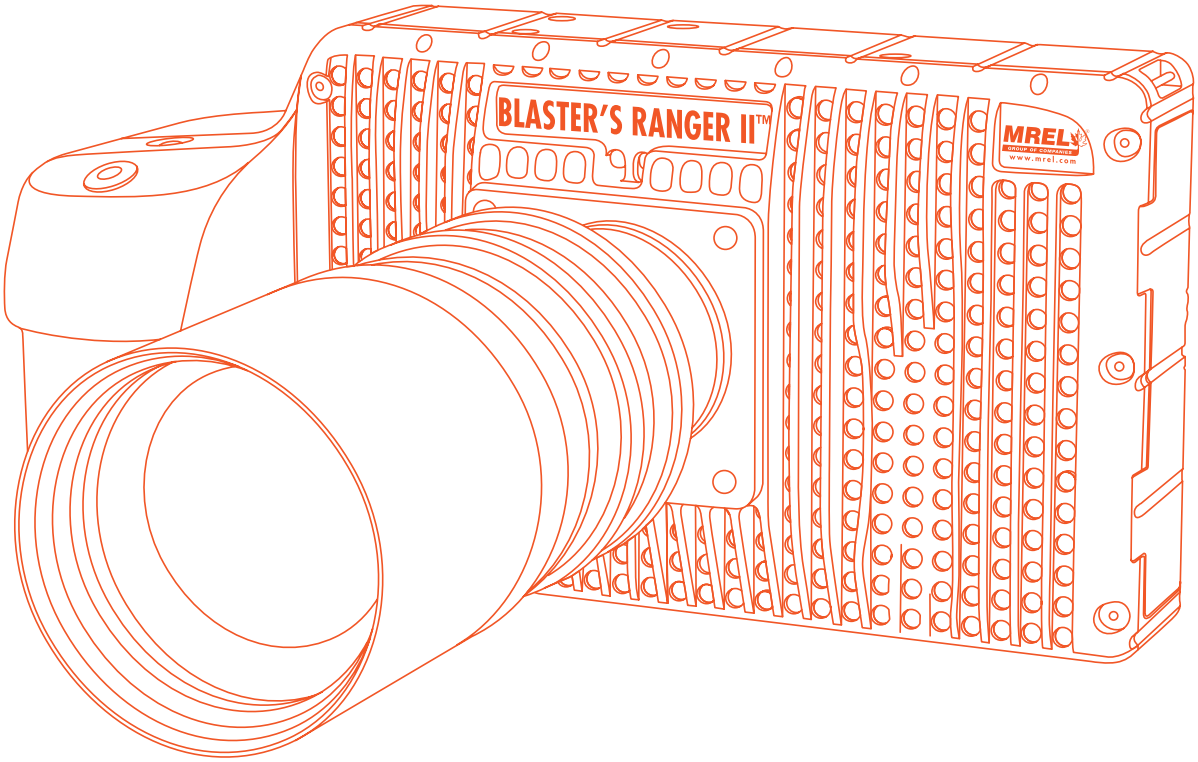
BLASTER'S RANGER II™
HIGH SPEED CAMERA

Operations Manual
RAII-TS5-0 Model

Edition 2.8



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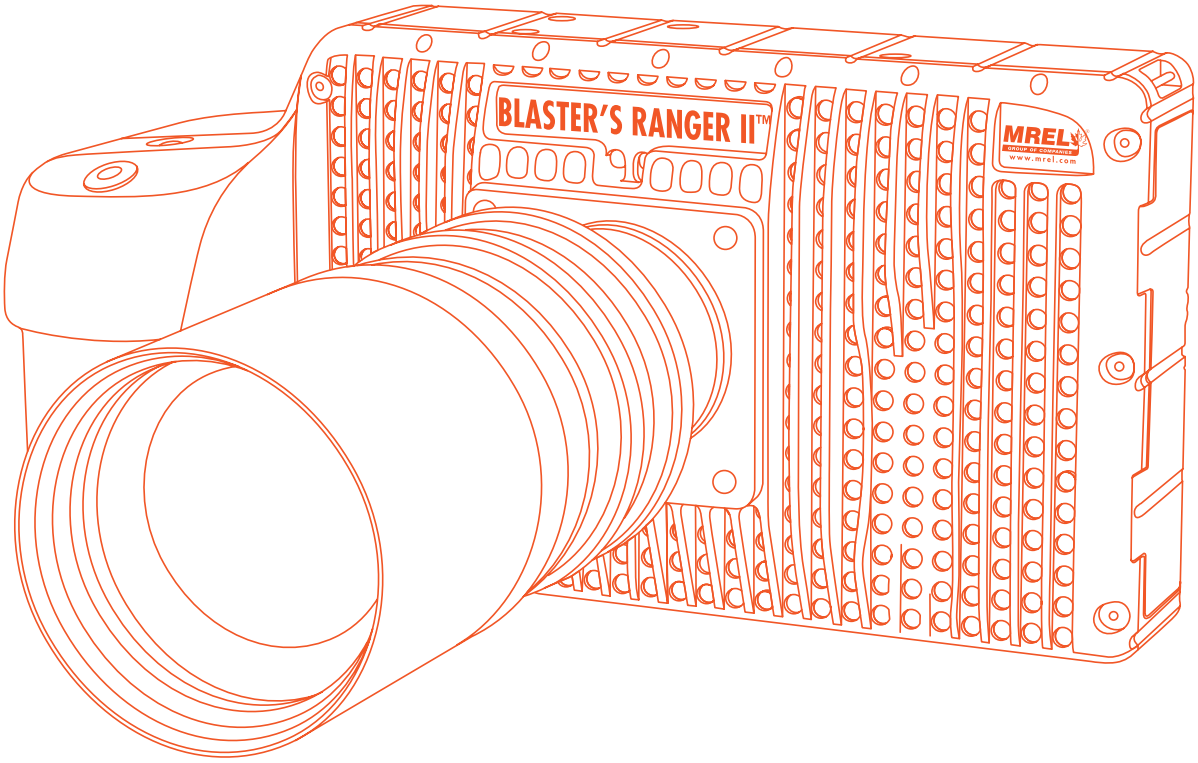
Introduction



Overview

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 II™ High Speed Digital Camera**. This Operations Manual provides instructions on the use of the hardware supplied with the **Blaster's Ranger II™ High Speed Digital Camera**.

1.2 High Speed Photography[1]

High speed photography is the practice of recording photograph images in rapid succession for playback at a lower speed. The event can then be viewed in what is commonly referred to as "slow motion". Standard video plays at a rate of 33 frames per second (fps) because standard video cameras record at 30 frames per second. However, it is possible to magnify the time scale if the playback speed is slower than the recording speed. The following is a simple equation to express time scale magnification in terms of the recording and playback speeds:

$$(1) \quad \frac{\text{Camera Recording Rate (fps)}}{\text{Viewing Rate (fps)}}$$

For example, a blast is recorded at 500 fps and played back at 10 fps. The time scale is therefore magnified 50 times, and as such the event will appear to occur 50 times slower in playback. If the event took two seconds to occur, it will now run for 100 seconds in playback.

The human eye cannot accurately resolve motion that occurs in less than 1/4 of a second. Short duration events such as a blast cannot be visually analyzed without the use of high speed photography.

1.3 High Speed Photography of Blasts[1]

High speed film cameras have been used by blasters to assist in optimizing blasts for many years. With the evolution of the high speed digital camera, blasters are now able to play, pause, and analyze a blast in perfect clarity as soon as the event has occurred!

It is the goal of the **Blaster's Ranger II™ High Speed Digital Camera** to put the simplicity of digital video editing and analysis into your hands without sacrificing the resolution that has typically accompanied high speed film cameras of the past.

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 optimize blasting operations. In the past, blast designs have been based largely on the personal experiences 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.

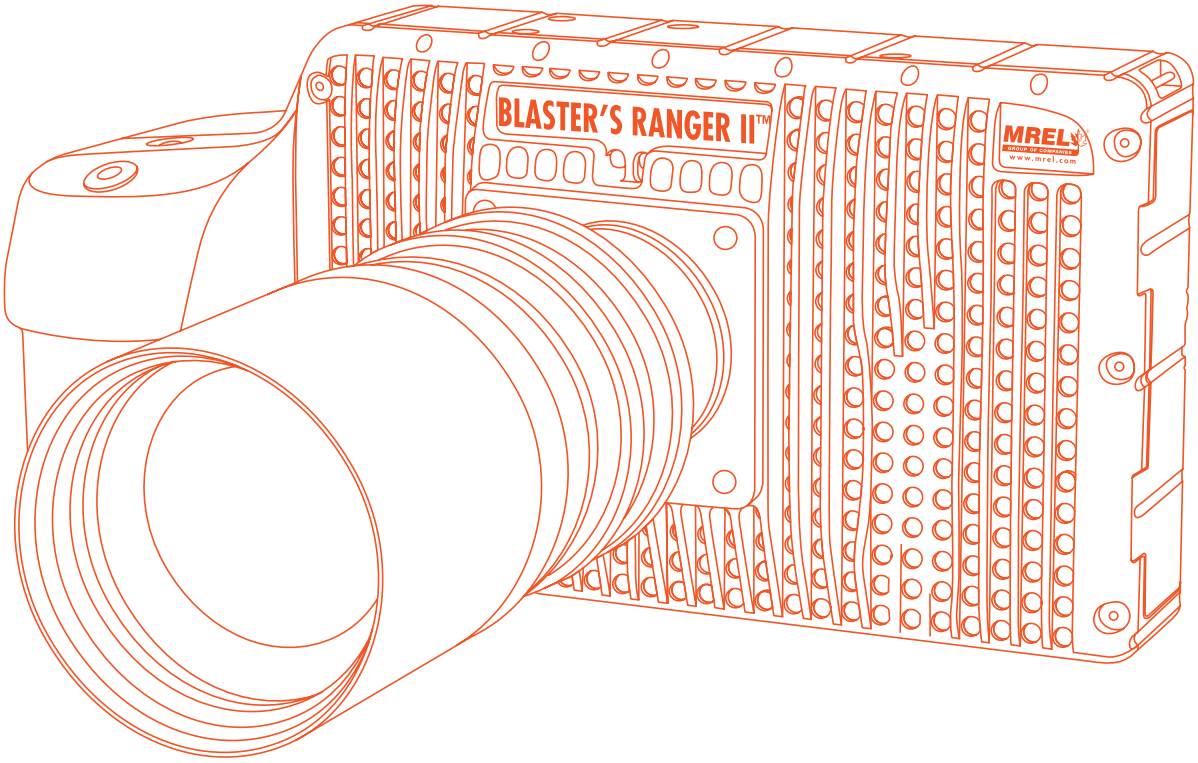
High speed video has two main uses in helping to optimize surface blasting results. The principal use is the direct photography of the blast, with the analysis of the resulting video and/or digital images representing the bulk of the optimization work. However, high speed video also can be used to analyze 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 analyzed. 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



Overview

This Chapter describes all of the hardware components provided with the Blaster's Ranger II™ High Speed Digital Camera.

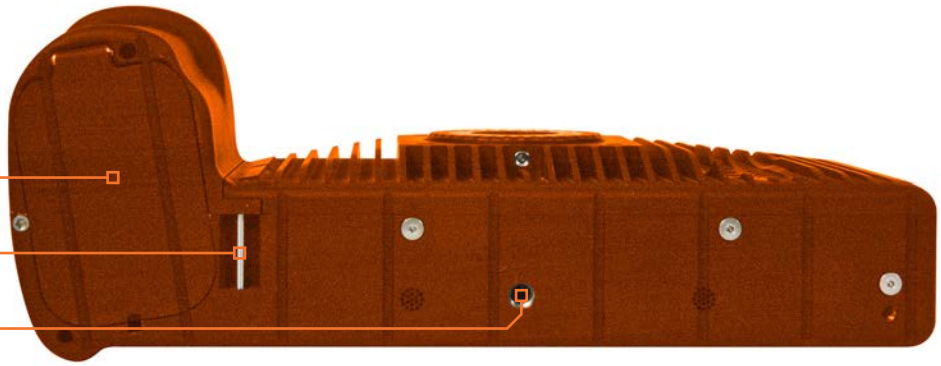
2.1 Blaster's Ranger II™ High Speed Digital Camera

The **Blaster's Ranger II™ High Speed Digital Camera** is encased in a rigid anodized aluminum housing. The housing is sealed to resist dirt and moisture and is equipped with many connection ports: the **Ethernet Communication** port and the **Blaster's Ranger II™ I/O Cable** port. The **Blaster's Ranger II™ I/O Cable** is comprised of a total of three connectors: **Sync In, Sync Out** and **Trigger In**.

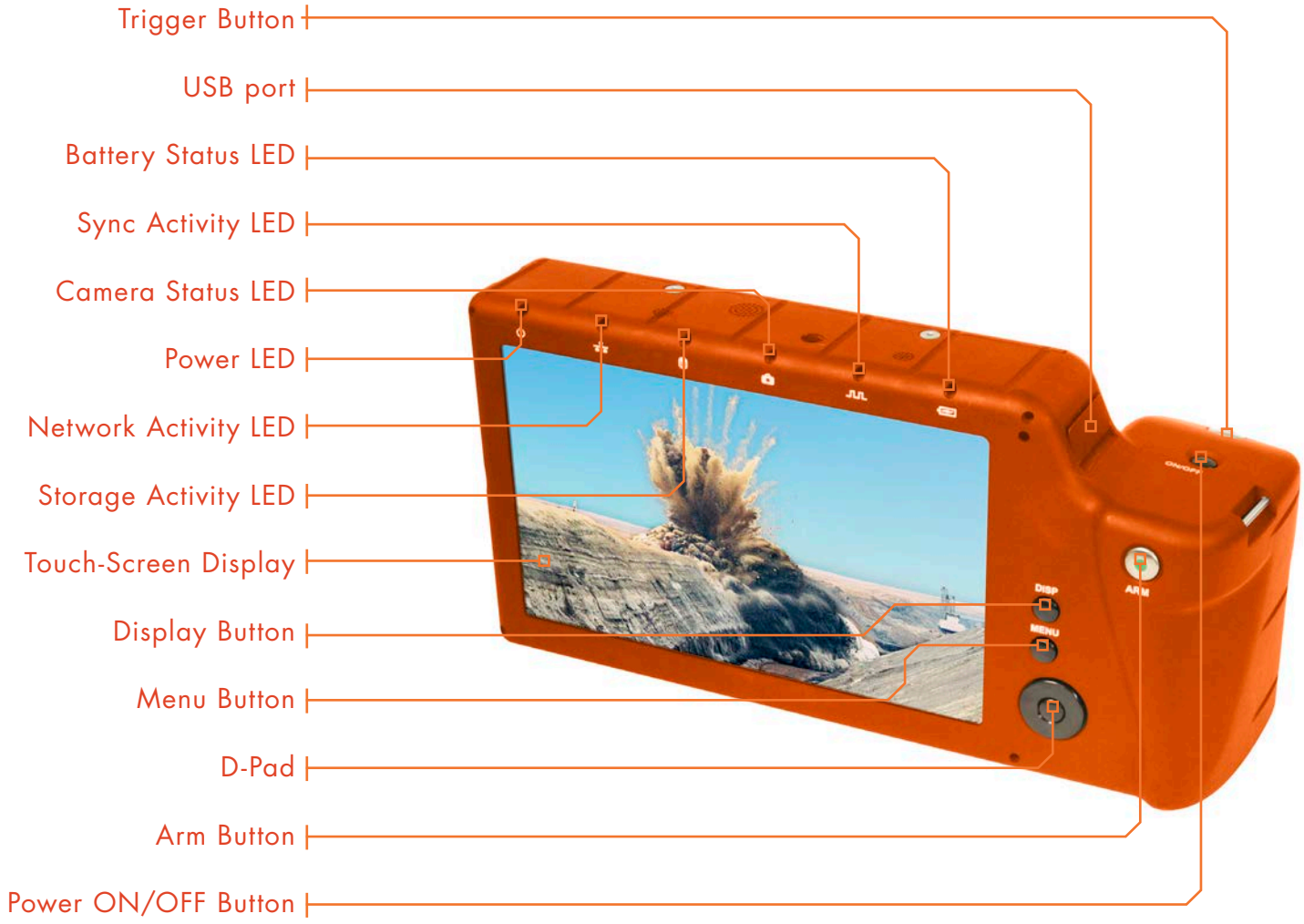
Photographs of the **Blaster's Ranger II™** are shown below. The **Mounting Adapter** is attached to the bottom of the **Blaster's Ranger II™** to allow the **Blaster's Ranger II™** to be quickly mounted onto the **Tripod's Grip Action Ball Head** (shown in **Section 2.2.3**). The **Mounting Adapter** and the **Tripod's Grip Action Ball Head** are part of the **Blaster's Ranger II™ Accessories Package**. The **Blaster's Ranger II™** is equipped to accept any standard **F-Mount Lens**.

2.1.1 Camera Front

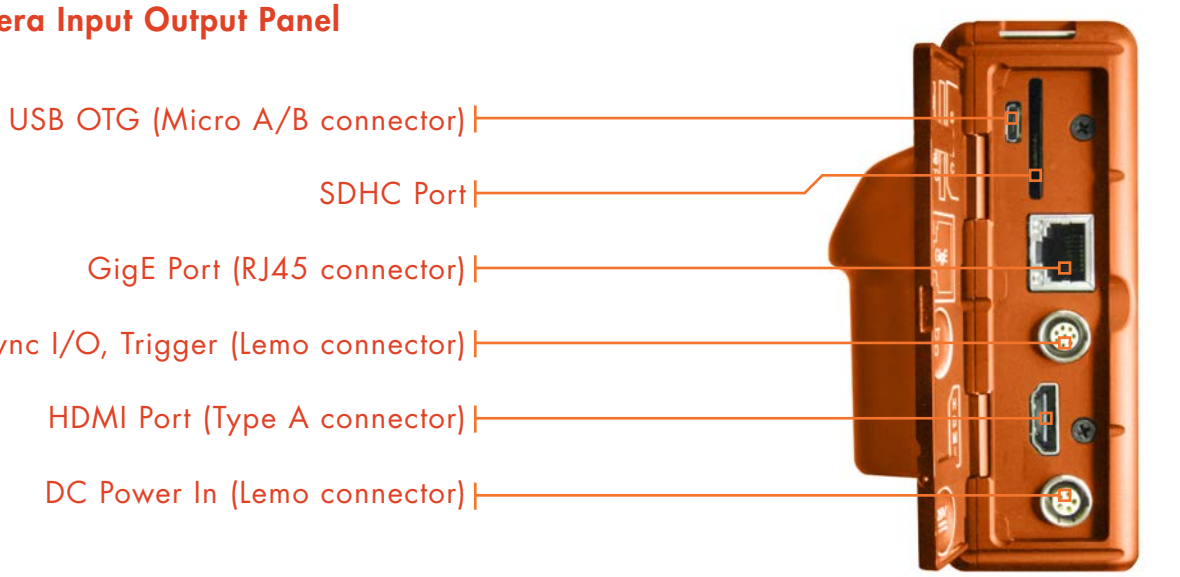
2.1.2 Camera Bottom



2.1.3 Camera Back



2.1.4 Camera Input Output Panel



2.2 BLASTER'S RANGER II™ 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 II™** in the field. The **Carry Case** is a pelican case which has water resistance capabilities.

2.2.2 Zoom Lens

The **Blaster's Ranger II™** is supplied with a **Zoom Lens** appropriate for imaging of blasts. The **Zoom Lens** (80-200 mm) is for the model of resolution of **1280x1024, 1920x1080 and 2560x2048**, and shown to the right. **Zoom lens** (12.5 – 75 mm) is for the model of resolution of **800x600**.

2.2.3 Tripod and Grip Ball Head

This is an aluminum **Tripod** with a 3/8" mounting screw. This **Tripod** is designed to support the **Grip Action Ball Head** with the **Blaster's Ranger II™** attached. This is the only item that does not fit inside the **Protective Carry Case**.

2.2.4 Blaster's Ranger II™ DC Power Cable

The **Blaster's Ranger II™ DC Power Cable** is used to connect to a 12V DC battery, the external DC power supply with a range of 12-26 VDC

2.2.5 Blaster's Ranger II™ I/O Cable

The **Blaster's Ranger II™ I/O Cable** is comprised of a total of three connectors: **Sync In**(blue), **Sync Out** (green) and **Trigger In** (red).

2.2.6 Blaster's Ranger II™ AC Adapter

The **Blaster's Ranger II™ AC Power Cable** will connect to a 110V to 220V power source.

2.2.7 Trigger Switch Cable With Button

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.

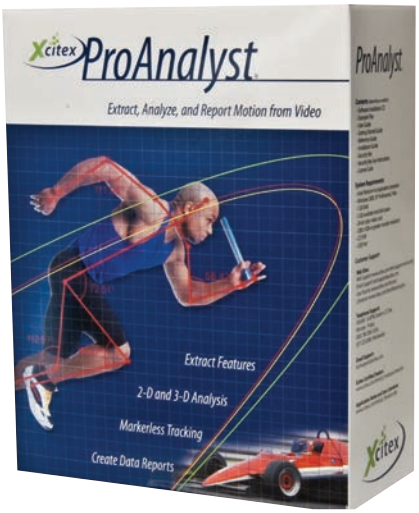
2.2.8 SD Card

The **Blaster's Ranger II™** is shipped with a 16GB high performance **SD Card**.

2.2.9 USB Communication Cable

It is a USB-A to USB-Micro-B cable. Once connected via the **Blaster's Ranger II™** OTG port to a PC, any mass storage device on the camera can be accessed by the PC. This includes an SD Card, Solid State Drive, or thumb drive in the USB port.

2.2.10 ProAnalyst® Introductory Edition Software

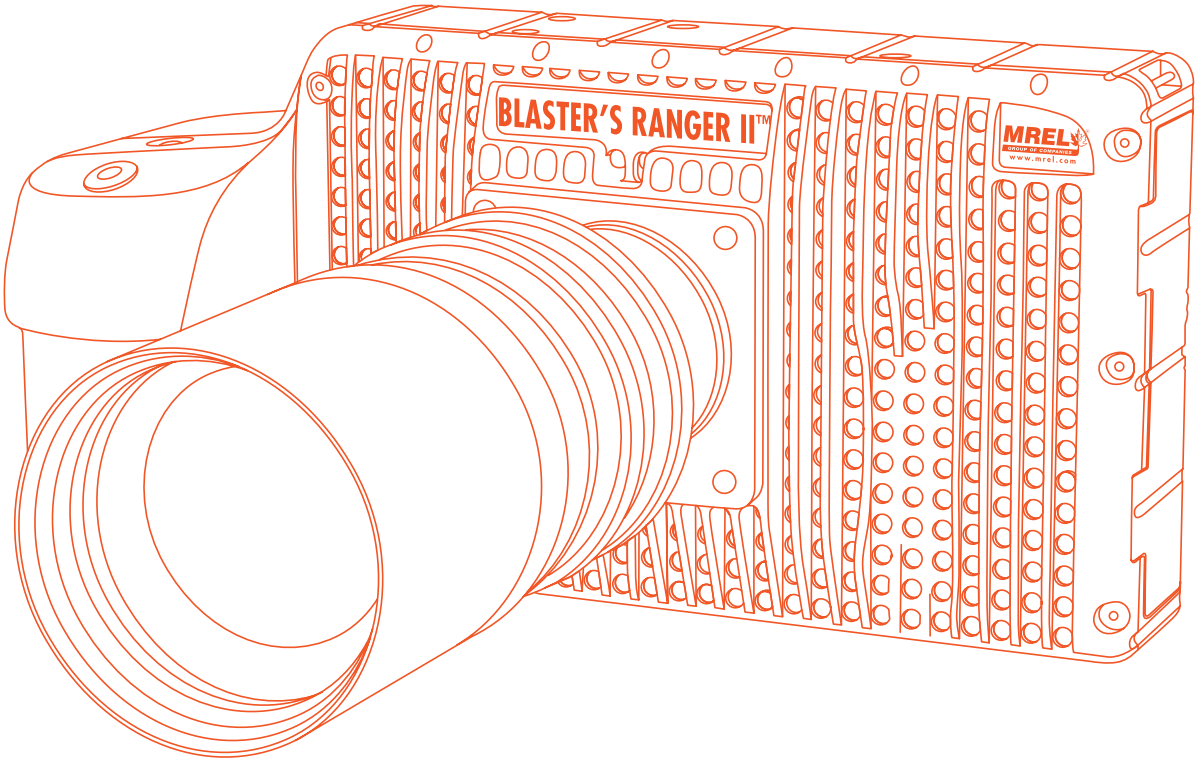


ProAnalyst® Introductory Edition allows auto-tracking of one feature, and manual tracking of up to 32 features. **ProAnalyst®** allows the user to export data to Excel or Matlab with ease for further analysis or graphing. This software is provided under licence from Xcitex, and as such requires the use of the included software key for installation. Instructions on using **ProAnalyst® Introductory Edition** are included in **Chapter 7**.

2.2.11 External Battery (Optional, with Long Recording Mode Upgrade)

11.1V **Battery Pack**, 8.8 Ah, 98Wh, which will support camera operations more than twice as long as the internal battery.

Chapter 3
Getting Started



Overview

This chapter provides an outline of how to setup the Blaster's Ranger II™. This chapter assumes that the user will first want to unpack the Blaster's Ranger II™ and set it up in an office environment in order to learn the camera controls.

3.1 Introduction

This chapter provides a detailed description of the setup procedure for the **Blaster's Ranger II™**. The **Quick Setup Guide** is also included in **Section 3.5**. For instruction on using the **Blaster's Ranger II™**, please refer to **Chapter 4**. For Instruction on using the **Blaster's Ranger II™** in the field, please refer to **Chapter 5**.

3.2 Powering Up

The **Blaster's Ranger II™** can be powered by its rechargeable 3.7V **Li-Ion battery** or the external **12V power supply cable**. Both are included with the camera. The battery is fully charged at the factory. The battery door is located on the underside of the camera.

The **Li-Ion battery** will power the **Blaster's Ranger II™** for up to several hours depending on configuration and mode of operation.

NOTE: When a new battery is installed, it must go through one complete discharge/recharge cycle to calibrate its internal "battery level." Until that time you will find that the % of charge shown on the lower right of the camera display as well as on any camera control software will not be correct.

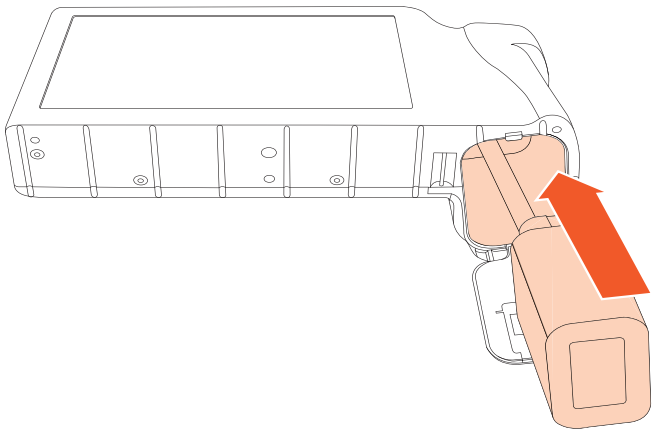
3.2.1 Removing the Battery

1. Turn the **Blaster's Ranger II™** upside down to access the battery compartment.
2. Slide the battery door latch to the **open** position. The spring loaded door will open.
3. Move the battery clasp away from the edge of the battery.
4. The battery may slide out easily, or you may need to hold the camera upright and shake it gently to get the internal battery connector to release.

3.2.2 Installing the Battery

1. Open the battery door (follow **steps 1-2**, above).
2. Look into the battery compartment and notice the connector at the bottom.
3. Look at the battery and notice the corresponding mating connector.
4. Orient the battery appropriately and slide it into the compartment.
5. With the battery seated properly in the compartment, the battery clasp will close, securing it in place.
6. Close the battery access door.
7. Slide the battery door latch closed.
8. The **Blaster's Ranger II™** should now power up. If it does not, please follow the instructions below for connecting the DC power supply and charging the battery.
9. With the **Blaster's Ranger II™** powered up, press the **Menu** button once to get the menus and status bar to appear on the LCD display.

Figure 1: Inserting the Battery



3.2.3 Attaching the External Power Supply

The **AC Power Supply** operates on 100-240VAC, 50-60Hz. The socket is a standard IEC- 320 C8 AC inlet, used worldwide for all types of electronic equipment.

1. Attach a power cord to the power supply and connect it to an AC power outlet.
2. Attach the power supply output cord to the camera via LEMO connectors. The LEMO connector is keyed: the red dot on the connector will face the LCD side (back) of the camera.

NOTE: If the camera was powered down before connecting the power supply, it will now power up. While operating on battery power the **Battery Status** on the **Status bar** will show a negative number -88%. (See **Figure 3: Battery Charge Indicator on Status Bar.**) When connected to a power supply (with the battery installed) the number becomes positive. If no battery is present it changes to A/C.

Figure 2: Attaching the DC Power Supply

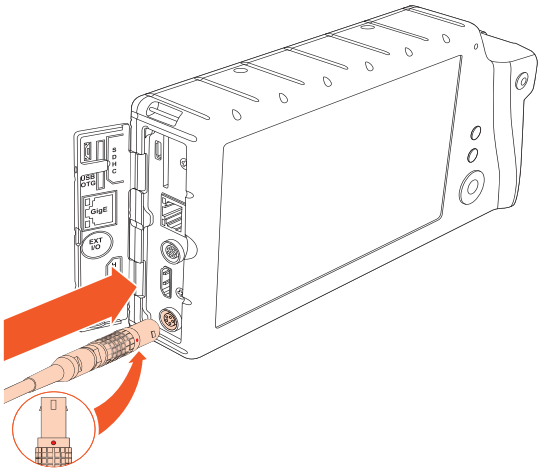
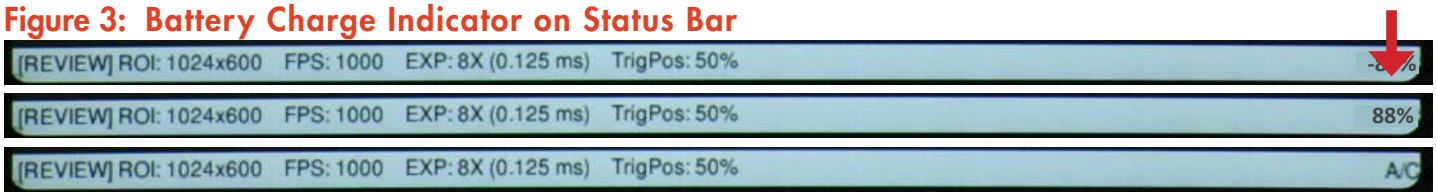


Figure 3: Battery Charge Indicator on Status Bar



3.2.4 Charging the Battery

The **Blaster's Ranger II™** battery does not charge automatically when the camera is attached to an external power supply while operating. Charging mode is initiated by pressing the **ON/OFF** button. When the battery is present while the camera is attached to an external power supply, the **ON/OFF** button will toggle the camera through three states:

1. Normal operation;
2. Charging (non operational);
3. Off.

NOTE: Pressing the **ON/OFF** button toggles the camera between three Modes if both the battery and external power supply are present. It toggles the camera between two Modes: **ON/OFF** if either the battery or the external supply is not present. (See **Table 1: ON/OFF** Button on **page 14**.

3.2.5 Long Recording Upgrade Powering Up (optional)

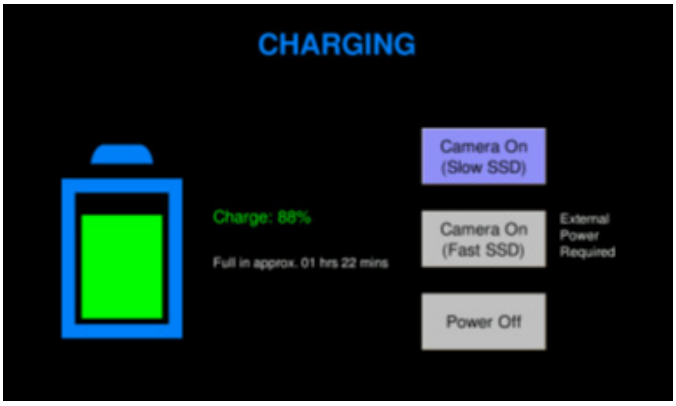
The **Blaster's Ranger II™** with the **Long recording upgrade** will power up only when:

- Power (12v to 26v DC) is applied at the power port.
- A charged battery is inserted into the camera.
- The camera is connected to a power source and/or has a battery installed and the Power On/Off button is pressed.

Upon power up, the **Blaster's Ranger II™** will either boot up in an operational mode or, if it is connected to an **external power supply** and a battery is installed, it will boot to a power up / charging menu. The power up / charging menu is showed below. "Slow SSD" means that writes to the SSD will be at about 240MB/sec, while "Fast SSD" bumps the write speed up to 480MB/sec.

It is highly recommended that you use an **external power supply** such as an AC adapter or battery belt when using "Fast SSD" mode.

At the power up / charging menu, select "**Camera On**" to boot the camera. If you do nothing, the camera will proceed to charge the battery.



3.2.5.1 Using Supplemental Power

The external battery which came with the **Long Recording upgrade** as shown in **Section 2.2.11**. It can be used in conjunction with the internal battery or as stand-alone power for the **Blaster's Ranger II™**.

It is a 12V Battery Pack, 98Wh, which will support camera operations more than twice as long as the internal battery.

Table 1: ON/OFF Button

Battery Present	External Supply	Mode	LEDs	Battery Charge % Indicator
•	•	1. Operating	Power / Camera / Battery (Green, Amber, or Red)	Batt: xx%
•	•	2. Charging	Power / Battery (Green, Amber, or Red)	(LCD off)
•	•	3. Off	None	(LCD off)
	•	1. Operating	Power / Camera / Battery (Blue)	A/C
	•	2. Off	None	(LCD off)
•		1. Operating	Power / Camera / Battery (Green, Amber, or Red)	Batt:-xx%
•		2. Off		(LCD off)

Table 2: Battery LED States

Operating / Charging	Charge Status	LED Behavior	
Operating	>15%		Green
Charging	> 15%		Blinking Green
Operating	< 15% > 5%		Amber
Charging	<15% >5%		Blinking Amber
Operating	<5%		Blinking Red
Charging	<5%		Blinking Red
Operating	Not Installed		Blue

3.3 Mass Storage

The **Blaster's Ranger II™** camera is equipped with from 4GB to 8GB of internal high-speed internal memory. Images stored in this memory may be reviewed on the camera, external monitor via HDMI, or PC, then saved to any of four types of mass storage devices:

1. Solid State Hard drive installed in the **Blaster's Ranger II™** at the factory (it is optional).
2. SD Cards (SDHC) inserted by the operator into the **SDHC** slot on the side of the **Blaster's Ranger II™**.
3. USB devices such as thumb drives or USB external hard drives (not included) connected via the **USB port**.
4. Memory devices on a networked PC using Custom Software.

3.3.1 Blaster's Ranger II™ Solid State Drives (Internal SSD)

Solid state drives (SSDs) are optional on the **Blaster's Ranger II™**. These drives serve as mass storage devices for the camera and are installed in the camera at the factory. Image data from the **Blaster's Ranger II™** high-speed internal memory may be downloaded to the SSD, thus making room for the next high-speed image capture. While the SSD does not add to the recording time of the camera (the number of images it can record in one session), it does allow the user to download large quantities of image data without ever connecting the **Blaster's Ranger II™** to a PC or other external device.

3.3.2 SD Card

The **Blaster's Ranger II™** is shipped with a 16GB high performance SD Card. This card has two functions:

1. It can be used as a mass storage device for downloading and distributing images. SD Cards and card readers are very commonly used storage devices among PC users and photographers.
2. Any field software updates for the **Blaster's Ranger II™** will be installed via the SD Card.

NOTE: An SD Card when used for a software update must be reformatted before it can be reused as a mass storage device.

Figure 4: Mass Storage

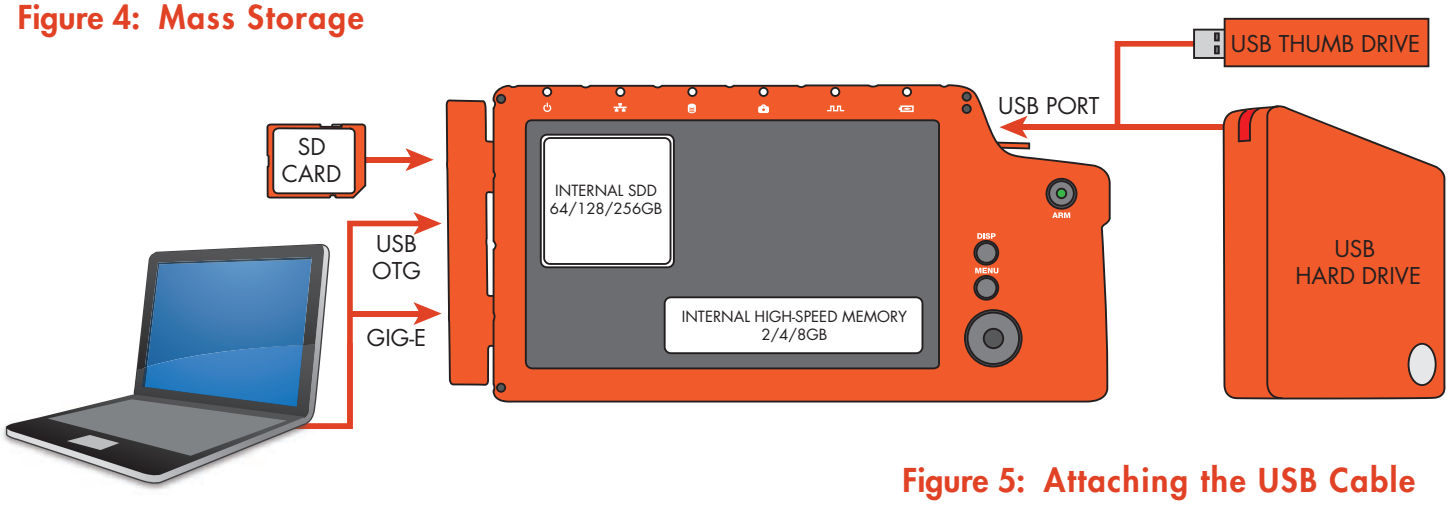
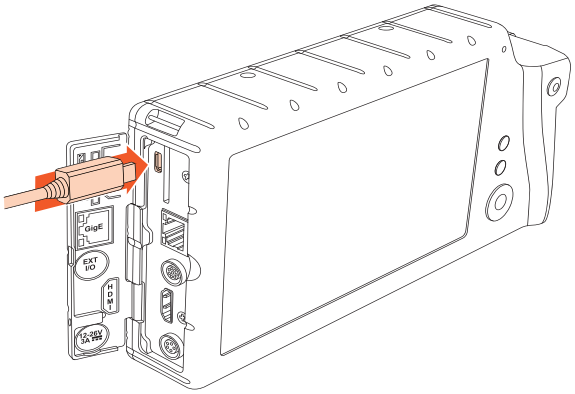


Figure 5: Attaching the USB Cable



The **Blaster's Ranger II™** will act as a Host to any USB mass storage device connected at the **USB port**. Image data may be saved to these devices.

3.4 USB-On The Go!

The **USB-OTG port** allows the camera to be connected as a slave to any PC using a USB-A to USB-Micro-B cable. Once connected via the **Blaster's Ranger II™ OTG port**, any mass storage device on the camera can be accessed by the PC.

This includes an SD Card, Solid State Drive, or thumb drive in the **USB port**.

To use this option:

1. Power up the **Blaster's Ranger II™**.
2. Install thumb drive and/or SD Card in the camera.
3. Attach the camera to the PC via the camera's **USB-OTG port**, which is next to the **SD Card slot** on the side of the camera. As each device is located by the PC an Autoplay window on the PC will open. This is a very simple way to transfer image data to a PC. This is for file access only–there is no way to control the camera via **USB-OTG**.
4. When you are finished, you need to eject the media from the PC. Click on the "**Safely Remove Hardware and Eject Media**" icon on your computer's task bar and select "**Eject Camera.**"

NOTE: Any device that is connected to the camera after the camera and PC are connected will not be seen by the PC.

Table 3: Blaster's Ranger II™ Mass Storage Functionality

Blaster's Ranger II™ Utilities:	Target Drive(s)	Functions
System/Storage/Explore	SSD/USB/SDHC	Move, Copy, and Delete Image files
System/Storage/Format	SSD/USB/SDHC	Format drive
System/Storage/Eject	USB/SDHC	Safely Eject Media
Review/Save	SSD/USB/SDHC	Save image Data from Internal High-Speed Memory
Record Still	SSD/USB/SDHC	Save a single still Image
Autosave	SSD/USB/SDHC	Autoave image Data from Internal High-Speed Memory

PC via Gig-E Connection:	Target Drive(s)	Functions
Explore	SSD/USB/SDHC	Open, Copy files, multiple files, directories from **Blaster's Ranger II™** to PC only
Web Application	SSD/USB/SDHC	Open, Copy files (one at a time) from **Blaster's Ranger II™** to PC only
Custom Software App	PC Drives+SSD/USB/SDHC	All **Blaster's Ranger II™** Utilities
PC via USB-OTG	SSD/USB/SDHC	Move, Copy and Delete all files and directories to and from **Blaster's Ranger II™**

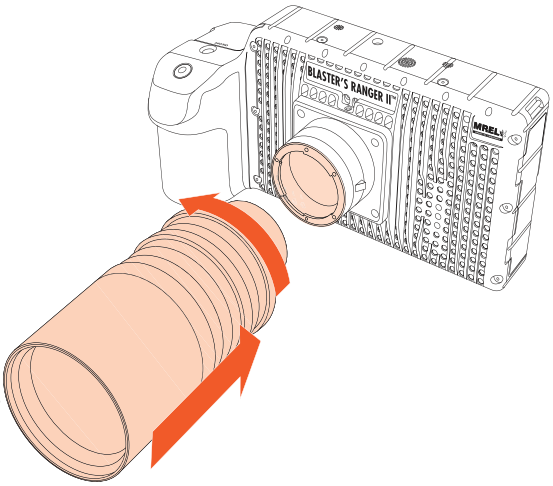
3.5 Camera Setup

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

3.5.1 Blaster's Ranger II™ Setup

Open and extend the Tripod legs. Attach the Grip Action Ball Head to the top of the Tripod using the 3/8" screw mount. Remove the Mounting Adapter from the top of the Grip Action Ball Head and connect the threaded screw of the **Mounting Adapter** to the bottom of the camera. Be sure that the Lens arrow is pointing towards the front

Figure 6: Mounting the lens



of the Lens. Attach the Mounting Adapter to the Grip Action Ball Head. Secure the camera using the locking lever located on the Grip Action Ball Head. It is also good practice to utilize the locking lever pin ensure the locking lever does not come free during operation.

3.5.2 Mount the F-Mount Zoom Lens to the Camera

Remove the lens receptacle cover from the camera's F-mount. This is a cover that is installed at the factory to protect the camera optics and sensor from dust contamination.

NOTE: Whenever threading lenses on or off the camera, face the camera lens down so that any contamination on the threads will tend to fall away from the camera rather than into it.

Thread the F-mount lens into the lens mount located in the front of the camera. DO NOT over tighten the lens! The lens should be "finger tight" only--just tight enough that you can adjust focus and aperture without unscrewing the lens.

3.5.3 Blaster's Ranger II™ I/O Cable and Trigger Switch Cable

The I/O Cable has 8-pin LEMO camera connector and BNC connectors for Sync-In, Sync-Out, and Trigger-In. The Trigger switch cable is attached to the Trigger-In connector.

3.5.4 DC Power Connection

The camera can be powered by its rechargeable 3.7V Li-Ion battery ,12 V AC/DC adapter or the external 12V DC battery. See **Figure 2: Attaching the Power Supply**.

Refer Quick Start Guide to power on the camera and get familiar with the camera.

Figure 7: Blaster's Ranger II™ Complete

Figure 8: I/O Cable and Trigger connected

3.6 Camera Display and Menu Navigation Buttons

The **Display** Button, **Menu** Button, and **Directional Pad** (**D-Pad**) are found on the back of the camera to the right of the LCD.

When the camera powers on for the first time, the default display is a live image with no menu displayed.

Pressing the **Display** (**DISP**) Button while toggles the LCD between three modes:

1. Display off;
2. Display on;
3. Display on with Histogram.

When there is captured video to review, a mode with playback controls is added.

The **Menu** Button toggles the on screen menus on and off. While navigating menus, the **Menu** button is used to go backward through levels of the menu. For example, if you are navigating a Menu pressing the **Menu** button will return you to the **Menu** Bar. (See Menu Terminology, below.)

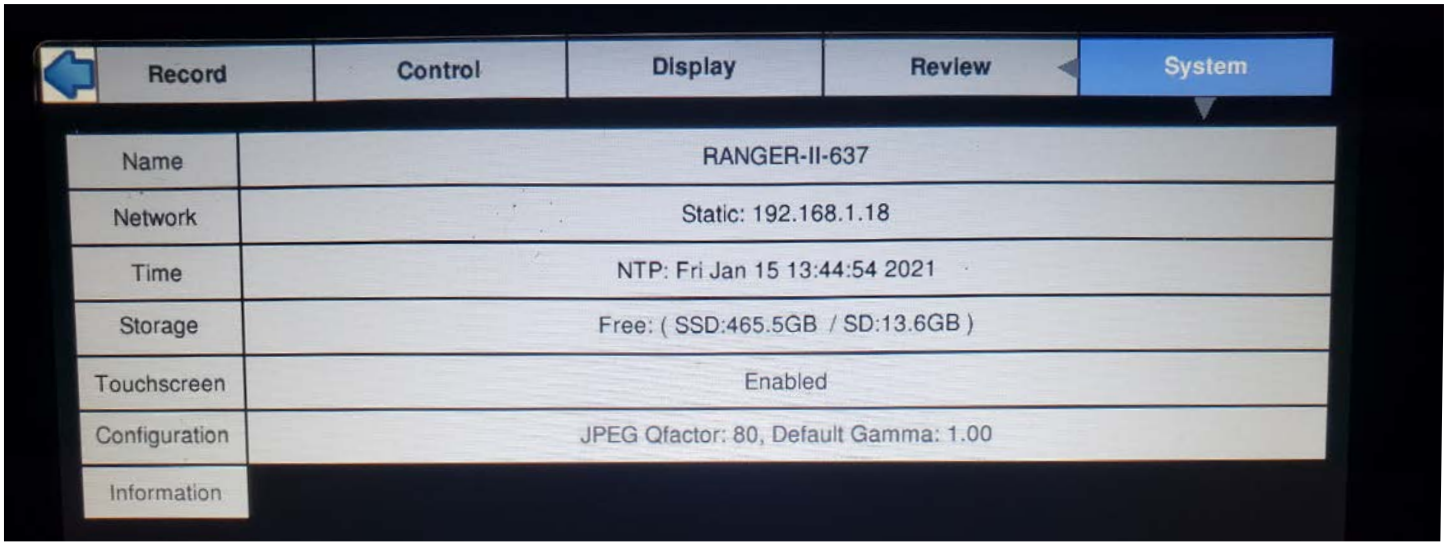
The **D-Pad** is used to move within menus and dialogs. It has an "**OK**" button in its center for selecting menu items and options.

While navigating through menus, the current location is indicated by a change of color from white or green to gray. When navigating a Menu, the drop down selections will always appear in the left most column. The selected menu will appear in white letters in the Menu Bar. Selected or Enabled items turn green once the cursor is moved away from them.

Table 4: Menu Terminology

Menu Bar	Across the top of the display: System, Record, Control, Display, Review
Menu	Having Made a selection from the **Menu Bar**, a drop down Menu Appears, such as the System Menu shown below. Present status for items in the selected menu are listed.
Element	The menu options i.e. Name, Network, etc. are called Menu Elements
Dialog Box	Having chosen an item from a menu, a dialog box may open such as the Frame Rate and Resolution. This is often a place where the user may make choices and/or input data.
Status Bar	The Status Bar is located at the bottom of the display. Information includes (from left to right): Operating Mode (Live= live view, CAP= recording, REVIEW= playback); ROI= Resolution; FPS= Frame rate; EXP= Exposure; Trigger Position; and Power /Batter Status (A/C= no battery, xx% = battery charge)

Figure 9: System Menu



3.7 Using the Touchscreen

The **Blaster's Ranger II™** 7" display uses touchscreen technology that allows the user to enter certain data directly with the touch of a finger rather than via the **D-Pad**. A special icon in the upper left hand corner of the screen is present whenever Touch is enabled. Pressing this icon acts the same as pressing the MENU button: it toggles the menus on and off and allows you to navigate backwards through menus and dialogs.

Note: the touchscreen uses "resistive" technology that is sensitive to a light touch of a fingernail or stylus. Unlike "capacitive" technologies used in many smart phones and tablet PCs, it is not very sensitive to the flesh of a fingertip.

3.7.1 To Enable the Touchscreen

1. Navigate to the **System Menu**, then to Touchscreen using the **D-Pad**.
2. If the touchscreen is currently disabled, there will be a "**Disabled**" button in the Touchscreen menu. If you click on that, it will turn green and the text will change to "**Enabled**."

3.7.2 Calibration

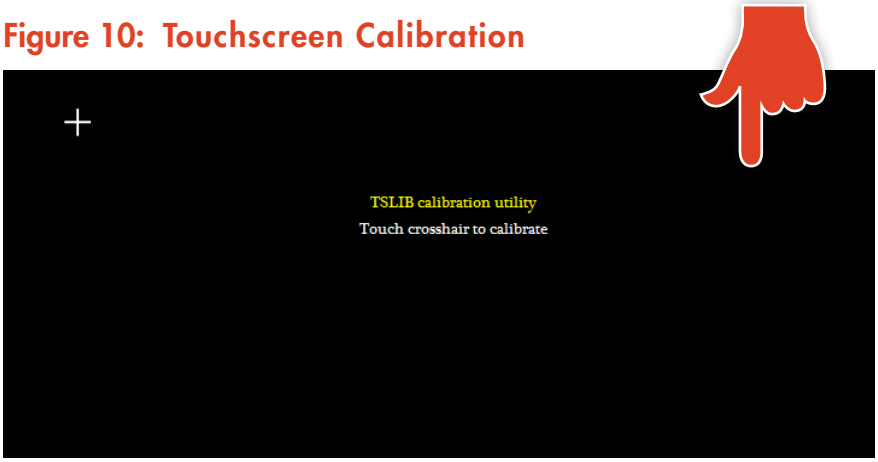
The touchscreen is calibrated at the factory. Routine calibration of the touchscreen in not necessary. Calibration of the touch screen may be done if you feel that the screen is sensing your touches inaccurately. For example if you use the alpha-numeric keyboard and you are not always getting the intended character where you are touching it, you should re-calibrate the touchscreen.

3.7.3 To Calibrate the Touchscreen

Calibration of the touchscreen is very simple and only takes a few seconds.

1. Navigate to the **System Menu**>**Touchscreen**>**Calibrate**.
2. When you select "**Calibrate**" you will see a warning message: "**Are you sure you want to re-calibrate the touchscreen?**" Select "**OK.**" (This is there to prevent you from accidently calibrating the touchscreen while handling the camera.)
3. The Calibration screen, **Figure 10: Touchscreen Calibration**, will appear and prompt you to touch a cross hair at each corner of the screen, then in the center.

Figure 10: Touchscreen Calibration



3.8 Controlling the Displays

There are three menu elements in the **Display** menu that control the behavior of the displays.

These are:

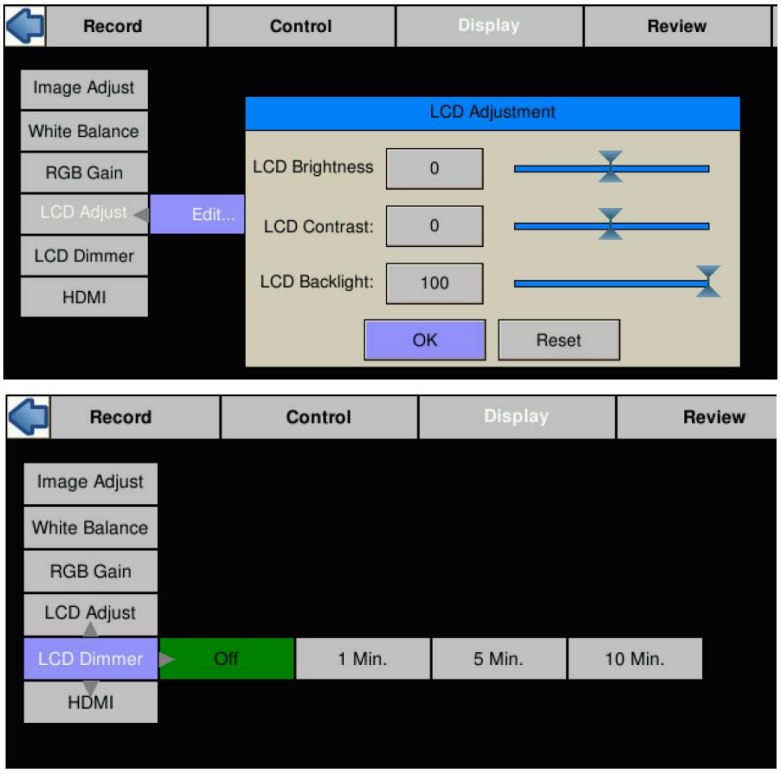
- **LCD Dimmer**
- **Backlight control**
- **HDMI**

The **LCD Dimmer** is a timer that turns the LCD display off after a number of minutes.

There are four choices:

- Off--the display will not "time out."
- 1 Min. The display will go dark after 1 minutes of non-use.
- 5 Min. The display will go dark after 5 minutes of non-use.
- 10 Min. The display will go dark after 10 minutes of non-use.

Figure 11: Display Controls



The **Backlight control** is a brightness adjustment for the LCD. There are two controls for this in the **Backlight** menu: Less and More.

There is a third element in the menu, which is a number between 0 and 255, that represents the current **Backlight brightness**.

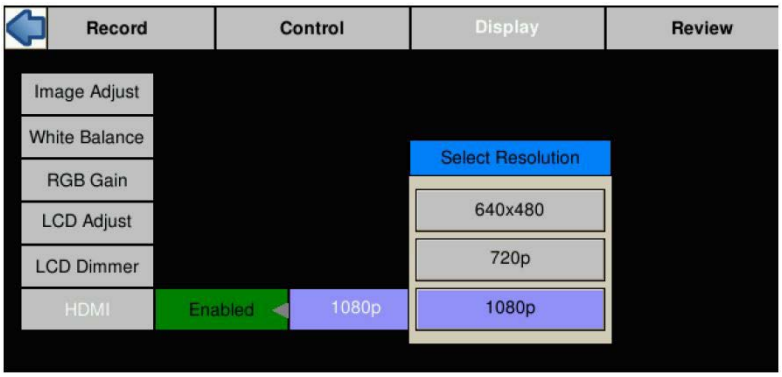
- Navigate to the Less button and hold down the **OK** button to make the display darker.
- Navigate to the More button and hold down the **OK** button to make the display brighter.

The Brightness, Contrast, Gamma, and Bit Depth (if present) elements do not control the LCD display. These are part of the image processing pipeline.

3.8.1 HDMI Display

While the 7" WVGA 800 x 480 display on the **Blaster's Ranger II™** is perfectly adequate for setting image captures and even reviewing video, watching the same video on a large flat panel display makes sharing the imagery with others much easier. With the **Blaster's Ranger II™** there is no need to download images to a PC to view them on a large display. Use a standard **HDMI** cable to connect the **Blaster's Ranger II™** to an **HDMI** compatible display.

Figure 12: HDMI Controls



The **HDMI** output control is also accessed in the **Display** menu. The **HDMI** output can be **Enabled** and **Disabled** here and the resolution 640 x 480, 720p, or 1080p may be selected. (Any resolution not supported by a display attached to the **Blaster's Ranger II™** will be Grayed out and the button not selectable.

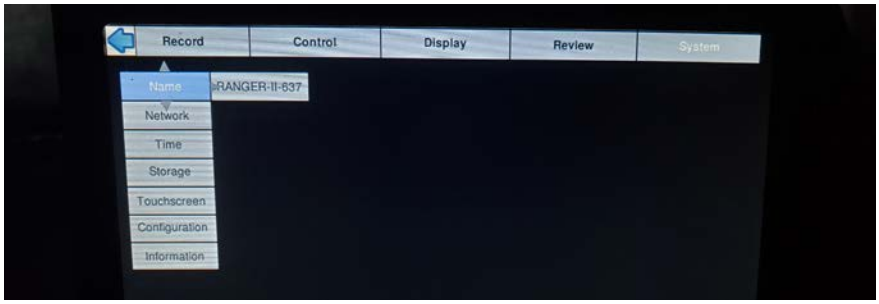
3.9 Blaster's Ranger II™ Name the Camera

3.9.1 Camera Name

When the **Blaster's Ranger II™** leaves the factory its default name is Ranger-II-xxx. The camera name can be used both for identification on a network and as part of the filename when saving images.

It may be beneficial to rename the camera according to its function, locality, field of view, etc. depending on how the camera is to be deployed.

Figure 13: Camera Name Menu



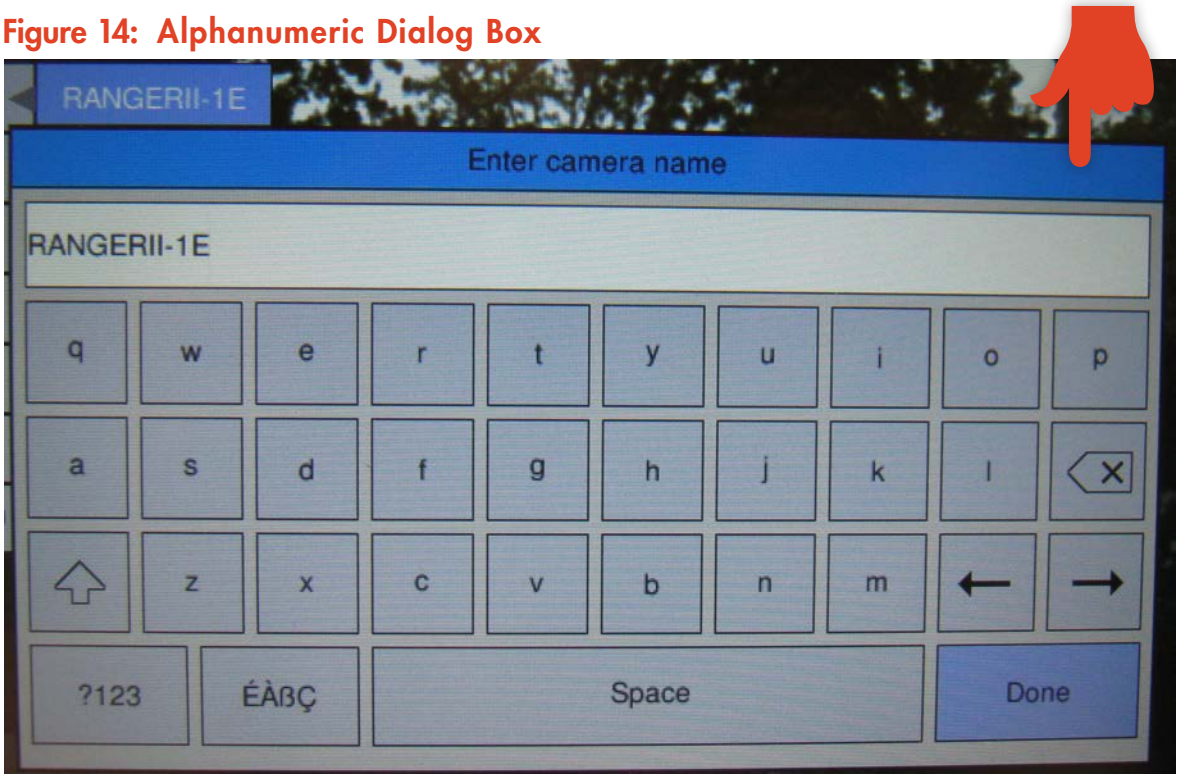
To change the camera name:

1. Navigate to the **System Menu**.
2. Select "**Name**."
3. Move the cursor to the box showing the current name and click "**OK**" to open the alpha-numeric dialog where you will enter the new camera name. If enabled, you can do this using the **Touchscreen**. If not you will use the **D-Pad**.
4. Delete the present camera name using the Backspace button in the dialog box, then enter the new name in its place.

CAUTION

There are many symbols available on the keypad that are not valid for camera naming. If you enter symbols that are not usable, those characters and any subsequent characters will be stripped from the camera name as soon as you navigate away from the **Name Menu**.

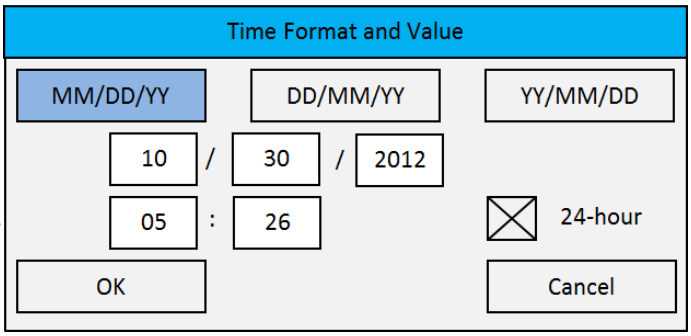
Figure 14: Alphanumeric Dialog Box



3.10 Setting the Time

Time Setup on the **Blaster's Ranger II™** is located in the **System Menu**. There are two choices for setting the time of the camera: **User** and **NTP**. If you select **User**, the time and date are manually entered into the camera. The camera's internal clock will maintain reasonable accuracy, but may drift over long periods of time. If **NTP** (Network Time Protocol) is used, the camera will get its time from an external **NTP server** via the Internet.

Figure 15: Time Format Menu



3.10.1 Setting the Time Manually

1. Navigate to the **System Menu** and select **Time**.
2. Select the format you wish to use for the date and time: MM/DD/YY, DD/MM/YY, or YY/MM/DD.
3. Select 24-hour, if you wish to use a 24-hour display rather than a 12-hour.

3.10.2 Setting the Time via NTP

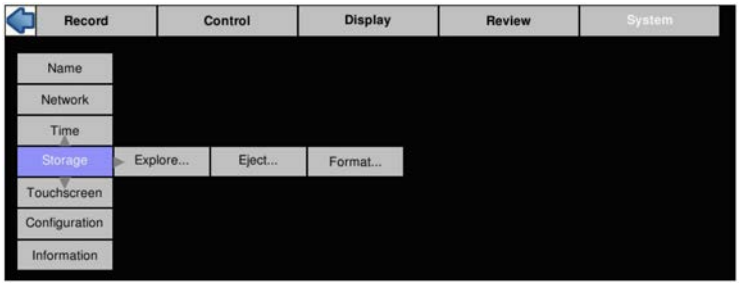
1. Connect the camera to a network with internet access. There is no need to attach the camera to a PC, although that is often the most obvious way to do it.
2. Navigate to the **System Menu** and select **NTP**.
3. Select an **NTP server** from the list. If there is a server that you would like to use that is not on the list, you may add it in the dialog box.
4. To exit the list, press the **right arrow** of the **D-Pad** and select **OK**. The **Blaster's Ranger II™** will now connect to the **NTP server** and sync its clock. If the camera cannot connect with the server, it will pause operation for a couple of minutes while it re-tries. The camera will always poll the **NTP server** when it powers up if it has an Internet connection.

NOTE: The **Blaster's Ranger II™** will not poll the **NTP server** if the Internet connection is not made, either when the camera boots, or when exiting the NTP dialog. Between times when the camera polls the **NTP server**, it will maintain time with its internal clock.

5. Select "**Zone**" to set the camera to the local time zone.

3.11 Storage Setup

Figure 16: Storage Setup Menu



The **Storage Menu** gives the user some amount of access and control of the **Blaster's Ranger II's** memory and any external memory installed i.e. **USB thumb drive** or **SD Card**.

The **Blaster's Ranger II™** has a 4GB or 8GB (depending on model and option) of internal high-speed memory used for capturing high-speed imagery. All of this memory may be used to capture one high-speed event. Total record time will depend on resolution, frame rate, and bit depth.

Explore allows you to access the **SSD** (Solid State Drive installed internally to the **Blaster's Ranger II™**), the **SD Card** inserted into the slot on the side of the camera, or a **USB thumb drive** connected via the **USB port** for file transfer:

1. Navigate to the **System Menu**.
2. Select **Storage**.
3. Select **Explore**.
4. A selection menu will open allowing you to pick the storage device you wish to access. Once you select the storage device, you will see the directory choices: **Stills** (containing stills taken by the camera), **Stacks** (stacks of high-speed video saved as **TIFF**, **BMP**, **JPEG** files), and **Videos** (**AVI** files). This does not show all of what may be on the mass storage device. You will see only the image data stored there by the **Blaster's Ranger II™**.
5. Select the **still**, **stack**, or **video** you wish to manage. A File Action dialog will open that will allow you to **Copy** or **Move** the selection to another storage device on the system, or **Delete** the selection.

Eject, also on the **Storage Menu**, should be used whenever you wish to remove media from the **Blaster's Ranger II™**.

The **Format** function on the **Storage Menu** should be used with some caution as formatting any media will remove any data on it.

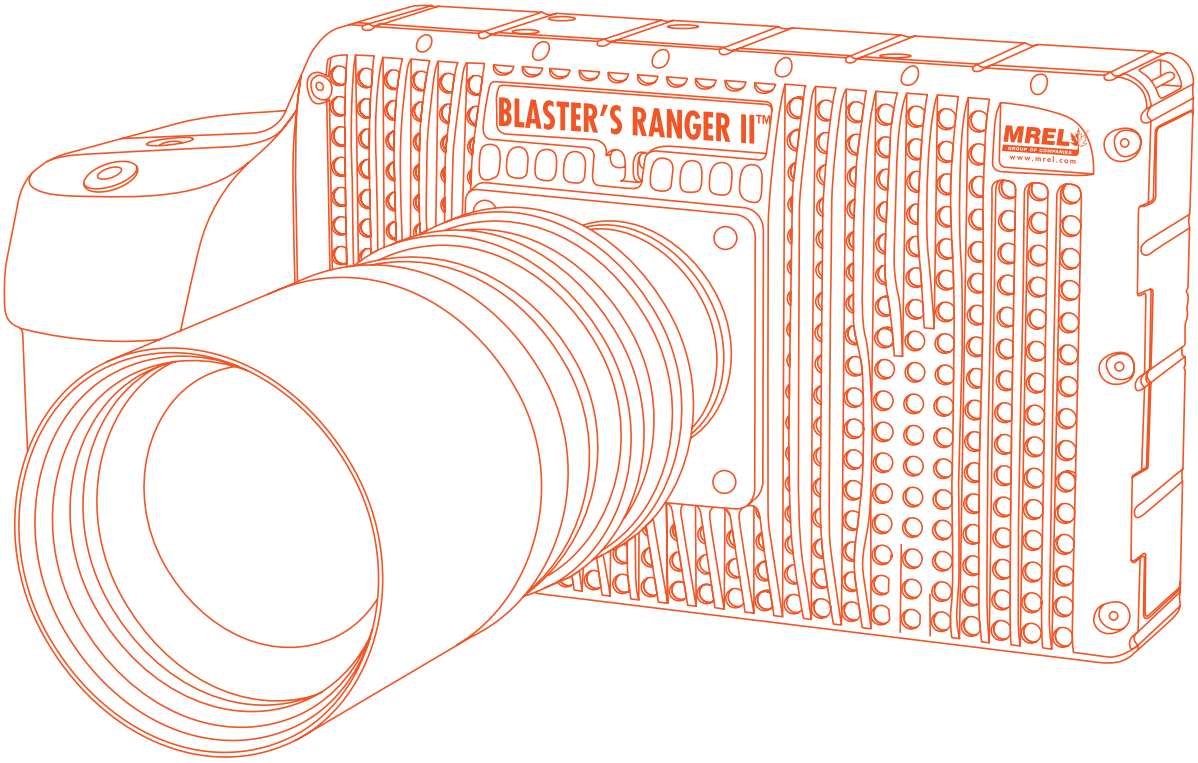
3.12 Configuration and Camera Information

Blaster's Ranger II™ Configurations, which include all **Network**, **Time**, and all camera settings, can be **Saved**, **Reloaded**, or **Reset to factory defaults**.

1. From the **System Menu**, navigate to **Configuration**.
2. Select **Save** to save the current configuration. The configuration may be saved as **Configuration #1** or **Configuration #2**.
3. Select **Load** to load a saved Configuration (**Configuration #1**, or **#2**)
4. Select **Reset** to load the factory default configuration.

General information about the camera, including MAC address and versions of software, FPGA, Sensor and Gig-E are available in Information in the System Menu.

Chapter 4
Operation of the Blaster's Ranger II™



Overview

This chapter provides an outline of how to setup the Blaster's Ranger II™ for recording, viewing, and saving events.

4.1 Selecting the Recording Mode

Blaster's Ranger II™ cameras record to internal high-speed DRAM memory. With up to 8GB of memory available, maximum recording times for **Blaster's Ranger II™** cameras range from about six seconds to several minutes depending on frame rate, resolution, and bit depth.

4.1.1 Standard Modes (recording to DRAM):

In Basic mode, all frame rates, resolutions and session lengths and trigger positions are available.

Basic workflow:

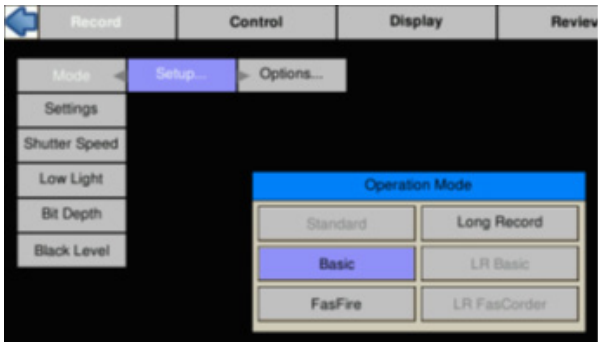
- Record to DRAM. Session length may be set from 0.25GB to 4GB or 8GB, depending on camera model.
- Review (Playback). Recorded high-speed video is available for immediate playback to the LCD, HDMI monitor, computer, or mobile device.
- Save recordings. Save images to any camera media (SD Card, USB device, or SSD (if installed)). After using LR mode you need to format the SSD in order to save video to it in Standard mode. The format may take several minutges depending the size. You can save image stacks or Partition Capture files to the SSD in Standard Mode, not avi format.

Or

- Record to DRAM, as above.
- Autosave/Re-Arm. If Autosave is enabled, the system will save the recording to selected media, and then re-arm the camera for the next recording.

To Select Standard Basic Mode:

1. Navigate to the **Record menu** and select "**Mode**" and then "**Setup**."
2. Click on "**Basic**," if available, otherwise click on "**Standard**," then return to /Record/Mode after the camera reboots in **Standard Mode**. (**Basic** will always be available on the **Blaster's Ranger II™**, but will only be available on the **Blaster's Ranger II™** when the camera is currently operating in **Standard** (not LR) mode.)
3. The **Basic Mode Options** dialog will open. **Trigger**, **Session**, and **Autosave** settings are displayed here. Click on any item to adjust the setting, and then click **OK** to accept.



In FasFire mode, all frame rates, resolutions, and trigger positions supported by the camera are available, but session length is limited to <1/2 DRAM, and Autosave is required.

FasFire workflow:

- Record to DRAM. Session length may be set from 0.25GB to <1/2 maximum.
- Autosave + Record. The camera re-arms and begins recording while saving the previous partitions.

To Select Standard FasFire Mode:

1. Navigate to the **Record menu** and select "**Mode**" and then "**Setup**.

2. Click on "**FasFire**" if available, otherwise click on "**Standard**," then return to /Record/Mode after the camera reboots in **Standard Mode**.
3. The **FasFire Mode Options** dialog will open. Note that the Session size is automatically adjusted to less than half the DRAM size and that Autosave is enabled. Click on any item to adjust the setting, and then click on **OK** to accept.

4.1.2 Long Record (LR) Modes (Recording to SSD) (Optional):

In **Standard Mode**, if you switch to Long Record mode, the camera will restart, and then goes to **Long Record** mode. You can choose **LR Basic** or **LR FasCorder** mode. In **LR Basic mode**, the entire SSD space is reserved for one recording only.

All trigger positions are supported.

LR Basic workflow:

- Make one recording to SSD. The session length cannot be set - it is always assumed to be all the space on the SSD. The trigger point may be set as with Standard modes.
- Review (Playback). Recorded high-speed video is available for immediate playback to the LCD, HDMI monitor, computer, or mobile device.
- Save. Clips may be saved to any SD Card, USB, or Path. Autosave is not available.

To Select LR Basic Mode on the Blaster's Ranger II™:

1. Navigate to the **Record menu** and select "**Mode**" and then "**Setup**."
2. Click on "**Long Record**," then return to /Record/Mode after the camera reboots in **LR Mode**.
3. The **Trigger Position** dialog will open. (**Session Length** and **Autosave** are not available in **LR Basic** mode at this time.)

FasCorder ROC mode is convenient when multiple recordings of various durations will be made or when there are pauses in the action that need not be recorded. **FasCorder BROC** mode records a specified number of frames with each trigger.

LR FasCorder ROC (Record on Command) / BROC (Burst Record on Command) workflow:

- Make multiple recordings to SSD. Record length is governed by toggling the Trigger between Record and Paused states in ROC (Camera LED blinks Red while recording), or by the **Burst Length** set by the slider or edit box in BROC mode.
- Review recordings. All recordings are available for playback on one timeline. Use **Record Start** markers to jump between the recordings during playback.
- Save. Clips may be saved to any SD Card, USB, or Path. **Autosave** is not available.

To Select LR FasCorder Mode on the Blaster's Ranger II™:

1. Navigate to the **Record menu** and select "**Mode**" and then "**Setup**."
2. Click on "**LR FasCorder**" if available, otherwise click on "**Long Record**," then return to /Record/Mode after the camera reboots in **LR Mode**.
3. The **FasCorder Options** Dialog will appear. Select either the **ROC** or **BROC** radio button. If ROC is selected the **Burst Length** slider and edit box will be grayed out as record length will be controlled by the Trigger. If **BROC** is selected, use the slider and/or edit box to select the time/# of frames for your recordings.

Press the **Arm** button. A message will appear giving you the option to continue recording or stop and go into **Playback**.

All recordings are available for playback on one timeline. Use Record Start markers to jump between the recordings during playback. Now you can save the videos or the interesting part video to the SD card or a USB card inserted in the camera. Autosave is not available.

Note: If you wish to stop recording before all of the post-Trigger frames are recorded, you may cancel the recording by pressing Arm, then select to "Retain the current session"

4.2 Setting Frame Rate and Resolution

Frame rate and resolution are set together as they are interactive. The maximum frame rate of the camera is based on its resolution as seen in **Table 5: Frame Rates and Resolutions**, below.

Table 5: Frame Rates and Resolutions

				Normal Mode		Long Record Mode	
			Resolution	Max Frame Rate (FPS)	Recording Time (sec.)	Max Frame Rate (FPS)	Recording Time (sec.)
BRII-TS5QC4-B			2560 x 2048 (QSXGA)	253	3.6	91	17.5
BRII-TS5QC4-B			2560 x 1440 (QHD)	359	3.6	130	17.3
BRII-TS5QC4-B	BRII-TS5HC4-B		1920 x 1080 (HD: 1080p)	634	3.7	231	17.3
BRII-TS5QC4-B	BRII-TS5HC4-B		1440 x 1080	634	4.2	308	17.3
BRII-TS5QC4-B	BRII-TS5HC4-B	BRII-TS5SC4-B	1280 x 1024 (SXGA)	991	3.2	366	17.3
BRII-TS5QC4-B	BRII-TS5HC4-B	BRII-TS5SC4-B	1280 x 1014	1001	3.2	369	17.3
BRII-TS5QC4-B	BRII-TS5HC4-B	BRII-TS5SC4-B	1280 x 720 (HD: 720p)	1403	3.2	520	17.3
BRII-TS5QC4-B	BRII-TS5HC4-B	BRII-TS5SC4-B	1000 x 1000	1015	4.1	478	17.3
BRII-TS5QC4-B	BRII-TS5HC4-B	BRII-TS5SC4-B	1024 x 768 (XGA)	1316	4.1	610	17.3
BRII-TS5QC4-B	BRII-TS5HC4-B	BRII-TS5SC4-B	800 x 600 (SVGA)	1677	5.2	993	17.3
BRII-TS5QC4-B	BRII-TS5HC4-B	BRII-TS5SC4-B	800 x 450	2221	5.2	1331	17.3
BRII-TS5QC4-B	BRII-TS5HC4-B	BRII-TS5SC4-B	768 x 576	2764	3.4	1084	17.3
BRII-TS5QC4-B	BRII-TS5HC4-B	BRII-TS5SC4-B	640 x 480 (VGA)	3289	4.2	1562	17.3
BRII-TS5QC4-B	BRII-TS5HC4-B	BRII-TS5SC4-B	512 x 384	4061	5.2	2441	17.3
BRII-TS5QC4-B	BRII-TS5HC4-B	BRII-TS5SC4-B	320 x 240	6267	8.7	5000	21.4

4.2.1 Scale and Resolution/Frame Rate

Selecting the proper resolution and frame rate for a given high-speed event is important. It is based on the **Field of View** (**FOV**) required to get a good image of your object of interest and the speed at which the object will move through that **FOV**.

For example, if you wish to image a car travelling at 80 km/h across an intersection, full resolution and a relatively slow frame rate will work because your **field of view** (**FOV**) will be large and the car will not be moving through it very quickly.

Imaging a bird travelling at the same speed will require a much smaller **FOV** as the bird is 1/20th the size of the car. If you wish to use the same scale (**object size/FOV**), the **FOV** becomes 1/20th the size and the bird moves through it 20x as fast.

If you got acceptable imaging of a car at 60FPS, it may take 1250FPS to get similarly acceptable imaging of a bird at moving the same speed.

4.2.2 Aliasing and Frame Rate

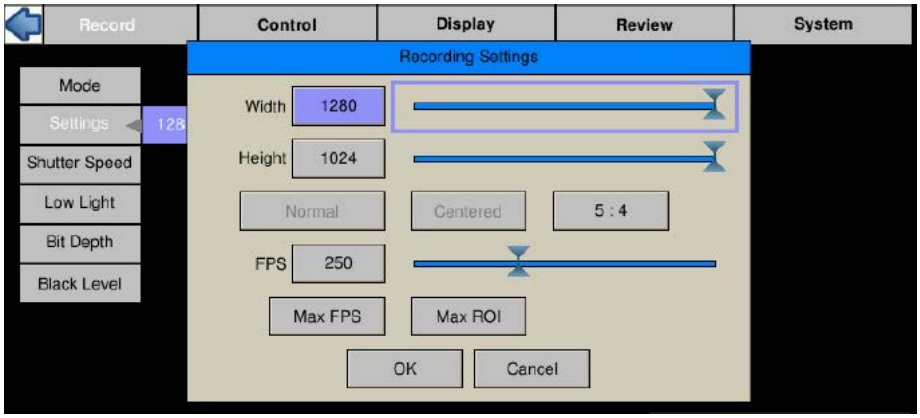
If you are imaging a motion that is cyclical in nature like a wheel spinning or a lever moving up and down, it is important to use a high enough frame rate to avoid motion aliasing. If you know the speed of the object, use a frame rate at least a few times as fast as the repetition rate to get a valid characterization of the motion. If you don't know the speed, use as high a frame rate as possible to start with and adjust from there. (Be sure to analyze the movement one frame at a time as the playback speed may cause aliasing as well.)

Generally you will choose to use the largest resolution possible for the frame rate required. This will give you the best definition of your object of interest. Smaller resolutions may be desired in order to increase the record time.

NOTE: The display resolution of the **Blaster's Ranger II™ LCD** is 800 x 480. Imagery taken at that resolution will look the best on the display.

To set the **Frame Rate** and **Resolution** of the **Blaster's Ranger II™** :

Figure 17: Frame Rate and Resolution Menu



2. Navigate to the **Record Menu** / **Settings**
3. Select either **Resolution** or **Frame Rate**. The Dialog box is interactive as the choices for **Frame Rate** will change with the selection of **Resolution** and visa-versa. The "**Basic**" **Frame Rate** and **Resolution** dialog box will open.
4. Autoselecting **Speed** or **ROI** will simply select the highest Speed for the **Resolution** chosen, or the highest Resolution (**ROI** = **Region of Interest** = **Resolution**) for the speed chosen.
5. Select **Advanced** to open the **Advanced Record Settings**. This dialog box makes use of the **Touchscreen** if it is enabled.
6. Here the **Auto ROI** and **Auto Rate** settings work the same as in the "**Basic**" menu, but the resolutions can be refined to any even-numbered pair from 24 x 12 to 1280 x 1024.

NOTE: The gray numbers beneath the **Width**, **Height**, and **Framerate** windows show maximum values associated with present **Resolution** or **Framerate** settings.

7. Choose from the four aspect ratio choices: **Custom**, **4:3**, **5:4**, **16:9**. With the **Custom** choice the width and height are independent. If any of the others are chosen, the width or height will adjust automatically to maintain aspect ratio.

4.2.3 Offset Control

Most of the time to make use of the best resolving properties of your lens, you will want to center the image at the optical center, which corresponds to the center of the sensor. In this case you would make sure that the "**Center**" check box is checked.

It is also possible, that you will wish to shift your **ROI** (**Region of Interest**) without moving the camera.

Lets say, for example, that you have captured images at 1024 x 1024 @ 500fps and are now interested at capturing a 512 x 512 portion of the scene, lets say the bottom right hand quarter @ 2000fps.

In this case, you would wish to add 512 to both the X and Y offset. For a 1024 x 1024 centered image the offsets will be 128 and 0. The resultant offsets for a 512 x 512 image (lower right quadrant) would be 740 and 512.

4.3 Binning and Subsampling on the Blaster's Ranger II™

4.3.1 Binning:

Binning electronically combines adjacent pixels in groups of 4 (2 x 2 Binning) or groups of 16 (4 x 4 Binning). When pixels are grouped together in this way, the image resolution is divided by 2 or 4, respectively, both horizontally and vertically.

The **Blaster's Ranger II™** sensor has a native pixel resolution of 2560 x 2048. While the highest resolutions supported by the **Blaster's Ranger II™** are lower than this, the full 2560 x 2048 pixel array may be utilized for Binning and Subsampling.

The advantages of Binning are:

- Increased frame rates without changing optics.
- Binning reduces noise because the combined pixels tend to reduce the pixel to pixel differences.

4.3.2 Subsampling:

Subsampling is much like Binning, in that the resolution is divided without changing the field of view, but instead of electronically combining the pixels, only one pixel is read per group.

The advantages of Subsampling are:

- Increased frame rates without changing optics.
- Better resolving power (sharper images) than with Binning.

To Set the Blaster's Ranger II™ Binning or Subsampling mode:

The button to open the mode setting will either be set to "**Normal**," which is the default, or to one of the Binning or Subsample modes.

1. Set the resolution using the Width and Height sliders to the resolution you wish to use.
2. Set the Binning or Subsampling mode

Note: If the chosen resolution is not supported, the highest resolution available at the present aspect ratio will be substituted.

Native Resolution*	2x Binned	4x Binned	2x Subsampled	4x Subsampled	2x Binned+ 2x Subsampled
2560 x 2048	1280 x 1024	640 x 512	1280 x 1024	640 x 512	640 x 512
2560 x 1440	1280 x 720	640 x 360	1280 x 720	640 x 360	640 x 360
2048 x 2048	1024 x 1024	512 x 512	1024 x 1024	512 x 512	512 x 512
2048 x 1152	1024 x 576	512 x 288	1024 x 576	512 x 288	512 x 288

*Actual sensor pixel resolution

4.4 Setting Shutter Speed

In the **Blaster's Ranger II™**, preset exposure times are expressed as xxxxms (1/1), (1/2), (1/4), (1/8) defined as:

For current Ranger II™:(1/1): 1/(Frame rate) - 12ms

Preset exposure times for 500fps for **Blaster's Ranger II™**:

1/(500fps)-12ms= 1.988ms; 1/(500fps * 2) = 1ms; 1/(500FPS * 4) = 500ms; 1/(500fps *8) = 250µs
Minimum exposure for all previous **Blaster's Ranger II™** cameras is 0.002ms (2ms), for current **Blaster's Ranger II™** the minimum exposure is 0.003ms (3µs).

Table 6: Frame Rates and Shutter Speeds

Frame Rates / Shutter Speeds	60 FPS	250 FPS	500 FPS	1000 FPS	4000 FPS
1X	1/60 s = 16.654ms	1/250 s = 3.988ms	1/500 s = 1.988ms	1/1000 = 0.988ms	1/4000 = 238µs
2X	1/120 s = 8.333ms	1/500 s = 2.0ms	1/1000 s = 1.0ms	1/2000 s = 500µs	1/8000 s = 125µs
4X	1/240 s = 4.167ms	1/1000 s = 1.0ms	1/2000 s = 500µs	1/4000 s = 250µs	1/16000 s = 62µs
8X	1/480 s = 2.083ms	1/2000 s = 500µs	1/4000 s = 250µs	1/8000 s = 125µs	1/32000 s = 31µs

Note: 6µs or 12µs is subtracted from the 1X exposures because there is a minimum inter-frame time.

4.4.1 Setting the Shutter Speed

1. Navigate to **Record Menu**.
2. Select **Shutter Speed**.
3. Select (**1/1**), (**1/2**), (**1/4**), or (**1/8**) for preset shutter speeds.
4. Select **Advanced** to open a slider and edit box for dialing in the exposure with greater precision.

Note: The Advanced Exposure Settings dialog expresses the exposure time in milliseconds and in degrees of shutter angle.

Assuming you have installed a lens, you should now see a live image. You may need to adjust the lens *f*-stop or the lighting as well as the shutter speed to get the exposure needed. Press the Display Button once to view a histogram to confirm that the image you see is not clipped (too dark or over-saturated.)

Note: Setting the *f*-stop to a lower value (more open iris) reduces the depth of focus, while setting the exposure to a higher value (longer exposure) increases motion blur.

4.5 Low Light Mode

There is an option labeled "**Low Light**."

THIS IS NOT A SHUTTER SPEED USED FOR RECORDING!
This does cause a lot of issues with customers.

This is a special shutter speed that works in "**Live Mode**" only - for Live view and not while recording.

In some special circumstances, the light available for setting up the **Blaster's Ranger II™** for a high-speed event is not the same as what will be used for event itself. For example, you may be using and extremely bright light or light of a spectrum that would be harmful or uncomfortable for people to work under. In **Low Light Mode** the camera framing and focusing can be done in available light. The exposure for **Low Light Mode** is much longer than would be possible for a high frame rate.

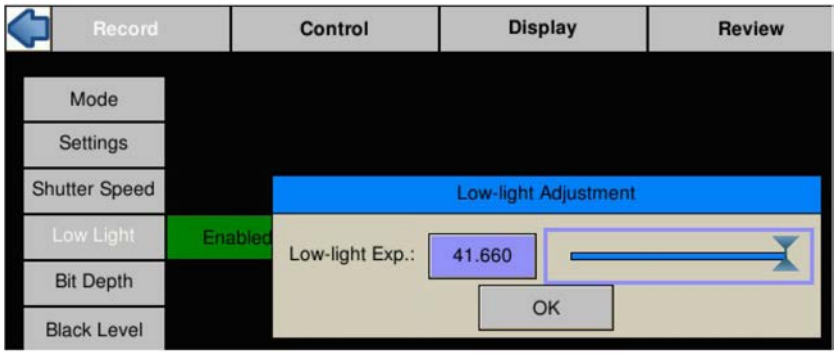
The default shutter speed for **Low Light mode** is 33.327ms, which is the "1X" shutter speed for 30 FPS. The shutter speed for **Low Light** may be adjusted via the **Web App** or custom camera software, but not via the on-camera interface.

4.5.1 To Enter Low Light Mode

NOTE: Be careful when using the **Low Light feature**! It is very easy to forget that it is on! Remember to set your exposure for the light that will be present during the image capture.

1. Set the **Shutter Speed** just as you need it for the high speed event.
2. Navigate to the **Record/Low Light Menu**.
3. If Low Light is not enabled, there will be two items in the menu: "**Disabled**," and an exposure setting (33.327 ms by default). When you click on the "**Disabled**" button, it will turn green and change to "**Enabled**." You will notice immediately that the Live image is much brighter.
4. Press the **Arm Button**.
5. The camera will begin recording. You will notice that the image is darker now than in Live Mode.
6. Press **Arm** again to quit recording. (Click "**OK**" on the Warning message to **Cancel**.)

Figure 18: Low Light Menu



4.6 Setting Bit Depth

Setting the recording bit depth for **Blaster's Ranger II™ Camera**:

1. Navigate to the Record Menu.
2. Select Bit Depth.
3. Select 8-mid, 8-high, 10-high, 12-bit or Advance. If any of the 8-bit mappings are chosen, the live image will immediately reflect that change. If 10-bit or 12-bit are is chosen, the displayed live image will default to 8-high.

Note: The image processor of the **Blaster's Ranger II™** does all of its calculations in 16-bit space in order to avoid quantization errors that would result in image contouring and reduction of the color palette. When 10 bits are recorded, the extra bits are used in image processing even though only 8 bits (24 bits in color) will ultimately be displayed.

Setting the recording bit depth of **Blaster's Ranger II™** cameras:

The **Blaster's Ranger II™'s** 12-bit sensor affords more bit selection choices than the previous cameras. There are presets that work just like those of the previous cameras, as described above.

Specifically, "8-high" and "10-high" presets select the high 8 bits or high 10 bits, respectively. The "8-mid" preset represents a 4x change in slope. In addition to the presets, there is also an "Advanced" button that opens the Bit Selection Dialog box. Here, both bit depth and the high-order bit may be selected. With 12 bits available, there are five possible bit shift positions for 8-bit images; three possible positions for 10-bit images; and only one possibility for 12-bit images.

Notice that the default is to set the high bit at 12 for each bit depth. This is done because that is the setting for optimal image quality.

Figure 19: Bit Depth Menu

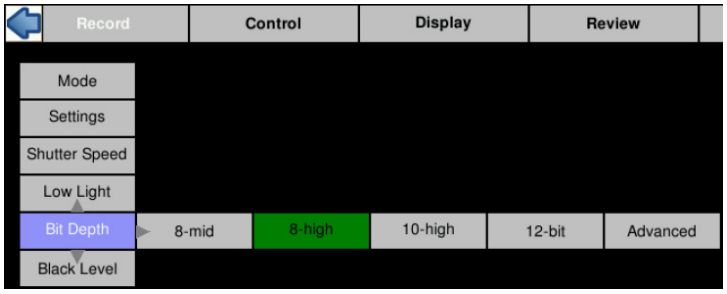
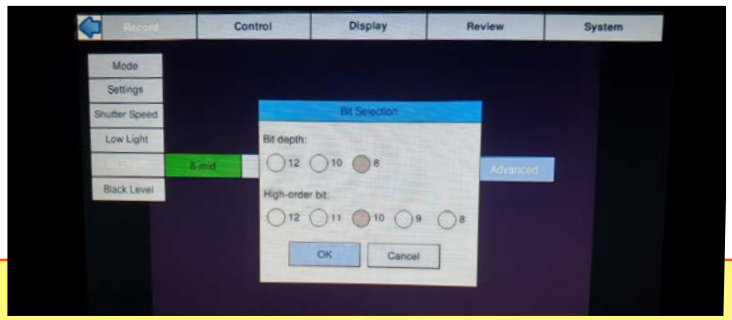


Figure 20: Advanced Bit Selection Dialog



Note: Camera frame rates on **Blaster's Ranger II™** cameras are lower in most modes when 12- or 10-bits are selected.

Note: Always perform a Black Level calibration after changing bit depth.

There are the following choices:

High-Order bit:	12	11	10	9	8
Digital Gain:	1 x	2 x	4 x	8 x	16 x
8-Bit	**Default**	X	X	X	X
10-Bit	**Default**	X	X		
12-Bit	**Default**				

4.7 Configuring the Trigger

The trigger Position menu will appear in the camera GUI when setting up Standard Basic, LR Basic, or Standard FasFire mode operation.

Select Start, 10%, 50%, 90% or End as shown in **Figure 21**.

Note: When controlling the camera via Web-Application, it is possible to position the trigger in 1% or even 1-frame increments.

4.7.1 Enabling the External Trigger

There are times when manually pressing the trigger button is not practical. The camera may be mounted in a location that is difficult or dangerous to reach, or it may be that the precision required to activate the trigger is much easier to maintain through electrical means.

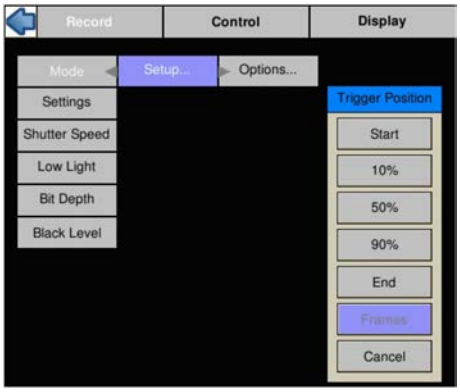
1. Navigate to the Control Menu.
2. Select Ext. Trigger.
3. If Disabled, click on the "Disabled" button. It will turn green and the text will change to "Enabled."
4. The next button to the right will either say Rising or Falling Edge. If you need to change the setting, click on this button to open the dialog box.

For use with the supplied trigger switch, the **Blaster's Ranger II™** should be set to Falling Edge. See **Figure 22**.

The external trigger is one of six external I/O connections available on the camera. Each of these may be used in one of two ways:

1. As a control I/O signal for the camera.
2. As an input for an external signal for creating Markers.

Figure 21: Trigger Position



Enable Sync In / Sync Out

Sync In and Sync Out functions are used to synchronize the frame timing of a camera with another device or clock. These may include other cameras, strobe lighting, machinery, etc. Sync In and Sync Out controls are somewhat interactive:

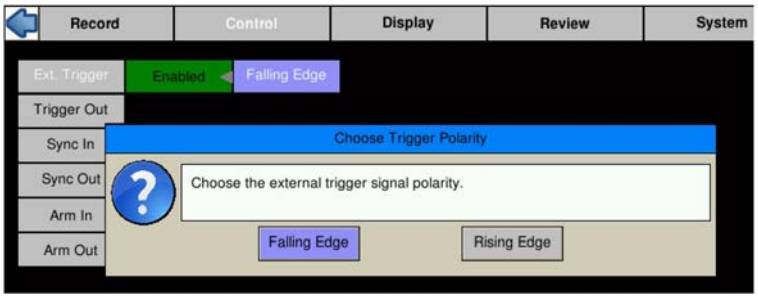
- When Sync In "Per Frame" is enabled, the Master Frame Rate and Rate divisor edit boxes are enabled, allowing you to set the frame rate lower than the Sync input. (Set Rate Divisor to 2 if you want 1/2 the master rate, etc.)
- When Sync In "Per Sec" is enabled, the Delay edit box is enabled, allowing a shift in integration timing from 0 to 1000msec to fine tune the phase relationship between cameras and other devices.
- When Sync Out "Per Frame" is enabled, the Shutter and Duty Cycle controls become active. Selecting "Shutter" makes the Sync Out pulse follow the shutter timing. Selecting "Duty Cycle" allows you to select the % of time the Sync Out pulse is "True." (This may be used in conjunction with polarity choices to establish the phase relationship between devices.)

Note: The **Blaster's Ranger II™** ships with a three-signal cable that supports Trigger In, Sync In, and Sync Out. A six-signal cable (PN: 1105-0405) is available that supports the Trigger Out, Arm In, and Arm Out signals as well.

Trigger Out

The trigger out dialog includes the options "Pass Thru" and "Invert Signal." If either of these is selected, Trigger Out will follow whatever the Trigger In signal is, either in its original, or its inverted form. If neither of these is selected, then you may select either "Active Low" or "Active High" and a Pulse Width for the signal.

Figure 22: External Trigger



Enable Arm In / Arm Out

The **Blaster's Ranger II™** may be Armed using the Arm button on the camera, using Web-App,, or using an "**Arm In**" signal via the camera's I/O cable.

In the case of Arm In, the signal may be either an "Edge" or a "Level."
If Edge is selected, the camera will Arm and begin recording as soon as it sees an edge. Whether this happens on a High to Low transition (Active Low) or a Low to High transition (Active High) is selectable. Once Armed, the camera will not change its recording state as a result of any activity on this input until the present recording ends.

If Level is selected, the camera will only remain in an "Armed" state while Arm In is held low: The camera will begin recording as soon as the Arm In goes Low. If the signal goes away before the camera receives a trigger, the camera will disarm and nothing will have been saved. If the signal goes low again, the camera will Arm and begin recording.

Note: The "Discard Unsaved Images" box. If this is checked and the camera has images in its buffer (in Review) when the camera receives an Arm In signal, they will be discarded without any additional user intervention. If this box is not checked, the I/O signal would be ignored if the camera has images in the buffer.

The Arm Out signal is used to pass the Arm signal to another camera or device or to light an external LED to inform a user that the camera is Armed. The Arm Out Signal can either follow the armed/unarmed state of the camera, or be a Pass Thru signal from "Arm In."

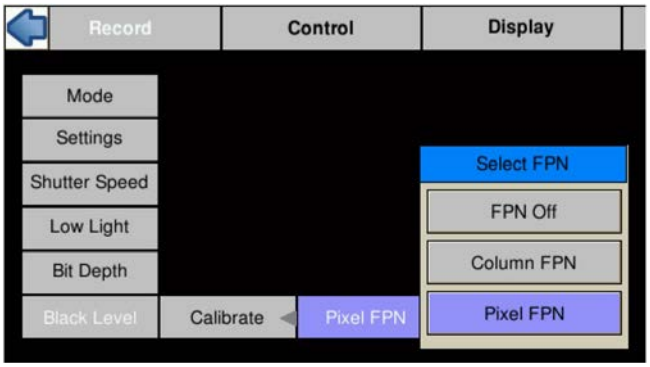
4.8 Black Level Calibration

Black level calibration does two things:

1. It sets the black level of the camera to ensure that, in the absence of all light, there is no offset or clipping (the "blackest" pixel will have a value of 0).
2. Dark frame data is saved for correcting **Fixed Pattern Noise** (**FPN**).

NOTE: Fixed Pattern Noise exists on every image sensor.

Figure 23: Black Level Calibration and Settings



4.8.1 Calibrate Black Level

The general rule is to do a **Black Level Calibration** if ever you believe the image looks noisy with **Pixel FPN** turned on.

To be assured that you are getting the best possible images, perform a calibration:

- When you first boot the camera up.
- If you change **Shutter Speed**, **Frame Rate**, **Resolution**, or **Offset**.

4.8.2 To Calibrate the Camera

1. Navigate to **Record/Black Level**
2. Shut out all light to the sensor: close the *f*-stop down all the way and put a lens cap on it or cover it securely.
3. Click on "**Calibrate**." There is a prompt to confirm that you have the lens cap on. You will see a little progress bar and you will see a couple of noisy images on the screen. When done, if **Pixel FPN** is on, the live image with the lens cap in place should be black.
4. Next to the **Calibrate** button, you will see an **FPN selection** button that will say **FPN Off**, **Column FPN**, or **Pixel FPN**. Click on that button and select the **FPN** setting you wish to use, based on the following:

Pixel FPN is a per-pixel image correction that is done in the **Blaster's Ranger II™'s** image processor engine. It provides the cleanest images available. This is the setting that is most highly recommended, especially if the images will be downloaded or viewed on large, high-contrast displays.

Column FPN is an image correction done on the **Blaster's Ranger II™**'s sensor. It does not do as good a job cleaning up the images as Pixel FPN.

FPN Off means that there is no noise correction being used.

4.9 Record: Arm and Trigger

- Dark Level Calibration has been done
- The scene is framed and focused
- The **Resolution** and **Frame Rate** are set
- The **Shutter Speed** is set
- The **Bit Depth** is set
- The **Trigger Point** and **Trigger Type** is set

4.9.1 Take a Still JPEG

Figure 24: Camera LED

Still **JPEG** Image. It is optional, but recommended, to take a reference still of the scene:

1. With the **Blaster's Ranger II™** in **Live Mode** (not Recording or Reviewing a recording) press the **Trigger Button**.
2. A dialog box will appear asking where to store the image. Select the storage media you wish to use. (The image will be saved in <storage device>/dcim/100fastc.)

To begin Recording, Press the **Arm Button**.

When the **Arm Button** is pressed the camera begins recording into its circular buffer. The Camera LED will change from Green to slowly flashing **Amber**. It will record for an indefinite period of time until it gets a Trigger.

If the **Arm Button** is pressed a second time, the Recording will abort. A courtesy message will appear asking for confirmation. You will need to use the **OK Button** on the **D-Pad** to accept.

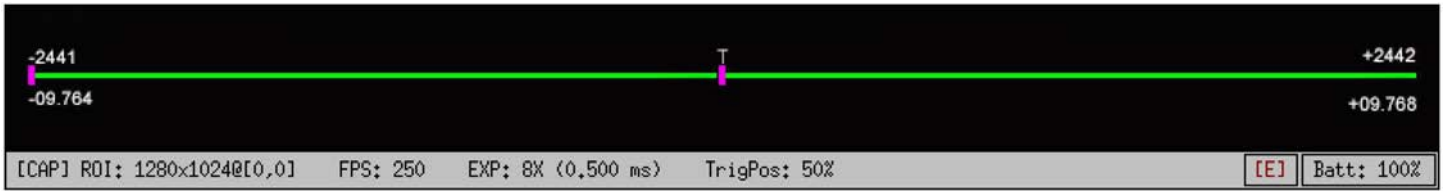
The recording state is indicated by a progress bar at the bottom of the **Blaster's Ranger II™** LCD display. (See **Figure 25: Progress: Armed Blaster's Ranger II™**.) For this example, a **50% Trigger Point** has been selected. The yellow/green bar represents the record buffer. The yellow half represents the pre-trigger portion; the green represents the post-trigger portion. The "T" in the center of the bar represents the **Trigger Point** (frame "0").

The numbers above and below the bar on each side indicate the number of frames and seconds for the pre-trigger portion, to the left, and the post-trigger portion, to the right. In this instance, because the **Trigger Point** is set at 50%, both the number of frames and amount of time is the same on both ends.

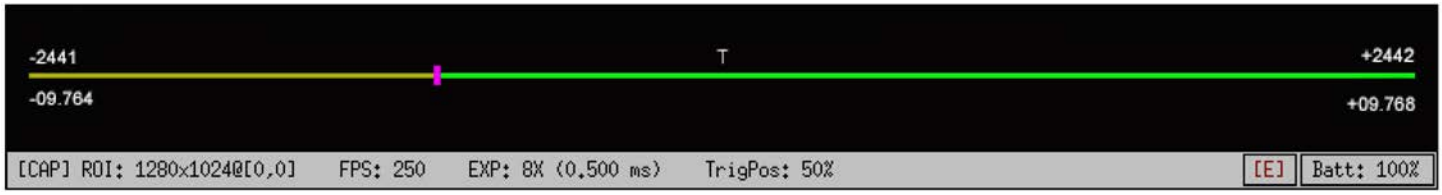
NOTE: If the **Blaster's Ranger II™** is triggered before the pre-trigger portion of the buffer is full, it will immediately cease taking pre-trigger frames, record frame "0" and progress to the post-trigger portion of the recording. When complete, the recording will have contiguous frames, with the full complement of post -trigger frames, but fewer pre-trigger frames.

Figure 25: Progress: Armed Blaster's Ranger II™

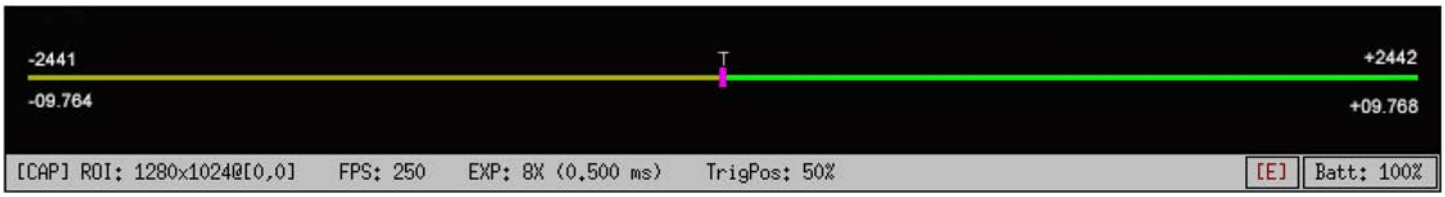
The recording has just been started (the **Arm Button** has just been pushed). The green progress line spans the whole distance between the left edge and the trigger point.



The recording has progressed through a little more than half of the pre-trigger portion. The marker has moved and the yellow line has proceeded with the progress of the recording.



All of the pre-trigger frames have been recorded. The **Blaster's Ranger II™** is continuing to record new frames as it discards the oldest. It can remain in this state indefinitely waiting for a **Trigger**.

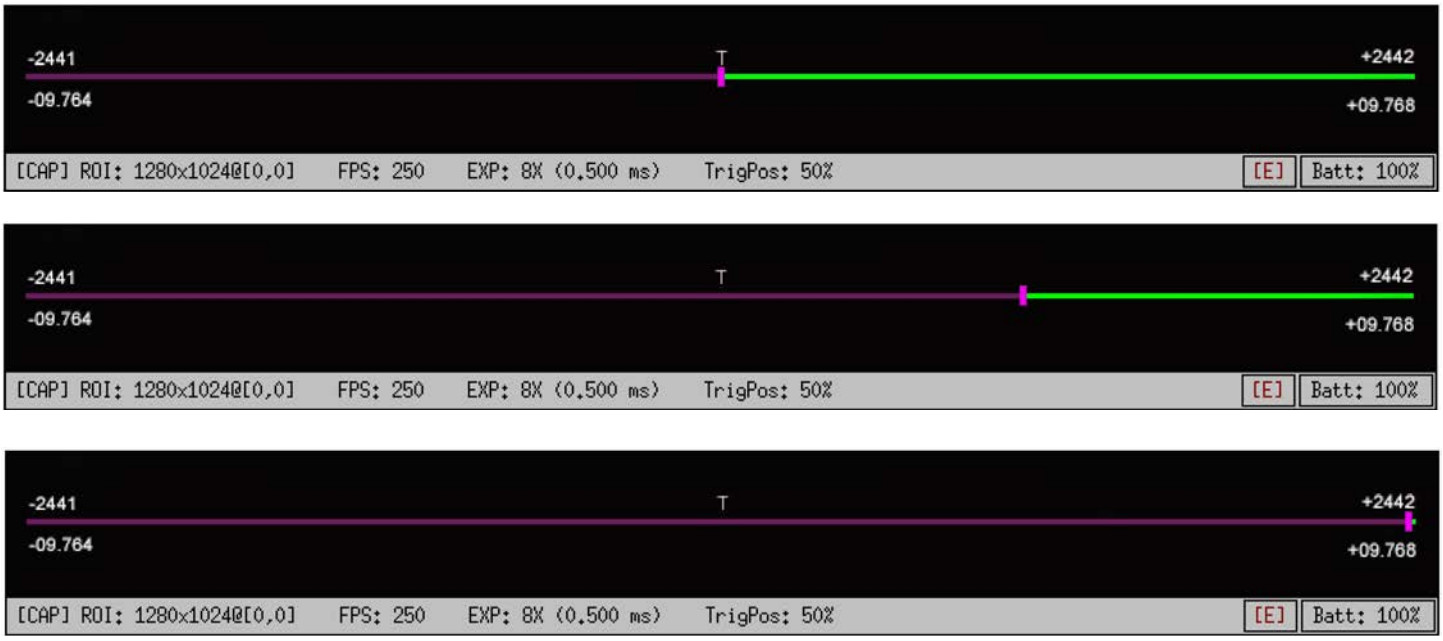


4.9.2 Trigger

To trigger the camera, press the **Trigger button** (see **2.1.3 Camera Back**) or the **Trigger Switch Cable** button.

When triggered, the **Blaster's Ranger II™** will capture frame "0" and the post-trigger frames. The progress bar will change color and move from the trigger point to the end as in the three images below. When the recording is complete, the progress bar will turn solid green.

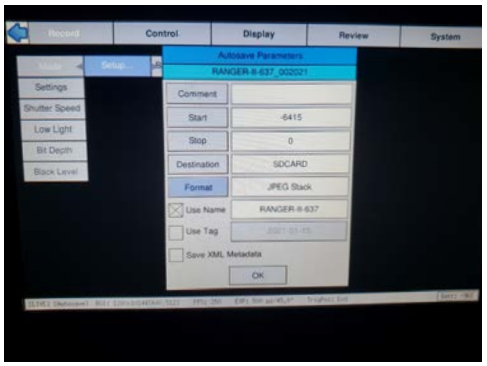
Figure 26: Recording Progress: Triggered Blaster's Ranger II™

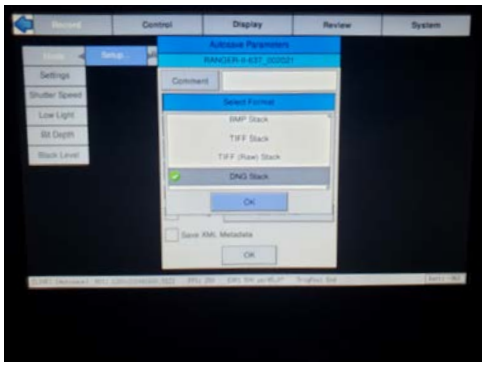


The **Blaster's Ranger II™** will now either enter **Review Mode** or, if **Autosave** has been enabled, the camera will save the images to a mass storage device and go back to **Armed Mode**, capturing pre-trigger frames and watching for a **Trigger.**

4.10 Autosave

Figure 27: Autosave Dialog





The **Blaster's Ranger II™** may be used to capture many consecutive events. Using **Autosave**, this can be done unattended, that is, the camera may be left at a location to automatically, Trigger, Save captured imagery, and then re-Arm itself indefinitely-constrained only by the mass storage space available.

Consider that a **Blaster's Ranger II™** with an optional 512GB SSD installed, depending on the resolution and download file format, could record and save hundreds or even thousands of events in a completely unattended mode!

Even if using an **SDHC**, many events may be captured.
Advantages of using **Autosave**:

- **Autosave** is the only choice for multiple unattended events. For remote locations or locations where networking is not possible, or for long shifts where there may be multiple events of interest that need to be captured without human intervention.
- **Autosave** is also useful for production environments or in any scenario where it is used for multiple consecutive tests without any setup changes. Here it is preferred because it limits human intervention, thereby limiting both human effort and the possibility of human error.
- In an unattended event, especially in a remote location or when there is no easy access to the camera, **Autosave** is recommended because it is the quickest way to secure the image data. Saving the data to nonvolatile memory can be important if there is a possibility of power loss.

- Use **Autosave** for any unattended event where there is a possibility of a spurious trigger. If this happens to an unattended camera, it is possible that the camera will trigger prematurely. If **Autosave** is used, there is a good chance that the camera will have returned back to Record mode in time to capture the planned event.

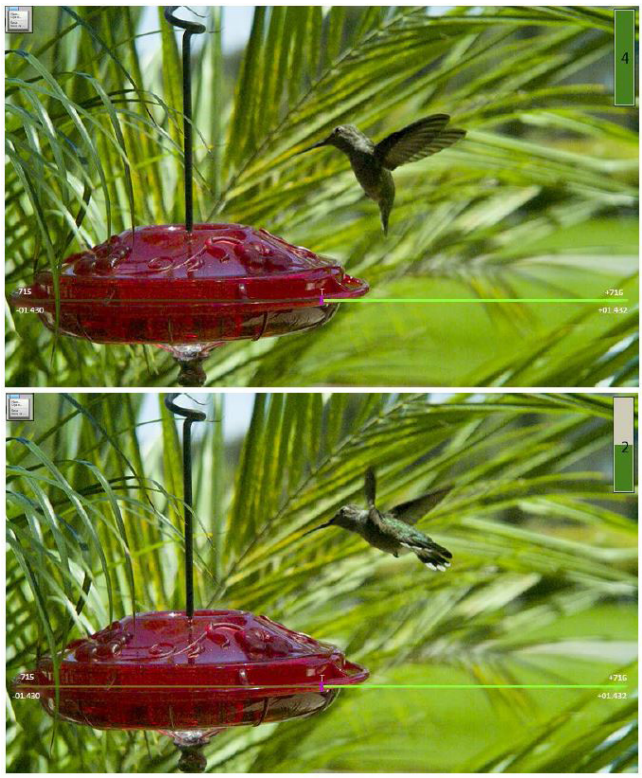
4.10.1 To set up Autosave

1. Navigate to the **Record Menu**, then select **Mode.**
2. Then select **Basic Options** and then tick **Autosave**.
3. Select **Disabled**. A dialog box will open to allow you to set up Start/Stop frames for downloading (the Start/Stop times for the recording are the defaults), the destination drive (mass storage target for downloads), file type options, and options for naming the downloaded files.
4. When finished setting up the **Autosave** settings, click on the **Save button**. When you navigate back to the **System menu** the "**Disabled**" button will have turned green and say "**Enabled**." The next button over will reflect the target file name.

NOTE: **Autosave** will continue re-arming itself, capturing images and downloading them until the target drive runs out of space. At this time it will progress to Review mode so the user download manually to a different drive or clear space.

4.11 Fasfire

Note: FasFire mode takes more power than other recording modes.



The **Blaster's Ranger II™** is capable of recording images to one memory partition while saving images from another partition to non-volatile media such as an SSD, SD Card, or USB device. Depending on the amount of high-speed DRAM memory (4GB or 8GB) on your camera and the Session Length (partition size) you set, the FasFire feature lets you capture many clips in quick succession without ever waiting for the camera to finish saving the last.

You will usually find that the camera has saved one or more partition before you get to the last one. Depending on the session size, the speed of the media, and the interval between events, you will often find that you will be able to keep recording clips at will until the space in the save media is exhausted.

For example, if you have 4GB of DRAM in your camera, and you set the Session Length to 0.50GB. You have divided the memory into 8 partitions. The camera will reserve one of these for buffering and open up the remaining 7 for FasFire.

4.11.1 Entering FasFire

The camera will operate in FasFire mode whenever there are at least two FasFire partitions and the camera is set to AutoSave. In FasFire, as soon as the camera receives an Arm signal, FasFire will commence.

4.11.2 Using the Gas Gauge

Using the **DISP** button on the **Blaster's Ranger II™** to toggle through the displays in **FasFire**, you will find that there is a "gas gauge" available at the upper left corner of the image.

When the gas gauge is solid green, as in the upper image on the previous page, all memory partitions are empty. This means that either you have not triggered the camera yet, or that all of the partitions you have recorded have been saved.

When you trigger the camera, the gas gauge retracts proportionately to the number of available partitions. The gas gauge in the center image shows that half the available partitions are available, and half are being saved.

If you continue to trigger the camera quickly, you may get down to the last partition. At this point the gas gauge turns red, as in the bottom image.

The gas gauge will recover as soon as partitions are saved to media, so if you wait for a while you will see the gas gauge recovering, a partition at a time, until it is solid green again.

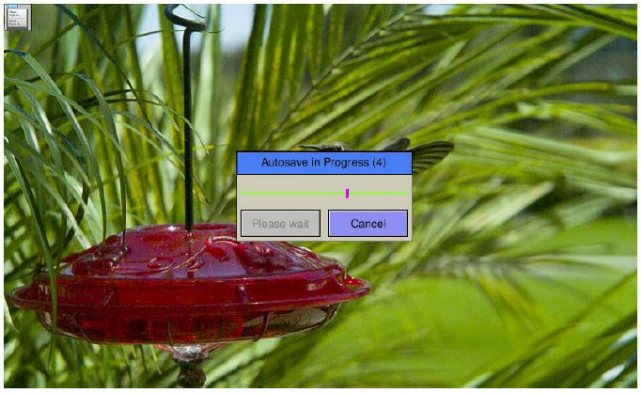
If you do use the last partition, the camera will display the Autosave Progress bar and indicate the number of partitions waiting to be saved. As soon as one partition is free, you will see the gas gauge again and may proceed to record images.

4.11.3 Cancelling FasFire

If you press the **Arm** button while recording, you will get a warning message asking if you wish to cancel. If you click on "**OK**," the Autosave Progress bar will appear.

If you click on **Cancel** from the Autosave Progress Bar, the camera will return to Live Mode.

There are still recordings in DRAM memory at this point. If you would like to recover them, go to the Review Menu. If you click on "Play," you will see the last partition in "Review" mode, from where you will be able to save the clip.



If you click on "**Free**," the camera will discard the last buffer and load the next in Review. You are thus able to Play, Save, or discard each partition in turn, working from newest to oldest.

4.12 Long Recording Modes (Optional)

Long Record Basic mode works much like Standard Basic mode:

1. Press the Arm button to begin streaming pre-trigger frames into a circular buffer on the SSD.
2. Trigger the camera at the appropriate time. The Trigger point may be at the beginning, end or somewhere between (presets on the camera are Start, 10%, 50%, 90% and End).

- When triggered, the camera will record the trigger frame, plus all post-trigger frames on the onboard SSD, then proceeds into Playback.
- Recording progress along the displayed timeline will appear just as with Standard basic mode.

Note: If you wish to stop recording before all of the post-Trigger frames are recorded, you may cancel the recording by pressing Arm, then elect to "Retain the current session" when you stop the recording.

There are three basic differences between Long Record Basic and Standard Basic modes:

- The basic performance specifications vary depending on model, but generally Long Record allows for much longer recordings at slightly slower frame rates than Standard mode.
- Autosave is available in Standard, but not in Long Record Mode.
- Long Record mode recordings are written to the SSD, which is non-volatile media. These recordings are not lost when the camera powers down.

FasCorder ROC mode is convenient when multiple recordings of various durations will be made or when there are pauses in the action that need not be recorded. FasCorder BROC mode records a specified number of frames with each trigger.

1. Once the camera is set to ROC or BROC mode, press the Arm button. You will now see the recording timeline and a live image on the display. The position bug will be all the way to the left.
2. Press the Trigger button. The Blaster's Ranger II™ is now recording and streaming the images directly to the onboard SSD. The camera LED will flash red.
3. ROC mode: Press the Trigger button again. The recording will now pause. The camera LED will flash amber. Repeated triggering will cause the camera to alternate between recording and paused states. When recording, the camera LED will flash red. When paused, the LED will flash amber and the position bug will stop. This can be repeated until space on the SSD is exhausted.

   BROC mode: The camera LED will flash red while recording a specified number of frames, then the camera will pause with the LED flashing amber. If the trigger is pressed before the specified number of frames have finished recording, the additional frames are appended to the recording.

4. Press the Arm button. A message will appear giving you the option to continue recording or stop and go into Playback.

Note: Appending to ROC and BROC recordings upon returning from Playback or a Power cycle will cause a number of black frames (up to 128) to be inserted in the recording timeline.

It is possible to alternate FasCorder ROC and BROC recordings in any combination as they are compatible formats. Long Record basic recordings, however, are not compatible with FasCorder and cannot coexist on the SSD.

4.13 Reviewing Captured Imagery: Playback

Once the recording is complete, if **Autosave** is not enabled, the **Blaster's Ranger II™** will open the recording in **Review Mode**.

There are three things to do in **Review**:

1. Play the video-play it forward, backward, frame by frame, adjust the cut-in and cut-out points (find the interesting portion of the clip), etc.
2. Adjust the image brightness, contrast, gamma, bit depth, color, etc.
3. Save video to a mass storage device.

To Review the video:

Figure 28: Playback Buttons

In **Review Mode** there is a series of buttons on the bottom of the display, and a progress bar, very much like the one used for **Record Mode** to mark the place in the video currently being viewed.

4.13.1 To Enter Review / Play

1. Either complete a recording, which will automatically open **Review** / **Play**, or navigate to the **Review Menu** and select **Play**. This will only be available when there is a recording in the **Blaster's Ranger II™** image buffer and the camera is not **Recording** or **Saving** to storage. When the image buffer is empty the **Review Menu** text will be grayed and the menu items are not accessible.
2. Use the **Playback Buttons** to move through the imagery. The **Status Bar** will reflect the record frame rate (FPS), the playback speed, current frame number, frame time (relative to the trigger), and the **Cut-In** and **Cut-Out** points.

Table 7: Playback Control

The playback buttons may be used with the touchscreen, if enabled or the D-Pad.

	Returns to **Live** image. (Recorded image is still in buffer.) To return to Play, navigate to **Review Menu** and select **Play**.
	Creates new **Cut-In** point at current frame. To remove **Cut-In** point, click again, then move cursor.
	Go to beginning of clip–goes to **Cut-In** point. Click a second time and it goes to the very beginning of the video.
	Move one frame backward. When highlighted, hold **OK button** on **D-Pad** to skip backward.
	Play backward. Use up and down buttons on **D-Pad** to adjust speed.

	Pause play.
	Play forward. Use up and down buttons on **D-Pad** to adjust speed.
	Move one frame forward. When highlighted, hold **OK button** on **D-Pad** to skip forward.
	Move to end of clip–goes to **Cut-Out** point. Click a second time to go to the end of the video.
	Jump to **Trigger frame**.
	Creates new **Cut-Out** point at current frame. To remove **Cut-Out** point, click again, then move cursor.
	Truncate / Delete. In LR ROC or BROC mode, use this to delete any amount of image data from some selected point to the end of the recording. In other modes, use to delete the present partition.
	Open **Save Partition** dialog box to save clip. (Uses current **Cut-In/Out** points for **Start** and **Stop** frames.

Table 8: Payback Rates

	Record Rate (FPS)						
	60	**125**	**250**	**500**	**1000**	**2000**	**4000**
Playback Rates	5	5	5	5	5	5	5
	10	10	10	10	10	10	10
	15	15	15	15	15	15	15
	30	30	30	30	30	30	30
	60	60	60	60	60	60	60
		120	120	120	120	120	120
		125	125	250	500	1000	2000
			250	500	1000	2000	4000

4.14 Image Processing

4.14.1 Setting Image Processing Options

Figure 29: White Balance Dialog

1. Navigate to the **Display Menu**
2. Select the image processing option you wish to change: **Brightness**, **Contrast**, or **Gamma**.
3. Experiment with the values in each of these controls to get the best possible image.
4. You may wish to open a histogram (**DISP Button**) for reference as you use these controls.
5. If you have recorded **10-bit** images, a menu item for **Bit Depth** will also be present in the **Display Menu**. If **8-bit** images have been recorded, the bit selection has already been made, so this menu does not appear.

NOTE: Making a selection from this menu only affects the **Displayed image** and any (non RAW) images saved to a mass storage device. It does not affect the either the **8-bit** or **10-bit** images as they are recorded into the **Blaster's Ranger II™**'s high-speed internal memory. Adjustments made here may be done before and/or after the imagery is captured.

4.15 Saving Images to Mass Storage

Image sequences are saved either as **AVI** videos, in which one file contains all the frames of the sequence, or **TIFF**, **JPEG**, or **BMP** stacks, which are collections of files, one file per frame of imagery. The file save options change depending on whether or **8-bit** or **10-bit** image data has been written to internal high-speed memory:

Table 9: Image File Save Options

10-bits recorded	8-bits recorded
TIFF (8-bit M /24-bit C) or **RAW TIFF**(16-bit)	**TIFF** (8-bit M / 24-bit C) or **RAW TIFF** (8-bit)
BMP (8-bit M /24-bit C)	**BMP** (8-bit M/ 24-bit C) or **RAW BMP** (8-bit)
AVI (8-bit M /24-bit C)	**AVI** (8-bit M / 24-bit C) or **RAW AVI** (8-bit)
JPEG (8-bit M /24-bit C)	**JPEG** (8-bit M / 24-bit C)

Calculating file sizes for **TIFF** and **BMP** images is very simple:

Resolution x Bit depth/8 = approximate BMP or TIFF file size in Bytes

(to convert Bytes to KB divide by 1024)

For example a 1280 x 1024 Mono **BMP** or **TIFF** is:
1280 x 1024 x 8 / 8 = 1,310,720 bytes = 1,280K

A 1280 x 1024 16-bit **RAW TIFF** is:
1280 x 1024 x 16 / 8 = 2,621,440 bytes = 2,560K

The actual file size of a 1280 x 1024 mono **BMP** or **TIFF** is about 1281K (the additional 1K for the file header). The actual size of **16-bit RAW TIFF** is 2561K (again add an additional 1K for the header).

NOTE: The **RAW 16-bit TIFF** saved from the camera actually has 10 bits of image data. The **16-bit** format is used for compatibility reasons.

Calculating file sizes for **AVI** and **JPEG** images is much more difficult. The compression is often approximately 10x to 20x, but it can be much greater for images with little content, and it can be much less for very complex images.

RAW images are not colorized, so Mono and Color images are the same size. Colorization increases file size 3x because 8 bits are saved for each of red, green, and blue channels.

To Save a recording to a connected mass storage device on the **Blaster's Ranger II™**:

1. Navigate to the **Review Menu**
2. Select **Save**. The **Save dialog box** will appear as in **Figure 29: White Balance Dialog**. The **Start** and Stop **frames** for the **Save** may be edited.

NOTE: The frame numbers initially shown in the dialog box will be the actual start and stop frames for the entire capture unless the **Cut In** and **Cut Out buttons** were used during **Review**. If you are not sure what the actual beginning and end frame numbers for the video are, you can find them on the far left / far right sides of the record bar. (See **Figure 26: Recording Progress: Triggered Blaster's Ranger II™**.)

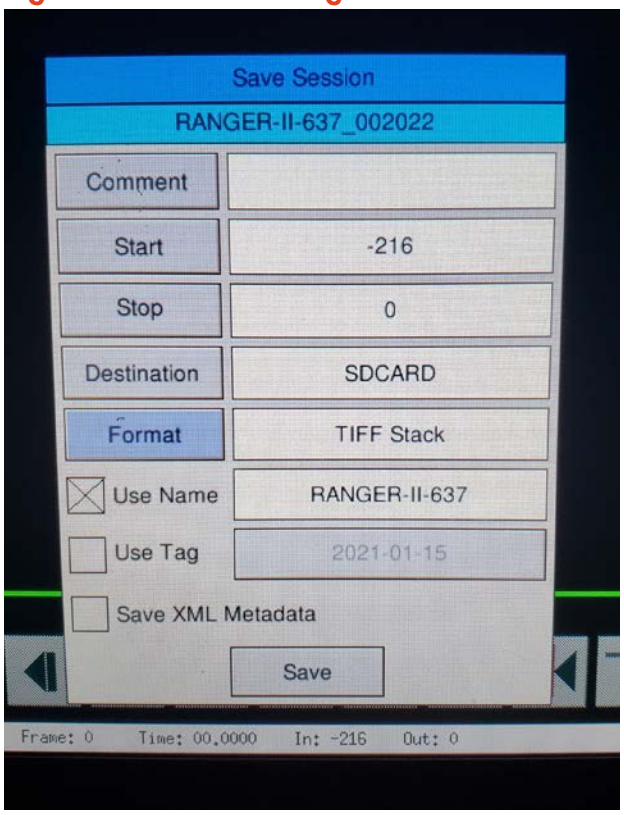
3. Selecting "**Destination**" will open a dialog box for selecting the mass storage device to save to.
4. Select "**Format**" to select the file type. Once you select a file type from the list, the **OK button** will turn blue. Press the **left arrow** to enable a **RAW format**, if available, depending on the bit-depth recorded. (See **Table 9: Image File Save Options**.)
5. The default file name format for the image stacks is Frame_000000.<TYPE>. If you would like the name to include the camera name, **Select Use Name** in the dialog. The resulting file name format for the example would become **RANGER-II-xxx_000000**.<TYPE>.
6. If you would like to add a tag to the name, select **Tag**. The **Tag** may be edited. Using the **Tag** in the example, the file name becomes 2011-10-11_000000.<TYPE>.
7. Both the **Name** and the **Tag** may be used, in which case the file name becomes RangerII-11_2011-10-11_000000.<TYPE> in the example.
8. If **AVI** files are saved, the default file name is RangerII_000000.AVI. The **Use Name** and **Use Tag** options are also valid for **AVI** files, in which case the resulting file names are RangerII-11_000000.AVI, or 2011-10-11_000000.**AVI**, etc. If the file size exceeds the 4GB limit for 32-bit file systems, the **Blaster's Ranger II™** will make a second file for the remainder of the imagery. (**ProAnalyst®** and other players will play the video as one.)

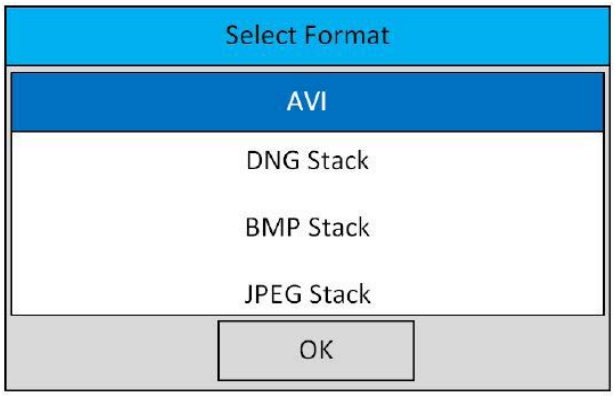
When the **Blaster's Ranger II™** saves imagery to mass storage it creates the following:

- DCIM. This is an industry standard directory name for Digital Camera Images.
- 100fastc. This is a sub-directory under DCIM.
- RangerII_000000. This is the first sub-directory under DCIM/100fastc, used for storing image stacks.
- hs-video. This is the directory that all AVI files are written to.
- <filename>.txt. For each download, the camera creates this text file. In it are the camera setup values, including resolution, frame rate, camera name, time stamp for the capture, image processing values, color processing values, etc.
- <filename>.cfg files. This is a binary file used for **ProAnalyst®** player so that it can properly play the image files as a movie.

NOTE: Image files may be saved multiple times using different formats, different start and stop points, and different image processing options (brightness, contrast, gamma, color, etc.). If **10-bit** images have been captured, imagery may be saved multiple times using different bit-depths.

Figure 30: Save Dialog Boxes





4.16 Sync In

The **Blaster's Ranger II™** is easily synchronized to an external device such as another camera, or a precision timing generator.

4.16.1 Per Frame

The "**Per Frame**" option is used when you wish the camera to capture at a rate of one sync-pulse per frame or greater.

To set up Sync-In:

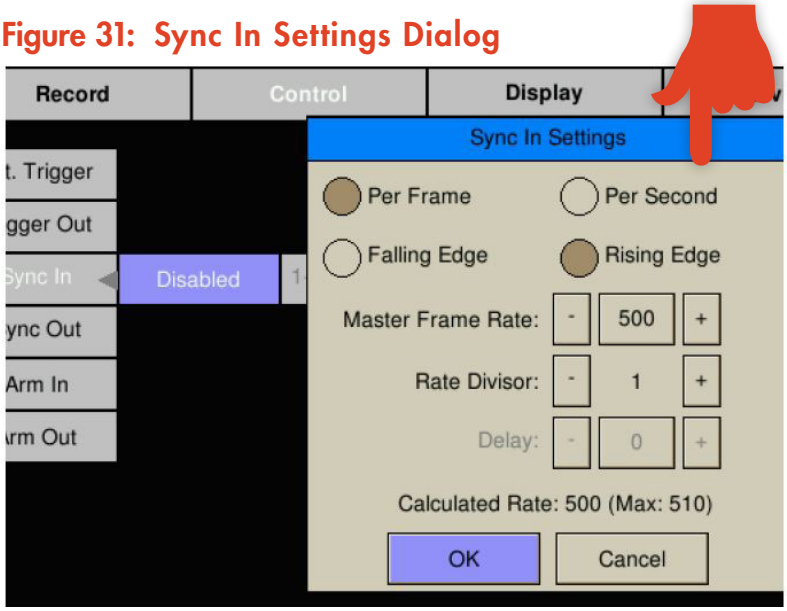
1. Navigate to the **Control Menu**.
2. Select **Sync In**. There are two buttons: **Enabled**/**Disabled**, and another that may say "**1-PPF**, **Rising Edge**, **Divisor=1**".
3. Change the state of the first button to "**Enabled**" (green), then click on the second button to open the **Sync In Settings** dialog.

The touchscreen feature is implemented for this dialog. If it is enabled, you will be able to enter data with your fingertip.

4. Select **Rising Edge** or **falling edge** depending on your preference.
5. Select **Per Frame**. (**Per Second Synchronization** will be covered in the next section.)
6. Set the **master framerate**. This is the speed in Hertz of the input signal. It is important that the input signal does not exceed this because this is the number the camera will use to calculate integration timing.
7. Set the **rate divisor**. In the example shown in **Figure 31: Sync In Settings Dialog**, The desired framerate is 1000, while the **Master Framerate** is 2000, so a divisor of 2 is used.
8. Click on **OK** to accept the settings. The camera's framerate will now be set at 1000 and all of the shutter settings are adjusted accordingly.

In this example, the Max (frame rate) is 1602. The camera's resolution was set at 800x480. 1602 is the maximum frame rate for that resolution. If you wish to change your maximum frame rate, you must change the resolution in the **Record/Settings menu**.

Figure 31: Sync In Settings Dialog



NOTE: With **Sync In** enabled, you will not get a live image unless a valid sync signal is present.

4.16.2 Per Second

Many commonly available sync sources have a precision
1 Hz output. IRIG and GPS are two that are very often used with high-speed data capture.

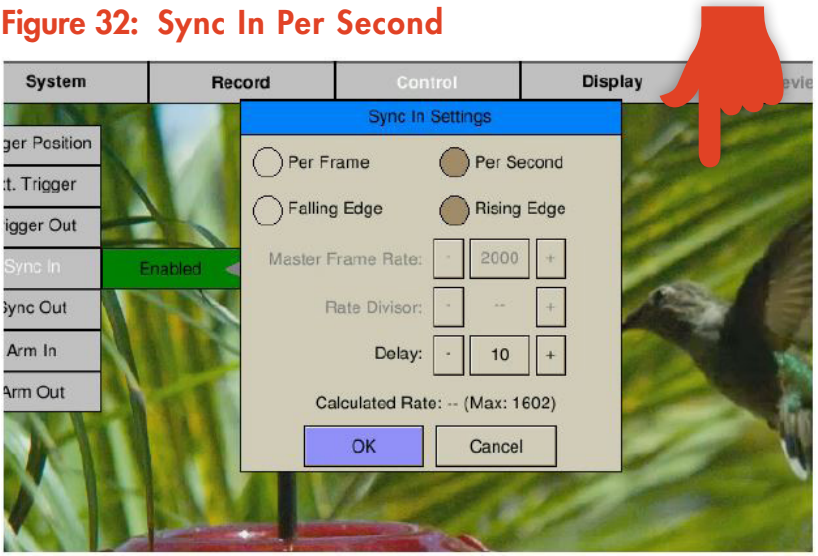
The **Blaster's Ranger II™** is able to utilize these signals for synchronization of cameras at any frame rate.

To use **Per Second Synchronization**:

1. Navigate to the **Control Menu** and open the **Sync In Settings dialog** (as in the previous section).
2. Select "**Per Second**" in the dialog box. The **Master Framerate** and **Rate Divisor fields** will gray-out.

3. The **Calculated Rate** will reflect the frame rate set in **Record/Settings**. If you wish to change those settings you will do those as for any normal recording. (See **4.2 Setting Frame Rate and Resolution** on **page 28**.)

Figure 32: Sync In Per Second



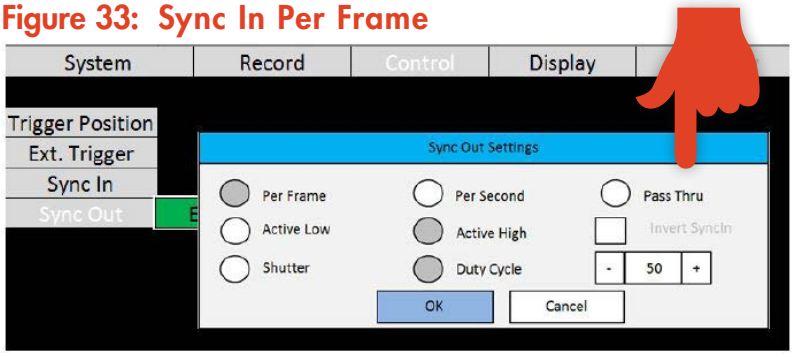
4.17 Sync Out

4.17.1 Per Frame

External devices such as additional cameras, strobe lights, and test instruments may be synchronized via **Sync Out** pulses from the **Blaster's Ranger II™**. The "**Per Frame**" option output is one pulse per frame--the sync pulse rate is equal to the recording frame rate.

To set up Sync Out:

Figure 33: Sync In Per Frame



1. Navigate to the **Control Menu**.
2. Select **Sync Out**. There are two buttons: **Enabled**/**Disabled**, and another that may say **1-PPF**, **Shutter**, **Active High**--or something similar.
3. Change the state of the first button to "**Enabled**" (green), then click on the second button to open the **Sync Out Settings Dialog**.
4. The signal can either be **Active High**, meaning the signal goes high when the shutter opens, or **Active Low**, meaning the signal goes low with when the shutter opens. Select **Active High** or **Low** from the dialog box.
5. The signal can either follow the **Shutter** (integration time) or you can select **Duty Cycle** and control the % of frame time (1/framerate) for the active portion of the signal using the number box provided.

4.17.2 Per Second

If you choose the "**Per Second**," the camera will output a 1Hz signal. The only active options in this mode are **Active High** and **Active Low**.

Pass Thru

When you select **Sync Out Pass Thru**, the signal received on **Sync In** is sent to **Sync Out**. The only setting that affects this signal is the Invert Sync In option, which simply inverts the signal.

4.18 Master/Slave Setup

There are many possible configurations used to synchronize groups of cameras. The **Master**/**Slave** configuration is often used when a

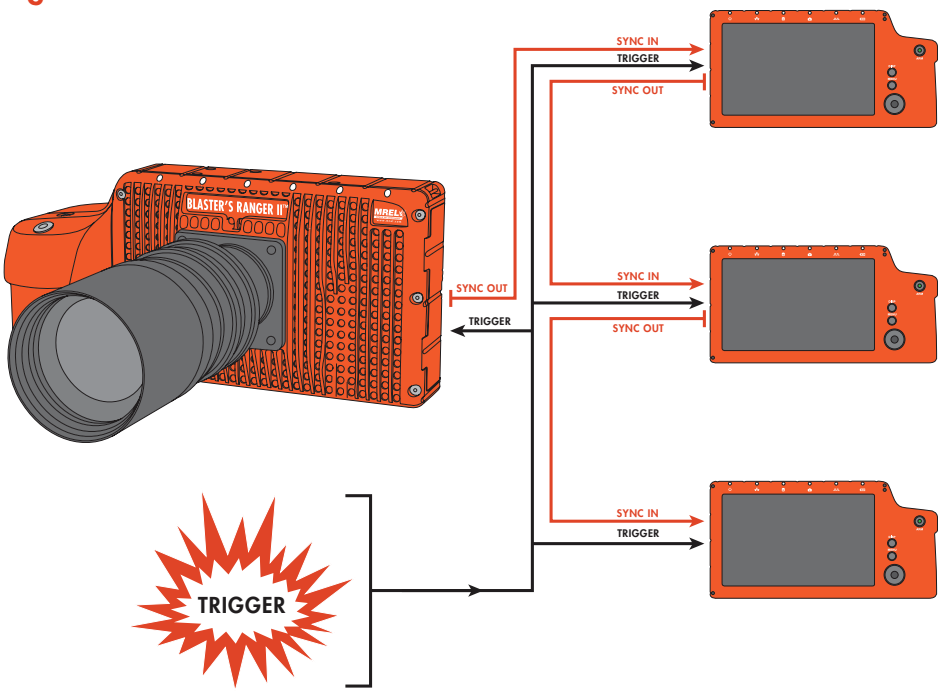
group cameras is used to capture multiple synchronous views of an event that is not driven by a clock or PLC. For example, when studying animal or human kinetics, the subject (animal or human) is not supplying a sync signal for the camera system, so the camera system uses its own: **Sync Out** from a **Master** camera.

In this configuration, any camera may be used as the **Master**.

Commonly, all cameras are set to the same **Frame Rate** and **Resolution**, are triggered together, and integrate frames together (synchronize frame start times).

For this setup:

Figure 34: Master and Slave Cameras



- Enable **External Trigger** for all cameras and use the same polarity for all.
- **Sync Out** from the **Master** camera is set to "**Per Frame**"
- **Sync Out** for the **Slave** cameras are set to "**Pass Thru**." **Invert Sync In** is not selected.
- **Sync In** for the **Slave** cameras **Master Framerate** is set the same as the **Framerate** of the **Master** camera.
- Choice of **Shutter** or **Duty Cycle** does not matter.

- If the **Master Sync Out** is **Active High**, then the **Slave Sync In** must be set for **Rising Edge**. If **Master Sync Out** is **Active Low**, then the **Slave Sync In** must be set for **Falling Edge**.

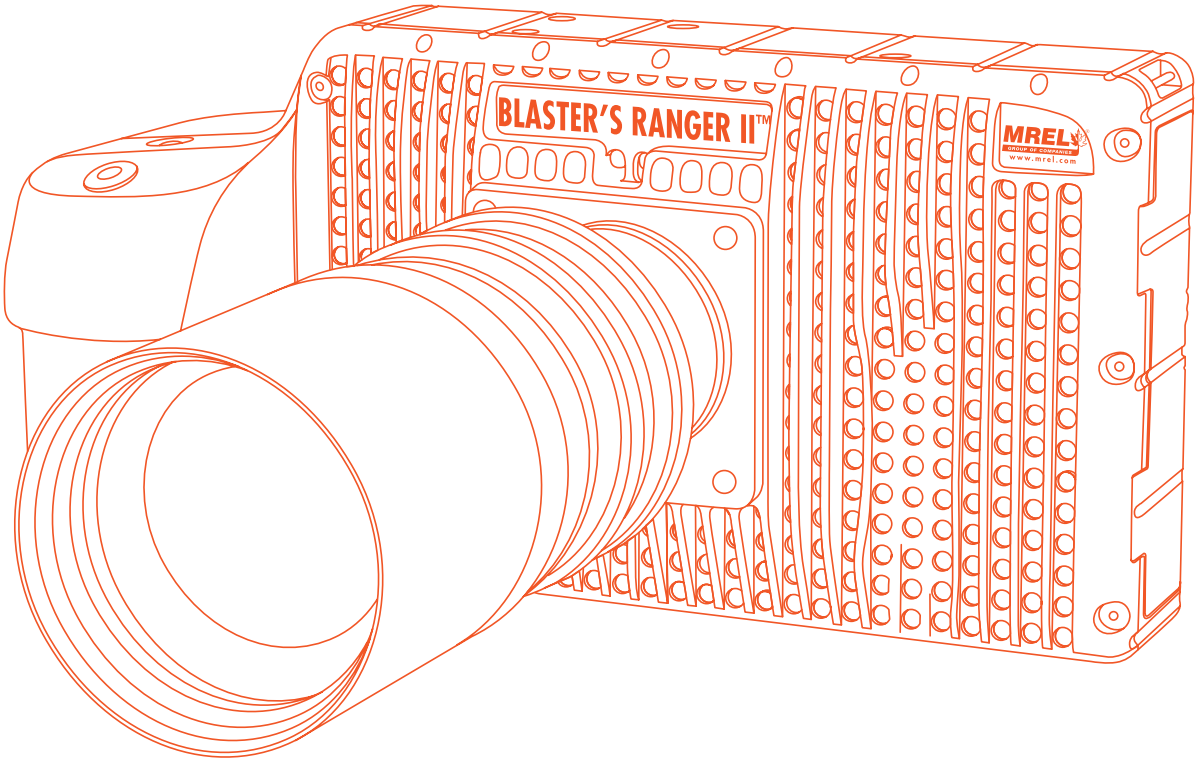
NOTE: For the "common" setup as well as for variations listed below, always make sure that the **Post Trigger** portion of the recording time for the **Master** camera is equal to or greater than each of the **Slave** cameras. This is important because **Sync Out** pulses cease with the completion of the capture, so the **Master** camera must continue recording until all **Slave** cameras complete their recordings.

Parameters that affect post trigger recording time include: **Trigger position**, **Resolution**, **Bit depth**, base internal Memory (camera model), **Framerate**.

Variations on Master/Slave:

- Use a slower framerate for one or more of the slave cameras by using a **Rate Divisor** in the **Sync-In** setup. (Make sure to make allowance for the extended time per the note above.)
- Extend the overall record time by adjusting the trigger position for all cameras. For example, set the **Master** to a **Start trigger**, the first **Slave** to 10%, the second **Slave** to 50%, etc. This would also be used if the subject is progressing through the different cameras' fields of view, as a runner running by each camera in sequence.
- Run cameras out of phase with each other. Higher effective frame rates can be simulated by running cameras out of phase with each other. This is usually done by using **Duty Cycle** in **Sync Out**, for example: if you set the **Duty Cycle** for 50% and invert the signal, the next camera in line will run 180 degrees out of sync.

Chapter 5
Field Operations



Overview

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

5.1 Introduction

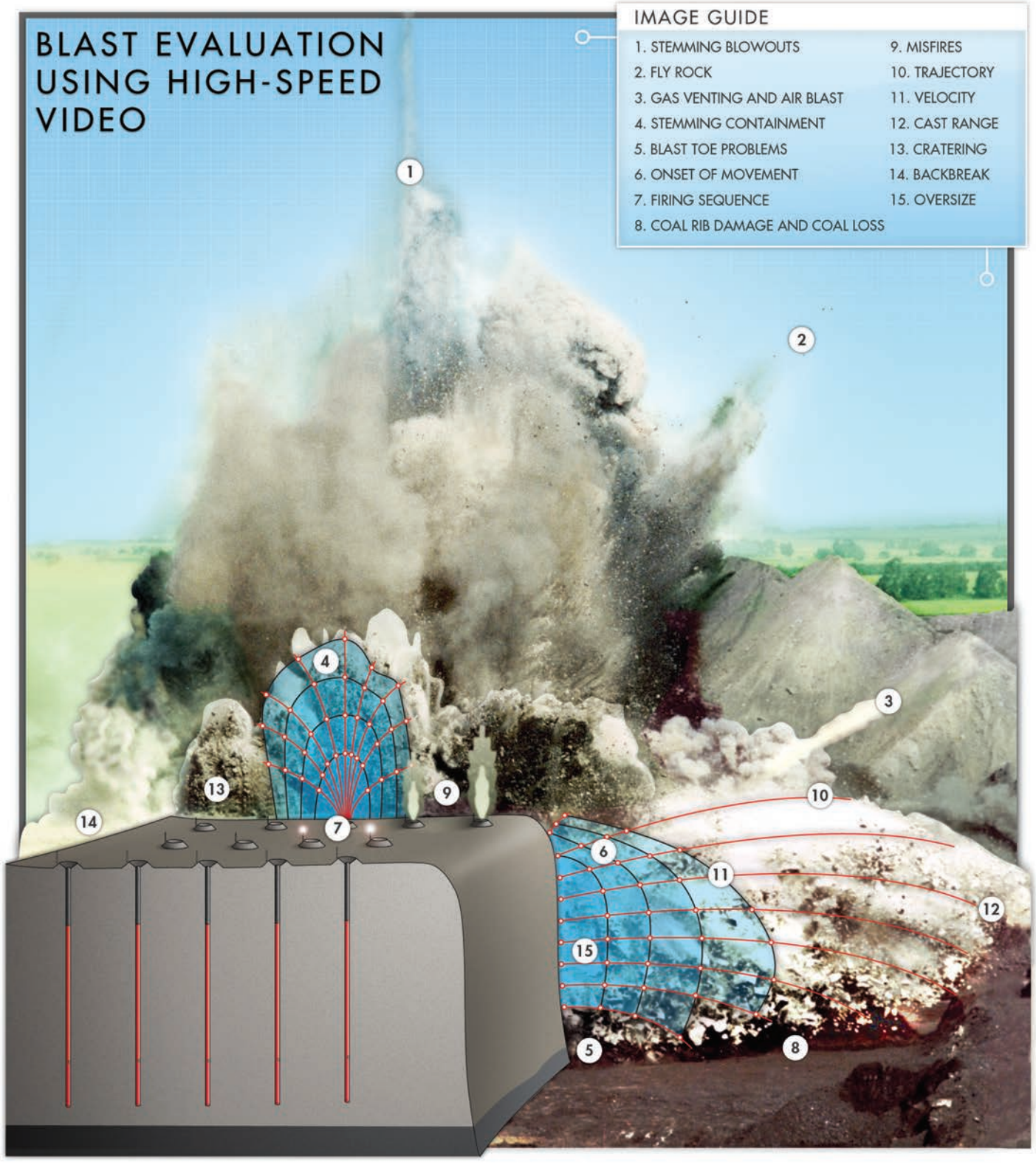
High speed photography has proven to be a very useful tool in the field. High speed photography can provide valuable information for troubleshooting and feedback for blast design.

Typical **Frame Rates** for capturing open pit blasts range from **250 - 1000 fps** for the reason that satisfactory

- 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 gas venting
- Assessment of the locations responsible for flyrock or other projectiles
- Evaluation of the extent of backbreak
- Determination of the location, time, and duration of nitrogen oxide emissions
- **Sensor Fusion™** Combinatory analysis of video data with VOD data or other sensors allows live visualization of issues perceived from other data acquisition methods such as those captured by the **MREL DataTrap II™** or **MREL MicroTrap™**.

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

Figure 35: High Speed Photography Application



5.2 Selecting a Camera Position

The position of the **Blaster's Ranger II™** is very important. It can sometimes be difficult to select an ideal location due to a lack of suitable elevation above the height of the blast, or obstructions in the line of sight. This can usually be overcome by careful combination of a suitable location and **Lens** parameters. When selecting a location it is of utmost importance to ensure the safety of all personnel on-site, and to ensure the survivability of instrumentation.

MREL always recommends the use of proper sheltering from flyrock to protect the **Blaster's Ranger II™** from damage. The User has the option of using a **Remote Trigger,** triggering, or a trigger that is associated with the blast event (i.e. a **Make Trigger** wrapped over the end of a detonator). If the User intends to trigger the recording manually, the push-button trigger device is available from MREL with any desired length of cabling.

Finally, the location should also ensure that during the blast, the first boreholes to fire do not obscure the line of sight of other boreholes. For this reason, it is best to choose a location so that the first boreholes are at the opposite end of the blast from the **Blaster's Ranger II™**.

For observation of surface movement, the **Blaster's Ranger II™** should be positioned behind the blast so that rock movement does not obstruct the view of the surface of the bench. For observation of the free face of the bench, position the **Blaster's Ranger II™** directly in front of the face, at a safe distance and preferably at an elevated location. For typical overall analysis of a bench blast, position the camera in front and to the side of the blast, at an elevated location a safe distance from the free face.

To analyze face velocities, the **Blaster's Ranger II™** should be located to the side of the blast, parallel with the free face. Brightly colored targets should be used as reference points for measuring distance in the **ProAnalyst® Introductory Edition Motion Analysis Software** when the sequence is being analyzed. These markers should be positioned exactly perpendicular to the line of sight of the **Blaster's Ranger II™** and the distance of separation from marker to marker should also be known exactly. This will allow for convenient and accurate velocity measurement. Remember to use markers that are easily visible at distance (vivid colors, generally one square foot or larger). Targets should be three-dimensional as they are likely to rotate out of orientation during the blast. Pay special attention to to targets that are lowered from the free face, so as they are correctly positioned and are able to snap free from their suspension when the face begins to heave.

5.3 Field Setup

5.3.1 System Setup

The **Blaster's Ranger II™** has been designed to assembly quickly and easily in the field. The complete setup of the system is detailed in **Chapter 3**.

1. Setup the **Tripod**.
2. Connect the **Mounting Adapter** to the Lens and attach the assembly to the **Grip Action Ball Head**.
3. Attach the **Lens** to the **Blaster's Ranger II™**.
4. Attach the **Trigger Switch** (or other trigger) to the **Trig In** connector of the **Blaster's Ranger II™** through the **Blaster's Ranger II™ I/O cable**.
5. Attach the appropriate power supply adapters (AC or DC) to the **Blaster's Ranger II™** through the power supply source (120/240 VAC, or 12 VDC battery) if desired. The camera has its own internal battery that can be utilized.

   If the **Tripod** is unstable, it is suggested that a weighted object be suspended from the center of the **Tripod**. The **Tripod** legs should be set as short as possible to increase stability and to mitigate camera movement as a result of ground vibration.

5.3.2 Power Supply Options

The **Blaster's Ranger II™** camera can be powered for 3 hours from its internal battery. If more time is required, an external power source can be attached.

If no AC power is available, the **Blaster's Ranger II™ DC Power Adaptor** has been provided with alligator clips to connect to a typical **12 VDC Lead-Acid Battery**. These batteries are very common and can be found in most passenger vehicles.

If AC power, such as a generator or a power inverter is used, then the **Blaster's Ranger II™** can be powered through the **Blaster's Ranger II™ AC Power Adapter**.

5.3.3 Camera Setup

Set up the **Resolution**, **Recording Speed**, **Shutter Time** and other parameters.

NOTE: Changes of **Resolution** or **Frame Rate** may alter the quality of recorded images. Now the new parameters will be sent to the **Blaster's Ranger II™**. All other parameters e.g. shutter time or analog gain, will be sent immediately to the **Blaster's Ranger II™** after entering. If there is no connection to the **Blaster's Ranger II™**, an error message will appear. Please make sure the **Blaster's Ranger II™** is connected correctly.

1. Navigate to the **Record Settings**, select **Settings Sub-Menu** and set the resolution and speed desired. At 1000 fps, the resolution needs to be **1280x1014** or **800x600**, can not be set to **1280x1024**. If the resolution was **1280x1024**, and you want to set the speed to 1000 fps, you need set the resolution lower first, then set the recording speed.
2. Navigate to the **Record Shutter Speed** Sub-Menu and set the desired exposure.
3. Navigate to the **Control Menu**, **Trigger Position** Sub-Menu and set the desired **Trigger point**. Select **Ext. Trigger**. Make sure it is **Enabled**. If **Disabled**, click on the **Disabled** button. It will turn green and the text will change to **Enabled**.
4. Frame and focus the scene.
5. Press the **Arm Button** to begin recording pre-trigger frames. The camera settings will be locked in. If you wish to abort the recording to change settings, press the **Arm Button** again.

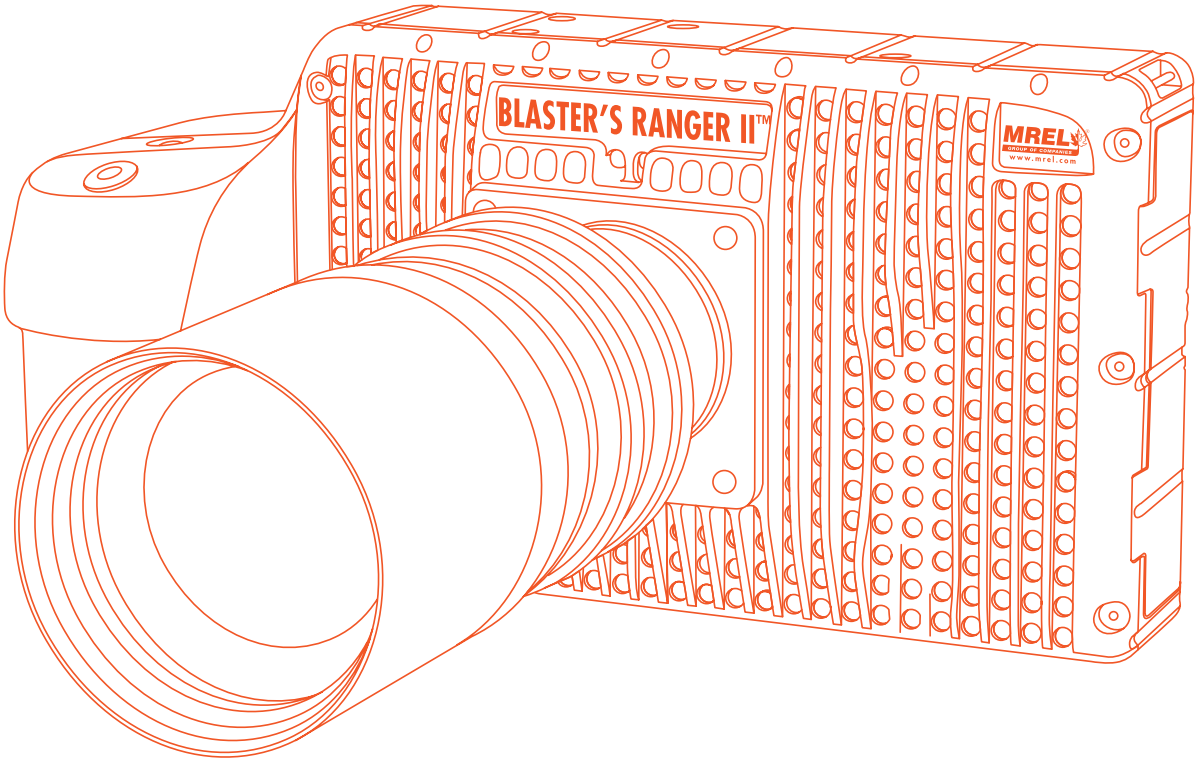
NOTE: The camera may remain Armed for an indefinite period of time because it is overwriting its circular buffer, it never runs out of space, but only retains the newest images.

6. Trigger the camera via the **Trigger Switch** cable attached to complete the recording. The **Blaster's Ranger II™** will enter **Review mode** when finished recording unless it is set to **Autosave**, in which case the camera will download the recording, then revert to **Armed Mode**.
7. Use the playback icons to play forward, backward, or jump to points of interest in the movie. Use the **Cut In** and **Cut Out** icons to select a portion of the movie to review or save.
8. Save video from **Image Memory**. Select the **Save Icon** from the playback controls. This will bring up a dialog that allows selection of the following: Start and Stop points of the clip.
9. Select the destination to save the movie. Choices include the optional built-in **SSD**, an **SD Card** or a **USB drive**.
10. Set the file Format to AVI. When the movie clip is set up as desired, press the **Save** icon on the **Save** dialog. A new dialog will open with the heading **Copy** in Progress. This dialog indicates the status of the file save operation.
11. When the file save is complete, the dialog will display a message indicating **Copy** completed successfully.
12. Press the **OK** icon to set the camera back into **Review Mode**.
13. Click on the **Live button** to put the camera back into Live Mode. From here a new recording can be made or the camera's configuration can be changed.

IMPORTANT

The **Blaster's Ranger II™ Camera** image memory is volatile memory and images will be lost if a new recording is initiated or the **Blaster's Ranger II™ Camera** is powered off . Be sure to save important videos before initiating a new recording or turning off the **Blaster's Ranger II™ Camera.**

Chapter 6
Using the Blaster's Ranger II™ with a PC



Overview

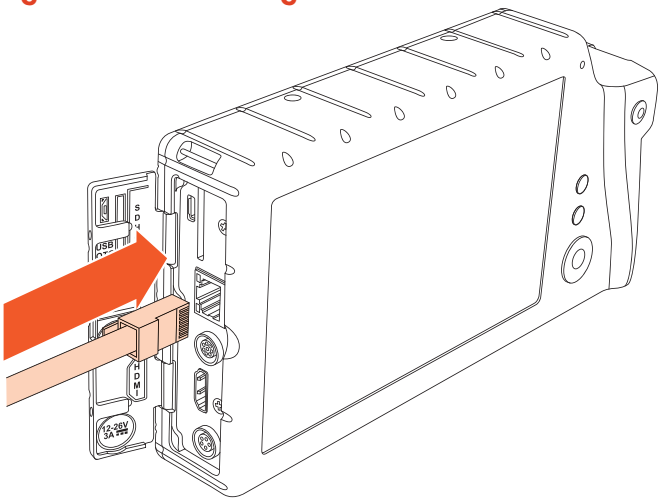
This Chapter provides the outline how to connect a PC to the Blaster's Ranger II™.

6.1 Connecting to a PC via Ethernet

The **Blaster's Ranger II™** may be connected to a PC using the **USB-OTG** connection, (Refer **Section 2.1.4**) or via the **Gig-E port**. While the **USB-OTG** connection is extremely useful for file transfers, an **Ethernet** connection has two major advantages:

1. It can be used to control the camera via the built-in **Web Application** or a **Custom Application**.
2. The camera and PC need not to be physically close to each other as with the **USB-OTG** connection, which is dependent on cables that are limited in length (generally less than 4.5m).

Figure 36: Attaching the Ethernet Cable



6.1.1 Benefits of Blaster's Ranger II™ Ethernet Connectivity

1. Once connected to a network, the **Blaster's Ranger II™** may be accessed for file transfer and camera operation (including live views, recording, reviewing, etc.) by any PC on the network. Multiple cameras may be accessed and controlled on a network.
2. Using the camera's **Web Application** (built into the camera) any PC that has network access to a camera can control it without installing any software. This works with popular web browsers such as **Google Chrome** and **Mozilla Firefox**.

Figure 37: Network Menu

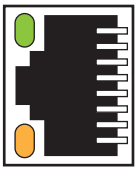
6.1.2 Setting up Networking on the Camera

The **Blaster's Ranger II™**'s **Networking** settings may be configured manually or using **DHCP**. When shipped the cameras are set for **DHCP**.

To change the settings:

1. Navigate to the **System Menu**.
2. Select **Network**.
3. Choose between **DHCP** or **Static**. Choose **DHCP** if the camera will be placed on a network with a **DHCP** server running on it. Choose **Static** if the camera and any PCs used to access it are manually configured.

Table 10: Network LEDs

LEDs on RJ-45 Connector		Camera Networking LED
		
Green (Connection)	Amber (Activity)	Amber (Activity)
1 Blink = 10Mb	Blinks for all network activity	Blinks for camera network activity only
2 Blinks = 100Mb		
3 Blinks =1Gb		

6.1.3 Autoconfiguration

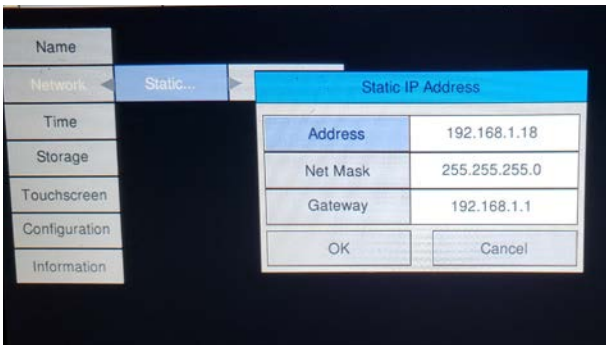
If the **Blaster's Ranger II™** is configured for **DHCP** and it does not find a server, it will autoconfigure itself with an IP address 169.254.xx.xx.

Most PCs will do the same. So, most of the time, if the **Blaster's Ranger II™** is configured for **DHCP** and you connect it to a PC that is also configured for **DHCP**, they will automatically connect without any further configuration.

If you choose to manually configure the network settings, there is a dialog box that opens to allow typing in the IP Address, Subnet Mask, and Gateway. (If **Touchscreen** is enabled, you will be able to use it with the alphanumeric keyboard for input of these values.)

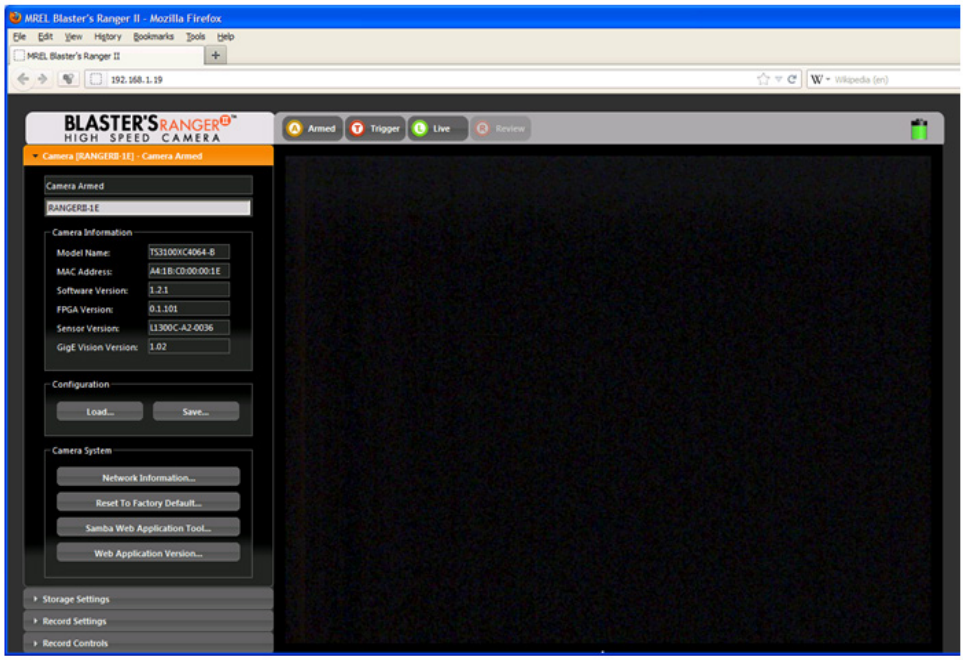
If you are unsure of these settings, please consult your network administrator.
If you need the MAC address of the camera, it is listed in System/Information/Status.

Figure 38: Static IP Dialog Box



6.2 Using the Blaster's Ranger II™ with a PC

Figure 39: Web Browser Screen



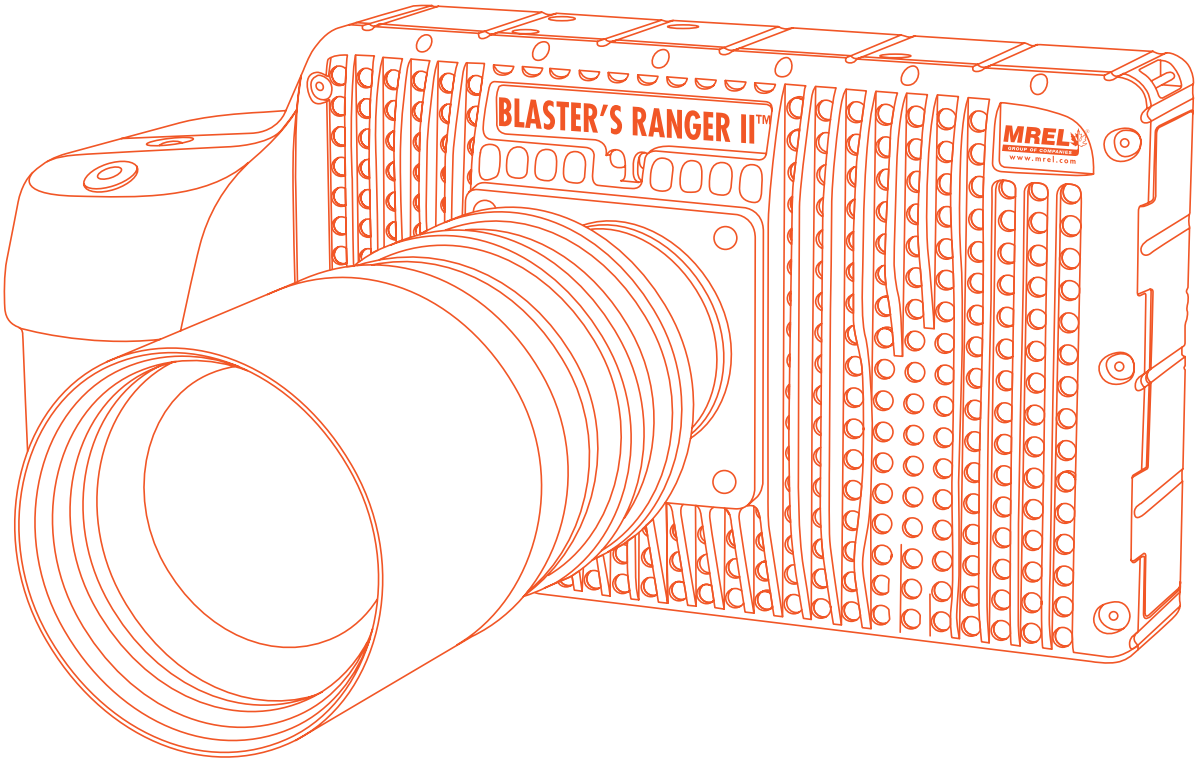
To open the Networked **Blaster's Ranger II™** in a Web browser to use the **Blaster's Ranger II™ Web App**:

Open a web browser on the PC. Of the available web browsers, **Google Chrome** has the best performance when using the **Web App**.

Type the camera's IP address or camera name into the browser's Location bar.

A camera control application within the camera does the rest. A control menu will appear in your browser that will give a live camera view and complete control over the camera operation.

Chapter 7
ProAnalyst® Introductory Edition Software



7.1 About ProAnalyst® Introductory Edition

ProAnalyst® Introductory Edition allows auto-tracking of one feature and/or manually tracking of up to 32 features. Will allow the User to 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**. **ProAnalyst® Professional Edition** 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 **ProAnalyst® Professional Edition**.

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

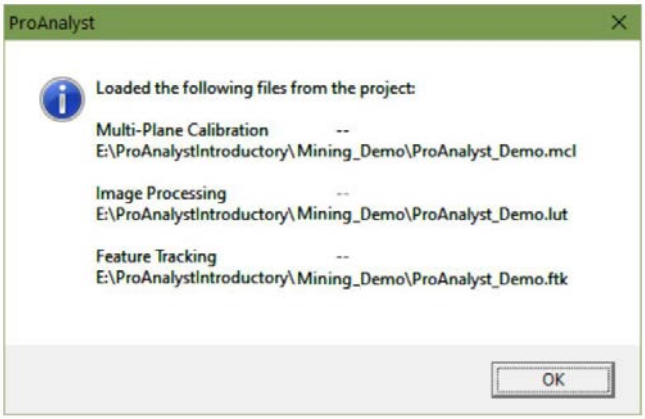
Now you can open **ProAnalyst® Introductory Edition**, and find the **ProAnalyst® Introductory Edition Reference Guide** from the menu **Help**, or the User can follow the instructions in the **Getting Started Guide** and **User Guide** to do the video analysis.

7.2 Example Demonstration File Explanation – Mining Example

This Mining example is for the purpose of learning **ProAnalyst® Introductory Edition**. The example file can be found in the Mining_Demo directory.

This example file was captured at **250** frames per second. The calibration of the video is as shown in the calibration tab with the distance between the two green markers is **12** meters. This summary is **ONLY** describing the items directly used for this example. All other functions within the software, please refer to the manual that came with the software.

- Open **ProAnalyst® Introductory Edition**. Select File, Open Project…
- Navigate to the directory where the files are stored and select Mining_Demo.mpj then click Open.
- The project file will open into its window with the file called Mining_Demo.
- Right click on the video file and the window below will open.
  - Click on === Load All Associated Files for This Video ===



- This will load all of the data files associated with the example.
  When the file opens, it will have loaded a **Multi-Plane Calibration** file (.mcl), **Image Processing file** (.lut) and a **Feature Tracking file** (.ftk) as shown below with the directory tree.
- Once the operator clicks **OK**, the window can be maximized with the video.
- To confirm the frame rate in entered into the software correctly, right click on the video and select **Modify Recorded Parameters**. This will allow the user to calibrate the time of the video. The user can also modify in this menu the used shutter speed and the modification of the zeroth frame.
- With the window maximized, the user will notice along the left edge of the video there are three tabs: **Raw**, **Processed** and **Thumbnail**.
  - The **Raw** tab is the original video with no modification which will be, in this example, the original coloring.

- The **Processed** tab is same video with the Image Processing applied.
- The **Thumbnail** tab is the video with thumbnails at particular points in the video.
  - Pressing **Z** decreases the size of the thumbnail while **A** increases the size.
  - Pressing **X** decreases the time between thumbnails while **S** increases the time.
- On the right side of the frame is a vertical tab of items to be used to perform the measurements required.

In order from the top to bottom: **Image Processing, Image Filtering, Multi-Plane Calibration, Display Layers, Notes, Annotations, Feature Tracking, Graph Configuration, Save All Associated Toolkits.** All of the changes will only be visible in the **Processed** tab because the **Raw** tab will remain unchanged.

In **Introductory Edition**, only some of the tabs can be used to manipulate the video, but can open all of the modifications from other versions of **ProAnalyst®**.

7.2.1 Image Processing 

Allows the operator to change the color of the video which includes the **Brightness**, **Contrast**, **Gamma and Exponential** / **Logarithmic**.

Below the sliders, the buttons can invert (reverse) the individual colors.

The **Convert to B&W** (Black and White) can change the color image to a grey scale. The sliders above the button can change the intensity of the individual colors. Once in **B&W**, the sliders below will be able to be changed as above.

The **Load** and **Save** buttons will load a previously saved **Image Processing file** (*.lut) while **Save** will generate a lut file from the current settings.

The Reset All will return all of the setting to the default location.

7.2.2 Multi-Plane Calibration 

This tab will allow the user to calibrate the video file.

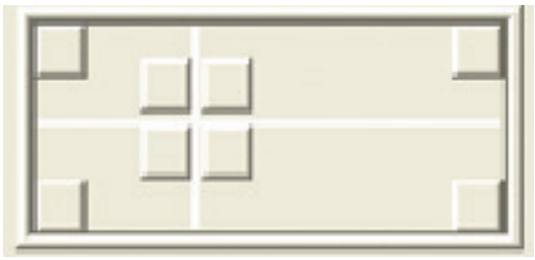
The software needs to relate the number of pixels to a known distance. The **Introductory Edition** can not use a perspective calibration as can the other versions of the software.

The Normal calibration can be performed within the **Introductory Edition**. A Normal calibration is able to measure items that move at right angles to the camera view.

To add a calibration, click on **Add Normal** and another line item will appear on the screen. Throughout this software package a standard convention will repeat. For example, on the calibration line on the right, there is an eye either open or closed. If the eye is open, the object is visible on the screen. If the eye is closed, the object will not be shown on the screen.

The wrench to the right of the eye will open a configuration menu. In the calibration wrench menu, it is labeled as Calibration # Settings where # is the number of the calibration. When the operator clicks on the screen, the reticle (cross hair) will move to the position clicked. If the operator then clicks on **Set Point #1**, the first point of the calibration will be set. The second point can be selected in a similar method. After the two points are selected, the user can enter the value between the two points selected and then select the units of measurement of the number from the pull down menu. After the units are selected, the **Apply Scale >>** button **MUST** be clicked. This will change the box beside the button to xx pixels/"units selected".

The origin of the coordinate system can be set in a similar method. Point the reticle to point were the operator requests the coordinate origin to be (0,0). This will be the reference point for all of the measurements. After the origin is set, the orientation of the axes must be set. As shown below, each of the buttons in the picture will set the orientation of the axes.



Each of the corner buttons will set the origin of the coordinate system in the respective corner. The positive orientation of the two axes will be along the edge of the frame. For example, the top left button will set positive X direction to the right and the positive Y direction down while the bottom right button will set the positive X direction to the left and the positive Y direction up. The four buttons around the reticle will set the positive orientation around the button pressed from the reticle position. If the orientation of the X axis is not horizontal, from the origin of the coordinate system place the reticle on the horizontal line and then click Set X Direction. Once the Origin and positive axes are set, the user MUST click **Apply Origin and Tilt >>** button. After the button is clicked, the pixels (origin) will be displayed as well as the degrees (tilt).

The user MUST then click **Apply** to set the changes and then **Close**. The user can then remove calibrations if they were made in error.

7.2.3 Display Layers

This menu allows the user to change which layers are displayed and the information displayed on the screen.

7.2.4 Notes

This will allow the user to make notes on the video file. The area labeled Video Notes is information about the displayed frame while the Global Notes area pertains to the whole video.

7.2.5 Annotations

The tab allows the user to draw and place text on the video frame.

7.2.6 Feature Tracking

This tab will allow the user to track a point on the video.

In the top left of the tab, **Feature Tracking** must be enabled. If user can not change any other part of the menu structure, click on **Enable**.

The user needs to decide whether a **Manual** or **Automatic mode** will be used to track an object.

In **Manual Mode**, the operator will manually select each and every point that will be used in the calculations. In **Manual Mode**, less video manipulation (Image Processing) is required because the human eye can distinguish the difference when tracking an object better than a computer algorithm. The operator can switch between **Manual** and **Automatic** while tracking a single object. When the user is in **Manual mode**, the user can click on **Add** and add a feature that can be used to track an object. This is the simplest way to track. Click to place the reticle on the object the user wishes to track and click **Set Point**. This needs to be done in every frame the operator wishes to track. This can be a long and tedious task if a lot of frames need to be

In **Automatic Tracking**, a feature can be added just as in Manual tracking but now the user needs to define a region of the video that they wish to track by clicking **Define Region** and drawing a rectangle around the object. The way that the user can select an area, the computer is looking for that exact defined area in the next frame. Therefore, the user should try to select an object that stays defined throughout the time of interest. This is where the Image Processing is very important to help distinguish the tracking object from the background image.

Within **Introductory Edition**, the user only can use the **Image Processing** while **Image Filtering** is not available. Once the user can separate the tracked object from the background and the area around the object has been defined and set, the grey box will turn a shade of cyan.

After the user clicks of the wrench, the settings box opens. The operator needs to give the **Feature** a name that makes sense for future reference. Then the correct **Calibration** needs to be selected from the pull down menu.

Within the Search Parameters section, the **Search Region Multiplier (%)** is the increased search area around the defined region. This area can be displayed around the defined area by right clicking on the video, **Feature Tracking> Show Search Regions.** This is the area that the **Defined Region** is looked for in the next frame of the video.

The larger the area, the larger the possibilities of the Automatic Tracking will follow something else in the area.

Too small of an area and the tracked object may not be within the area in the next frame.

The **Threshold Tolerance (0.0 – 1.0)** is the type of match from frame to frame where 1.0 is a perfect match. Normally, the tolerance is between 0.75 and 0.95. The **Frames to Search After Loss** is the number of frames the software will look ahead if it has lost the tracked object. Normally, it is set to 0.

The other important setting is the **Feature Rotation**. If the tracked object is rotating in the frame the software can loose the Automatic Track on the object. The operator can Enable and set the **Angular Range (deg)** to the maximum expected rotation between two frames. This is a positive as well as the negative rotation angle. The **Step Size (deg)** is the number of degrees between the iterations. The larger the number, the higher the possibility of missing the object, while too small of a number will take a long time to process.

The **Show Points** selection will display on the video the points.

7.2.6.1 Show All

Display every point created.

7.2.6.2 Show Past

Display only past point created in the video.

7.2.6.3 Show Current

Display only the current point.

7.2.6.4 Show None

This will not display any points.

7.2.7 Under the Tracking Box

The buttons from left to right are: **Track Backwards**, **Track One Frame Backwards**, **Stop**, **Track One Frame Forward** and **Track Forward**.

The software takes an image of the **Defined Region** when the **Set Region** button is pressed. At some points, the **Automatic Tracking** may loose the item of interest, the user **MUST** stop the tracking by pressing the middle Tracking button and play the video back (not track backwards) to the point of the tracking failing and reset the **Set Region**.

The operator can then continue the track in the same direction (forward or backwards) and the previously tracked points will move to the new location.

Once the object is tracked, the lock between the eye and the wrench should then be closed (to the locked position) to avoid and changes to the points.

The **Units & Export** section will allow the user to select the units to export the data to as well as the form that the file will be.

In this example, the setup was Meters and Text. The text file was placed in the same directory labeled **ProAnalyst_Demo.txt**.

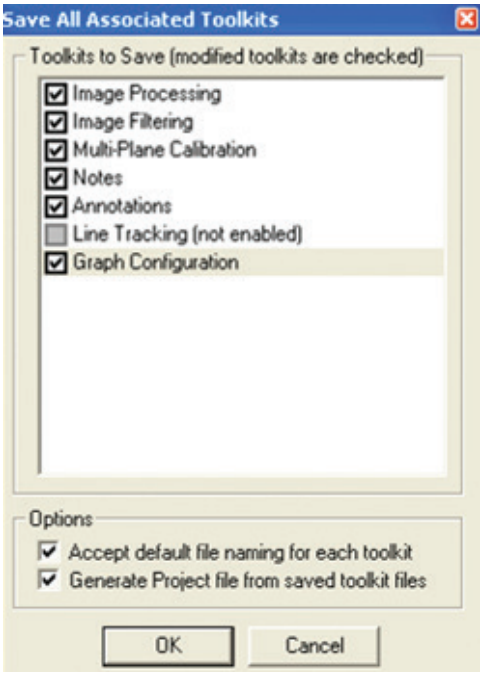
The Introductory Edition does not offer graphing, therefore, for this example the data was imported and graphed in Excel. The file is labeled as **ProAnalyst_Demo.xls**.

7.2.8 Save All Toolkits

After all of the analysis has been performed, it is very important to associate the files to the video. This will allow in the future, opening the analyzed video as easily as this example. It is important to select all of the boxes because the software will save everything.

The bottom two boxes under **Options** are also very important because the file names will be the same as the video file name. This will make it easier for the user in the future.

The Generate Project is also very important because it will be the overall association. This is the *.mpj file which will keep everything neat and tidy.



7.3 Excel Spreadsheet – Mining_Demo.xls

This spreadsheet was generated from the exported file from **ProAnalyst® Introductory Edition**. On the first sheet (Mining_demo) displays the data from the text file with a Red shading. Everything with the Red shading of the cell was imported from the **ProAnalyst®** text file. All of the white (unshaded) cells were calculated within Excel.

7.3.1 Explanation of the Unshaded Cells

Feature 1 Values:

Since the values of X and Y start at zero, there is no requirement to correct them back to zero.

Feature 1 (Top_Marker) Vector (column E): This column is the vector sum of the X and Y.
Equation: E# = √ (C#2 + D#2) where # is the current cell in the E column

The Graphs tab has all of the measurements in a graphical solution.

The graph on the left is the final solution produced by MREL to show the user what a completed graph could look like. The two white lines and text boxes were manually generated by hovering the cursor over the graph to record the values. This can be done on the graph on the right.

The points used in this example are:

Lower Line:
Point #1: (0.984, 2.034001316)
Point #2: (1.600, 9.266355494)
Therefore, the average velocity between these two points is:

Velocity = (9.266355494 – 2.034001316) meters / (1.600 - 0.984) second = 7.232254178 / 0.616 = 11.74 m/s

Upper Line:
Point #1: (1.656, 9.650500598)
Point #2: (2.956, 23.96412087)

Therefore, the average velocity between these two points is:

Velocity = (23.96412087 – 9.650500598) meters / (2.956 - 1.656) second = 14.3162027 / 1.300 = 11.01 m/s

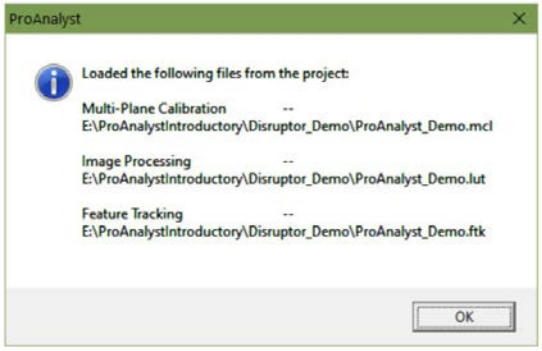
Two lines were chosen because of the 'bump' in the data graph near 1.6 seconds. As well, the slope of the line needs to match the data.

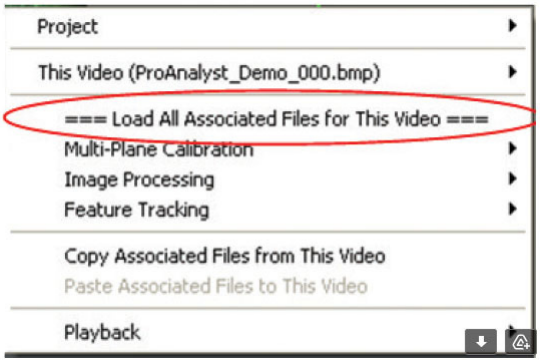
7.4 Example Demonstration File Explanation – Disrupter Example

This Mining example is for the purpose of learning **ProAnalyst® Introductory Edition**. The example file can be found in the Disrupter_ Demo directory.

This example file was captured at 1000 frames per second. The calibration of the video is as shown in the calibration tab with the distance from the edge of the blue container to the third sensor (which is a third of the distance from the tip to the pole) is 5 meters. This summary is ONLY describing the items directly used for this example. All other functions within the software, please refer to the manual that came with the software.

- Open **ProAnalyst® Introductory Edition**. Select File, Open Project…
- Navigate to the directory where the files are stored and select ProAnalyst_Demo.mpj then click Open.
- The project file will open into its window with the file called ProAnalyst_Demo_000.bmp.
- Right click on the video file and the window below will open.





  - Click on === Load All Associated Files for This Video ===
- This will load all of the data files associated with the example. When the file opens, it will have loaded a **Multi-Plane Calibration** file (.mcl), **Image Processing file** (.lut) and a **Feature Tracking file** (.ftk) as shown below with the directory tree.
- Once the operator clicks **OK**, the window can be maximized with the video.
- To confirm the frame rate in entered into the software correctly, right click on the video and select **Modify Recorded Parameters**. This will allow the user to calibrate the time of the video. The user can also modify in this menu the used shutter speed and the modification of the zeroth frame.
- With the window maximized, the user will notice along the left edge of the video there are three tabs: **Raw**, **Processed** and **Thumbnail**.
  - The **Raw** tab is the original video with no modification which will be, in this example, the original coloring.
  - The **Processed** tab is same video with the Image Processing applied.
  - The **Thumbnail** tab is the video with thumbnails at particular points in the video.
    - Pressing **Z** decreases the size of the thumbnail while **A** increases the size.
    - Pressing **X** decreases the time between thumbnails while **S** increases the time.
- On the right side of the frame is a vertical tab of items to be used to perform the measurements required.

In order from the top to bottom: **Image Processing, Image Filtering, Multi-Plane Calibration, Display Layers, Notes, Annotations, Feature Tracking, Graph Configuration, Save All Associated Toolkits.** All of the changes will only be visible in the **Processed** tab because the **Raw** tab will remain unchanged.

In **Introductory Edition**, only some of the tabs can be used to manipulate the video, but can open all of the modifications from other versions of **ProAnalyst®**.

7.4.1 Image Processing

Allows the operator to change the color of the video which includes the **Brightness**, **Contrast**, **Gamma and Exponential** / **Logarithmic**.

Within this example, the user will notice that the individual colors can be adjusted be double clicking on the slider in question.

Below the sliders, the buttons can invert (reverse) the individual colors.

The **Convert to B&W** (Black and White) can change the color image to a grey scale. The sliders above the button can change the intensity of the individual colors. Once in **B&W**, the sliders below will be able to be changed as above.

The **Load** and **Save** buttons will load a previously saved **Image Processing file** (*.lut) while **Save** will generate a lut file from the current settings.

The Reset All will return all of the setting to the default location.

7.4.2 Multi-Plane Calibration

This tab will allow the user to calibrate the video file.

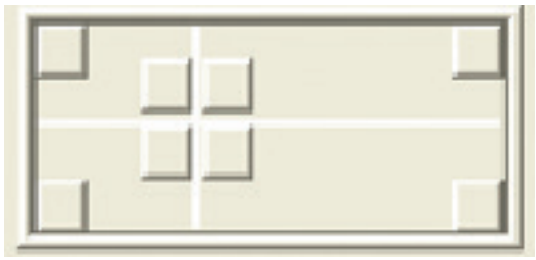
The software needs to relate the number of pixels to a known distance. The **Introductory Edition** can not use a perspective calibration as can the other versions of the software.

The Normal calibration can be performed within the **Introductory Edition**. A Normal calibration is able to measure items that move at right angles to the camera view.

To add a calibration, click on **Add Normal** and another line item will appear on the screen. Throughout this software package a standard convention will repeat. For example, on the calibration line on the right, there is an eye either open or closed. If the eye is open, the object is visible on the screen. If the eye is closed, the object will not be shown on the screen.

The wrench to the right of the eye will open a configuration menu. In the calibration wrench menu, it is labeled as Calibration # Settings where # is the number of the calibration. When the operator clicks on the screen, the reticle (cross hair) will move to the position clicked. If the operator then clicks on **Set Point #1**, the first point of the calibration will be set. The second point can be selected in a similar method. After the two points are selected, the user can enter the value between the two points selected and then select the units of measurement of the number from the pull down menu. After the units are selected, the **Apply Scale >>** button **MUST** be clicked. This will change the box beside the button to xx pixels/"units selected".

The origin of the coordinate system can be set in a similar method. Point the reticle to point were the operator requests the coordinate origin to be (0,0). This will be the reference point for all of the measurements. After the origin is set, the orientation of the axes must be set. As shown below, each of the buttons in the picture will set the orientation of the axes.



Each of the corner buttons will set the origin of the coordinate system in the respective corner. The positive orientation of the two axes will be along the edge of the frame. For example, the top left button will set positive X direction to the right and the positive Y direction down while the bottom right button will set the

positive X direction to the left and the positive Y direction up. The four buttons around the reticle will set the positive orientation around the button pressed from the reticle position. If the orientation of the X axis is not horizontal, from the origin of the coordinate system place the reticle on the horizontal line and then click Set X Direction. Once the Origin and positive axes are set, the user MUST click **Apply Origin and Tilt >>** button. After the button is clicked, the pixels (origin) will be displayed as well as the degrees (tilt).

The user MUST then click **Apply** to set the changes and then **Close**. The user can then remove calibrations if they were made in error.

7.4.3 Display Layers 

This menu allows the user to change which layers are displayed and the information displayed on the screen.

7.4.4 Notes 

This will allow the user to make notes on the video file. The area labeled Video Notes is information about the displayed frame while the Global Notes area pertains to the whole video.

7.4.5 Annotations 

The tab allows the user to draw and place text on the video frame.

7.4.6 Feature Tracking 

This tab will allow the user to track a point on the video.

In the top left of the tab, **Feature Tracking** must be enabled. If user can not change any other part of the menu structure, click on **Enable**.

The user needs to decide whether a **Manual** or **Automatic mode** will be used to track an object.

In **Manual Mode**, the operator will manually select each and every point that will be used in the calculations. In **Manual Mode**, less video manipulation (Image Processing) is required because the human eye can distinguish the difference when tracking an object better than a computer algorithm. The operator can switch between **Manual** and **Automatic** while tracking a single object. When the user is in **Manual mode**, the user can click on **Add** and add a feature that can be used to track an object. This is the simplest way to track. Click to place the reticle on the object the user wishes to track and click **Set Point**. This needs to be done in every frame the operator wishes to track. This can be a long and tedious task if a lot of frames need to be

In **Automatic Tracking**, a feature can be added just as in Manual tracking but now the user needs to define a region of the video that they wish to track by clicking **Define Region** and drawing a rectangle around the object. The way that the user can select an area, the computer is looking for that exact defined area in the next frame. Therefore, the user should try to select an object that stays defined throughout the time of interest. This is where the Image Processing is very important to help distinguish the tracking object from the background image.

Within the **Introductory Edition**, the user only can use the **Image Processing** while **Image Filtering** is not available. Once the user can separate the tracked object from the background and the area around the object has been defined and set, the grey box will turn a shade of cyan.

After the user clicks of the wrench, the settings box opens. The operator needs to give the **Feature** a name that makes sense for future

reference. Then the correct **Calibration** needs to be selected from the pull down menu.

Within the Search Parameters section, the **Search Region Multiplier (%)** is the increased search area around the defined region. This area can be displayed around the defined area by right clicking on the video, **Feature Tracking> Show Search Regions.** This is the area that the **Defined Region** is looked for in the next frame of the video.

The larger the area, the larger the possibilities of the Automatic Tracking will follow something else in the area.

Too small of an area and the tracked object may not be within the area in the next frame.

The **Threshold Tolerance (0.0 – 1.0)** is the type of match from frame to frame where 1.0 is a perfect match. Normally, the tolerance is between 0.75 and 0.95. The **Frames to Search After Loss** is the number of frames the software will look ahead if it has lost the tracked object. Normally, it is set to 0.

The other important setting is the **Feature Rotation**. If the tracked object is rotating in the frame the software can loose the Automatic Track on the object. The operator can Enable and set the **Angular Range (deg)** to the maximum expected rotation between two frames. This is a positive as well as the negative rotation angle. The **Step Size (deg)** is the number of degrees between the iterations. The larger the number, the higher the possibility of missing the object, while too small of a number will take a long time to process.

The **Show Points** selection will display on the video the points.

7.4.6.1 Show All

Display every point created.

7.4.6.2 Show Past

Display only past point created in the video.

7.4.6.3 Show Current

Display only the current point.

7.4.6.4 Show None

This will not display any points.

7.4.7 Under the Tracking Box

The buttons from left to right are: **Track Backwards**, **Track One Frame Backwards**, **Stop**, **Track One Frame Forward** and **Track Forward**.

The software takes an image of the **Defined Region** when the **Set Region** button is pressed. At some points, the **Automatic Tracking** may loose the item of interest, the user **MUST** stop the tracking by pressing the middle Tracking button and play the video back (not track backwards) to the point of the tracking failing and reset the **Set Region**.

The operator can then continue the track in the same direction (forward or backwards) and the previously tracked points will move to the new location.

Once the object is tracked, the lock between the eye and the wrench should then be closed (to the locked position) to avoid and changes to the points.

The **Units & Export** section will allow the user to select the units to export the data to as well as the form that the file will be.

In this example, the setup was Meters and Text. The text file was placed in the same directory labeled **ProAnalyst_Demo.txt**.

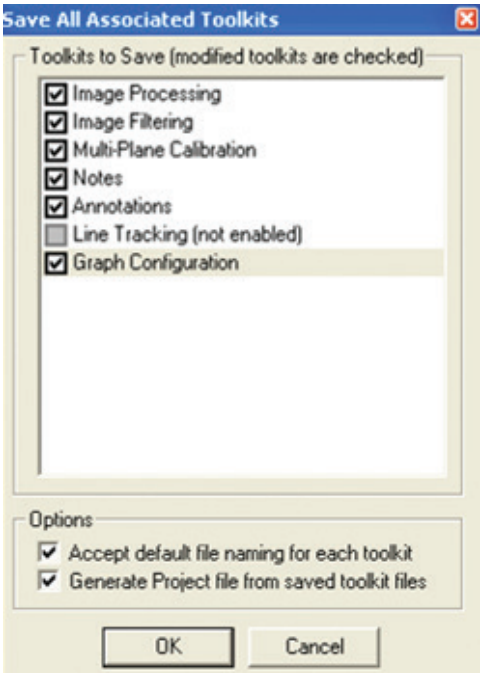
The Introductory Edition does not offer graphing, therefore, for this example the data was imported and graphed in Excel. The file is labeled as **ProAnalyst_Demo.xls**.

7.4.8 Save All Toolkits

After all of the analysis has been performed, it is very important to associate the files to the video. This will allow in the future, opening the analyzed video as easily as this example. It is important to select all of the boxes because the software will save everything.

The bottom two boxes under **Options** are also very important because the file names will be the same as the video file name. This will make it easier for the user in the future.

The Generate Project is also very important because it will be the overall association. This is the *.mpj file which will keep everything neat and tidy.



7.5 Excel Spreadsheet – ProAnalyst_Demo.xls

This spreadsheet was generated from the exported file from **ProAnalyst® Introductory Edition**. On the first sheet (ProAnalyst_Demo) displays the data from the text file with a Red shading. Everything with the Red shading of the cell was imported from the **ProAnalyst®** text file. All of the white (unshaded) cells were calculated within Excel.

7.5.1 Explanation of the Unshaded Cells

Feature 1 Values:

Feature 1 (Right_Side) X (corrected) (column D): This column is used to correct the offset of the data points from the origin of the coordinate system. Equation: D# = (C# - C12) where # is the current cell in the D column.

Feature 1 (Right_Side) Y (corrected) (column F): This is the same process as X (corrected).

Feature 1 (Right_Side) Vector (column G): This column is the vector sum of the X (corrected) and Y (corrected).
Equation: G# = √ (D#2 + F#2)

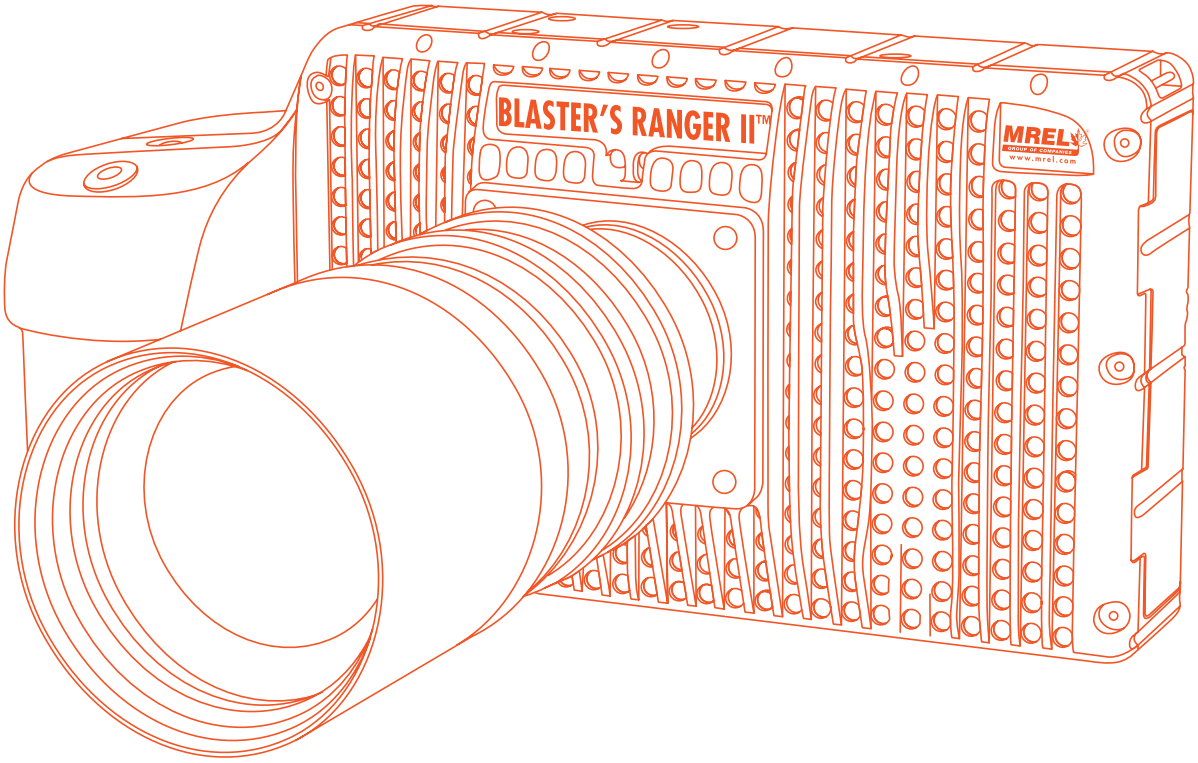
Feature 2 Values:

Feature 2 (Left_Side) X (corrected) (column J): This column is used to correct the offset of the data points from the origin of the coordinate system. Equation J# = (I# - I12)*(-1) where # is the current cell in the J column. The values are required to be multiplied by negative 1 (-1) because the coordinate system was defined with Positive X to the right, the left side positive motion is to the left. The other solution is to define another calibration for the Left_Side measurement.

All of the other measurements are as described above.

The Graphs tab has all of the measurements in a graphical solution.

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.

Appendix A: Definition of Terms

Arm

When armed, the camera will capture and write images into a partition of camera memory, and then overwrite it continually until it receives a trigger.

Arm/Record Bug

The Arm/Record Bug is the small vertical line used in conjunction with the Record Bar to indicate the progress of the camera while acquiring pre- and post-trigger images.

AVI

Audio Video Interleave (AVI) is a popular file type for electronic video. AVI files may include certain types of image/video data (compressed or un-compressed), audio data, and metadata.

Backlight

The Backlight is the illumination used to light the LCD display on the camera.

Battery Status LED

Battery Status LED States

Bit Depth

Images captured by the **Blaster's Ranger II™** sensor are read in binary form. Each pixel is given a binary 10-bit value from 0000000000 to 1111111111, or, in decimal form, from 0 to 1023. 0 is black, 1023 is white—all numbers in between are shades of gray from very dark to very bright. The camera operator has the option of recording all ten bits (1024 shades) or 8 bits (256 shades). If the operator chooses to record 8-bit data, they must choose which 8 bits of the ten to record. They may wish to record the Lower 8 bits, which will greatly enhance the dark areas of the image, tend to saturate the bright areas, and will expose more noise; or the Middle 8 bits, which will somewhat enhance the dark areas wash out the brighter areas, and expose some noise; or the High 8 bits, which will be the cleanest image, but with the least definition in the darker areas.

BMP Stack

BitMaP (BMP) files contain un-compressed image data. Each file contains one image. A BMP Stack is a collection of images. The BMP Stack produced by the **Blaster's Ranger II™** is a collection of frames, written as BMP files representing a captured video sequence.

Brightness

Linear image control that boosts all pixel values without disturbing the slope of the curve.

CinemaDNG

CinemaDNG is an open digital cinema format that uses the Adobe Digital Negative Specification (DNG), widely used as an archival format for Raw images. The specification is an attempt to standardize digital commercial video format thereby simplifying collaboration and workflow across the entertainment industry and all other industries dependant on digital video recording, i.e. automobile crash testing, military testing, etc.

Color Temperature

The Color Temperature of an ideal black body is defined as its surface temperature in kelvins (K). The Color Temperature of a light source is an assigned value that closely approximates what a human would perceive as a match between that light source and an ideal black body at that Temperature (K). High color temperatures are seen bluish, while lower color temperatures are seen reddish.

Config

Camera Configuration that can be saved and reloaded. Includes settings for Frame Rate, Resolution, Shutter Speed, Trigger, bit depth, and Auto Save.

Contrast

Linear image control that enhances the difference between pixel values by changing the slope of the curve, while maintaining the mean value.

Cursor

The cursor may be any graphic indication of where the current focus is within the user interface. This may be anything from a blinking vertical line as used within a dialog box when the user is entering text, or it may be a change in the color of a button as when navigating through menus.

Custom Camera Control Application

Camera control software compatible with the **Blaster's Ranger II™**.

DHCP

DHCP is a utility by which a server dynamically assigns IP addresses to clients on a network. When DHCP is selected in the Network Menu, the camera will allow a server on a connected network to assign it an IP address.

Dialog

A Dialog is a box that requires user input such as the selection of an option, or the entering of a number or text.

Download

Electronically moving image data from a camera to a "remote" device, i.e. a PC or other mass storage.

Enable Raw

A raw image is one where all image processing including colorization, white balance, brightness, contrast, and gamma, are all bypassed.

File Type

Digital files are commonly identified by their extensions. Familiar types include PDF, TXT, JPEG,TIFF, DOC, MP3, etc. Each of these files has a specified format that usually includes information in the file header and specially formatted data that applications on PCs, Cameras, Printers, Smartphones, and other electronic devices can read, write, and decipher for human viewing, editing, listening, etc.

Gain

In imaging the term Gain is most often used as a multiplier applied to a pixel value.

Gamma

Gamma encoding of images is required to compensate for properties of human vision - to maximize the use of the bits or bandwidth relative to how humans perceive light and color.[1] Human vision under common illumination conditions (not pitch black or blindingly bright) follows an approximate gamma or power function. If images are not gamma encoded, they allocate too many bits or too much bandwidth to highlights that humans cannot differentiate, and too few bits/bandwidth to shadow values that humans are sensitive to and would require more bits/bandwidth to maintain the same visual quality-

HDMI

HDMI, High-Definition Multimedia Interface, is used to transmit digitized video (and audio) data from the camera to a remote display. This is a popular method for connecting consumer products such as televisions, cable TV boxes, DVD players, etc.

Image Memory

Image memory is the internal memory in the camera reserved for raw image data. This is volatile memory that is erased when the camera is shut down.

JPEG Stack

Joint Photographic Expert Group (JPEG) file format is a highly compressed file format, capable of reducing image files to a fraction of the size of a BMP or lossless TIFF. The image quality of JPEGs is excellent, although there may be some discernible noise in the displayed image, often referred to as JPEG artifacts.

Menu

Once an item in the Menu Bar is selected, the corresponding Menu appears below.

Menu Bar

The Menu Bar is the bar across the top of the camera display that lists the Menu Items.

Network

The camera may be connected to one or more computers via its RJ45 GigE (Gigabit Ethernet) connection.

NTP Time

Network Time Protocol: Network Protocol for synchronizing time clocks of devices attached to a given network or internet, within a few hundredths of a second.

Play/Review Bug

In Review there is a progress bar that graphically indicates the position of the currently viewed frame within the image sequence. The small vertical line that is used as the indicator is referred to as the Review Bug.

Record

The camera is acquiring images and storing them in internal memory. This begins when the camera is armed, and ends after a trigger is received.

Record Bar

When the camera is Armed and it commences capturing images, the Record Bar presents a graphic indication of the progress of filling the buffer.

Refresh Rate

Rate at which image data is re-painted on the display. For CRTs this is analogous to the vertical frequency.

Review

Review is a camera utility for viewing image data while it resides in camera memory. It includes options for playing the imagery as a movie, forward or backward, or stepping through the frames one at a time, or stepping through every 10th frame. It also allows the user to adjust starting and ending points for an image sequence for viewing or saving. The user may adjust image properties such as brightness, contrast, gamma, color balance when reviewing the images. If 10 bit images have been saved, the user may also select which 8 bits to display. It is important to note that image adjustments made while using Review do not alter the image data in camera memory although they do alter the viewed and saved images.

Save

Moving image data from a camera's internal memory to some other mass storage device. This mass storage may be local, such as the SSD drive within the camera, or remote, such as a PC.

SD

This is Secure Digital memory, such as the SD Card used as a plug-in mass storage device for the camera.

SSD

Solid-state drive that is located inside the camera. This is a non-volatile mass storage device retains its data when the camera is powered down.

Static IP

In order for one networked device to "talk" to each other, they need to have compatible IP addresses. One way to assure this is for the user to assign unchanging (static) IP addresses to each device.

Status Menu Bar

The Status Bar is a line of text at the bottom of the display that appears when the camera menus are turned on.

Sub Menu

Within each Menu, there may be additional Sub Menus from which to select.

TIFF Stack

Tagged Image File Format (TIFF) is a much more flexible format than the BMP, in that it may use one of several compression schemes, may be used to store multiple images (multi-page TIFF), and may include metadata in the form of Tags. Developers may apply for their own block of private Tags. The TIFF is the only file format used in the **Blaster's Ranger II™** that is compatible with 10-bit images. The TIFF Stack produced by the **Blaster's Ranger II™** is a collection of frames, written as BMP files representing a captured video sequence.

Trigger

The trigger is a signal sent to the camera either via the trigger switch on the camera or from an external source applied to the camera's trigger input connector. When an armed camera receives a trigger, it will capture and write a prescribed number of frames into camera memory, then stop capturing images. If the **Blaster's Ranger II™** receives a Trigger while in Live Mode, it will take a still image.

Update Rate

The rate at which the **Blaster's Ranger II™** or a PC can process a new frame of video and send it to the display.

USB

A thumb drive or some other mass memory device may be attached via the USB port of the camera.

USB OTG

When a PC is connected to the USB OTG (USB On The Go) port of the camera, the camera appears as a mass storage device to the PC, much like plugging a thumb drive into a PC's USB port. The camera is automatically a slave to the PC.

Web Application

Camera control software that runs via web browser such as Windows Internet Explorer, Safari, Firefox, etc.

White Balance

Many different kinds of illumination may be used with high speed cameras. Typical color temperatures for common types of illumination are used to compute RGB gains, which, when applied to captured imagery, should approximate what a human would perceive as accurate color. The term White Balance refers to the idea that, presented with a white card under a given light source, the camera should produce a white image.

Appendix B: Blaster's Ranger II™ Specifications

System Design	Stand alone, battery powered, portable with multiple PC I/O ports	
Sensor	12-bit CMOS sensor with 5µm square pixels, color or monochrome	
Resolution	1280 x 1024 pixel maximum	
Pixel Size	14 µm square	
Light Sensitivity	3,200 ISO monochrome, 1,600 ISO color	
Record Rate	BRII-TS5QC4-B:	2560 x 2048 @ 253fps;
	BRII-TS5HC4-B:	1920x1080 @ 634fps;
	BRII-TS5SC4-B:	1280x1024 @ 991fps
	BRII-TS5QLC4-B:	800x600 @ 1677fps
Long Record Max frame Rate at Max Resolution by Model	BRII-TS5QC4-B:	2560 x 2048 @ 91fps;
	BRII-TS5HC4-B:	1920x1080 @ 231fps;
	BRII-TS5SC4-B:	1280x1024 @ 366fps;
	BRII-TS5QLC4-B:	800x600 @ 993fps
Shutter	Global electronic shutter from 3µsec to 41.654ms	
Image Memory	4GB standard	
Removable Storage	SDHC up to 32 GB	
Multi-Sequence Mode	1, 2, 4, 8 or 16 individual recording partitions	
File Formats	BMP, TIFF, JPG, AVI, RAW	
Lens Mount	C-Mount or F-Mount	
Built-in Monitor	Ultra bright, 178mm diagonal (7"), WVGA LCD	
Ports	USB(2), SD, GigE	
PC Interface	PC or Mac compatible via Gigabit Ethernet or USB 2.0	
Control Software	MAC, Windows or Linux OS compatible	
Trigger	Contact Closure or LVTTL	
Sync	External sync inputs via BNC	
Video Out	HDMI	
Construction	Machined Aluminum Housing	
Power	Rechargeable Battery Pack – 3 hours, or 10-26 VDC external power supply	
Power Consumption	7.5 Watts maximum	
Operating Environment	+5°C to +40°C	
Size and Weight	228mm W x 114mm H x 89mm D. 1.8 kg	

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

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