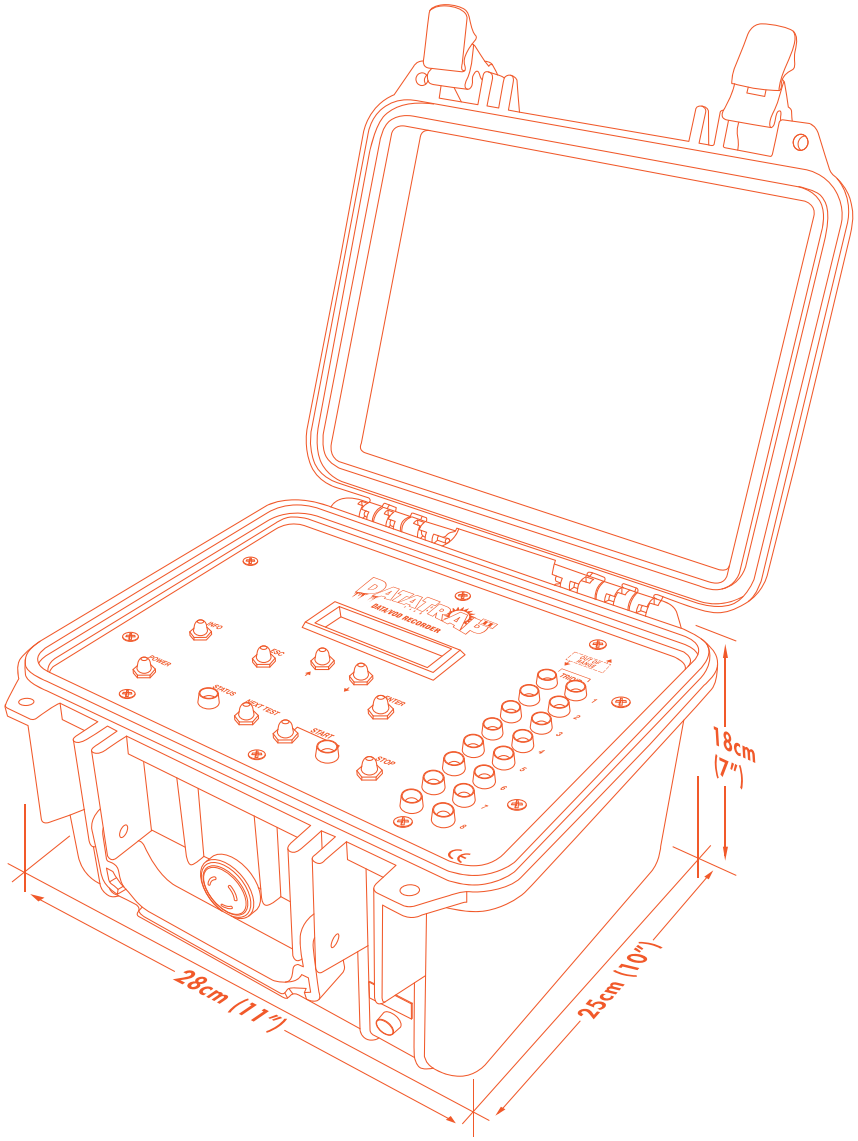
DATA TRAP II™
DATA/VOD RECORDER

Operations Manual
Edition 5.4



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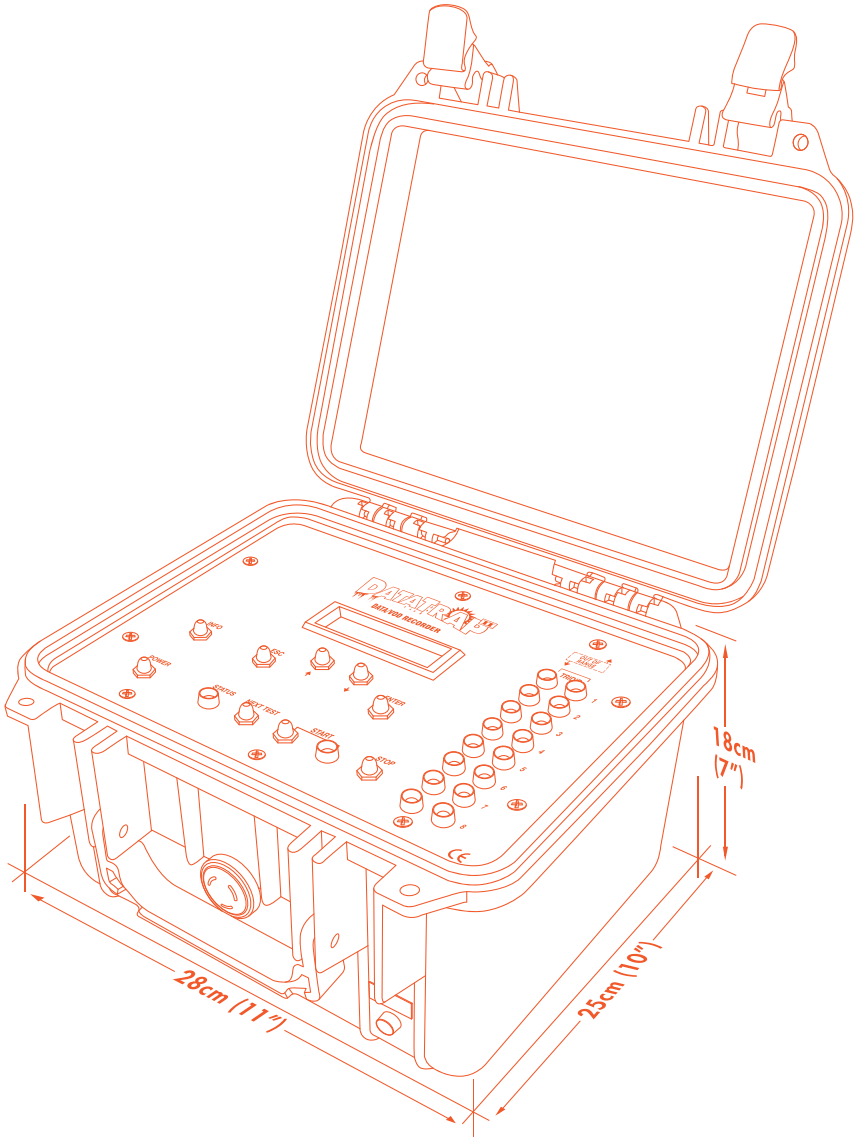
Getting Started



Overview

All of the steps detailed in this Chapter should be completed before the Operator goes into the field to conduct a VOD test:

1. **Ensure that all DataTrap II™ components have been received and are available.**
2. **Install the DAS™ Data Acquisition Suite Software on the Operator's computer.**
3. **Ensure that the Operator's computer and DataTrap II™ are able to communicate with each other.**
4. **Program the DataTrap II™'s internal Recording Parameters using the DAS™ Data Acquisition Suite Software.**

1.1 Ensuring That All DataTrap II™ Hardware Has Been Received

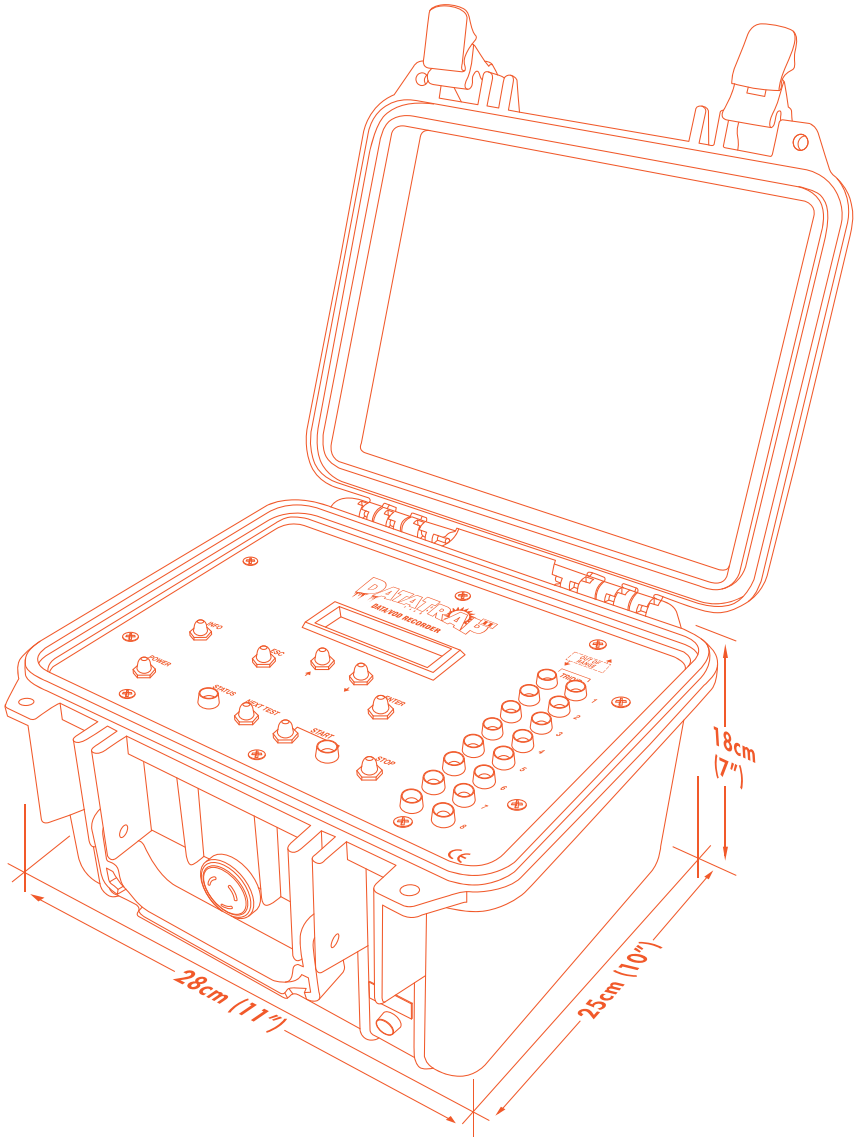
Photographs of these hardware components are contained in **Section 3.1**.

1. **DataTrap II™ Data/VOD Recorder**.
2. Universal **DataTrap II™ Battery Charger** that is labeled 100-240 VAC.
3. **Communications Cable** - USB cable.
4. **BNC Adapters** x 10.
5. **DAS™ Data Acquisition Suite Operations Software** and **Manual** on USB.
6. **DataTrap II™** Operations Manual.

1.2 Installing The DAS™ Data Acquisition Suite Software

Refer to the **DAS™ Data Acquisition Suite Manual** for installation procedure.

Chapter 2
Introduction



Overview

This Chapter provides an introduction to the DataTrap II™ Data/VOD Recorder.

2.1 Background

The **DataTrap II™ Data/VOD Recorder** is a portable, 8 channel, high speed, high resolution, Data Recorder. The **DataTrap II™ Data/VOD Recorder** can be upgraded easily and inexpensively to record continuous **VOD** of explosives. The **VOD Upgrade** provides the **DataTrap II™ Data/VOD Recorder** with the unparalleled ability to record high resolution **VODs** of explosives and simultaneously record transient events such as blast vibrations, explosion pressures, air blast, etc at high speeds and high resolutions.

The **DAS™ Data Acquisition Suite** allows the Operator to analyze **VOD** traces and convert DC voltage signals recorded by the **DataTrap II™ Data/VOD Recorder** into the desired engineering units for analysis and presentation. The Software is used to program the recording parameters of the **DataTrap II™ Data/VOD Recorder**, and to: retrieve, display, analyze, print and export **VOD** and data from other types of gauges. The software runs in **Windows® XP** and above (including **Windows® 8**). This facilitates extremely fast data handling, and the ability to copy and paste **DataTrap II™ Data/VOD Recorder** graphs into any word processors and/or spreadsheets running under the **Windows®**.

The main features of the **DataTrap II™ Data/VOD Recorder** for Data recording are:

- Eight channels capable of recording at up to 10 MHz (10 million data points/sec). This speed provides a time resolution of one data point for every 0.1 microseconds.
- A large, circular, digital memory of 128 MB (64 million data points) to store the recorded data in the **DataTrap II™ Data/VOD Recorder**. This allows the **DataTrap II™ Data/VOD Recorder** to record for relatively long periods (6 seconds) on one channel when recording at a rate of 10 MHz. The memory can be upgraded easily and inexpensively to provide 12 or 25 seconds for a total memory of 256 MB or 512 MB (128 or 256 million data points). Contact **MREL** for **DataTrap II™ Data/VOD Recorder Memory Upgrade** information.
- The capability to store up to 32 events in its permanent (non-volatile) memory before having to download the recorded data to a computer.
- The data is downloaded to any personal computer (PC) through the **USB 2.0 port**. Downloading takes less than 4 minutes.

STOP

Persons not trained and/or authorized to handle explosives should not attempt to utilize the **DataTrap II™** for monitoring explosive properties.

2.2 Safety Considerations

The **DataTrap II™ Data/VOD Recorder** is an easy and safe instrument to operate. However, one should be aware of the inherent risk associated with explosive's handling and familiar with working in blasting environments. For this reason, it is always recommended that knowledgeable personnel, experienced in handling explosives and familiar with blasting procedures, operate the **DataTrap II™ Data/VOD Recorder** when testing explosives. The standard rules of safety used with explosives should apply when monitoring **VODs** or other explosive parameters.

When recording **VODs** (if the **DataTrap II™ Data/VOD Recorder** has the **VOD Upgrade**), the **DataTrap II™ Data/VOD Recorder** outputs a low voltage (less than 8 VDC) and an extremely low current (less than 50 mA) to the probes within the explosives from the channel

connectors on the **DataTrap II™ Data/VOD Recorder**. This low excitation signal ensures that the **DataTrap II™ Data/VOD Recorder** will not prematurely initiate explosives and/or detonators. When measuring DC signals, the **DataTrap II™ Data/VOD Recorders** channels do not output any excitation voltage or signal.

Standard (and common sense) rules apply when it comes to the presence of electrical storms near the testing area. Due to the inherent hazards associated with blasting during these storms, in addition to the possibility of electrical interference causing false trigger signals to the **DataTrap II™ Data/VOD Recorder**, it is recommended to immediately suspend all blasting activities and evacuate the area. This is standard policy at most blasting operations.

2.3 DC Signal Recording Applications of the DataTrap II™ Data/VOD Recorder

As previously mentioned, the **DataTrap II™ Data/VOD Recorder** has the ability to function as a digital oscilloscope to record DC voltage signals from a wide variety of commercially available gauges. Typical applications of the **DataTrap II™ Data/VOD Recorder** when used as a voltage recorder include:

- Measurement of detonation pressure using calibrated PVDF (polyvinylidene fluoride) gauges.
- Measurement of air blast over-pressures using commercially available air blast pressure transducers.
- Measurement of cross-blasthole pressures using carbon composition resistors and/or commercially available tourmaline gauges.
- Measurement of temperatures using thermocouples.
- Measurement of strains using strain gauges.
- Measurement of any phenomena that can be instrumented with gauges producing DC voltage signals in the range from -10 to +10 volts.

2.4 VOD Recording Applications of the DataTrap II™ Data/VOD Recorder With VOD Upgrade

If the **DataTrap II™ Data/VOD Recorder VOD Upgrade** has been installed, **VOD** can be recorded or DC voltage and **VOD** can be recorded simultaneously. When used as a **VOD** recorder, the main applications of the **DataTrap II™ Data/VOD Recorder** include:

2.4.1 Testing of Explosive Samples

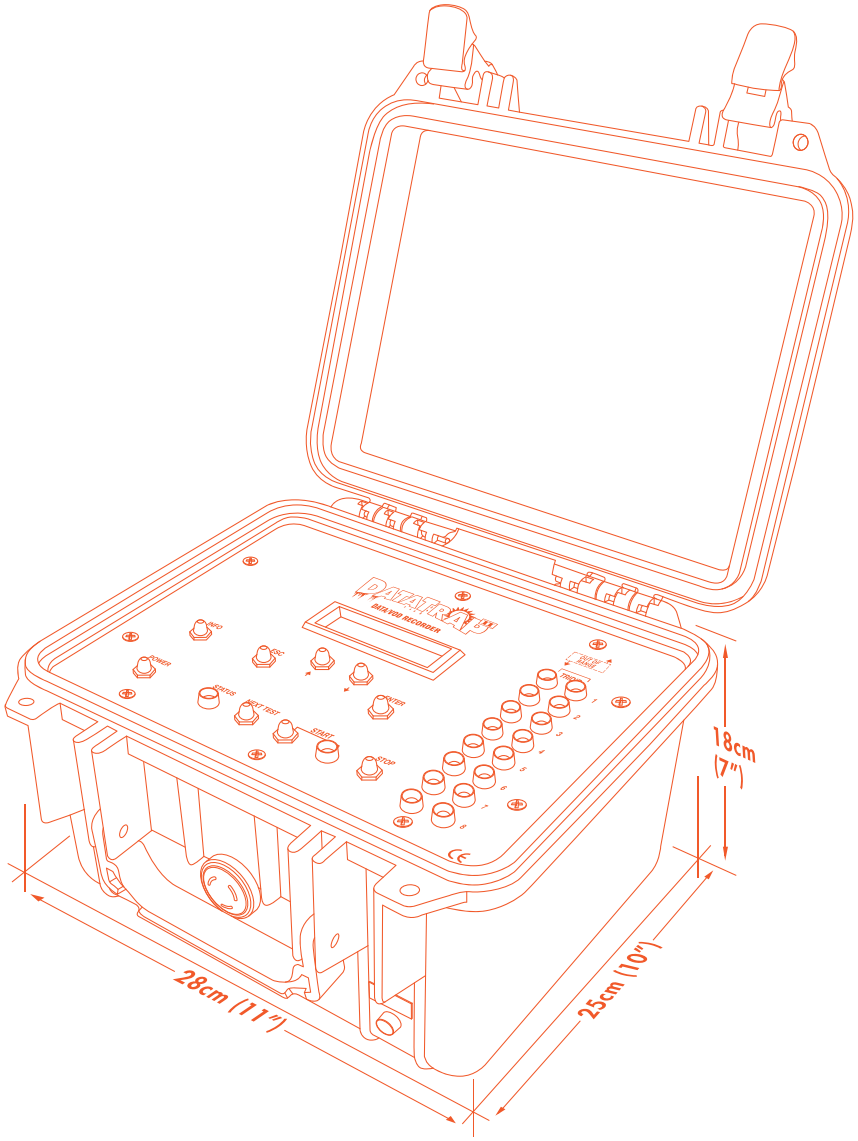
- Test the performance of explosives against the quality control standards set by the manufacturers.
- Measure the continuous **VOD** in any charge diameter under confined or unconfined conditions.
- Determine the critical diameter and critical density of an explosive charge.
- Determine the gap sensitivity of explosives.
- Measure the timing accuracy of detonators.
- Measure the continuous **VOD** of primers/boosters.
- Determine the minimum booster size for any explosive by measuring run-up velocities.

2.4.2 Testing of Explosives In Blastholes

- Measure the continuous **VOD** in any hole diameter, wet or dry holes, and in any type of rock.
- Measure the continuous **VOD** in multiple holes per blast per channel.
- Since the **DataTrap II™ Data/VOD Recorder** has 8 channels, it can record 8 holes firing simultaneously.

- Determine whether full detonation, low order detonation or failure occurred, and where in the explosive column it happened.
- Check **VODs** against manufacturers' specifications in full scale blasting environments.
- Determine the minimum booster size for any explosive by measuring run-up velocities in full scale blasting environments.
- Measure the timing accuracy of detonators in full scale blasting environments.
- Measure the effects of water, drill cuttings, and rocks, etc trapped within the explosive mass.
- Determine the length of explosive column to use in decking operations to evaluate the effect of stemming and drill cutting dilution, water pick-up, etc on the explosive run-up requirements.

Chapter 3
Hardware



Overview

This Chapter describes all of the hardware components provided with the DataTrap II™ Data/VOD Recorder.

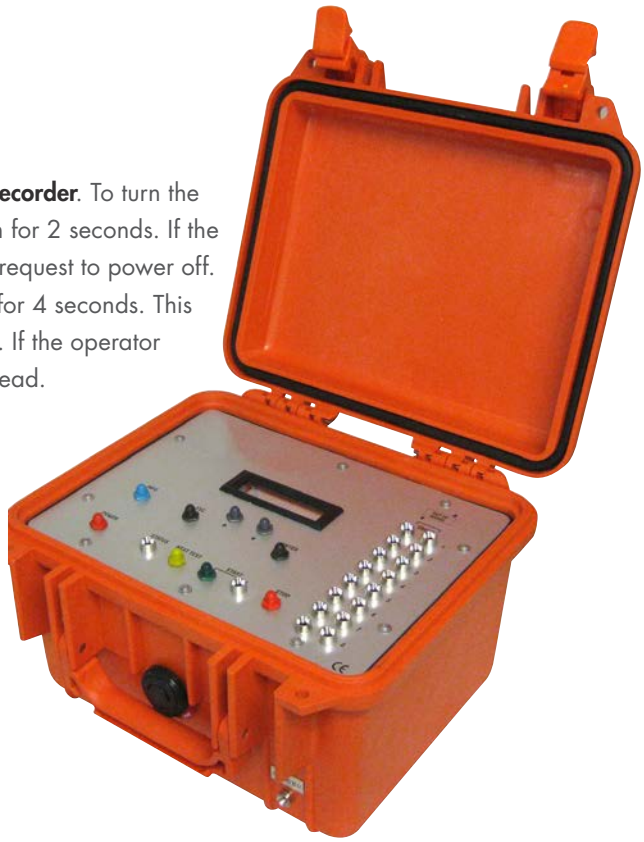
3.1 Hardware Components

The hardware components of the **DataTrap II™ Data/VOD Recorder** System include the **DataTrap II™ Data/VOD Recorder**, a **Battery Charger**, a **USB Communications Cable** and ten (10) **BNC Adapters**. Also included with the **DataTrap II™ Data/VOD Recorder** System are the **DataTrap II™ Data/VOD Recorder** Operations Manual and the **DAS™ Data Acquisition Suite Software**. A brief description of each of the hardware components is in the following sections.

3.1.1 DataTrap II™ Data/VOD Recorder

The **DataTrap II™ Data/VOD Recorder** contains electronic circuitry and an internal rechargeable battery within a protective plastic case measuring approximately 28 x 25 x 18 cm (11 x 10 x 7 in.) and weighing 4 kg (8.8 lbs). The protective case prevents damage from water, sand, snow, dust and similar harsh weather conditions. As well, the case offers resistance to high temperatures, shocks and vibrations. The **DataTrap II™ Data/VOD Recorders** top panel is shown below.

MAIN CONTROL PANEL

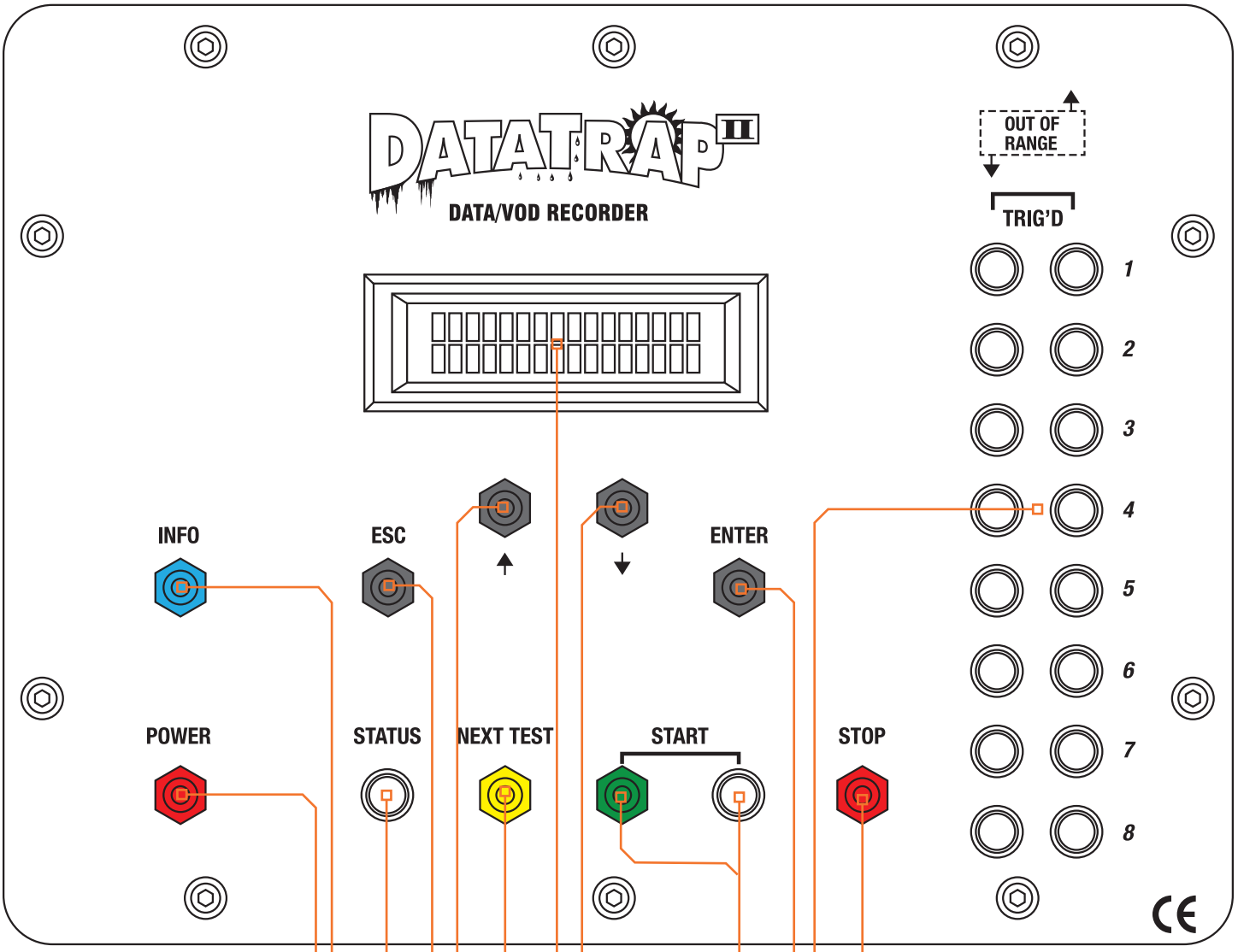


POWER Button:

The POWER button is used to provide power to the **DataTrap II™ Data/VOD Recorder**. To turn the **DataTrap II™ Data/VOD Recorder** on or off, press and hold the **POWER** button for 2 seconds. If the **DataTrap II™ Data/VOD Recorder** is acquiring or saving data, it will ignore a request to power off. The operator can force power off by pressing and holding **POWER** and **INFO** for 4 seconds. This will interrupt any activity the **DataTrap II™ Data/VOD Recorder** is carrying out. If the operator needs to stop a test while acquiring data, they should use the **STOP** button instead.

INFO Button:

The **INFO** shows the battery level and the current date/time on the Display. Holding it down will display Test **N** of **M** where **M** is the number of tests set up and **N** is the number of tests that have been run (from **0** to **M**). If **N** and **M** are equal, the **DataTrap II™ Data/VOD Recorder** memory is full and no more tests can be run.



POWER Button

INFO Button

STATUS Indicator

ESC Button

UP ARROW Button

NEXT TEST Button

STOP Button

TRIG'D/Out of Range Indicators

ENTER Button

START Button and Indicator

DOWN ARROW Button

LED Display

STATUS Indicator:

In **Active** mode, the light is illuminated, indicating that the **DataTrap II™ Data/VOD Recorder** is ready for the Operator to press the **START** button. When the **START** button is pressed, the **DataTrap II™ Data/VOD Recorder** begins to monitor the event to be recorded while awaiting a trigger signal.

In **Stand-by** mode, the light flashes slowly, indicating that the **DataTrap II™ Data/VOD Recorder** has finished collecting and storing data. In **Stand-by** mode, the **DataTrap II™ Data/VOD Recorder** is waiting for the Operator to either switch the **DataTrap II™ Data/VOD Recorder** power **OFF**; press the **NEXT TEST** button (to go to **Active** mode); or download the data to a computer.

In **Communications** mode, the light flashes quickly, indicating that the **DataTrap II™ Data/VOD Recorders USB communications** port is connected to a computer, through the **Communications Cable**, for setting the **DataTrap II™ Data/VOD Recorder** Recording Parameters and for transferring data to the computer and a communication is in progress.

Out Of Range (TRIG'D) Indicators

If **NEXT** has been pressed, these show if a channel is out of range (left light = below minimum, right light = above maximum). You will be prevented from pressing **START** if one of the lights is on. Check for shorted or open connections. You can override this by holding down the **START** button for 5 seconds.

If **START** has been pressed, the left light for a channel shows that it has been triggered, the right hand light shows that it has used up all the time allocated for that channel. If the lights are blinking, the entire test is over. The test can be ended manually by pressing **STOP**. To make the lights stop blinking, press **STOP**.

ESC Button, ENTER Button, UP ARROW Button and DOWN ARROW Button

The 4 buttons **ENTER**, **ESC**, ↑(**UP**) and ↓(**DOWN**) are used to view and adjust test settings. The menu is started by pressing **ENTER**, then using the **UP** and **DOWN** buttons to choose an option. Once the option is chosen, press **ENTER** to choose that option, which may take an action or may go to a deeper level into the menu. Press **ESC** to move up a level in the menu. Pressing **ESC** repeatedly will eventually take the operator back to the original menu. The menu structure is discussed in more detail in **Section 3.2**.

NEXT TEST Button:

The **NEXT TEST** button is used to change the **DataTrap II™ Data/VOD Recorders** mode from **Stand-by** to **Active**. When in **Active** mode, the **DataTrap II™ Data/VOD Recorder** waits for the Operator to press the **START** button to instruct the **DataTrap II™ Data/VOD Recorder** to await a trigger signal. The operator can press **ESC** to go back to **Stand-by** mode.

STOP Button:

The **STOP** button is particularly useful when the **DataTrap II™ Data/VOD Recorder** has been set at a relatively slow sampling rate. Once the Operator is satisfied that the required data has been recorded the **STOP** button can be pressed. This stops the recording, saves the data recorded up to that point then reverts to **Stand-by** mode. This allows the Operator to avoid having to wait for the full recording time.

START Button and Indicator:

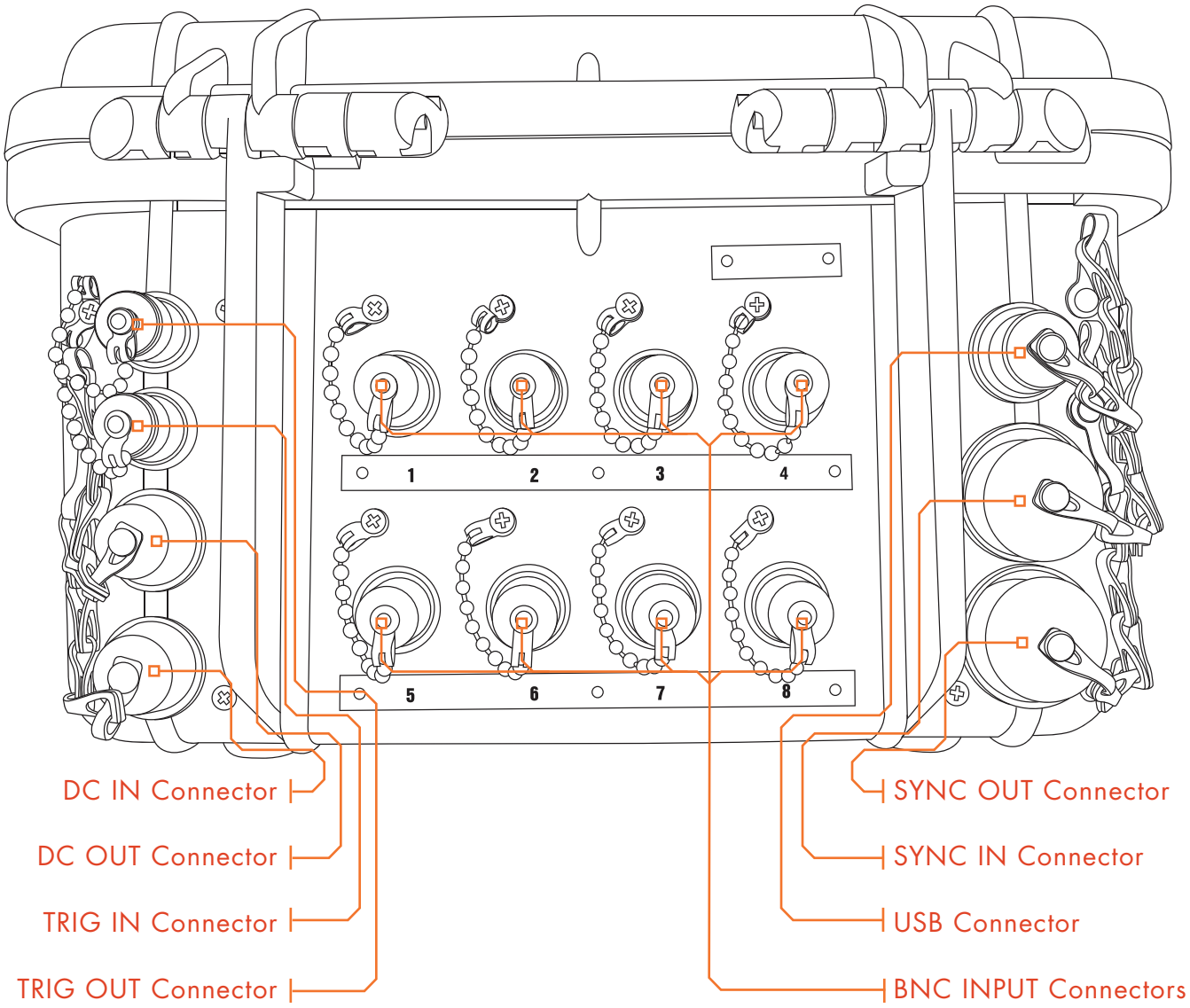
The **START** button instructs the **DataTrap II™ Data/VOD Recorder** to wait for a trigger signal to occur. When the **START** button is pressed the **START** light illuminates.

LED Display:

There is a two-line **Display** to show the current settings of the **DataTrap II™ Data/VOD Recorder** and the number of tests. The **Display** is also used to access a menu to set up the **DataTrap II™ Data/VOD Recorder**.

BACK PANEL

The back of the **DataTrap II™ Data/VOD Recorder** has a variety of input and output ports that are described below:



TRIG OUT Connector:

Signal on this connector becomes active (TTL high level) for several seconds when the **DataTrap II™ Data/VOD Recorder** has been triggered.

TRIG IN Connector:

BNC connector for the trigger wire, if external triggering is used.

DC OUT Connector:

It can be used to supply 10 VDC as an excitation source for other types of gauges.

DC IN Connector:

Used to connect the **DataTrap II™ Data/VOD Recorder** to the **Battery Charger** to recharge the **DataTrap II™ Data/VOD Recorder** internal battery, and to operate the **DataTrap II™ Data/VOD Recorder** from AC mains power.

USB Connector:

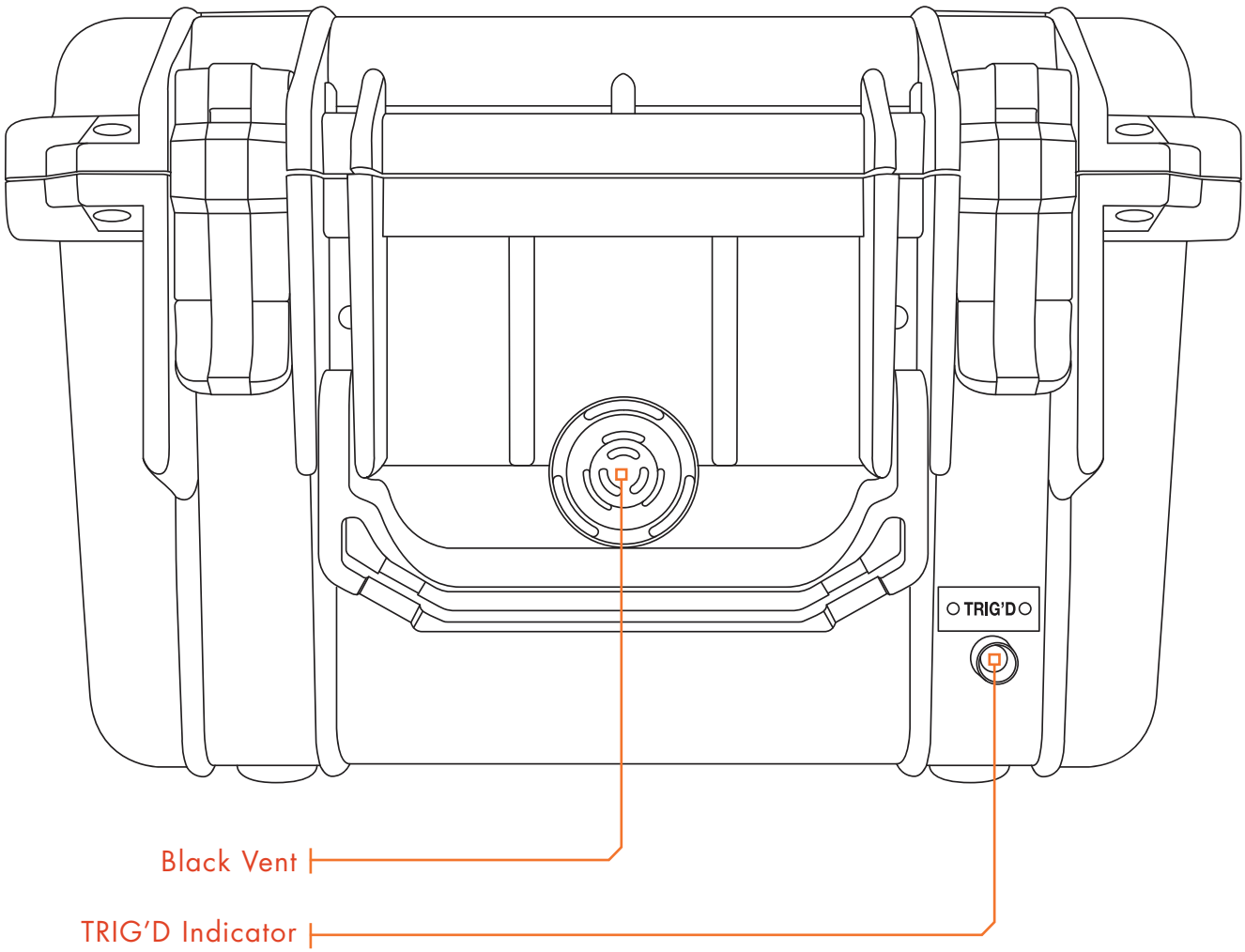
The **USB port** is used to connect the **Communications Cable** to the **DataTrap II™ Data/VOD Recorder**. The other end of the **Communications Cable** is connected to a **USB port** of the computer. A **USB 2.0** port is recommended. **USB 1.1** can be used, but downloading data is much slower. Be careful **NOT** to plug the **Power Cable** into the **USB port**.

SYNC IN and OUT Connectors:

The **SYNC** in and out ports are used to synchronize the time codes of several **DataTrap II™ Data/VOD Recorder** units working together. If synchronization is required to be used with multiple units, contact **MREL** for instructions with the software required**.**

BNC INPUT Connectors:

BNC connectors for connecting **DC** gauges or **VOD** probes (if **VOD Upgrade** is present) to inputs of channels to 8. The operator can check which channels will be active in the next test by using the display menu.



FRONT PANEL

Black Vent:

The **black Vent** on the front of the **DataTrap II™ Data/VOD Recorder** is an automatic pressure relief valve. When transporting the **DataTrap II™ Data/VOD Recorder** as by air, this valve allows pressure equalization upon landing. At high altitudes the internal pressure of the **DataTrap II™ Data/VOD Recorder** may drop, causing a negative air pressure at ground elevation which makes the lid very difficult to open without this pressure equalization valve.

TRIG`D Indicator:

The **TRIG'D** indicator light on the front of the **DataTrap II™ Data/VOD Recorder** will illuminate when at least one channel has been triggered. It will remain illuminated during collection of the data, which in turn depends on the recording rate selected for the test. The **TRIG'D** light flashes rapidly while the data is being stored in the **DataTrap II™ Data/VOD Recorders** non-volatile memory. The **TRIG'D** light flashes slowly once all data from the test has been stored in the **DataTrap II™ Data/VOD Recorders** memory. Otherwise, the light will remains off.

3.1.2 Battery Charger

The **Battery Charger** is used to charge the **DataTrap II™ Data/VOD Recorders** internal rechargeable battery, and it can be used to operate the **DataTrap II™ Data/VOD Recorder** from AC mains. It is Universal (100 – 240 VAC) adaptor.

3.1.3 USB Communications Cable

The **Communications Cable** is provided to connect the **DataTrap II™ Data/VOD Recorder** to a Personal Computer for programming the recording parameters of the **DataTrap II™ Data/VOD Recorder** and for downloading of the recorded data. The **Communications Cable** is connected between the **USB port** on the back panel of the **DataTrap II™ Data/VOD Recorder** and a **USB port** of the computer.

3.1.4 BNC Adapters

Ten (10) **BNC Adapters** are provided to facilitate easy connection between the channel input connectors on the **DataTrap II™ Data/VOD Recorder** to the coaxial cable (preferably RG-58/U) leading to the probes, and the external trigger wire, respectively.

3.1.5 Daisy Chain Cable

This allows up to 7 **DataTrap II™ Data/VOD Recorder** units to be synchronised. To set this up, use the **LED** menu to set one of the **DataTrap II™ Data/VOD Recorder** unit to be "**Master**" and the others to be "**Slave**". (Menu-Services-Synchronisation-Off/Master/Slave) For the proper software to utilize this feature, contact **MREL** for further instructions.

3.2 LED Display

The **DataTrap II™ Data/VOD Recorder** menu allows the operator to view information about the **DataTrap II™ Data/VOD Recorder** and also to change some of the settings. It is started by pressing the **ENTER** button after turning on the **DataTrap II™ Data/VOD Recorder**. This gives the above output: "**DATATRAP II Services Config**".

Using the menu has common pattern as follows:

1. Press **ENTER**.
2. Press the **UP** and **DOWN** arrows one or more times to choose an option.
3. When the option is reached, the operator may only want to view the current value of the setting. In this case, **ESC** is pressed to exit and go back to the previous group of options.
4. If the Operator presses **ENTER**, this processes the current option. Processing the current option will do one of the following:
   - Take an immediate action, such as changing the voltage range for a channel
   - Act if the user confirms the choice, such as erasing the last test.
   - Move down to a lower menu level which is read-only, such as the length of time for a channel in a test. After a choice of this type, the user can only press **ESC** to go back to the previous choice.
   - Move down to a lower menu level which allows further choices using the **UP** and **DOWN** arrows.

Initially, the options are **Services** and **Config**. The complete list of options are:

Services
↑ ↓ - Chooses Erase last test or Erase all tests
Erase last test
Press ↑ to confirm this
Erase All Tests
Press ↑ to confirm this
Synchronization : Off / Master / Slave
Timed Start : Off / Day-Time / Activate
Auto Advance : Off / 1 sec / 5 sec / 10 sec / 30 sec / 1 m / 2 m / 5 m / 10 m / … 240 m
Temperature : (read only) Shows internal and battery temperature
Maintain Battery : Fully discharges the battery to recalibrate the battery % indicator. (Tip: discharge overnight, then charge the next day)
Version Info : (Read only) This may be helpful for troubleshooting. PM is the Power Management (battery charging and measuring) firmware, MD is the main firmware.

Config
Configuration Test N (where N = a test number from 1 to 32)
↑ ↓ - Chooses the test number

Enter – Goes to Test Settings

↑ ↓ Chooses Edit, Summary, or Delete

Summary – Shows the number of channels active and the number of points assigned for that test.

Delete – Deletes the currently viewed test

Edit – Goes to Channel Settings

↑ ↓ Chooses which Channel to edit.

♦ : means that a channel is active

- : means that a channel is not monitored

Enter – Goes to the settings for the current channel

Range -

↑ ↓ Chooses VOD mode or a voltage range

(Press Enter to choose current range)

Recording Rate

↑ ↓ - Chooses the rate

(Press Enter to choose current rate)

Length

Shows length of time stored for that channel in seconds

(Read only – press ESC to exit)

Recording Rate

↑ ↓ - Chooses the rate

(Press Enter to choose current rate)

PreTrigger Time

↑ ↓ - Chooses % Pretrigger Time

(Press Enter to choose current amount)

Internal Trigger

↑ ↓ - Chooses Mode or Level

Mode

↑ ↓ - Low Level, High Level,

Rising Edge, Falling Edge, Rise or Fall

(Press Enter to choose current Mode)

Level

↑ ↓ - Chooses % Trigger Level

(Press Enter to choose current Level)

External Trigger

↑ ↓ - Chooses Mode

Mode

↑ ↓ - Low Level, High Level,

Break, Make, "Break or Make"

(Press Enter to choose current Mode)

(Press Enter to choose current amount)

Note: A channel that is set to be **inactive** using the software **cannot** be made active using the **LED menu.**

3.3 DataTrap II™ Data/VOD Recorder Internal Rechargeable Battery

The **DataTrap II™ Data/VOD Recorder** has an internal NiCad rechargeable battery. The **DataTrap II™ Data/VOD Recorder** is supplied with an approved 100-240 VAC Battery Charger. When the internal battery is fully charged, the **DataTrap II™ Data/VOD Recorder** can operate for 8 hours (typical use power consumption) before battery recharging is required. The **DataTrap II™ Data/VOD Recorder** is shipped from **MREL** fully charged. Since some time may elapse before the **DataTrap II™ Data/VOD Recorder** is actually put to use, the **DataTrap II™ Data/VOD Recorder** may not be charged fully the first time it is used. Full operating time will be obtained when the **DataTrap II™ Data/VOD Recorder** is recharged.

CAUTION

The DataTrap II™ Data/VOD Recorder shuts itself off to help prevent complete discharging of the internal battery. It is important to note that the DataTrap II™ Data/VOD Recorder has a non-volatile memory, allowing the data to be stored safely regardless of the power status of the internal battery.

3.4 Testing The DataTrap II™ Power Status

The procedure to check the power status of the **DataTrap II™ Data/VOD Recorder** is as follows:

1. Turn the **DataTrap II™ Data/VOD Recorder** on by pressing the **POWER** button for 2 seconds.
2. Press the **INFO** button on the front panel or hold it down to wake up the **DataTrap II™ Data/VOD Recorder** if it is in a power conservation mode.
3. The display will show the energy remaining in the battery as a percentage of the full charge.

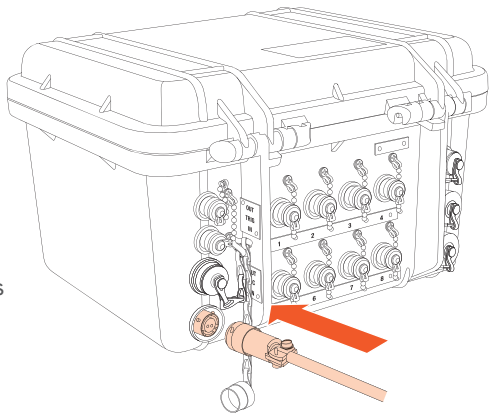
CAUTION

The DataTrap II™ Data/VOD Recorder circuitry ensures that the internal battery can not be overcharged. According to the battery Manufacturer's specifications, recommended recharging temperature is 20 to 30 °C (68 to 86 °F).

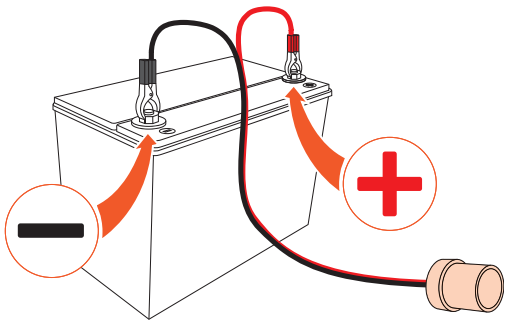
3.5 Recharging the DataTrap II™ Data/VOD Recorder

The procedure to recharge the **DataTrap II™ Data/VOD Recorder** is as follows:

1. With the **DataTrap II™ Data/VOD Recorder** switched **OFF**, connect the **Battery Charger** to the **DC IN** port on the back of the **DataTrap II™ Data/VOD Recorder** and the wall outlet. The display will show "**Charging**" indicating that charging is progressing. If the battery is discharged completely, precharge will be performed automatically. During the precharge cycle the "**Charging**" text will appear for a while once per several seconds. The precharge cycle takes several minutes, after that normal charging process will take place automatically.
2. Full recharging will take up to 8 hours. When charging has been completed, the display will read "**Battery full**".



3. Unplug the **Battery Charger** from the wall outlet and then from the **DataTrap II™ Data/VOD Recorder**. The **DataTrap II™ Data/VOD Recorder** battery status can be tested as detailed in **Section 3.4**.
4. Be careful to avoid touching the **Power Plug** to the **USB port.**

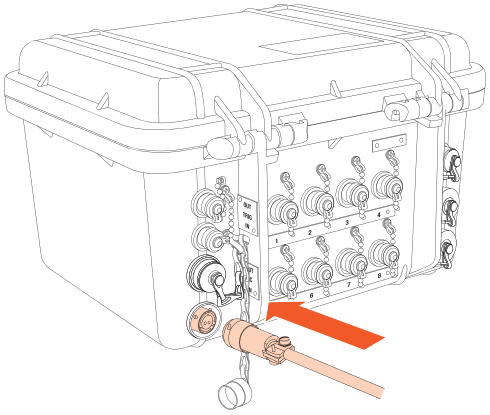


3.5.1 Operating the DataTrap II™ Data/VOD Recorder with the 12V Adapter (Optional)

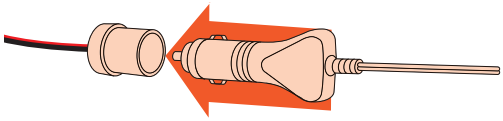
The **DataTrap II™ Data/VOD Recorder** can operate for a longer period of time using an external **12 V battery** as a power source. Typically, it will operate for 1 hour for each Ah of capacity of the battery

1. Connect the alligator clips to the battery. Ensure that **Red** (**positive**) is connected to **Red** and **Black**(**negative**) to **Black**.

2. Connect the power connector to the **DataTrap II™ Data/VOD Recorder** as shown to the right.



3. Connect the **Cigarette Lighter Adapter** (Optional) to complete the connection.



When the **DataTrap II™ Data/VOD Recorder** is **off**, it will charge in slow mode (1% to 2% per hour) and the screen to the right will be shown on the **DataTrap II™ Data/VOD Recorder.**

Note: It is really not useful to charge using a 12 V battery, but it can be very useful to operate with it.

When the **DataTrap II™ Data/VOD Recorder** is turned **on**, it will indicate that it is running on DC power and the screen to the right will be shown on the **DataTrap II™ Data/VOD Recorder**

3.6 Long Term Storage Considerations

There are no special procedures, other than those pertaining to the internal battery, should be taken for long term storage of the **DataTrap II™ Data/VOD Recorder**. In the eventuality that the **DataTrap II™ Data/VOD Recorder** remains idle for long periods, it is recommended to recharge the **DataTrap II™ Data/VOD Recorder** once per month per the procedure in **Section 3.5**. This will maintain the conditioning of the internal battery.

3.7 VOD Resistance Probes Used By The DataTrap II™ with VOD Upgrade

The following types of **VOD** resistance probes are available from **MREL** and are uniquely calibrated for use with the **DataTrap II™ Data/VOD Recorder**:

3.7.1 VOD PROBEROD

The **VOD PROBEROD**, shown above, is a calibrated rigid probe consisting of a high resistance insulated wire placed within a small diameter, metal tube, which acts as the return lead of the circuit. **PROBERODs** are specifically designed to measure **VODs** of explosive cartridges and/or of short sample tubes of explosives, under confined or unconfined conditions. They are available from **MREL** in a standard length of 1 m (3.3 ft.) and are supplied with leads ready to be connected to the **RG-58 coaxial cable**, which connects to the channel connectors on the back of the **DataTrap II™ Data/VOD Recorder**. **PROBERODs** are also available in custom lengths. Contact **MREL** for additional **PROBEROD** information.

3.7.2 VOD PROBECABLE

Two types of calibrated flexible resistance wire are available from **MREL**: **VOD PROBECABLE "GREEN"** and **VOD PROBECABLE-LR "BLUE"**. These cables have been specially developed and refined by **MREL** with extensive feedback and assistance from **MREL's VOD** Instrumentation Customers since 1987. They are ideally suited to all explosive types loaded into all blasthole conditions including wet holes. They have the classical configuration of a standard RG-type coaxial cable, where the high resistance wire is the central conductor and the braided shield acts as the return lead. A dielectric material placed between the resistance wire and the return lead provides both electrical insulation and a physical barrier between them. The latter feature reduces the possibilities of short circuits during handling of the **PROBECABLE**. A plastic outer layer protects the **PROBECABLE** from tearing actions during loading.

PROBECABLE and **PROBECABLE-LR** are used for measuring **VODs** of explosives in blastholes, and the delay times between holes and decks. The selection of either **PROBECABLE** or **PROBECABLE-LR** is based on the total resistance of the circuit, which in turn depends on the number of holes being monitored. The only difference between these two cables relates to their nominal or unit resistance. **PROBECABLE** has a unit resistance of 10.8 ohm/m (3.29 ohm/ft) while **PROBECABLE-LR** (LR stands for Low-Resistance) has a unit resistance of 3.38 ohm/m (1.03 ohm/ft). The latter allows **VOD** recording for lengths up to approximately 850 m (2,800 ft) per test.

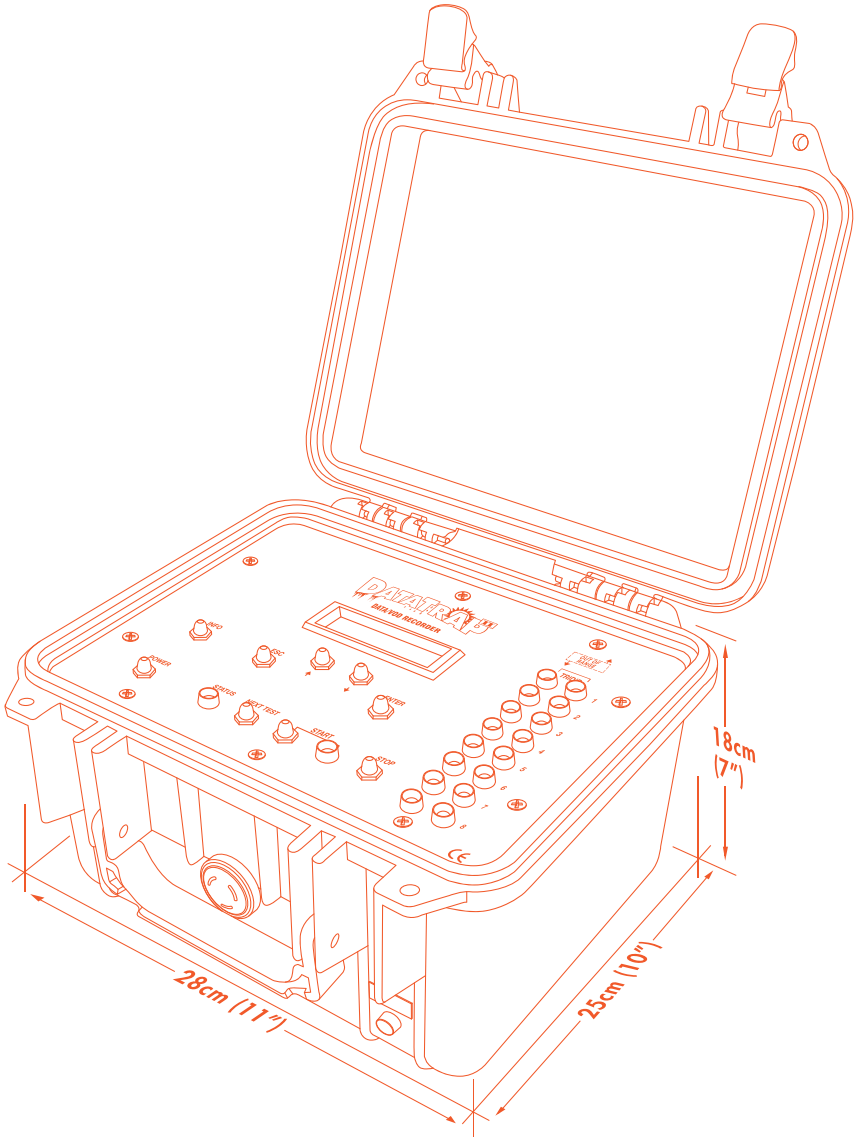
Both types of **PROBECABLE** are available directly from **MREL** in a unique "reel-in-a-box" packaging with 1,000 m (3,280 ft.) per box. The reel-in-a-box allows free spooling of the **PROBECABLE** into the blasthole by one operator without the need for a cable reel stand or another person to hold the reel of cable. The cable in each box is checked by **MREL**. The exterior of the box has a unique Quality Tracking Number and its unit resistance applied. Contact **MREL** for additional **PROBECABLE** information.

3.8 DataTrap II™ Technical Specifications

Number of Channels and Input Ranges	8 channels that can be independently set by the operator to: OFF, 0-2.5 VDC, 0-5 VDC, 0-7.5 VDC, 0-10 VDC, +/-2.5 VDC, +/-5 VDC, +/-7.5 VDC or +/-10 VDC using the **DataTrap II™ Data/VOD Recorder** Software or the integrated LCD menu on the **DataTrap II™ Data/VOD Recorder** panel. Upgradeable to provide 8 independent channels of accurate strain measurements in masonry walls, concrete and other structures. Upgradeable to allow the independent setting of up to 8 VOD channels for testing explosives performance. Up to 56 channels using multiple **DataTrap II™ Data/VOD Recorders** connected together through the synch connector on each **DataTrap II™ Data/VOD Recorder**.
Resolution	14 bits, 1 part in 16,384.
Recording Rates	Adjustable by the operator from 1 Hz to 10 MHz per channel using the **DAS™ Data Acquisition Suite** or the integrated LCD menu on the **DataTrap II™ Data/VOD Recorder** panel. Recording rate is independent of the number of channels in use. When using the synch connector, recording rate is limited to 5 MHz.
Total Memory	Standard = 128 MB (64 million data points). Optional = 256 MB (128 million data points) or 512 MB (256 million data points). Memory is allocated across the number of channels in use.
Pre-Trigger Time	Adjustable by the operator from 0% to 100% of the Total Memory using the **DAS™ Data Acquisition Suite** or the integrated LCD menu on the **DataTrap II™ Data/VOD Recorder** panel.
Trigger Mode	Selectable by the operator: trigger internally on the signal from the event (2 to 98%) or trigger externally from TTL or a trigger wire. The external trigger type can be selected by the operator as "trigger on make circuit" or "trigger on break circuit" using the **DAS™ Data Acquisition Suite** or the integrated LCD menu on the **DataTrap II™ Data/VOD Recorder** panel.
Multiple Event Storage	Adjustable by the operator to allow from 1 to 32 tests to be stored in the **DataTrap II™ Data/VOD Recorders** internal memory using the **DAS™ Data Acquisition Suite**.
Power	Internal rechargeable NiCad battery which provides 6 hours of active operation on a full charge. Full battery recharging is obtained overnight. The **DataTrap II™ Data/VOD Recorder** can also be operated through the Battery Charger from AC mains power, and from any external 12 to 20 VDC power source through the 12 VDC Battery Adapter.
Field Settings/Menus	The **DataTrap II™ Data/VOD Recorder** operates without the need for the operator to make any **DataTrap II™ Data/VOD Recorder** recording settings in the field. The operator can use the integrated LCD display with menu buttons to confirm and/or change the **DataTrap II™ Data/VOD Recorder** recording parameters when a computer is not available. The basic **DataTrap II™ Data/VOD Recorder** operating procedure is: connect the gauge outputs to the signal input BNC connectors on the **DataTrap II™ Data/VOD Recorder**, turn the **DataTrap II™ Data/VOD Recorder** power on, press the **NEXT TEST** button, press the **START** button and walk away. When the trigger condition is met, the **DataTrap II™ Data/VOD Recorder** is triggered and it automatically records the data without operator assistance.
System Components Provided	**DataTrap II™ Data/VOD Recorder**, 100-240 VAC Battery Charger, **USB Communications Cable**, 12 VDC Battery Adapter, colour Operations Manual, **DAS™ Data Acquisition Suite** for **Windows®**.
Size and Weight	**DataTrap II™ Data/VOD Recorder**: 28 x 25 x 18 cm (11 x 10 x 7 in.) 4 kg (8.8 lbs).
Environmental	Fully operational at -40 to +80 °C (-40 to +185 °F). Snow, rain, dust and sand proof. Drop proof from a height of at least 1 m (3.3 ft.).

PC Connection	At any time after recording, the operator can connect the **DataTrap II™ Data/VOD Recorder** to a computer's USB port to download and view the data on a computer. The connection between the **DataTrap II™ Data/VOD Recorder** and the computer also allows the operator to confirm and/or change the **DataTrap II™ Data/VOD Recorder** recording parameters. The operator can also use the integrated LCD display with menu buttons to confirm and/or change the **DataTrap II™ Data/VOD Recorder** recording parameters when a computer is not available.
DataTrap II™ Software for Windows	The **DAS™ Data Acquisition Suite** for **Windows®** operates under **Windows® XP** and later. It provides an easy-to-use and familiar graphical-user-interface that allows the operator to easily download the data to the computer and analyze the data. Voltage data are automatically displayed as graphs of voltage versus time. The data can be graphed as voltage versus time or converted to graphs of engineering units (vibration, temperature, pressure, acceleration, user-defined) versus time using the **DataTrap II™ Data/VOD Recorder** Software. All Software operations are "point and click". The Software allows unlimited graphical zoom on graphs, creation of annotated sub-graphs. The Software contains a wide variety of functions for data analysis along with the ability to accept user-defined functions to analyze the data. Annotating, printing, saving and export of graphs and data to other **Windows®** software are all easily accomplished.
Warranty	**MREL's** 1 year Comprehensive Parts and Labour Warranty.
Technical Support	**MREL's** Unlimited Technical Support Program by email, fax and telephone.
VOD Upgrade	Factory installed by **MREL** in the **DataTrap II™ Data/VOD Recorder**. Provides **VOD** recording capability to each of the 8 channels of the **DataTrap II™ Data/VOD Recorder** allowing the Operator to select **VOD** or **Scope** input on each channel independently. Utilizes the memory in the **DataTrap II™ Data/VOD Recorder**. Includes installation of **DataTrap II™ Data/VOD Recorder VOD Upgrade** circuit board.
STRAIN Upgrade	Can be attached to the **DataTrap II™ Data/VOD Recorder** by the Operator. Provides 8 channels of continuous strain recording capabilities to the **DataTrap II™ Data/VOD Recorder**. Dynamic strain resolution: 5 µstrain (0-3000 µstrain range). Includes provision of **DataTrap II™ Data/VOD Recorder Strain Module**.

Chapter 4
Memory And Triggering



Overview

This Chapter provides information on the memory of the DataTrap II™ Data/VOD Recorder and triggering.

4.1 Information on Memory and Triggering

4.1.1 Memory

The **DataTrap II™ Data/VOD Recorder** has a large circular memory containing either: 64 million, 128 million or 256 million data points, depending on the Memory Option installed. These data points are allocated according to the number of tests in which the **DataTrap II™ Data/VOD Recorders** memory has been divided, and the number of Channels being recorded. These values, for a selected Recording Rate, define the available **Total Recording Time** for each test. Selection of the number of tests to be recorded, the number of Channels and the Recording Rate is done using the Software as detailed in the **DAS™ Data Acquisition Suite Manual**. The **DataTrap II™ Data/VOD Recorder** Software automatically calculates and displays the Total Recording Time per Test and the **Pre-Trigger Time**. The exact amount of memory allocated to a particular channel for a particular test can be adjusted.

The typical usage of the **DataTrap II™ Data/VOD Recorder** is to set it up by choosing the number of tests and channels, which divides memory equally between them. After that, sizes can be increased or decreased for specific tests and channels. For planning a sequence of tests, the following equation is useful:

A general equation to calculate the Total Recording Time (Pre-trigger Time + Post-trigger Time) is:

Total Recording Time (seconds) = P / [(# of tests) x (# of channels) x (recording rate)]

Where P=# of points currently set up in the **DataTrap II™ Data/VOD Recorder** = 64, 128, or 256 million

Note: because of binary rounding (1 megabyte = 1.048 million bytes), the actual number of data points is 67 million, 134 million, and 268 million.

If the number of tests selected is one, and only one channel is being recorded, the available recording time will be maximized for a given Recording Rate. For example, at the maximum Recording Rate 10 MHz, and a **DataTrap II™ Data/VOD Recorder** with maximum memory, the Total Recording Time will be:

268,000,000 / ((1 test) x (1 channel) x (10,000,000 points/sec)) = 26.8 seconds

For 8 channels, it is,

268,000,000 / ((1 test) x (8 channels) x (10,000,000 points/sec)) = 3.3 seconds

When using precise adjustment to set up a channel, the length of test can only be increased or decreased 1024 points at a time. **Pre-Trigger** time can be adjusted to an exact number of points.

4.1.2 Triggering

When the trigger type is selected in the Software to be External, the trigger signal that the **DataTrap II™ Data/VOD Recorder** receives is from the **Trigger Wire**. This corresponds to time = 0 on the resulting **VOD** graph.

When the trigger type is selected in the Software to be Internal and set to **Low Level** the **DataTrap II™ Data/VOD Recorder** is triggered

by the signal received from the probe placed in the explosives. This trigger signal occurs according to the following principle: when the explosive detonates, the probe is consumed and the probe length is reduced. This in turn reduces the resistance and thus the voltage across the probe decreases from the initial 5.0 VDC (approximately) set automatically by the **DataTrap II™ Data/VOD Recorder**. When the voltage across the probe reaches the value corresponding to the **Trigger Level** selected by software, the **DataTrap II™ Data/VOD Recorder** is triggered. This represents time = 0 on the resulting **VOD** graph. For example, with a **Trigger Level** setting of 95%, the **DataTrap II™ Data/VOD Recorder** will be triggered when the voltage signal coming from the probe crosses the 95% level (4.75 VDC of the full-scale voltage, which is approximately 5.0 VDC).

Once the **DataTrap II™ Data/VOD Recorder** receives the trigger signal, it stores the **VOD** information received immediately prior to the trigger signal into the pre-trigger memory; the **VOD** information received after the trigger signal is stored into the post-trigger memory. The recording time for each memory allocation (pre and post-trigger) will depend on the setting selected, using the software, for **Pre-Trigger** %. The **DAS™ Data Acquisition Suite** Software automatically calculates and displays the Total Recording Time per Test and the Pre-Trigger Time. For those Operators with additional interest in recording times:

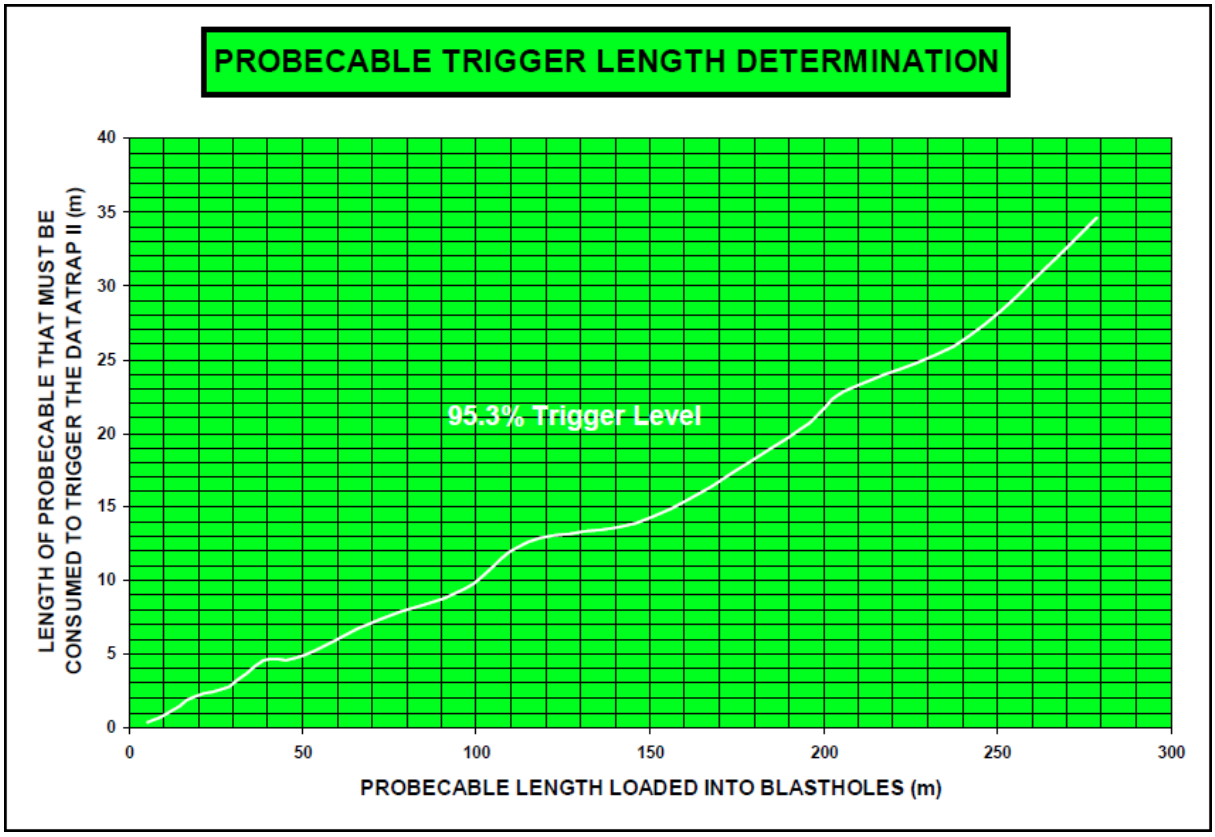
Pre-Trigger Time = (Total Recording Time) x Pre-Trigger %
Post-Trigger Time = (Total Recording Time) - (Pre-Trigger Time)

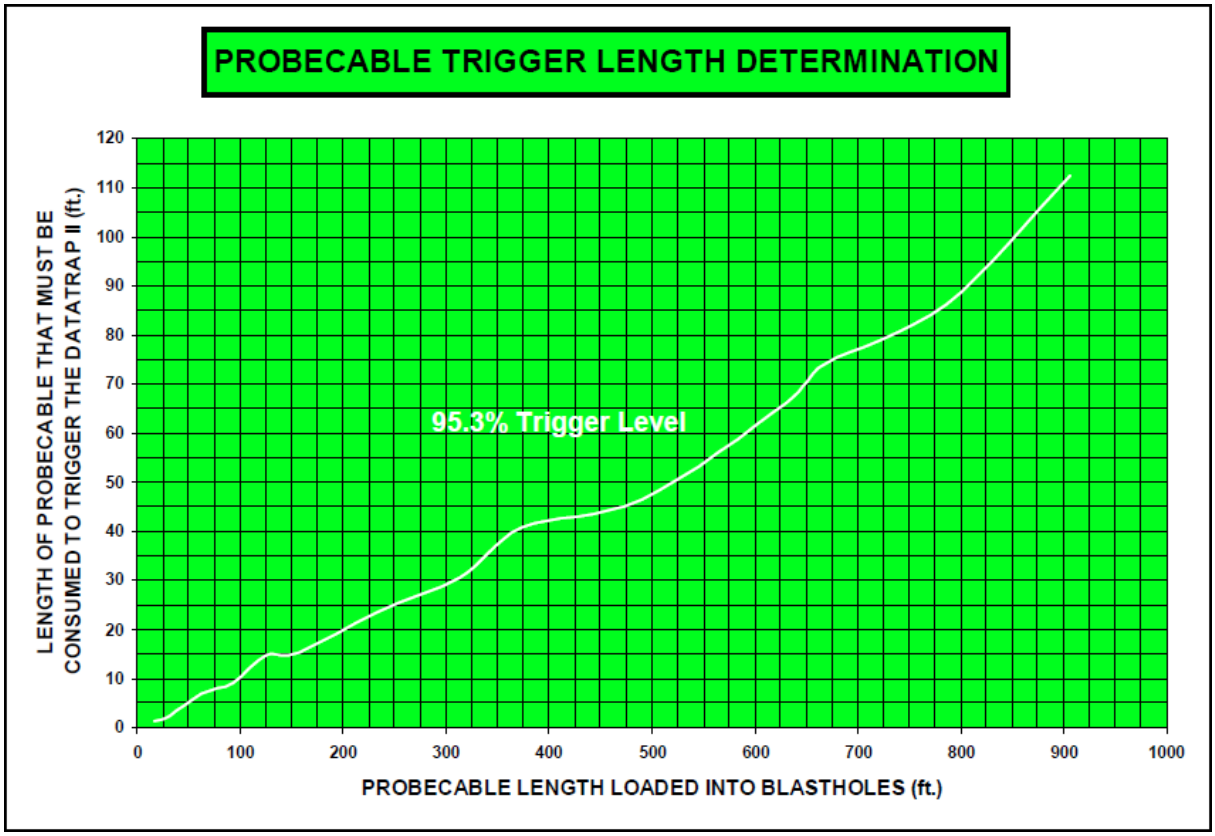
For the **PROBECABLE** or **PROBECABLE-LR** length loaded in the blastholes, and the recommended TRIG% setting of 95.3%, the graphs on the following pages show the lengths of **PROBECABLE** and **PROBECABLE-LR** that must be consumed for the **DataTrap II™ Data/VOD Recorder** to receive the INTernal trigger signal. **PROBECABLE-LR** should be used for tests involving several holes where if **PROBECABLE** was used it would result in the Total Resistance exceeding the maximum resistance accepted by the **DataTrap II™ Data/VOD Recorder** (3,000 ohms).

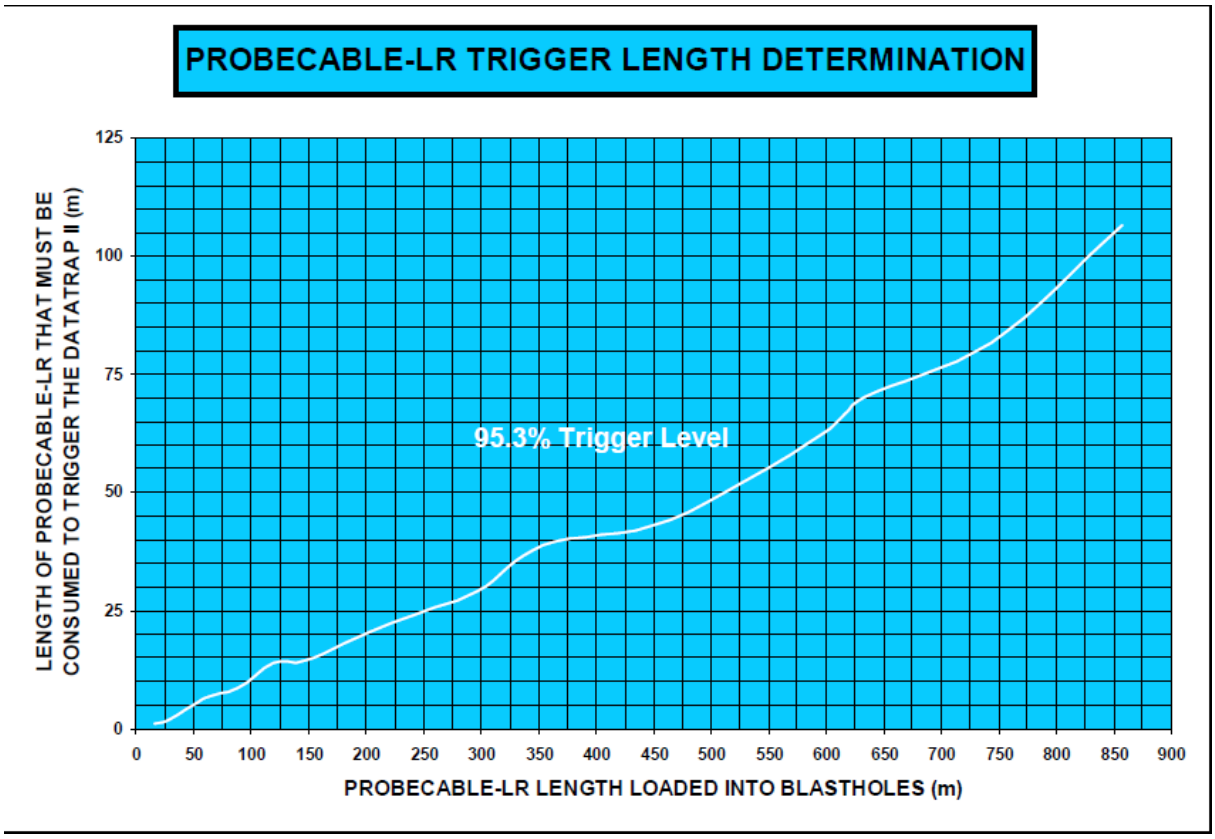
For example, at a 95.3% **Trigger Level** and with 250 metres of **PROBECABLE** loaded into blastholes, then 28 metres of **PROBECABLE** must be consumed to trigger the **DataTrap II™ Data/VOD Recorder**. If the first hole does not consume a sufficient length of **PROBECABLE** to trigger the **DataTrap II™ Data/VOD Recorder**, then all of the **VOD** data for the first hole will be before time = 0.

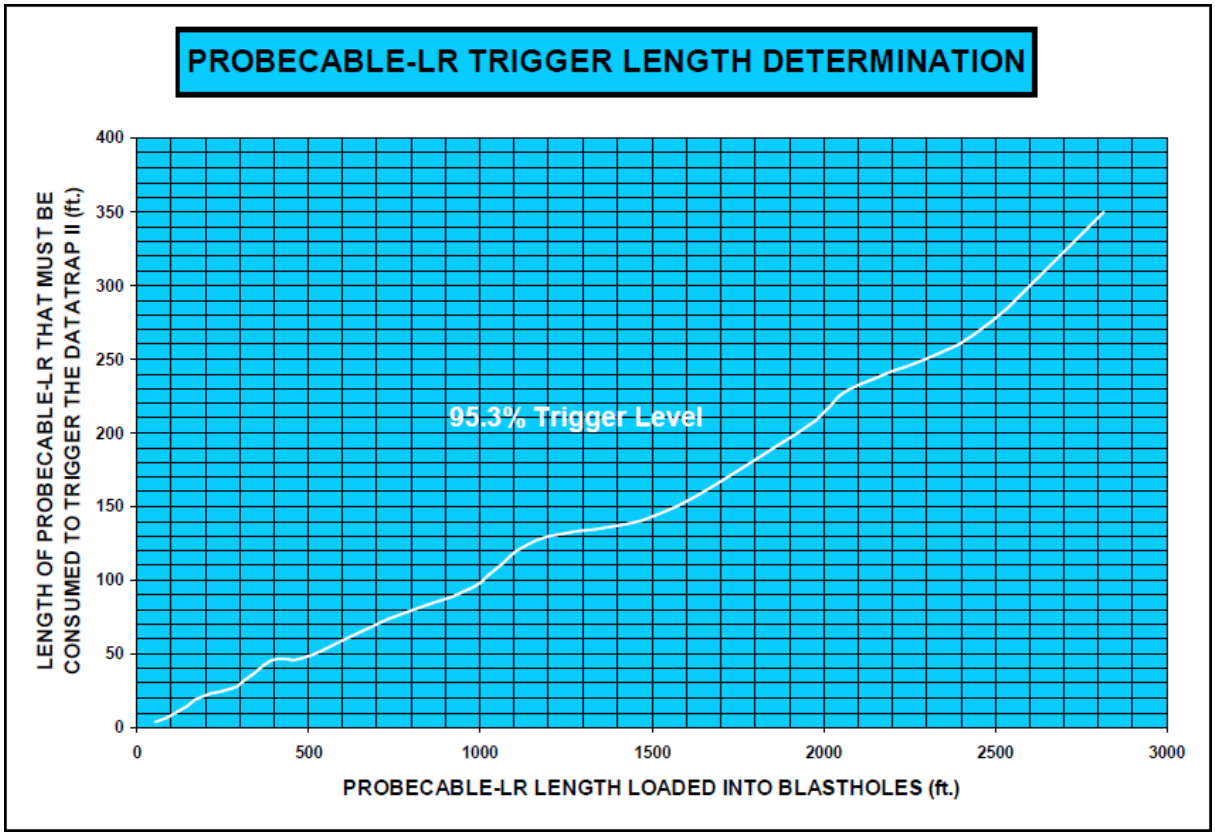
The Operator should ensure that there is sufficient **Pre-Trigger** time to record the time it takes for the trigger length of **PROBECABLE** to be consumed in the blast. This is particularly important if several delayed holes must be detonated in order for sufficient **PROBECABLE** to be consumed. The **DataTrap II™ Data/VOD Recorder** has a very large memory and a very long Total Recording Time. At a Pre-Trigger % setting of 25%, the **DataTrap II™ Data/VOD Recorder** has a long **Pre-Trigger Time**. It is likely that there will always be sufficient **Pre-Trigger Time** to record the time it takes for the trigger length of **PROBECABLE** to be consumed in the blast.

If there is insufficient **Pre-Trigger time**, the best procedure is for the Operator to re-program the **DataTrap II™ Data/VOD Recorder** using the Software and increase the Pre-Trigger % to increase the amount of **Pre-Trigger Time** to suit the test. Alternatively, the Operator can reduce the Recording Rate to increase the amount of both Pre and Post-Trigger Time.

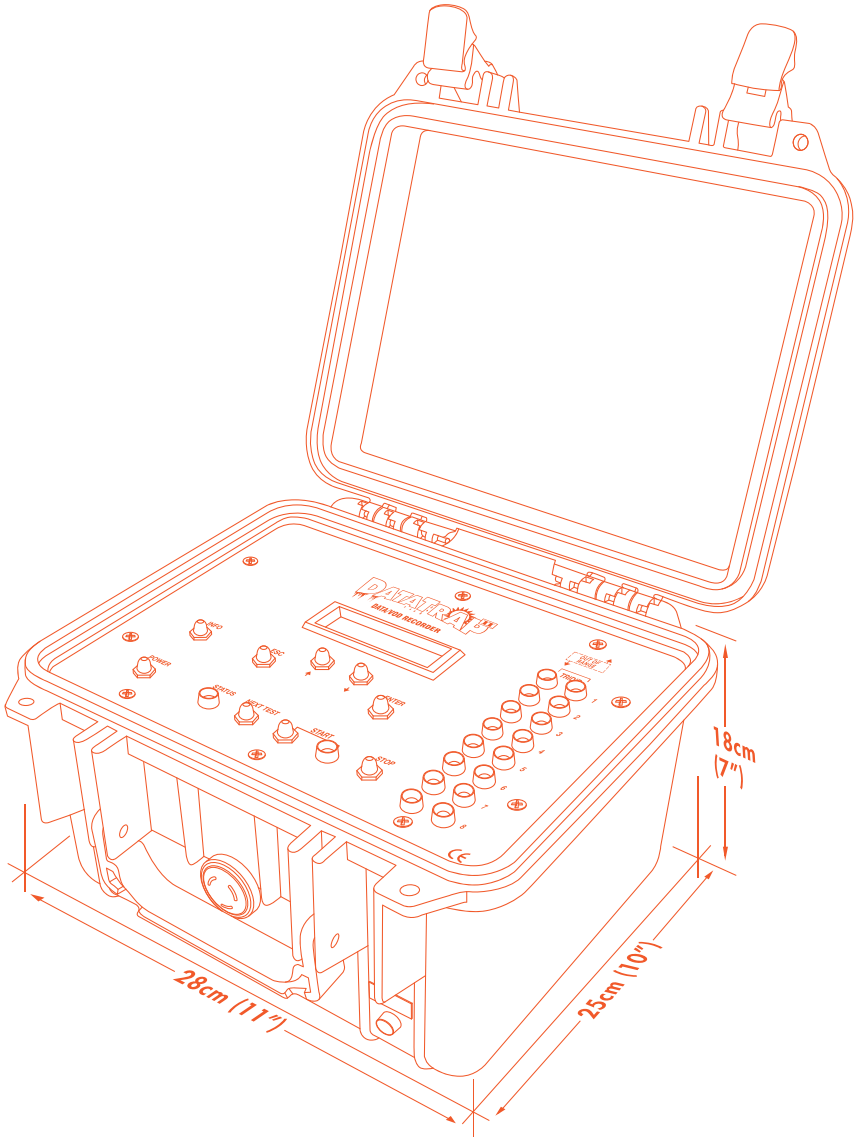

PROBECABLE TRIGGER LENGTH DETERMINATION
LENGTH OF PROBECABLE THAT MUST BE CONSUMED TO TRIGGER THE DATATRAP II (m)
95.3% Trigger Level
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
PROBECABLE LENGTH LOADED INTO BLASTHOLES (m)


PROBECABLE TRIGGER LENGTH DETERMINATION
LENGTH OF PROBECABLE THAT MUST BE CONSUMED TO TRIGGER THE DATATRAP II (ft.)
95.3% Trigger Level
0
10
20
30
40
50
60
70
80
90
100
110
120
0
100
200
300
400
500
600
700
800
900
1000
PROBECABLE LENGTH LOADED INTO BLASTHOLES (ft.)


PROBECABLE-LR TRIGGER LENGTH DETERMINATION
LENGTH OF PROBECABLE-LR THAT MUST BE CONSUMED TO TRIGGER THE DATATRAP II (m)
125
100
75
50
25
0
95.3% Trigger Level
0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900
PROBECABLE-LR LENGTH LOADED INTO BLASTHOLES (m)


PROBECABLE-LR TRIGGER LENGTH DETERMINATION
LENGTH OF PROBECABLE-LR THAT MUST BE CONSUMED TO TRIGGER THE DATATRAP II (ft.)
400
350
300
250
200
150
100
50
0
95.3% Trigger Level
0 500 1000 1500 2000 2500 3000
PROBECABLE-LR LENGTH LOADED INTO BLASTHOLES (ft.)

Chapter 5
Recording VOD And Hole/Deck Delay Times



Overview

This Chapter provides detailed instructions on selecting a suitable site for testing sample explosives, loading VOD PROBEROD and VOD PROBECABLE and connecting the DataTrap II™ Data/VOD Recorder to record VODs and deck delay times.

5.1 Safety Considerations For Selecting An Explosive Testing Site

STOP

Contact **MREL** for site specific recommendations for testing samples of explosives.

Care must be taken to select a good site for detonation and **VOD** recording of explosive samples. If convenient, permanent test sites may be constructed. A pit surrounded by an earth wall suffices as a simple detonation site. A similarly protected shelter for the **DataTrap II™ Data/VOD Recorder** and personnel can be constructed some distance away. The distance will depend on the amount of explosive being detonated at one time, and if the explosives are confined (hazard from steel fragments). Ensure that the area is well demarcated and that access is restricted.

If samples of explosives are to be detonated at an unprepared site, then the Operator must be careful when deciding upon what type of ground the charges are to be placed. Avoid placement on ground with stones, rubble or anything that is likely to turn into a projectile. The best surfaces are fines, sand or tailings.

If the Operator is recording large surface blasts in air and there is concern of airblast overpressure, then the **DataTrap II™ Data/VOD Recorder** can be placed in a steel box and buried approximately 30 cm (1 ft.) under the ground surface to provide the best protection from airblast overpressure.

It is always good practice to have maximum control over the time of firing of the test, therefore safety fuse initiation is not recommended. Electric or shock tube initiation is best with the detonator either initiating the sample of explosives or initiating the primer/booster in the explosive sample.

5.2 The Resistance Wire Technique For Measuring VOD

The **DataTrap II™ Data/VOD Recorder** is capable of monitoring the continuous **VOD** profile along the entire length of an explosives column. The **DataTrap II™ Data/VOD Recorder** can measure the **VOD** of relatively short explosive samples such as explosive cartridges. The **DataTrap II™ Data/VOD Recorder** can also measure the **VOD** of explosives loaded in blastholes in surface or underground blasts, in single and multiple hole blasts. The **DataTrap II™ Data/VOD Recorder** provides a regulated constant excitation signal to the **VOD** probes and monitors the drop in voltage across them.

The **DataTrap II™ Data/VOD Recorder** uses the proven continuous resistance wire technique for monitoring **VODs**. An **MREL**-qualified probe of known linear resistance (i.e. ohm/m or ohm/ft) is placed axially in the explosive sample or explosive column. As the detonation front of the explosive consumes the probe, the resistance of the circuit will decrease in proportion to the reduction in length of the probe. The **DataTrap II™ Data/VOD Recorder** records the resulting decrease in voltage across the **VOD** probe versus time.

The **DAS™ Data Acquisition Suite Software** automatically converts the recorded data into a graph of distance versus time for each **VOD** channel utilized. The slope of this graph at any position is the **VOD** of the explosive at that particular position. The Software includes menu functions that will automatically calculate and display the **VOD** of an explosive at any selected location in the graph. Other

functions allow the Operator to calculate and display the delay time between selected blastholes or between selected explosive decks within a blasthole.

5.3 Installing ProbeRods For Testing Samples Of Explosives

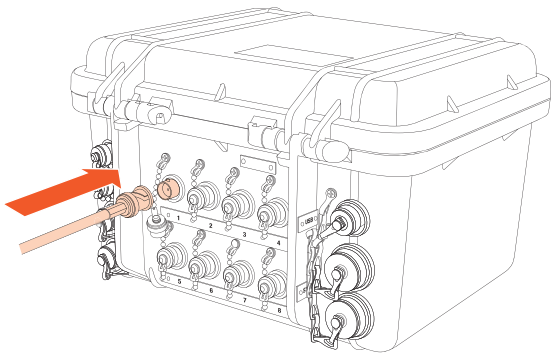
The equipment and supplies that are required to conduct VOD tests on samples of explosives or on explosive cartridges are:

1. The **DataTrap II™ Data/VOD Recorder** System with **VOD Upgrade** installed
2. **VOD PROBEROD** (available from **MREL**) - one (1) per explosive sample.
3. Coaxial cable (type RG-58 is recommended) - sufficient length to run between the **DataTrap II™ Data/VOD Recorder** location and the explosives.
4. Wire cutters and electrical tape.
5. Explosives, detonators and shot exploder.

The procedure for preparing a **VOD** test is as follows:

1. Demarcate the charge detonation area.
2. Place the **DataTrap II™ Data/VOD Recorder** in a protective shelter and/or a safe distance away from the detonation area. This distance may be closer than what is considered safe for the Operator. Once the setup is completed, the **DataTrap II™ Data/VOD Recorder** does not require an Operator to collect the data; it does so automatically without Operator assistance.
3. For each **VOD PROBEROD** to be recorded per test, run a length of coaxial cable from the **DataTrap II™ Data/VOD Recorder** to the **PROBEROD** with enough excess length to compensate for cable shortening or cable damage from each test (if applicable). Shorter lengths of coaxial cable may be connected together using the wire cutters and electrical tape. A male **BNC connector** should be attached to the end of the coaxial cable that is to be attached to the channel inputs (labeled **1 2 3 4 5 6 7 8**) on the back of the **DataTrap II™**. Convenient **BNC Adapters** have been supplied with the **DataTrap II™ Data/VOD Recorder** for this purpose. The Adapters can be connected to the coaxial cable using the wire cutters and electrical tape. The connection should be shielding to shielding and centre conductor to centre conductor. Ensure that the centre conductor and the shielding connections do not touch each other.
4. Note the Unit Resistance of the probe by reading the value in ohm/m or ohm/ft from the **MREL** factory label on the **PROBEROD**. Note the ohm/m value if the **VOD** is to be reported in m/s. Note the ohm/ft value if the **VOD** is to be reported in ft/sec. The Unit Resistance information will be requested later by the **DataTrap II™ Data/VOD Recorder** Software.
5. Insert a **PROBEROD** axially in the sample of explosives. Start at the opposite end from where the detonator will be placed as shown on the next page.

   If bulk explosives are being tested in paper tubes, plastic tubes or steel pipes which have been sealed at both ends, make a small central hole to allow the **PROBEROD** to be inserted. If a measurement of run-up to detonation is required, ensure that the **PROBEROD** is pushed well into the explosives so that it reaches the position of the detonator or booster. If the **PROBEROD** reaches the booster or protrudes past it, the effect of the booster will be recorded by the **DataTrap II™ Data/VOD Recorder**. The same holds true for cartridges of explosives. To test the **VOD** of detonation cord, tape the detonation cord along the entire length of the **PROBEROD**.



6. Connect the **PROBEROD** to the coaxial cable using the wire cutters and electrical tape. The polarity of the connection is not important.
7. At the **DataTrap II™ Data/VOD Recorder** end, connect the coaxial cables to the input connectors (labeled **1 2 3 4 5 6 7 8**) located on the outside and at the back of the **DataTrap II™ Data/VOD Recorder**.

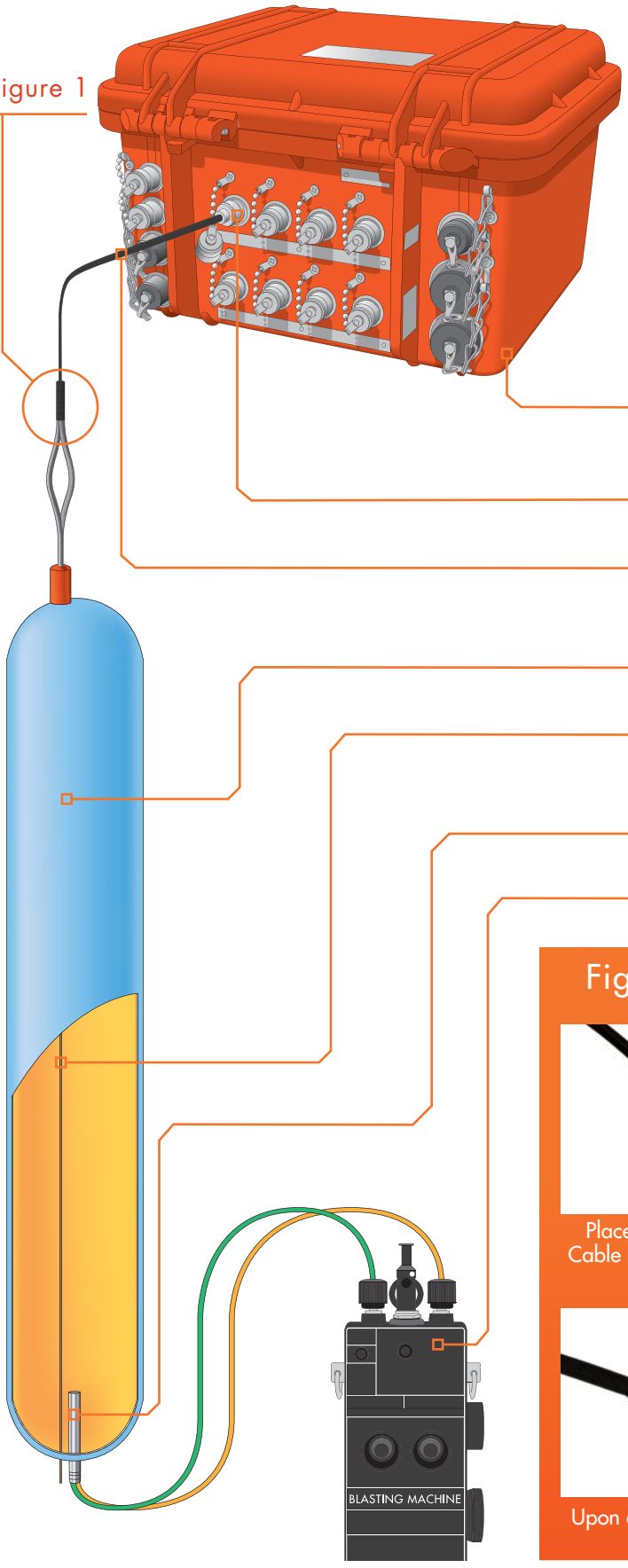


Figure 1

Place the RG-58/U Coaxial Cable beside the leads from the PROBEROD.

Place the RG-58/U Coaxial Cable beside the leads from the PROBEROD.

Upon completion, the taped connection should look as shown above.

8. The **PROBEROD** installation aspects of the test are complete. The Operator can now place the detonator and connect it to the shot exploder as per standard procedures. The **DataTrap II™ Data/VOD Recorder** is now ready to be prepared to record the test.

5.4 Installing ProbeCable For Testing Explosives In Blastholes

The equipment and supplies that are required to conduct **VOD** tests on samples of explosives in blastholes are:

1. The **DataTrap II™ Data/VOD Recorder** System with **VOD Upgrade** installed.
2. **VOD PROBECABLE** "**GREEN**" or **VOD PROBECABLE-LR** "**BLUE**" (available from **MREL**).
3. Coaxial cable (type RG-58 is recommended) - sufficient length to run between the **DataTrap II™ Data/VOD Recorder** location and the last blasthole in the blast to be recorded.
4. Wire cutters and electrical tape.
5. Explosives, detonators and shot exploder.

5.4.1 Preparation Of ProbeCable For Single Blasthole Recording

1. Prepare the end of the **PROBECABLE** by using the wire cutters to remove the insulation from the end. Then short the **PROBECABLE** by connecting the shielding wire to the center conductor wire and twist them together. Protect the connection well with electrical tape.
2. Using tape or wire, attach the short circuit end of the **PROBECABLE** to the primer/booster or to a rock and lower the **PROBECABLE** into the hole as shown in the diagram to the right. Detonation cord downlines may damage the **PROBECABLE** or cause side initiation of the bulk explosive. When initiating with detonation cord, attach the **PROBECABLE** to a rock and lower it on the side of the hole opposite to the detonation cord downline.
3. The **PROBECABLE** can then be cut at the top of the hole.
4. Note the Unit Resistance of the probe by reading the value in ohm/m or ohm/ft from the **MREL** factory label on the spool of **PROBECABLE**. Note the ohm/m value if the **VOD** is to be reported in m/s. Note the ohm/ft value if the VOD is to be reported in ft/sec. The Unit Resistance information will be requested later by the **DAS™ Data Acquisition Suite**. When measured with a blaster's galvanometer, the Probe Resistance should compare favorably with the calculated resistance of the **PROBECABLE** (Unit Resistance multiplied by length). If this is not the case then remove the length of **PROBECABLE** and reload another length into the hole.
5. The hole can now be loaded with explosives and stemming per usual procedure. Hold the **PROBECABLE** taut during the loading of the explosive to avoid slack in the hole. If you will not be present during loading, tie the **PROBECABLE** taut around a hole marker stake, or around a rock at the top of the borehole. After loading, you may wish to check the total resistance of the **PROBECABLE** to ensure that no damage has occurred. Damage is unlikely, as the **PROBECABLE** is well protected with PVC coating.
6. Connect the **PROBECABLE** to the coaxial cable using the wire cutters and electrical tape. The connection should be "shielding to shielding" and "center to center". Ensure that the center conductor and the shielding connections do not touch each other.
7. Place the **DataTrap II™ Data/VOD Recorder** in a protective shelter (a short piece of steel pipe is a good shelter) and/or a safe distance away from the blast area as dictated by flyrock. This distance may be closer than what is considered safe for the User. When set, the **DataTrap II™ Data/VOD Recorder** does not require a User to collect the data; the **DataTrap II™ Data/VOD Recorder** records the data automatically.
8. Run the coaxial cable from the **PROBECABLE** to the **DataTrap II™ Data/VOD Recorder**. Shorter lengths of coaxial cable may be connected together using the wire cutters and electrical tape. Somewhere along the length of the coaxial cable, loop the coaxial cable around a large rock. When the blast is fired, and the ground moves, looping the coaxial cable around a large rock will stop the blast from pulling the coaxial cable, and the **DataTrap II™ Data/VOD Recorder**, with the blast. Alternatively, leave sufficient slack in the coaxial cable to allow for ground movement.
9. A male BNC connector should be attached to the end of the coaxial cable that is to be attached to the channel inputs (labeled **1 2 3 4 5 6 7 8**) on the back of the **DataTrap II™ Data/VOD Recorder**. Convenient **BNC Adapters** have been supplied with the **DataTrap II™ Data/VOD Recorder** for this purpose. The BNC Adapters should be connected to the coaxial cable using the wire cutters and electrical tape. The connection should be shielding to shielding and center conductor to center conductor. Ensure that the

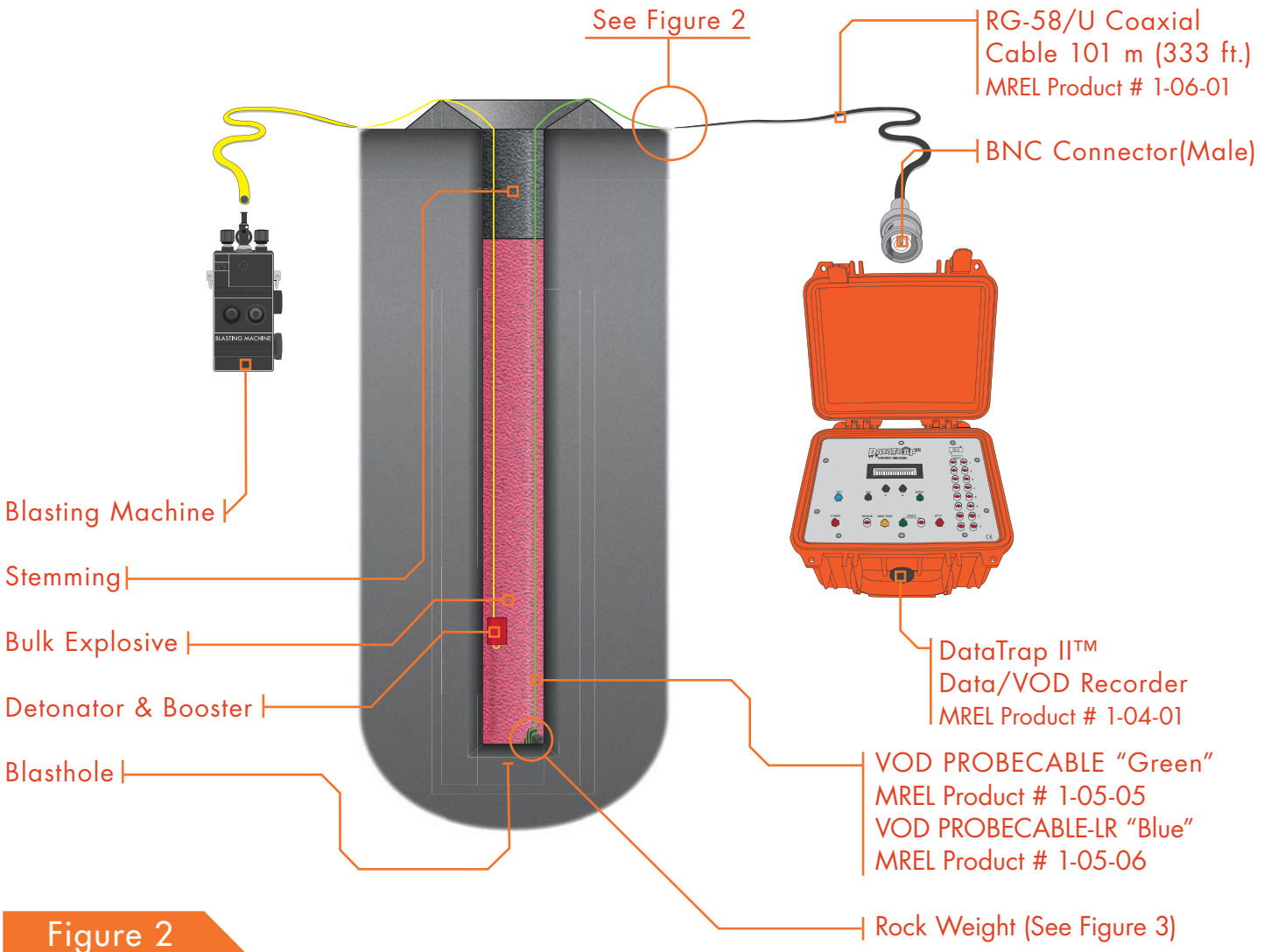
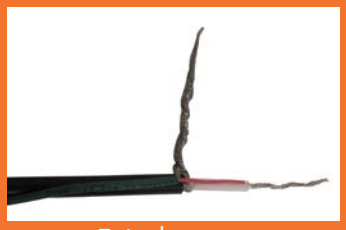


Figure 2

Place the RG-58/U Coaxial Cable beside the leads from the PROBECABLE-HT.

Twist the shielding of the coax and the PROBECABLE-HT together.



Twist the center conductors together.

Pull the shielding wires back along the cables and start taping from the cable to the end.

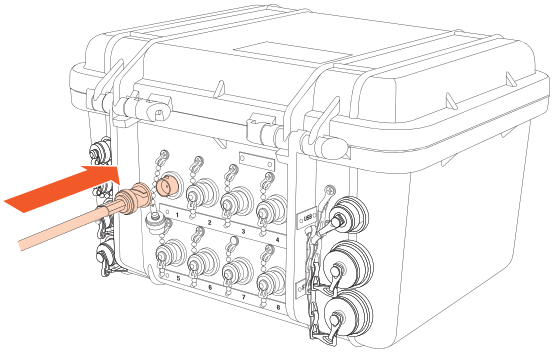
Making sure that there is now loose wires from the shielding touching the center conductors, continue to tape past the end.

Upon completion, the taped connection should look as shown above.

For strain relief, tie a loose knot down the cables from the connection as shown above.

center conductor and the shielding connections do not touch each other. It is a good idea to check the total resistance of the **PROBECABLE** and coaxial cable circuit at the BNC connector using a blaster's galvanometer to ensure that there are no bad connections.

10. At the **DataTrap II™ Data/VOD Recorder** end, connect the coaxial cables to the input connectors (labeled **1 2 3 4 5 6 7 8**) located on the outside and at the back of the **DataTrap II™ Data/VOD Recorder**.
11. The **PROBECABLE** installation aspects of the test are complete. The **DataTrap II™ Data/VOD Recorder** is now ready to be prepared to record the test.



5.4.2 Preparation Of Probecable For Multiple Blasthole Recording

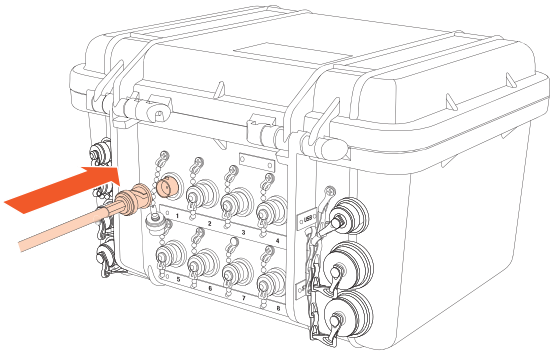
1. Prepare the end of the **PROBECABLE** by using the wire cutters to remove the insulation from the end. Then short the **PROBECABLE** by connecting the shielding wire to the center conductor wire and twist them together. Protect the connection well with electrical tape.
2. Start with the blasthole that is designed to detonate first of the multiple holes to be recorded by the **DataTrap II™ Data/VOD Recorder**. Using tape or wire, attach the short circuit end of the **PROBECABLE** to the booster or to a rock, and lower the **PROBECABLE** into the hole. Detonation cord downlines may damage the **PROBECABLE** or cause side initiation of the bulk explosive. When initiating with detonation cord, attach the **PROBECABLE** to a rock and lower it on the side of the hole opposite to the detonation cord downline.
3. Run the **PROBECABLE** between the first hole and the second hole leaving sufficient slack between the holes to allow for ground movement between the delayed holes. Excess **PROBECABLE** between holes is not a concern for the **DataTrap II™ Data/VOD Recorder**.

Figure 3

4. Each blasthole following the first hole will require a doubled length of **PROBECABLE** in order to form a continuous circuit throughout the blast. There are two common methods of lowering a doubled length of **PROBECABLE** in these holes. The first and simplest method is to run the **PROBECABLE** through a wire loop that has been tied or taped around a rock or booster. This allows the rock to slide along the **PROBECABLE** as the **PROBECABLE** is lowered into the hole, until the rock reaches the bottom of the hole. The second method is to measure out the midpoint of the length of **PROBECABLE** that is to be lowered into the hole, and attach the rock or booster so that it reaches the exactly the bottom of the hole when inserted.
5. After the last hole to be recorded has been loaded with **PROBECABLE**, the **PROBECABLE** can then be cut at the top of that hole.
6. Note the Unit Resistance of the probe by reading the value in ohm/m or ohm/ft from the **MREL** factory label on the spool of **PROBECABLE**. Note the ohm/m value if the **VOD** is to be reported in m/s. Note the ohm/ft value if the **VOD** is to be reported in ft/sec. The **Unit Resistance** information will be requested later by the **DAS™ Data Acquisition Suite**. When measured with a Blaster's galvanometer, the Probe Resistance should compare favorably with the calculated resistance of the **PROBECABLE** (Unit Resistance multiplied by its length). If this is not the case then remove the length of **PROBECABLE** and reload another length into the hole.
7. The hole can now be loaded with explosives and stemming per usual procedure. Hold the **PROBECABLE** taut during the loading of the explosive to avoid slack in the hole. If you will not be present during loading, tie the **PROBECABLE** taut around a hole marker stake, or around a rock at the top of the borehole. After loading, you may wish to check the Probe Resistance with a digital **Blaster's Galvanometer** to ensure that no damage has occurred to the **PROBECABLE**.
8. Do not use a standard mulitmeter because they can put too much current through the cable.
9. At the top of the last hole, connect the **PROBECABLE** to the coaxial cable using the wire cutters and electrical tape. The connection

should be "shielding to shielding" and "center to center". Ensure that the center conductor and the shielding conductor do not touch each other across the connection.

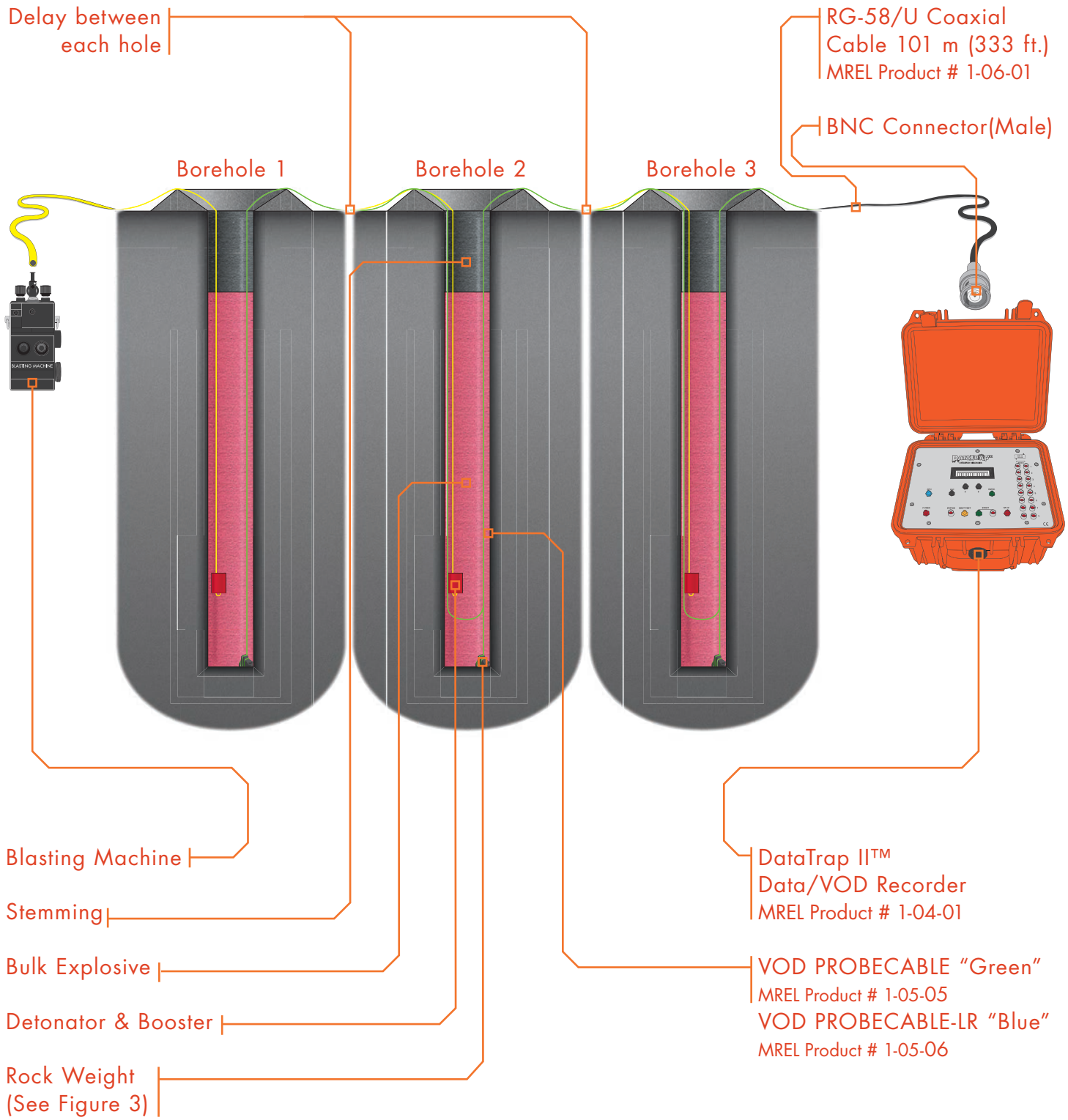
10. Place the **DataTrap II™ Data/VOD Recorder** in a protective shelter and/or a safe distance away from the blast area as dictated by flyrock. This distance may be closer than what is considered safe for the User. When set, the **DataTrap II™ Data/VOD Recorder** does not require a User to collect the data; the **DataTrap II™ Data/VOD Recorder** records the data automatically.
11. Run the coaxial cable from the **PROBECABLE** to the **DataTrap II™ Data/VOD Recorder**. If necessary, shorter lengths of coaxial cable may be connected together using the wire cutters and electrical tape to make a longer length of coaxial cable. Somewhere along the length of the coaxial cable, loop the coaxial cable around a large rock. When the blast is fired, and the ground moves, looping the coaxial cable around a large rock will stop the blast from pulling the coaxial cable and the **DataTrap II™** with the blast. Alternatively, leave sufficient slack in the coaxial cable to allow for ground movement.
12. A male **BNC** connector should be attached to the end of the coaxial cable that is to be attached to the channel inputs (**labeled 1 2 3 4 5 6 7 8**) on the back of the **DataTrap II™ Data/VOD Recorder**. Convenient **BNC Adapters** have been supplied with the **DataTrap II™ Data/VOD Recorder** for this purpose. The **BNC Adapters** should be connected to the coaxial cable using the wire cutters and electrical tape. The connection should be shielding to shielding and center conductor to center conductor. Ensure that the center conductor and the shielding connections do not touch each other. It is a good idea to check the total resistance of the **PROBECABLE** and coaxial cable circuit at the **BNC** connector using a blaster's galvanometer to ensure that there are no bad connections.
13. At the **DataTrap II™ Data/VOD Recorder** end, connect the coaxial cables to the input connectors (**labeled 1 2 3 4 5 6 7 8**) located on the outside and at the back of the **DataTrap II™ Data/VOD Recorder**.
14. The **PROBECABLE** installation aspects of the test are complete. The **DataTrap II™ Data/VOD Recorder** is now ready to be prepared to record the test as detailed in **Chapter 4.6**.



5.5 ProbeCable And Coaxial Cable Protection

It is important to protect the **PROBECABLE** and the coaxial cable from damage caused by personnel and machinery operating on the blast. It is also important to protect the **PROBECABLE** from damage caused by detonation of other holes and/or surface accessories such as detonating cord, detonating relays, and shock tube bunch blocks.

The cables may be protected in many ways. It is best to lead the **PROBECABLE** and coaxial cable under the detonating cord and leave a barrier of sand or drill cuttings between the cables and the detonating cord. A danger point is the collar area of the holes as the detonating cord or shock tube bunch blocks that initiate the downlines may cross directly over the **PROBECABLE** or coaxial cable. A good procedure is to protect the area where there is a cross over for about 1.5 m (5 ft) along the length of cable. Experience has shown that a sand or stemming barrier thickness of 15-30 cm (0.5-1 ft) is sufficient to protect the cables.


Delay between each hole
RG-58/U Coaxial Cable 101 m (333 ft.)
MREL Product # 1-06-01
BNC Connector(Male)
Borehole 1
Borehole 2
Borehole 3
Blasting Machine
Stemming
Bulk Explosive
Detonator & Booster
Rock Weight (See Figure 3)
DataTrap II™ Data/VOD Recorder
MREL Product # 1-04-01
VOD PROBECABLE "Green"
MREL Product # 1-05-05
VOD PROBECABLE-LR "Blue"
MREL Product # 1-05-06

5.6 DataTrap II™ Data/VOD Recorder Setup Procedure For VOD Measurements

Once the **VOD** probe has been placed in the explosive and connected to the RG-58 coaxial cable running to the channel inputs (labeled **1 2 3 4 5 6 7 8**) on the back of the **DataTrap II™ Data/VOD Recorder**, the Operator can start setting the **DataTrap II™ Data/VOD Recorder** to record **VOD** experiments. Changing the **DataTrap II™ Data/VOD Recorder** recording parameters, such as recording rate, number of channels, trigger level, pre-trigger memory and allocating the **DataTrap II™ Data/VOD Recorder** memory to multiple tests should all have been accomplished, if required, in the office environment through use of the **DAS™ Data Acquisition Suite**. Some settings can be changed using the **DataTrap II™ Data/VOD Recorder** display menu.

CAUTION

When shipped from MREL, the **DataTrap II™ Data/VOD Recorders** recording parameters have been pre-set to settings appropriate for most blasthole VOD recording situations. Recording Rate = 10 MHz. Number of channels utilized = 1. Number of tests = 1. Total Recording Time = 6.4 seconds, with standard 128 MB memory, 12.8 seconds with optional 256 MB memory and 25.6 seconds with optional 512 MB memory. Pre-trigger Time = 25% of Total Recording Time = 0.5 seconds. Trigger Level = 95%. These settings recommendations for VOD recording on one channel are based on MREL's extensive worldwide experience in VOD recording. Of course when recording multiple channels, the recording time decreases accordingly.

CAUTION

MREL recommends a Trigger Level of about 95% and a Pre-Trigger Time of about 25% for **VOD** recording of explosives samples and explosives in blastholes.

MREL recommends setting the Number of Tests = 1 for **VOD** recording of blastholes using **PROBECABLE**. The Operator will normally be able to download the data from the **DataTrap II™** to a computer before conducting the next **VOD** test. At a 10 MHz recording rate, a **DataTrap II™ Data/VOD Recorder** with standard memory, utilizing 1 channel per test, will record for a total of 6.4 seconds per test if the Number of Tests = 1. This is more than sufficient recording time for most VOD recording applications. At a 10 MHz recording rate, a **DataTrap II™ Data/VOD Recorder** with standard memory, utilizing 8 channels per test, will record for a total of 800 ms per test if the Number of Tests = 1. If this is insufficient time, then the recording rate can be reduced to increase the recording time or the Operator can double or quadruple the Memory in the **DataTrap II™ Data/VOD Recorder** with the **Memory Upgrade Options.**

MREL recommends setting the Number of Tests = 32 for **VOD** recording of samples of explosives using a **PROBEROD**. This reduces the quantity of data collected per test and conserves the computer's disk space. At a 10 MHz recording rate, a **DataTrap II™ Data/VOD Recorder** with standard memory, utilizing 1 channel per test, will record for a total of approximately 200 ms per test if the Number of Tests = 32. This is more than sufficient recording time for a sample of explosives. At a 10 MHz recording rate, a **DataTrap II™** with standard memory will record for a total of 52 ms per test if the Number of Tests = 16. This is more than sufficient recording time for a sample of explosives.

The procedure to record a new **VOD** test consists of the following steps:

1. Ensure that the coaxial cable coming from the **VOD** resistance probe(s) is connected to the input connectors (labeled **1 2 3 4 5 6 7 8**) on the **DataTrap II™ Data/VOD Recorder**. If the test includes DC voltage measurement, ensure that sensors are connected to the correct channels as set in by the **DAS™ Data Acquisition Suite**. The channels set to **VOD** mode will apply a current to any sensor that is attached, which may affect the sensor.
2. Press the **POWER** button for 2 seconds to turn the **DataTrap II™ Data/VOD Recorder ON**. The **STATUS** light will illuminate and begin to flash slowly.
3. Press the **INFO** button to see the total number of tests and the number of tests used.
4. If the number of tests used is greater than zero, then there are one or more tests already in the **DataTrap II™ Data/VOD Recorders** internal memory. This would occur under the following situations:
   a. The test about to be conducted is part of a series of tests that is being conducted in succession before the data from all of the tests is to be transferred to a computer.
   b. The **DataTrap II™ Data/VOD Recorders** internal memory was not cleared by the Software during the previous data transfer to the computer.

IMPORTANT

If the Operator is sure they do not wish to keep the existing data in memory, then the Operator can either clear the **DataTrap II™ Data/VOD Recorders** internal memory using the **DAS™ Data Acquisition Suite** or by the following procedure:

a. Turn **ON** the **DataTrap II™ Data/VOD Recorder**.
b. Press the **ENTER** button to start the **DataTrap II™ Data/VOD Recorder** menu. Press the Up Arrow to choose Services. Using the up and down arrow, the option to erase the last test and erase all tests can be chosen.
c. Press **Enter** to erase the last test or all tests.
d. Press the **Up** Arrow to confirm this.
e. Go to Step 3.

5. Press **Next Test** and look for the **OUT OF RANGE** warning light indicators (↓ and ↑). If there is a warning light for a channel, then the resistance of the corresponding circuit is out of the allowable initial resistance range of 50 to 3000 ohms. There is a problem with either: the resistance probe, the coaxial cable and/or the **BNC Adapter** for the channel indicating **OUT OF RANGE**. If this is the case, the Operator is referred to **Section 4.7** for possible solutions. If the **OUT OF RANGE** lights are not illuminated the Operator can proceed with the next step.
6. Press the **START** button. The **START** light will illuminate steadily. The **DataTrap II™ Data/VOD Recorder** then starts monitoring the test, waiting for the trigger signal to set the zero time for collecting data. Personnel can now vacate the **DataTrap II™ Data/VOD Recorder** location.
7. When the triggering condition is met (i.e. a sufficient length of **PROBEROD** or **PROBECABLE** has been consumed by the detonation or the external trigger condition has been met), the **DataTrap II™ Data/VOD Recorder** will trigger and finalize collecting data. Upon triggering, the left side **TRIG'D** light will illuminate and remain illuminated during the collection of data (this time depends of the Recording Rate programmed into the **DataTrap II™ Data/VOD Recorder**). The right side **TRIG'D** light will illuminate when data collection has finished. The **START** and **STATUS** lights will be on.
8. Once data collection ends, the **TRIG'D** and **START** lights flash rapidly and the **DataTrap II™ Data/VOD Recorder** starts storing data into its non-volatile memory. During the storing period, the **STATUS** light is on and the menu reads "**Saving data, please wait**". Do not switch the **DataTrap II™ Data/VOD Recorder OFF** at this point. Usually, this will have finished by the time the operator has returned to the **DataTrap II™ Data/VOD Recorder**.
9. Upon finishing the data storing process, the **START** light will go off, and the **STATUS** and **TRIG'D** lights will begin to flash slowly. The **DataTrap II™ Data/VOD Recorder** returns to the Stand-by mode.

IMPORTANT

If the **DataTrap II™ Data/VOD Recorder** has triggered prematurely and the data collected is of no use, for example due to someone driving over the signal lines, then the Operator may reset the DataTrap II™'s internal memory back one test using the following procedure

a. Turn ON the **DataTrap II™ Data/VOD Recorder**.
b. Press the **ENTER** button to start the **DataTrap** II™ Data/VOD Recorder menu. The first option shown is Erase Last Test.
c. Press **ENTER** to erase the last test.
d. Press the Down Arrow to confirm this.

If the choice "Erase All Tests" is chosen, the **DataTrap II™ Data/VOD Recorder** cannot be used until programmed using a computer.

10. If testing has been completed then go to Step 12. Otherwise, press the **INFO** button to confirm how many tests can be still hosted by the **DataTrap II™ Data/VOD Recorder** before downloading of the data to a computer is required. If there are 1 or more tests remaining in the memory:
    a. The **DataTrap II™ Data/VOD Recorders Recording Parameters** can be changed for subsequent tests by using the **DAS™ Data Acquisition Suite**, or
    b. If the Recording Parameters are to remain the same and another test is to be performed then go to **Step 3**.

    If there are 0 tests remaining in the memory, then either download the data to a computer using **DAS™ Data Acquisition Suite** and return to Step 1.
11. If no more experiments are to be conducted and the data storing process has been finished (**Step 10** above), then the data are ready to be transferred to a computer using the Software as detailed in the **DAS™ Data Acquisition Suite Manual**. If data transfer is to be conducted later, then the **DataTrap II™ Data/VOD Recorder** can be switched **OFF** and the data will remain in the **DataTrap II™ Data/VOD Recorder** non-volatile memory.

5.7 Probe Resistance Out Of Range

There are two **OUT OF RANGE** warning lights on the **DataTrap II™ Data/VOD Recorder** for each channel. One is labeled ↑, which illuminates when the total resistance (resistance probe plus coaxial cable) is greater than 3,000 ohms. The other is labeled ↓, which illuminates when the total resistance is less than 50 ohms. The **DataTrap II™ Data/VOD Recorder** is only calibrated to perform **VOD** tests between these two initial resistance values (50 – 3,000 ohms).

There are three reasons for the initial total resistance to be LOW:

1. A short circuit somewhere in the coaxial cable and probe assembly, including any BNC connector(s) or **BNC Adapter**;
2. A damaged **PROBEROD**;
3. An insufficient length of **PROBECABLE**.
4. Item 1 can be tested using a blaster's galvanometer to test the resistance/continuity of the coaxial cable and probe assembly. It can be and solved by remaking the connections or replacing faulty **BNC Connectors**. Item 2 is addressed by replacing the damaged **PROBEROD**. If Item 3 can be addressed by attaching some additional length of **PROBECABLE** to the probe circuit. This will not affect the **VOD** results. If **PROBECABLE-LR** is being used in the test, then considering using **PROBECABLE** for such tests in the future. The unit resistance of **PROBECABLE** is approximately 3 times that of **PROBECABLE-LR**.

There are three reasons for the total resistance to be HIGH:

1. An open circuit somewhere in the coaxial cable and probe assembly, including any BNC connector(s) or **BNC Adapter**;
2. A damaged **PROBEROD**;
3. Too long a length of **PROBECABLE**.

CAUTION

The continuity mode of commercial multimeters may apply a higher current than is allowed at a blasting site. Any tests with continuity mode of a multimeter should be done with cables which are in a non-blasting field location.

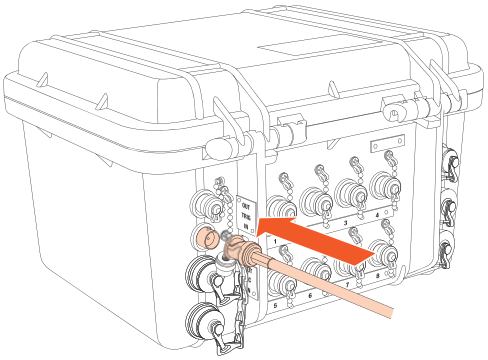
Item 1 can be tested using a blaster's galvanometer to test the resistance/continuity of the coaxial cable and probe assembly. It can be and solved by remaking the connections or replacing faulty **BNC Connectors**. Item 2 is addressed by replacing the damaged **PROBEROD**. If Item 3 is the cause, then reduce the length of the **PROBECABLE** used in the test by cutting out excess **PROBECABLE** between holes and remaking the connections using the wire cutters and electrical tape. Alternatively, this can be achieved by reducing the number of holes being recorded by cutting the **PROBECABLE** and remaking the appropriate connection with the wire cutters and electrical tape. If **PROBECABLE** is being used in the test, then considering using **PROBECABLE-LR** for such tests in the future. The unit resistance of **PROBECABLE-LR** is approximately 1/3 that of **PROBECABLE**.

If one or more of the channels is **Above Range**, you can start the test anyway by holding down the **Start** button for 5 seconds. This is not helpful for **OUT OF RANGE Low** because it would trigger immediately.

5.8 Utilizing The External Trigger

In some data recording applications, it may be desirable to have the **DataTrap II™ Data/VOD Recorder** begin to record exactly when a specific event occurs. For the specific event to start at time = 0 on the graph, the **EXT TRIG** connector, on the outside and back of the **DataTrap II™ Data/VOD Recorder**, is used.

Connect one of the **BNC Adapters** to the **TRIG IN** connector. Connect a duplex wire to the **BNC Adapter** using cutters and electrical tape. The polarity of the connection does not matter. The assembly consisting of the **BNC Adapter** and duplex wire is called the "**Trigger Wire**".



The test is set to **External Trigger** using the Program section of the Software as detailed in the **DAS™ Data Acquisition Suite Manual**. When this setting has been chosen, the **DataTrap II™ Data/VOD Recorder** will begin finalizing its recording when the external trigger condition has been met as follows:

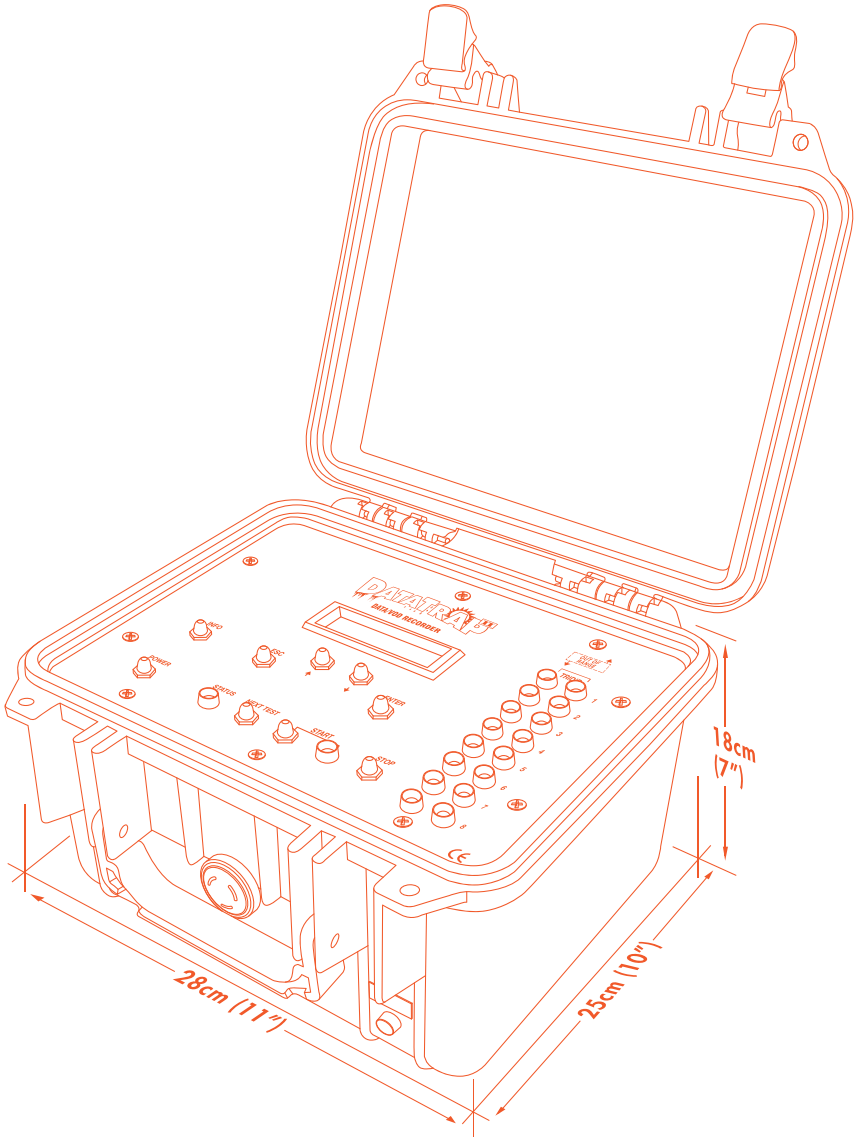
1. If it has been set for **MAKE** Circuit, it triggers when the **Trigger Wire** becomes shorted.
2. If it has been set to **BREAK** Circuit, it triggers when the **Trigger Wire** becomes open circuit (broken).
3. If it has been set to **LEVEL HIGH**, it triggers when the TTL input becomes high.
4. If it has been set to **LEVEL LOW**, it triggers when the TTL input becomes low.

If using external trigger for **VOD** tests, **MREL** recommends using only the Make or Break modes of external trigger.

To prepare the "**test**" end of the duplex wire to wait for a **MAKE** Circuit trigger: remove the insulation from one of the wires and wrap it around the second insulated wire such that the circuit remains open. Upon the duplex wire circuit becoming shorted, the **DataTrap II™ Data/VOD Recorder** will begin recording data. Any explosive event such as a detonator firing, detonating cord firing or a booster firing will short such a circuit and cause the **DataTrap II™ Data/VOD Recorder** to collect data. **Pre-Trigger** points will still be collected per the settings of the **DataTrap II™ Data/VOD Recorder**, but time=0 on the graph will be the precise time when the Trigger Wire became shorted.

To prepare the "**test**" end of the duplex wire to wait for a **BREAK** Circuit trigger: connect the two stripped ends of the duplex wire together such that the circuit is closed. Upon the duplex wire circuit becoming broken, the **DataTrap II™ Data/VOD Recorder** will begin recording data. Any explosive event such as a detonator firing, detonating cord firing or a booster firing will break such a circuit and cause the **DataTrap II™ Data/VOD Recorder** to collect data. **Pre-Trigger** points will still be collected per the settings of the **DataTrap II™ Data/VOD Recorder**, but time=0 on the graph will be the precise time when the **Trigger Wire** became broken.

Chapter 6
Recording Voltage Signals From Gauges



Overview

This Chapter provides the Operator with detailed instructions on connecting the gauges to the DataTrap II™ Data/VOD Recorder and setting the DataTrap II™ Data/VOD Recorder hardware to record the voltage signals produced by the gauges.

6.1 Introduction To Recording DC Voltage Signals

The **DataTrap II™ Data/VOD Recorder** is capable of recording DC voltage signals on 1 to 8 channels. Additionally, if the **DataTrap II™ Data/VOD Recorder VOD Upgrade** has been installed, any channel can be used to record VOD data simultaneous with the recording of voltage signals on other channels. Details on the procedure for recording VOD data are provided **Chapter 5**.

The **DataTrap II™ Data/VOD Recorder** and associated **DAS™ Data Acquisition Suite** Software are specifically designed to be used with gauges, power supplies and signal conditioning equipment producing DC voltage signals in the -10 to +10 VDC range or lower. The channels can be individually set to accept a variety of uni-polar and bi-polar voltage ranges. The 0-2.5, 0-5, 0-7.5 and 0-10 volt ranges refer to the uni-polar setting commonly used to measure slow changing events such as temperature recordings. The ±2.5, ±5, ±7.5, and ±10 volt ranges refer to the bipolar mode which is frequently used to record faster events such as explosion & detonation pressures, blast vibrations, overpressures, air blast, strains, etc.

Gauges or transducers used to measure parameters commonly studied in blast situations are commercially available. Examples are the tourmaline and carbon resistor gauges to measure cross-borehole propagation, the PVDF transducers to measure detonation pressures, various PCB gauges to measure blast over-pressures as well as various types of thermocouples to measure temperatures. The **DataTrap II™ Data/VOD Recorder** channels do not apply any voltage or current to the gauges or transducers when in DC Input mode. Should they require excitation signals to operate, the appropriate power supply(s) should then be acquired from the gauge manufacturers or suppliers.

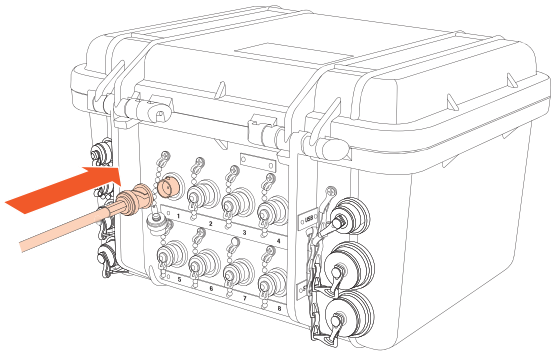
The **DAS™ Data Acquisition Suite** automatically displays the recorded data as graphs of voltage versus time. The Software includes menu functions that allow the Operator to apply equations to convert the voltage data into graphs of engineering units versus time. The type of engineering units depends on the type of gauge being recorded and is easily defined by the Operator. For more detail, please review the **DAS™ Data Acquisition Suite Manual.**

6.2 Connecting Gauges To The DataTrap II™ Data/VOD Recorder

The equipment and supplies that are required to record voltage signals from gauges are:

1. The **DataTrap II™ Data/VOD Recorder** System.
2. Gauges (maximum 8).
3. Coaxial cable (type RG-58 is recommended) - sufficient length to run between the **DataTrap II™ Data/VOD Recorder** location and the gauge.
4. Wire cutters and electrical tape.

The procedure for connecting the gauges to the **DataTrap II™ Data/VOD Recorder** is as follows:



1. Place the **DataTrap II™ Data/VOD Recorder** in a protective shelter and/or a safe distance away from the test area. This distance may be closer than what is considered safe for the Operator. Once the setup is completed, the **DataTrap II™ Data/VOD Recorder** does not require an Operator to collect the data; it does so automatically without Operator assistance.
2. For each gauge to be recorded, run a length of coaxial cable from the **DataTrap II™ Data/VOD Recorder** to the gauge with enough excess length to compensate for cable shortening or cable damage from each test (if applicable). Shorter lengths of coaxial cable may be connected together using the wire cutters and electrical tape. A male BNC connector should be attached to the end of the coaxial cable that is to be attached to the Scope inputs (labeled **1 2 3 4 5 6 7 8**) on the back of the **DataTrap II™ Data/VOD Recorder**. Convenient **BNC Adapters** have been supplied with the **DataTrap II™ Data/VOD Recorder** for this purpose. The Adapters can be connected to the coaxial cable using the wire cutters and electrical tape. The connection should be shielding to shielding and centre conductor to centre conductor. Ensure that the centre conductor and the shielding connections do not touch each other.
3. Note the calibration factors of the gauges being used. These calibration factors are generally equations relating voltage to engineering units. The calibration factors will be entered in the **DAS™ Data Acquisition Suite** Software by the Operator to convert the voltage versus time graphs, to graphs of engineering units versus time.
4. Install the gauges.
5. Connect the gauges to the coaxial cable using the wire cutters and electrical tape. Notice that the polarity of the connection is important. The centre conductor of the coaxial cable is “active” and the shielding is “common”.
6. At the **DataTrap II™ Data/VOD Recorder** end, connect the coaxial cables to the input connectors (labeled **1 2 3 4 5 6 7 8**) located on the outside and at the back of the **DataTrap II™ Data/VOD Recorder**.
7. The gauge connection aspects of the test are complete. The **DataTrap II™ Data/VOD Recorder** is now ready to be prepared to record the test as detailed in **Section 7.4**.

6.3 Signal Cable Protection

It is important to protect the gauge signal cable from damage caused by personnel and machinery operating at the test area. If testing explosives, it is also important to protect the cable from damage caused by detonation of other holes and/or surface accessories such as detonating cord, detonating relays, and shock tube bunch blocks.

The cables may be protected in many ways. Experience has shown that it is best to lead the signal cable and coaxial cable under the detonating cord and leave a barrier of sand or drill cuttings between the cables and the detonating cord. A danger point is the collar area of the holes as the detonating cord or shock tube bunch blocks that initiate the downlines may cross directly over the coaxial cable. A good procedure is to protect the area where there is a cross over for about 1.5 m (5 ft) along the length of cable. Experience has shown that sand or stemming barrier thickness of 15-30 cm (0.5-1 ft) suffices to protect the cables.

6.4 DataTrap II™ Data/VOD Recorder Setup Procedure For Recording Voltage Signals

Once the gauge(s) has been installed and connected to the RG-58 coaxial cable running to the input connectors (labeled **1 2 3 4 5 6 7 8**) on the **DataTrap II™ Data/VOD Recorder**, the Operator can start setting the **DataTrap II™ Data/VOD Recorder** to record voltage signals. Changing the **DataTrap II™ Data/VOD Recorder** recording parameters, such as recording rate, number of channels, trigger level, pretrigger memory and allocating the **DataTrap II™ Data/VOD Recorders** memory to multiple tests should all have been accomplished, if required, in the office environment through use of the **DAS™ Data Acquisition Suite** Software. Some settings can be changed using the **DataTrap II™ Data/VOD Recorder** display menu.

The procedure to record a new test consists of the following steps:

1. Ensure that the coaxial cable coming from the gauge(s) is connected to the input connectors (labeled **1 2 3 4 5 6 7 8**) on the **DataTrap II™ Data/VOD Recorder**.
2. Press the **POWER** button for 2 seconds to turn the **DataTrap II™ Data/VOD Recorder ON**. The **STATUS** light will illuminate and begin to flash slowly.
3. Press the **INFO** button to the total number of tests and the number of tests used.
4. If the number of tests used is greater than zero, then there are one or more tests already in the **DataTrap II™ Data/VOD Recorders** internal memory. This would occur under the following situations:
   a. The test about to be conducted is part of a series of tests that is being conducted in succession before the data from all of the tests is to be transferred to a computer.
   b. The **DataTrap II™ Data/VOD Recorder** internal memory was not cleared by the Software during the previous data transfer to the computer.

IMPORTANT

If the Operator is sure they do not wish to keep the existing data in memory, then the Operator can either clear the **DataTrap II™ Data/VOD Recorder** internal memory using the **DAS™ Data Acquisition Suite** Software or by the following procedure:

a. Turn ON the **DataTrap II™ Data/VOD Recorder**.
b. Press the **ENTER** button to start the **DataTrap II™ Data/VOD Recorder** menu. Press the **Up** Arrow to choose Services. Using the up and down arrow, the option to erase the last test and erase all tests can be chosen.
c. Press **Enter** to erase the last test or all tests.
d. Press the **Up** Arrow to confirm this.
e. Go to Step 3.

5. Press **Next Test** and look for the **OUT OF RANGE** warning light indicators (↓and↑). If there is a warning light for a channel, then the voltage being produced by one of the gauges is out of the voltage range set by Software. The out of range is numbered, so note the channel(s) that is out of range. If the current voltage range for that channel is less than ±10 V, it can be increased using the menu. Press **ESC** to go back to Stand-by mode, then press **ENTER** to start the menu, press the **DOWN ARROW** to choose Config, then **ENTER** to choose the current test, then **Edit**, then choose the channel that was out of range, press **ENTER**. The first choice is **Range**, press **ENTER** again. Use the up and down arrows to choose a new range, and then press **ENTER**. After this, press **ESC** until the menu reads "**DataTrapII Services Config**". Press **Next Test** and check if the channel is still out of range. If so, the Operator should test the cable connections to the gauge and power supply. A voltmeter should be used to verify the baseline voltage output of the gauge. If the **OUT OF RANGE** lights are not illuminated the Operator can proceed with the next step.
6. Press the **START** button. The **START** light will illuminate steadily. The **DataTrap II™ Data/VOD Recorder** then starts monitoring the test, waiting for the trigger signal to set the zero time for voltage data. Personnel can now vacate the **DataTrap II™ Data/VOD Recorder** location.

7. When the triggering condition is met (i.e. the voltage signal on one of the channels has crossed the trigger level), the **DataTrap II™ Data/VOD Recorder** will trigger and finalize collecting voltage data. Upon triggering, the left side **TRIG'D** light will illuminate and remain illuminated during the collection of data (this time depends of the Recording Rate programmed into the **DataTrap II™ Data/VOD Recorder**). The right side **TRIG'D** light will illuminate when data collection has finished. The **START** and **STATUS** lights will be on.
8. Once data collection ends, the **TRIG'D** and **START** lights flash rapidly and the **DataTrap II™ Data/VOD Recorder** starts storing data into its non-volatile memory. During the storing period, the **STATUS** light is on and the menu reads "**Saving data, please wait**". Do not switch the **DataTrap II™ Data/VOD Recorder OFF** at this point.
9. Upon finishing the data storing process, the **START** light will go off, and the **STATUS** and **TRIG'D** lights will begin to flash slowly. The **DataTrap II™ Data/VOD Recorder** returns to the **Stand-by** mode.

IMPORTANT

If the **DataTrap II™ Data/VOD Recorder** has triggered prematurely and the data collected is of no use, for example due to someone driving over the signal lines, then the Operator may reset the **DataTrap II™ Data/VOD Recorders** internal memory back one test using the following procedure

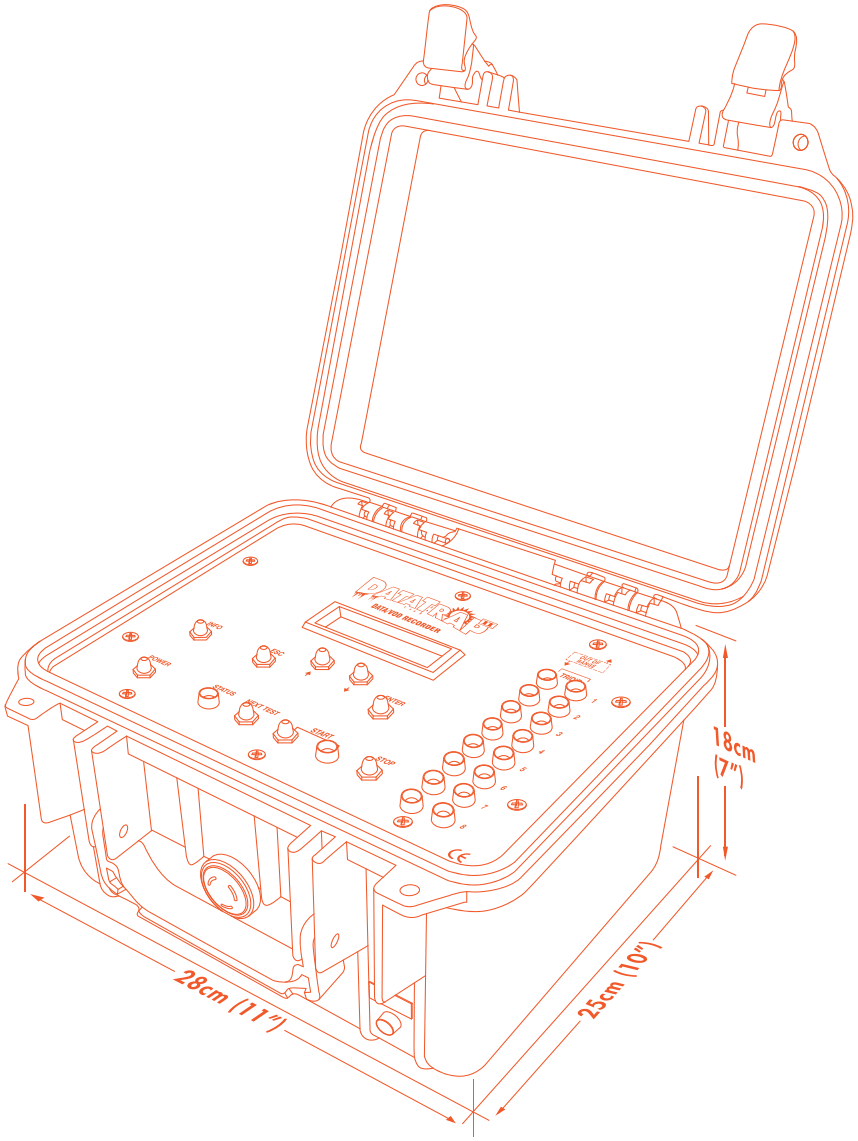
a. Turn **ON** the **DataTrap II™ Data/VOD Recorder**.
b. Press the **ENTER** button to start the **DataTrap II™ Data/VOD Recorder** menu. The first option shown is **Erase Last Test**.
c. Press **ENTER** to erase the last test.
d. Press the **Down Arrow** to confirm this.

10. If testing has been completed then go to Step 11. Otherwise, press the **INFO** button to confirm how many tests can be still hosted by the **DataTrap II™ Data/VOD Recorder** before downloading of the data to a computer is required. If there are 1 or more tests remaining in the memory:
    a. The **DataTrap II™ Data/VOD Recorders Recording Parameters** can be changed for subsequent tests by using the Software, or
    b. If the **Recording Parameters** are to remain the same and another test is to be performed then go to Step 3.
    If there are 0 tests remaining in the memory, then either download the data to a computer and return to Step 1, or go to Step 11.
11. If no more experiments are to be conducted and the data storing process has been finished (Step 10 above), then the data are ready to be transferred to a computer using the Software. If data transfer is to be conducted later, then the **DataTrap II™ Data/VOD Recorder** can be switched **OFF** and the data will remain in the **DataTrap II™ Data/VOD Recorders** non-volatile memory.

6.5 Utilizing The External Trigger

To use an external trigger with the **DataTrap II™ Data/VOD Recorder,** please see **Section 5.8**.

Chapter 7
Strain Gauge Upgrade



Overview

This Chapter provides information about the DataTrap II™ Data/VOD Recorder Strain Gauge Upgrade, what is included and how to perform Strain Gauge tests.

7.1 Introduction

The **Strain Gauge** upgrade for the **DataTrap II™ Data/VOD Recorder** consists of a special lid for the **DataTrap II™ Data/VOD Recorder** that supplies a constant voltage across each channel and **Pre-Amplifier** units that condition the signal from the **Strain Gauge**. The **DataTrap II™ Data/VOD Recorder** reads and stores the voltage level during a test and displays the result in microStrains vs Time using the **DAS™ Data Acquisition Suite** software.

7.2 Ensuring That All Components Hardware Have Been Received

1. **DAS™ Data Acquisition Suite** Software for **Strain Gauge Analysis**.
2. **DataTrap II™ Data/VOD Recorder** with **Strain Gauge Upgrade Lid** (As shown to the right).
3. One (1) power cable for the **Signal Conditioner Lid**. Both ends has 3 pins to plug the **Signal Conditioner Lid** into the DC Out of the **DataTrap II™ Data/VOD Recorder**.

4. For each channel of strain that is required to be monitored, the following equipment is required: a **Pre-Amplifier**, **BNC Extension Cable** and a **DataTrap II™ Strain Signal** & **Power Cable**.

   The **Pre-Amplifier** units may be either 120 ohm or 350 ohm. This can be seen on the label. Please confirm immediately after receiving **Strain Gauge** equipment that the correct **Pre-Amplifier** units have been shipped.

5. **DataTrap II™ Data/VOD Recorder Strain Signal** & **Power Cable** used to connect the **Pre-Amplifiers** to the **Signal Conditioner** Lid. They are available in two (2) different lengths: 20m and 100m.

All accessories used for **Strain Gauge** measurement are contained in a case as shown to the right:

- 8 **Pre-Amplifier** units
- 8 **BNC Channel Extension Cables**
- 1 **Signal Conditioner Power Cable**

7.3 Hardware Components

The hardware components needed for conducting a Strain Gauge test include:

- **DataTrap II™ Data/VOD Recorder Strain Upgrade** – P/N: 1-04-06
- **DataTrap II™ Data/VOD Recorder Strain Signal** & **Power Cable** (20m or 100m) – P/N: 1-04-08 or 1-04-09

7.3.1 DataTrap II™ Strain Upgrade

This part number (1-04-06) includes the following equipment:

- Replacement lid for the **DataTrap II™ Data/VOD Recorder** that includes the electronics to communicate with the **Pre-Amplifiers** and convert the signal for each channel. — Quantity: 1
- **Strain Gauge Pre-Amplifiers** configured for EITHER **120 ohm** or **350 ohm** strain gauges. These units are encased in a steel body for durability. — Quantity: 8
- **Power Cable** to connect the **Signal Conditioner Lid** to the DC out of the **DataTrap II™ Data/VOD Recorder**. — Quantity: 1
- **BNC Extension Cables** to connect the channel out from the **Signal Conditioner Lid** to the **Channel In** on the back of the **DataTrap II™ Data/VOD Recorder**. — Quantity: 8
- Hard sided case to house the **Pre-Amplifiers** and cabling when it is not in use. — Quantity: 1
- **Strain Gauge** software to be used with the **DataTrap II™ Data/VOD Recorder** for programing, downloading and analysing the data. — Quantity: 1 (can be installed on as many computers as desired)
- Operations Manual — Quantity: 1

7.3.2 DataTrap II™ Strain Signal & Power Cable (20m)

This part number (1-04-08) includes the following equipment:

- **Cable** 20 metres (65.6 feet) in length required to connect the Pre-Amplifiers to the **DataTrap II™ Data/VOD Recorder Signal Conditioner Lid**. — Quantity: 1

This item will allow the user to measure one (1) channel of strain. Multiple cables are required if more than one channel of strain is required to be measured.

7.3.3 DataTrap II™ Strain Signal & Power Cable (100m)

This part number (1-04-09) includes the following equipment:

- Cable 100 metres (328 feet) in length required to connect the Pre-Amplifiers to the **DataTrap II™ Data/VOD Recorder Signal Conditioner Lid**. — Quantity: 1

This item will allow the user to measure one (1) channel of strain. Multiple cables are required if more than one channel of strain is required to be measured.

7.4 Details of Items Required but Not Supplied

7.4.1 Strain Gauges

The required strain gauges will need to match the delivered **Pre-Amplifier** resistance. This is **120 ohm** (standard) or **350 ohm** (requested specially).

7.4.2 External Trigger

The user can not trigger internally from a strain channel. If only strain measurements are being made, an external trigger is required. This can be as simple as a push button with the settings of the **DataTrap II™ Data/VOD Recorder** set to make. Refer to the external trigger section of this manual for more details on the different trigger methods. The external trigger is not required IF the user is recording another channel that can be used (either scope or the optional **VOD**).

7.5 Installation Of Software

Refer to the **DAS™ Data Acquisition Suite Manual.**

7.6 Preparing The DataTrap II™ For A Strain Gauge Test

A **Strain Gauge** test can be set up with a pre-programmed set of values or more specific settings, including **VOD** channels, can be set up using the normal settings software, then the values for the channels using the **Strain Gauge** can be entered later.

A **Strain Gauge** test must be set up with the following settings:

1. The **Voltage Range** must include [0 to 7.5] Volts. A wider range, such as +/- 7.5 or +/- 10 Volts can be used to allow later flexibility of use of channels in the field if other devices might be used on some channels. If some channels are set as **VOD**, make note of them. The setting of each channel can be checked in the field using the **LED** menu on the **DataTrap II™ Data/VOD Recorder** before attaching cables.
2. If none of the channels are **VOD**, **Trigger Type** should be set to **External** for the channels that will have **Strain Gauges** attached. **VOD** channels can be set to internal trigger with the **Strain Gauge** channels set with no trigger – they will trigger when the **VOD** channel triggers.
3. During the test, record which channels used a **Strain Gauge** and the **Gauge Factor Values** for these channels.
4. During the downloading of the test the gauge factors for each channel can be entered.

7.7 Field Setup Of The DataTrap II™ Strain Gauge System

The steps to collect **Strain Gauge** data with the **DataTrap II™ Data/VOD Recorder** are detailed below:

1. Turn on the **DataTrap II™ Data/VOD Recorder** and confirm that there are tests remaining on it and the battery has been charged.
2. Connect one end of the **3-pin Signal Condition Power Cable** to the DC Out port on the back of the **DataTrap II™ Data/VOD Recorder** and the other end of the 3-pin cable to the **Signal Conditioner Lid**. If the power light does not come on, check that the cable has been connected correctly.
3. Connect the **External Trigger** cable. The power and data cables for each channel must now be set up as detailed below.

The power and data cables for each channel must now be set up.

Do the following for **Channel 1**:

1. Connect the **Channel Extension Cable** from the **Channel 1** BNC connector on the back of the **DataTrap II™ Data/VOD Recorder** to the **Channel 1** BNC connector on the **Signal Conditioner Lid**.
2. Connect the **Power/Data Cable** to the **Channel 1** 4-pin socket on the lid. Unroll the cable to the location of the **Pre-Amplifier**.
3. Mount the **Strain Gauge** for **Channel 1** on the surface to be measured.
4. Connect the lead wires from the **Strain Gauge** to the **Pre-Amplifier**.
5. If you have manually adjustable preamplifiers, adjust the **Pre-Amplifier** so that both lights have gone out. The directions to turn the adjustment screw are shown below. If the light over the "**E**" in **BALANCE** is list, turn it clockwise. If the light over the "**B**" is lit, turn it counter clockwise. If the screw becomes hard to turn, do not force it, confirm that the **Strain Gauge** does not have a short or broken wire.

6. If you have auto-adjustable **Pre-Amplifiers** (see picture on the right), press the **BALANCE** button if the **LO** or **HI** light is on. The pre-amplifier will now balance itself. If this is not confirmed by both lights being off, check cable connections and confirm that the **Strain Gauge** does not have a short or broken wire.

Repeat steps 1-4 and either 5 or 6 for **Channel 2** and higher channels.

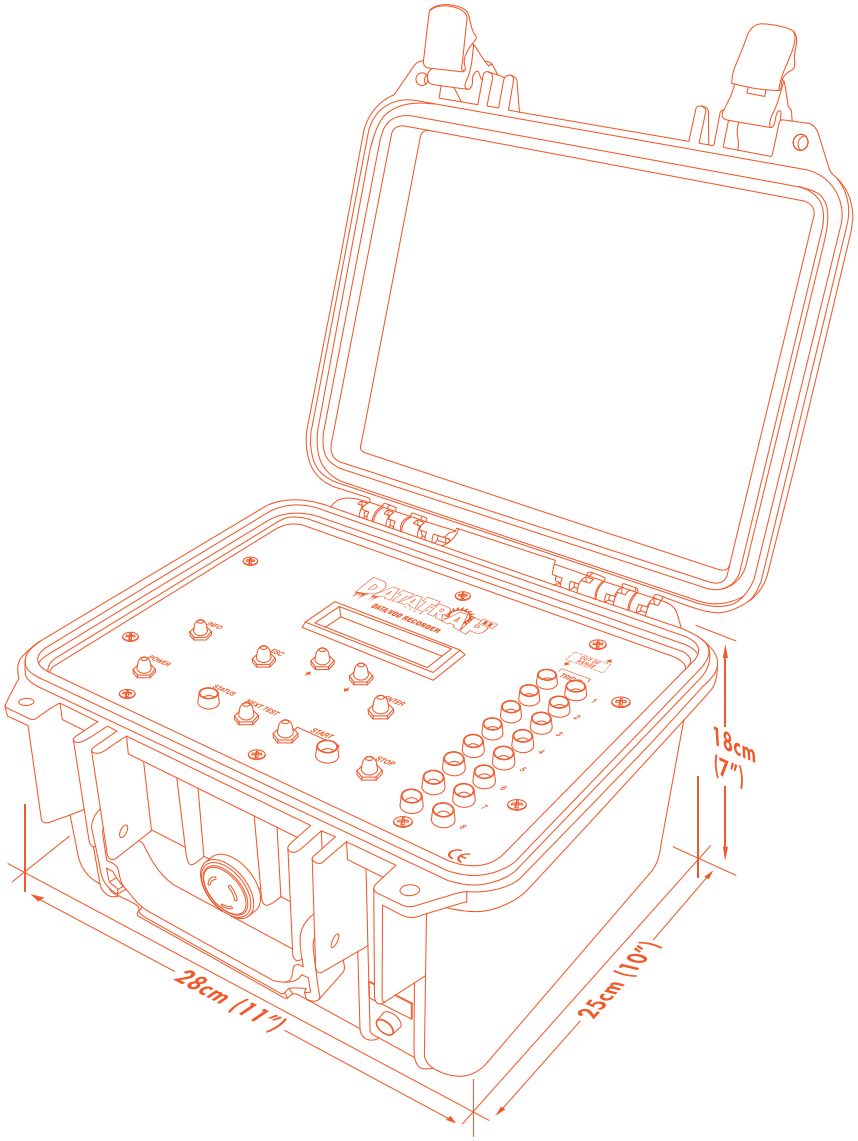
7.8 Running A Strain Gauge Test

1. Press the **Next Test** button then the **Start** button.
2. Wait for the event to be tested.
3. If the **DataTrap II™ Data/VOD Recorder** is triggered manually, trigger it as soon as the event occurs.
4. Once it has been triggered, the **TRIG'D** light on the outside of the **DataTrap II™ Data/VOD Recorder** becomes lit. Once it has written data to its permanent memory, the light begins flashing. The data can now be downloaded.

7.9 Downloading A Strain Gauge Test

Refer to the **DAS™ Data Acquisition Suite** manual.

Chapter 8
Contacting MREL for Technical Support



8.1 Contacting MREL

MREL Group of Companies Limited

Blasting Instrumentation Team

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Kingston, Ontario K7L 1H3
Canada

Toll Free Canada/USA: +1-877-544-MREL
Tel: +1-613-545-0466

Email: support@mrel.com

Webpage Support: www.mrel.com/contact.html

MREL looks forward to providing you with assistance.

MREL is committed to product innovation; accordingly product may undergo specification improvements without notice.

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