BLASTER'S Ranger

Operations Manual

Edition 2.1.0

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ABOUT THIS MANUAL

Congratulations on your acquisition of the Blaster's Ranger™, a system integrated specifically for blasters by MREL Group of Companies Limited (MREL). This Operations Manual has been supplied with the Blaster's Ranger™ to provide the Operator with detailed instructions on its use for recording events that occur at high-speeds. The Operations Manual is divided into the following Chapters:

CHAPTER 1: INTRODUCTION

This chapter provides an introduction to high-speed photography and to high-speed photography of blasts.

CHAPTER 2: HARDWARE

This chapter describes all of the hardware components provided with the Blaster's Ranger™ as well as the Blaster's Ranger™ Accessories.

CHAPTER 3: GETTING STARTED

This chapter provides an outline of how to setup the Blaster's Ranger™ for recording, viewing and saving events to CF card and/or digitally to a computer. This chapter assumes that the first thing the operator will want to do when the system arrives is to unpack the equipment, set it up in an office environment and operate the controls of the camera and computer requirements to operate the software for USB 2.0 capture.

CHAPTER 4: FIELD OPERATIONS

This chapter provides instructions on using the Blaster's Ranger™ to record blasts in the field for proper setup and location of the camera.

CHAPTER 5: PROANALYST® TRACKONE SOFTWARE

This chapter provides the information about ProAnalyst® TrackOne Edition software.

CHAPTER 6: CONTACTING MREL FOR TECHNICAL SUPPORT

This chapter provides detailed contact information for MREL's Blasting Instrumentation Team.

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CHAPTER 1: INTRODUCTION

> **This Chapter provides an introduction to high-speed photography and to high-speed photography of blasts.**

1.1 INTRODUCTION

Congratulations on your purchase of a Blaster's Ranger™ high-speed digital video camera system. This Operations Manual provides instructions on the use of the hardware supplied with the Blaster's Ranger™. This Manual is applicable to the following Blaster's Ranger™ systems:

Model RA1000ME-O (monochrome, maximum recording speed = 1,000 fps with enhanced memory - 4368 frames)
 Model RA1000CE-O (color, maximum recording speed = 1,000 fps with enhanced memory - 4368 frames)

1.2 HIGH-SPEED PHOTOGRAPHY[1]

High-speed photography allows a series of very rapid photographs (or *images*) to be taken in quick succession of a short duration event such as a blast. By viewing this succession of images at a slower rate than at which they were filmed (or *recorded*), the event can be viewed in what is commonly referred to as "slow motion". The "normal" rate of viewing video recorded with standard video cameras is at 33 frames per second (fps) since standard video cameras record at 33 frames per second. By increasing the recording rate above the viewing rate, the event can be made to appear slower, this time magnification being defined by:

$$\frac{\text{Camera Recording Rate (fps)}}{\text{Viewing Rate (fps)}}$$

If, for example, a blast was recorded at 500 fps and viewed at 10 fps, the time magnification is 500/10 or 50. Thus if the event took two seconds to occur, at a 10 fps playback it would take 2 x 50 = 100 seconds to view.

Normally, the eye cannot resolve motion that occurs in less than 1/4 of a second. High-speed video recording of a blast allows motion to be slowed so that it can be analysed both qualitatively and quantitatively. This allows the extraction of data which otherwise could not be obtained.

1.3 HIGH-SPEED PHOTOGRAPHY OF BLASTS[1]

High-speed film cameras have been used by blasters to assist in optimising blasts for many years. With the Blaster's Ranger™ high-speed digital video cameras, blasters are able to: view the blasting results in slow motion detail immediately after blasting; and analyse the blasts quantitatively using computers. The Blaster's Ranger™ high-speed digital video cameras bridge the gap which has historically existed between the economy and resolution of high speed film cameras and the convenience of high speed video systems. The convenience of the video system is due to the near-real time availability of the actual event due to the playback capabilities of video systems.

One of the major concerns of a surface mining operation is the high cost of drilling and blasting. In some mines operating in hard taconite-iron formations, this can account for 60% of the mining costs. In coal operations, blasting can be used to excavate nearly 50% of the overburden material. With the aim of reducing costs, mine personnel have been attempting to optimise blasting operations. In the past, blast designs have been based largely on the personal experience of the blasting crew and blast evaluations were done by visual observations with changes being made on a trial and error basis. This traditional approach is gradually being replaced by a

technology based on the concepts of energy input per ton of rock, fragmentation and rock movement, along with the use of high-speed video for the analysis of the blast movement.

High-speed video has two main uses in helping to optimise surface blasting results. The principal use is the direct photography of the blast, with the analysis of the resulting video and/or digital images representing the bulk of the optimisation work. However, high-speed video also can be used to analyse and inspect the performance of individual blast components, particularly the actual delay times for such accessories as detonating relays, down-the-hole delays and other delaying and initiating systems.

The information that may be obtained from high speed video includes: the firing sequence of the blast; the location of the first rock movement and the shape of the face movement; the occurrence of gas venting at the face; the degree of confinement due to stemming; the occurrence and location of misfires; the nature of the muck-pile formation; the onset time for rock movement (both at the face and at the top of the bench); the acceleration, velocity and direction of flyrock travel from the face and the top of the bench; the hole venting and stemming ejection velocities; the actual hole/deck delay times; and the casting range of the muck.

With proper preparation and care during the set-up, operation and analysis, considerable information may be obtained which can suggest where improvements may be required in the blasting operation. In addition, the video provides a permanent record of the event and allows any changes made between blasts to be easily and accurately analysed. Before the introduction of high speed photography, what occurred during a blast had to be inferred from observing the results after the fact. With high-speed digital video photography, many of these phenomena and occurrences can now be observed "as they happen".

1. *"High-Speed Photography in Open Pit Blasting" by Mining Resource Engineering Limited. March 1983. ISBN 0-9691314-0-2. Available from the International Society of Explosives Engineers (www.isee.org).*

CHAPTER 2: HARDWARE

> **This Chapter describes all of the hardware components provided with the Blaster's Ranger™.**

2.1 BLASTER'S RANGER™ HIGH SPEED DIGITAL VIDEO CAMERA

The Blaster's Ranger™ is made of 18 gauge cold-rolled steel. The housing, keypads, connectors, and CF card interface are sealed to resist dirt and moisture. It is equipped with a single **Bendix Connector**. The **Bendix Connector** has Sync In, Sync Out, IRIG, Video Out and Trigger signals connectors along with the Power connector. The camera is specially designed for extreme portability and standalone operation in harsh environments.

Photographs of the **Camera** are shown below. The **Mounting Adapter** is attached to the bottom of the **Camera** to allow the **Camera** to be quickly mounted onto the **Tripod's Grip Action Ball Head** (shown in Section 2.2). The **Mounting Adapter** and the **Tripod's Grip Action Ball Head** are part of the Blaster's Ranger™ Accessories package. The **Camera** is equipped to accept any standard C-mount TV lens. A **110/220 VAC Power Adapter** is supplied with the camera and shown below.

Blaster's Ranger™ (Rear)　　　　　　　Blaster's Ranger™ (Front)

Bendix Connector　　　　　　　　110/220 VAC Power Adapter

2.2 BLASTER'S RANGER^{TM} ACCESSORIES

2.2.1 PROTECTIVE CARRY CASE

The **Carry Case** is designed to contain, for transportation and storage all the components required for setup and use of the Blaster's Ranger™ in the field. The **Carry Case** is made from a durable material which has water resistance capabilities.

The **Carry Case** contains pre-formed foam material, which allows for compartmentalization of the various components for easy access. Photograph of the **Carry Case** are shown in the right.

2.2.2 SIX (6) VDC POWER CABLE ADAPTER

The power adapter will connect to an external 6 VDC power supply such as the battery shown below (not supplied). This option will allow longer operating times in the field for video capture.

DO NOT CONNECT TO A 12 VOLT BATTERY!
DAMAGE WILL OCCUR.

The recommended battery is a **lead acid 6 volt** rechargeable battery (not supplied). The power of the recommended battery is **12 ampere hour (Ah)**. This battery will allow the user to have the camera operate for **3 hours** when the battery is fully charged. DO NOT USE A 12 V BATTERY! DAMAGE WILL OCCUR.

2.2.3 ZOOM LENS

The Blaster's Ranger™ is supplied with a **Zoom Lens** appropriate for imaging of blasts. A photograph of the **Zoom Lens** (12.5 – 75 mm) is shown to the right.

2.2.4 TRIPOD

This is an all aluminum construction **tripod** with a 3/8" mounting screw. This **tripod** is designed to support the **Grip Action Ball Head** with the Blaster's Ranger™ attached to video the object of interest.

2.2.5 GRIP ACTION BALL HEAD

A photograph of the **Grip Action Ball Head** is shown to the right. This accessory mounts to a **tripod** with a 3/8" mounting screw.

2.2.5   TRIGGER CABLE WITH SWITCH

The trigger cable with switch allows the user to trigger the camera at a distance. The user can extend this cable with the appropriate BNC connectors and a reel of RG-58 coaxial cable.

2.2.6 HIGH-SPEED COMPACT FLASH CARD

The **Compact Flash (CF)** card permits the user to save the captured video in the field and return to the office for analysis.   Recommendation of the appropriate size of **CF Card** for your model of Blaster's Ranger™ can be found in Section 4.3.5.

2.2.7 USB COMMUNICATION CABLE

This cable is used in the real-time video capture mode and to control the camera. This cable can also allow the user to transfer the video file to a computer from the CF card.

2.2.8 COMPACT FLASH CARD READER

This card reader will allow the user to transfer the video from the CF card at a higher transfer rate then the USB communications cable. This reader will allow the user to format the CF card with greater ease.

2.2.9 PROANALYST® TRACKONE EDITION SOFTWARE

ProAnalyst® TrackOne Edition allows auto-tracking of one feature and/or manually tracking of up to 32 features. Quickly export to Excel or Matlab for further analysis and graphing. This is a licensed piece of software which has a separate license key.
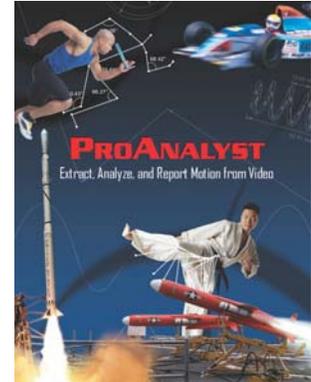
2.2.10   MIDAS EXPRESS SOFTWARE

MiDAS Express allows the user of the Blaster's Ranger™ to download the video in the RAW format and convert it to an AVI format on a computer. This is a licensed piece of software which has a separate license key.
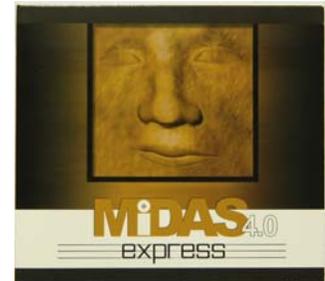
2.3   BLASTER'S RANGER^{TM} OPERATIONS MANUAL

This Operations Manual is supplied with the Blaster's Ranger™.
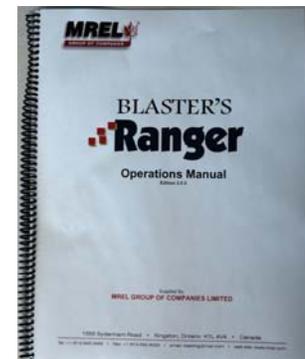
MREL
GROUP OF COMPANIES

CHAPTER 3: GETTING STARTED

> **This Chapter provides an outline of how to setup the Blaster's Ranger™ for recording, viewing and saving events to compact flash card and/or digitally to a computer. This Chapter assumes that the first thing the Operator will want to do when the system arrives is to unpack the equipment, set it up in an office environment and operate the controls of the camera.**

3.1 INTRODUCTION

This Chapter provides a detailed description of the setup procedure for the Blaster's Ranger™ and also the quick start instructions. Operation of the Blaster's Ranger™ is straightforward, however it should be noted that only the instructions/utilities that are commonly used are outlined in this discussion.

3.2 SETTING UP THE EQUIPMENT

The key pieces of equipment required for the setup of the Blaster's Ranger™ in an <u>office environment</u> are: the **Blaster's Ranger™** with **110/220 VAC Power Adapter**, **Bendix Connector, 12.5 – 75 mm C-Mount Zoom Lens, tripod with the pistol grip action Camera Ball Mount, Trigger Cable with switch, the high-speed Compact Flash Card, the Compact Flash Card Reader, Blaster's Ranger™ CD-ROM** and a printed **Blaster's Ranger™ Quick Start Guide**. The other Blaster's Ranger™ Accessories include: protective **Carry Case, 6 VDC Power Cable Adapter and a USB Communications Cable.**

There are several precautions that must be remembered prior to using the Blaster's Ranger™. The suggested procedure for assembly and connection of the system is detailed in the following Sections.

> *DO NOT ALLOW ANY DUST/DIRT/MOISTURE TO ENTER THE C-MOUNT CONNECTION PORT ON THE CAMERA WHEN ATTACHING THE ZOOM LENS.*

3.2.1   CAMERA/TRIPOD

Open/extend the **tripod** legs and set the **tripod** on a flat surface. Attach the **Grip Action Ball Head** to the top of the **tripod**. Take the **Mounting Adapter** from the **Grip Action Ball Head**, use the threaded screw and connect the **Mounting Adapter** to the bottom of the **Camera**. The **Mounting Adapter** should be attached to the threaded hole located on the underside of the **Camera**. Attach the **Camera** with **Mounting Adapter** to the **Grip Action Ball Head**. Secure the **Camera** using the locking lever located on the **Grip Action Ball Head**. It may be necessary to utilize the locking lever pin to close the locking lever on the **Mounting Adapter**.

3.2.2   INSTALLING INTERNAL BATTERIES

The Blaster's Ranger™ camera can be powered by four (4) D-Cell Nickel Metal Hydride (NiMh) batteries with high capacities (9,500 mAh or higher is recommended) (not included), or an external 6V power supply (not included). The batteries are installed in the bottom of the camera. For typical blasting applications, the available operating time when powering the camera from D-Cell batteries is <u>insufficient</u> and use of external 6V power is suggested.

Variables affecting run time operated by batteries include the rated amperage of the batteries and the number of cycles they have been through. A general estimate of capacities of the run time of the camera using 9,500 mAh NiMH **internally**, the camera with 1GB of internal memory can run for approximately 2.0 hours.

The battery icon has three bars and will appear in the lower right side of the built in LCD display. The battery icon will be present when the camera is on AC power even if no batteries are installed. As the batteries draw down there may be short periods of time when the indicator will move from 3 to 2 bars and then back to 3. This will also happen across the 2 to 1 indicator boundary. As a general rule when the icon indicates 1 bar, it is the time to save any work and switch to a second set of charged batteries or an AC/DC converter if they are going to continue shooting.

To install or remove the batteries, close the LCD screen cover and place the camera upside down on a work surface. Remove the two screws of the battery door. Install the batteries as indicated by the battery keying symbols inside the battery compartment.

Replace the battery door by sliding it back into its retaining slot. The post size on 'D' NiMh batteries can vary. If the post size is too small, the batteries may not fit securely, and power may be interrupted if the camera is moved or shocked.

 When the door is securely in place, turn the camera over, and open the LCD screen cover. The power button is the right bottom button.

3.2.3   CONNECTING AN EXTERNAL AC POWER SUPPLY

If the camera is on and powered from its batteries, turn the camera off by pressing the power switch before connecting the external power supply. **Make sure to download the videos you want to save to the CF card before turning off the camera, otherwise the videos will be lost.** After power is off, connect **110/220 VAC Power Adapter** to an AC outlet, then connect it to the power cable of the **Bendix Connector**. To connect to an external 6 VDC battery, please refer to Section 4.3.1.

MREL DOES NOT RECOMMEND PLUGGING THE EXTERNAL POWER JACK INTO THE CAMERA BEFORE PLUGGING IT INTO THE AC OUTLET. WALL TRANSFORMERS SOMETIMES GENERATE POWER SPIKES THAT CAN DAMAGE ELECTRONICS WHEN THE TRANSFORMERS ARE FIRST PLUGGED INTO THE WALL.

When the power plug is securely attached, turn the black locking knob to open the LCD screen cover of the display, and push the upper of the cover to the left and release to hold it, press the Power button.

Pivot Point

Black Locking Knob

Bendix Connector

3.2.4 LENS INSTALLATION

Focus Adjustment Ring

Zoom Adjustment Ring

Aperture Adjustment Ring

A cover is inserted in the lens mount at the factory to protect the sensor from contamination during shipment; remove this cover by unscrewing it. Do not loose this cover and should be placed on the camera whenever a lens is not on the camera. Thread any standard C-Mount lens into the receptacle in the front of the camera – the lens should be "finger tight". Using a lot of force to tighten the lens could result in changes to the lens mount which will affect the focus of the lens!

Try to avoid holding the camera with the lens opening facing up after the dust cover is removed. Any dust which settles on the face of the sensor may degrade the quality of the user's pictures until the camera is cleaned.

Once the lens is installed, move the aperture and focus rings to reasonable settings. A fully opened aperture (smallest number) will provide the highest possible recording rate with the largest amount of light, but there will not be much depth of field. Only a narrow range of objects in front of the camera will be in focus.

A small, closed aperture will provide good depth of field, but a lot more light will be needed to record at the highest rates. As a starting point, MREL suggests opening the aperture about halfway, and setting the focus all the way to "far", which should place most objects in focus more than 3 metres (10 feet) away.

The zoom ring will allow the object to be moved within the frame. This will permit the user more flexibility in the position of the camera.

Tips to make focus easier:
When you adjust the focus, change the resolution lower, for example RES 640X480 to 320X240, adjust the Focus Adjustment Ring to focus it then change the resolution back to 640X480.

3.2.5 TRIGGER SWITCH, AC POWER, USB CABLE AND BENDIX CONNECTOR

Although not used for typical blasting applications where the use of the CF card is preferred, the **USB Cable** attaches to the plug under the cover shown in the picture below in Section 3.3.2. The last two connections that remain to be made are the connection of the **Trigger Switch** and the **AC Power Adapter**. These are connected to the **Bendix Connector**. To connect the **Bendix Connector**, unscrew the protective cover by turning it counter-clockwise. With the cover removed, the **Bendix Connector** will only connect one way. The notch in the connector cable must be at the top of the cable to match the post in the housing of the camera. With the notch and post lined up, push the cable into the housing and turn the metal thread nut clockwise to tighten the cable. At the end of the **Bendix Connector** cable the **Trigger Switch** is connected to the "TRIGGER" BNC connector, and the **Power Adapter** is connected to the long cable. Note that the **AC Power Adapter** can be powered by 110/220 VAC.

3.2.6 SYNC IN, SYNC OUT, VIDEO OUT AND IRIG

The other connections on the **Bendix Connector** are: Sync In and Out allows the user to synchronize multiple Blaster's Ranger™ cameras together for a common time base. The IRIG timing protocol is used by the US military to embed millisecond timing information in the image stream. VIDEO OUT outputs NTSC and PAL video.

3.2.7 COMPACT FLASH CARD INSTALLATION

The camera can capture and play back high speed video clips without a CF card installed, but **to save the files for later viewing, a CF card must be inserted**.

The CF card receptacle is located behind the access door on the lower right side of the camera when viewed from the rear.

Insert a new card with the label facing towards the back of the camera. Press the card along the guide slots until it rests against the connector pins at the bottom of the camera. To remove the CF card from the camera, after the door is opened, press the ejector mechanism which is just above the CF card, then remove the CF card from the slot.

CF Card Slot
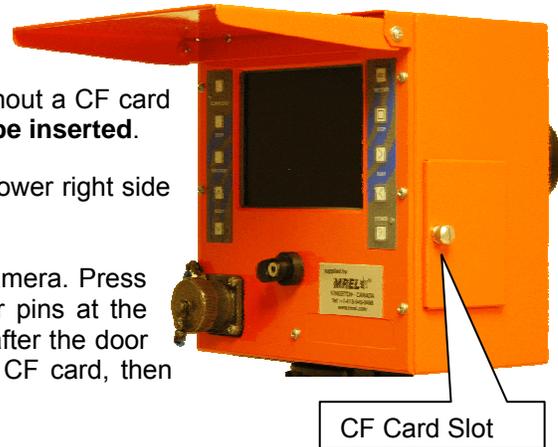
The Blaster's Ranger™ camera can record the video file to the CF Card in three (3) formats:
AVI, RAW, MPEG. Uncompressed (lossless) recordings are in an AVI file format, while compressed (loss) recording are in a MPEG1 format. The RAW format is a lossless compressed format that can be read and converted to a standard AVI file using MiDAS Express software provided with the camera. The AVI and MPEG video files downloaded to the CF card are a common form of video file that can be viewed using a conventional video player, such as the Windows Media Player. The format is selected using the menu screen. Files on the CF card can be added and deleted using a desktop computer and CF card reader, or connecting the camera over the USB link. The CF cards can be FAT and FAT 32 formats.

3.2.7.1 DIFFERENCES WITH DOWNLOAD FORMATS

3.2.7.1.1 AVI FORMAT

The download format of AVI from the Blaster's Ranger™ is a lossless compression. There is no data lost from the camera resolution to the playback resolution. Each pixel is present in the downloaded file and can be resolved in the file at a later date. The drawback of this format is it requires a large amount of time to download to the CF card and a large amount of space on the CF card.

3.2.7.1.2 MPEG FORMAT

The download format of MPEG from the Blaster's Ranger™ is a loss compression. There is data that is lost when the camera processes the video to be saved onto the CF card. MPEG is designed to exploit known limitations of the human eye, notably the fact that small color changes are perceived less accurately than small changes in brightness. Thus, MPEG is intended for compressing images that will be looked at by humans. If you plan to machine-analyze your images, the small errors introduced by MPEG may be a problem for you, even if they are invisible to the eye. This produces a problem when performing Motion Analysis on the captured video.

3.2.7.1.3 RAW FORMAT

The download format of RAW from the Blaster's Ranger™ is a lossless compression. The camera will download in a native form known to the camera and MiDAS Express software. The advantage to downloading in the RAW format is the downloaded size of the file is smaller (than AVI format) and without any loss of information. The transfer time required to download a set number of frames (compared to AVI format) is approximately 3 times faster. This will allow the computer to process the video with more computing power and a reduced overall time.

3.3   CONNECTING TO A COMPUTER

3.3.1 SYSTEM REQUIREMENTS

Any IBM compatible personal computer with an unused USB port can be used to operate and configure the Blaster's Ranger™ Camera, but a computer is not necessary for capturing and viewing high speed video recordings on the camera's built-in LCD screen.

Each of the AVI files produced by the camera can be hundreds of megabytes, or more, in size. If the operator uses the camera with a computer, they should select one with resources that can support manipulation of video clips that are this large. MREL recommends a minimum configuration of:

1GHz or better processor, Intel or AMD

Windows XP operating system

256 MB (Megabytes) or more of SDRAM

24 bit color graphics adapter at 1280 by 1024 screen resolution

SVGA multi-sync monitor capable of 1280 by 1024 resolution

Large hard disk drive with 10 GB (Gigabytes) or more of free space

The camera can be made to operate on less capable systems, with penalties in speed and convenience.

3.3.2 CONNECTING TO A COMPUTER USING USB

Although not typically recommended for recording blasts, the Blaster's Ranger™ camera can be connected to a computer through its USB 2.0 port using an USB 2.0 cable. It is another way to operate the camera. This allows the operator to control the camera remotely, and to save the recorded videos to the computer directly without the use of a CF card. **Before proceeding, ensure that the CF slot in the camera is empty**. The MiDAS 4.0 Express software package must be installed on the computer before continuing any further in this section.

> **ERROR:** If the CF card is in the camera when starting the MiDAS software, the camera will appear as a mass storage device and MiDAS will not recognize it.

USB 2.0 plug

The USB connector is located behind the rubber weather resistant cover on the left side of the camera, as viewed from the rear of the camera. The USB connector is at the very top of opening covered by the rubber weather resistant cover as shown in the above illustration.

Plug one end of the USB cable into the personal computer or USB hub intended to control the camera. **Do not plug the other end into the camera until the camera has been turned on, and the camera file system memory has been setup.** This guarantees the camera will respond promptly to request from the computer for identification information. The camera has different capabilities, depending on whether it is plugged in with the CF card installed, or if the CF card slot is empty. In either case, the camera looks like a new removable disk to the Windows operating system.

ERROR: If the operator powers up the camera with the USB cable already connected, the camera may not respond promptly to requests from the host. These requests start as soon as the computer detects power, but it will take a few seconds before the camera is able to communicate. This can sometimes result in a failure to connect properly.

3.4 ABOUT SOFTWARE

3.4.1 PROANALYST® TRACKONE EDITION SOFTWARE

ProAnalyst® TrackOne Edition is a piece of software that will allow the user to track objects moving frame of video. This software uses a hardware license key (dongle) that connects through an available USB plug. This key can be moved from computer to computer, but the ProAnalyst® TrackOne Edition will only operate when the dongle is plugged into the computer.

For more information and the operation of the software, please refer to the manual and the quick start guide for the full details about the software.

3.4.2 MIDAS EXPRESS SOFTWARE

MiDAS Express is a piece of software that will allow the user to control and download the video from the Blaster's Ranger™ when connected by the USB cable. The other item that is required to use MiDAS Express is to convert the video files downloaded from the Blaster's Ranger™ in the RAW format. The MiDAS Express software will allow the user to use the more powerful computer to convert the RAW file to a standard AVI file. This software is a software key is can only be installed on one computer and can not be moved very easily. Generally, the user needs to pick a computer that is either the one which does all of the video analysis or the computer that travels with the camera.

For more information and the operation of the software, please refer to the instructions on the disc for the full details about the software.

3.5   QUICK START INSTRUCTIONS (REFER TO CHAPTER 4 & 5 FOR DETAILS)

Here are the quick instructions to operate the camera when using a CF card to save the video:

1. Plug the **110/220 VAC Power Adapter** into the AC power source, or attach the **6 VDC Power Cable Adapter** to a 6 volt source. (The 6V rechargeable battery is not included.)

> *MREL DOES NOT RECOMMEND PLUGGING THE EXTERNAL POWER JACK INTO THE CAMERA BEFORE PLUGGING IT INTO THE AC OUTLET. WALL TRANSFORMERS SOMETIMES GENERATE POWER SPIKES THAT CAN DAMAGE ELECTRONICS WHEN THE TRANSFORMERS ARE FIRST PLUGGED INTO THE WALL.*

OR

2. Open/extend the **tripod** legs and set the **tripod** on a flat surface. Attach the **Grip Action Ball Head** to the top of the **tripod**. Take the **Mounting Adapter** from the **Grip Action Ball Head**, use the threaded screw and connect the **Mounting Adapter** to the bottom of the **Camera**. The **Mounting Adapter** should be attached to the threaded hole located on the underside of the **Camera**. Attach the **Camera** with **Mounting Adapter** to the **Grip Action Ball Head**. Secure the **Camera** using the locking lever located on the **Grip Action Ball Head**. It may be necessary to utilize the locking lever pin to close the locking lever on the **Mounting Adapter**.

3. Unscrew the **Zoom Lens** C-mount protector and the **Camera** C-mount protector. Insert the **Zoom Lens** into the threads and rotate, with gentle pressure, the **Zoom Lens** clockwise until it stops turning. Do not over tighten the **Zoom Lens** because damage to the lens or mount may occur. Turn the **Zoom Lens** counter-clockwise to remove it from the **Camera**.

4. Connect the **Bendix Connector** to the Blaster's Ranger™.
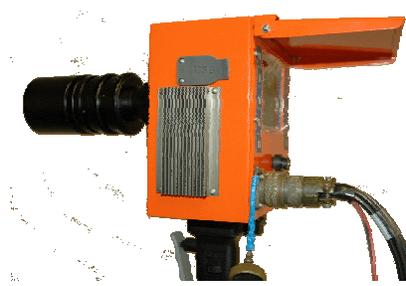
Then connect the **110/220 VAC Power Adapter** or the **6 VDC Power Cable Adapter** to the **Bendix Connector** and connect the power leads to mains power or to a 6 Volt rechargeable battery.

5. Open the cover of the LCD and press the **power** button. After a few seconds, the camera wakes up in **record mode**. The images are stored in a circular memory buffer. The camera stays in **record mode** until a trigger signal is received.

6. CAPTURE AN EVENT
Focus the lens and adjust the lens aperture setting. Depending on the trigger setting, press **STOP** button or press the **Trigger Switch** to capture the event and exit the **record mode** and enter **playback mode**.

7. OBSERVE A STORED EVENT
Review the saved video clip using the **PLAY FWD**, **PLAY REV** buttons. Images in memory are displayed in a continuous loop until the **STOP** button is pressed.

8. SAVE A STORED EVENT TO CF CARD

After capturing an event, open the CF card access door on the side and insert a CF card.

- Using the **SELECT** buttons set **F/Sec** to step mode.

- Press the **FUNCTION** button once to select the **FRAME**: menu.

- Using the **PLAY** buttons display the first frame of the recorded event of interest.

- Press the ▼**SELECT** button to mark the first frame to be saved to the CF card.

- Using the **PLAY** buttons display the last frame of the recorded event of interest. (Please see details of the save limits of the video file in Section 4.3.5)

- Press the ▲**SELECT** button to mark the last frame to be saved to the CF card.

- Press the **DOWNLOAD** button to save marked frames as an AVI file on the CF card.

When the AVI file is completed, press **RECORD** to start recording a new event.

9. Copy the AVI file from the CF card to a computer using the **card reader**.

Please refer to Section 4.6 for the instructions using the USB Communication Cable and MiDAS 4.0 Express to operate the camera.

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CHAPTER 4: FIELD OPERATIONS

This Chapter provides instructions on using the Blaster's Ranger™ to record blasts in the field.

4.1 INTRODUCTION

High-speed cinematography/videography and their applications to the blasting industry have proven to be extremely valuable tools. These systems can be extremely useful when used correctly; they can provide valuable information and feedback for any single system in terms of troubleshooting and assisting in the blast design. In other words, visual "capture and review" of a blast allows the mine operator to locate and correct various problems which can occur.

Typical filming rates for full-scale blasts usually range from approximately 250 to 1000 frames per second. Some of the applications for high-speed video imaging include:

- immediate availability of the blast for review
- confirmation of the firing sequence of holes
- measurement of the firing time and scatter in detonators
- assessment of the degree of confinement, stemming blowouts, and flyrock zones
- confirmation of the functioning of explosives, primers, and accessories
- determination of the location, time, and duration of escaping gases
- assessment of the locations responsible for flyrock or other projectiles
- determination of the causes of misfires and poor loading practices
- evaluation of the effects of redrills, water, gas venting, and buffers
- evaluation of the degree and extent of backbreak
- determination of the location, event time, and duration of deadly oxides of nitrogen gases resulting from incomplete detonation
- correlation of the visual images of the blast with the appearance of less-then-optimum explosives performance as determined using in-situ VOD measurements.

The Figure on the following page illustrates the various high-speed video photography applications.

STEMMING BLOWOUTS

FLYROCK

STEMMING
CONTAINMENT

GAS VENTING
AND AIR BLAST

ONSET
OF MOVEMENT

TRAJECTORY

VELOCITY

BACKBREAK

CRATERING

MISFIRES/
CUTOFFS

FIRING
SEQUENCE

100ms   150ms   200ms   250ms   300ms

OVERSIZE

CAST
RANGE

BLAST TOE
PROBLEMS

COAL RIB DAMAGE
AND COAL LOSS
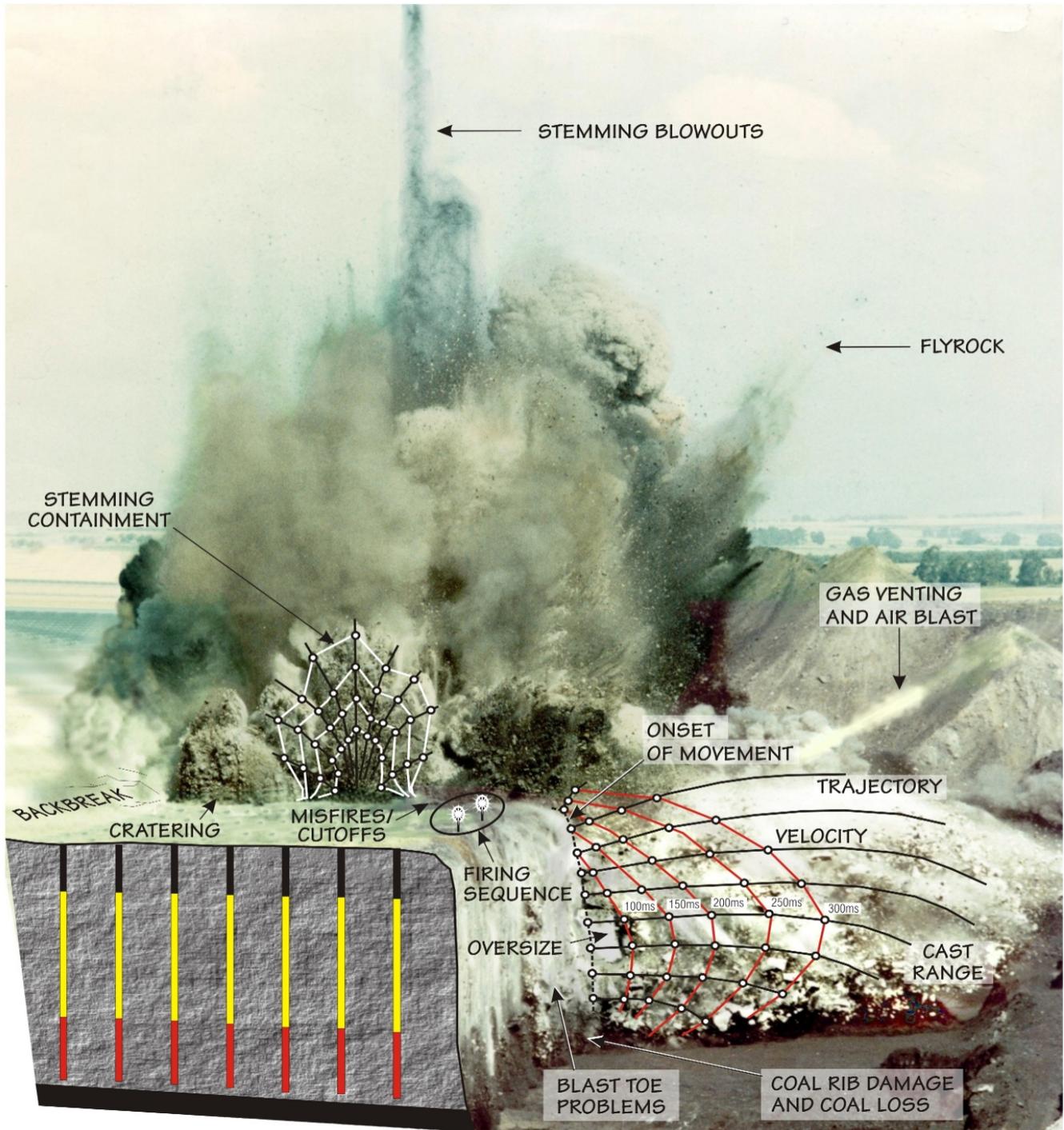
4.2 SELECTING A CAMERA POSITION

The position of the camera is very important – it should be chosen as carefully as possible. Often it is difficult to select an ideal location due to obstructions or lack of elevation between the camera and the blast. This can usually be overcome by careful selection of both the available location and the lens. When selecting the location safety is foremost, especially if the camera Operator has, or wants, to be with the camera. If there is any chance of flyrock, the Operator should be provided with adequate protection or a remote triggering system should be considered. The **Trigger Switch** provided with the Blaster's Ranger™ Accessories can provide a small semblance of remote control (camera outside shelter with the Operator under shelter). It should be noted that this switch can be extended using standard coaxial cable (RG 58) with appropriate BNC connectors. Alternatively, a make-wire trigger setup can be tied in directly with the explosive event. Finally, the location should also ensure that during the blast, the first holes to detonate do not obscure those behind them. For this reason, it is often best to be situated so the last holes to detonate are nearest the camera.

The location of the camera should be selected based on the field of view desired by the Operator. For observation of surface movement, the camera should be located above the blast and to the side or back, with the last holes to be detonated closest to the camera. For an overall view of the blast, the camera should be located at some point in front and somewhat higher than the blast, again with the blast propagating towards the camera. For a view of the blast face, the camera should be located a safe distance directly in front of the blast, if possible at a slightly elevated level.

For the determination of face velocities, the camera should be located to the side of the blast, as parallel as possible to the face and with the blast propagating towards the camera. It should be noted that when conducting blast analysis of surface and/or face velocities, markers should be positioned either on the surface or on the face at an exact distance determined both vertically and horizontally. These distances become the reference points for use in the **ProAnalyst**® **TrackOne Edition** Motion Analysis Software.

For the markers used on the top of the blast, they should be placed so a line connecting them would be perpendicular to the line of sight from the camera. This allows their separation to be measured directly in the software, without compensating for any correction due to orientation.

Any targets suspended over the face should be secured on a thin rope or wire at a measured distance apart. The targets should be of adequate size (generally one to two square feet) to be observed on the video. The targets should be a vivid color (when using a color system) or white (on a grey/black face when using a monochrome system) to allow easy identification; also a three dimensional target (box, canister, sphere) should be used. Pay special attention when lowering the targets down the face that they do not get hung up on the rocks. The separation can be used to check the scale factors used in the analysis. Finally, care should be taken that the markers can break free from the rope/wire during movement, otherwise the markers may be held back and not follow the true trajectory.

4.3   FIELD SETUP

4.3.1 POWER SUPPLY OPTIONS

Once the camera position has been selected, it is a simple matter to assemble, position, and set the camera parameters for the recording of the blast event. Typically, in the field, DC power can be made available through a rechargeable 6 VDC lead acid battery. The Blaster's Ranger™ will draw 4 amps – a typical 6 volt lead acid battery has 12 ampere hours (AmpH); therefore the camera will operate for 3 hours. The **6 VDC Power Cable Adapter** has been provided with alligator clips to connect to a typical 6 volt lead acid battery. If AC power, such as a generator or a power inverter is used, then the camera can be powered through the **AC Adapter**. Photographs of these accessories are shown in Chapter 2.

4.3.2 SYSTEM SETUP

4.3.2.1 PHYSICAL SETUP
The setup of the system was detailed in Chapter 3.

i)   Setup the **Tripod**;

ii)   Connect the **Mounting Adapter** to the **Camera** and attach the assembly to the **Grip Action Ball Head**;

iii)   Attach the **Trigger Switch** to the TRIGGER connector in the **Bendix Connector**;

iv)   Attach the **Zoom Lens** to the front of the **Camera** and **insert a CF card into the Camera**;

v)   Attach the appropriate power supply adapters (AC or DC) to the **Camera** through the **Bendix Connector** and to the power supply source (120/240 VAC, or 6 VDC battery);

Now with the power turned on, the blaster can remove the protective lens cover from the **Zoom Lens**, and establish the desired image in the **Display Screen** using: the **Grip Action Ball Head**; exposure controls (**Zoom Lens** F-stop, **Camera** shutter speed); field of view (**Zoom Lens** zoom); and focus (**Zoom Lens** focus).

If the user is having difficulties focusing the camera at infinity with the lens, the operator needs follow the following steps to perform the lens back-focus adjustment. When you perform a back-focus adjustment you change the distance between the flange mount surface of the lens and the CMOS sensor array. A properly focused lens will maintain focus at both ends of its zoom range.

In most cases, changing the lens on your camera will not require a lens back-focus adjustment.

Step 1 Place the camera on a tripod.
Step 2 Turn on the camera and focus on an object as far away as possible (at least 20 feet away).
Step 3 Set the lens aperture to wide open (smallest number).
Step 4 Zoom in on the target object (if using a zoom lens).
Step 5 Adjust the focus normally until the picture is sharp.
Step 6 Zoom out from the target (if using a zoom lens).
Step 7 Loosen the back-focus ring retaining screws (two screws behind the lens).
Step 8 Rotate the C mount until the picture is sharp (rotate no further than 45 degrees in either direction):
        Counter-clockwise rotation increases lens focal length.
        Clockwise rotation decreases lens focal length.
Step 9 Tighten the back focus ring retaining screws.
Step 10 Check for sharp focus at both ends of the focus range.
Step 11 Repeat steps 4 through 10 until the focus is sharp at both ends of the focus range.

There are three points that should be noted: first, for field trials, focus control is usually set to infinity. Second, if the **Tripod** is unstable, it is suggested that a weighted object such as a bag of sand or water be suspended from the centre of the **Tripod**. This provides considerable motion stabilisation to the **Tripod**. Third, set the **tripod** with its legs as short as possible to increase stability and to remove as much as possible the camera motion induced by ground movement.

4.3.2.2 CAMERA SETUP

Once the camera is powered up, has a lens attached, and a CF card installed, it is ready to use. Camera operations can be divided into several modes or categories:

- Setting up recording parameters
- Recording and saving high speed video
- Playing back a captured clip
- Saving a video clip to an AVI file
- Advanced configuration and setup options

The following figure shows the Camera Displays, Controls and Indicators. The control button descriptions listed below are from the top left down to the bottom left and then top right to bottom right.

DOWNLOAD
Start a download of images to CF card.

SETUP
Display the camera Configuration menus: Setup, Info, Set Date/Time and Default Settings.
Camera configuration commands and camera status are accessed through these four Configuration Screen menus.

FUNCTION
Choose the activated items. You can use floating menus to access the most commonly used camera settings in real time. Select a superimposed floating menu item on the camera LCD display. The active menu item is turned into green.

SELECT Up/Down
Select a specific parameter from the available parameters displayed by a floating menu item.

RECORD/STOP
Start or stop recording a video. When the camera is powered up, the default setting is Record mode.

PLAY Fwd/Rev
Play back a captured event in a forward or reverse direction.

All of these functions have a common menu interface controlled by the "Setup" button, and the "Up" and "Down" arrow buttons. There are two kinds of menu presentations: "Floating" menus that are superimposed on the current image, or a menu list that is painted on a black background.

Floating menus are used for the most commonly accessed settings in the mode that is in use. Less commonly accessed settings are available through menu lists. These lists are accessed by depressing the "Setup" button.

In both cases, the active menu item is highlighted in green, while inactive items are drawn in blue. The "Up" and "Down" buttons change the value of the active (green) menu item. As the buttons are pushed, the value changes immediately.

4.3.2.3 RECOMMENDED CAMERA SETTINGS
In the setup menu, it is recommended that the camera has its light source should be set to daylight (with a color camera) and the compression set to AVI or RAW.

4.3.3 OPERATING THE CAMERA IN RECORD MODE

The camera starts up in **record mode**. In this mode it is constantly recording high speed video to a circular buffer, waiting for a stop signal. The stop signal can come from either an external trigger, or the **STOP** button located next to the **RECORD** button. The three most important values that can be adjusted during recording are the recording rate, the shutter speed, and the trigger point.

The following figure shows the Record Mode floating menu configuration commands and displays:
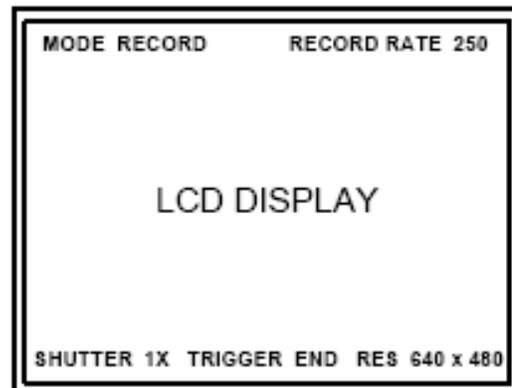
MODE RECORD Display the current camera operational mode (Record).

RECORD RATE 250 Display the current Record Rate setting in frames per second.

The highest recording rate possible for the camera at 640 X 480 pixels image size with the maximum recording frame rate of 1000 frame per second (fps). The **Enhanced Memory** will capture 4368 frames, or approximately 4 seconds of recording time at 1000 fps.

Slower Recording rates allow the lens to be stopped down, and video clips can be captured with less light. With the lens stopped down (using a larger aperture number), the depth of field will increase. The longer exposures possible at slow rates (at 250 frames per second, maximum exposure is 4 ms) may also result in more motion blur in each frame.

Slower recording rates also allow the total recording time to be extended so that slower events can be captured. At a 25 fps recording rate (PAL video rate) the camera can store over a minute of full motion video.

SHUTTER 1X
Display the current Shutter Speed setting. The default setting is 1X.
The shutter speed is defined as the inverse values of the frame rate times the shutter multiplier. The shutter multiplier setting determines the camera shutter speed.
For example: Frame rate=250fps (inverse value is 1/250 or 0.004 seconds
Shutter Multiplier = A setting of 4X (inverse value is 1/4th or .25)
Then, Shutter speed=0.004x.25 or 0.001 seconds
Shutter multiplier settings of 1X, 2X 3X, 4X, 5X, 10X and 20X are selectable from the menu system.
But remember, the higher the shutter multiplier, the more light the camera needs. Changing shutter does not change record rate or frame resolution. Faster shutter speeds reduce object blur.

Record Rate Vs Shutter Speeds – values in seconds

Shutter Speed	50 fps	60	125	250	500	1,000
1X	0.0200	0.0167	0.00800	0.00400	0.002000	0.001000
2X	0.0100	0.0083	0.00400	0.00200	0.001000	0.000500
3X	0.0067	0.0056	0.00267	0.00133	0.000667	0.000333
4X	0.0050	0.0042	0.00200	0.00100	0.000500	0.000250
5X	0.0040	0.0033	0.00160	0.00080	0.000400	0.000200
10X	0.0020	0.0017	0.00080	0.00040	0.000200	0.000100
20X	0.0010	0.0008	0.00040	0.00020	0.000100	0.000050

TRIGGER END
Capture Event Trigger command: Display the current Trigger setting.

The video capture buffer is organized around the frame that is recorded at the moment the stop button is pushed or an external trigger input is detected - this frame is called the trigger point. The trigger point is expressed as a percentage of the total frames captured, or as "Start" or "End" for trigger points at the beginning or end of the video clip.
If the trigger point is set to "Start", the camera will record the entire clip after the trigger is detected. The trigger point frame will be the first one in the capture memory. If the trigger point is set to "End" the camera will stop recording immediately when the trigger is detected. All frames recorded up to the moment of the trigger event will be saved in the buffer.
External trigger signals are connected through one of the BNC connectors located at the end of the Bendix Cable. The external trigger signal can be used to trigger the camera. The signal needs to be greater than 3.3 Volt to 5 Volt logic signal that drops to ground when the trigger event occurs. At the end of the capture, the trigger frame is the one displayed on the LCD when camera reaches its Playback Mode.

Trigger Points and Functions

Trigger	Function
Start	Begin capturing image frames in camera memory when the trigger point is detected. It makes the trigger point the first frame captured.
25%	Retain **25%** of the frames captured **before** the trigger point was detected. It records new frames in the remaining 75% of camera memory.
50%	Retain **50%** of the frames captured **before** the trigger point was detected. It records new frames in the remaining 50% of camera memory.
75%	Retain **75%** of the frames captured **before** the trigger point was detected. It records new frames in the remaining 25% of camera memory.
End	Stop capturing frames in camera memory once the trigger point is detected. It retains all frames recorded in camera memory up to the moment of the trigger.

A good recommendation for trigger setup for a typical mining blast is 25%. With the camera set at 25%, as soon as there is movement on the pattern detected by the operator, the **trigger switch** should be pressed. This will allow a small collection of frames before the blast starts and will maximize the time after the blast with the other settings used.

RES 640X640
Display the current Record Resolution setting in pixels. Factory Default Setting: 640 x 480. 320 x 240 is a selectable resolution.

L: T1
Before beginning recording, you need to select the light source. It can be set using the "floating menu". Light source is used to set the camera color processing constants to match the current environmental light source. Cameras are affected by the color of the light used to illuminate the image.

For color cameras, the following lighting options are available:
D1 (Daylight): Sets camera color processing constants to daylight balance.
Original: Allows camera to determine the color to be represented as neutral based upon the average color in the frame.
**T1 (Tungsten):** Sets camera color processing constants to tungsten balance.

Daylight is for outdoors, and tungsten is for indoors under normal domestic lighting. If you use daylight under tungsten light the images will be very yellow. If you use tungsten in daylight the images will be very blue. For original, white looks white, not yellow or blue. If you know what your light source is you can usually set the camera to it and this may give better results. The Operator can cycle the lighting settings to display the best image on the LCD screen. The downloaded images will look exactly to the displayed images.

4.3.4 OPERATING THE CAMERA IN PLAYBACK MODE

When a trigger event has been detected and the capture buffer has been filled, the camera enters **Playback Mode**, with the trigger frame shown as a still on the LCD display. The frame number of the image displayed on the LCD is shown in the lower left corner. The elapsed time for the frame is shown in the lower right.

The following figure shows the **Playback** and **Stopped Mode** floating menu configuration commands and displays.

```
MODE PLAY: STOPPED              F/Sec 30
MODE PLAY: <===>
or
MODE PLAY ZOOM: STOPPED


         LCD DISPLAY


F: -2183  ▼-2183  ▲00000  TIME: -08732
```
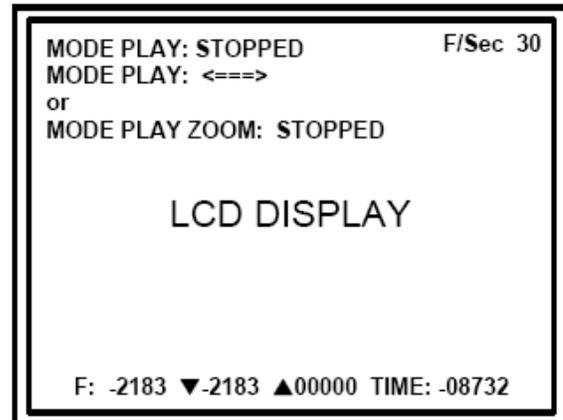
F/Sec 30
Display the current playback rate setting in frames per second.
The default setting is 30 frames per second.
To change the rate, highlight it by pressing **FUNCTION** button, and use "**UP**" and "**DOWN**" to change the rate.

FRAME: -2183
Frame number currently being displayed. Play button reverse playback direction.

▼-2183 (First Frame) ▲ 00000 (Last Frame)
Beginning (▼) and ending (▲) points of the frame interval saved to CF card when the **Download** button is pressed. The default setting is all frames. You can also mark beginning and ending point using **PLAY** Fwd and Rev before press **DOWNLOAD** button to download the interest video.

TIME: -08732
Display the elapsed playback time, the time displayed is in milliseconds. Playback rates can be set from "Step" to 1000. In step mode, the "Step +" and "Step –" switches move the displayed frame forward and backward one step at a time. If a step switch is held, frames are displayed continuously, starting at 1 per second, and accelerating to a maximum of 30 per second. The maximum real display rate to the LCD is about 25 frames per second. Higher playback rates result in frames being skipped to simulate the appearance of the recording in real time.

4.3.5 DOWNLOADING VIDEO FILES IN THE FIELD

4.3.5.1 SETTING THE SAVE LIMITS

> **WARNING: DO NOT PRESS THE DOWNLOAD BUTTON UNTIL AFTER THE SAVE LIMITS HAVE BEEN SET.**

Often, the entire recording does not need to be saved, and instead a smaller subset of the frames in memory is useful. After capturing an event, set the markers of the interested video:

- Using the **SELECT** buttons set **F/Sec** to step mode.

- Press the **FUNCTION** button once to select the **FRAME**: menu F:.

- Using the **PLAY** buttons display the first frame of the recorded event of interest.

- Press the **▼SELECT** button to mark the first frame to be saved to the CF card.

- Using the **PLAY** buttons display the last frame of the recorded event of interest.

- Press the **▲SELECT** button to mark the last frame to be saved to the CF card.

4.3.5.2 DOWNLOADING VIDEO FILES TO CF CARD
Once the markers have been satisfactorily set, open the CF access door and insert a formatted CF card. Pressing the **DOWNLOAD** button will cause the frames between the markers to be saved to an **AVI** or **RAW** or **MPEG** file according to the settings in **SETUP** menu on the CF card. The files will be named according to the event number under which the data were recorded. If you want to save all the videos from the camera memory after you stop recording, just press **DOWNLOAD** button. The default is to download all of the videos to the CF card.
 As each frame is saved, it is displayed on the LCD. At the end of the operation the camera automatically switches back to **playback mode** so additional clips from memory can be saved if desired. To save an additional clip on the same CF card, the event number must be changed so the first file will not be overwritten. The event number can be changed manually in the **Setup Menu**.

Pressing the **RECORD** button will start a new recording. If the CF card runs out of space during the file save operation, the file will be closed, but will be incomplete. Each frame of a compressed **MPEG1** file uses about 25KB (kilobytes) of storage, so a 1000 frame recording will need 25 MB (megabytes) of free space in the CF card. The amount of free space available can be checked in the **Setup / Menu** lists. In uncompressed mode, each frame is 300 KB of storage.

For resolution 640X480, the cameras with the onboard memory will store 4368 frames. The following is the typical download time to CF cards and file sizes. The size and download time in the table below is set for AVI files. RAW file structure will perform the same as the AVI for analysis with the conversion using MiDAS Express but the file size and download time is 1/3 of the AVI file.

Resolution	# of Frames	Color/Mono	Size	Download Time
320 x 240	100	Mono	7.5 MB	5 Seconds
320 x 240	100	Color	30 MB	15 Seconds
640 x 480	100	Mono	30 MB	15 Seconds
640 x 480	4368	Mono	1310 MB	10.92 Minutes
640 x 480	100	Color	90 MB	45 Seconds
640 x 480	4368	Color	3930 MB	32.76 Minutes

4.3.6 COPY VIDEOS FROM CF CARD TO COMPUTER

To transfer the video from the CF card to the computer, the user must install the card reader to the computer. To view the video on the computer, any Windows-based video software, including Windows Media Player, can be used to play the AVI file.

4.3.6.1 INSTALLING THE CF CARD READER
If the user is connecting the ImageMate 12-in-1 reader to a computer using Windows 2000 with Service Pack 3, XP, VISTA, ME or 7, Windows will automatically recognize the reader and install the proper drivers.

If the user is connecting the device to a computer using Windows 98SE, or Windows 2000 with Service Pack 1 or Service Pack 2, the user must insert the CD included labeled "ImageMate USB 2.0 Reader/Writer" into the computer. Select the setup.exe file on the CD and follow the on-screen directions.

4.3.6.2 COPYING VIDEOS FROM CF CARD TO COMPUTER
Insert the CF card into the slot labeled CF I&II. Windows will recognize the card and list it as a removable drive in the My Computer directory in Windows Explorer. Open the card and move the file to the desired location on the hard drive. Once the file has been moved, the card will be blank and ready to copy more frames from the camera.

4.4 ADVANCED CONFIGURATION AND SETTINGS

All user configurable camera settings are managed by the following screen menus (accessed by toggling the **SETUP** button).
1. SETUP – Change record mode settings
2. INFO – Display camera information
3. SET DATE/TIME – Set saved AVI file header date and time values
4. MEMORY MENU – Display camera memory and associated recording parameters.
5. FILE REVIEW – Display or delete stored events on the CF card from the camera. This menu is only displayed when the **DOWNLOAD** button is pressed while in the record mode.

4.4.1 SETUP MENU

The following figure shows the SETUP menu and current configuration settings.

RECORD RATE
Set record speed in frames per second. All cameras can record at 25, 30, 50, 60, 125, 250, 500 and 1000 fps.

SHUTTER
Set shutter speed. 1X, 2X, 3X, 4X, 5X, 6X, 10X and 20X can be selected.

TRIGGER
Select camera trigger. Start, 25%, 50%, 75%, or End can be selected. See 4.3.3 OPERATING THE CAMERA IN RECORD MODE for more details.

AUTO DOWNLOAD MODE
When it is set to ON, after you stop recording, it will start downloading the videos from the memory to CF card automatically, and go back to **RECORD** mode after finishing downloading.

EVENT NUMBER
Set a record/capture event number. Each recording is given an automatically incrementing event number. The event number can be changed by using the **FUNCTION** and **SELECT** buttons in the **SETUP** menu.

LIGHT SOURCE
Light source is used to set the camera color processing constants to match the current environmental light source. Cameras are affected by the color of the light used to illuminate the image.
D1 (Daylight): Sets camera color processing constants to daylight balance, used for outdoors.
Original: Allows camera to determine the color to be represented as neutral based upon the average color in the frame.
T1 (Tungsten): Sets camera color processing constants to tungsten balance, used for indoors under normal domestic lighting.

If you use daylight under tungsten light the images will be very yellow. If you use tungsten in daylight the images will be very blue. For original, white looks white, not yellow or blue. If you know what your light source is you can usually set the camera to it and this may give better results.

RESOLUTION
Set camera resolution. Either 640 x 480 or 320 x 240 can be selected.

FILE FORMAT
Set file format to AVI, RAW or MPEG.

SYNC MODE
Set camera sync mode to Master, Slave, Off. Allow two or more cameras to be synchronized for 2-dimensional or 3-dimensional image capture.

TRIGGER MARKER

 Marks the frames, start to end, to which the trigger will be applied.

TRIGGER
 Selects trigger input either falling or rising edge.

VIDEO MODE Set video record mode to NTSC or PAL standard.

4.4.2 INFO MENU

The Info menu contains status information for the CF card, memory, time and the date.

```
            INFO MENU
▶PWM BRIGHTNESS              NORMAL
  FILE SPACE REMAINING    4089 KB FREE
  FILE SPACE IN USE         2 KB USED
  DATE             WED SEPT 10, 2008
  TIME                    06:17:54
  TYPE                        COLOR
  MODEL NAME              TS2LR 1000
  FIRMWARE REV          version: 347
  FPGA REV              version:  11
  MTC BOOT REV          version: 000
  MTC APP REV           version: 112
       (PRESS STOP TO EXIT MENU)
```

PWM BRIGHTNESS
Set the brightness of the screen to normal or maximum.

FILE SPACE REMAINING
Both the free space and used space on the CF card are displayed. The value is given in Kilobytes (KB). 1 MB (Megabyte) = 1024 KB.

DATE AND TIME
The date and time values shown are included in the header information for each of the AVI files saved on the CF card. Date and time are saved and restored through a power cycle. If the batteries are removed, or allowed to go dead for a period of many days, the date and time may be forgotten and must then be reset. To set the date and time, use the up and down arrow keys to adjust each of the entries in the SET DATE / TIME menu list.

TYPE
This value displays MONO for a monochrome model and color for a color model.

MODEL NAME
The model name reflects the capabilities of the camera.

FIRMWARE REVISION
This value shows the version of camera control firmware installed in the camera.

FPGA REV
Displays the FPGA firmware revision number. FPGA = Processor that moves data from the sensors to the RAM.

MTC BOOT REV
Displays the revision number of the MTC (Master Timing Control) Processor Boot Code.

MTC APP REV
Displays the revision number of APP Code.

4.4.3 SET DATE/TIME MENU

The following figure shows the SET DATE/TIME menu and current configuration settings.
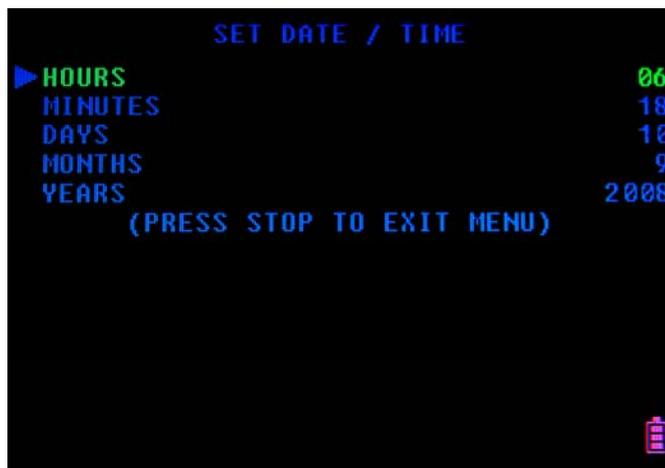
4.4.4 MEMORY MENU

TOTAL CAMERA MEMORY Display the camera memory size.

PARTITION INDEX Partition number currently in use.

TOTAL PARTITIONS Set the number of memory partitions.

RECORD RATE Set record speed in frames per second.

RESOLUTION Set camera resolution.

TRIGGER Set camera trigger points (START, 25%, 50%, 75%, END).

PARTITION SIZE (MB) Display the amount of memory available to each partition.

PARTITION SIZE (FRMS) Display the number of memory frames available to each partition.

RECORD TIME (TOTAL: Secs) Display the record time available to each partition.

RECORD TIME (PRE-TRIG: Secs)
Display the amount of pre-trigger record time **available.**

RECORD TIME (POST-TRIG: Secs)
Display the amount of post-trigger record time **available.**

The following steps show you how to record events in Partitioned Memory:

Step 1 Toggle the **SETUP** button to select the Memory Menu.

Step 2 Use the **FUNCTION** button to select the **TOTAL PARTITIONS** option.

Step 3 Use the down or up **SELECT** buttons to choose the number of Memory Partitions (maximum of 64). By default, record starts in memory partition one. Change the **PARTITION INDEX** option to start recording in another memory partition.

Step 4 Press the **STOP** button to exit the Setup menus.

Step 5 Press the **RECORD** button to begin recording in the designated memory partition.

Step 6 To select another memory partition for recording, press the **STOP** button.

Step 7 Use the **FUNCTION** button to select the **PART #** floating menu. Use the down or up **SELECT** buttons to choose the desired memory partition.

Step 8 Press the **RECORD** button to begin recording in the selected memory partition.

4.4.5   FILE REVIEW MENU

This is the only configuration menu that is **not** available when the **SETUP** button is pressed.

To access this menu, press the **DOWNLOAD** button while in the **RECORD** mode. Once open, this menu displays a number of soft keys that allow you to review and delete AVI files saved on the camera compact flash card.
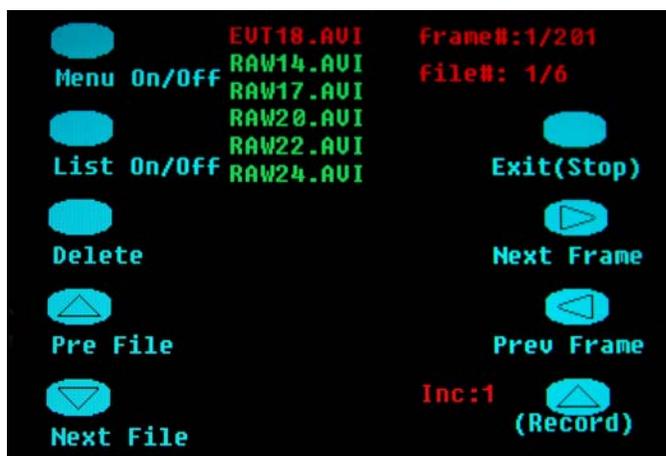
Menu On/Off
Toggle the **DOWNLOAD** button to turn the soft key display On and Off.

List On/Off
Toggle the **SETUP** button to turn the AVI file list On and Off.

Delete Press the **FUNCTION** button to delete the file highlighted in red.

Pre File Press the **SELECT** button to display the previous AVI file stored on the compact flash card.

Next File Press the **SELECT** button to display the next AVI file stored on the compact flash card.

EVT18.AVI, RAW14.AVI, RAW17.AVI, RAW20.AVI, RAW22.AVI, RAW24.AVI Six files currently stored on the CF card being viewed.

Frame #: 1/201 Frame number of EVT18.AVI currently displayed in the background.

File#: 1/6 Displayed file number/Number of files on CF card

Exit (Stop) Press the **STOP** button to exit the File Review menu.

Next Frame   Press the ► **PLAY** button to increment displayed frames. Hold down the ► **PLAY** button to scroll frames.

Pre Frame   Press the ◄ **PLAY** button to decrement displayed frames. Hold down the ◄**PLAY** button to scroll frames.

(Record)   Toggle the **RECORD** button to increment the number of frames to skip (Inc:#) between each displayed playback frame during file review.

4.5   AFTER RECORDING THE BLAST

The Operator is now ready to analyze the motion of the blast using the Motion Analysis Software. Check the ProAnalyst® TrackOne Edition help file.

4.6 SETUP AND OPERATE THE CAMERA USING MIDAS EXPRESS 4.0

This is a brief overview of MiDAS Express. For more information, please review the disc provided. Your camera is provided with a MiDAS 4.0 Express CD ROM. The CD is accompanied with a serial number and activation code. The activation code is a 16-digit number that will unlock the various components of the MiDAS 4.0 Express software. This software program is used for remotely controlling and adding functionality to your Blaster's Ranger™ high speed camera. For updates to your MiDAS software, visit the web site download page at:

http://www.xcitex.com/downloads.html.

While installing the MiDAS 4.0 Express software, the MiDAS 4.0 Express User's Guide is automatically loaded onto your computer in an Adobe PDF format. The User's Guide can be accessed any time.
To install the application, refer to the *MiDAS 4.0 Express CD* enclosed with your camera.

4.6.1 CONNECTING THE CAMERA TO A COMPUTER

All Ranger cameras can be connected to a computer via USB 2.0 cable. The camera USB connector is on the left side of the camera's connector panel, (viewed from the rear). Once the camera is connected to the computer, the MiDAS 4.0 Express software can be used to remotely configure and control camera operation. Events recorded in the camera memory should be saved as AVI files on the computer for MiDAS 4.0 Express to be used effectively.

> **Note:** MiDAS 4.0 Express should be already installed onto your computer prior to performing the procedure below. If not, perform the installation using the enclosed MiDAS 4.0 Express CD enclosed with your camera.

4.6.2 REMOTELY CONFIGURE AND CONTROL THE CAMERA FROM A PC

1. Supply power to the camera.
2. If a compact flash card is installed in the camera, remove the card.
3. Open the LCD screen cover; press the camera **POWER** button - ON.
4. Using a USB cable, connect the camera to your computer USB port. The device window shown below opens on the computer desktop indicating a connection with the camera. The USB cable needs to have a Mini D 5-Pin connector at the camera connection point. To your computer, the camera appears as a mass storage device and typically opens a window like this when connected.
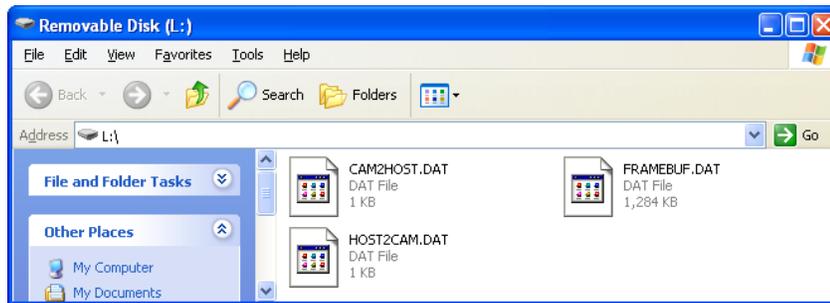
5. Double-click on the MiDAS 4.0 Express desktop icon to open the application.

   For further information regarding interacting with MiDAS 4.0, refer to the MiDAS 4.0 Express User's Guide which you can find in the MiDAS directory after you have MiDAS installed.

4.6.3 SAVE RAW FORMAT TO NORMAL AVI FORMAT

Open the RAW files:
Double click MiDAS 4.0 Express desktop icon, click File from the menu, then open video file, go to the folder where the RAW files are and select the first file. On the picture, right click the mouse, select Bayer Color Adjustment, choose the suitable Color Temperature Factory Preset (Tungsten) or Daylight or Manual Settings.

Save back to AVI files:
File Menu…Save Video/Data file as..., you can save only the parts interested or all video, select No Compression and click OK.
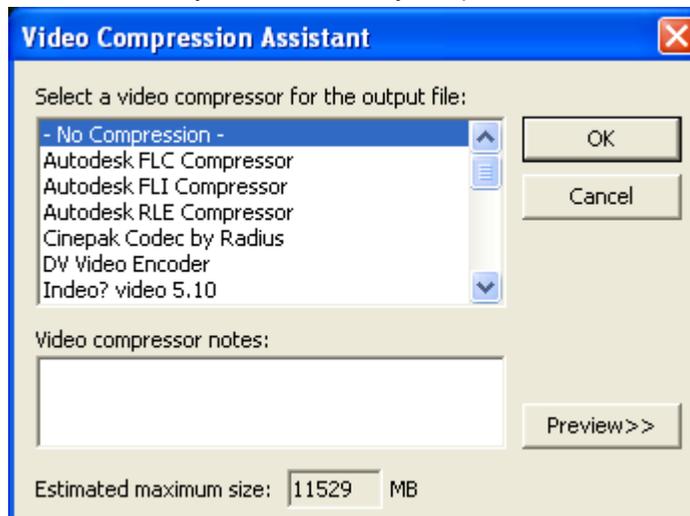
CHAPTER 5: PROANALYST® TRACKONE EDITION SOFTWARE

5.1 ABOUT PROANALYST® TRACKONE EDITION

ProAnalyst® TrackOne Edition allows auto-tracking of one feature and/or manually tracking of up to 32 features. Quickly export to Excel or Matlab for further analysis and graphing. If you need to track more than one point at the same time, please contact MREL to upgrade to ProAnalyst Professional edition. For ProAnalyst Professional edition it includes all the analysis features and engines for auto-tracking objects in 1-D and 2-D, data reduction and report generation. Optional toolkit image stabilization can work with the Professional edition.

Please follow the ProAnalyst® TrackOne Edition installation Guide to install ProAnalyst® TrackOne Edition software on your computer. The ProAnalyst® TrackOne Edition Installation Guide is in the box of the ProAnalyst®.

Now you can open ProAnalyst® TrackOne Edition, and find the ProAnalyst® TrackOne Edition Reference Guide from the menu Help, or you can follow the instructions in the Getting Started Guide and User Guide to do the video analysis.

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CHAPTER 6: CONTACTING MREL FOR TECHNICAL SUPPORT

6.1 CONTACTING MREL

MREL Group of Companies Limited
Blasting Instrumentation Team
1555 Sydenham Road
Kingston, Ontario K7L 4V4
Canada
Toll Free Canada/USA: 1-877-544-MREL
Tel: +1-613-545-0466
Fax: +1-613-542-8029
Email: support@mrel.com

MREL looks forward to providing you with assistance.

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