	USER NAME	DISTANCE (if entered)
NOTES (if entered)	NOTES (if entered)	WEIGHT (if entered)
DISTANCE (if entered)	DISTANCE (if entered)	SCALED DIST (if entered)
WEIGHT (if entered)	WEIGHT (if entered)	BATTERY LEVEL
SCALED DIST (if entered)	SCALED DIST (if entered)	MEMORY STATUS
BATTERY LEVEL	BATTERY LEVEL	
MEMORY STATUS	MEMORY STATUS	

3.4.8. M Key (Start Monitoring)

Press this key to enter the monitor mode. The BlastMate II will be able to record events.

3.4.9. TRIGGER SOURCE Key

The trigger source sets the BlastMate II to trigger and start recording an event automatically on ground vibrations, measured by a transducer, or air pressure, measured by a microphone. The BlastMate II has three trigger source settings: transducer alone (GEOPHONE), microphone alone (MICROPHONE), or both transducer and microphone together (GEO/MIC). When you choose both transducer and microphone together, triggering occurs and recording begins if an event's ground vibrations or air pressure exceeds the trigger level for either the transducer or the microphone, not both.

To choose a trigger source, press the **TRIGGER SOURCE** key when the Main Window is displayed. Press the **Up** or **Down Arrow** keys to scroll through the trigger sources. Press the **ENTER** key to select a trigger source when it appears on the BlastMate II display.

3.4.10. TRIGGER LEVEL Key

The trigger level sets a threshold that must be exceeded by an event's activity before the BlastMate II begins recording in automatic modes. Set a trigger level for the trigger source or sources chosen above.

Use your judgment when setting the trigger level. You must set the level high enough so the BlastMate II does not trigger on unwanted events such as nearby vehicle traffic. At the same time, you have to set the trigger level low enough so that an event's activity exceeds the trigger level and starts the BlastMate II recording.

To set the trigger level, press the **TRIGGER LEVEL** key when the Main Window is displayed. The Geo Trig or Mic Trig Window appears depending on the trigger source chosen above. To change the Geo trigger level, press the **Right** or **Left Arrow** key to move the cursor and the **Up** or **Down Arrow** key to change the numbers. The range of values available is 0.005 in/s to 9.999 in/s (0.13 mm/s to 253.99 mm/s). Press the **ENTER** key to save your setting.

If both the geophone and microphone were chosen as trigger sources, pressing the **ENTER** key saves the Geo trigger level setting and then displays the Mic Trig Window. Set the mic trigger level and press the **ENTER** key to save your setting. The following range of values are available for "Linear" and "C" weight: 0.00029 psi to 0.03625 psi, 2.0 Pa to 250 Pa, 100 dB to 142 dB. For "A" weight the range is from 50 dB(A) to 110 dB(A) in 0.2 dB steps.

3.4.11. RECORD TIME Key

The **RECORD TIME** key is used to determine how long the BlastMate II will record after being triggered. You can choose either to enter a fixed record time in seconds or use the AUTO setting. Once you have made your setting press the **ENTER** key to save it.

If you select AUTO, the BlastMate II continues to record event activity as long as that activity remains above the trigger level. (Sufficient memory and battery power must be available.) Recording stops a specified period of time (called the Auto Window) after the event activity falls below the trigger level. If the event is longer than 10 seconds, it may split into a number of events. If for example there were 11.6 seconds of triggerable activity, the first event would consist of 10 seconds followed by an event of 2 seconds (the last event is rounded to the next highest integer).

When AUTO appears in the display, pressing **A** enables you to select the AUTO WINDOW setting. Use the **Up** or **Down Arrow** keys to change the time allowed for sensing the signal to determine if recording should stop. The default setting is 3 seconds, and the range of available times is 1 to 9 seconds. Pressing **ENTER** will store the displayed value.

You may also enter a fixed record time, as we did in the Basic Tutorial: once the record time has elapsed, the BlastMate II stops recording. Be sure to set the record time long enough to record an entire event but not so long that unnecessary data is recorded, thus filling the BlastMate II memory.

A helpful rule of thumb when setting a record time for a blast event is to add the delays between detonating holes or use the longest delay, then add one second for each one thousand feet (300 m) from the event to the BlastMate II to account for the speed of sound. For example, in the figure below the minimum record time required is 1.1 seconds. To be on the safe side and ensure you record all the event's activity, set the record time to 2.0 seconds. There is no foolproof method for setting a record time. Use your knowledge and experience to determine a record time.

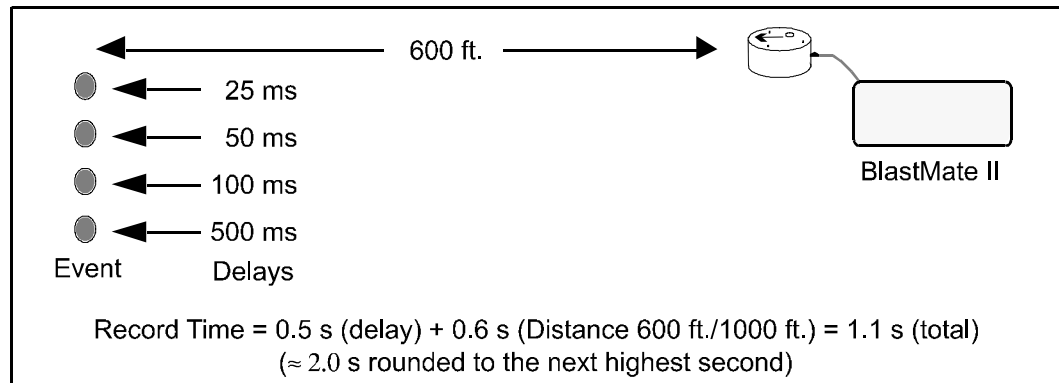


Figure 3-9 Calculating a Recording Time.

After triggering and recording, the BlastMate requires minimal time to process and store data, as shown in the table below. Sensorcheck is normally performed before monitoring. Add 5 seconds if Sensorcheck is performed between events.

Data Storage Times			
Record Time	Summary Only	Full Wave	Auto Record
1	2.4	4.9	4.4
2	2.4	6.6	5.6
3	2.4	8.3	6.8
4	2.4	10.0	8.0
5	2.4	11.7	9.2
6	2.4	13.4	10.4
7	2.4	15.1	11.6
8	2.4	16.8	12.8
9	2.4	18.5	14.0
19	2.4	20.2	15.2

3.4.12. RECORD MODE Key

The **RECORD MODE** key sets the record mode, storage mode, and geophone range.

a. Record Mode

A record mode determines how the BlastMate II records events. The BlastMate II offers the following record modes.

(1) CONTINUOUS

In Continuous mode the BlastMate II will trigger automatically on preset criteria, process and store event data, and then resume monitoring. Except for short interrupts to process and store events, it monitors blasts in a *continuous* unattended manner. The trigger source and levels entered by the user are the criteria used to determine if an event is of sufficient magnitude to record.

(2) SINGLE-SHOT

In Single-Shot mode the BlastMate II operates in the same way as in continuous, except that it will record only *one* blast record. After processing and storing the data the BlastMate II returns to the Main Window to await instructions.

(3) MANUAL

In Manual mode operation is similar to that of Single-Shot except that the triggering is initiated by the *operator* by pressing the **M** key. All other triggering criteria are ignored. Manual triggering might be used if automatic triggering is unreliable because of wind or vehicle activity, or to get a record of back-ground noise in the vicinity of the blast site.

(4) STRIP-CHART

Strip-Chart mode is used for *long duration* continuous monitoring, such as pile driving, based on current setups. The BlastMate II stores summary event information in intervals rather than in the real time continuous method used in the other record modes. The monitor samples data continuously at the chosen sample rate but only stores the relevant peaks for the interval. This reduces the data recorded to specific criteria only and greatly increases the monitor's recording time.

To Select a Record Mode:

Press the **RECORD MODE** key. The Recording Mode Window appears. Press the **Up** or **Down Arrow** keys to scroll through the record modes. Press the **ENTER** key to select a record mode when it appears on the display.

b. Data Storage Mode

Once you have selected the Record Mode, you are prompted to select a Data Storage Mode for events. This determines how much data will be stored, and consequently how much memory space will be used. Either **Save ALL DATA** or **Save SUMMARY ONLY** may be selected. The waveform portion, interval data and Sensorcheck waveform are not stored if Save SUMMARY ONLY is selected. (A condensed version of Sensorcheck data indicating simply "pass" or "fail" is stored). This leaves room for 250 summary events in the DS-477 and 1,750 in the DS-677. If memory is full the unit will automatically plot each event and save the data temporarily until the next event overwrites it. Doing so prevents false triggering from overwriting those "legitimate" events previously stored.

To select the Data Storage Mode, press the **Up** or **Down Arrow** keys until the desired mode appears, and then press the **ENTER** key to save your setting.

c. Plotting Range (Strip-Chart Mode Only)

In Strip-Chart Mode, you must also select one of six values for the Geophone and one of two values for the Microphone as the range for plotter output. Be sure that your chosen plotting range is large enough to accommodate every peak expected. If the range is too small the plotted result would be very large.

To set the Geophone plotting range, press the **Up** or **Down Arrow** keys until the desired setting appears, and then press the **ENTER** key. Repeat this procedure for the Microphone Plotting Range.

Note: When you select the plotting range the sensitivity of the instrument may also change automatically.

d. Recording Interval (Strip-Chart Mode Only)

The recording interval is the period of time the monitor records event information before applying the data analysis techniques. At the end of each interval the data is searched and the maximum value is placed in memory giving a record of peak particle velocities, sound intensities, frequencies at peaks and peak vector sum over the entire recording time. At the end of a session you may produce a printed record (in either strip-chart or tabular form) which also contains the number of triggers.

On the printout of the event, time intervals are indicated by vertical slash marks ("/"). These slash marks represent different lengths of time depending on the Strip-Chart recording interval, as shown in the following table.

Recording Interval	Value of slash mark
5 sec	1 minute
15 sec	5 minutes
1 minute	20 minutes
5 minutes	100 minutes

The BlastMate II offers four recording intervals: 5 seconds, 15 seconds, 1 minute or 5 minutes. To set the recording interval, press the **Up** or **Down Arrow** keys until the desired setting appears, and then press the **ENTER** key.

3.4.13. Edit Keys

The BlastMate II enables you to enter various information about events that will be stored with event data, including the name of the client, the location and the person using the monitor. This information is entered using the four Edit keys: CLIENT NAME, LOCAT'N, USER and NOTES.

The content is entered using the alphanumeric keys and is visible on the display as you type. It is stored by pressing the **ENTER** key and is retained even when the unit is turned off. The **SHIFT** key together with the Arrow keys may be used in editing: **SHIFT** + **Up Arrow** = Home; **SHIFT** + **Down Arrow** = End; **SHIFT** + **Right Arrow** = Advance 4 characters; and finally **SHIFT** + **Left Arrow** = Backspace.

An underline cursor on the display indicates the character entry point. Typing at the cursor position replaces the existing character and moves the cursor ahead, but it can also be moved independently with the Right or Left Arrow keys. The **RETURN** key (**SHIFT** + **6**) produces a Carriage Return and moves the cursor to the beginning of the next line. The **DELETE** key (**SHIFT** + **0**) will erase the character currently selected.

SHIFT and any letter key will input a capital letter. **SHIFT** and one of the symbols above the numerical keys will input the special characters : / # & , **RETURN** - + . **DELETE**. If **OPTION**, **SHIFT** and the number **0** are pressed simultaneously the message “erase all text Y/N?” appears. Answering Y to this question causes the content of the category to be erased. It is deliberately difficult to do this so that accidental erasure does not take place.

a. CLIENT NAME Key

To enter your client’s name, press the **CLIENT NAME** key and enter the name, up to 20 characters, using the keyboard. Press **ENTER** to save your setting.

b. LOCAT’N Key

You may also enter the location, up to 20 characters, where monitoring took place. Press the **LOCAT’N** key and enter the location using the keyboard. Press **ENTER** to save your setting.

c. USER Key

This key may be used to enter the name of the person performing the event monitoring. Press the **USER** key and enter the name using the keyboard. Up to 20 characters can be entered. Press **ENTER** to save your setting.

d. USER NOTES Key

The **USER NOTES** key is used to enter extended notes on the event or location. Up to 620 characters can be used in the notes section and depending on the number of characters per line, up to 60 lines can be entered.

To enter your notes, press the **USER NOTES** key and then type them in using the keyboard. Press **ENTER** to save your notes.

When editing is complete and **ENTER** is pressed, there is a prompt for **DISTANCE** and **WEIGHT**. The computed scaled distance is then displayed momentarily and the unit returns to the Main Window. Scaled distance values are stored with each event, are shown in the Event Summary Report, and are read by BlastWare III when events are uploaded to your PC. If zero (0) is entered the scaled distance values are not plotted.

3.4.14. TIME/DATE Key

The **TIME/DATE** key adjusts the BlastMate II time and date settings.

a. Setting the Time

The BlastMate II uses the twenty four hour (e.g. 23:55:23) time format. To set the time, press the **TIME/DATE** key when the Main Window is displayed. Use the **Right** or **Left Arrow** key to move the cursor and the **Up** or **Down Arrow** key to set the current time. Press the **ENTER** key to save your setting.

b. Setting the Date

The BlastMate II uses the Day/Month /Year date format (e.g. 12 May 1999). To set the date, press the **TIME/DATE** key when the Main Window is displayed. Press the **ENTER** key to display the date window. Use the **Right** or **Left Arrow** key to move the cursor and the **Up** or **Down Arrow** key to set today’s date. Press the **ENTER** key to save your setting.

c. Adjusting the Clock Speed

Pressing the **S** key (for clock speed) after the **TIME/DATE** key will display an error message; except after a cold start (fuse pulled and replaced) when it will display a signed number representing clock speed adjustment for seconds gained or lost. This value can be changed with the arrow keys, before placing the unit into Monitor mode. *It should not be altered from the factory setting unless long-term time accuracy is in doubt.* Pressing the **ABORT** key twice displays the Main Window.

3.4.15. SPECIAL SETUPS Key

The **SPECIAL SETUPS** key configures the BlastMate II timer, daily self check, Sensorcheck, units of measure, microphone channels, microphone weight, microphone units, geo and mic alarm levels and language.

The Special Setups menu can be exited at any time by pressing the **ABORT** key. Any settings you saved up to this time by pressing the **ENTER** key will be retained.

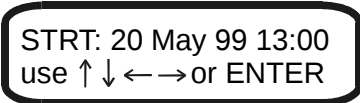
a. Timer Mode

The timer function sets the BlastMate II to automatically turn on and start monitoring operations at a preset time in the future. The timer can be set for a one time monitoring session or it can be set to record at the same time everyday. Using the timer extends the BlastMate II battery life because the unit turns on and begins monitoring only when the event you wish to record occurs. It also minimizes the recording of false events from other sources.

Once you have set the start and stop times, you must press the **M** key to enter Monitor Mode. To stop timer recording at any time, press the **ABORT** key.

(1) Timer = ON

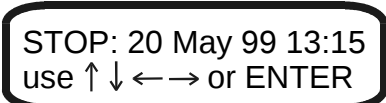
To set the BlastMate II to monitor at some time in the future, press the **SPECIAL SETUPS** key when the Main Window is displayed. Press the **Up** or **Down Arrow** keys to display “Timer = ON”. Press the **ENTER** key to display the Monitor Start Time Window. Enter the start time for monitoring operations to begin. Use the **Right** or **Left Arrow** key to move through the date and time displays. Use the **Up** or **Down Arrow** key to change the settings. The display should resemble the following:



STRT: 20 May 99 13:00
use ↑ ↓ ← → or ENTER

Figure 3-10 Monitor Start Time Window.

Press the **ENTER** key to save the Monitor Start Time setting and display the Monitor Stop Time Window. Enter the stop time for monitoring operations to end. Use the **Right** or **Left Arrow** key to move through the date and time displays. Use the **Up** or **Down Arrow** key to change the settings. The display should resemble the following:



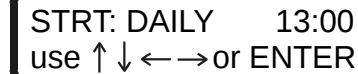
STOP: 20 May 99 13:15
use ↑ ↓ ← → or ENTER

Figure 3-11 Monitor Stop Time Window.

Press the **ENTER** key to save the stop time. Press the **M** key to enter the timer mode. The timer is now set to start monitoring operations automatically according to your start and stop dates and times.

(2) Timer = DAILY

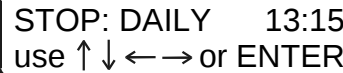
To set the BlastMate II to monitor at the same time each day, press the **SPECIAL SETUPS** key when the Main Window is displayed. Press the **Up** or **Down Arrow** keys to display “Timer = DAILY”. Press the **ENTER** key to turn the timer on and display the Daily Start Time Window. Use the **Right** or **Left Arrow** key to move the cursor and **Up** and **Down Arrow** key to change the hour and minute settings. The display should resemble the following:



STRT: DAILY 13:00
use ↑ ↓ ← → or ENTER

Figure 3-12 Daily Start Time Window.

Press the **ENTER** key to save your start time. The Daily Stop Time Window appears. Use the **Right** or **Left Arrow** key to move the cursor and the **Up** or **Down Arrow** key to change the hour and minute settings. The display should resemble the following:



STOP: DAILY 13:15
use ↑ ↓ ← → or ENTER

Figure 3-13 Daily Stop Time Window.

Press the **ENTER** key to save your stop time. Press the **M** key to enter the timer mode. The BlastMate II is now set to start and stop monitoring operations automatically at the same time everyday.

b. Daily Self Check

The Daily Self Check is meant to be used for remote monitoring where you require a record indicating the monitor was operating properly over a period of time. The Daily Self Check program operates when the BlastMate II is in the monitor mode. The program temporarily exits the monitor mode, at a time specified by you, performs the check, and returns to monitor mode. The results appear in a monitor log entry. You can turn Daily Self Check on by choosing ON or you can turn it off by choosing OFF. If you choose ON, the BlastMate II displays a time window that allows you to set when the Daily Self Check will occur.

To set the Daily Self Check, press the **SPECIAL SETUPS** key when the Main Window is displayed. Press the **ENTER** key to scroll through the windows until the Daily Self Check Window appears. Press the **Up** or **Down Arrow** key to display the message “Daily self check=ON”. Press the **ENTER** key to turn the Daily Self Check on. Set the time for the check to occur and press the **ENTER** key to save your setting. If you do not require the Daily Self Check, choose “Daily self check=OFF” and press the **ENTER** key.

c. Stest (Sensorcheck)

This setting chooses when to automatically run Sensorcheck to test the monitor and its sensors. (You can run Sensorcheck manually by pressing the **S** key when the Main Window is displayed.) You can choose to run Sensorcheck after recording each event, or only once before monitoring starts. If you choose “AFTER event”, Sensorcheck runs after recording each event. Results are saved with each event and appear on the monitor display. If you choose “BEFORE monitoring”, Sensorcheck runs once before monitoring starts, when you enter the monitor mode. The results of this single Sensorcheck appear with each event recorded during the monitoring session. This reduces processing time, by not having to run Sensorcheck for each event, and speeds up recording especially when using the continuous record mode.

To set when to run Sensorcheck, press the **SPECIAL SETUPS** key when the Main Window is displayed. Press the **ENTER** key to scroll through the windows until the Stest Window appears. Press the **Up** or **Down Arrow** key to display the “AFTER event” or “BEFORE monitoring” choices. Press the **ENTER** key to select a choice when it appears on the display.

d. Units of Measure

The BlastMate II uses the Metric (e.g. mm/sec) or Imperial (e.g. in/sec) measurement system.

To choose either Metric or Imperial units, press the **SPECIAL SETUPS** key when the Main Window is displayed. Press the **ENTER** key to scroll through the windows until the Units Window appears. Press the **Up** or **Down Arrow** key to display the “IMPERIAL” or “METRIC” choices. Press the **ENTER** key to select a choice when it appears on the display.

e. MIC Channel

In the fifth menu item the microphone can be enabled or disabled for recording. If disabled, no readings are taken for the channel and the summary display shows that the Mic channel is off rather than giving a peak. If the Mic channel is turned off and the trigger source includes the Mic, the source will be reset to Geo and the following message will appear.

SOURCE: MIC IS OFF
SOURCE = GEOPHONE

To set the MIC Channel, press the **SPECIAL SETUPS** key when the Main Window is displayed. Press the **ENTER** key to scroll through the windows until the MIC Channel Window appears. Press the **Up** or **Down Arrow** key to display the “ON” or “OFF” choices. Press the **ENTER** key to save your setting.

f. MIC Weight

The MIC Weight command is used to select a microphone weighting for the BlastMate’s microphone. One of three responses can be used for processing: LINEAR, “C” or “A”. If “LINEAR” is chosen, the microphone determines air pressure loads on structures. If “C” is chosen, the DC component is removed and some high-pass filtering is used. The overall signal strength is reduced but the higher frequency variations in the signal remain. “C” weight corresponds to the response of the human ear at higher sound levels. When “A” is chosen, the signal is attenuated and converted to RMS (Root Mean Square). The value represents the general response of the human ear and is more effective in assessing annoyance rather than possible structural damage.

To select a microphone weighting, press the **SPECIAL SETUPS** key when the Main Window is displayed. Press the **ENTER** key to scroll through the windows until the MIC Weight Window appears. Press the **Up** or **Down** key to display the three microphone types: “LINEAR”, “C” or “A”. To choose a setting, display it and then press the **ENTER** key.

g. MIC Units

The measurement units used on the microphone channel depend on the measurement system selected above. For “LINEAR” or “C” sound pressure, you have the choice between psi (or pa) or dB. For “A” weight microphones, units are dB only. For this reason, when you chose the “A” Weight microphone type, this window does not appear on the BlastMate II display.

To choose a microphone measurement unit, press the **SPECIAL SETUPS** key when the Main Window is displayed. Press the **ENTER** key repeatedly to scroll through the windows until the MIC Units Window appears. Press the **Up** or **Down Arrow** key to display the two microphone unit choices. Press the **ENTER** key to select a measurement unit when it appears on the display.

h. Geo Alarm Level

The geo alarm level controls the triggering of an optional remote alarm (p/n 711A1401). The remote alarm sounds two alarms: warning and alarm. The warning alarm sounds when event activity exceeds the geophone trigger level. The geo alarm level can be set to a higher level than the geophone trigger level. This allows for the triggering of a second alarm at the higher level.

For example, in pile driving operations the remote alarm triggers a warning when activity exceeds the trigger level for the geophone, notifying the operator that the pile driving activity has exceeded that set level. The second alarm triggers when activity exceeds the geo alarm level, set to a higher level, notifying the operator that operations should cease immediately.

The Remote Alarm is connected to the AUX connector on the BlastMate. Adapter cables can be used to extend the length of the input cable. Output can be used to drive an external load.

To set the geo alarm level, press the **SPECIAL SETUPS** key when the Main Window is displayed. Press the **ENTER** key repeatedly to scroll through the windows until the G Alarm Window appears. Use the **Up** or **Down** and **Left** or **Right Arrow** keys to set the alarm level. Press the **ENTER** key to save your setting.

i. Mic Alarm Level

The remote alarm can also be triggered by the microphone using this command. The remote alarm sounds two alarms: warning and alarm. The warning alarm sounds when event activity exceeds the microphone trigger level. The mic alarm level can be set to a higher level than the microphone trigger level. This allows for the triggering of a second alarm at a higher level. See the Geo Alarm Level section, above, for an example.

To set the mic alarm level, press the **SPECIAL SETUPS** key when the Main Window is displayed. Press the **ENTER** key repeatedly to scroll through the windows until the M Alarm Window appears. Use the **Up** or **Down** and **Left** or **Right Arrow** keys to set the alarm level. Press the **ENTER** key to save your setting.

j. Language

The BlastMate II supports two languages: English and French. All windows and menus will appear in the language of your choice.

To set the language, press the **SPECIAL SETUPS** key when the Main Window is displayed. Press the **ENTER** key repeatedly to scroll through the windows until the Languages Window appears. Use the **Up** or **Down Arrow** keys to set the language, and then press the **ENTER** key to save your setting.

3.4.16. PLOTTER SETUPS Key

The **PLOTTER SETUPS** key controls printing on the BlastMate II and the contents of the Event Summary Report. To configure the settings, follow the steps outlined below. Exit is possible from the menu at any time by pressing the **ABORT** key.

a. Print Events

The first menu item determines when events are printed, either automatically after each event or only when you press the **PRINT EVENT** key.

To select when to print events, press the **PLOTTER SETUPS** key when the Main Window is displayed. Press the **ENTER** key to scroll through the windows until the Plot Window appears. Use the **Up** or **Down Arrow** keys to select either “AUTOMATICALLY” or “ON REQUEST” ONLY, and then press the **ENTER** key to save your setting.

b. Number of Copies

This sets the number of copies printed for each Event Summary Report. The number of copies ranges from one to ten. You can also print any number of copies of an event manually by pressing the PRINT EVENT key while viewing an event.

To set the number of copies to be printed, press the **PLOTTER SETUPS** key when the Main Window is displayed. Press the **ENTER** key repeatedly to display the Number of Copies Window. Use the **Up** or **Down Arrow** keys to set the number of copies to be printed. Press the **ENTER** key to save your setting.

c. Monitor Log Depth

This setting controls the depth to which the monitor log is reported (i.e. how many of the log entries will be printed). You can choose to print out up to 30 monitor log entries. The most recent entry is DEPTH 1, the next oldest is DEPTH 2, etc. The log depth is used only to select how many sessions are printed, not how many are recorded.

The Monitor Log function prints a record of the start and end times along with triggering information of monitor sessions. A "circular" log file is maintained which retains up to a maximum of 30 log entries. If the file is full, the most recent entry moves to the queue and the oldest entry is lost. An entry contains the following information: Monitor start time, Monitor start day, Monitor end time, Monitor end day, Cause of Monitor exit, and Daily Self Check status (where applicable). An example of the monitor log printout is shown in the figure below:

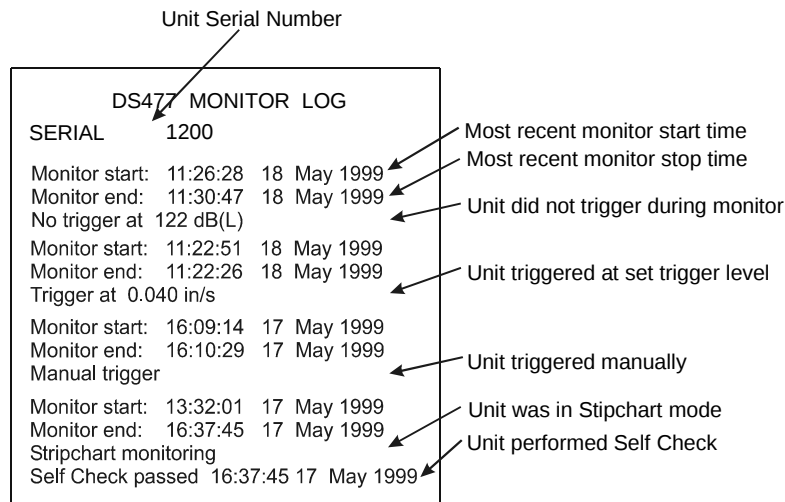


Figure 3-14 Monitor Log Printout.

To set the Monitor Log Depth, press the **PLOTTER SETUPS** key when the Main Window is displayed. Press the **ENTER** key repeatedly to display the Monitor Log Depth Window. Use the **Up** or **Down Arrow** keys to set the number or to select "NO Monitor Log". Press the **ENTER** key to save your setting.

d. Print Setups

This setting controls the printing of the current BlastMate II setups in the Event Summary Report. You can choose to include the setup information on every recorded event's Event Summary Report by selecting the "PRINT setup info" setting. You can also choose not to print the BlastMate II setup information by choosing "DON'T PRINT setups."

To choose a setting, press the **PLOTTER SETUPS** key when the Main Window is displayed. Press the **ENTER** key repeatedly to display the Print Setups Window. Press the **Up** or **Down Arrow** keys to display the required setting on the display, and then press the **ENTER** key to save your setting.

e. USBM/OSMRE Graph

The fifth menu item allows setting of how the compliance graph is plotted. Selecting “NO frequency plot” suppresses USBM/OSMRE and DIN plotting. Selecting “COMBINED freq. plot” superimposes the results of the three ground channels on one graph, while selecting “SEPARATE freq. plot” produces a graph for each ground channel.

To choose a setting, press the **PLOTTER SETUPS** key when the Main Window is displayed. Press the **ENTER** key repeatedly to display the Freq. Plot Window. Press the **Up** or **Down Arrow** keys to display the required setting, and then press the **ENTER** key to save your setting.

Figure 3-15 shows simplified diagrams of damage control plots. In the USBM/OSMRE plot the solid line represents OSMRE criteria, whereas the larger-dashed line represents USBM RI 8507 criteria for drywall or plaster, while the smaller-dashed line represents USBM RI 8507 criteria for plaster walls. In the DIN 4150 plot, three lines, representative of three groups of buildings are plotted. The DIN 4150 plot is used mainly in Europe whereas the USBM/OSMRE plot is used mainly in North America.

Frequency is found by scanning the waveform for a zero crossing. The time interval between the first and second zero crossing is multiplied by two and inverted to yield frequency. The peak is plotted on a graph of log-velocity versus log-frequency. The last half cycle may not always be included in the graph since the frequency cannot always be determined before recording stops.

Note: In Super Condensed scale only combined frequency plotting is supported to save space.

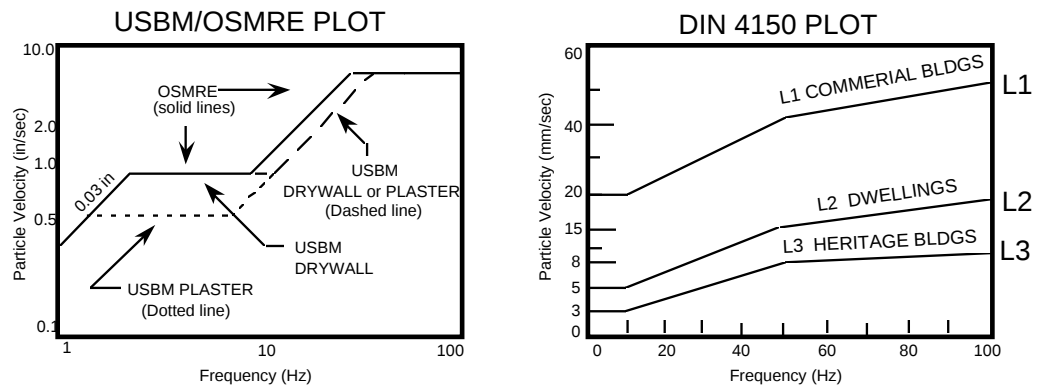


Figure 3-15 Velocity vs Frequency Chart for Damage Control.

f. Waveform or Strip-chart Graphs

This setting determines whether a graph is to be plotted for all recording modes. In many instances the graph may not be needed and time can be saved by not plotting it.

To choose a setting, press the **PLOTTER SETUPS** key when the Main Window is displayed. Press the **ENTER** key repeatedly to display the Plot Graph Window. Press the **Up** or **Down Arrow** keys to display either “PLOT graph” or “DON’T PLOT graph”, and then press the **ENTER** key to save your setting.

g. Sensorcheck Plot

The Sensorcheck Plot is a graphical representation of the Sensorcheck test of each geophone. You can choose to include the Sensorcheck Plot in the Event Summary Report or not.

Press the **PLOTTER SETUPS** key when the Main Window is displayed. Press the **ENTER** key repeatedly to display the Sensorcheck Plot Window. Press the **Up** or **Down Arrow** key to scroll through the settings to display the required setting on the display. Press the **ENTER** key to select and save the displayed setting.

h. Plotting Scale

You can choose to scale the Event Summary Report printout produced by the BlastMate II. The paper is moved at a constant speed and the displayed information never changes. The difference in the four scales is in the size of the information. The four settings are: 1X Scale (standard size), 2X Scale (enlarged), Condensed scale, and Super condensed.

Note: In Super condensed scale only combined frequency plotting is supported to save space.

To scale plots, press the **PLOTTER SETUPS** key when the Main Window is displayed. Press the **ENTER** key repeatedly to display the Plotting Scale Window. Press the **Up** or **Down Arrow** keys to display the desired scale and then press the **ENTER** key to save the setting.

i. Stripchart Data

The final menu item allows for plotting stripchart numerical data. This option is in effect only when printing stripchart events from memory by using the **PRINT EVENT** key.

Press the **PLOTTER SETUPS** key when the Main Window is displayed. Press the **ENTER** key repeatedly to display the Stripchart Data Window. Press the **Up** or **Down Arrow** key to scroll through the settings to display either "PLOT stripchart data" or "DON'T PLOT chrt data". Press the **ENTER** key to select and save the displayed setting.

3.4.17. PRINT EVENT Key

Press this key to print an Event Summary Report for all the events stored in the BlastMate II or for a specified event only. This key is also used to print an event list, and to delete events and clear the monitor log. You can stop printing at any time by pressing the **ABORT** key.

a. Plot Event

Use this command to print an Event Summary Report for a selected event. Press the **ENTER** key, and then use the **Up** or **Down Arrow** keys to scroll through the events to display the desired event. Events are displayed in chronological order, beginning with the most recent event. When the desired event appears in the display, press the **PRINT EVENT** key to print the Event Summary Report, or press **ABORT** to return to the Main Window.

All events are identified by a prefix showing the event type. "W" events contain full waveform data whereas "w" event contains only a waveform summary. An "S" or "s" event is a stripchart event where the "S" contains all of the recorded data whereas an "s" contains the summary only. This is followed by the date and time on the first line, and the Peak Particle Velocity and Peak Sound Pressure on the second line. An example display is shown in Figure 3-16.

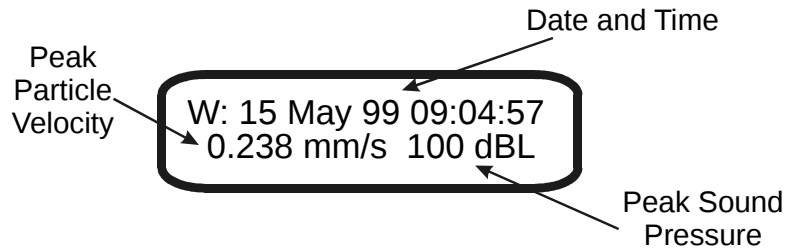


Figure 3-16 Print Event Display.

b. Plot All Events

You can print an Event Summary Report for every event stored in the BlastMate II.

To print all the events, press the **PRINT EVENT** key when the Main Window is displayed. Press the **Up** or **Down Arrow** keys to scroll through the windows to display the Print All Events Window. Press the **ENTER** key to select this choice. The display briefly shows the total number of events to be printed, and then printing begins, starting with the monitor log (if enabled). The BlastMate II displays each event while it is being printed.

Pressing the **ABORT** key during printing will cancel printing of the current event. You can resume printing subsequent events by pressing the **PRINT EVENTS** key. To cancel printing entirely, press the **ABORT** key again.

c. Print Listing

This command enables you print an event list indicating all the events stored in the BlastMate II along with each event's date, time, and recording results.

To print the List of Events, press the **PRINT EVENT** key when the Main Window is displayed. Press the **Up** or **Down Arrow** keys to scroll through the windows to display the Print Listing Window. Press the **ENTER** key to print the event list.

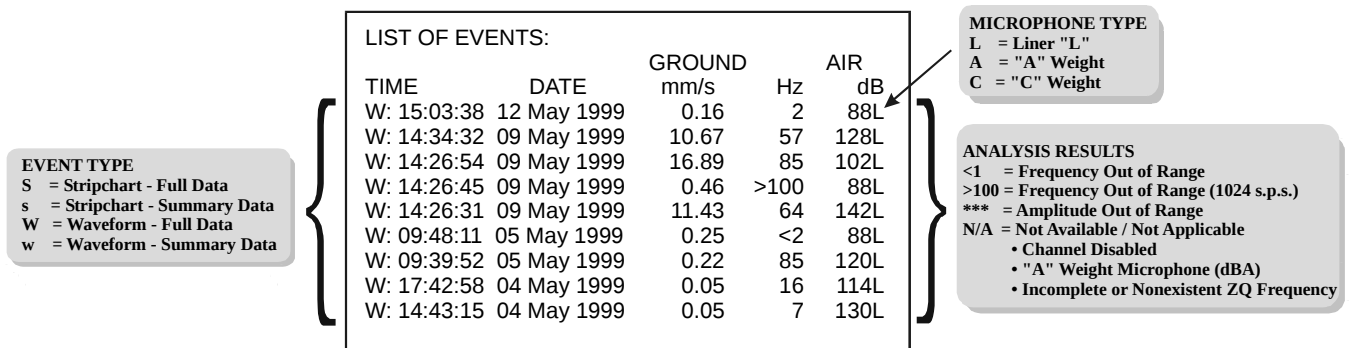


Figure 3-17 Event List Printout.

d. Clear Monitor Log

This command is used to erase the contents of the monitor log. You should always print a copy of the log prior to erasing it, either from the monitor or BlastWare III.

WARNING: Once the monitor log has been deleted, it cannot be recovered.

To delete the monitor log, press the **PRINT EVENT** key when the Main Window is displayed. Press the **Up** or **Down Arrow** keys to scroll through the windows to display the Clear Monitor Log Window. Press the **ENTER** key to begin the deletion. A second window appears asking you to hold the **ENTER** key for five seconds to delete the monitor log. This window asks you to

confirm your initial choice or exit without continuing. Press and hold the **ENTER** key for five seconds to delete all events, or press the **ABORT** key to return to the Main Window.

e. Delete All Events

Deleting all the events stored in the BlastMate II frees up internal memory space to record additional events.

WARNING: Once the events have been deleted, they cannot be recovered.

Be sure to protect your events by either printing them first to obtain a paper record or uploading the events to a personal computer. If you upload the events, check that the events transferred properly and can be viewed and printed before deleting.

To delete all the events stored in the BlastMate II, press the **PRINT EVENT** key when the Main Window is displayed. Press the **Up** or **Down Arrow** keys to scroll through the windows to display the Delete All Events Window. Press the **ENTER** key to begin the deletion. A second window appears asking you to hold the **ENTER** key for five seconds to delete all the files. This window asks you to confirm your initial choice or exit without continuing. Press and hold the **ENTER** key for five seconds to delete all events, or press the **ABORT** key to return to the Main Window.

3.4.18. ACCESS DISK Key

This key is not used.

3.4.19. PAPER FEED Key

Pressing the **PAPER FEED** key advances the paper one line. Press and hold the key to rapidly advance the paper.

3.4.20. PAPER TAKEUP Key

Pressing the **PAPER TAKEUP** key rolls up the printed paper. Press and hold the key to rapidly takeup the paper.

3.4.21. OPTION Key

When entering notes on an event using the **NOTES** key, all text can be deleted if the **OPTION**, **SHIFT** and the number **0** keys are pressed simultaneously.

3.5. Handling Full Memory in the Field

Under normal operation, the user transfers events from the BlastMate II to a PC regularly, thereby ensuring generous space for recording future events. Instances could arise in the field, however, where memory space becomes depleted. When this happens, a Memory Full message appears, and the BlastMate II automatically prints the event. The event will be held in short term memory, but if you enter Monitor mode again it will be lost. Events recorded when memory is full can only be printed and cannot be copied to a PC.

By pressing the **PRINT EVENT** key an event can be printed provided the **Up** and **Down Arrow** keys are not used. Pressing either of them will cause an event from main memory to be plotted and the currently held event will be lost.

4. REFERENCE

This chapter discusses wall and ceiling installation procedures, and the theory of operation for Instantel's standard transducer, microphone, Sensorcheck, antialias filter, and data analysis techniques.

4.1. Additional Installation Procedures

The following sections outline procedures to install the standard transducer on walls and ceilings.

4.1.1. Wall Installation

The standard transducer may be installed on a wall alone or with the optional leveling plate where leveling is required. In both cases, bolts install the standard transducer to a wall. Before installing the standard transducer, you must switch the position of the vertical and transverse Geophones. This positions the Geophones to their natural axes compensating for the vertical wall installation. This is a simple procedure requiring no special tools.

To switch the vertical and transverse Geophones, remove the three screws on the top cover. Insert a screwdriver into the slot on the side of the standard transducer and pry off the top cover. Switch the vertical and the transverse Geophones. Replace the top cover while maintaining the gasket's position. Align the cover with the screw holes and the center hole. Insert the three screws and tighten until the cover, gasket, and housing press together. Finally, tighten the three screws in a clockwise sequence to assure proper gasket seating. Tighten each screw to 10 lbf/in. (1.2 N.m) torque. A proper seal occurs when the gasket begins to bulge out slightly from the transducer cover and housing.

WARNING: Do not over-tighten the lid or the installation bolt. Over-tightening the lid may damage the gasket and break the seal, strip the screw hole threads, or cause Sensorcheck failure.

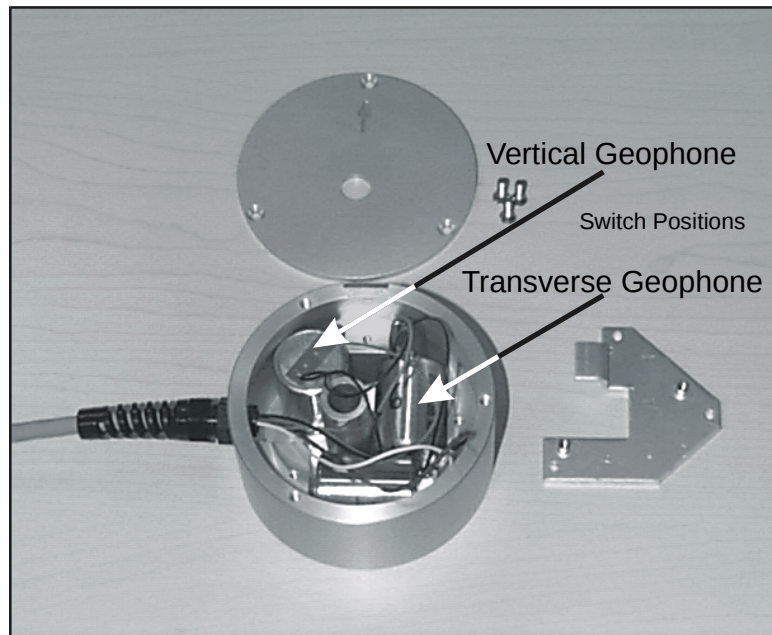


Figure 4-1 For Wall Installations of the Standard Transducer, Switch the Positions of the Transverse and Vertical Geophones.

Place the standard transducer on the wall with the arrow pointing in the direction of the event. Mark the position of the bolt. Install the bolt into the wall according to the manufacturer's instructions. If using the leveling plate, secure the leveling plate to the standard transducer with the three screws provided. Slide the standard transducer over the bolt with the arrow pointed in the direction of the event. Slide a 3/8 inch (9.5 mm) washer and a 3/8 inch (9.5 mm) lock washer over the bolt. Screw on the retaining nut to hold the unit in position. Level the assembly by placing a level across the standard transducer's top cover and adjusting the leveling feet. The integrated bubble level does not work when installing the leveling plate on a wall. Tighten the retaining nut on the bolt to secure the installation. Press the **S** key to check your sensors using Sensorcheck.

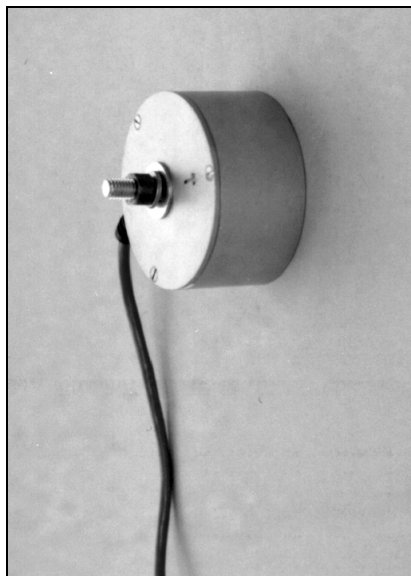


Figure 4-2 Installing the Standard Transducer on a Wall.

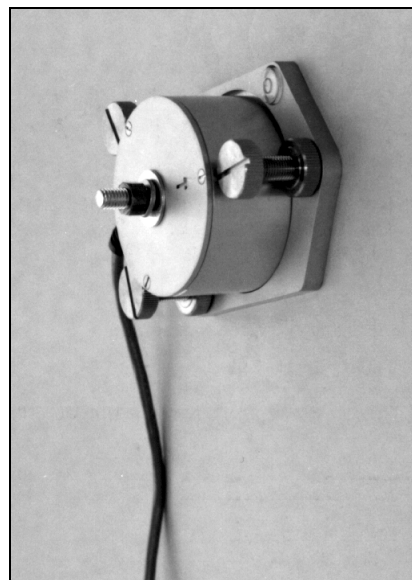


Figure 4-3 Installing the Standard Transducer on a Wall using the Leveling Plate.

4.1.2. Ceiling Installation

The standard transducer may be installed on a ceiling alone or with the leveling plate where leveling is required. In both cases, bolts secure the standard transducer to a ceiling.

a. Installing the Standard Transducer

The transducer may be installed on level ceilings where no leveling adjustments are required. To mount a transducer, install a bolt into the ceiling according to the manufacturer's instructions. Hold the transducer in the upright position and slide it over the bolt. This ensures the vertical geophone, located inside the transducer, maintains its original axis. Point the arrow in the direction of the event. Slide on 3/8 inch (9.5 mm) washer and a 3/8 inch (9.5 mm) lock washer over the bolt and tighten with the retaining nut. Press the **S** key to check your sensors using Sensorcheck.

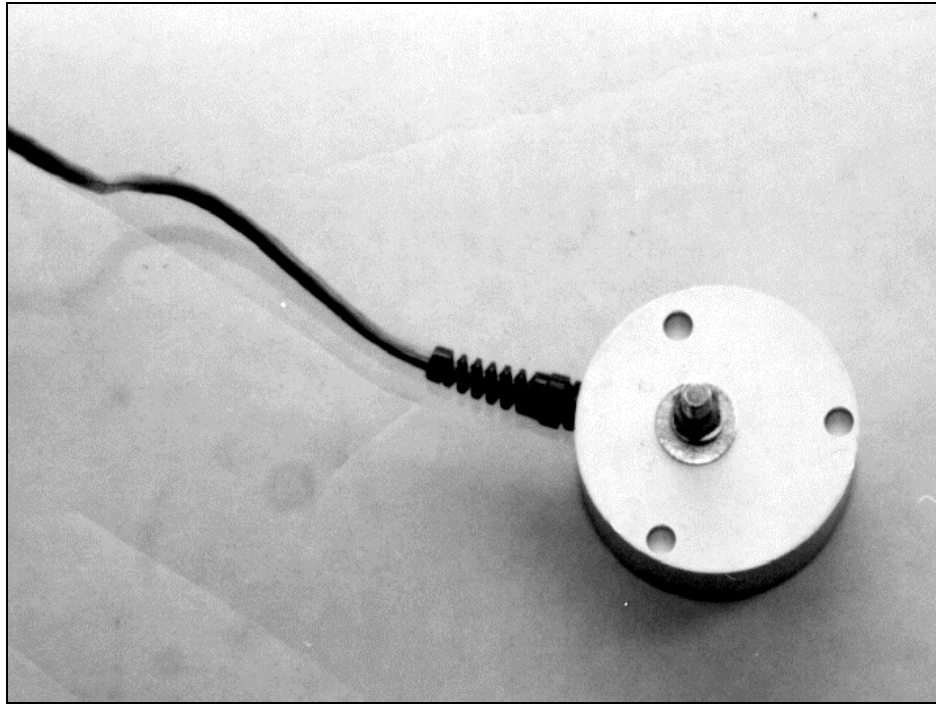


Figure 4-4 Installing the Standard Transducer on a Ceiling Right Side Up.

b. Installing the Standard Transducer Using the Leveling Plate

The standard transducer may also be mounted on a ceiling using the leveling plate. This requires optional extended leveling feet for the leveling plate (700O5402). Secure the standard transducer to the leveling plate with the three screws provided. Remove the existing leveling feet and replace with the extended leveling feet. Screw the leveling feet through the bottom of the leveling plate. Place the assembly on the ceiling with the transducer right side up and the arrow pointing in the direction of the event. Mark the position of the bolt. Install the bolt into the ceiling according to the manufacturer's instructions. Slide the leveling plate with the transducer over the bolt. Slide a 3/8 inch (9.5 mm) washer and a 3/8 inch (9.5 mm) lock washer over the bolt. Slide a retaining nut to hold the unit in position. Level the assembly by placing a level across the bottom of the leveling plate and adjusting the leveling feet. The integrated bubble level cannot be seen when installing the leveling plate on a ceiling. Use a level to check the installation. Tighten the retaining nut on the bolt to secure the installation. Press the S key to check your sensors using Sensorcheck.

4.2. Technical Data

This section describes how Instantel's transducer and microphone operate. It also discusses Instantel's Sensorcheck program, antialias filter, and the data analysis techniques used to calculate monitoring results.

4.2.1. Geophone Operation

Functionally a geophone sensor is a coil of wire suspended over a permanent magnet (see Figure 4-5.) The coil is free to move in a field of magnetic flux lines. By Lenz's Law induced voltage is proportional to the speed at which flux lines are traversed. Induced coil voltage is therefore proportional to coil or magnet velocity relative to each other and in practice it does not matter

whether the coil or the magnet moves. Only the motion and speed relative to each other are important.

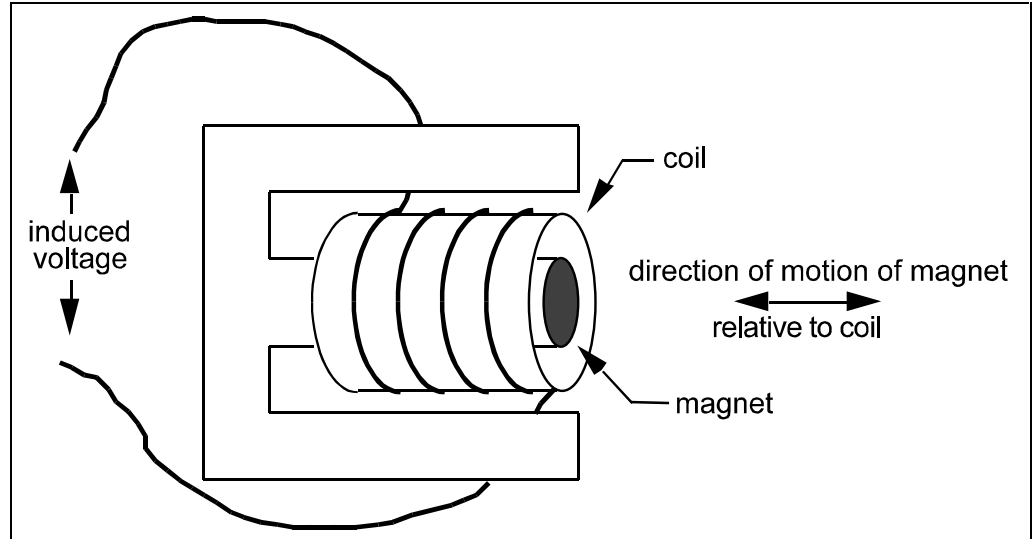


Figure 4-5 Functional structure of a Geophone Sensor.

Geophone sensor specifications give a number known as the Intrinsic Voltage Sensitivity. It is the coil voltage induced for a given coil vs magnet speed with units of V/in/s. In seismic applications the magnet is moved by the blast energy because it is coupled to the particles of surrounding terrain. The coil, because of its inertia, does not move and the resulting magnet vs coil motion induces a voltage which is proportional to particle velocity.

4.2.2. Particle Velocity, Acceleration and Displacement

Voltages produced by the vibrating sensors are proportional to particle velocities along the longitudinal, transverse and vertical directions. In the BlastMate, geophone voltage from each sensor is measured 1024 times per second and converted to particle velocity by the internal computer.

Acceleration, the rate of change of velocity, is computed by dividing the difference in velocity by the difference in time. Since a new velocity is available 1024 times each second, the acceleration is obtained by subtracting two velocity readings and dividing the result by the elapsed time between them. In equation form acceleration would be expressed as;

$$a = dV/dt \approx \Delta V/\Delta t \text{ where } \Delta t \text{ is a small interval.}$$

Displacement, or particle distance traveled, is found by multiplying speed by time. In the BlastMate the interval velocity is multiplied by the time interval and the resulting displacement segments are summed. In equation form;

$$s = \int V dt \approx \sum (V \Delta t) \text{ where } V \text{ is the velocity in each interval.}$$

A BlastMate plot contains peak particle velocity, acceleration and peak displacement. The peak acceleration and displacements do not necessarily occur in the same time interval as the peak velocity. Acceleration is calculated at each point along the entire waveform and the peak value found is reported. To obtain the peak displacement, each wave segment of the entire waveform is integrated between zero crossings, the largest is selected, and half the value is taken as the 1/4 wave peak displacement.

4.2.3. Sensorcheck

Sensorcheck ensures the verification and calibration of the system's Geophones each time they are used and precludes using the machine with damaged or inaccurate Geophones.

The validity of a geophone can be estimated by measuring its natural frequency and damping. Many commercial Geophones vary by as much as 10% from published values. When taking into account the effect of temperature extremes in the field additional errors are introduced.

Sensorcheck measures certain geophone features. If a geophone fails to meet requirements a message identifies it. For example, if the geophone housing is placed upside down, a message will indicate that the vertical sensor is out of calibration. If it is placed on its side, the transverse and vertical sensors will be flagged.

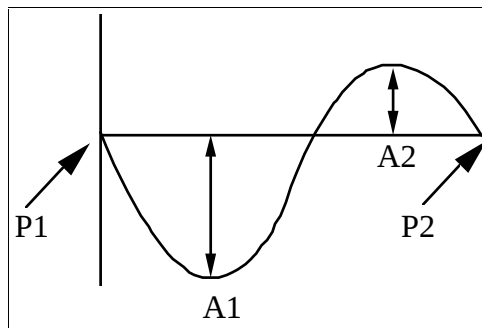


Figure 4-6 Graph of geophone coil "free fall" response. P1 and P2 are used for frequency calculations. A1 and A2 are used for overswing calculations.

4.2.4. Graphical Sensor Validation

The natural period (t) of the sensor coil assembly can be checked by waveform measurements. On a Sensorcheck plot, the distance from P1 (Figure 4-6) to the end of the graph window represents 0.15 seconds. It is typically 1.15 inches in 1X space, which gives a scale factor of $0.15/1.15 = 0.13$ s/in. With a vernier, measure the distance between P1 and P2 (see Figure 4-6 and use the 1X scale). Multiply the result by 0.13 (or a value you compute using your print-out) to obtain the time in seconds. Frequency is the reciprocal of the period, i.e., $F=1/t$. A good sensor will have a natural frequency between 6.5 and 9.5 Hertz.

The overswing ratio (OR) is an indication of damping and is calculated by computing the ratio of the magnitude of adjacent waveform peaks.

$$OR = A1/A2.$$

A good geophone should have an overswing ratio between 2.8 and 4.8.

At the bottom of a Sensorcheck print-out you will notice coded messages; e.g., FT=74 OT=39 etc. These are measurements made during the Sensorcheck procedure. FT stands for Frequency Transverse and is ten times the natural oscillating frequency of the transverse sensor (7.4 Hz). Similarly OT stands for Overswing ratio Transverse (3.9). The others are Frequency Vertical (FV), Overswing Vertical (OV), Frequency Longitudinal (FL), Overswing Longitudinal (OL), Frequency of Microphone test signal (FM), Peak of Microphone (PM) and Battery Level (BL), respectively. The microphone and the microphone channel are both tested. The values are printed to assist service technicians in case of malfunction.

Common causes of failure are poor connections (broken or worn cables), improper placement and improper leveling. A Sensorcheck can fail with good sensors if the block is accidentally moved or vibrated during a check. A microphone failure will be indicated if it is not connected by a 'check mic' LCD message.

4.2.5. Frequency Calculations

To estimate the frequency of blast vibrations from a plot the period of oscillation is first deduced. Convenient waveform positions for measuring period, (the time for one complete cycle) is between two successive peaks, troughs, or zero crossings (BlastMate method). In Figure 13, the distance representing the period may be measured either from P1 to P2 or from P3 to P4. Frequency is the number of periods which occur in one second and can be calculated from the formula;

$$\text{frequency} = 1/\text{period}$$

The time axis during a standard plot is approximately 0.13 s/in . With a vernier measure the distance between P1 and P2 (see Figure 4-7) and multiply the result by 0.13 to obtain the time in seconds.

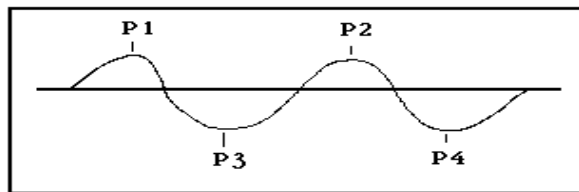


Figure 4-7 Graph of a Periodic Waveform.

At higher frequencies there are fewer sample points per cycle and greater error. The following table illustrates how error increases with frequency.

Frequency Sample Rate Error	
Frequency Range	1024 Hz Recording Rate
0 – 30 Hz	negligible error
31 – 50 Hz	up to 5 Hz error
51 – 70 Hz	up to 8 Hz error
71 – 90 Hz	up to 18 Hz error
91 – 150 Hz	up to 50 Hz error

Frequencies above 100 Hz are not plotted because of the high error level. The plotter outputs the message ">100 Hz" instead of the actual value. Furthermore if a waveform is very complex, or if it contains a large offset value, the zero crossings may lie outside an acceptable window. Whenever a frequency cannot be resolved the message "<2 Hz" is printed. Fast Fourier Transform (FFT) analysis by the optional BlastWare III Advanced Module can provide more accurate information on frequency content of waveform.

4.2.6. Graphical Acceleration and Displacement Calculations

A BlastMate printout contains waveform plots of particle velocity versus time. The area under a curve represents displacement and slope represents the acceleration. Graphical methods for calculating area and slope depend on the nature of the waveform being analyzed. A complete discussion of the procedures is beyond the scope of this manual. Two good reference texts are G. A. Bolliger, *Blast Vibration Analysis*, Southern Illinois University Press and Charles H. Dowding, *Blast Vibration Monitoring And Control*, Prentice-Hall Inc. In each of the subsequent examples some formulae are stated with no attempt at derivation and the following definitions apply:

A	=	amplitude in inches/s measured from the zero line
A _m	=	amplitude measured in millimeters/s.
T	=	period in seconds
Y	=	absolute change in amplitude over time measured in inches/s.
Y _m	=	absolute change in amplitude over time measured in millimeters/s.

4.2.7. Nearly Triangular Waveforms

Motion is irregular and has large amplitude.

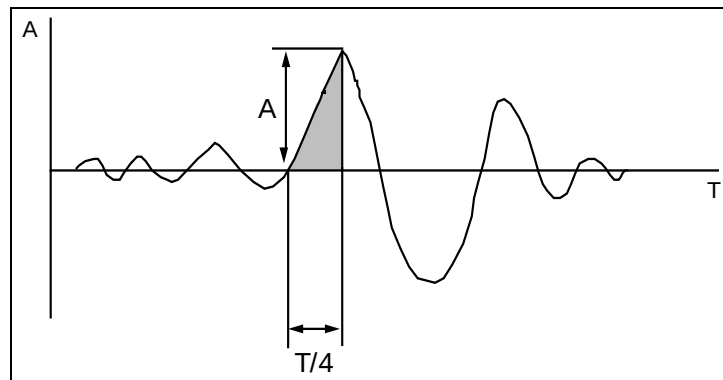


Figure 4-8 Manual Waveform Calculations on Nearly Triangular Waveforms.

a. Calculating Displacement:

$$\text{Maximum Displacement (in.)} = \frac{T}{8} \times A$$

$$\text{Maximum Displacement (mm)} = \frac{T}{8} \times A_m$$

b. Calculating Acceleration:

$$\text{Maximum Acceleration (in./s}^2\text{)} = \frac{1}{T} \times Y$$

$$\text{Maximum Acceleration (mm/s}^2\text{)} = \frac{1}{T} \times Y_m$$

4.2.8. Sinusoidal Waveforms

The motion is essentially sinusoidal with gradual amplitude and frequency changes.

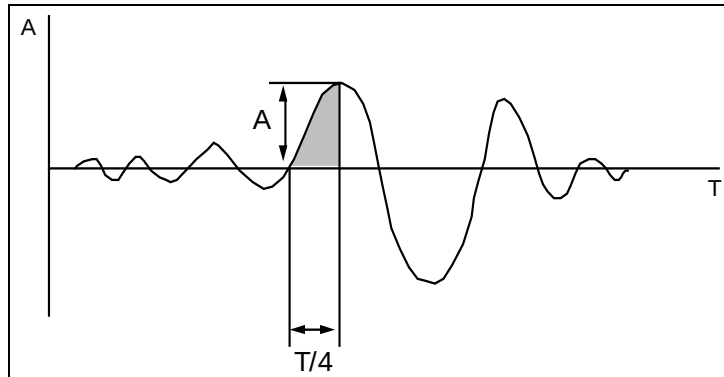


Figure 4-9 Manual Waveform Calculations on Sinusoidal Waveforms.

a. Calculating Displacement:

$$\text{Maximum Displacement (in.)} = \frac{T}{2\pi} \times A$$

$$\text{Maximum Displacement (mm)} = \frac{T}{2\pi} \times A_m$$

b. Calculating Acceleration:

$$\text{Maximum Acceleration (in./s}^2\text{)} = \frac{2\pi}{T} \times A$$

$$\text{Maximum Acceleration (mm/s}^2\text{)} = \frac{2\pi}{T} \times A_m$$

4.2.9. Irregular Waveforms

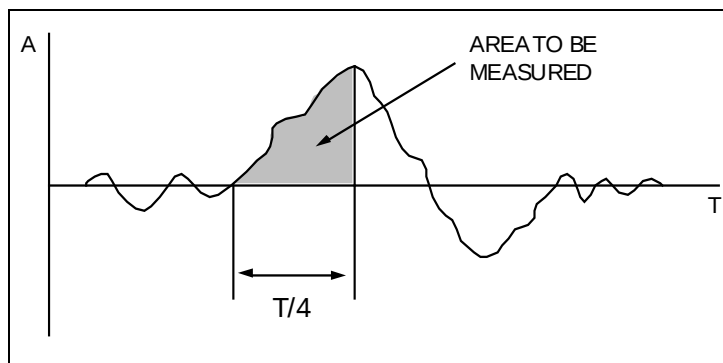


Figure 4-10 Manual Waveform Calculations on Irregular Waveforms.

a. Calculating Displacement:

Maximum Displacement = area under curve measured by a planimeter.

4.2.10. Compound Waveforms

If the record exhibits interference by two or more predominant frequencies then the maximum displacement will be the sum of the maximum of each individual frequency component.

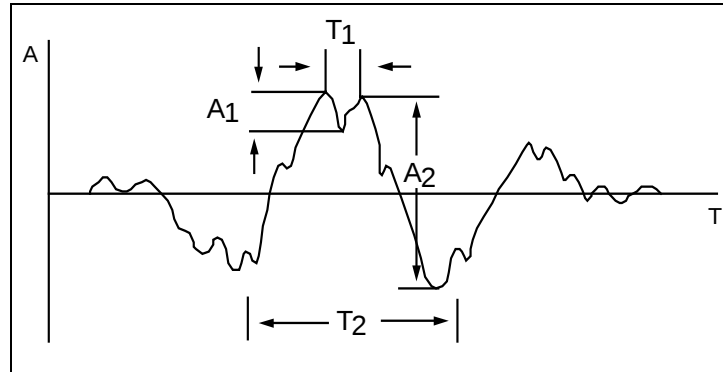


Figure 4-11 Manual Waveform Calculations on Compound Waveforms.

a. Calculating Displacement:

$$\text{Maximum Displacement (in.)} = \frac{T_1}{2\pi} \times A_1 + \frac{T_2}{2\pi} \times A_2$$

$$\text{Maximum Displacement (mm)} = \frac{T_1}{2\pi} \times A_{1m} + \frac{T_2}{2\pi} \times A_{2m}$$

b. Calculating Acceleration:

$$\text{Maximum Acceleration (in./s}^2\text{)} = \frac{2\pi}{T_1} \times A_1 + \frac{2\pi}{T_2} \times A_2$$

$$\text{Maximum Acceleration (mm/s}^2\text{)} = \frac{2\pi}{T_1} \times A_{1m} + \frac{2\pi}{T_2} \times A_{2m}$$

4.2.11. Graphical Vector Sum

EVENT WAVEFORMS			MAGNITUDE			PEAK VECTOR
TRANSVERSE	VERTICAL	LONGITUDINAL	T	V	L	
			-0.34	-0.33	0.14	0.494
			0.38	-0.47	0.38	0.714
			0.29	-0.31	0.51	0.663
			-0.53	0.23	-0.31	0.655
			0.24	0.07	0.36	0.440
			-0.23	-0.16	-0.15	0.318

Figure 4-12 Instantaneous Waveform Magnitudes and Peak Vector Sum.

Figure 4-12 shows three random waveforms plotted in a format similar to that of a BlastMate printout and is presented to illustrate the procedure of graphically calculating peak vector sums. Measured magnitudes are tabulated for six different times and represent velocities in each of the three dimensions. The vector sum represents true particle velocity and is calculated by squaring and adding the magnitudes and taking the square root. In general if:

T = particle velocity along the transverse plane

V = particle velocity along the vertical plane

L = particle velocity along the longitudinal plane

V_{gm} = particle velocity of the ground movement

$$V_{gm} = [(T)^2 + (V)^2 + (L)^2]^{1/2}$$

Notes:

5. MAINTENANCE

This chapter outlines maintenance procedures for the BlastMate II including battery charging, cleaning, and loading paper into the printer.

5.1. Battery Charging

The BlastMate II internal battery requires periodic and regular charging. To check the battery charge, turn the BlastMate II on and press the BATTERY LEVEL key.

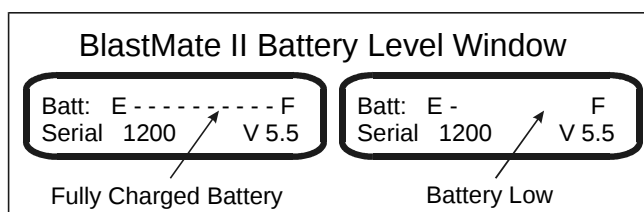


Figure 5-1 Battery Level Indicator.

To charge the battery, plug the DV-1250 AC adapter, supplied with your monitor, into the connector marked PWR located under the handle of the BlastMate II. Plug the other end into a 120 VAC 60 Hz electrical outlet. The battery charging indicator light turns on. For electrical outlets other than 120 VAC 60 Hz, you must use an optional power converter; contact your dealer for more information. A 220 VAC adapter (p/n TC50A) is also available from InstanTel for use with the DV-1250 AC adapter.

A discharged battery can be returned to 90% of full charge within 16 hours. The recommended temperature range for most efficient charging is 59°F to 77°F (15°C to 25°C). You may use your BlastMate while it is charging.

You can also charge your BlastMate II from a vehicle's 12 volt electrical system to conserve internal battery energy while in the field. Remove the cigarette lighter and in its place plug in the optional automobile cigarette lighter adapter (p/n 712A3001). Connect the other end of the adapter to the power socket on the BlastMate just as you would the charger. Now the car's electrical system will act as a charger for the BlastMate.

WARNING:

- Open the monitor's lid to ensure adequate battery ventilation during charging. Always charge the monitor in a well ventilated area.
- Do not allow the battery to become discharged and left in a discharged state for any extended period of time. Allowing the battery to become discharged may cause permanent damage to the battery.
- Use only the charger supplied by InstanTel.
- Attached loads on the same power line may cause voltage fluctuations of sufficient intensity to cause false triggering. In such cases a power line filter may be used.

5.2. Cleaning the BlastMate II

Vacuum dust, dirt, and sand from the BlastMate II. Use isopropyl alcohol to remove stains. Do not use paint thinners or ketone solvents. These may damage the BlastMate II. To avoid scratching the

protective cover and display, do not scrub the surfaces with abrasive material including cleaning pads.

5.3. Loading Paper into the Printer

When a new roll of printer paper is required, it should be installed in a clean environment. Dust, dirt and contaminants will accumulate on the plotter parts over time, and may cause a malfunction requiring repairs.

During plotting, the pen moves to locate the horizontal coordinate while the paper moves to locate the vertical. It is essential that the paper unroll freely or its motion may be impeded. New rolls of paper tend to stick, especially near the perimeter due to the glue used to secure the end of the paper. Friction may be reduced if the end is unrolled to approximately 10 feet and then re-rolled, or discarded.

To load paper into the printer follow the steps below:

1. Turn the BlastMate II on and open the printer door. Press the **PAPER FEED** key to remove any remaining paper from the plotter.
2. Remove the Paper Feed Roller, discard the old roll, and insert the new paper roll. Slide the Paper Feed Roller back into the slot in the printer compartment. Check that the paper rolls off the bottom of the roll.
3. Fold the paper to create a point in the center of the paper end. Insert the paper into the feed-slot near the bottom of the plotter mechanism.
4. Press the **PAPER FEED** key to advance the new roll of paper. Make sure that the paper passes under the two guides at either end of the roller. Do not turn the roller by hand as this can damage it.
5. Feed the paper into the slot located in the Takeup Roller and press the **PAPER TAKEUP** key to advance the roller and take up the paper slack. Do not turn the Takeup Roller by hand as this can damage it. You can also feed the paper through the printer door tear off slot. Feed the paper through the slot. Adjust the Tear Off Plate by loosening the two knobs, adjust the plate's position and tighten the knobs. Your BlastMate II is ready to print.

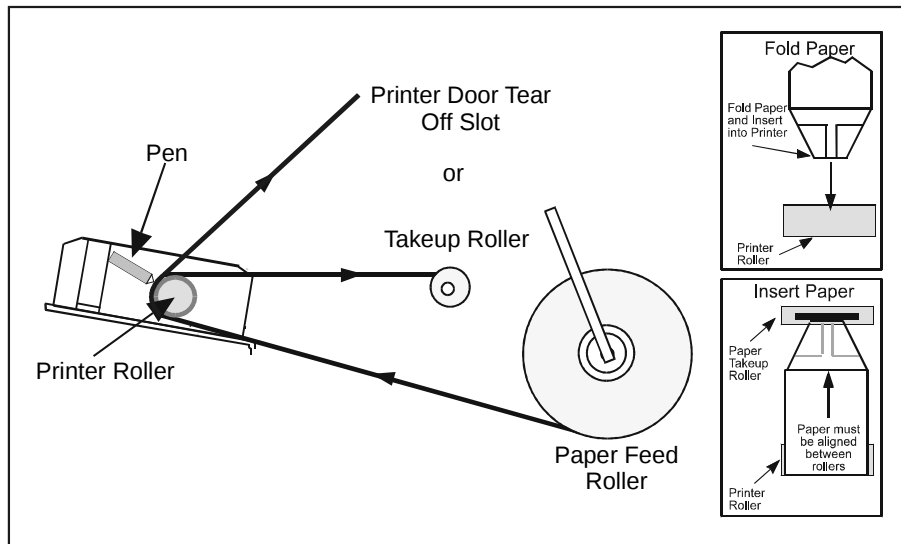


Figure 5-2 Loading Paper into the Printer.

6. TROUBLESHOOTING

Use the following information to help solve operation problems.

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
The monitor does not turn ON.	No power source.	Verify 120 VAC is supplied. Check the fuse. Check the battery.
The monitor does not turn ON with battery only but does turn on using the AC Adapter.	Battery needs recharging.	Recharge the battery.
	Battery is dead.	Contact your authorized service facility.
The monitor sounds a “Beeping” Indicator and a message appears on the display.	Battery needs recharging.	Recharge the battery.
	Battery is dead.	Contact your authorized service facility.
The monitor turns off unexpectedly.	Battery needs recharging.	Recharge the battery.
	Blown Fuse	Replace the fuse (5 Amp, fast blow)
	Battery is dead.	Contact your authorized service facility.
The monitor fails to trigger and record an event.	The monitor is not in monitor mode.	Press the M key to enter monitor mode.
	Trigger Level set too high.	Lower Trigger Level.
The monitor triggers continuously.	Trigger Level set too low.	Raise the Trigger Level.
	Noisy electric power supply.	Connect the monitor to a dedicated electric power supply line with no line noise or use a broadband noise filter.
The monitor does not record events.	The monitor’s memory is full.	Transfer events from the memory, verify the events transferred okay, then delete the events.
WARNING! MEMORY < 15% message appears.	The monitor’s memory is almost full.	Transfer events from the memory, verify the events transferred okay, then delete the events.
Check T chan(s) message appears.	Transducer not connected.	Connect the transducer.
	The transducer not installed level.	Check the transducer installation for level.
	The transducer moved during Sensorcheck.	Press the S key to run Sensorcheck again. Do not touch the transducer.
	Transducer cable improperly installed or damaged.	Check the cable connections and cables.
	Wall Installation – transverse and vertical Geophones not switched.	Switch the transverse and vertical Geophones.
	Damaged transducer.	Have the transducer checked by an authorized InstanTel service facility.

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
Check V chan(s) message appears.	Transducer not connected.	Connect the transducer.
	Transducer not installed level.	Check the transducer installation for level.
	Transducer moved during Sensorcheck.	Press the S key to run Sensorcheck again. Do not touch the transducer.
	Transducer cable improperly installed or damaged.	Check the cable connections and cables.
	Transducer installed upside down.	Check the transducer for the arrow on the top.
	Ceiling Installation – Vertical geophone not inverted.	Invert the vertical geophone.
	Damaged transducer.	Have the transducer checked by an authorized InstanTel service facility.
Check L chan(s) message appears.	Transducer not connected.	Connect the transducer.
	Transducer not installed level.	Check the transducer installation for level.
	Transducer moved during Sensorcheck.	Press the S key to run Sensorcheck again. Do not touch the transducer.
	Transducer cable improperly installed or damaged.	Check the cable connections and cables.
	For wall installations, the arrow was not pointed towards the event.	Point the arrow located on the top of the standard transducer towards the event.
	Damaged transducer.	Have the transducer checked by an authorized InstanTel service facility.
Check M chan(s) message appears.	Microphone not connected.	Connect the microphone.
	Damaged microphone or microphone cable.	Have the microphone checked by an authorized InstanTel service facility.

Appendix A

a) Parts and Accessories

DESCRIPTION	PART NUMBER
Transducers	
Round Standard Transducer	713A0601
Standard Uniaxial Geophone	Vertical – 712A2801 Horizontal – 712A2802
Bore Hole Sensor	712A4501
Hydrophone Sensor	700A3501
Microphone Accessories	
Microphone Windscreen	33-1065FW
Microphone Stand Assembly	714A3401
Event Memory	
Extra 300 Event Capacity (installed)—Converts DS-477 to DS-677	714A4301
Power Supply	
120 VAC, 60 Hz Adapter	712A1901
220 VAC, 50 Hz Adapter (used with the 712A1901)	TC50A
Auto Lighter Plug 12 V adapter	712A3001
Cables	
BlastMate to PC RS-232 Cable	715A2301
Extension Cable 100 ft. (30 m) for microphone and transducer	709A0501
Extension Cable 250 ft. (75 m) for microphone and transducer	709A0502
Three-way Splitter Cable—used to connect three Geophones	712A2601
Remote Alarm/RS-232 Splitter Cable—for use with simultaneous remote alarm and modem operation	712A3501
BlastMate Trigger Cable	712A3901
Accessories	
MiniMate to BlastMate Cable: RS-232 cable for programming MiniMate from BlastMate II	715A0501
BlastMate II replacement Printer Paper Roll (Package of 3)	26-1428
Plotter Pens (Package of 4)	26-1480
Replacement Dust Caps	716A1401
Remote Alarm	711A1401
DS 20 Wire Trigger	677A9601
Standard Transducer Leveling Plate—complete with leveling feet and level	714A1801
Ground Spikes—for geophone or MiniMate	1100241
Accessory case with rigid foam insert. Same as BlastMate case. Used to carry and store accessories. Can also be used to store and carry 1–2 MiniMate units	714A2601

b) Specifications

		DS-477	DS-677
Seismic	Maximum Range	10 in/s (254 mm/s).	
	Minimum Resolution	0.000625 in/s (0.0159 mm/s) with built-in 8x preamp.	
	Trigger Levels	0.005 to 9.999 in/s (0.127 to 253.99 mm/s) in steps of 0.001 in/s (0.01 mm/s).	
	Peak Acceleration	0.01 to 30 g's calculated.	
	Peak Displacement	0.0001 to 1.5 in. (0.00254 to 38.1 mm) calculated.	
	Frequency Analysis	Freq. at Peak, plus USBM/OSMRE and DIN 4150 field frequency analysis.	
	Accuracy	Calibrated to within 1% of B & K* reference accelerometer @ 15 Hz	
Air Linear & "C" Weight	Range	88 to 148 dB, 0.03625 psi, 250 Pa. (Peak).	
	Minimum Resolution	7.25 x 10 ⁻⁵ (0.5 Pa).	
	Trigger Levels	100, 102, 104, and 105 to 142 dB in steps of 1 dB. 0.00029 to 0.03625 psi, in steps of 7.25 x 10 ⁻⁵ psi (2 to 250 Pa, steps of 0.5 Pa).	
	Frequency Analysis	Frequency at Air Pressure Peak standard.	
	Accuracy	Linear calibration to within 0.2 dB of B & K* reference @ 30 Hz and 127 dB.	
"A" Weight	Range	55 to 110 dB.	
	Resolution	0.2 dB.	
	Trigger Levels	55 to 110 dB in steps of 0.2 dB.	
	Frequency Response	0.5 to 8 kHz, independent of record time, impulse filtering.	
Frequency	Sampling Rate	1024 samples per second, all channels, all record modes.	
	Frequency Response (-3 dB points)	Seismic and Linear Air 1.5 to 250 Hz, independent of record time. Hardware "Anti-alias" filters to ensure accurate frequency measurement.	
Full Waveform Recording	Record Modes	Manual, single shot, continuous and auto.	
	Fixed Record Time	1 to 10 sec in 1 sec increments, plus 0.25 sec pretrigger.	
	Auto Record Mode	1 to 24 sec.	1 to 60 sec.
	Cycle Time	Complete data analysis and storage < 5 seconds per second record time.	
Strip Chart Recording	Record Method	Record to memory and/or internal printer.	
	Intervals	5, 15, 60, 300 sec.	
	Analysis	Peak, frequency of peak, and peak vector sum for each interval.	
	Max Record Time @ 5 min Intervals	20 days continuous recording to memory.	110 days continuous recording to memory.
	Print from Memory	Graphic plot of ground and air peaks, text plot of peaks and frequencies.	
Event Storage	No. of Full Wave Events	40	300
	No. of Summary Events	250	1750
	Storage method	Solid State Memory with >10 year storage life. Events and program still retained with battery removed.	

* Bruel and Kjaer

b) Specifications (continued)

		DS-477	DS-677
Special Functions	Timer Operation	Programmed start/stop.	
	Self Check	Programmable daily check.	
	Measurement Units	Imperial or metric, dB or linear air pressure.	
	Languages	English or French standard, others optional.	
	Microphone	Disable/Enable Mic for recording.	
Documentation	Notes	Up to 60 lines of notes (620 characters) stored with each event. Flexible format editing with standard and custom titles.	
	Scaled Distance	Weight and distance stored with event.	
	Monitor Log	History printout programmable up to all events stored.	
User interface	Keyboard	63 domed tactile with separate keys for common functions.	
	Display	2 line by 20 character high contrast display with on line help.	
Printer	Selectable Output	Setups, Frequency Analysis, Waveform, Sensorcheck, Strip Chart.	
	Plot Scales	2x, 1x, condensed, super condensed.	
	No. of Print Copies	Selectable from 1 to 10 copies, automatic or manual printing.	
	Condensed Print Time	<2 min including full analysis, frequency and waveform plot.	
	Plotter	Precision high resolution, 0.00787 in/step (0.2 mm/step).	
	Paper	Continuous 4.5" (11.4 cm) roll, unlimited shelf life.	
	Pen	Minimum 810 ft (250 m) plot life.	
	Paper Takeup	Paper tear slot or automatic paper takeup for unattended printing.	
	Manual Print Control	Separate keys for manual paper feed and paper takeup.	
Battery	Battery Type	Rechargeable 6V sealed gel cell 10 AHr capacity.	
	Battery Life	30 days continuous recording, 45 days with timer, printing will decrease life.	
Fuse	5 A/250 V		
Physical	Dimensions	10.6 " x 14.0 " x 6.5 " (269 mm x 355 mm x 165 mm).	
	Weight	15 lbs. (6.8 kg).	
	Case	Structural ABS foam with integral splash tight seal. Hinged lid is supported with a locking lid stay.	
Warranty	1 Years Parts and Labor.		
Environmental	Electronics	-4 to 140 degrees F (-20 to 60 degrees C) operating.	
	Printer/ LCD	14 to 122 degrees F (-10 to 50 degrees C) operating.	
	Storage	-4 to 160 degrees F (-20 to 70 degrees C).	

Instantel reserves the right to change specifications without notice.

c) Compliance Reports

The BlastWare III software enables you to quickly and easily prepare compliance reports from your BlastMate II blast data. The examples below are only a small sampling of the many different national compliance standards available. Please see the BlastWare III Operator Manual for details.

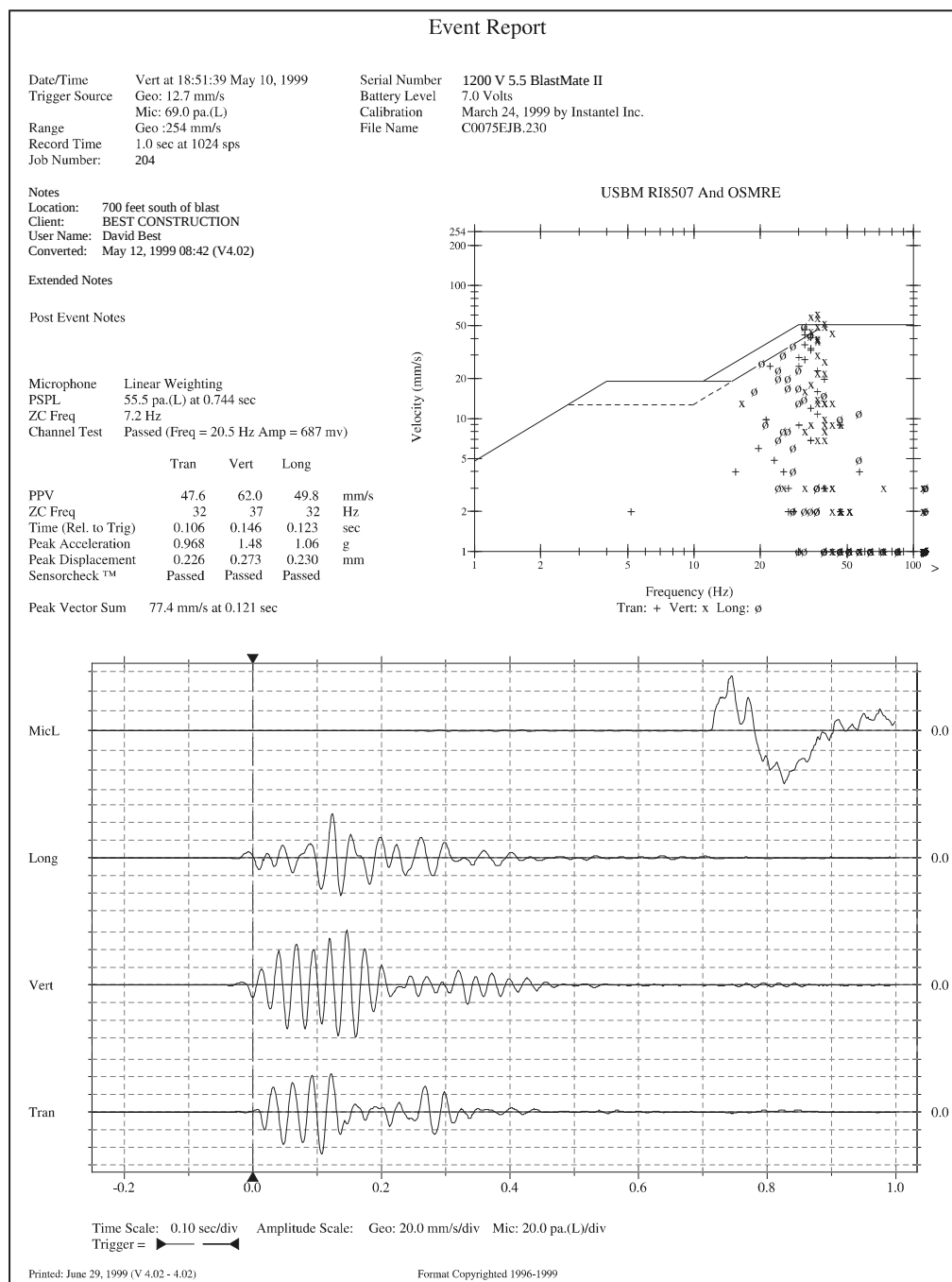


Figure A-1 BlastWare III Event Report Using the USBM Compliance Standard.

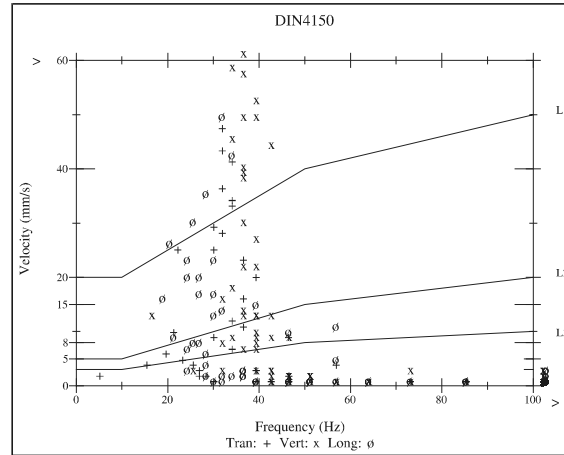


Figure A-2 German DIN 4150 Standard Frequency Plot.

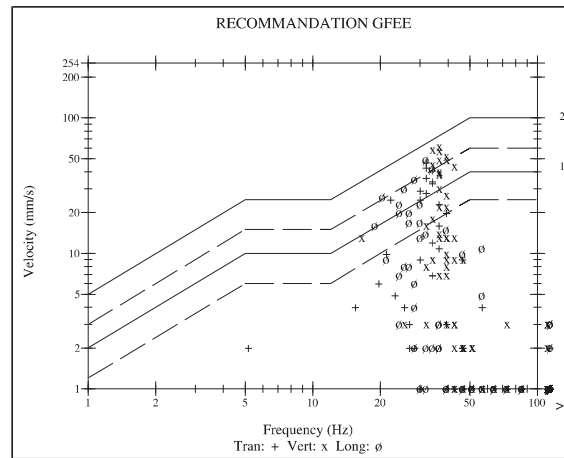


Figure A-3 French GFEE Standard Frequency Plot.

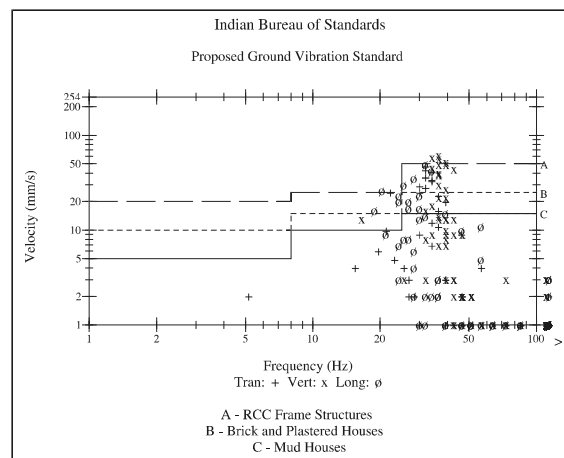


Figure A-4 Indian Bureau of Standards Frequency Plot.

d) Calculating Battery Life

The BlastMate II battery life depends on current draw, battery longevity, and ambient temperature.

Battery Capacity and Longevity

It is important to distinguish between “battery capacity” and “battery longevity.” Battery capacity is the length of time a battery functions reliably between charge and discharge. Battery longevity refers to useful service life and depends on use and abuse. A new battery may have a longevity of some 4-5 years in standby use. It is more meaningful to state the longevity in terms of the number of charge-discharge cycles. A battery will last much longer if it is kept in a charged condition. The table below gives some typical values.

Depth of Discharge (Capacity)	Longevity (Charge/Discharge Cycles)
100%	200
50%	400
10%	2,000
1%	20,000

Each bar on the battery level message represents approximately 0.1 volt above the 5.5 volt discharge level, or approximately three days of remaining operating life in monitor mode (with no plotting). The battery should be charged as soon as the display drops to a level of five bars or less and whenever the unit is not in use. A warning message appears to inform the user to charge the battery immediately if it falls below 2 bars. Below one bar it will cease to function and the unit turns itself off. Program and event data stored in the BlastMate will not be lost even if all power is off.

Batteries are rated in ampere-hours, a value obtained by multiplying the discharge current by the discharge time. Theoretically a 100 ampere-hour battery should be able to supply a current of 100 amperes for one hour, or 10 amperes for 10 hours, or even one ampere for 100 hours, provided that the product of current (amperes) and hours equals the value 100. In actual practice other factors such as temperature and the load current affect the ampere-hour value. When quoted by the manufacturer the ampere-hour value is usually based on a discharge time of 20 hours at a given temperature. The actual current draw on a BlastMate was used to produce the graph in Figure A-5 which gives approximate life remaining under differing plotting modes assuming that only one battery was used. With the optional second battery all values are approximately doubled.

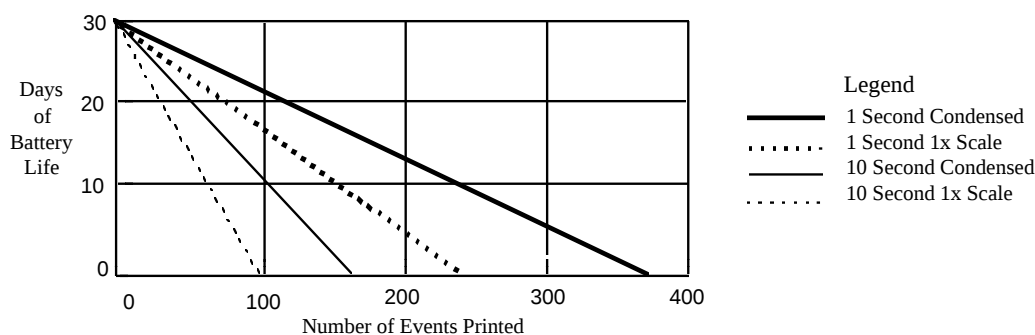


Figure A-5 Battery Life Based on One Second Events and Different Printing Modes.

If the timer is used to put the unit in Monitor Mode for limited daily times (say 8 hours), or if the unit is only briefly in Monitor Mode, the battery life between charges may be increased by a further 50%.

Battery Capacity Varies with Ambient Temperature

Battery capacity is a function of ambient temperature and rate of discharge. At 68°F (20°C) the rated capacity is 100%. The capacity increases above this temperature and decreases below this temperature.

e) Printer Roll Capacity

The number of events that can be printed on one roll of printer paper varies depending on the printing scale and length of the event. Using the 1X scale each roll can hold approximately 95 one second records and over 300 summary events. The table below shows example printer roll capacities at different scales.

Print Scale	Full Waveform Events	Summary Events
2x	75	300
1x	95	300
Condensed	190	600
Super condensed	265	600

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