

PHANTOM

# Miro<sup>®</sup> LAB / LC / R High-Speed Cameras



VISION  
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**AMETEK<sup>®</sup>**  
MATERIALS ANALYSIS DIVISION



# MANUAL

When it's too fast to see, and too important not to.<sup>®</sup>

[www.visionresearch.com](http://www.visionresearch.com)

# Phantom Miro LAB / LC / R Series MANUAL

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# features

Performance Levels and Key Specifications	LAB110 LC110 R111	LAB310 LC310 R311	LAB3a10	LAB120 LC120 R121	LAB320 LC320S R321S	LAB140 R141	LAB340 R341
Max. Resolution	1280 x 800		1280 x 1280	1920 x 1200		2560 x 1600	
Sensor Mpx	1Mpx		1.6Mpx	2.3Mpx		4Mpx	
Max. FPS at Max. Resolution	1600 fps	3200 fps	1850 fps	730 fps	1380 fps	410 fps	800 fps
Throughput	1.6 Gpx/s	3.2 Gpx/s		1.6 Gpx/s	3.2 Gpx/s	1.6 Gpx/s	3.2 Gpx/s
Sensor Size	25.6mm x 16.0mm		12.8mm x 12.8mm	19.2mm x 10.8mm		25.6mm x 16mm	
Pixel Pitch	20 µm		10µm				
CAR	64 x 8 increments (Continuous Adjustable Resolution)						
Min. Exposure	2 µs	1 µs					
Straddle Time	500 ns		1.4 µs	500 ns	1.4 µs		
Native ISO (12232 SAT Method)	16,000 T Mono 2,000 T Color <sup>1</sup> 6,400 D Mono <sup>1</sup> 2,000 D Color <sup>1</sup>		12,500 T Mono 1,600 T Color <sup>1</sup> 5,000 D Mono <sup>1</sup> 1,250 D Color <sup>1</sup>				
Memory	6GB, 12GB high-speed internal RAM CineFlash non-volatile memory storage (120GB or 240GB w/Dock)						
Trigger Options	Dedicated BNC, via capture port, Image-Based Auto-Trigger, Phantom PCC software, or On-Camera Controls						
Ethernet	Standard Gb Ethernet for control and data						
Video Out	Not all camera models support video output. And, the RCU is not supported on models without video output (see Video System table on a page 5)						
Special Features	Partition memory into segments and make shorter recordings back-to-back without missing any action (63 maximum), Burst mode, Shutter off mode for PIV exposure, Continuous recording, Extreme Dynamic Range (EDR)						
Power	12 - 28 VDC, 65 W						

Key Specification Based on Body Style	LAB-Series	LC-Series	R-Series	
			Rxx1 -Series	Rxx0 -Series
Battery Power	None	Sony BP-U30 or BP-U60 rechargeable, external charger required	Sony BP-U30 or BP-U60 rechargeable, external charger required	Sony BP-U30 only, rechargeable, external charger required
Internal Mechanical Shutter	Standard	Standard	Standard <sup>2</sup>	Optional, if equipped shock rating limited to 40G maximum

<sup>1</sup> Measured using the ISO 12232 SAT method

<sup>2</sup> Option to remove for higher-shock applications

# 1 Introduction

## Introduction

Phantom Miro cameras come in a variety of models and a range of performance levels. There are three-body styles.

The LAB-Series is designed for laboratory / office-environment applications where computer control is preferred – for example, a fixed installation where high-speed Cines are immediately saved on a computer for viewing and analysis.

The LC-Series has an integrated flip out LCD touch screen for on-camera control and viewing of recorded cines. It is best employed where the camera will be used in a variety of applications, often requiring portability.

The R-Series is also designed for applications where computer control is used, and is packaged in a robust, shock-tolerant, all-metal body for applications in outdoor and harsh environments.

Not all performance levels are available in all body styles. Below is a table showing what is available.

Body Style	LAB-Series	LC-Series	R-Series
Miro 11x	√	√	√
Miro 31x	√	√	√
Miro 3a1x	√		
Miro 12x	√	√	√
Miro 32x	√		
Miro 32xS		√	√
Miro 14x	√		√
Miro 34x	√		√

## Camera Capabilities

The LAB310, LAB110, LC310, LC110, R311, and R111 cameras are capable of capturing 1 Giga-pixels per second (Gpx/s) of data from our proprietary CMOS sensor. At full resolution (1280 x 800), the LAB310, LC310, and R311 can capture at 3,200 frames-per-second (fps); the LAB110, LC110 and R111 can capture at 1,600 fps.

The LAB3a10, LAB320, LAB340, LC320S, R341, and R321S, feature 3.2 Gpx/s throughput. The maximum frame rate of 1,850 fps at full resolution (1280 x 1280) can be achieved by the LAB3a10. The LAB320, LC320S, and R321S support a maximum frame rate of 1,380 fps at full resolution (1920x1200). And the LAB340, and R341 can record at a maximum frame rate of 800 fps full resolution (2560x1600)

The LAB120, LC120, and R121S, achieve 1.6 Gpx/s throughput, as do the LAB140, and R141. The LAB120, LC120, and R121 maximum frame rates are 730 fps at full resolution (1920 x 1200) while the maximum frame rate of the LAB140, and R141 is 410 fps at full resolution (2560x1600)

## Image Storage

High throughput is important. At any given resolution, a camera with the highest throughput will provide the fastest possible frame rates.

The Phantom Miro LAB / LC / R Series cameras can be equipped with 6GB, or 12GB of high-speed memory. Cameras with 12GB of memory, recording at 1,000 fps can record a single high-speed shot (called a Cine) for almost 2.7 seconds.

The Phantom Miro LAB / LC / R Series cameras are also compatible with Phantom CineFlash long recording devices available in 120GB and 240GB capacities.

The Phantom Miro LAB / LC / R Series cameras can securely save to an attached Phantom CineFlash specially designed for high throughput, which translates into save and retrieval times far better than what you get with commercial solutions designed for slow-speed cameras. The ability to save data at rates up to 70MB per second translates into less downtime due to long file save times and higher camera productivity.



## Sensor Characteristics

The Phantom Miro LAB / LC / R Series use a proprietary CMOS sensor designed by Vision Research and are available in monochrome or color versions.

The sensor resolution / shape of the allows the user to keep moving objects within the frame longer and is compatible in the aspect ratio with modern display technology. The physical sizes of the sensors are listed in the table below.

Phantom Camera Model	Resolution. (Width x Height in pixels)	Pixel Size ( $\mu\text{m}$ )	Size (Width x Height in mm)	Size (Diagonal in mm)
Miro LAB340 / R340	2560 x 1600	10 $\mu\text{m}$	25.60 x 16.00	30.19
Miro LAB140 / R140	2560 x 1600	10 $\mu\text{m}$	25.60 x 16.00	30.19
Miro LAB320 / LC320S / R320S	1900 x 1200	10 $\mu\text{m}$	19.20 x 12.00	22.64
Miro LAB120 / LC120 / R121	1900 x 1200	10 $\mu\text{m}$	19.20 x 12.00	22.64
Miro LAB 3a10	1280 x 1280	10 $\mu\text{m}$	12.80 x 12.80	18.10
Miro LAB310 / LC310 / R311	1280 x 800	20 $\mu\text{m}$	25.60 x 16.00	30.19
Miro LAB110 / LC110 / R111	1280 x 800	20 $\mu\text{m}$	25.60 x 16.00	30.19

The 10 micron ( $\mu\text{m}$ ) pixels of the LAB340, R340, LAB140, R140, LAB320, LC320S, R320S, LAB120, LC120, R121, and LAB3a10 result in a light sensitivity of ISO 5,000D1 and 12,500T for monochrome cameras, and color cameras 1,250 D1 and 1,600T1.

The 20 micron ( $\mu\text{m}$ ) pixels result in high light sensitivity. The LAB310, LC310, R311, LAB110, LC110 and R111 cameras have a sensitivity of ISO 6,400D1 and 16,000T for monochrome cameras, and color cameras 2,000 D1 and 2,000T1.

All Phantom Miro Series cameras have global electronic shutters, with minimum exposure times of 1 $\mu\text{s}$  for the LAB340, R340, LAB140, R140, LAB320, LC320S, R320S, LAB120, LC120, R121, and LAB3a10 cameras; 2 $\mu\text{s}$  for the LAB310, LC310, R311, LAB110, LC110 and R111 models.

<sup>1</sup> Measured using the ISO 12232 SAT method

## Command and Control

Phantom Miro cameras are easy to set up and control. Use our Phantom Camera Control (PCC) software over a Gb Ethernet connection, a hand-held Phantom RCU, or the on-board LCD touch screen (on the LC-Series only) to access and control the camera's features. (An SDK enabling custom software interfaces and LabView drivers are also popular ways to set up and control Phantom cameras.)



Detailed information about Phantom cameras, features, and software can be found at:  
[www.visionresearch.com](http://www.visionresearch.com)

## Video Out

Not all camera models support video output. And, the RCU is not supported on models without video output.

The Video System table below shows what video system is available on each model.

Body Style	LAB-Series	LC-Series	R-Series
Miro 11x	None	NTSC / PAL	NTSC / PAL
Miro 31x	None	NTSC / PAL	NTSC / PAL
Miro 3a1x	None	–	–
Miro 12x	None	NTSC / PAL	NTSC / PAL
Miro 32x	None	–	–
Miro 32xS	–	HD-SDI	HD-SDI
Miro 14x	None	–	None
Miro 34x	None	–	None

## Advanced Features

**Image-Based Auto-Trigger (IBAT):** Phantom Miro LAB / LC / R Series cameras can detect changes an image which can be used to trigger the camera (or even a number of cameras), making it easy to record unpredictable events.

**Multi-Cine:** The internal memory of a Phantom Miro LAB / LC / R Series camera can be partitioned into as many as 63 segments for shorter recordings, back-to-back, without missing any action.

**Burst Mode:** Precisely generate a programmable number of frames for every (internal or external) frame synchronization pulse.

**Internal Mechanical Shutter:** Easily perform black references remotely using the built-in mechanical capping shutter for optimum image quality.

**Continuous Recording:** Automatically save cines from internal camera memory to an external storage, without user intervention.

**Extreme Dynamic Range (EDR):** Vision Research's unique Extreme Dynamic Range (EDR) feature is standard on all Phantom Miro LAB / LC / R models. With EDR enabled, each pixel in a frame will receive one of two exposure times – a short exposure for potentially over-exposed pixels and a longer exposure for pixels receiving normal light levels. This provides detail in areas of the image that would otherwise be overexposed. EDR is usually recommended for monochrome cameras only.

## Lensing

**Shutter Off:** The Shutter Off mode was designed for PIV applications, and maintains a maximum exposure regardless of frame rate. This allows for a straddle time of 500 ns for the LAB, 310LAB120, LAB110, LC310, LC120, LC110, R311, R121, R111 cameras, and 1.4  $\mu$ s on the LAB340, LAB320, LAB3a10, LAB140, LC320S, LC120, R341, R321S, R141, R121 cameras.

Phantom Miro LAB / LC / R Series cameras are available with 4 different interchangeable lens mounts, which must be chosen at the time of purchase.

Choose between a Canon EOS, Nikon F-mount, 1" C-mount, or 35mm PL-mount.

The EOS mount enables the use of compatible EF and EF-S lenses, and focus and aperture can be adjusted via our Phantom Remote Control Unit (RCU), Phantom Camera Control software (PCC), or using an adjustment ring on the lens mount. Remote control of focus and aperture is a huge benefit when cameras are remotely located and/or difficult to reach.

The Nikon F-mount support F & G style lenses.

A Nikon F mount adapter allows the use of F-mount lenses on EOS mount.

# on-camera controls



## Autoset

A

Tap to scroll through video tool functions:

Zoom (1:1), Threshold and Live mode

Long press (3 seconds) will perform an internal CSR (current session reference)

## Autoset

B

Press once to trigger the camera

Long press (5 seconds) will delete the last RAM Cine file and re-arm the camera.

# lcd panel controls



*Image shown is of the LCD screen flipped around and folded back into the side of the camera*

## Menu

A

Turns on / off 'Menu' icons. Exiting the menu is an electronic reset of the touch screen. Reset takes about 5 seconds. Double-clicking the square button also resets the screen.



Mount camera onto suitable support.  
Attach and adjust appropriate lens.

## OSD Display

B

Turns on/off all on-screen displays.

## Menu

C

Displays the main 'capture and setting' control interface.



See 'Chapter 3: Miro LC Touch Screens' for a brief description of the various 'Menu' screens.

# rear connector panel



*LAB Series Body Style*

Camera models supported with this body style are the Phantom Miro 11x, Miro 31x, Miro 3a1x, Miro 12x, Miro 32x, Miro 32xS, Miro 14x, and Miro 34x.

**CineFlash Compartment Door**

**A**

Phantom CineFlash access door.

**1Gb Ethernet**

**B**

RJ45 CAT5 (for control and data transfer)

**I/O-1**

**C**

F-Sync / Event / Strobe / Memgate (Aux1) selectable:

- F-Sync / +5V maximum threshold, input is also compatible with TTL levels and must be properly terminated, (50-ohms).
- Event / active-low isolated input marks events during recording; signal must be active when the strobe is high.
- Strobe / isolated collector output with 1k pull-up, active during frame exposure.
- MemGate / active-low isolated input, temporarily stops image acquisition during recording.

**I/O 2**

**D**

Ready / Strobe / selectable:

- Ready / isolated collector output with 1k pull-up, indicates camera is ready for trigger.
- Strobe / see description (C) above.

**IRIG-In**

**E**

Unmodulated IRIG-B timecode format input. Input withstands signals of up to +/- 15v. The input threshold is 1.5V, compatible with TTL levels.

**Trigger**

**F**

Isolated input; active low. Can be activated by a switch to ground. Pulse must be 3 $\mu$ s long minimum.

**+12-28 VDC**

**G**

+12-28 Volts DC standard Miro power.

**Battery Reset Switch**

**H**

Forces battery power off. When activated any Cine stored in camera RAM will be purged.



*LAB Series Body Style*

Camera models supported with this body style are the Phantom Miro 11x, Miro 31x, Miro 12x, and Miro 32xS, Miro 14x, and Miro 34x.



**CineFlash Compartment Door**

**A**

Phantom CineFlash access door.

**Battery Status Button**

**B**

Provides status of battery charge.

**1Gb Ethernet**

**C**

RJ45 CAT5 (for control and data transfer)

**Capture**

**D**

Provides I/O signaling via attached capture cable (signals) or Miro Break-Out Box (signals).

**Power**

**E**

+12-28 Volts DC standard Miro power.

**Off / Auto / On Switch**

**F**

Determines camera powering options:

- Off / camera off (no power applied to a camera).
- Auto / requires DC input to power up camera (battery, if connected and charged, maintains power if Cine is stored in RAM and DC power loss only).
- On / camera immediately runs with DC or battery input power is applied.

**F-Sync**

**G**

F-Sync / +5V maximum threshold, input is also compatible with TTL levels and must be properly terminated, (50-ohms).

**Trigger**

**H**

Trigger / Isolated input; active low. Can be activate by a switch to ground. Pulse must be 3 $\mu$ s long minimum.



### Prepare Your Computer

Camera controlling computers:

1. Must have either the Microsoft Windows XP Pro, VISTA Business Edition, Windows 7 or Windows 8.1 operating system installed.
2. Firewalls must be turned off.  
(Contact your IT Group if necessary)
3. Using the 'Windows Control Panel' set the IP address of your computer's network card to 100.100.100.1 with a 255.255.0.0 subnet mask.

### Install PCC Software

Install the latest version of Phantom Camera Control (PCC) software from the accompanying CD or USB key.

### Connect the Camera to the Computer

Connect the 12-28 VDC power supply to the camera's Power Input connector.

Attach the supplied Ethernet cable between the Phantom camera and the computer.

Connect the supplied Capture cable to the Phantom camera.

If an external trigger is being used to trigger the camera, connect it to Trigger connector on the rear panel of the camera.

### Attach Phantom CineFlash

Mount a Phantom CineFlash, if available.



Detailed information about attaching a Phantom CineFlash can be found in Chapter 7: Phantom CineFlash & CineFlash Dock of this manual.

### Select Camera for Use

In the 'Manager' tab double-click on the Phantom camera to be used from the 'Cameras' group folder.

## Define Recording Parameters

Click the 'Live' tab.

Click 'Cine Settings' and define following parameters by either the selecting the required value from the pull-down selection list, or type a value into the respective data entry field.

1. Set 'Resolution' to the required Width x Height.
2. Choose the required 'Sample Rate' and 'Exposure Time'.
3. Ensure the EDR, (Extreme Dynamic Range) exposure time is set to zero (0).
4. Post Trigger to zero (0) by:
  - a. Moving the 'T' (Trigger Position) slider to the right, or
  - b. Enter zero (0) into the 'Last' data entry field.

Click on the CSR button to perform a Current Session Reference.

## 'Arm' Camera

Click the 'Capture' button to start recording to the camera's internal memory (circular buffer).

## Trigger

At the end of the action, click the action 'Trigger' button on the bottom of the 'Live' panel, or

Provide a switch closure or an external trigger signal (TTL pulse) via the Trigger connector.

Click the 'Play' tab.

## Edit Cine

Using the following Video Control Buttons to locate the first image of the cine to be saved.



Rewind



Fast Rewind



Pause



Rewind 1 Frame



Play



Advance 1 Frame



Fast Forward

Locate the first image of the cine to be saved.

Click the 'Mark-In button. 

## Review Edited Cine

## Save to Computer

## Save to Attached Phantom CineFlash

## Confirm Computer Save

Locate the last image of the cine to be saved.

Click the 'Mark-Out' button. 

Select 'Play, Speed, & Options" and enable (check) 'Limit to Range'.

Under the Video Control Buttons, click the 'Jump to Start' button. 

Review the edited cine using the Video Control Buttons.

Click the 'Save Cine...' button on the bottom of the 'Play' panel.

In the 'Save Cine' window:

1. Navigate to the folder where you want to save the cine file.
2. Enter a file name for the cine file in the 'File name:' data entry field.
3. From the Save as type pull-down selection list, select the 'Cine Raw, \*.cine' file format.
4. Click the Save button to begin downloading the cine file from the camera to the computer's hard drive.

Click the down-arrow of the 'Save Cine...' button.

Select 'Save RAM Cine to Flash' (in popup window).

Click the Save button to save the cine file onto the Phantom CineFlash.



Confirm cine save before deleting from internal memory

Click the 'Open File'  button.

In the 'Open Cine' window:

Navigate to the folder containing the saved cine file.

Highlight the cine file to be opened.

Click the Open button.

## Confirm CineFlash Save

Using the Video Control Buttons, review the saved cine file.

Click the 'Manager' tab.

Double-click on the 'Cine F#' file under the camera used to record the cine.

Using the Video Control Buttons, review the saved cine file.

## Power Up Camera

## Setup Video Monitor

## Attach Phantom CineFlash

## Set Recording Parameters

## Perform Black Reference

## Perform White Balance (Color Cameras Only)



Mount camera onto suitable support.  
Attach and adjust appropriate lens.

Connect a suitable power supply (12-28VDC) to the Power Input connector, then set the power switch to the 'ON' position, or insert battery.

Connect a suitable HD-SDI video monitor (not supplied) to the 'HD-SDI' connector on the connector panel of the camera.

Mount a Phantom CineFlash, if available. For detailed instruction see Chapter 7: Phantom CineFlash & CineFlash Dock IV.

Click the 'Menu' button (square) to display touch screen menu.

Tap the 'Menu' icon as to bring up the main capture and setting control interface.

- Set 'Resolution' to the required width x height
- Choose the required 'Speed' (frame rate) and 'Exposure Time' (shutter)
- Set the 'Post Trigger' (trigger position) at the beginning, or the end, or some position within the internal memory.

Scroll up and down for desired setting. Tap once to select parameter to change.

Press (3 seconds) the 'Autoset' button (front of the camera) to perform an internal CSR (Current Session Reference).



Black Reference should be performed after all recording parameters have been set.

Tap on 'AWB' (Automatic White Balance) icon (upper right).

Place a white or neutral non-saturated object in the center square and tap once.

## 'Arm' Camera

Press the 'Trigger' button (front of camera) for 5 seconds to switch from 'Pre-trigger' or 'Cine Stored' to 'Waiting for Trigger' ('Loop' mode).

## Trigger

Tap the 'T' (Trigger) icon (right-side) or Press the 'Trigger' button (front of camera).

## Edit Cine

Tap the play icon in the 'Cine Stored' screen.

Tap 'Forward' or 'Reverse' icons to play RAM cine (multiple times to speed up playback).

Tap 'Pause' icon to stop playback.

Locate the first image to be saved and select 'Mark-In' icon.

Locate the last image to be saved and tap the 'the Mark-Out' icon.

Review the edited Cine.



Apply a long press over the Mark-In and/or Mark-Out icons to reset Cine file start/end points respectively.

## Save to CineFlash

'Save' marked frames to Phantom CineFlash.

## Verify Save to CineFlash (optional)

Tap the 'file management' icon on the LCD menu, and then tap on the 'CF' (CineFlash) icon to bring up the CF menu. This will show the entire list of files on the CineFlash drive. Ensure the last shot is there by checking the time and file size.



Files stored within the CineFlash cannot be played back on the LCD menu or over video. They can, however, be viewed in Phantom PCC software.

## 'Re-Arm' Camera

From the LCD menu, tap on the File Management icon. The RAM Cine and status will be visible. Tap on the RAM Cine and then tap the X to delete. Tap the Record icon to start the camera in capture.



If there is an asterisk\* next to the RAM file that means it has not been saved to the CineFlash.

Alternatively, a long press (5 seconds) on the front camera trigger button will also delete the last RAM Cine and put the camera back in Capture mode.



## 'Connect Camera to Remote Control Unit

Connect an HD (BNC) cable between the 'Video-In' connector on the rear of the Remote Control Unit (RCU), and the HD-SDI connector on the rear panel of the camera.

Connect the Remote cable (9-pin female) to the 'Remote' connector on the rear of the RCU.

Connect the Remote cable (9-pin male) to the 'Remote' connector on the camera's rear panel.

## Power Up Camera

Connect a suitable power supply (20-28VDC) to the Power Input connector, then set the power switch to the 'ON' position.

## Power Up RCU

Hold in the RCU 'Menu' button (2 seconds).

## Install Phantom CineMag IV

Insert a Phantom CineFlash, if available. For detailed instruction see Chapter 7: Phantom CineFlash & CineFlash Dock.

## Set Recording Parameters

Gently depress the 'Setup' button, then the Acq, (Acquisition), button.

Set the 'Aspect Ratio': Press the down-arrow (right of 'Aspect Ratio' field) and select an 'Aspect Ratio' from the pull-down selection list.


Define the Resolution, Frame Rate, Exposure, and Post Trigger settings using the Numerical Keypad to specify the desired setting.

1. To overwrite the present value:
2. Tap the entry field once, (turns entry field yellow), then
3. Tap the key pad to enter the desired value.
4. Tap the Enter key to set the value.

To append the value:

1. Tap the entry field twice, (turns entry field white), then
2. Tap the key pad to append the value.
3. Tap the Enter key to set the value.

## Perform CSR

Press the Return,  icon (upper-left) to return to the Setup Screen.

Press the 'Capture' button.

Tap the CSR, (Current Session Reference), button

When prompted tap the Begin button.

## Perform White Balance (Color Cameras Only)

Tap the 'White Balance' button.

Place a white or neutral non-saturated object in front of the camera.

When prompted tap the Begin button.

## 'Arm' Camera

Press the Rec, (Record), button.

## Trigger

Apply a trigger to the camera by depressing the hardware Trigger' button (on RCU), or apply 'Trigger-In' (TTL pulse) signal to the Trigger connector on the back of the camera.


## Edit Cine

Click the Play button.

Locate the first / last image to be saved by:

Performing a Quick Search:

Rotate the Jog/Scroll dial until desired point in cine is achieved, or

Press and hold down on 'Image Location Identifier' arrow, , located just below the Cine Editor Bar and slide finger right to quickly advance cine, slide left to quickly rewind (present image number is displayed above).

Using Video Control buttons:

 Play

 Reverse

 Pause

Click the Mark-In  and Mark-Out  buttons to set the first / last images, respectively, of the cine to be saved.

## Save to CineMag

Tap the 'Save' button to save the edited RAM cine file to the Phantom CineMag.

# 3 Phantom Software



The latest version of Phantom PCC software can be found and downloaded from the support section of the Vision Research website: [www.visionresearch.com](http://www.visionresearch.com)

## Pre-Installation

Phantom control software is certified to operate with the following Microsoft Windows operating systems: Windows XP Pro, Windows VISTA Business Edition, Windows 7 and 8.

The computer and camera must be associated with the same sub-network to communicate with one another.

Vision Research has preset IP address (100.100.x.x) with a subnet mask (255.255.0.0) to the camera. Typically, the IP address 100.100.100.1 / 255.255.0.0 is defined to the control computer. When multiple computers are used to control the same camera, each computer requires a unique IP address, for example, 100.100.100.1 (255.255.0.0), 100.100.100.2 (255.255.0.0), and so on.

The software is built around a multi-layered work area that includes the following work areas:

## Toolbar

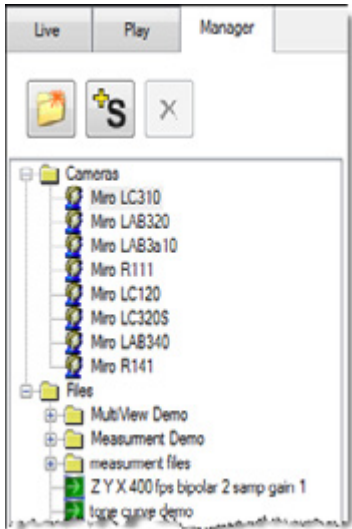
Provides quick access to the most frequently used functions. Position the mouse over a button and wait for a second to display a text box describing what it is.



Note the 'Help' buttons which provide valuable reference information about the software, including extensive documentation.

## PCC (Phantom Camera Control) Application Overview

## Control Tabs



The main window of PCC is divided into three tabs: Live, Play and Manager.

When first started, the 'Manager' tab is selected. It is in this tab connected cameras are displayed, selected for use, and renamed. It is also used to manage saved Cine files.

To rename, highlight then click the name of a camera. This can be useful when working with multiple cameras.

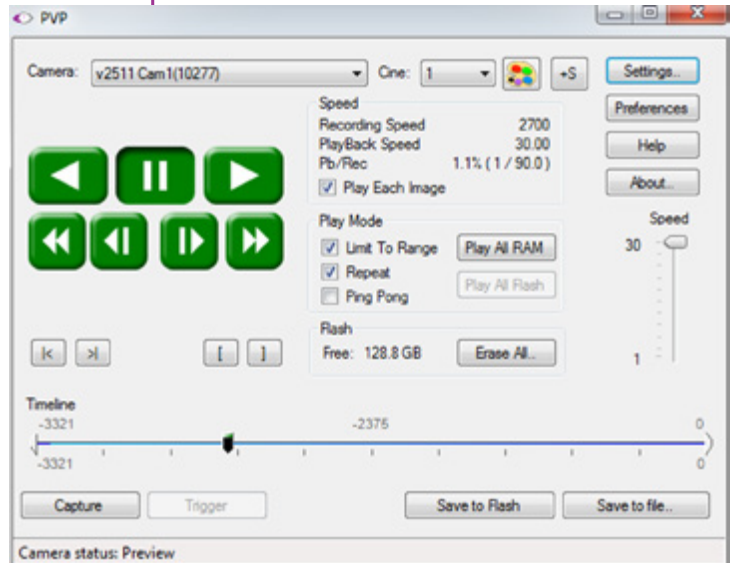
All camera control and setting of shooting parameters (frame rate, shutter, etc.) are performed in the 'Live' tab.

The 'Play' tab is used to review, edit, and save Cine files, (either from the camera or from files on the local hard drive).



## PVP (Phantom Video Player) Application Overview

PVP can be launched directly from the desktop, or by clicking the 'Video Out' toolbar button in PCC. PVP controls only the camera's HD-SDI outputs as connected to a compatible SDI monitor.



# pcc software

PVP, provides the ability to view, capture, review, edit, and/or save a Cine recorded into the camera's RAM to a hard drive, or installed Phantom CineMag IV. PVP is extremely effective when used with the high-resolution cameras since most computers are not powerful enough to view the live or captured raw files smoothly.



The camera's video mode and display settings are also set through PVP. Video systems will vary based on the country you are in, what kind of video monitor used, and the required display resolution. All available video setting for the connected camera can be found in the 'Settings' menu of PVP.

## Camera Control via PCC

PCC provides the ability to select various units for specific camera parameters by clicking the 'Preference' button at the bottom Manager tab.

Units can be set to commonly used values ('Presets') or they can be customized using the pull-down selection lists. First-time users should use one of the three 'Presets'.



The 'Exp' unit is probably the most important unit to be set. It specifies what unit to use when setting the exposure time. You probably will want this set to micro-seconds. The other unit to set is PTF (Post Trigger Frames) covered later in this section. Every Phantom Ultrahigh-speed cameras support EDR (Extreme Dynamic Range) exposure.

## Selecting a Camera

Double-click the camera(s) to be controlled listed in the 'Manager' tab, or select the camera(s) from the 'Camera' pull-down list in the 'Live' tab.

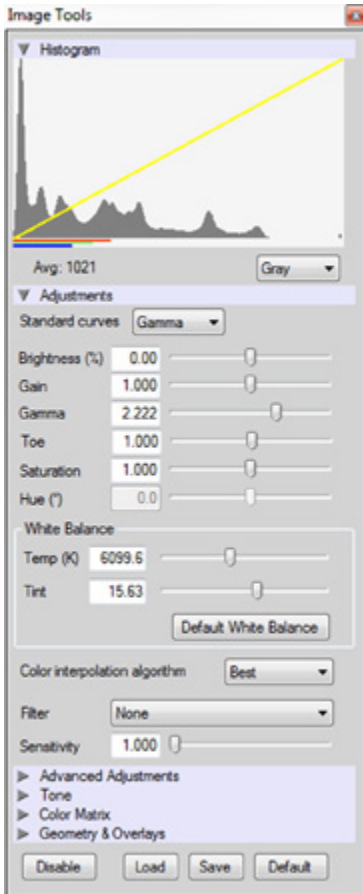


## Image Processing

Once a camera is selected a 'Preview' panel will display to the left of the control tabs showing the current image being captured by the camera. This image may differ slightly to that of the image being output over the camera's two HD-SDI ports due to display differences in the video monitor and computer screens.



You can adjust the display options by clicking on the 'Image Tools' toolbar button.



The 'Image Tools' window is used to view a 'Histogram' and change settings that affect the computer display and the video output from the camera.

Some of the variables include; brightness, gain, gamma, saturation, hue, white balance adjustments (Temp (K) and Tint), individual red, green and blue pedestal, gain and gamma values, tone control, and more.

When Log mode is selected, most of these variables are locked and cannot be adjusted.

At the bottom of the window is a 'Default' button that restores all parameters except white balance, tone, and color matrix to their default values.

The 'Default White Balance' button restores white balance to the default (which under the most typical lighting will produce a green image).

The Tone 'Reset' button restores the image tone to the default values, and the Color Matrix 'Restore' button return the color matrix values to their default values.

Changes made only affect the meta data of the Cine file, not the raw data. If you are recording the camera's video output it is important that these be set to values that produce the image you wish to record.



The 'Zoom Actual Size' toolbar button resizes the images being displayed in the Preview/Playback panel to their actual size.



The 'Zoom Fit' toolbar button resizes the images to fit panel.



Images can also be zoomed to a specific magnification ratio by selecting a number from the pull-down list to right of the Zoom Fit button.

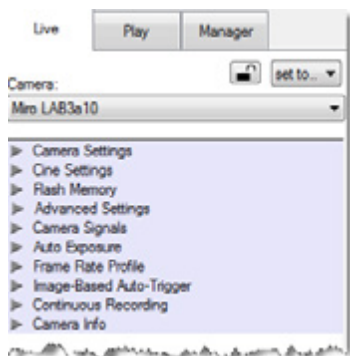
## Automatic White Balance

Once a camera is selected a 'Preview' panel will display to the left of the control tabs showing the current image being captured by the camera. This image may differ slightly to that of the image being output over the camera's two HD-SDI ports due to display differences in the video monitor and computer screens.



## Capture Settings

Just below the 'Camera' selector, in the 'Live' tab, are a series of expandable headers, which contain groups of related camera settings.

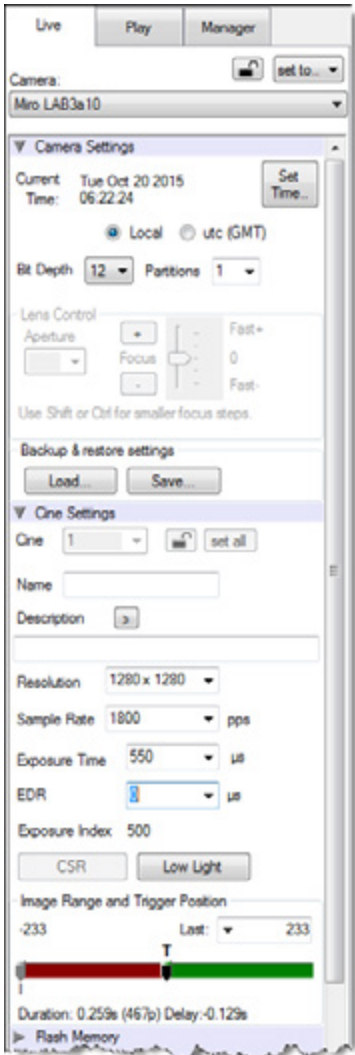


This manual will cover the most commonly used settings, see the 'Pcc Help' file for details of other settings.



## Camera Settings & Cine Settings

Camera Settings are used to set and recall the overall camera system parameters. Cine Settings are used to set the capture parameters.



**Set Time:** Synchronizes the time stamps embedded in the recorded image data to the computer's clock or supplied IRIG-B clock.

**Bit Depth:** All Miro LAB / LC / R, cameras operate in 12-bit mode only.

**Partitions:** Select the number of desired partitions (evenly divided memory segments) from the 'Partitions' pull-down menu. For basic camera setups, this should be set to one.

**Lens Control:** Will be available for Canon EF lenses only, for control of aperture and focus.

**Backup & Restore:** Allows for user settings to be saved and recalled from the camera's memory.

**Resolution:** Set the number of pixels used to capture an image. For example, if 1280 x 800 (width x height) is set, the full sensor space is available. Smaller resolutions allow higher recording speeds. Cropped resolutions are set using the 'Crop and Resample' menu in Image Tools.

**Sample Rate:** Set the acquisition frame rate in frames-per-second (FPS).

**Exposure Time (shutter):** Set the exposure time in microseconds, percentage, or degrees (this depends on how the PCC preferences are set).

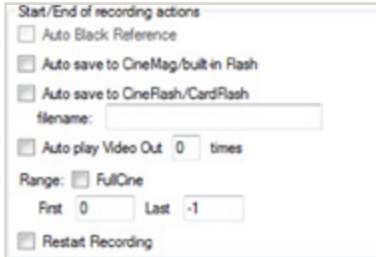
**EDR (Extreme Dynamic Range):** Set a unique exposure time (defined in microseconds or a percentage of the defined 'Exposure Time') to pixels that may become saturated, (over exposed).

**Exposure index:** This is a reference display of the EI value in relation to the Image settings.

**CSR (Current Session Reference):** Closes the camera's internal shutter and resets the black point of every pixel for optimal image quality.

**Image Range and Trigger Position:** The slider represents the memory buffer, with the 'Duration' indicated in seconds and the total number of frames available.

## Key Advanced Settings



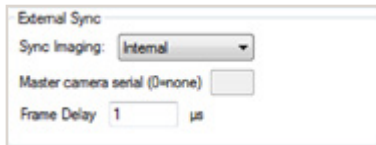
The trigger position is indicated in the 'Last' pull-down menu or as the 'T' slider along the timeline. The trigger position is the point at which the camera stops continually recording when a trigger signal is detected.

The first of these key features is the option to enable the 'Start/End of recording actions' to be performed automatically at the beginning or end of a shot. The most common ones are:

- 'Auto save to CineMag/Built-in Flash' this feature saves a user-specified portion of a clip to the Phantom CineMag immediately after recording.
- 'Auto play Video Out' begins playback after recording. The range marked under 'Auto play Video Out' affects both playback and saving to the Phantom CineMag.
- 'Restart Recording,' when enabled, automatically restarts the recording process after the 'Auto' actions has been performed.



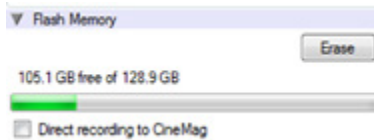
When 'Restart Recording' is enabled PCC does not provide any user confirmation before the clip is erased from RAM and starts recording again. This feature should be used with care!



'External Sync' instructs the camera to utilize one of the following three frame sync clock sources:

- Internal - instructs the camera to utilize its' internal crystal oscillator to drive the camera's frame rate.
- External - should be selected when an externally supplied frame sync clock pulse is supplied to drive the frame rate. This can be used to synchronize two cameras together via F-Sync.
- IRIG - should be selected when an IRIG-B signal is supplied to drive the camera's frame rate.
- LockToVideo - Frame rate is driven by the camera's current video rate. FPS will jump to the closest multiple of the current video rate (23.98, 24, 25, 29.97 or 30).

## Flash Memory



## Recording a Cine

Specifies the camera's operation mode in relation to CineMag recording: Loop (record to RAM first) or R/S (bypass RAM and record directly to CineMag).

It also displays the amount of 'Free' space and size (in Gigabytes) of the Phantom CineMag.

In 'Loop' mode to begin recording to the camera's RAM click the red 'Capture' button.



The red 'Capture' button changes to 'Abort Recording' and the green 'Trigger' button is enabled when the camera is recording. The Abort Recording button instructs the camera to stop recording, leaving the camera's RAM empty.



## Triggering the Camera

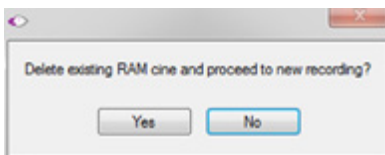
Selecting the 'Trigger' button instructs the camera to immediately stop recording when the 'Trigger Position' is set to zero. If a value greater than zero is set, the camera will continue to record 'post-trigger' frames until the user specified value is met.



Using the camera's 'Trigger' button, or an external trigger signal provides a more accurate trigger to the camera.



If a clip exists in the camera's memory, you will be asked if you are sure you wish to delete it before continuing. If yes, click 'Delete cine(s) and start new recording'.



## Reviewing a Cine

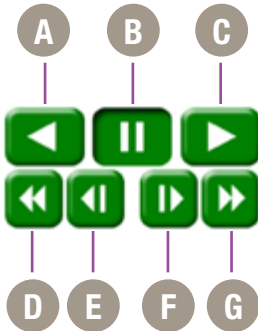
Once the camera has completed recording a Cine in the camera's RAM or CineMag it can be reviewed by selecting it from the 'Cine' pull-down selection list in the PCC 'Play' tab.



A previously saved Cine stored on the computer's hard drive can be opened using the 'Open File' toolbar button (also places the file under the 'Cines' group folder in the Manager tab).

The viewing option can be changed via the 'Play Speed & Options' and the Cines' metadata can be viewed in the 'Frame Info' and 'Cine Info' sections.

Use the 'Video Control' buttons to review the cine.



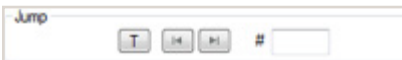
- A** Rewind
- B** Pause
- C** Play
- D** Fast Rewind
- E** Rewind 1-Frame
- F** Advance 1-Frame
- G** Fast Forward

## Performing a Quick Search Through a Cine

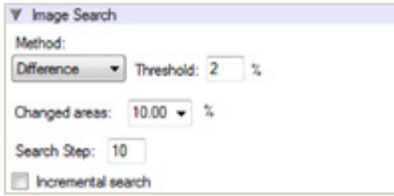


Quickly search through cine files to find the points of interest:

'Scroll' (scrub) through the clip using the 'Image Location' slider or click anywhere on the timeline to jump to points in the cine quickly.





'Jump' to the trigger frame by clicking on the 'T' button, or jump to specific frames by entering the frame number into the jump '#' data entry field, then hit the enter key.




## Editing a Cine

'Image Search'. The goal is to search or find an image change in the recording, based on the difference between image content. Right-Click on the 'Play' button to begin the image search. Besides image content changes, Image Search can also look for images that are tagged as 'Event' images.

Using the following 'Video Control' buttons locate the first image of the cine to be saved and click the 'Mark-In'  button.

Locate the last image of the cine to be saved and click the 'Mark-Out'  button.

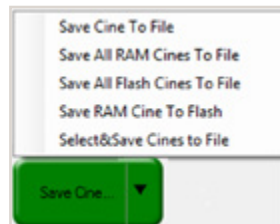
Click 'Play, Speed, & Option' and enable (check) 'Limit to Range'.

Under the 'Video Control' buttons click the 'Jump to Start'  button, then review the edited cine.

## Saving a Cine

Click the 'Save Cine...' button to save the edited cine to the computer's hard drive.

If you wish to save the clip to an attached Phantom CineMag, click the down-arrow to the right of the 'Save Cine...' button and select 'Save RAM Cine to Flash'.



For further instructions on working with CineFlash, please see Chapter 7: Phantom CineFlash & CineFlash Dock.

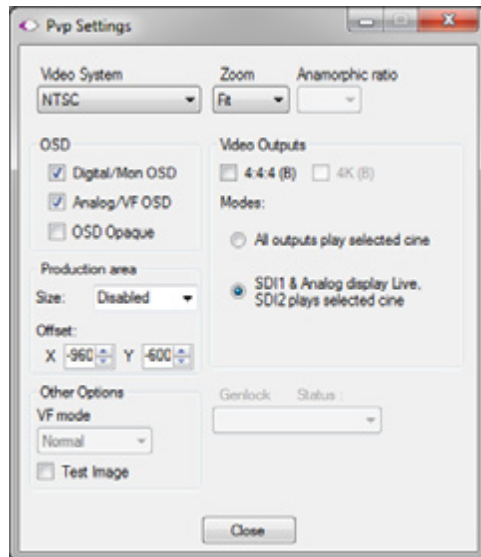
## Using PVP (Phantom Video Player)

PVP (Phantom Video Player) is a streamlined application used to control the video playback of the camera, and can be used to quickly capture, review, edit and save to or from the CineMag.

PVP can be opened directly from the desktop or by clicking the 'Video Out' toolbar button in the PCC software.

## PVP Settings

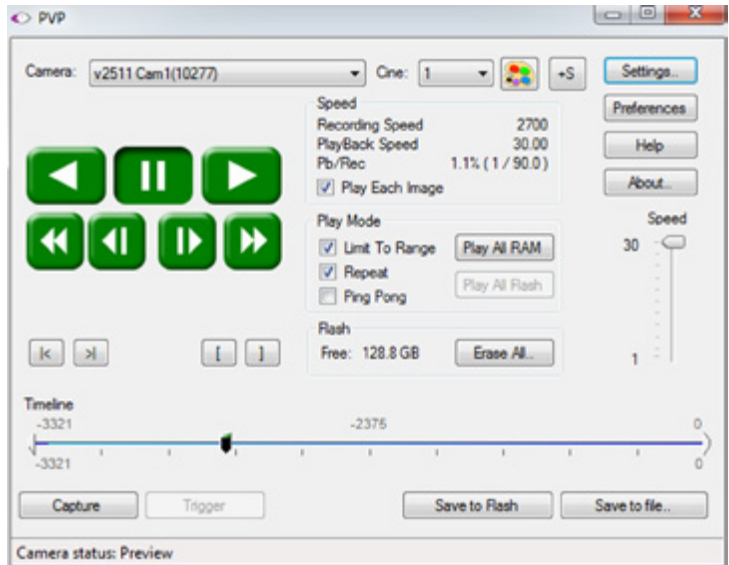
Video output parameters are set by opening the 'Pvp Settings' windows. This includes control for the video system, 4K video and on-screen display parameters including production area rectangles.



## Image Tools

Click on the palette from the main PVP window to activate the 'Image Tools' menu. It is basically the same as the equivalent menu in PCC. It can be used to adjust image processing parameters including; brightness, gain, gamma, toe, saturation, white balance and more.

Any image tools adjustments will also apply to the PCC live image and the metadata in saved Cine Raw files.



## The Main PVP Window

Basic capture and playback are performed from the main 'PVP' window. The 'Capture' button starts recording to RAM when the camera is in 'Loop' mode. Press 'Trigger' to stop recording.

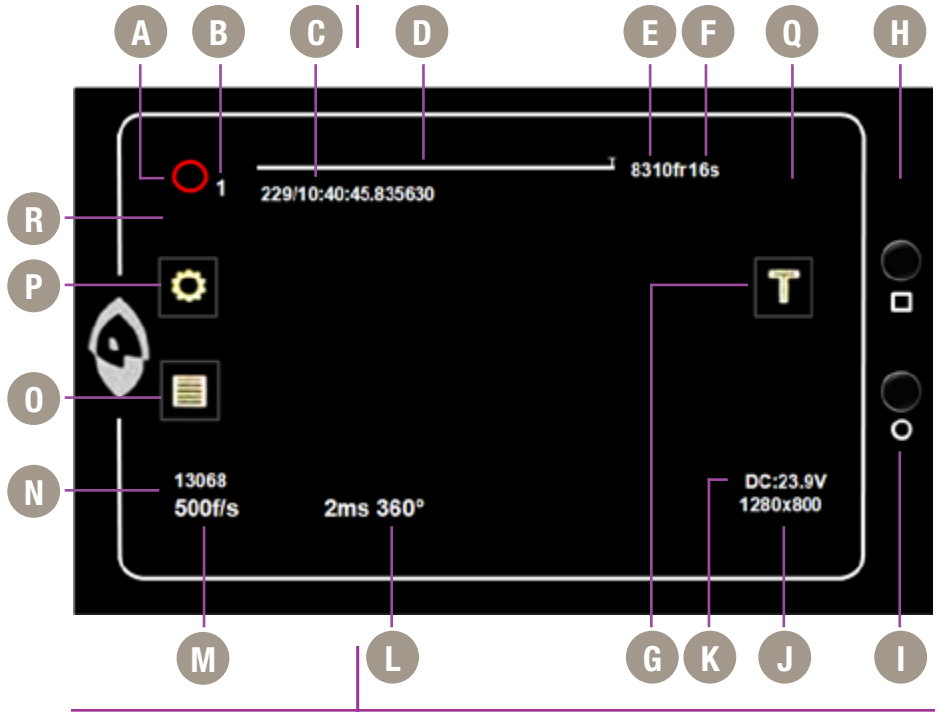
Switch to the desired clip to view by selecting it in the 'Cine:' pull-down menu. Clips from the Phantom CineMag are preceded by the letter 'F'. To return to the live output, select 'Live.'

Scroll through a Cine by dragging the play head back and forth on the timeline. Use the playback controls to play forward and in reverse. Use the speed slider to change the playback speed.

Use the '[' and ']' buttons to mark in and out points. After trimming a clip, press the 'Save to Flash' button to save it to the Phantom CineMag, or 'Save to File...' to download it to the computer.

It is also possible to erase the entire contents of a CineMag by clicking the 'Erase All...' button.

# capture & setting



- |   |                                 |
|---|---------------------------------|
| <b>A</b> Camera State                   | <b>K</b> Voltage / Battery Life |
| <b>B</b> Cine # (for multi-Cine setups) | <b>L</b> Exposure Time          |
| <b>C</b> Time Stamp                     | <b>M</b> Speed                  |
| <b>D</b> Internal Memory                | <b>N</b> Serial Number / Name   |
| <b>E</b> Number of Frames Available     | <b>O</b> Cine Management        |
| <b>F</b> Record Time                    | <b>P</b> Menu                   |
| <b>G</b> Trigger                        | <b>Q</b> CineFlash Status       |
| <b>H</b> Menu Button                    | <b>R</b> IBAT Enabled           |
| <b>I</b> OSD Button                     |                                 |
| <b>J</b> Resolution                     |                                 |



# 4

# Miro LC Touch Screens

## Introduction

The LCD Touchscreen can be used both as a viewfinder and for touch screen controls.

The display will flip vertically when positioned upside down (such as mounted against the side of a camera, facing outward).

## Camera State

A

The symbol and color will change based upon the state of the camera.



Live: camera is not recording to internal memory. Displays a 'Live' image on the LCD and attached video monitor.



Capture: camera is recording to internal memory (RAM), and awaiting a trigger signal. Displays a 'Live' image on the LCD and attached video monitor.



Triggered: camera has been triggered, and is filling internal memory ('Post-Trigger' frames). Displays a 'Live' image on the LCD and attached video monitor.



Cine Stored: recording has ended, and a Cine is stored in internal memory. Displays a 'Live' image on the LCD and attached video monitor.



Playback: camera is in PLAYBACK mode. RAM Cines can be selected for playback.

## Cine

B

Indicates the internal memory (RAM) partition the Cine is being recorded into.

## Time Stamp

C


Indicates the day of the year/hour:minute:second:microsecond.

## Internal Memory

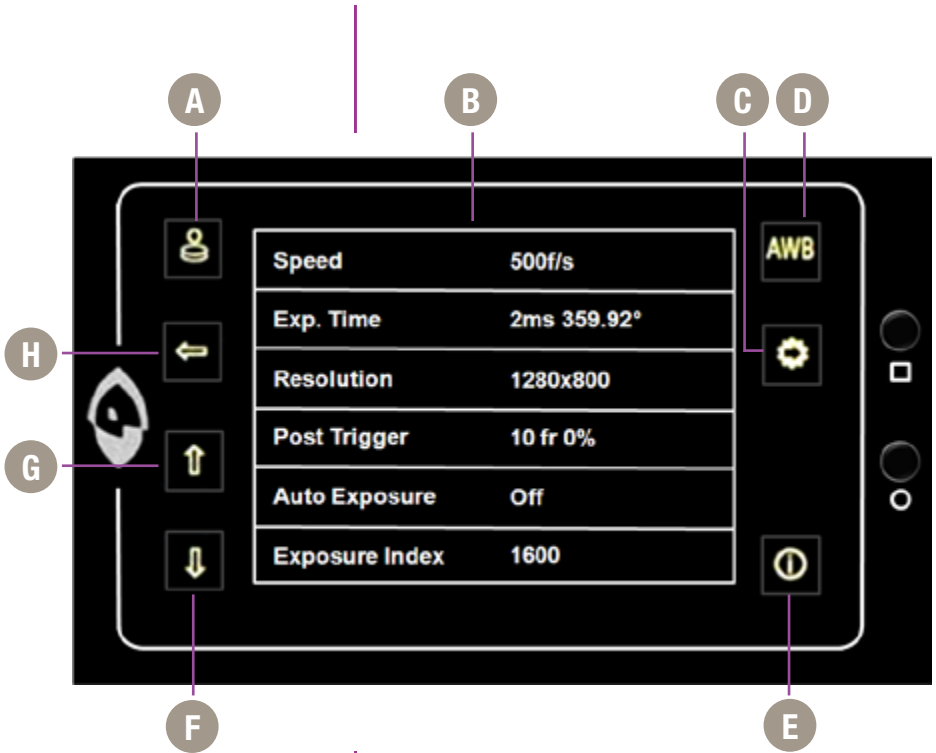
D

This 'time line' represents all frames available in the camera's internal memory (RAM buffer / circular buffer)

The 'T' symbol above the time line represents the user-defined trigger point.

<b>Number of Frames Available</b>	<b>E</b>	Indicates the exact number of recordable frames available in the camera's internal memory.
<b>Record Time</b>	<b>F</b>	Indicates the total length of recording time (in minutes and/or seconds).
<b>Trigger</b>	<b>G</b>	Triggers the camera. Trigger is also available from the red button on the front of the camera body, or via capture port.
<b>Menu Button</b>	<b>H</b>	Turns on/off 'Menu' icons. Exiting the menu is an electronic reset of the touch screen. Reset takes about 5 seconds. Double-clicking the square button also resets the screen.
		<div data-bbox="582 549 1106 646" style="background-color: #e6f2ff; padding: 10px; border: 1px solid #add8e6;">  <p>Tapping the center of the screen will also bring up menu icons.</p> </div>
<b>OSD Button</b>	<b>I</b>	Turns on/off all on-screen displays.
<b>Resolution</b>	<b>J</b>	Indicates the user-defined resolution (width x height), in pixels.
<b>Volatge / Battery Life</b>	<b>K</b>	Indicates the power status (counts down).
<b>Exposure Time</b>	<b>L</b>	Indicates the user-defined Exposure Time (in milliseconds or microseconds).
<b>Speed</b>	<b>M</b>	Indicates the user-defined frame rate.
<b>Serial Number / Name</b>	<b>N</b>	Indicates the camera serial number or user-defined camera name.
<b>Cine Management</b>	<b>O</b>	Tap to view and select Cine files stored in RAM, save and/or delete to re-arm the camera.
<b>Menu</b>	<b>P</b>	Tap to view the main 'Capture and Setting' control interface.
<b>CineFlash Status</b>	<b>P</b>	Displays the status, number of gigabytes used, and size (in gigabytes) of the Phantom CineFlash.
<b>IBAT Enabled</b>	<b>P</b>	Displays when IBAT (Image-Based Auto-Tigger) is enabled.

# main menu



## Factory & User Settings

A

Tap to display 'Factory & User Settings' menu used to load the factory settings, access three factory-saved presets, or store up to 6 of your own presets.

## Capture & Settings

B

Scroll up and down for desired setting. Tap once to select parameter to change.

## Menu Categories

C

Used to jump to menu categories in the camera's main menu list.

**AWB**

**D**

AWB (Automatic White Balance) automatically adjusts the camera's white balance.

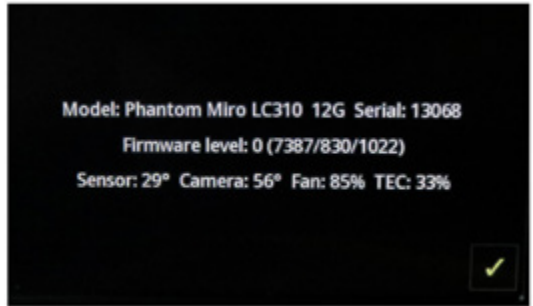


**Camera Info**

**E**

Place a non-saturated white or neutral object in the center square and tap once.

Camera Info displays model, serial #, memory size, firmware level, and current temperature readings.



**Scroll Up**

**F**

Scroll up the 'Capture & Setting' menu.

**Scroll Down**

**G**

Scroll down the 'Capture & Setting' menu.

**Return**

**H**

Move up one level within the menu structure.

# menu description

Speed	100 f/s
Exp. Time	9ms 324°
Resolution	1280x800
Post Trigger	10 fr 0%
Auto Exposure	Off
Exposure Index	4000
Video Format	NTSC
Color Bars	Off
Prod. Area	0x0
White Balance	5191K
Color Comp.	+0.51
Master Gamma	2.222
IBAT Enable	Off
IBAT Area	1x1
IBAT Position	-1,-1
IBAT Speed	0 fr
IBAT Sensitivity	Custom
RAM Partitions	1
At End of Recording	Do Nothing
Language	English
Advanced Settings	On

Menu above is always available

Auto Exp. Comp.	0.000
Shutter	Enabled
EDR	0µs 0%
Frame Burst	Off
Burst Period	305.9µs
Auto Black Ref.	Off
Save Region Start	First Frame
Save Region End	Last Frame
Frame Sync	Internal
Trigger Polarity	Falling Edge
Trigger Filter	32µs
Frame Delay	0ns
Aux Signal	Strobe
Ready Deasserts	After Trigger
Saturation	1.000
Master Black	0.000
Gain	1.000 1.000 1.000
Pedestal	0.000 0.000 0.000
Gamma	2.222 2.222 2.222
Matrix	Off
Tone	Off
PA Offset	0,0

Expanded menu (above) is displayed when 'Advanced Settings' is set to 'On'

## Setting Access

From the 'Main' screen tap the 'Menu' icon as indicated to bring up the main 'capture and setting control interface'.

Scroll up and down for desired setting, then tap once to select parameter to change.

## Speed

Defines the 'Speed' (Frame Rate / Sample Rate) that the camera will capture at. The available speeds will change according to the 'Resolution' selected. Smaller resolutions allow higher speeds.



The Resolution parameter should be defined before setting the Speed.

## Exp. Time

Defines the amount of time the sensor is exposed to light (in  $\mu\text{s}$  of exposure time and degrees of shutter angle). A smaller exposure time (shutter angle) reduces the chance of motion blur.

## Resolution

Resolution is the number of pixels used to capture an image. For example, Miro M120, if 1920 x 1200 (width x height) is set, the full sensor space is available.

Smaller resolutions allow higher recording speeds.



The image aspect ratio will be displayed with the defined 'Resolution' setting.

## Post Trigger

Defines the number of frames past the trigger point to be stored in the camera's internal memory (RAM / circular buffer).

## Auto Exposure

Adjusts the overall exposure of the image based on the light level measured within a user defined area of interest. The default is a 50% average exposure. As the lighting changes, the camera automatically adjusts the shutter speed to maintain a constant light level in the defined area.



This feature should not be enabled while performing a CSR, (Current Session Reference). Once enabled EDR (Extreme Dynamic Range) will be disabled.

## Exposure Index

EI (Exposure Index) is a reference value for the ISO level of the current shooting settings. A camera's default EI value is measured at the default gamma of 2.222. Increasing the EI adds gain to the video image, the more gain that is added the more digital noise will be visible in the resulting Cine. Vision Research recommends maintaining the EI as close to default as possible for best image quality.

## Video Format

Defines the video signal format the camera will transmit to a monitor. Formats include; NTSC, PAL, HD-SDI (1080psf, 1080i, 720p).

## Color Bars

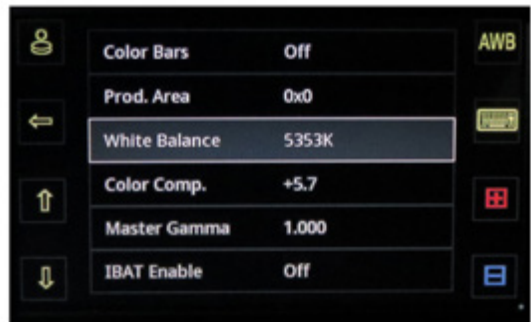
These are SMPTE Color bars, generated by the camera and output over the video signal. They are used for setting up a video monitor.

## Production Area

The camera will show the PA (Production Area) specified placing a red rectangle over the image. The production area is an overlay and is not recorded in the RAW data.

## White Balance

The camera's white balance can be set with the AWB on the upper right or manually by adjusting the color temperature and color compensation.



## Color Comp.

Color temperature adjusts the red and blue components of white balance.

Color Compensation (CC+0) adjusts the magenta and green components of the white balance.

<b>Master Gamma</b>	Gamma is the nonlinear relationship between signal level and brightness output of pixels, (a small signal level change at low voltage produces a larger variation in brightness than the same change in level at high voltage). A linear gamma would have the value of 1.0. The camera's default gamma setting is 2.2, which is a standard Rec709 compensation for most video monitors.
<b>IBAT Enable</b>	With IBAT (Image-Based Auto-Trigger) Enable set to 'On' the camera triggers itself when the image changes occur in a selectable region of the frame.
<b>IBAT Area</b>	Defines the size of the area (width x height) in pixels to check for an auto-trigger event.
<b>IBAT Position</b>	Defines the position of the 'IBAT Area' from the top left of the image at 0,0.
<b>IBAT Speed</b>	Defines the number of frames (interval) between updates the auto-trigger region is checked.
<b>IBAT Sensitivity</b>	Defines the amount a pixel value must change for auto-trigger purposes.
<b>RAM Partitions</b>	Defines the number of partitions, (15 segments maximum), the camera's internal memory buffer (RAM) will be evenly divided into.
<b>At End of Recording</b>	End of recording (automatic actions) can be set to: Play and Save, Play and Restart, Save and Restart, Play, Save and Restart.
<b>Language</b>	Changes the menu display to the desired language.
<b>Advanced Settings</b>	With 'Advanced Settings' set to 'Off', the menu ends here, and all advanced parameters are set to the camera's defaults.  With 'Advanced Settings' set to 'On', the menu expands and the camera's full functionality can be accessed.
<b>Auto Exp. Comp.</b>	Allows for plus / minus two f-stops from the default value of 50% of average exposure.



## Shutter

This activates shutter-off mode for PIV applications.

## EDR

EDR (Extreme Dynamic Range™) sets a unique exposure time (defined in microseconds or a percentage of the defined 'Exposure Time') to pixels that may become saturated, (over exposed).



This feature should not be enabled while performing a CSR, (Current Session Reference). Once enabled 'Auto Exposure' will be disabled.

## Frame Burst

Sets the number of frames in a burst, ('off' disables Burst Mode).

## Burst Period

Sets the interval between frames in a burst (defined in microseconds).

## Auto Black Ref.

When set to 'On' a black reference operation will be performed when the camera is placed into the capture or 'waiting for trigger' mode with the results being saved with the Cine.

## Save Region Start

Sets the first frame for automatic functions like auto-save to CineFlash and Auto-Play to video. If not selected the first frame will always be the beginning of the full recording.

## Save Region End

Sets the last frame for automatic functions like auto-save to CineFlash and Auto-Play to video. If not selected the last frame will always be the end of the full recording.

## Frame Sync

This field instructs the camera to utilize one of the following three frame sync clock sources:

- Internal - instructs the camera to utilize its' internal crystal oscillator to drive the camera's 'Speed' (sample / frame rate).
- External - should be selected when an externally supplied frame sync clock pulse is supplied to drive the camera's sample rate.
- IRIG - should be selected when an IRIG-B signal is supplied to drive the camera's sample rate.

## Trigger Polarity

Defines whether the 'Rising Edge' (leading edge) or 'Falling Edge' (trailing edge) of a TTL supplied input trigger signal is used to trigger the camera.

## Trigger Filter

Specifies the length of time (in microseconds) the trigger signal state (high / low) must be held to be a valid trigger signal.



If 'Trigger Polarity' is set to 'Rising Edge' the signal must be held low for a minimum of 10-times the 'Trigger Filter' time prior to going high to be a valid trigger signal.

## Frame Delay

Sets a delay time (defined in microseconds) between the 'Frame Sync' clock pulse and the frame capture to provide a phase shift in the timing.

## Aux Signal

Sets the signal type to be activated on the 'Auxiliary' pin of the capture connector.

## Ready Deasserts

Defines when the 'Ready' signal is turned off.

## Saturation

Adjust the color 'Saturation' of the images being displayed. Increasing the value results in the images being displayed with more brilliant color, while decreasing the value results in the images being displayed with less dazzling color.

## Master Black

The 'Master Black' (Pedestal) parameter is used to change the voltage level corresponding to black or to the maximum limit of black peaks.

## Gain

'Gain' will raise or lower the gain in each independent color channel when adjusted.

## Pedestal

'Pedestal' will raise or lower the black level of each independent color channel when selected.

## Gamma

'Gamma' will apply an independent gamma curve to each color channel.



Gain, Pedestal, and Gamma settings are applied on top of the overall gamma and color corrections.

## Matrix

Color Matrix is an advanced color matching tool, which previously was reserved for video engineers to match the HD-SDI output of cameras in a broadcast environment. In Phantom Miro M- and LC-series cameras, a user 'Matrix' can be specified to fine-tune the color of both the Cine image and HD-SDI output.

By adjusting the user 'Matrix' the image can be finely tuned, so that individual colors can be adjusted in terms of tint and saturation. A common use for this is to match the color with another camera on the same shoot accurately.

## Tone

Tone allows manual control over the tone curve of the image. Tone curves change the shadow / highlight relationship between the original values (on X axis) and resulting values (on Y axis).

Tone curves can be useful to boost mid tones within the image without affecting highlights or shadows, for example. They can also be used to push the darks lower, which may result in richer images when details in the shadows are not required. There is a relationship with overall image gamma, which has a predefined curve, which is the equivalent of Rec709.

## PA Offset


The Production Area Offset is used to move a user-defined 'Production Area' displayed on the LCD or attached monitor. By default, the 'Production Area' is displayed in the center of the image display area.

# setting parameters

## Menu Access

Click the 'Square' button once to bring up touch screen menu. Tapping the center of the screen will also bring up 'main menu' icons.

## Select Setting

Tap the menu  icon to bring up the main 'capture and setting' control interface.

Scroll up and down for desired setting, then tap once to select parameter to change.

## Set Parameter

On the right, + and - symbols will appear when applicable, and a keyboard symbol can also be selected for data entry.



The keyboard/data entry menu allows you to enter any available value, then tap the 'return' key to accept.



## Factory & User Settings

Click the 'Factory & User Settings' icon.

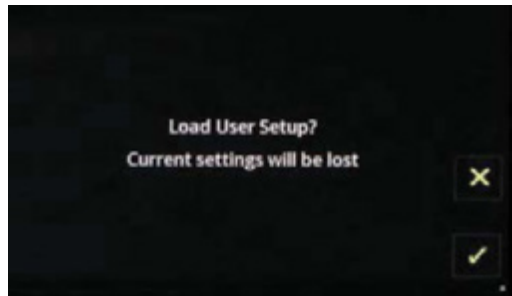
Load the factory settings, access three factory-saved presets, or store up to 6 of your own presets.



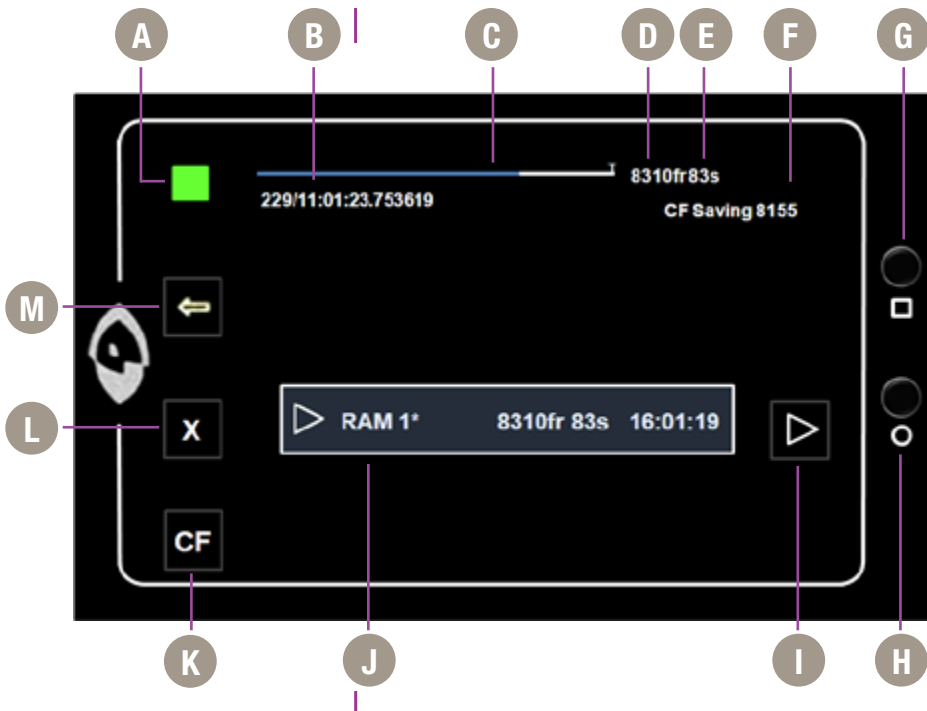
When saving a user-setup, enter a name and tap the 'return' button to save it. Any of the three factory saved presets can be modified or overwritten.



When loading any of the user settings or factory defaults, you must tap to confirm or cancel.



# file management



- |                                     |                               |
|-------------------------------------|-------------------------------|
| <b>A</b> Camera State               | <b>H</b> OSD Button           |
| <b>B</b> Time Stamp                 | <b>I</b> Play Cine            |
| <b>C</b> Internal Memory            | <b>J</b> Cine List            |
| <b>D</b> Number of Frames Available | <b>K</b> CineFlash Management |
| <b>E</b> Record Time                | <b>L</b> Erase Cine           |
| <b>F</b> CineFlash Status           | <b>M</b> Return               |
| <b>G</b> Menu Button                |                               |

A B C D E G H

See 'Capture & Setting' earlier in this chapter for descriptions.

M

See 'Main Menu' earlier in this chapter for description.

CineFlash Status

F

Displays the status of the Phantom CineFlash, space used and the number of frames being saved.

Play Cine

I

Opens the 'Play' Cine screen.

Cine List

J

Used to select a Cine from the list to play or erase (asterisk indicates Cine was not yet saved).

CineFlash Mangement

K

Opens the CineFlash Management screen (displays list of Cine files stored on CineFlash drive).

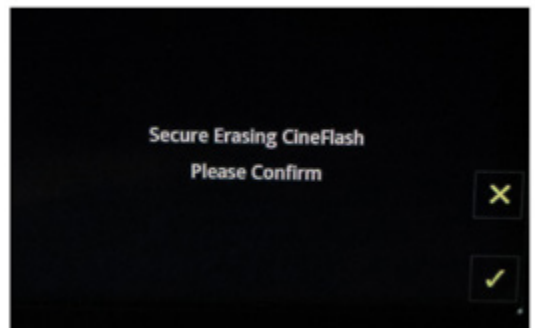
Erase Cine

L

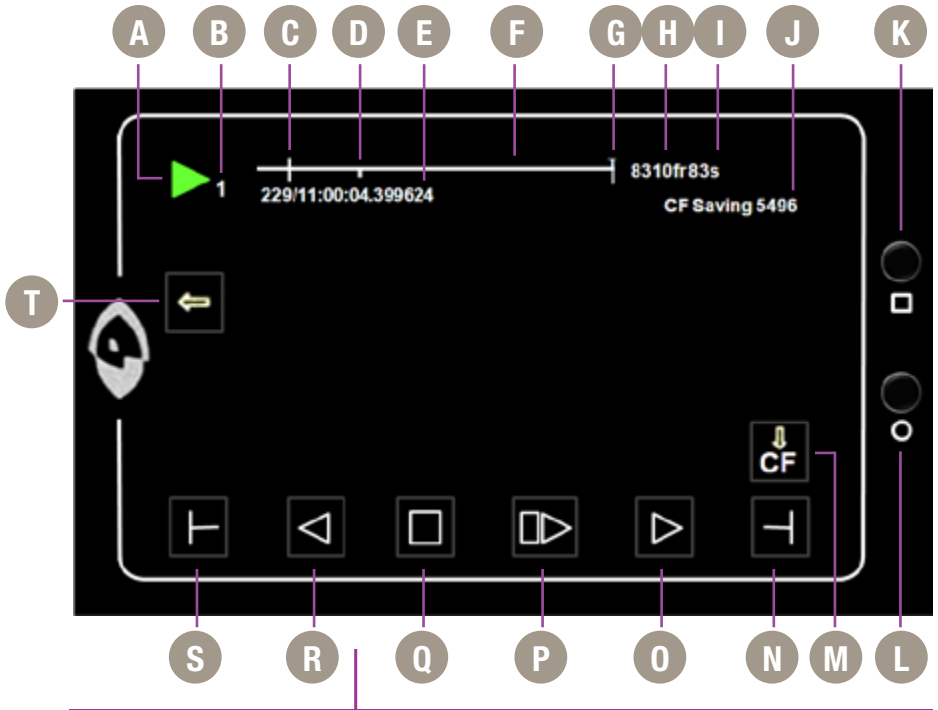
Erases selected Cine from the camera RAM (displays when a Cine is selected).



Delete individual takes, or tap 'XCF' to format (secure erase) the drive.




# play



- |                                     |                            |
|-------------------------------------|----------------------------|
| <b>A</b> Camera State               | <b>L</b> OSD Button        |
| <b>B</b> Cine                       | <b>M</b> Save to CineFlash |
| <b>C</b> Mark In Point              | <b>N</b> Mark Out          |
| <b>D</b> Image Location             | <b>O</b> Forward           |
| <b>E</b> Time Stamp                 | <b>P</b> Forward 1-Frame   |
| <b>F</b> Internal Memory            | <b>Q</b> Stop / Pause      |
| <b>G</b> Mark Out Point             | <b>R</b> Reverse           |
| <b>H</b> Number of Available Frames | <b>S</b> Mark In           |
| <b>I</b> Record Time                | <b>T</b> Return            |
| <b>J</b> CineFlash Status           |                            |
| <b>K</b> Menu Button                |                            |



<b>A</b>			See 'Capture & Setting' earlier in this chapter for descriptions.
<b>E</b>			
<b>F</b>			
<b>H</b>			
<b>I</b>			
<b>K</b>			
		<b>L</b>	
		<b>T</b>	See 'Main Menu' earlier in this chapter for description.
	<b>Cine</b>	<b>B</b>	Indicates the internal memory (RAM) partition Cine being reviewed.
	<b>Mark In Point</b>	<b>C</b>	Indicates the first image of the entire Cine to be saved.
	<b>Image Location</b>	<b>D</b>	Indicates the displayed frame's location within the stored Cine file.
	<b>Mark Out Point</b>	<b>G</b>	Indicates the last image of the entire Cine to be saved.
	<b>CineFlash Status</b>	<b>J</b>	Displays the status of the CineFlash and the frame number being saved (counts up).
	<b>Save to CineFlash</b>	<b>M</b>	Saves Cine file to CineFlash.
	<b>Mark Out</b>	<b>N</b>	Sets the end point of the Cine file to save.
	<b>Forward</b>	<b>O</b>	Plays the Cine file. Tap multiple times to speed up playback.
	<b>Forward 1-Frame</b>	<b>P</b>	Advances the Cine file one image.
	<b>Stop / Pause</b>	<b>Q</b>	Pauses playback. When paused button changes to 'Reverse 1-Frame' button.
	<b>Reverse</b>	<b>R</b>	Plays the Cine file in reverse. Tap multiple times to speed up playback.
	<b>Mark In</b>	<b>S</b>	Sets the starting point of the Cine file to save.

 Apply a long press over the 'Mark In' and 'Mark Out' buttons to reset .



# 5

## Download & Image Processing

### Introduction

The images recorded on the camera's RAM or Phantom CineMag are stored in a Vision Research proprietary RAW (uncompressed) file structure called a 'Cine' file.

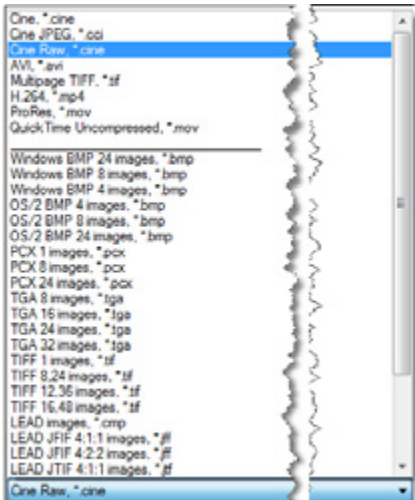
These Cine files can be converted to industry-standard formats (ProRes, H264, DPX, DNG, TIFF, JPEG, and more) with PCC software provided by Vision Research. Phantom PCC and PVP software are only compatible with Windows operating systems; however, there are third party solutions available for working with Phantom cameras in Mac OSX.

### PCC Software Solutions

Windows-based PCC software provides the ability to convert cine files into a number of other formats.

### Converting Cine Files

Single cine files can be converted by selecting the desired format from the 'Save as Type' selection list in the 'Save Cine' dialogue window.



The file formats above the separator line in the 'Save as Type' selection list are 'movie-like' formats (meaning the entire clip will be saved as a single file) while the formats below the line are image formats (meaning each frame of cine will be saved as a sequence of images).



Apply a long press over the 'Mark In' and 'Mark Out' buttons to reset .

To convert a cine to a 'movie-like' format select the desired format from the list, navigate to the destination folder, assign a file name to the clip and save.

Some valuable parameters can be found in the 'advanced settings' window, such as the particular codec (coder / decoder). In the case of ProRes, the default is 4:2:2 HQ; however, other options are available.

Other formats, like .avi and .mp4 allow the compression ratio to be entered. The lowest compression is the default.

To convert a cine clip into a sequence of images (frames) you must add one of the following annotations to the end of the file name: '!n' or '+n (where n is the number between 1 to 8). This will assign the sequential frame numbers to the file name for each frame being created.

Example: image\_!5.tif

The '!' annotator instructs the software to append the cine's image number (relative to the trigger point) to the file name. If the first frame in the clip is - 100, then the first converted frame will have the name: image\_-00100.tif.

The '+' annotator will add frame numbers starting from 1.

Example: image\_+5.tif

This will cause the first converted frame to have the name: image\_00001.tif



Ensure all image adjustments have been applied prior to initiating the conversion process. All metadata (gain, gamma, saturation, etc.) will be embedded into the converted images.

## Batch Convert



The 'Batch Convert Files' toolbar button can be used to convert a single, or multiple saved cine files into any one of the supported file formats.

Use the shift and/or control keys, to select the cine files you wish to convert in the 'Open Cine' dialogue window, then click the 'Open' button.

Navigate to the destination folder, in the 'Multifile Convert Destination' dialogue window, and select the file format.

The 'File Name' will depend upon the type of file format you are converting to.

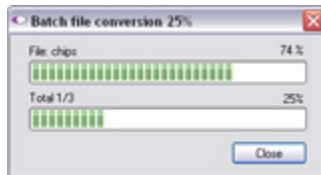
If you are converting the Cine file into a 'movie-like' formats leave the file name as 'All selected files'. The software automatically assigns the original file name to the converted file and appends the appropriate file extension.

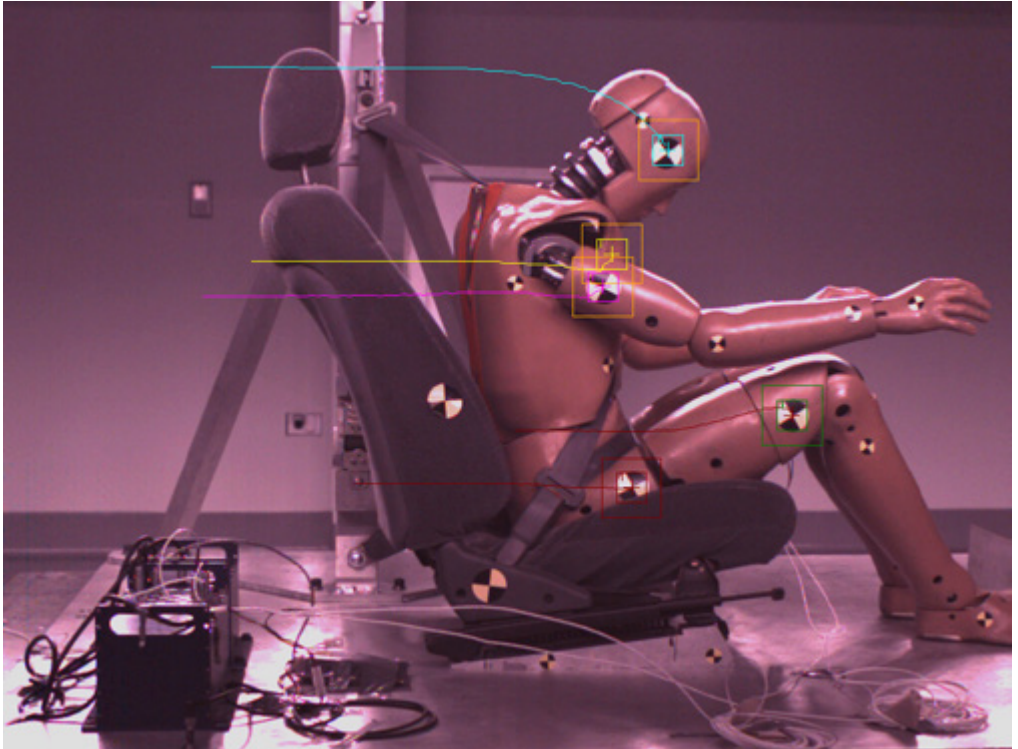
However, if you are converting the file into a sequence of images, you need to enter the Annotation only detailed in the 'Convert a Cine' topic earlier in this chapter.

Example: +4

The software automatically creates a separate folder for each of the files being converted, assigns the original file name, and appends the appropriate image number and file extension to each image.

Once the 'Convert' button is clicked a progress window appears. Each converted cine will be placed in its own folder named after the original cine file.





*For details on how to use the various PCC measurement tools can be found in the Phantom (PCC) Camera Control Application Help File > Step-by-Step Procedures > Play Panel Procedures > Measurements.*

# 6 Measurements

## Introduction

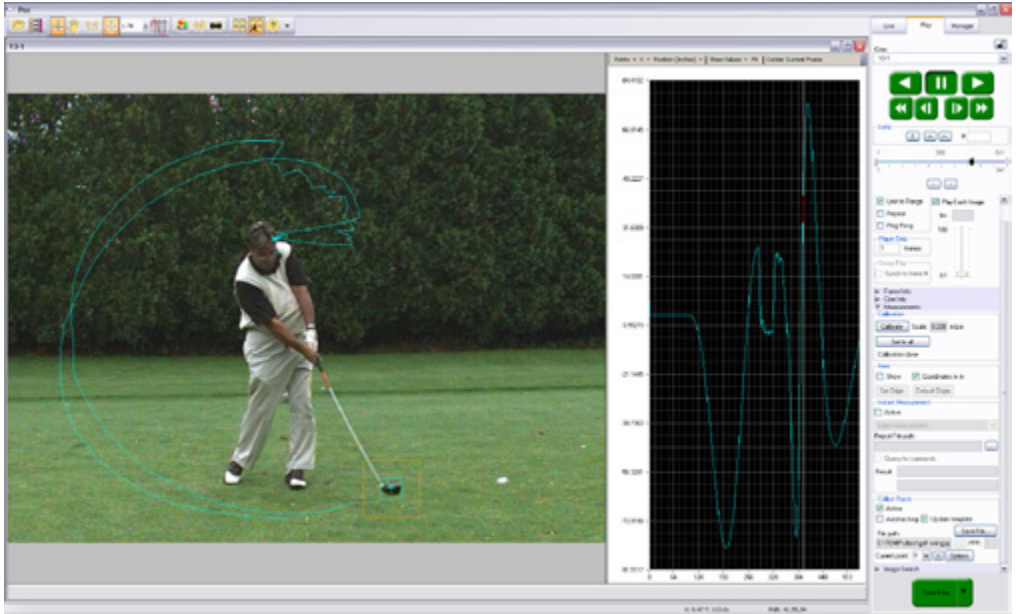
High-speed photography is as much of an engineering tool as an oscilloscope, spectrum analyzer, or logic analyzer. The photographic technique enables us to visualize and analyze motion, especially motion that is too fast for the human eye or conventional cameras to perceive.

For decades, Phantom Cine (high-speed digital video) files have been used to measure moving objects by the defense, scientific and research, and industrial communities to extract and quantify motion from a file.

As high speed digital cameras continue to make advancement in recording speeds, sensitivity and resolutions so must the motion analysis software used to extract the data they record. Data that allows the defense community to examine the speed, angle and angular speed a shock wave from an explosive device.

Information automotive engineers require to evaluate the safety and effectiveness of an airbag design by determining the time, speed, and angle it takes the airbag to deploy fully. Studies by the scientific and research community analyzing human locomotion by measuring the angle, a knee joint bend and the compression the knee joint endures while running, or the speed of a lightning bolt. Not to mention manufacturers needing to measure the angular speed (Revolutions Per Minute) a new hard drive motor can spin without causing damage to the disk, or being able to measure the effect the angle of impact a golf club will have on the rotational speed of a golf ball.

The ability to analyze all of this data quickly and accurately inherently decreases product development time, and more importantly reduces research and development expenditures. Of course extracting this information from a digital high speed video is only as good as the tools used to accomplish it.



*PCC Multi-Layer Graphical User Interface automatically tracks golf club head to calculate swing speed, path, and acceleration.*

Using 2-D motion analysis tools, such as Vision Research, PCC (Phantom Camera Control) software calculates this valuable data. With today's software, the end-user can perform timing, position, distance, velocity, angle and angular speed measurements, and track multiple points or objects to compute and graph their XY-coordinates, speed, or acceleration. PCC, for example, provides several edge detection algorithms and image processing tools to improve the measurement process. The measurement technology provides a motion analysis system that harmonizes measured data with images. In this chapter, we will review the various PCC measurement capabilities.

## Units of Measurement

Units of Measurement specify the computing and reporting unit for distance, speed, acceleration, angle, and angular speed measurements.



Establishing a measurement scale is required to set a specified number of pixels in the image equal to a scale unit size, such as millimeters, meter, inches, feet, or pixels.

To define a measurement scale, the analyst needs to select two points in the image with a known scale, then specify that scale size. Once created, all measurements are computed and displayed using the scale unit. If no measurement scale exists, the default scale will be 1 pixel = 1 pixel.

### Timing

To perform timing measurements accurately, a time stamp (date and time) is embedded into every frame captured. The PCC software function, for example, calculates the time difference between two event frames (start / end of an event) or from the captured image being displayed to the trigger (t0) frame automatically.

### Coordinate

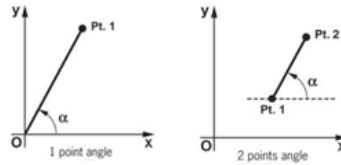
Coordinate measurements are calculated from an Origin point pixel, by default the top-left corner of the image; however, the Origin can be changed when performing measurements. Each coordinate consists of two numbers (x1, y1) indicating the position of a pixel in the image on the two-dimensional plane from the Origin point.

### Distance, Angle, Speed

Using 'Distance and Angle and Speed' instant measurement tools makes analyzing launch speed, angle, and angular speed or the revolutions of a rotating object extremely simplistic.

They allow engineers' developing large caliber weaponry to analyze the effect the design of the shell has on the projectile trajectory based on launch speed and angle to determine the optimal performance, or manufacturers of scientific equipment like anemometers to determine the best size and type motor to enhance their product by performing angular speed (rotational measurements) on the motors used to generate an electric current as they rotate.

PCC measures the distance from the Origin point to a chosen point, and the angle made by the Origin and Ox axis of the selected point using the Distance and Angle and Speed: Origin + 1 Point instant measurement tool.



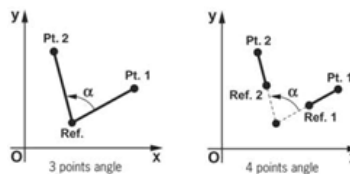
Given the coordinates of two points on the image plane, the distance ( $d$ ) between the points is calculated using the following formula:  $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ .

If the Origin and the chosen point are on the same image, PCC will calculate distance and angle only; however, if the Origin and the selected point are on different frames, the software also calculates speed and angular speed.

Speed ( $s$ ) is calculated using the formula:  $s = d/dt$ , where  $d$  = measured distance, and  $dt$  = [time of the point frame] – [time of the origin frame] if point and origin are on different frames.

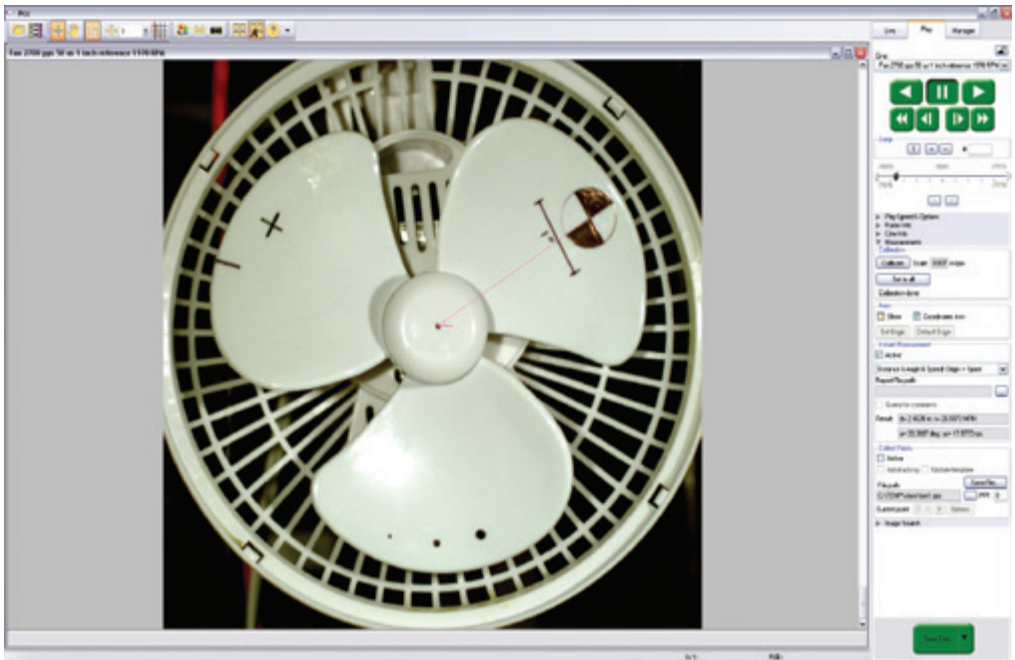
Angular speed is calculated using the formula:  $as = a/dt$ , where  $a$  = measured angle, and  $dt$  = [time of the point frame] – [time of the origin frame] if point and origin are on different frames.

The 'Angle and Angular Speed: 3 Points' instant measurement tool from PCC calculates the angle made by three points (two lines with a common reference point) while the Angle and Angular Speed: 4 Points calculates the angle formed by four points [Pt.1 Ref.1 and Ref.2 Pt.2]; two lines without a common reference point.



If all the points are in the same image when performing three or four-point measurements, the software only calculates the angle. In order to compute angular speed the first point and the reference point must be on the same image while the second point (three-points measurements) or reference point 2 and point 2 (four-point measurements) must be on different images.

Angular speed is calculated using the formula:  $\omega = \frac{a}{dt}$ , where  $a$  = measured angle,  $dt$  = [time of the last point frame] – [time of the first point frame] if first and last points are on different frames.



*PCC calculates speed (mph) and angular speed (rpm) of the fan motor using Distance, and Angle, and Speed: Origin + 1 Point measurement tool.*

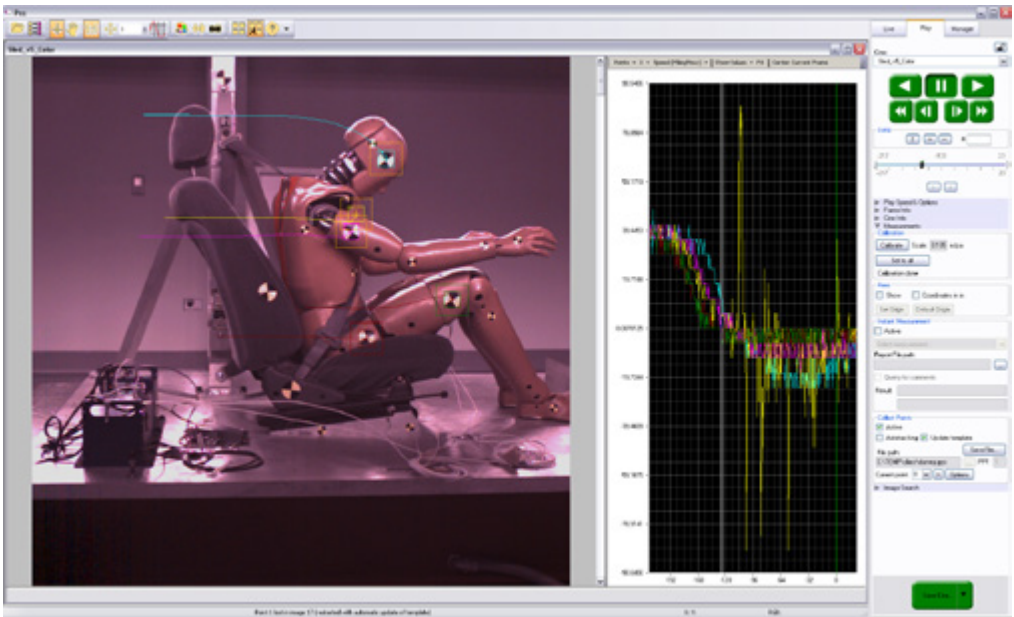
These measurement tools are exceptional when analyzing a rotating object.

The ability to measure an object, like a projectile rotating in mid-air, to determine its angular speed can be applied in other sciences, for example, the way 2 x 4 board could tumble in hurricane-force winds can be applied by

## Collect Point (Tracking)

manufacturers who develop unbreakable glass windows, or engineers developing stabilizers for aircraft.

PCC also provides a Collect Point (tracking) tool to compute the position, speed, acceleration, and / or generate motion graphs of a point (or object) or multiple points (up to 99), with respect to the image plane, over time. The analyst can use one of two methods to track 2D motion (Automatic or Manual).



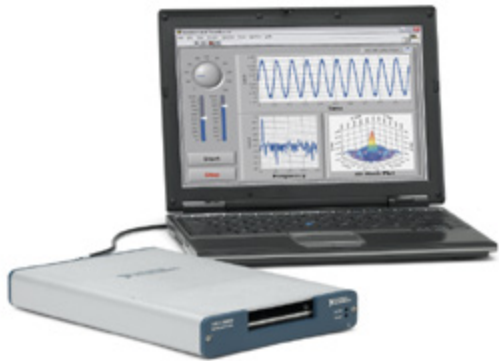
Example of three points being tracked. The graph plots and displays, by default, the x-axis coordinate of all points / targets from the Origin point.

With Automatic Tracking, the analyst needs to define a rectangle (width and height in pixels) around a template image region (the point being tracked). The analyst defines a second rectangle that the tracking algorithm should search in (how large of an area to search) for the previously tracked point. A value equal to the track point indicates that the tracking algorithm should search in a region as large as the initial region size.

Larger values will result in greater search areas, which will take a longer time to search. Typically, this parameter is set two to three times the size of the initial image template (defined in pixels). When initiated, the software will automatically find and track the template region as it progresses through each frame.

Manual Tracking requires the analyst to select every point being tracked for each frame. With either method all tracked points are logged to a measurement file that can be used to generate a coordinate, speed, or acceleration spreadsheet easing report generation.

## Data Acquisition



To investigate the effect environmental conditions may have on the recorded data, a National Instrument™ USB- or M- Series Data Acquisition (DAQ) module can also be used to acquire data from a wide range of sensors, and synchronize it with slow-motion video images recorded on a Phantom camera, using Phantom Camera Control (PCC) software.

## SDK (System Developer Kit)



Phantom camera control, and Cine playback, analysis and measurements can be customized to meet the specific test protocols using the Phantom System Developer Kit (SDK) for LabVIEW (Laboratory Virtual Instrument Engineering Workbench) or MATLAB (matrix laboratory) drivers.

The LabVIEW SDK contains visual instrument (VI) files needed to call Phantom SDK functions from LabVIEW, various utilities, and demo applications. This SDK uses the LabVIEW interface to shared libraries to call functions from Phantom libraries.

The MATLAB SDK contains header files needed to call Phantom SDK functions from MATLAB, function wrappers, a simple object-oriented layer and demo scripts. This SDK uses the MATLAB interface to shared libraries to call functions from Phantom libraries.

SDKs allow, for example, automotive manufacturers to create command line scripts to control a Phantom camera directly from a computer or run in a Graphical User Interface specifically designed to perform or analyze airbag tests with having to use PCC. Anyone who wishes to have more control over their Phantom camera or the Cine files record would benefit using one of these Phantom System Developer Kits.

## Conclusion

Digital high speed video has been and continues to be a useful test and measurement tool.

Along with PCC software, the need to use calculators or slide rules to perform complicated mathematical calculations to compute distance, speed, angle, angular speed, or acceleration measurements of single or multiple points from 2D images has been eliminated.

The ability to perform these calculations with just a few clicks of a mouse button allow engineers, science and researchers, and developers will significantly reduce research and development time thereby increasing productivity.

These tools provide them with the ability to conduct even more precise and accurate analyses of ballistics, explosions, weapon's development, trajectory, biomechanics, sport performance, flow analysis, crash, combustion, and stress studies, just to mention a few.





# 7 CineFlash & CineFlash Dock

## Introduction

The Phantom CineFlash is a powerful component of the Phantom Miro LAB / LC / R product lines, enabling Cine raw footage to be quickly transferred from the camera's RAM to safe, non-volatile storage. These lightweight, solid-state storage devices are hot-swappable and designed to keep you shooting on the go.

There are several benefits to Phantom CineFlash drives:

- **Security.** Immediately save your high-speed images from the camera's dynamic RAM to CineFlash non-volatile memory so you have a secure copy of your shot.
- **Productivity.** Eliminates the need to download the file after each shot, meaning less down-time in between takes.
- **Quality.** Files saved to the CineFlash are always saved in the Cine raw format, which maximizes image quality and workflow options.
- **Portability.** Whether using a Phantom RCU, the LCD interface or an auto-save setup, when saving to the CineFlash, there's no need to connect the camera to a PC during capture.

Once the CineFlash drive is full, download Cine raw files over the camera's Ethernet connection or via the Phantom CineFlash Dock's E-Sata or USB 3.0 connection. Using the CineFlash Dock and appropriate drivers, you can mount the CineFlash on a PC or Mac computer and easily manage your Cines files.

Every Miro LAB / LC / R Series camera purchase comes standard with a Phantom CineFlash drive and CineFlash Dock. Phantom CineFlash drives are available in 120GB, (Gigabytes) or 240GB sizes.

## Phantom CineFlash Installation

Open the Phantom CineFlash compartment door. Carefully align the insertion key guards, and slide the CineFlash into the camera until it is properly seated, then close the CineFlash compartment door.



## Phantom CineFlash Removal

Re-open the CineFlash compartment door.

Prior to removing the Phantom CineFlash verify that it is safe to remove it by ensuring the 'CineFlash Recording Indicator' (located inside the CineFlash compartment on the lower right-hand side) is inactive.



If the indicator is active (red), do not remove the CineFlash because a Cine is being recorded to the CineFlash.

## Phantom CineFlashDock Installation

Footage from Phantom Miro LAB / LC / R camera models is stored on CineFlash drives as 10-bit log raw cine files. The CineFlash drive is formatted using the Linux Ext2 file system, and can be accessed from the camera body over Ethernet, or remotely using a Phantom CineFlash Dock via USB3 or eSATA.

The CineFlash Dock is compatible with both PC and Mac computers once the appropriate EXT2 driver is installed. This allows 3rd party solutions that can read Cine raw files to see the file directly from the CineFlash. This also means that you can “drag and drop” the file from the CineFlash to local storage on a computer.



Phantom CineFlash Docks shipped after October 1, 2015 include the recommended Paragon ExtFS driver on a USB flash drive, which can be installed on a single Windows OS or Macintosh OSX computer, and installation instructions. During the installation process, you will be asked to provide a ‘Product Key’ and ‘Serial Number’ (located on the bottom of the Phantom CineFlash Dock – also beginning October 2015) to validate the single-user license.

Please note that the Product Key and Serial Number are bound to the computer on which the ExtFS driver is installed, not the Phantom CineFlash Docking Station.

CineFlash Dock users without the USB drive or product key can download and purchase the latest Paragon ExtFS drivers at <https://www.paragon-software.com/>

Once installed, the CineFlash will automatically be mounted when inserted into the dock. The CineFlash is less tolerant of being removed from the dock (disconnected from the computer) than a typical USB drive. Therefore, you should ALWAYS unmount the CineFlash before removing it from the dock or disconnecting the dock from the computer if it has a CineFlash in it. This ensures that all data is written and flushed to the disk before removing the drive.

Users can access, play, edit and save the cine files using Phantom PCC or the Phantom CineViewer software (Windows only). To view and play the cines on a Mac, the GlueTools Phantom Cine plugin is recommended and is available from GlueTools.com



# 8

## Accessories

### Batteries & Battery Charger

The Sony BP-U30 and BP-U60 are lithium-ion batteries designed for professional video shooting in both the field and the studio. These BP-U Series compact lithium-ion batteries boast high power in a compact body.

The batteries are equipped with the professional 'INFO' function that intelligently communicates battery status data to the camera.

The remaining capacity of the battery is displayed on the LCD monitor and viewfinder when the camera is powered on. This intelligent battery-management function allows operators to monitor the battery status easily and accurately.

The BP-U30 and BP-U60 also have LED displays to indicate the remaining capacity of the battery at the push of a button on the battery itself.

The BC-U1 Battery Charger can be used to charge one BP-U60 or BP-U30 battery at a time. And provides a 12 VDC, 2.0A power output.






BC-U1 Battery Charger must be used to recharge the batteries.

Batteries do not recharge through the camera.



*BC-U1 Battery Charger*

Specifications	BP-U30 Lithium-ion Battery	BP-U60 Lithium-ion Battery
		
<b>Dimensions (W x H x D)</b>	1 11/16 x 3 1/4 x 2 3/4 in (41.5 x 82.5 x 69.7 mm)	1 11/16 x 3 1/4 x 2 3/4 in (41.5 x 82.5 x 69.7 mm)
<b>Mass</b>	8 oz (220 g)	15 oz (350 g)
<b>Maximum / Nominal Voltage</b>	16.4 VDC / 14.4 VDC	16.4 VDC / 14.4 VDC
<b>Miro Run Time</b>	45 minutes	90 minutes
<b>Approximate Charge Time (Using the BC-U1)</b>	130 minutes	170 minutes
<b>Operating Temperature</b>	-4 to +113 °F (-20 to +45 °C)	-4 to +113 °F (-20 to +45 °C)
<b>Remaining Capacity Display</b>	Four LED (20, 40, 60, and 80%)	Four LED (20, 40, 60, and 80%)

	BP-U30 Lithium-ion Battery
	
<b>Power Requirements</b>	100 VAC to 240 VAC, 50/60 Hz
<b>Power Consumption</b>	38 Watts
<b>Operating Temperature</b>	+32 to +113 °F (0 to +45 °C)
<b>Dimenisons (W x H x D)</b>	5 1/8 x 1 13/16 x 3 7/8 in (128 x 45 x 98 mm)
<b>Weight</b>	12 oz (330 g)
<b>DC Output</b>	12V, 2.0A
<b>Number of Mountable Batteries</b>	1
<b>Chargable Battery</b>	BP-U90 / BP-U60 / BP-U30
<b>Supplied Accesories</b>	(1) Operating Instructions (1) DC Output Cable (1) Warrenty Booklet
<b>Approximate Charge Time</b>	170 min (BP-U60, 57 Wh) / 130 min (Bp-U30, 28 Wh)



Vision Research recommends the following procedure for safe battery installation and removal. Only Sony BP-U30 and BP-U60 batteries are guaranteed. Larger, heavier batteries should not be used. Failure to follow this procedure could result in physical damage to the camera, which must be repaired at a Vision Research service center.

## Battery Installation

Carefully insert the battery just above the terminals. Notice the key guides on the sides of the battery and camera. Insert battery either bottom-first or perfectly straight, then press down gently to lock in place.



Never insert the battery at a top-first angle.



Battery should lower smoothly, then snap in place. Guides will ensure the battery lowers over the terminals perfectly straight.



## Battery Removal

Slide the battery lock, on the top of the camera, forward, and lift the battery up and back to remove.



## RCU-2 (Remote Control Unit)

The Phantom Remote Control Unit (RCU) is a small, lightweight, hand-held controller, which allows you to adjust most settings on your camera as well as view and save recorded cines to the CineMag. The RCU is available in both wired and wireless versions. Both versions will connect with an included 5 meter cable direct to the back of the camera. It includes a Bluetooth dongle that allows for operation from up to 100 meters. Alternatively, the wireless model includes a Bluetooth dongle that allows for operation from up to 100 meters.

The 5" active TFT display is easy to use – even outdoors.

The display can act as an HD-SDI video monitor, a full-featured touch-screen controller, or both. An SDI cable connection is required to view the HD-SDI output from the camera on the RCU screen. Video is not transmitted via Bluetooth.

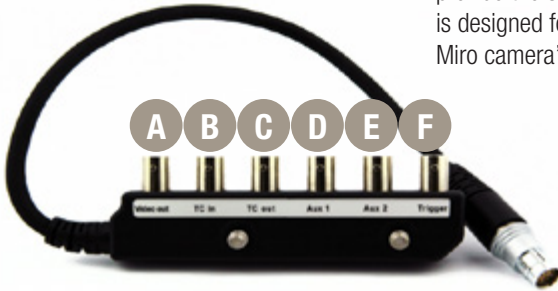


*Remote Control Unit*



## Miro Mini Break Out Box / Capture Cable

The Miro 'Capture' port is compatible with a multi-bnc capture cable and Phantom Miro Mini Break out Box (commonly known as the Miro MiniBOB). Both accessories provide the same functions. However, the Miro MiniBOB is designed for better cable management enhancing the Miro camera's capability.



Miro Mini Break Out Box



### Definitions of the available MiniBoB auxiliary signals:

**F-Sync (input / output):** Connect an external source, including the F-Sync from a second Phantom camera, to drive the camera's frame rate. Use in combination with Sync: External.

**Event (input):** When the Event signal is active, frames are tagged with an Event marker (as metadata). These events can be searched or referenced during playback.

**Strobe (output):** Signal goes low for the duration of each frame's exposure.

**MemGate (input):** When MemGate signal is active, the camera stops recording into its internal memory (frames are discarded).

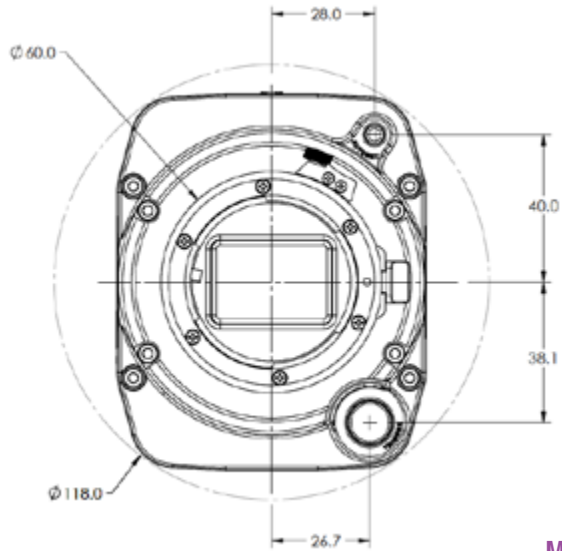
**Ready (output):** When Ready signal is high, it indicates that the camera is in capture mode. Using PCC, signal can be set to go low at trigger or at the end of recording.

- A** Video Out / Analog video (NTSC / PAL)
- B** TC In / TimeCode In (IRIG-B)
- C** TC Out / TimeCode Out (IRIG-B)
- D** Aux 1 / F-Sync, Event, Strobe, MemGate
- E** Aux 2 / Ready, Strobe
- F** Trigger

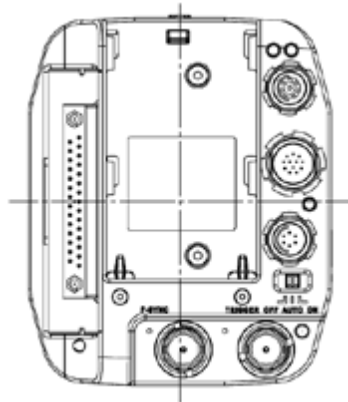


Capture Cable

- A** IRIG-In (White)
- B** Trigger (Red)
- C** Video Out (Green)
- D** F-Sync / Auxiliary (Black)
- E** IRIG-Out (Blue)

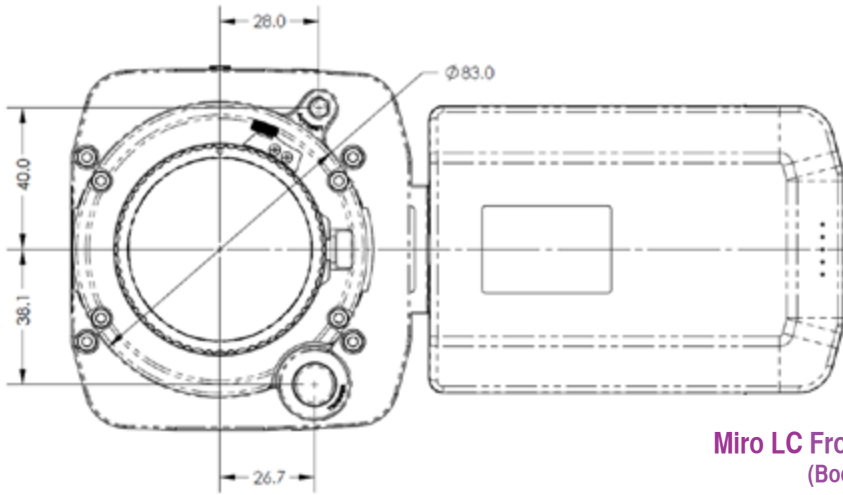


Miro R Front View  
(Body Type I)

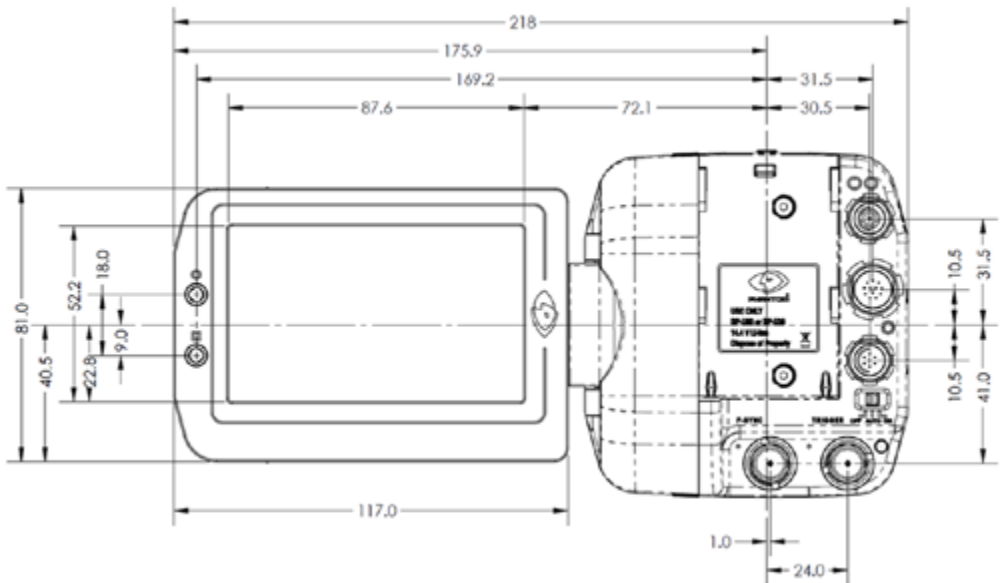


Miro R Rear View  
(Body Type I)

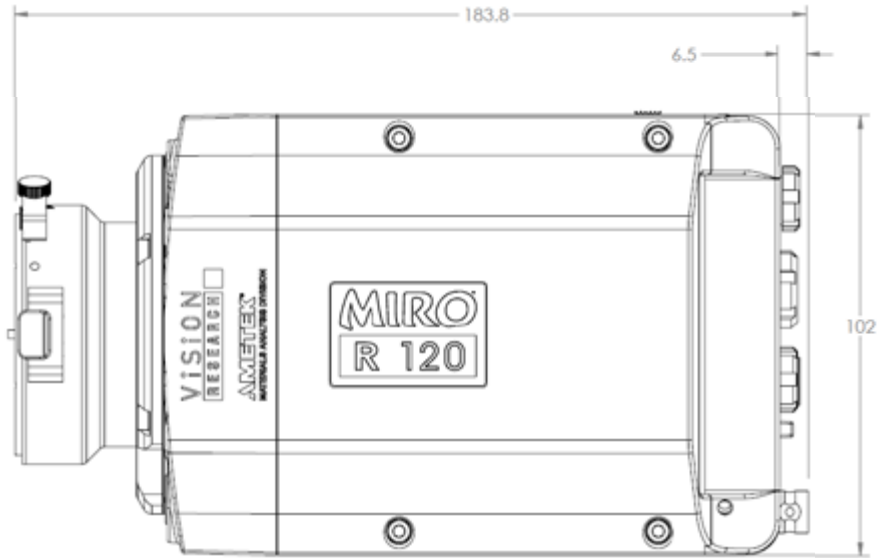
# 9 | Support



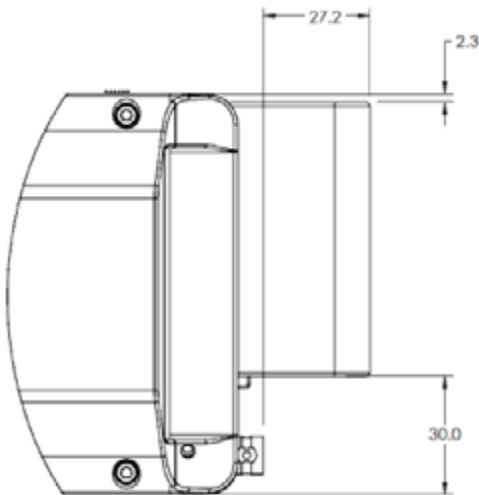
**Miro LC Front View**  
(Body Type I)



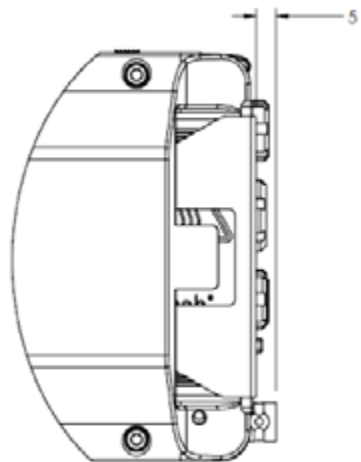
**Miro LC Rear View**  
(Body Type I)



Miro R Left View without Battery  
(Body Type I)



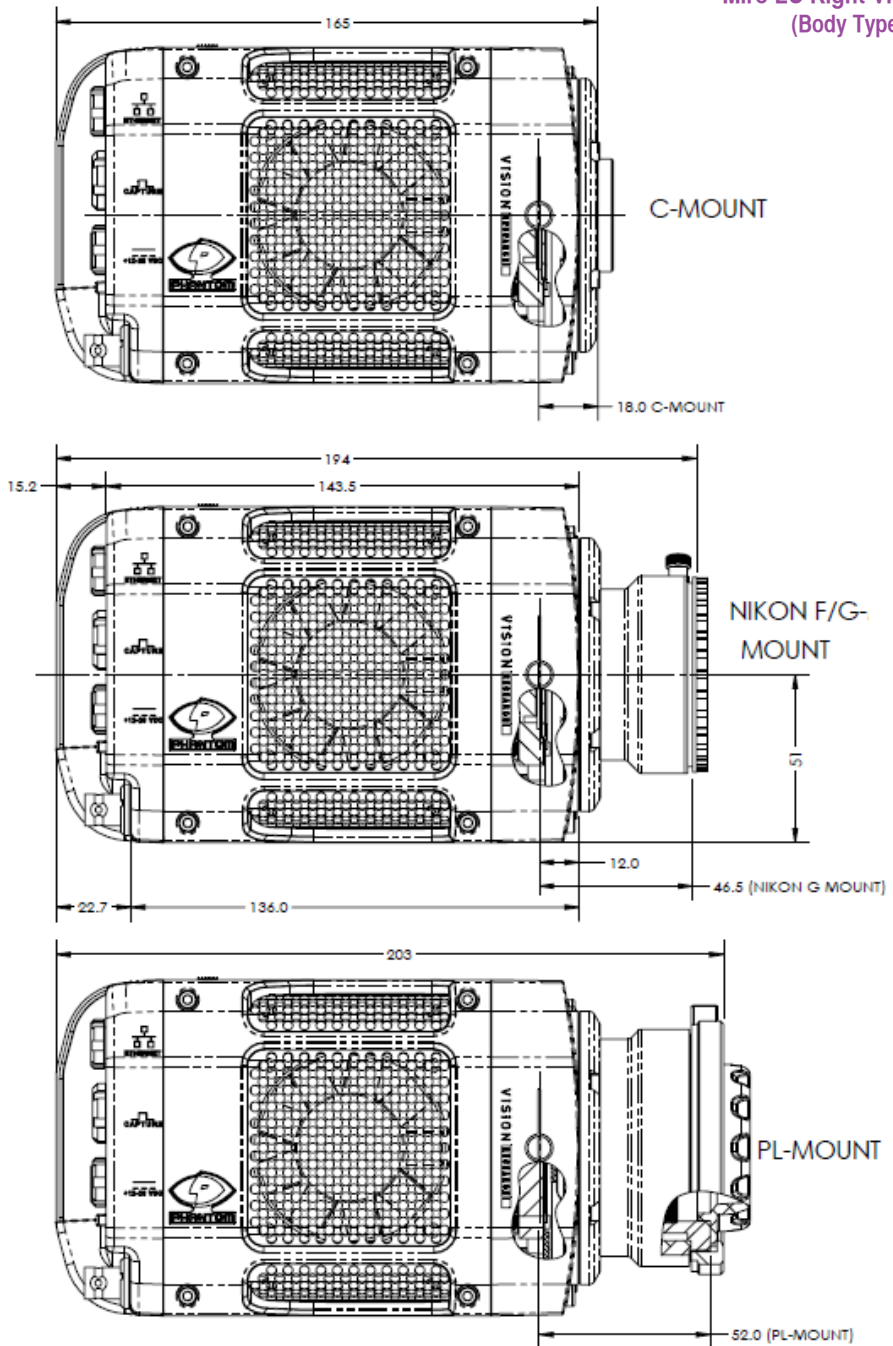
Miro R Left View with Battery  
(Body Type I)



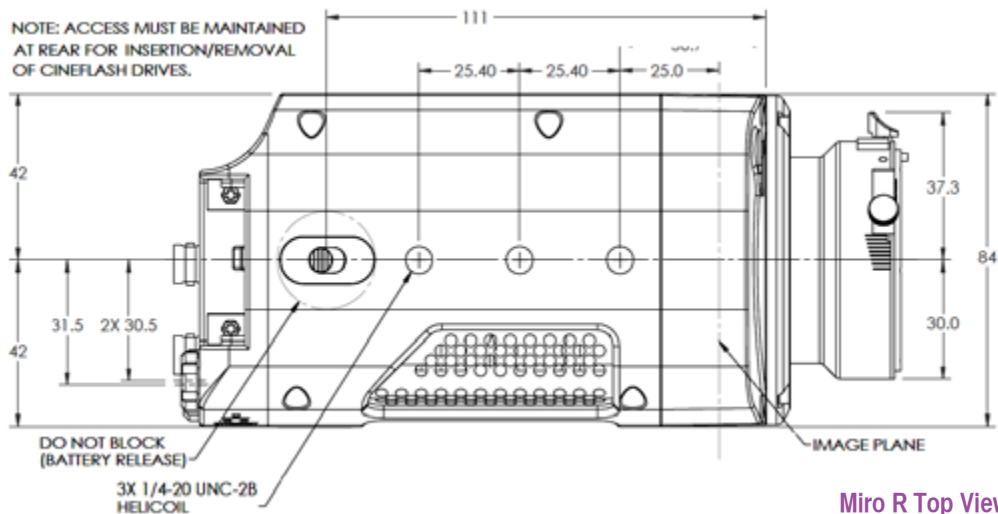
Miro R Left View with CineFlash  
(Body Type I)



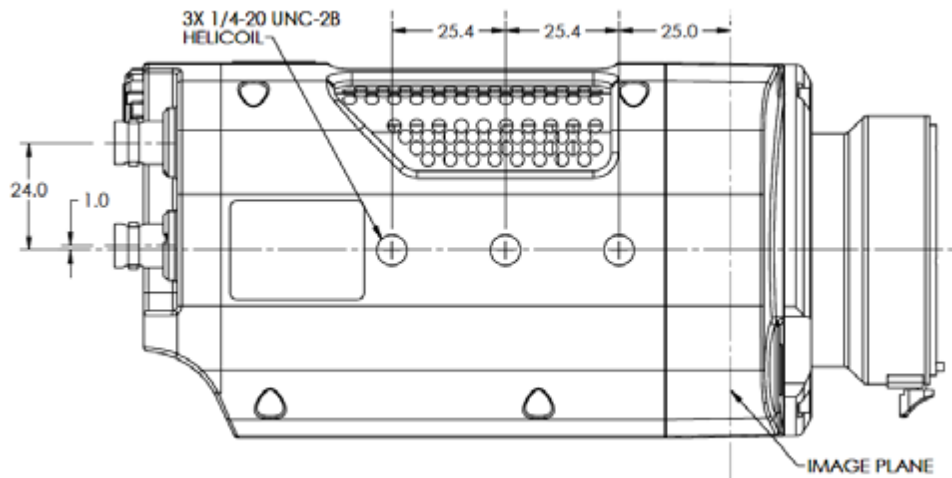
Miro LC Right View  
(Body Type II)



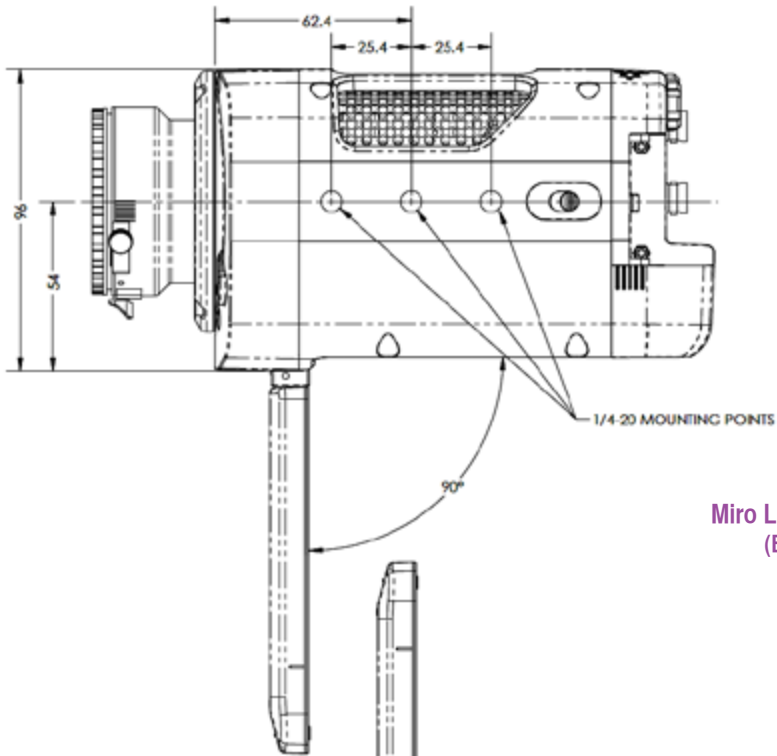
NOTE: ACCESS MUST BE MAINTAINED AT REAR FOR INSERTION/REMOVAL OF CINEFLASH DRIVES.



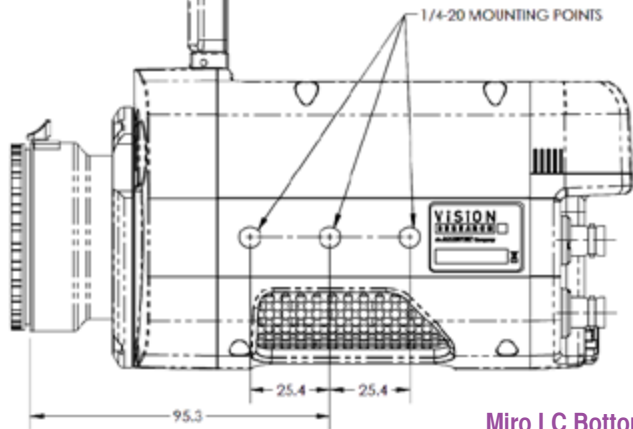
Miro R Top View  
(Body Type I)



Miro R Bottom View  
(Body Type I)

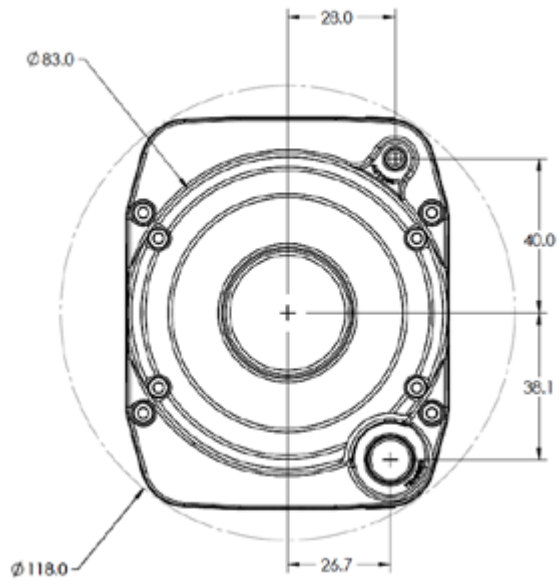


Miro LC Top View  
(Body Type II)

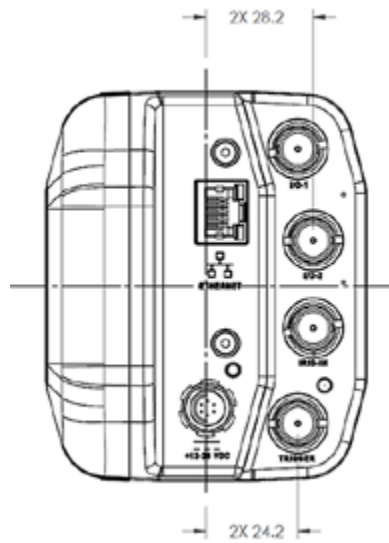


Miro LC Bottom View  
(Body Type II)

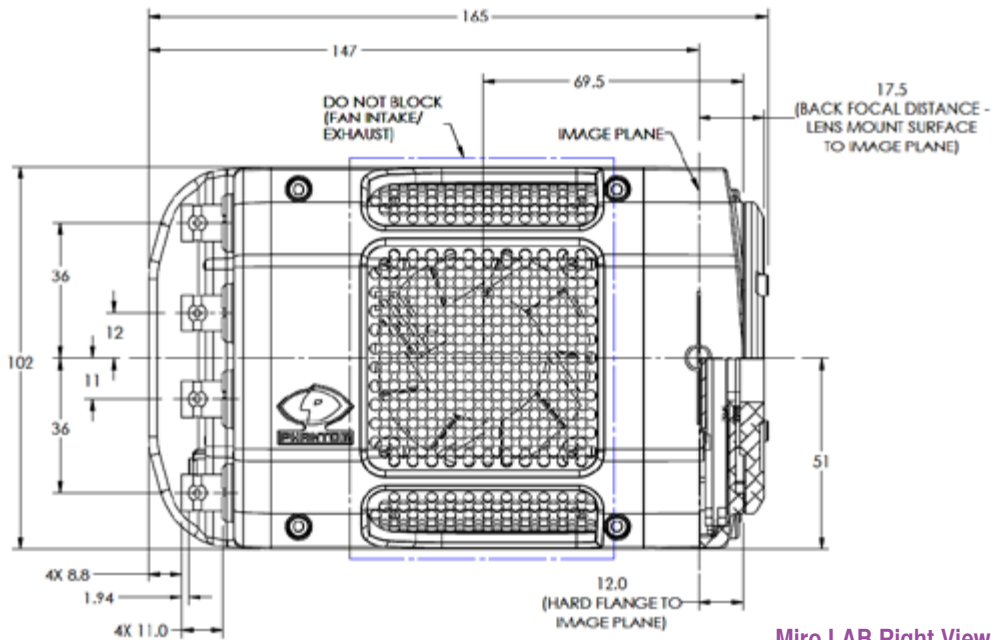




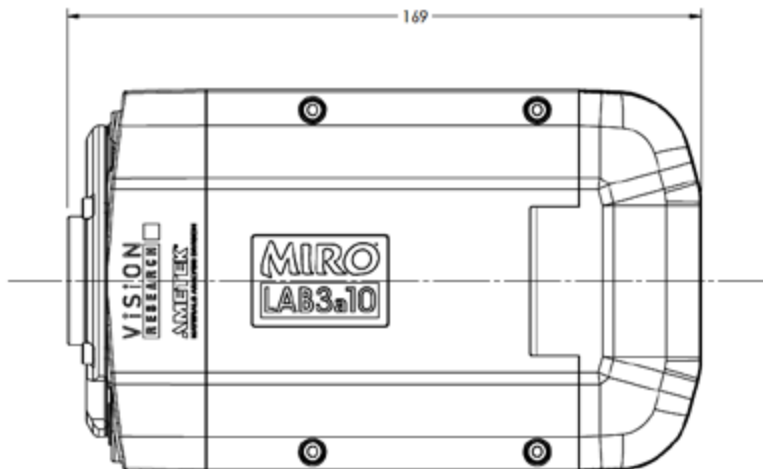
Miro LAB Front View  
(Body Type III)



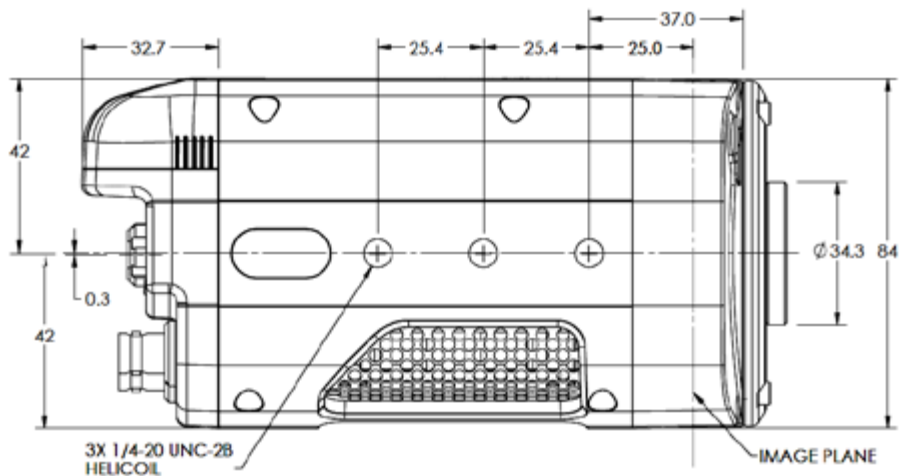
Miro LAB Rear View  
(Body Type III)



Miro LAB Right View  
(Body Type III)

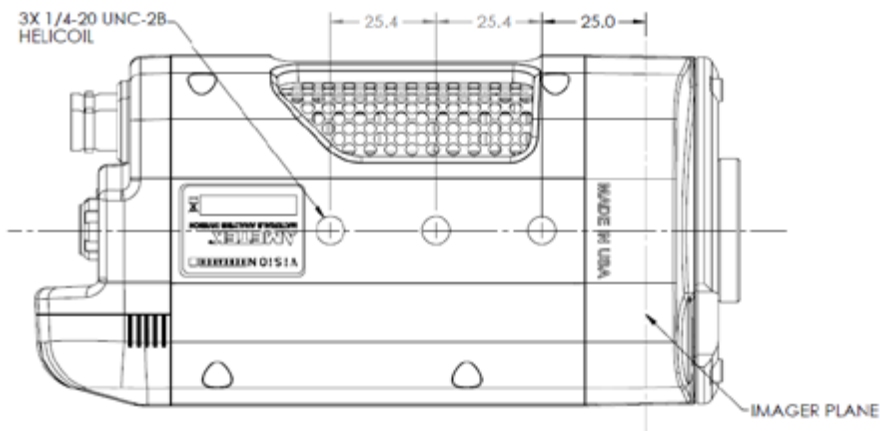


Miro LAB Left View  
(Body Type III)



Miro LAB Top View  
(Body Type I)

NOTE: CLEARANCE MUST BE PROVIDED FOR ROTATIONAL TRAVEL OF SSD DOOR AND ACCESS MAINTAINED AT REAR FOR INSERTION/REMOVAL OF CINEFLASH DRIVES.



Miro LAB Bottom View  
(Body Type I)

# indicators



Miro LAB / LC / R Series



Miro LC / R Series



The functionalities of the LED indicators are the same for both camera body types.

- Ethernet Link** **A** Ethernet Link - active (Green) when the camera connected to Ethernet network.
- Ethernet Activity** **B** Ethernet Activity - active (Yellow) when data transmission occurs between camera and control computer.
- Power** **C** Power - active (Red) when power is supplied to the camera (DC or battery).
- Capture** **D** Capture - active (Red) when the camera is recording to RAM); flashing when the camera is recording post-trigger frames to RAM); inactive when the camera in 'Live' mode.
- CineFlash Record** **E** CineFlash Record - active (Red) when saving image data to CineFlash. Do not remove the CineFlash if active.



Use these schematics to build custom cables at your own risk. Mis-wired cables can cause serious damage to the camera, which is not covered under warranty. Vision Research recommends only using cables supplied by Vision Research.



These pin-out diagrams refer to the connector on the camera body. Part numbers indicated are for the cable's connector.

## Phantom Miro LC / R Capture Connectors



Capture port  
12-pin Fischer (male) part # S-1031-Z012-130

PIN	NOMENCLATURE / FUNCTION
1	GND / Power Ground
2	GND / Power Ground
3	GND / Power Ground
4	TRIGGER-IN / Isolated Input. Active low. Can be activated by a switch to ground. The trigger pulse needs to be at least 3 microseconds long. Capture cable = Red
5	AUX / Strobe, Event, MemGate selectable. Capture cable = Black Strobe / isolated collector output with 1k pull-up, active during frame exposure. Event / active-low isolated input marks events during recording; signal must be active when the strobe is high. MemGate / active-low isolated input, temporarily stops image acquisition during recording.
6	READY / isolated collector output with 1k pull-up, indicates camera is ready for trigger. Capture cable = Black
7	IRIG-IN / Unmodulated IRIG-B timecode format input. Input withstands signals of up to +/- 15v. The input threshold is 1.5V, compatible with TTL levels. Capture cable = White
8	VIDEO GND / Reference Pin 9
9	VIDEO-1 OUT / Standard level, 75-ohm output; not isolated. Output should only drive a properly terminated (75-ohm) input. For anything but the shortest runs, quality 75-ohm coax (e.g. RG59/U) must be used. Capture cable = Green
10	POWER / Nominal power supply voltage is +24VDC (acceptable range is +12-28VDC).
11	POWER/ Reference Pin 10

## Miro LAB / LC / R +12 - 28 VDC Connector



Power port  
6-pin Fischer (male) part # SS 103 Z 056 130

PIN	NOMENCLATURE / FUNCTION
1	PGND / Power Ground
2	+VINBF / The +VDC In (Battery Freed) connector provides +24VDC (Direct Current) positive power to the Phantom camera.
3	RxD1 / RS-232 Receive Data 1
4	TxD1 / RS-232 Transmit Data 1
5	UNUSED

## Miro LAB / LC / R RJ45 Ethernet



GigE Ethernet port  
RJ-45 CAT-5

PIN	NOMENCLATURE / FUNCTION
1	ETHRXP / 10/100/1000BASE-T Ethernet Receive (positive)
2	ETHRXN / 10/100/1000BASE-T Ethernet Receive (negative)
3	ETHTXP / 10/100/1000BASE-T Ethernet Transmit (positive)
4	ETHTXN / 10/100/1000BASE-T Ethernet Transmit (negative)
5	MDI2P / 10/100/1000BASE-T Media Dependent Interface 2 (positive)

## Miro LAB / LC / R RJ45 Ethernet



GigE Ethernet port  
8-pin Fischer (female) part # SS 103 A058-130

PIN	NOMENCLATURE / FUNCTION
1	ETHRXP / 10/100/1000BASE-T Ethernet Receive (positive)
2	ETHRXN / 10/100/1000BASE-T Ethernet Receive (negative)
3	ETHTXP / 10/100/1000BASE-T Ethernet Transmit (positive)
4	ETHTXN / 10/100/1000BASE-T Ethernet Transmit (negative)
5	MDI2P / 10/100/1000BASE-T Media Dependent Interface 2 (positive)

## Miro LAB / LC / R BNC



I/O Signal ports  
BNC

Signal	NOMENCLATURE / FUNCTION
I/O-1	<p>F-Sync, Event, Strobe, Memgate selectable:            F-SYNC/ +5V maximum threshold, input is also compatible with TTL levels and must be properly terminated, (50-ohms).            EVENT / active-low isolated input marks events during recording; signal must be active when the strobe is high.            STROBE / isolated collector output with 1k pull-up, active during frame exposure.            MEMGATE / active-low isolated input, temporarily stops image acquisition during recording.</p>
I/O-2	<p>Ready, Strobe / selectable:            READY / isolated collector output with 1k pull-up, indicates camera is ready for trigger.            STROBE / see description (C) above.</p>
IRIG-In	<p>IRIG-B (unmodulated) timecode format input. Input withstands signals of up to +/- 15v. The input threshold is 1.5V, compatible with TTL levels.</p>

## Miro LC / R BNC



I/O Signal ports  
BNC

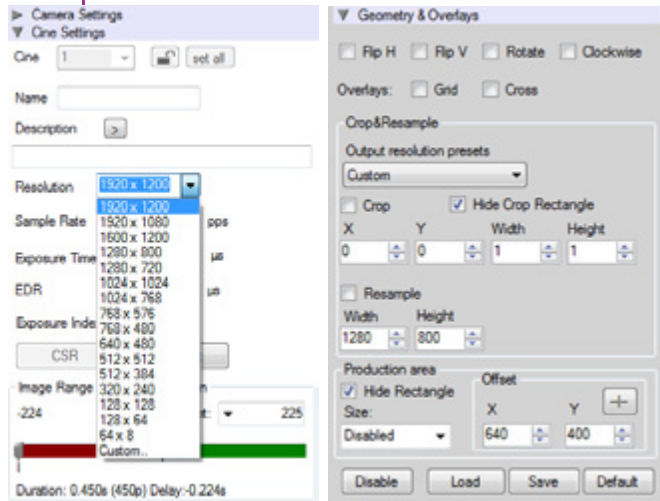
Signal	NOMENCLATURE / FUNCTION
F-Sync	<p>F-SYNC / +5V maximum threshold, input is also compatible with TTL levels and must be properly terminated, (50-ohms).</p>



## What is the difference between 'Native' and 'Cropped' resolutions?

To simplify things, specific resolutions are available from the camera menu. The choices are a variety of common resolutions and aspect ratios.

The resolution controls in PCC software are somewhat flexible in choosing how the images are captured and output. First, the native resolution must be selected from the 'Cine Settings / Resolution' pull-down. However, an output resolution can be set using the 'Geometry & Overlays' section of the 'Image Tools' menu.



There are a variety of pre-set output resolutions available, or any value can be typed in and offset with the X & Y coordinates listed. Cropped or scaled resolutions set on the camera body will automatically set the 'Crop & Resample' parameters appropriately.

Cine Raw files saved from PCC software will maintain the full native resolution, with the crop / resample settings flagged in metadata.

Exporting those files in a format other than Cine Raw (like .mov or .dpx) will apply the settings, and the resulting files will be at the intended cropped and/or resampled output resolution.

Cine Raw files that have been flagged with crop / resample metadata can still be exported at the full captured resolution by turning off the Crop & Resample options in PCC's Image Tools menu.



The PCC 'Image Tools / Crop & Resample' menu is also a powerful way to manipulate saved Cine file prior to exporting the files to a different format.

## Resolutions / Speed Charts

1Mpx Miro Camera						
Resolution	LAB110 / LC110 / R111		LAB310 / LC310 / R311		LAB3a10	
	FPS	Sec*	FPS	Sec*	FPS	Sec*
1280 x 1280	-	-	-	-	1850	2.7
1280 x 1024	-	-	-	-	2310	2.7
1024 x 1024	-	-	-	-	2780	2.7
1280 x 800	1630	4.7	3260	2.3	2950	2.7
1280 x 720	1810	4.7	3630	2.3	3280	2.6
896 x 720	2520	4.7	5040	2.4	4390	2.9
640 x 480	5090	5.1	10100	2.5	8450	3.2
512 x 512	5790	5.2	11500	2.6	9290	3.4
384 x 288	12900	5.6	25900	2.7	19400	3.9
256 x 256	19800	6.1	39700	3.0	27200	4.7
128 x 128	60400	8.0	120700	4.0	66600	7.7
128 x 64	113200	8.6	226300	4.3	114700	8.9

2Mpx Miro Camera								
Resolution	LAB120 / LC120 / R121		R320S / LC320S (Monochrome)		R320S / LC320S (Color)		LAB320	
	FPS	Sec*	FPS	Sec*	FPS	Sec*		
1920 x 1200	730	4.7	1380	2.5	1380	2.5	1380	2.5
1920 x 1080	800	4.8	1540	2.5	1530	2.6	1540	2.5
1152 x 1152	1220	4.9	2250	2.6	2240	2.6	2250	2.6
1024 x 1024	1530	4.9	2780	2.7	2770	2.9	2780	2.7
1280 x 800	1600	4.8	2960	2.6	2940	2.7	2960	2.6
1280 x 720	1780	4.8	3280	2.6	3200	2.7	3280	2.6
896 x 720	2450	5.0	4400	2.8	4300	2.9	4400	2.8
640 x 480	4910	5.3	8490	3.0	8300	3.3	8490	3.0
512 x 512	5540	5.5	9330	3.2	9200	3.4	9330	3.2
384 x 288	12200	5.9	19600	3.6	19000	3.9	19600	3.6
256 x 256	18300	6.6	27600	4.4	26400	4.8	27600	4.4
128 x 128	52400	9.3	69000	7.0	62000	8.1	69000	7.0
128 x 64	95300	10.2	121900	8.0	102000	9.7	121900	8.0
128 x 8	250000	31.0	325000	25.0	240000	45.0	325000	25.0

4Mpx Miro Camera				
	LAB140 / R140		LAB340 / R340	
Resolution	FPS	Sec*	FPS	Sec*
2560 x 1600	410	4.7	800	2.5
1600 x 1600	650	4.7	1200	2.5
1920 x 1200	730	4.7	1380	2.5
1920 x 1080	800	4.8	1530	2.6
1280 x 1280	1000	6.3	1850	2.7
1024 x 1024	1530	5.2	2780	2.7
1280 x 800	1530	4.9	2960	2.6
1280 x 720	1600	4.8	3280	2.6
640 x 480	1780	4.8	8490	3.0
512 x 512	5540	5.5	9330	3.2
256 x 256	18300	6.6	27600	4.4
128 x 128	52400	9.3	69000	7.0
128 x 64	95300	10.2	121900	8.0
128 x 8	250000	31.0	325000	25.0

\* Record time into maximum memory of 12GB



## How does the Miro LAB differ from other Miro models?

The Miro LAB is designed for office-like environments such as you'd see in many laboratories, classrooms, etc. So, the LAB uses industry-standard connectors for Ethernet and I/O instead of the more ruggedized custom connectors found on the M-, R-, and LC-Series. Also, in an office-like environment, there is good assurance of reliable AC power, so we have eliminated the battery backup feature on the LAB-Series. Finally, since the camera is always used in a computer-tethered workflow, there is no need for a video monitor or remote control access. Otherwise, it inherits all the features and proven design of the Miro Family of cameras.

## There is no capture cable / Break-out-Box for the LAB-Series. How do I access the signals for controlling or monitoring the camera?

There are four BNC connectors on the camera that provide programmable signaling:

- I/O-1: This is the same as Aux1 on some of our other cameras, and you can choose for it to be FSYNC, Event, Strobe or Memgate in PCC
- I/O-2: This is the same as Aux2 on some of our other cameras, and you can choose for it to be Ready or Strobe
- There is a dedicated IRIG-IN BNC.
- And a dedicated Trigger In BNC.



There is no IRIG-OUT signal on the LAB-Series so it cannot be used as an IRIG source. Also, there is no analog or digital video output.

## Does the LAB-Series support the CineFlash storage system?

Yes! However, unlike the other Miro Family members, a CineFlash, and CineFlash Dock do not come bundled with the camera. A kit containing these items is available as are individual items as needed.

## What is the difference between the LAB310 and the LAB3a10?

We have feedback from customers about the need for a 1 mega pixel camera with smaller pixels than the 20 micron pixels on the LAB310. Smaller pixels have advantages in some applications. So, we invented an "alternate" (thus the "a") 1 Mpx camera. The advantage in many imaging applications. Now, you can choose whichever 1 Mpx camera best meets your needs. Your sales representative can give you more details about the advantages and disadvantages of large versus small pixels.

**The LAB3a10 at 1280 x1280 and with 10 micron pixels, has an image circle that is greater than 18 mm diameter. What lensing can I use to cover that area?**

Sensor coverage will only be a consideration if you have a C-mount on the camera. The other mounts – Canon EOS, Nikon F and PL, support 35 mm lenses and cover the sensor easily. However, a standard 1" C-mount lens may vignette, especially at shorter focal lengths. We recommend the use of a 4/3" C-mount lens with the LAB3a10 when equipped with a C-mount. We have a selection of five different focal length 4/3" lenses from KOWA available. These and other 4/3" C-mount lenses are readily available from a variety of sources.

**What is the resolution and size of the touch screen?**

The native resolution of the Miro LC touchscreen is 800 x 480 pixels. The physical size is 4" diagonal, or 3.5 x 2.0" (87.5 x 52.5mm).

**Is the touch screen resistive or capacitive?**

The Miro LC uses a capacitive LCD touchscreen. Advantages of the capacitive screen include better sensitivity and accuracy of the human touch, and also better image rendition of the screen. Disadvantages include the inability to wear gloves or use other devices (like a stylus) to control the camera.

**When running under battery power, the touch screen seems to be less receptive. Why?**

The touchscreen works best when the person controlling it is also touching the casing around or in back of the screen, or a metallic surface on the camera body. Some people will naturally draw more current than others when using a capacitive touchscreen, so the severity of this potential issue can differ between person to person. If you find this to be an issue, we recommend always holding the back or edge of the screen while controlling it, or touch any metallic surface on the camera with either hand.

This is not an issue when the camera is running on AC power.

Yes the physical button on the side of the screen marked with a square icon turns the menu display on and off. When turning the menu off the screen automatically resets. A good way to force the re-set is to double-click that square button. The reset will take 5-10 seconds before you can access the controls again.

**Can I use a stylus with the Miro LC screen?**

No, Vision Research has not identified a stylus to work with the Miro LC. The screen only responds to a human touch.

**How well does the LCD screen work in daylight?**

The screen has a glossy surface with sufficient brightness to work OK in bright sunlight. It is rated up to 40°C, however on hot sunny days we recommend keeping the screen out of direct sunlight as much as possible.

**Can saved Cine files in the CineFlash drive be reviewed on the LCD screen?**

A handy feature on all LC cameras is the threshold mode. Tap the top button on the front of the camera (autoset) to cycle through threshold, zoom, and live video tools. Threshold mode makes it easy to see the sections of the image that are overexposed.

The camera's menu system allows you to review the amount of takes on the CineFlash, their size, and the drive's remaining capacity. However, they cannot be played back on the screen. Files that are still in the camera's RAM can, however, be played over video and on the screen.

**What does the '\*' symbol next to a Cine number on the Cine list display mean?**

There are two ways to view and save stored Cine files from CineFlash drives. The camera can be connected to Phantom PCC software via an Ethernet connection, or the drive can be mounted outside the camera via a CineFlash Dock where files can be viewed and saved over an eSata connection, from PC or Mac operating systems.

**Is there any way to select multiple Cines for deletion or saving?**

This means that cine, in internal DRAM, has not yet been saved and will be lost if erased or if power is lost. Once the cine is saved to CineFlash, the asterisk will disappear.

If you double tap on any cine in the cine list display, all cines with the same save state will be selected. This way, you can save all unsaved cines, or delete all saved cines.

**When I select a trigger point using a percentage number like 20%, the trigger is 20% from the end of the available frames not 20% from the beginning. What is going on?**

**How can I cancel and reset the in-point or out-point that I set in the playback screen?**

**Can I scrub through the video on the playback screen?**

**What are the differences between the Miro LC and R-Series cameras?**

**Is there any difference in battery life between the LC and R-Series cameras?**

**Can the R-Series be used as an Airborne camera?**

**What is the maximum resolution I can with a c-mount lens on the R120 and R320S?**

**Can you record directly to the CineFlash?**

When selecting the trigger point using frames, you set the number of post-trigger frames. To be consistent with this, when using percent, you set the percentage of frames you want to be post-trigger, rather than pre-trigger.

If you need to cancel your in- or out-point setting, just long-press on the mark-in or mark-out button.

There is currently no “scrub” gesture, but subsequent presses on the play or rewind controls will increase the playback speed allowing you to do a fast-forward or fast-reverse playback.

The main difference is the addition of a flip-out touch screen on the LC-Series. This adds about 12mm to the width of the camera. It also adds an on-camera control interface and a live preview image for framing, focus, and playback from RAM. There are no other functional differences or differences in specifications.

The LCD screen on the side of the camera uses slightly more power; therefore, battery life is slightly diminished. A BPU-30 battery provides about 45 minutes of battery life, where the BPU-60 provides about 90 minutes.

It will work fine in airborne applications that are within the published specifications. It has good environmental specifications (shock, vibration, temperature, operating altitude) for most airborne applications and can work with airborne power and trigger voltages (typically 28VDC.)

Up to about 1152 x 1152 square or 1280 x 920 rectangle with a 1" c-mount lens. And, up to about 1600 x 1200 with a 4/3" c-mount lens. Depending upon the lens, some vignetting can occur with very short lenses.

No, you cannot record directly to the CineFlash. There is no “run/stop” mode on the Miro cameras.

### What video formats are available?

Not all camera models support video output. Therefore, the RCU would not make a good controller for these cameras. The reason is the lack of video output from the camera to the RCU would mean you were 'flying blind'. You would not be able to see the live image on the RCU screen to frame and focus your shot, for example.

The Video System table below shows what video system is available on each model.

Body Style	LAB-Series	LC-Series	R-Series
Miro 11x	None	NTSC / PAL	NTSC / PAL
Miro 31x	None	NTSC / PAL	NTSC / PAL
Miro 3a1x	None	-	-
Miro 12x	None	NTSC / PAL	NTSC / PAL
Miro 32x	None	-	-
Miro 32xS	-	HD-SDI	HD-SDI
Miro 14x	None	-	None
Miro 34x	None	-	None

### How do I frame, focus and review recording with cameras that don't support video output?

You must use images that are sent over the Gb Ethernet port to software hosted on a computer for framing, focusing and viewing playback. An obvious solution is to use PCC running on a PC connected to the camera. However, there are other alternatives such as LabView (using the Phantom SDK and LabView drivers), as well as 3rd party camera control solutions.





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