ΡΗΑΝΤΟΜ

Ultrahigh-Speed Cameras v2512 / v2012 / v1612 / v1212



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when it's too fast to see, and too important not to."

Phantom Ultrahigh-Speed Cameras MANUAL

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Written and produced by the Marketing Department at Vision Research.

The contents of this manual are subject to change without notification.

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	v2512	v2012	v1612	v1212
Max. Speed	25,600 fps at full resolution 1280 x 800; 1,000,000 fps at reduced resolution of 128 x 32 w/FAST option (677,000 w/o)	22,0000 fps at full resolution 1280 x 800; 1,000,000 fps at reduced resolution of 128 x 32 w/FAST option (666,000 w/o)	16,000 fps at full resolution 1280 x 800; 1,000,000 fps at reduced resolution of 128 x 16 w/FAST option (647,000 w/o)	12,000 fps at full resolution 1280 x 800; 820,000 fps at reduced resolution of 128 x 16 w/FAST option (571,000 w/o)
Min. Speed		100	fps	
Pixel		28 µm size,	12-bit depth	
Sensitivity	Mono	chrome: 32,000D (Day Color: 6,400I	light)*; 100,000T (Tung D*; 10,000T*	gsten)
CAR		128 x 16 (Continuous	Adjustable Resolution)	
Throughput /	25 Gpx/s / 25,000 fps	20 Gpx/s / 20,000 fps	16 Gpx/s / 16,000 fps	12 Gpx/s / 12,000 fps
oheen	1 Gpx	/s throughput Direct Re	cord to Phantom Cinel	Vlag IV
Exposure	1 µs minimum standard; 265 ns min w / FAST option	1 µs minimum standard; 290 ns min w / FAST option	1 µs minimum standard; 500 ns min w / FAST option	1 µs minimum standard; 500 ns min w / FAST option
Exposure in PIV	375 ns	425 ns	400 ns	550 ns
Memory	72GB, 144GB, 288GB high speed internal RAM CineMag IV non-volatile memory storage (1TB, 2 TB)			
Trigger Options	Dedicated BNC, via capture port, On-Camera Controls, Image-Based Auto-Trigger, or via Phantom PCC software			
Ethernet	Standard Gb Ethernet and 10Gb Ethernet for faster download speed			
Power	Two ports for primary and backup (20-28 VDC) on camera back panel			
Video Out	Two HD-SDI ports on camera; Analog video (NTSC or PAL) available on Break-out-Box; Component viewfinder port			
Special Features	Partition memory into segments and make shorter recordings back-to-back without missing any action (63 maximum) Internal mechanical shutter for hands-free and remote CSR (Current Session Reference) Advanced 'On-Camera Controls' for camera setup, capture, playback, edit, and save to Phantom CineMag IV			ck-to-back without te CSR playback, edit,
Popular Accessories	CineMag IV, CineStation IV for CineMag IV, RCU, Break-out-box, Video monitor for use with on-camera controls			

* Measured according to ISO 12232:2006 method

| Introduction



Camera Capabilities

The Phantom ultrahigh-speed UHS-12 Series consists of the v1212, v1612, v2012, v2512.

The Phantom v1212 digital high-speed camera is capable of capturing 12 Giga-pixels per second (Gpx/s) of data from our proprietary CMOS sensor. At full resolution (1280 x 800), the camera can capture 12,000 frames-per-second (fps).

The Phantom v1612 features 16 Gpx/s throughput and a maximum frame rate of 16,000 fps at full resolution (1280 x 800).

The Phantom 2012 achieves over 22 Gpx/s throughput and a maximum frame rate of 22,000 fps at full resolution (1280 x 800).

The Phantom 2512 boasts 25 Gpx/s throughput and a maximum frame rate of more than 25,000 fps at full resolution.

	All Ultrahigh-speed cameras are capable of over 570,000 fps at reduced resolution. The FAST option (export controlled), available for all ultra high-speed cameras, increases frame rates to 800,000 fps for the Phantom v1212 and 1,000,000 fps for the Phantom Phantom v1612, v2012, and v2512 camera models.
	High throughput is important. At any given resolution, a camera with the highest throughput will provide the fastest possible frame rates.
Image Storage	The Phantom v1212, v1612, v2012, and v2512 cameras can be equipped with 72GB, 144GB, or 288GB of high-speed memory. A camera with 288GB of memory, recording at 10,000 fps at 1280 x 800 can record a single high-speed shot (called a cine) for almost 20 seconds.
	The Phantom v1212, v1612, v2012, and v2512 cam- eras are also compatible with Phantom CineMag IV long recording devices available in 1TB and 2TB capacities.
	The Phantom v1212, v1612, v2012, and v2512 cameras can securely save a 288 GB cine to an attached Phantom CineMag IV in about 4.5 minutes. (Phantom CineMag IV throughput is 1GB/s for these cameras).
Sensor Characteristics	The Phantom v1212, v1612, v2012, and v2512 use a proprietary CMOS sensor designed by Vision Research and are available in monochrome or color versions.
	Their 28 micron (µm) pixels result in very high light sensitivity. All UHS-12 Series monochrome cameras have a sensitivity of ISO 32,000D* and 100,000T, and color cameras ISO 6,400D* and 10,000T*
	Sensor resolution is 1280 x 800 pixels "wide-screen" format. The rectangular shape of the 1 Mpx sensor allows the user to keep moving objects in the frame longer and is compatible in aspect ratio with modern display technology. The physical size of the sensor is 35.8mm x 22.4mm (42.27mm diagonal).
	*: Measured using the ISO 12232 SAT method.

All Phantom Ultrahigh-speed cameras have global electronic shutters, with minimum exposure times of 1µs (standard). With the (export controlled) FAST option minimum exposure times are: v2512 - 265ns, v2012 - 290ns, v1612 - 500ns, v1212 - 500ns.

Advanced Features

Image-Based Auto-Trigger (IBAT): Phantom v1212, v1612, v2012, and v2512 cameras can detect changes in 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 v1212, v1612, v2012, and v2512 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.

10Gb Ethernet: 10GBase-T (RJ45) Ethernet port for very fast data transfer.

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

Exposure in PIV: The Phantom Ultrahigh-speed cameras have an extremely short inter-frame (straddle) time, (the Phantom v2512 is 375ns, the v2012 is 425ns, the v1612 is 400ns, and the v1212 is 550ns), and are easily synchronized with external devices.

Command & Control

All Phantom ultra-high speed cameras can be setup and controlled using the built-in On-Camera Controls (OCC), the user-friendly Phantom Camera Control (PCC) software, or a Phantom Remote Control Unit (RCU).



Detailed information about Phantom cameras, features, and software can be found at: *www.phantomhighspeed.com*

controls era c a m 20



PLAYBACK

camera without the need to connect to a PC.

(hold 1 sec) button.

and Threshold functions.

(hold for 1 sec) button.

On-Camera Controls (OCC) provide full control of the

B-REF - when the camera is 'Live' and 'Waiting for Trigger' this button initiates a Black Reference.

During 'Playback', it is the Play, Pause, or Fast Forward

Tools - when the camera is 'Live' and 'Waiting for Trigger' this button toggles between a Live image, and the Zoom,

During 'Playback', it is the Rewind, Pause, or Fast Rewind











Using the Menu Knob

- 1. From any of the 'Live' screens; rotate the Menu knob to display the 'Camera' menu
- 2. Rotate the knob to the desired camera parameter, then press the knob to select
- 3. Rotate the knob, in either direction, to change the selected parameter, then press knob to confirm

Playback - used to select a cine for playback (from internal memory / Phantom CineMag IV).

Menu - used to display the Setup menu and to navigate / select recording parameters.

During 'Playback', it can be used to select, edit, save, or scroll (scrub) through cines.

Trigger - used to:

- Switch from 'Pre-trigger' to 'Waiting for Trigger'
- Trigger the camera ('Loop' mode)
- Start (hold 1 sec) / Stop recording ('Run/Stop' mode)
- Return to 'Live' mode







Out Start Guides

Prepare Your Computer Camera controlling computers: 1. Must have either the Microsoft Windows XP Pro, VISTA Business Edition or Windows 7 or 8 operating system installed. 2. Firewalls must be turned off. (Contact your IT Group if necessary) 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. 4. If working with a 10Gb Ethernet connection the computer's IP address should be set to 172.16.0.1 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** Connect the 20 - 28 VDC power supply to the camera's Primary DC Input connector. the Computer 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 CineMag IV Mount a Phantom CineMag IV, if available. Detailed information about attaching a Phantom CineMag IV can be found in Chapter 7: Phantom

CineMag & CineStation IV of this manual.

Define Recording ParametersClick 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: e. Moving the 'T' (Trigger Position) slider to the right, or f. Enter zero (0) into the 'Last' data entry field.Click on the CSR button to perform a Current Session Reference.'Arm' CameraTriggerAt the end of the action, click the action 'Trigger' button at the bottom of the 'Live' panel, or
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Drovido a gwitch closuro or an ovtornal 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 Rewind
Pause Rewind 1 Frame
Play Davance 1 Frame
Fast Forward

	Locate the first image of the cine to be saved.
	Click the 'Mark-In button.
	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 Edited Cine	Review the edited cine using the Video Control Buttons.
	Click the 'Save Cine' button at the bottom of the 'Play' panel.
Save to Computer	In the 'Save Cine' window:
	1. Navigate to the folder where you want to save the cine file.
	Enter a file name for the cine file in the 'File name:' data entry field.
	From the Save as type pull-down selection list select the 'Cine Raw, *.cine' file format.
	 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.
Save to Attached	Select 'Save RAM Cine to Flash' (in popup window).
Phantom CineMag IV	Click the Save button to save the cine file onto the Phantrom CineMag IV.
	Confirm cine save before deleting from internal memory

Click the 'Open File' 店 button.
 Click the 'Open File' Est 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. 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.

5		Mount camera onto suitable support. Attach and adjust appropriate lens.
L	Power Up Camera	Connect a suitable power supply (20-28VDC) to the Primary DC Input connector, then set the power switch to the 'ON' position.
nt	Setup Video Monitor	Connect a suitable HD-SDI video monitor (not supplied) to the 'HD-SDI 1' connector on the connector panel of the camera.
0	Attach Phantom CineMag IV	Mount a Phantom CineMag IV, if available. For detailed instruction see Chapter 7: Phantom CineMag & CineStation IV.
•	Set Recording Parameters	From any of the 'Live' screens; rotate the Menu knob to display the '1/2 Camera' menu.
-		Rotate the knob to the desired camera parameter, then press the knob to select.
c a m e		 Rotate the knob, in either direction, to change the selected parameter, then press knob to confirm. Set 'Resolution' to the required Width x Height Choose the required 'Speed' (frame rate) and 'Shutter' (exposure time). Set the 'T' (trigger position) at the beginning, or the end, or some position within the internal memory
0 u - 0	Perform Black Reference	Press 'B-REF' button.
ŋ		Black Reference should be performed after all recording parameters have been set.
>		

Perform White Balance (Color Cameras Only)	From the '1/2 Camera' screen; rotate the 'Menu' knob until the '2/2 Image' screen displays.
	Point camera towards a non-saturated white area.
	Set 'White Balance' to 'OK', then press the 'Menu' knob.
	Set 'CC+0' (Color Compensation) to 'Auto', then press the 'Menu' knob.
	'White Balance' (Color Temperature) adjusts the red and blue components, while 'Color Compensation' adjusts the magenta and green components of the white balance.
'Arm' Camera	Press the 'Trigger' button to switch from 'Pre-trigger' to 'Waiting for Trigger' ('Loop' mode).
Trigger	Press the 'Trigger' button.
Select Cine	Press 'Menu' knob to access the 'Select' screen.
	Rotate 'Menu' knob to the cine to be reviewed, then depress to select it.
Edit Cine	Press 'Playback' knob to access the 'Play Options' screen.
	Locate the first image to be saved and select 'Set In' to set the Mark-In point.
	Locate the last image to be saved and select 'Set Out' to set the Mark-Out point.
Playback	Review the edited cine.
Save to Phantom CineMag IV	'Save' marked frames to Phantom CineMag IV (optional).



Confirm save to Phantom CineMag IV before deleting from internal memory

nit	'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 2 connector on the rear panel of the camera.
D		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.
L 0	Power Up Camera	Connect a suitable power supply (20-28VDC) to the DC Input connector, then set the power switch to the 'ON' position.
-	Power Up RCU	Hold in the RCU 'Menu' button (2 seconds).
0 D	Install Phantom CineMag IV	Insert a Phantom CineMag IV, if available. For detailed instruction see Chapter 7: Phantom CineMag & CineStation IV.
5	Set Recording Parameters	Gently depress the 'Setup' button, then the Acq, (Acquisition), button.
Ð		Set the 'Aspect Ratio': Press the down-arrow (right of 'Aspect Ratio' field) and select an 'Aspect Ratio' from the pull-down selection list.
0		Define the Resolution, Frame Rate, Exposure, and Post Trigger settings using the Numerical Keypad to specify the desired setting.
		To overwrite the present value:
		1. Tap the entry field once, (turns entry field yellow), then
		2. Tap the key pad to enter the desired value.
		3. Tap the Enter key to set the value.
		To append the value:
σ		 Tap the entry field twice, (turns entry field white), then
		5. Tap the key pad to append the value.
		6. Tap the Enter key to set the value.

	Press the Return,, icon (upper-left) to return to the Setup Screen.
Perform CSR	Press the 'Capture' button.
	Tap the CSR, (Current Session Reference), button
	When prompted tap the Begin button.
Perform White Balance	Tap the 'White Balance' button.
(Color Cameras Only)	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, A 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 Play
	Reverse
	Pause Pause
	Click the Mark-In A) and Mark-Out B 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.phantomhighspeed.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.
hantom Camera Control) Application Overview	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 provides valuable reference information on the software, including extensive documentation.

Live	Play	Manager	
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1 de la	v2011 v2511		
	justin blink		

Control Tabs

PVP (Phantom Video Player) Application Overview

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.) is 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 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.

Speed Recording Speed 2700 PayBack Speed 30.00 Pb/Rec 1.1% (1/90.0) Play Each Image Play Mode Play Mode Play AI RAM Page AI Pag Pag Play AI Rash Reseat Pag Pag Play AI Rash Free: 128.8 GB Erase AI. State	Cine: 1 🔹 🃚 +S 📘	Settings
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eine 3321 -2375	8.8 GB Erase Al	1
	5	
1321	1 1 1	1
Capture Tripper Save to Rash Save	Save to Flash Save	e to file

pcc software

Camera Control via PCC

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.

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'.

Eve	Man Care -	Presets	Eve	March Constant	Presets
DΦ	MicroSec *	Scientific	DØ	Micro Sec •	Scientific
EDR	Micro Sec 🔹	Percent	EDR	Percentage Degrees	Percent
PTF	Frames •	Cinematography	PTF	Frames •	Cinematography

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. All 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.

mage Tools			
mage roots			-
- Hatogram			
Avg: 1021		Gray	*
▼ Adjustments	8		
Standard curve	65 Gamma	•	
Brightness (%)	0.00	-0	
Gain	1.000	-0	
Gamma	2.222		
Toe	1.000	- 0	
Saturation	1.000	-0	
Hue (*)	0.0		
White Balance			
Temp (K) 6	099.6	0	
Tint	15.63	0	
	Def	aut White Balan	
Color interpolat	ion algorithm	Best	•
Filter	None		•
Sensitivity	1.000		
 Advanced / Tone Color Matrix Geometry 8 	Adjustments C. Overlays		
Disable	Load	Save Defau	à.

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	*	
1.2	3.	

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 of 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 can not 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.



Live Play Manager set to... -Camera v2511 + Camera Settings **Cine Settings** Flash Memory Advanced Settings Auto Exposure Frame Rate Profile Image-Based Auto-Trigger Continuous Recording Camera Info

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.

♥ Camera Settir	ngs			
Current Tue Ja Time:	ul 29 2014 22:	40:52	Set Time	
	Local 🔘 u	te (GMT)		
GPS: N/A				
Bit Depth 12	Partions	1 👻		
Lens Control Aperture	Focus for smaller focus	Fast+ 0 Fast-		
De la charte				
Backup & restor	e settings	n i		
Load	Save	J		
♥ One Settings	_			
Cine 1	· 🔒	set all		
Name				
Resolution 1	280 x 800 👻			
Sample Rate	1000 -	pps		
Exposure Time	900 👻	μя		
EDR	0 -	μs		
Exposure Index	2500			
CSR	Low Lig	ht		
Image Range a	nd Trigger Positi	on		
-760		L	et: •	1999
-	I	_		
Ĩ				
Duration: 2.760s	(2760p)			

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

Bit Depth: The Phantom v1212, v1612, v2012, and v2512 camera 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 framesper-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 El 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.

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.

Key Advanced Settings

Start/End of recording actions Auto Black Reference	
Auto save to CineMag/built-in Rash	
Auto save to CineRash/CardRash filename:	
Auto play Video Out 0 times	
Range: 📰 FullOne	
First 0 Last -1	
Restart Recording	

Sync Imaging:	Inten	nal	-
Master camera	serial (0=none)	
Frame Delay	1	105	

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 have 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

	Erase
5.1 GB free of 128.9 G	В

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

>				×
Delete existing R/	AM cine an	d proceed	to new rea	cording?
	Yes	No		

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 userspecified value is met.



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'.

Set R/S (Run/Stop) mode by selecting the 'Direct Recording to CineMag' box in the Flash Memory section. Start recording by clicking the red 'Record' button. Once the camera is recording directly to the Phantom CineMag the 'Record' button changes to a 'Stop Recording' button.





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

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

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.



Performing a Quick Search Through a Cine



✓ Image Search				
Method:				
Difference •	Threshold:	2	2	
Changed areas:	10.00 👻	%		
Search Step: 10				

Editing a Cine Us

'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'

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 CineMags, please see Chapter 7: Phantom CineMag & CineStation IV.

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.

Video System	Zoom Anamorphic ratio
HDTV 1080p30 •	- R ▼ ▼
OSD	Video Outputs
Digital/Mon OSD	🔁 4:4:4 (B) 🗌 4K (B)
Analog/VF OSD	Modes:
📃 OSD Opaque	All outputs play selected cine
Production area	
Size: Disabled -	 SDI1 & Analog display Live, SDI2 plays selected cine
Offset:	
X -960≑ Y -600≑	
Other Options	GenLock Status: Not Locked,
VF mode	
Nomal *	
Test Image	

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.

mera:	v2511 Cam1(10277)	🕶 Cne: 1 💌 毳	+S Settings
		Speed Recording Speed 2700	Preferences
		PlayBack Speed 30.00	Help
\triangleleft		Pb/Rec 1.1% (1/90.0)	About
		Play Mode	Speed
		Umit To Range Play Al RAM	30 9
_		Ping Pong Play Al Rash	
		Rash	
	x []	Free: 128.8 GB Erase AL.	1 -
eline 3321		-2375	
321	· · · •	1 I I I	· · · ·
Cart	Trinner	Save to Rash	Save to file

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.
1 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

Converting Cine Files

-

Cine Raw, * cine	
Cine Raw, *.cine	
AVI, *.avi	
Multipage TIFF, "tif	
H.264, *.mp4	
ProRes, *mov	
QuickTime Uncompressed, *.mov	
Windows BMP 24 images, *bmp	
Windows BMP 8 images, "bmp	
Windows BMP 4 images, ".bmp	
OS/2 BMP 4 images, * bmp	
OS/2 BMP 8 images, "bmp	
OS/2 BMP 24 images, ".bmp	
PCX 1 mages, "pcx	
PCX 3 mages, pcx	
TGA 8 mages, pck	
TGA 16 mages, *toa	
TGA 24 images, "toa	
TGA 32 images, *tga	
TIFF 1 images, "1f	
TIFF 8,24 images, ".tif	
TIFF 12.36 images, *tf	
TIFF 16.48 images. "til	
LEAD mages, ".cmp	
LEAD JFIF 4:1:1 mages, IT	
LEAD ITIE 4:1:1 images. If	
LEAD ITIE 4:2:2 images * H	
JPEG images, tion	
JTIF images, "ipg	
RAW images, * raw	
DNG images, ".dng	
DPX images, * dox	

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

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).



Re-saving a clip in the 'Cine RAW' format can be useful for creating sub-clips with no loss in image quality or metadata.

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. 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 on 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 file.' 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.

File: chips	74.3
Total 1/3	254



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.

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 bends 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 on 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 selected 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: $d=\sqrt{(x2-x1)2} + (y2-y1)2)$.

If the Origin and the selected 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: as=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 to other sciences, for example, the way 2 x 4 board could tumble in hurricane-force winds can be applied by manufacturers who develop unbreakable glass windows, or engineers developing stabilizers for aircraft.

Collect Point (Tracking)

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.



To investigate the effect environmental conditions may have on the recorded data, a National Instruments[™] 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.

Data Acquisition



SDK (System Developer Kit)

Phantom camera control, and Cine playback, analysis and measurements can be customized to meet 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 allows 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.





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

Live Pre: camera is in LOOP mode but is not recording to internal memory. Displays a 'Live' image on the video monitor.

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

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

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

Playback: camera is in PLAYBACK mode a cine can be selected for playback.

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

Indicates the exact number of recordable frames available in the camera's internal memory.

Indicates the total length of recording time (in minutes and/or seconds).

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

Indicates the user-defined frame rate.

Indicates the camera serial number or user-defined camera name.

Indicates the user-defined Exposure Time (in milliseconds or microseconds).

Indicates the user-defined resolution (width x height), in pixels.



Camera State

·

1/2 CAMERA Speed 100 f/s Frame burst off	Shutter 324° 9ms Period 59.95us ∎
Res 1280 x 800 Auto bref off	Capture Loop
PA 0 x 0	PAO 0,0
Zoom fit	Color Bars off
How to Set the Parameters Speed	 From any of the 'Live' screens; rotate the Menu knob to display the 'Camera' menu Rotate the knob to the desired camera parameter, then press the knob to select Rotate the knob, in either direction, to change the selected parameter, then press knob to confirm 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.
Shutter	The Resolution parameter should be set before setting the Speed. Defines the amount of time the sensor is exposed to light (in degrees of shutter angle and µs of exposure time). A small shutter angle or short exposure time reduces the chance of motion blur.
Frame burst	Sets the number of frames in a burst, ('off' disables Burst Mode).

Period	Sets the interval between frames in a burst (defined in microseconds).					
Trigger	This 'time line' represents all frames available in the camera's internal memory (RAM buffer / circular buffer). The 'T' symbol above the time line sets the trigger point.					
	Frames before the 'T' are 'Pre-trigger' frames, while frames after the 'T' are 'Post-trigger' frames.					
Res	Resolution is the number of pixels used to capture an image. For example, if 1280x800 (width x height) is set, the full sensor space is available. This is called 'Full Frame'.					
	Smaller resolutions (320 x 240) for example allow higher recording speeds.					
	The image aspect ratio will be displayed with the defined Resolution setting.					
Capture	This field selects whether the camera is to run in Loop or Run/Stop (R/S) mode.					
	In Loop mode, a trigger signal starts the recording and stops after all 'Post-trigger' frames are recorded. This is the default setting. Any cine can be played over HD-SDI, or saved to an attached computer, or Phantom CineMag IV (if available).					
	In Run/Stop mode images are recorded directly into an attached Phantom CineMag IV.					
	In R/S mode no 'Pre-Trigger' frames are saved, and the user must start and stop each recording.					
Auto bref	When set to 'on' a black reference operation will be performed when the camera is placed into the capture or 'waiting for trigger' O mode with the results being saved with the cine.					

For cameras with an attached Phantom CineMag IV operating in R/S mode, the recording into the Phantom CineMag IV is delayed until the black reference operation has completed. All frames saved to the Phantom CineMag IV will be corrected with the obtained CSR (Current Session Reference).

PA 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.

PAO The PAO (Production Area Offset) parameters are used to move the user-defined PA (Production Area) displayed on the attached monitor. By default, the Production Area Offset will set to 0,0. These settings instruct the Production Area to be displayed in the center of the image display area.

The first POA variable offsets, or moves, the Production Area horizontally, while the second PAO variable move the Production Area vertically.

Zoom The Zoom field is used to resize the images being displayed, on an attached monitor and switches between pixel-to-pixel (1:1) and fit.

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.

2/2 IMAGE

White bala	ance Ok	CC+0 Auto		
Master gamma 1.000			EI 800	
Master black 0.000				
	R	G	В	
Gain	1.000	1.000	1.000	
Pedestal	0.000	0.000	0.000	
Gamma	1.000	1.000	1.000	

Most of the settings in this menu pertain to color cameras only.

White balance	 A White Balance process is used to balance the active pixels of the image sensor to the overall color temperature of the lighting. 1. Point the camera towards an area that represents white, or place a white object in front of the camera. Ensure that the white subject is not fully saturated. 2. Select and highlight "OK" next to the word "White Balance". 3. Rotate the Menu knob to select a white balance value and press again
CC+0	Color temperature adjusts the red and blue components of white balance, while Color Compensation (CC+0) adjusts the magenta and green components of the white balance. Color Compensation is automatic, however it can be further adjusted if necessary.

Master gamma	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 compensation for most video monitors.
EI	El (Exposure Index) is a reference value for the ISO level of the current shooting settings. A camera's default El value is measured at the default gamma of 2.2. Increasing the gamma will also increase the El, and decreasing the gamma to a minimum value of 1.0 will decrease the El. The El can also be adjusted by the adjusting the El value itself, using the on-camera controls, as indicated here. Increasing the El 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 El as close to default as possible for best image quality.
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 (R, G, B)	The gain can be adjusted in three separate color channels, red, blue, and green.
Pedestal (R, G, B)	The pedestal can be adjusted in three separate color channels, red, blue, and green.
Gamma (R, G, B)	The gamma can be adjusted in three separate color channels, red, blue, and green.

Post Trigg

O		66.77kfr 11'	285/19.14:22.738368
11696 100f/s 9ms			1280x800
11606 100f/s 9ms		66.77k# 11'	285/19:14:22.738368 1280x800
Capture Screen	The on-secreen screen, and the same as the 'Liv state designato	display information 'Post Trigger Record ve Preview' display o rs.	for the 'Capture' ding' screen, are the except for the camera
	An empty red ci to internal mem Displays a 'Live	ircle indicates the ca ory (RAM), and awa ' image on the video	amera is recording iting a trigger signal. 5 monitor.
er Recording Screen	A full red circle and is filling inte Displays a 'Live	indicates the camer ernal memory ('Post ' image on the video	ra has been triggered, -Trigger' frames). D monitor.





A green square indicates the recording has ended, and a cine is stored in internal memory.

Indicates the user-defined start point, (the first frame), of the cine to be saved.

Indicates the frame the camera detected a trigger signal at when capturing the cine.

Indicates the user-defined end point, (the last frame), of the cine to be saved.

Indicates the number of frames recorded in the camera's internal memory.

Indicates the total length of recording time (in minutes and/or seconds).

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

Indicates the user-defined frame rate.

Indicates the camera serial number or user-defined camera name.

Indicates the user-defined Exposure Time (in milliseconds or microseconds).

Indicates the user-defined resolution (width x height), in pixels.

C CINELIST RAM1 11696 100f/s 9m	19:20:0	■ 66.77kfr 11' 285/19:14:22.738368 2154 fr 1280x800
		The Playback' screen includes all the on-screen display information shown in the 'Cine Stored' screen along with the following additions:
Frame Position Indicator	B	The Cine Number Indicates the cine selected via the Cine List to review, edit, and/or save. The white square, below the internal memory 'time line' represents where the frame being displayed is located within the internal memory buffer or attached Phantom CineMag
Cine List	C	The Cine List displays the list of cines the end user can select to review, edit, and/or save.

▶ 1 		66.77kfr 11'	285/19:14:22.738368
PLAY OPTIONS			
Save Set In Set Out Forward Reverse Back			
100f/s 9ms			1280×800
	The 'Play Cir display inforr along with th	ne Options' screen includ mation displayed in the 'F ne following additions:	es all the on-screen Playback' screen
Save	Used to save	the cine to an attached	CineMag IV.
Set In	Defines the r	new start point of the sele	ected cine file.
Set Out	Defines the r	new end point of the sele	cted cine file.
Forward	Plays the sel	ected cine in the forward	l direction.
Reverse	Plays the sel	ected cine in the reverse	(backward) direction.
Back	Returns the o	display screen to the 'Pla	yback' screen.

Phantom CineMag IV Indicators On the back of the Phantom CineMag IV are a number of LED indicators that show the current Phantom CineMag IV status.

Mag Capacity Indicator:

When a Phantom CineMag IV is empty, all LEDs will be illuminated. As material is recorded to the mag, the LEDs will turn off. The last LED will always stay on to indicate power.

Erase protect switch:

When the erase-protect switch is in the lock position, the CineMag IV cannot be erased. Use an appropriate tool, such as a micro-flathead screwdriver to flip the switch.

PHRNTOMCIRCHIEGTN

Activity LED:

Green for read activity Red indicates recording Orange indicates erasing

7 | Phantom CineMag IV & CineStation IV

Introduction

The Phantom CineMag IV is a high-speed solid-state storage module, compatible with all Phantom Ultrahigh-speed Series - 12 cameras for recording. Cines can be downloaded from the CineMag either through the camera body itself, or through a CineStation IV. It records raw sensor data in 10-bit packed format, and differs significantly from a traditional hard drive or solid state disk in that there is no file system.

For high-speed recording, you must record to the camera's RAM buffer first, review, and then transfer to the CineMag - this is known as 'Loop' mode. For lower speed recording, the camera can run in Run/Stop mode, writing direct to the CineMag, allowing several minutes of recording. .

It is not possible to delete individual clips from a CineMag IV because all frames are recorded contiguously. This is an important consideration when saving clips – once the CineMag is full; you can only re-record on it by deleting its entire contents. For this reason it's recommended that RAM cines are reviewed and trimmed by setting in and out points prior to transfer from the RAM buffer to the CineMag.

.cine files are downloaded over Ethernet (either 1Gb or 10Gb) using Windows-based Phantom PCC.

Phantom CineMag IV and Previous Generations of CineMag

There have been a few generations of Phantom CineMags. The Phantom CineMag IV has higher capacity than the first generations of Phantom CineMag and CineMags II. These earlier generations are not compatible with the Phantom Ultrahigh-speed v2512, v2012, v1612, and v1212 cameras.



Attaching a CineMag IV The Phantom CineMag IV slides into the top compartment of the camera, as pictured, an the door latches shut. Ensure the CineMag slides in evenly and mounts securely. **Removing a CineMag IV** To remove the Phantom CineMag IV, pull the red tab on the slide door, and pull the CineMag out of the camera. The CineMag IV is hot-swappable, and the camera can remain on during this procedure, but ensure the camera is not writing or reading from the CineMag before removing it. Saving from a CineMag IV Vision Research recommends that you save the clips from a Phantom CineMag IV as Cine Raw files, even though it is possible to save them in a number of file formats. Cine Raw files not only preserve all the metadata

of the clip (such as frame rate, shutter speed, timestamps, etc.) it will also be the fastest and best-quality format.

Saving an Individual Cine from a CineMag IV

	Save Cre 🔻
Save as type:	Cine Raw. *.cine 🔹
	Save Cine To File Save All RAM Cines To File
	Save All Flash Cines To File
	Save RAM Cine To Flash Select&Save Cines to File

Selected Cine Files from a CineMag IV

The 10-bit 'Packed' format is the default when saving Cine Raw files from a CineMag IV. This results in smaller, more manageable files than the 12-bit 'unpacked' format, and with no quality loss. If you are using 3rd party post production software to read the Cine Raw files, please ensure they are compatible with this 'packed' format. To save the Cine Raw in an unpacked format, simply un-check the 'Packed' box prior to saving.

From the 'Play' tab in PCC, select the cine you want to save from the 'Cine:' pull-down menu. You will see all clips in the RAM as well as the CineMag in this list. Once you've selected a clip, you can mark an in and out point if desired by clicking the '[' and ']' buttons respectively.

Alternatively, use PVP software in a similar manner when using video playback from the camera body.

Then click the green 'Save Cine...' button.

In the 'Save Cine' dialog box, choose 'Cine Raw' as the file format, navigate to the folder where you wish to save the clip and click 'Save.'

In the Play Tab, click the triangle to the right of the 'Save Cine...' button, and from the popup menu select 'Save All Flash Cines To File.'

In the subsequent save dialog window, navigate to the folder where you wish to save the clips, and select the 'Cine Raw' file format. Choose a name for the group of Cine files and click the 'Save' button. Each Cine's file name will start with the name you choose, and end with the cine number.

In the PlayTab, click the triangle to the right of the 'Save Cine...' button, and from the popup menu select 'Select&Save Cines to File.'

In the pop-up window, select the cines you wish to save. Use the shift key to select a range of clips, or the control key to add individual clips. When you've

See Tel: (ne	to and the second
Aures Chyseness 2 fotos 2 fatos	C. Ok. Cont

Erasing a CineMag IV

selected the cines you want to save, click 'OK.' In the subsequent save dialog, navigate to the folder where you wish to save the clips, and select the Cine Raw file format. Choose a name for the clips and click the 'Save' button.



'_Flashcine#' will be appended to the file name of all batch-saved clips, where '#' represents the number of each take.

A CineMag IV can be erased via the Phantom PCC and PVP software from the camera or CineStation IV.

In PCC software, navigate to the 'Live>Flash Memory' menu and click the 'Erase' button. Confirm that you wish to delete all clips.

In PVP software, simply tap the 'Erase All' button, and confirm. Erase progress is indicated on the video OSD, on the camera screen, and by a progress bar in the software.



A 1TB CineMag IV will take about 2.5 minutes to erase, and a 2TB CineMag IV will take up to 5 minutes to erase.

Erase Protection

Once complete, all data on the CineMag IV will be erased, and the CineMag will be ready for recording again right away.

In order to protect the contents, there is a tiny erase protect switch on the front of the CineMag IV. When locked, the CineMag can be recorded to, but not erased. If you find it impossible to erase the CineMag check that the erase protect switch is in the unlocked position.



Phantom CineStation IV

The CineStation IV is a simple device meant to quickly and efficiently download the contents of a CineMag IV. When connected to a computer running Phantom software, a CineStation behaves almost identically to a camera, except that no capture or live functions will be enabled.

There are two 3G SDI video ports on the back of the CineStation IV, with video buttons on the front.

These video ports and buttons pictured here are not active.



Connecting a CineStation IV to Phantom Software	The CineStation IV is available with a 1Gb and 10Gb Ethernet port. The 1Gb network works with the same settings needed for a Phantom camera:
	Network IP 100.100.100.1
	Subnet: 255.255.0.0
	Ensure no firewalls or virus protection is enabled
	To use the CineStation IV with a 10G connection, connect a CAT 6A (or greater) cable from the 10Gb Ethernet port on the CineStation IV to an approved 10Gb NIC (Network Interface Card) in the host computer, and use the following network settings:
10G Network Settings	10G Network IP: 172.16.0.1
	Subnet: 255.255.0.0
	The Phantom software will automatically detect the IP address of the CineStation IV. If you need to manually connect to the CineStation IV, its IP address is printed on the side of the device, label XIP.
	While most modern 10GBASE-T interface card installed in a PC should work, we have been using and testing the interface with the Intel X540-T1 and X540-T2 cards and find them to be very reliable.
	Once the NIC is installed in the PC, ensure the latest driver is installed from the manufacturer's website. Generally, the computer and all devices must be re-booted after the driver installation.
	Certified Phantom 10G Ethernet drivers need to be installed through PCC software. The Phantom Installer will prompt the user to install the Phantom10G Ethernet drivers.
	For optimum results, ensure there are no bottlenecks in the system - a striped RAID is recommended for the fastest save speeds.

O Phantom 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. 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 fullfeatured touch-screen controller, or both. An SDI cable connection is required to view the HD-SDI output of the camera on the RCU screen. Video is not transmitted via Bluetooth.





Front View (with / without CineMag)



Rear View (with / without CineMag)










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 vxx12 BNC Connectors



I/O Signal ports BNC

NOMENCLATURE / FUNCTION		
Trigger	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.	
Time Code In	Timecode In / can accept IRIG-B and SMPTE standards.	
I/O 1	Ready / Isolated collector output with 1k pull-up.	
1/0 2	F-Sync / +5V maximum threshold, input is also compatible with TTL levels and must be a properly terminated, (50-ohms).	
I/O 3	Timecode Out / for IRIG-B or SMPTE timecode.	
I/O 4	Strobe / Isolated collector output with 1k pull-up.	
HD-SDI 1 & 2	Two HD-SDI ports can acts as identical 4:2:2 HD-SDI ports with one set up to provide an optional) on-screen display to monitor the on-camera controls and cameaa operation. Or, they can be configured as a 'single 4:4:4 Dual-Link HD-SDI port.	

Phantom vxx12 Range Data Connector



Range Data port 8-pin Fischer part # S103.Z058

PIN	NOMENCLATURE / FUNCTION		
1	GND / Power Ground		
2	ROUT+ / Remote/Range Data Out (Positive), (RS-422); +5V maximum. Depending on data transmission rates, RS-422 can be used at distances to 4,000 feet (1,275 meters).		
3	ROUT- / Remote/Range Data Out (Negative), (RS-422); +5V maximum. Depending on data transmission rates, RS-422 can be used at distances to 4,000 feet (1,275 meters).		
4	RIN+ / Remote/Range Data In (Positive), (RS-422); +5V maximum. Depending on data transmission rates, RS-422 can be used at distances to 4,000 feet (1,275 meters).		
5	RIN- / Remote/Range Data In (Negative), (RS-422); +5V maximum. Depending on data transmission rates, RS-422 can be used at distances to 4,000 feet (1,275 meters).		
6	+3V3R		
7	+24VR		
8	GND / Power Ground		

Phantom vxx12 GPS Connector



GPS (Ground Positioning System) port 6-pin Fischer part # S103Z056

PIN	NOMENCLATURE / FUNCTION	
1	GND / Power Ground	
2	RxD / RS-232 Receive Data	
3	Unused	
4	+5V/0.2A / $+5VDC$ (Direct Current) positive power to the Phantom camera at 0.2 amps.	
5	pps In / Parts-per-Second In	
6	pps Ground / Parts-per-Second Ground	

Phantom vxx12 Remote Connector



Remote port (for Phantom RCU) 5-pin Fischer part # S103.A054

PIN	NOMENCLATURE / FUNCTION	
1	+24VDC	
2	PNG / The power input and the acquisition control sig- nals are isolated from the camera system ground. This isolation is designed to avoid system ground loops only, and should not be subject to high voltages.	
3	XRXD / Receive Data (RS-232); +5V maximum, normally limited to 50 feet (16 meters).	
4	XTXD / Transmit Data (RS-232); +5V maximum, normally limited to 50 feet (16 meters).	
5	IOGND2 / RS232 Ground - All the serial ports are not isolated (referred to system ground). As such, they should only be connected to properly earthed equipment.	

Phantom vxx12 Power Connector (Primary / Battery Backup)



Power ports 3-pin Fischer part # SS 104Z040-80

PIN	NOMENCLATURE / FUNCTION
1	+20 - 28 Volts DC
2	CHGND / Chassis Ground
3	GND / Power Ground

Phantom vxx12 GigE Ethernet Connector



GigE Ethernet port 8-pin Fischer 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)		
6	MDI2N / 10/100/1000BASE-T Media Dependent Interface 2 (negative)		
7	MDI2P / 10/100/1000BASE-T Media Dependent Interface 3 (positive)		
8	MDI3N / 100/1000BASE-T Media Dependent Interface 3 (negative)		

Phantom vxx12 10GigE Ethernet Connector



10GigE Ethernet port 8-pin RJ45

PIN	NOMENCLATURE / FUNCTION
1	XMDI0+ / MDI 0 (positive)
2	XMDI0- / MDI 0 (negative)
3	XMDI1+ / MDI 1 (positive)
4	XMDI2+ / MDI 2 (positive)
5	XMDI2- / MDI 2 (negative)
6	XMDI1 - / MDI 1 (negative)
7	XMDI3+ / MDI 3 (positive)
8	XMDI3- / MDI 3 (negative)

MDI - Media Dependent Interface

Phantom vxx12 Capture Connector



Capture port 19-pin part # PTO6A-14-19S

PIN	NOMENCLATURE / FUNCTION		
A	Event-In / active-low isolated input; signal must be active when strobe is high, and be 30µs long minimum.		
В	Trigger / Isolated Input. Active low. Can beactivated by a switch to ground. The triggerpulse needs to be at least 3 microseconds long. Capture cable = Red		
С	Strobe Out / Isolated collector output with 1k pull-up.		
D	IRIG- In (Unmodulated) / IRIG-B timecode input. Capture cable = White		
E	IRIG GND		
F	Video Out (Composite) / Standard (non-isolated) 75-ohm output level. Capture cable = Green		
G	Video GND (Composite) / Ground / Shield (for signals: F, and T).		
Н	Serial (RS-232) Ground / Should only be connected to properly earthed equipment (Serial ports are not isolated).		
J	Chassis GND /		
K	Transmit Data (RS-232) / standard RS-232 level.		
L	+12-30VDC / DC output (0.5A amp Max.) Typically used to power break out boxes.		
М	Power GND / isolates power input and acquisition control signals from system ground to avoid system ground loops only, and should not be subject to high voltages.		
N	Auto-Trigger Output / Pulled low when an auto-trigger condition detected. Capture cable = Black		

Capture port (continued)

PIN	NOMENCLATURE / FUNCTION
Р	ISO GND / Ground / Shield (for signals: A, B, C, R, and V)
R	Pre-Trigger In / MemGate In Pre-Trigger In / Places camera into the 'Ready' state or 'Capture' mode with dtection of TTL (falling edge) pulse. Mem-Gate In / Active-Iow isolated input. Capture cable = Red
S	IRIG Out (Unmodulated) / IRIG-B timecode output. Swings to RS-232 levels of +/- 9V Capture cable = Blue
Т	GenLock / Synchronizes playback to a properly terminated (75-ohm) video signal (not exceeding +1.56V maximum), utilizing a composite video inbound signal, or synch live video, by synchronizing the SDI outputs to the GenLock signal.
U	Receive Data (RS-232) / standard RS-232 level.
V	Ready / Isolated collector output with 1k pull-up.

Phantom vxx12 Viewfinder Connector



Component VF port 7-pin Fischer part # S103.A057

PIN	NOMENCLATURE / FUNCTION	
1	GND / Power Ground	
2	GND / Power Ground	
3	PB HD Blue Channel	
4	PR HD Red Channel	
5	Y HD Green Channel	
6	GND / Power Ground	
7	+12V Positive 12 VDC / 1.5 Amp	

What is the difference between 'Native' and 'Cropped' resolutions? To simplify things, only specific resolutions are available from the camera menu. The choices are a variety of common resolutions and aspect ratios.

1/2 CAMERA	
Speed 100 f/s	Shutter 324° 9ms
Frame burst off	Period 59.95us
Trigger	Ţ
Res 1280 x 800	Capture Loop
Auto bref off	
PA 0 x 0	PAO 0,0
Zoom fit	Color Bars off

The resolution controls in PCC software are somewhat different, and allow more flexibility 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.

Cine 1 v	set al	Pip H Pip V Rotate Occkwis
Name Resolution 1280 x 800 1280 x 800		Overlays: Grid Cross Crop&Resample Output resolution presets Custors
Sample Rate 1280 x 720 1024 x 768 500 sure Time 768 x 768	pps	Crop V Hide Crop Rectangle X Y Width Height
EDR 768 x 576 768 x 480 640 x 480	a	0 0 0 0 1 0 1 0
Exposure Inde 512 x 512 512 x 384 512 x 320		Resample Width Height
256 x 256 mage Range 256 x 128	on	Production area Offset
-760 128 x 64 128 x 16 Custom	Last: 🕶 1999	Size: X Y + Disabled ● 640 ÷ 400 ÷

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.



'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. 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.

	v2512	v2012	v1612	v1212
Width x Height	Max FPS	Max FPS	Max FPS	Max FPS
1280 x 800	25,600	22,500	16,600	12,600
1280 x 720	28,500	25,100	18,400	14,000
1024 x 800	30,500	26,900	19,700	15,000
1024 x 512	47,300	41,800	30,700	23,400
896 x 800	33,600	29,800	21,800	16,600
768 x 768	39,100	34,700	25,300	19,300
640 x 480	69,900	62,400	45,500	34,700
512 x 512	75,400	67,700	49,100	37,500
512 x 384	99,500	89,000	65,000	49,60
385 x 256	170,600	154,200	112,300	85,700
256 x 256	205,00	187,200	135,400	103,600
256 x 128	375,700	343,500	253,00	193,900
128 x 64	764,700*	708,800*	538,400	415,500
128 x 32	1,000,000*	1,000,000*	840,000*	653,00*
128 x 16	1,000,000*	1,000,000*	1,000,000*	820,000*

Supported Resolutions

* Assumes FAST Option is installed Maximum v2512 standard; 677,000 fps Maximum v2012 standard; 666,000 fps Maximum v1612 standard; 646,000 fps Maximum v1212 standard; 570,000 fps

faqs

What is the difference between the Phantom UHS-12 Series (v2512, v2012, v1612, and v1212) and the previous UHS-11 Series (v2511, v2011, v1611, and v1211)?

The v2512, v2012, v1612, and v1212 all have 10Gb Ethernet interface. Tell me more about it and how to use it.

Can I use a viewfinder with the Phantom v2512, v2012, v1612, or v1212? The UHS-12 Series are similar to the UHS-11 Series, except for two differences. The first difference is the increase in memory. The UHS-12 Series can be equipped with either 72GB, 144GB, or 288GB of RAM. The second difference is that the UHS-12 Series take advantage of the CineMag IV, with 1TB or 2TB of non-volatile memory. These enhancements are designed to make capturing, accessing, and managing your critical data much easier. The UHS-12 Cameras have the same excellent sensitivity and framerates as the UHS-11 cameras, with the same Phantom Features and outstanding image quality you've come to expect from Phantom digital high-speed cameras.

Yes, a copper UTP 10Gb Ethernet interface is standard on the camera. When properly configured, this allows for cine downloads at speed up to 4 or 5 times that of the Gb Ethernet interface. While any compatible 10GBASE-T interface card installed in a PC should work, we have been using and testing the interface with the Intel X540-T1 and X540-T2 cards and find them to be very reliable.

Vision Research provides a ruggedized connector carrier to be used when connecting a standard CAT6 or CAT6A Ethernet cable between the camera and the interface card. The customer must supply the appropriate cable.

A CAT6A cable is recommended and gives you a maximum 100m distance between the camera and the interface card. (A CAT6 cable is limited to 50m.)

Additional information is available in a Phantom Note named "10Gb Ethernet Solutions for Phantom Cameras and Accessories" and can be found at: http://www.phantomhighspeed.com/Service--Support/ Downloads/Documents/Technical-Notes/

Yes. In fact, there is a viewfinder port on the camera that will supply video and power to a viewfinder or monitor. All UHS-12 digital cameras come with a 280W power supply, providing ample power for a camera with maximum 288GB memory, a 2TB CineMag, and the viewfinder What signals are available on the Capture Connector, on the back of the camera, and which of those are provided on the standard Capture Cable that ships with the camera? There is a 19-pin Amphenol connector on the back of the camera that is called the Capture Connector. The connector has the following available signals:

- Event input (an external signal can "mark" one or more frames with an event marker making it easy to later find and view specific frames)
- Trigger input (provides a hardware trigger to the camera)
- Strobe output (is a low during the frame exposure time)
- Ready output (is high when the camera is capturing pretrigger frames)
- IRIG-In (external sync and time stamping from a modulated or unmodulated IRIG source)
- IRIG-Out (provides an unmodulated IRIG source that contains timing information from the camera)
- Video Out (a composite video signal, either NTSC or PAL)
- Serial Port input (for serial protocol control of camera)
- Power Out (24VDC, used to power the Break-out-Box)
- A-Sync output (optionally, signal goes low when a trigger event is detected by the Image-Based Auto-Trigger feature allowing for multiple cameras to be synchronized to an event trigger)
- Pre-trigger/Memgate input (mode is set in software; if Memgate is low, acquired frames are discarded rather than saved to camera memory; Pre-trigger signal "arms" the camera and starts the acquisition of pretrigger frames)

Detailed information about these signals is available using the PCC application's Help feature.

All v2512, v2012, v1612 and v1212 cameras ship with a standard Capture Cable that connects to the Capture Connector and provides access to:

- Ready
- Strobe
- A-Sync
- Pre-trigger/Memgate
- Video

All other signals are accessible by using a Phantom Break-out-Box. See the related FAQ.

No, you must use the 280W power supply shipped with the camera. It is part number: VRI-PWR-SUPPLY-280W-FIS. Spares and replacement power supplies are available from Vision Research.

Prior to the introduction of the Phantom UHS-10 Series (the predecessors to the UHS-11 and UHS-12 Series), Phantom cameras did not have a physical power switch. Instead, the camera powered up any time an appropriate DC voltage appeared on the power input to the camera. This was done so that cameras can be powered up (booted) remotely by providing primary power and did not require physical access to the camera.

However, there is a physical power switch on the v2512, v2012, v1612 and v1212. It has three positions: AUTO, ON, and OFF.

When the switch is set to AUTO, providing power to the Primary DC Input will power up (boot) the camera and it will be ready for use. In AUTO, providing power to the Battery Backup power input of an unpowered camera WILL NOT power up the camera. However, if there is a loss of primary power, then the Battery Backup power will be used to maintain camera operation and protect any stored data.

Can I use any Vision Research power supply with the v2512, v2012, v1612, and v1212? I have a power supply from a UHS-11 Series camera, can I use it?

What does the AUTO/ON/OFF switch do?

When the switch is in the OFF position, the camera is off. Providing power to the Primary DC Power input or the Battery Backup input will not cause the camera to power-up.

When the switch is moved to the ON position, the camera will power-up immediately provided there is power connected to the Primary DC Power port OR the Battery Backup port on the camera

There are several use-cases this scheme enables:

- Battery backup for mission critical tests: Set the camera to AUTO. Power through the Primary input and provide local battery backup power to the Battery Backup input. If primary power is lost, camera operation will continue and data is protected by the battery backup.
- 2. Remote power up: You can turn the camera on by providing power to the Primary DC Power input when the camera is in AUTO or ON.
- Remote power cycle: If the camera will need to have power cycled remotely, set the switch to AUTO and do not use a battery for battery backup.

Battery operation: Connect a battery to the Battery Backup port. Set the switch to ON.

There is no danger. First, there is actually very little liquid in the heat pipe. And, it is under very low pressure. So, while the liquid might freeze, it will not damage the heat pipe. Soon after powering the camera, the liquid will thaw.

Will the liquid in the heat pipes freeze and damage the heat pipes if the camera is stored or transported at temperatures below zero?

What is the worst case power draw of the camera that I would use to calculate battery requirements?

You should assume the camera will consume 240 watts. This assumes that you are not using a viewfinder with the camera, but that it has a CineMag and full memory.

I see there are two power inputs ports. One is the Primary DC Power and the other is Battery Backup. How do these work?

The primary input is where you plug the 280W A/C power supply provided with the camera. This is your primary source of power for the camera. You can optionally connect a backup source of power–often a battery–to the backup battery power input. If the camera power switch is set to AUTO, and if there is a loss of power on the primary input, even momentarily, the backup power will immediately take over - providing uninterrupted power to the camera. This is important to protect any images stored in the camera's high-speed memory from accidental loss.

Connecting power to the battery backup port will not turn on the camera. (See FAQ about the AUTO/ON/OFF switch.) There is no drain from the connected battery unless a loss of primary power causes the power input to switch to the battery backup.

The battery backup port will not charge a connected battery.

In case of primary power loss, the backup battery port will not only protect images saved in memory, but can provide sufficient power to power all camera operations until the input voltage drops below the minimum required, \sim 18VDC.

If primary power is restored, that again becomes the power source for the camera and the battery port reverts to a backup mode.

The GPS port on the Phantom v2512, v2012, v1612 and v1212 can be used to provide date, time and location information from the GPS satellite network. Vision Research sells a compatible GPS receiver (VRI-GPS-18X-LVC-5M). With the GPS receiver connected to the camera, and assuming it has a valid satellite fix, GPS timing can be used similarly to IRIG timing. You can synchronize the camera's internal clock to the GPS, timestamp frames with GPS timing accuracy, and even save the camera's latitude and longitude with any cine file (location error is < 3 meters after a satellite fix.)

The GPS connection supplies 5 volts at 0.2 A maximum, and an RS-232 connection to a GPS device.

1 PPS pulse is used for timing in the camera.

Tell me more about the GPS port on the back of the camera.

Communication with the device is at 4800 baud over the NEMA 0183 standard protocol which is very common.

The GPS position is recorded in the Cine header file.

Connection diagram is available.

All of the Phantom Ultra High-Speed Cameras (v2512, v2012, v1612 and v1212) are equipped standard with 10GB Ethernet and can be equipped with the unique CineMag interface, precisely for fast downloading.

The 10GB Ethernet allows data transfer at up to 500 MB/ second on optimized systems, meaning all 288GB of memory can be downloaded in approximately 8 minutes.

The CineMag interface can transfer images from the camera's high-speed memory to non-volatile, flash memory at about 1Gpx/sec. A full resolution frame is 1 Mpx, so you can save about 1000 frames each second to a CineMag. Or, another way to state this is you can save about 1.5GB/sec to non-volatile mass-storage. A Phantom Ultra High-Speed Camera, equipped with maximum memory of 288GB, can save its full memory buffer to a CineMag in just over 3 minutes.

Once a shot is saved to the CineMag it is safely stored and available for later retrieval. This means you immediately can use the camera for another shot.

Images stored on a CineMag are available for later retrieval using the Phantom Camera Control (PCC) software with the CineMag mounted on either the camera or the offline docking station known as a CineStation, and may be downloaded either through the camera or the CineStation, using their 10Gb Ethernet ports.

The v2512, v2012, v1612 and v1212 are only compatible with CineMags IV's, offered in 1TB and 2TB versions.

No. We've been able to achieve these rates of speed without the use of such technology

These camera have alot of memory in them! How long does it take to save a shot from these cameras?

Is it true that a camera that runs this fast must be powered by either dilithium or silithium crystals?

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