

PHANTOM v2640

2048 x 1952 **4MP**
@ 6,600 fps

1024 x 976 **1MP**
@ 25,030 fps



NEW GENERATION SENSOR WITH BINNING!

***Ultimate Flexibility for
Image Quality & Speed***



SAMPLE FOOTAGE:

www.phantomhighspeed.com/v2640

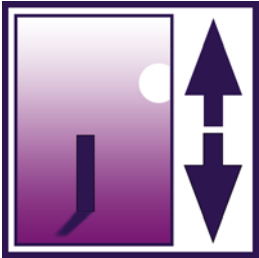
DOWNLOAD PHANTOM CINE VIEWER:

www.phantomhighspeed.com/cineviewer

Specs Subject to Change | Rev 1 | Mar 2021

Choosing your camera

New generation cameras allow flexibility to manage linearity, noise levels, dynamic range and sensitivity; based on application.

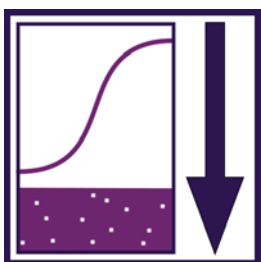
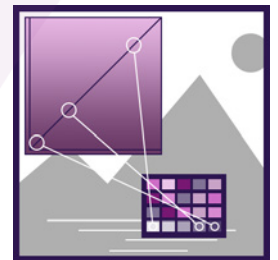


Dynamic Range

Dynamic Range is the extent to which a sensor can collect useful data deep into the shadows, and preserve detail in the highlight values. Higher sensitivity and lower noise will decrease this important characteristic of your sensor.

Linearity is the extent to which a sensor provides an accurate representation of tones across a scene's dynamic range. Prioritizing high sensitivity over accurate linearity may result in lost data for cases where mid-tones are reassigned to highlight or shadow values, whilst visually deceiving the user by creating a high-contrast and brighter image.

Linearity



Noise

Noise is unwanted image data created by various electronic and optical hardware. It is inherent to digital sensors and mis-managed sensitivity increases will directly generate higher noise levels, creating poor data.

ISO is the standard by which sensitivity is compared. There are no ISO standards designed for high-speed digital sensors, however the SAT 12232 standard has become accepted and is used by Vision Research for Phantom cameras.

ISO



Sync Snapshot

Sync Snapshot is an important user interface allowing easy capture of calibration files of a single camera or multiple synchronized cameras. With a few simple mouse clicks, calibration files can be automatically sent to preset destinations, re-captured and checked before easy integration with 3rd party DIC, BOS or other applications.

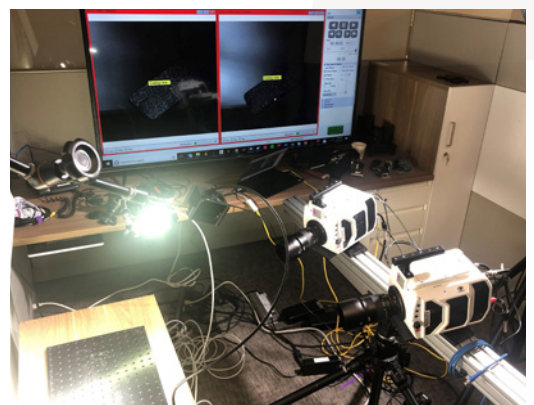


Figure 1: Photograph of two v2640's setup for DIC.

Balancing Key Parameters

v2640 Standard Mode, Employing CDS

The new “Standard Mode” in the v2640 uses “Correlated Double Sampling” to help give the cleanest image produced in high-speed sensors. All sensors suffer from noise characteristics, and traditionally reference black frames were the primary method of reducing these artefacts. Sensors however change dynamically over short periods of time, and so do their responses. Along with traditional black referencing, “CDS” samples reference pixel voltages for every individual frame under known parameters and uses these to offset the unknown values produced by exposure, thus removing variable changes due to heat and other electron sources within the hardware.

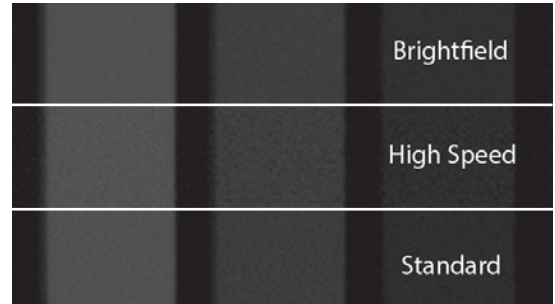


Figure 2: Sample Image of v2640 modes

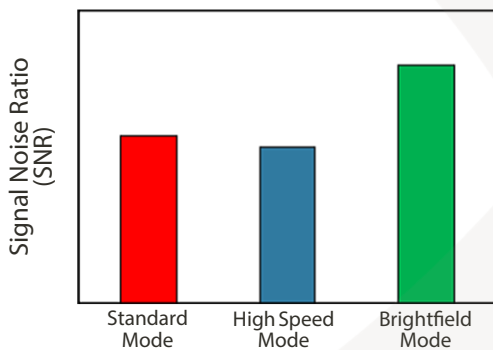


Figure 3: Noise levels of modes.

v2640 High-Speed Modes

Whilst ultimate image quality is ideal, the CDS process uses some resources we could repurpose to provide higher capture speeds. By using the v2640 High-Speed mode, traditional black referencing is used to retain new generation image quality standards, while maximizing the throughput across the whole range of resolution choices.

v2640 Brightfield Mode

Brightfield mode enables extremely high SNR (Signal-Noise Ratio) for high key applications with lower sensitivity requirements.

v2640 In-Camera Binning Modes

The v2640 sensor is unique in that it can be switched from a 4MP sensor, to a 1MP sensor by 2x2 pixel binning. In these modes (available in Std & HS), four pixels are combined at the sensor to create one gray value. In the v2640, four 13.5µm pixels combine as a single 27µm pixel.

Note: Binning mode produces a grayscale image for color sensors.

The benefits of binning are:

- Approx. double FPS for a given resolution
- Approx. double sensitivity for a given resolution

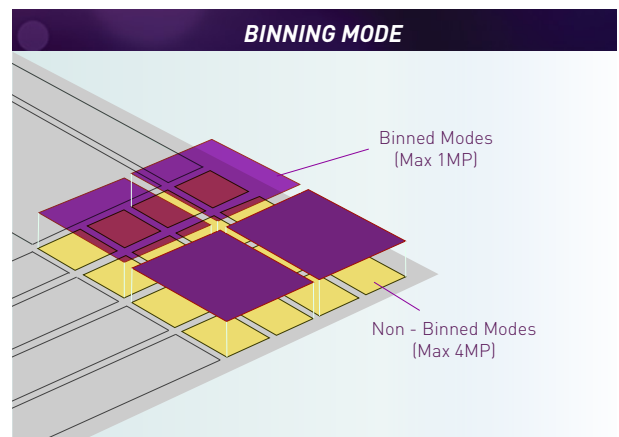


Figure 4: Binning Mode

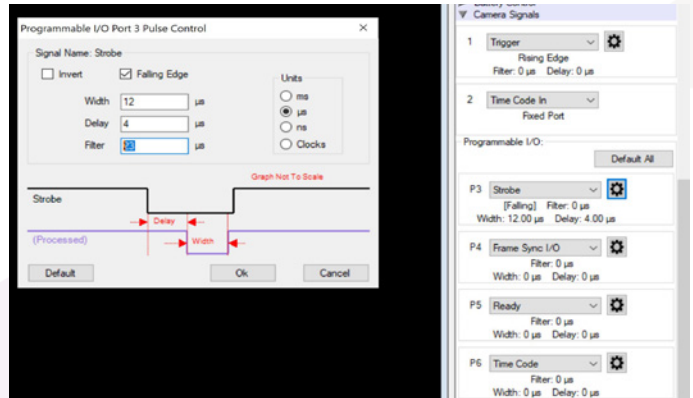
PHANTOM v2640 FEATURES

10Gb Ethernet Connection

10Gb Ethernet allows for greatly increased Cine playback and download speeds. With 10Gb Ethernet, Phantom cameras can achieve significantly higher download speeds which makes it a great option for saving large data sets quickly out of RAM. Expected download speeds: 400-600MB/sec (dependant on PC system).

Programmable I/O

Programmable ports allow the end user to select a signal type from a pull-down selection list, and set the characteristics for the signals such as polarity, signal width and delays. A large range of device signals can be accepted by Phantom cameras through programmable I/O. It also makes controlling devices such as pulsed lasers, other cameras, tracking mounts etc. very practical.



E.I.

EI sets the exposure index (Effective ISO) of the image, by loading preset tone curves to increase the effective ISO of the camera up to 5x the base value. Adjusting gamma, gain and other settings will contribute to the overall EI value, to achieve a higher ISO performance while managing the noise and dynamic range characteristics.

PIV Mode

Exposure in PIV mode reduces duration between frames (frame 'straddle' time / inter-frame gap) required for Particle Imaging Velocimetry (PIV) applications.

Burst Mode

Burst mode drives the camera to make multiple exposures within one F-Sync (frame clock) cycle and works in 'internal' and 'external' sync modes, as well as in PIV mode. A typical implementation of the feature involves providing an external F-Sync pulse, thereby triggering a specific number of images at a frame rate greater than the external F-Sync rate.

Note: Effective frame rate cannot exceed camera max frame rate under given resolution.

Auto File Naming Convention

Automatic file naming gives you the option to have a series of images, cine files or snapshots named sequentially using functions that you choose. Parameters such as save number, trigger time and serial number can be included in the file name and appended sequentially to save time and to make organization and analysis of images easier.

Sync Snapshot

Sync Snapshot feature is developed to enable easy calibration of 2D or stereo imaging systems in applications such as DIC (Digital Image Correlation), BOS (background oriented schlieren) and for general composition record keeping. For each sync snapshot, you get an image from each camera of the sync family, and all images will be nicely archived under a preset path using auto file naming convention.

Scheimpflug Compatibility

For applications such as PIV where focal plane angle adjustment is necessary, a scheimpflug compatible front panel is available, allowing a larger freedom of movement for a selected scheimpflug mount.

PHANTOM v2640 FEATURES

IBAT

The Image-Based Auto-Trigger (IBAT) feature allows selected Phantom camera models to analyze images at the sensor/ firmware level and automatically trigger and/or send a trigger output to other devices. IBAT user set thresholds are managed per frame and do not require a PC connection once set up.

Continuous Recording

Continuous recording allows a Phantom camera to automatically download a cine file to your PC. The flexibility this feature offers when combined with restart recording and a partitioned memory, saving via 10Gb ethernet as well as features such as IBAT opens up a world of applications! The subject could be moving into view at random moments and the V2640 can automatically detect the motion and capture your footage, download to a preset file system, clear the partition of memory and wait for another key event to occur. Continue to capture until the hard drive is full.

CineMag

The Phantom CineMag is a high speed non-volatile solid state storage module, which differs significantly from common SSD in that its proprietary management enables extremely high datarate downloads. End users can benefit from the CineMag not only in saving download time on site, but also in direct recording to CineMag in lower frame rates for a much longer record times, or easy playback to a video monitor to complete stand alone workflow with on camera control.

Tone Curve

Tone curve is an input / output management system which allows any pixel value to be re-assigned to another value. This allows complete control by the user to override manufacturer preset Gain, Gamma or EI curves. Tone curve can be applied before or after recording to RAM, or to an existing cine RAW file saved from a Phantom camera with the tone curve feature.

Quiet Fan

When selected, a camera will turn off the fans or set them to its' minimum speed, which will significantly reduce vibration and air flow for a short time to create a better testing environment. Techniques such as schlieren or high magnification / microscopy will benefit.

Trigger Modes

Phantom cameras provide various trigger modes including hardware trigger, software trigger and image-based-auto-trigger, you can also set trigger position in x1 frame increments from 0 post trigger frame to the maximum RAM available.

Frame Time Stamp

"Current Time" is tagged to the end of each image recorded from the camera, when there is no IRIG-B time code clock source attached to the camera, "computer time" will be synchronized to "Current Time". GPS time is available with a compatible Garmin GPS unit.

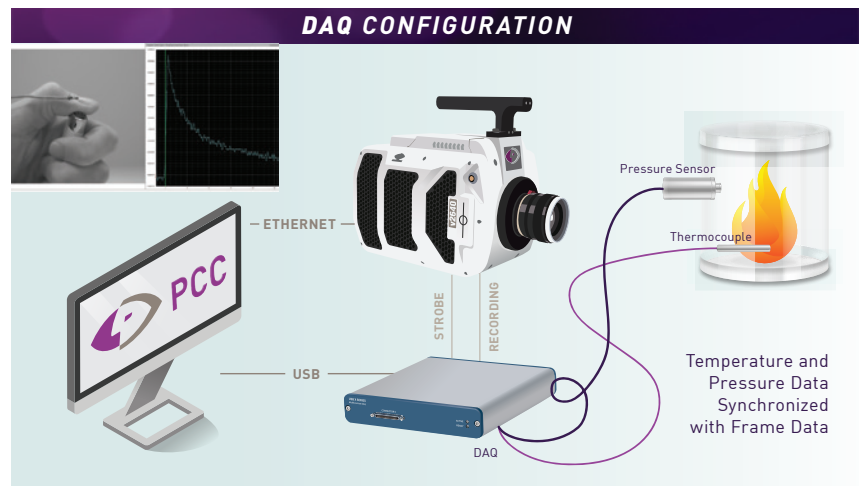
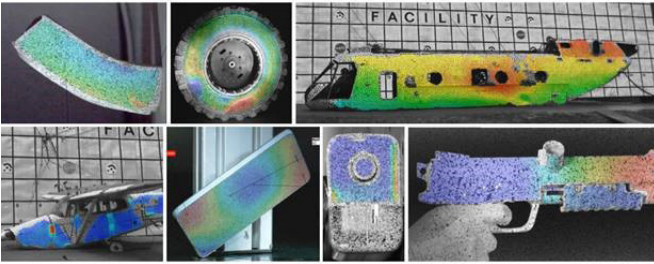


Figure 5: A typical high-speed DAQ system.

Applications & Techniques

You can access to application video by clicking on below image in e-version file.

DIC (Digital Image Correlation)

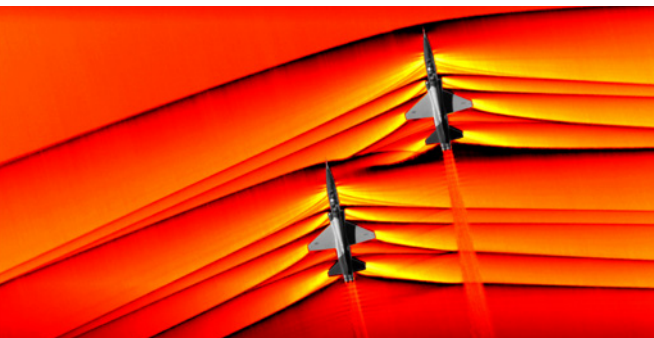


Digital Image Correlation requires high resolution at high frame rates to provide details of strain and deformation map data. A large dynamic range will allow easier management of difficult lighting conditions such as using natural textures as a speckle pattern.

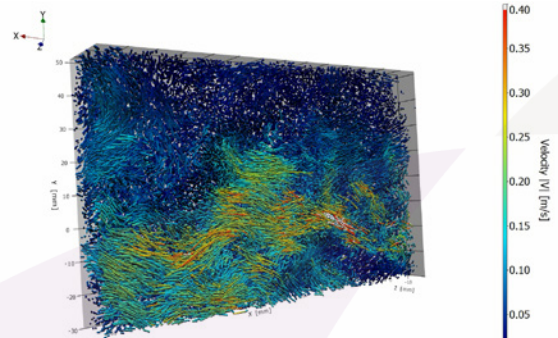
Range / Field Trials



The v2640 has become a favorite for Range testing and field trials due to its flexible operating modes allowing high resolution for arena or DIC testing, while having the throughput and sensitivity required for high speed events such as ballistics and other projectile observation and tracking requirements.

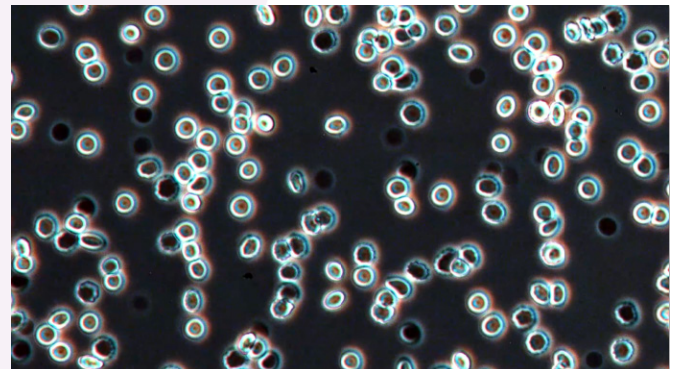


TR-PIV (Time Resolved Particle Image Velocimetry)



The PIV technique often captures the majority of integration window data from shadow areas where noise degrades the dataset reliability. The v2640's unmatched low noise characteristics allow for shorter exposure durations while maintaining high sensitivity.

Microscopy



The small but highly light sensitive pixel size of the v2640 reduces the optical magnifications required to fill the field of view with the subject. This in turn allows for faster exposure times and higher frame rates than were previously possible – pushing the boundaries of research in modern medicine and science.

Schlieren

Phenomena observed in schlieren systems typically falls into the categories of gas flows, or the much high velocity of shock phenomena. The v2640 caters for both of these scenarios with its various modes and specific gray values often hidden within the flow can be highlighted using PCC's customizable tone curve outputs.



Specifications

Throughput

26 GP/S (Gigapixel per second)

Sensor

Type	CMOS
Effective Pixels	3,997,696
Max. Resolution	2048 x 1952
Pixel Size/Pitch	13.5um
Binned Modes Pixel Size (aggregate)	27um
Size	27.6 x 26.3mm
ADCs	12bit
Continuously Adjustable Resolution	128 x 8
Binned CAR	128 x 16

Mode Dependant Sensitivity (D)

Monochrome	ISO	EI Range
Standard (CDS)	16,000	16,000 - 80,000
High Speed (non-CDS)	12,500	12,500 - 62,500
Standard Binned (CDS)	25,000	25,000 - 125,000
High Speed Binned (non-CDS)	25,000	25,000 - 125,000

Color	ISO	EI Range
Standard (CDS)	3,200D	3,200 - 16,000
High Speed (non-CDS)	3,200	3,200 - 16,000
Standard Binned (CDS)	5,000	5,000 - 25,000
High Speed Binned (non-CDS)	5,000	5,000 - 25,000

Note: Color camera images are rendered in grayscale for binned modes.

Recording Time

7.8 seconds at maximum frame rate, 12 bits, 2048 x 1952 resolution and into maximum internal memory. max FPS @ Full resolution

File Formats

Cine (native Phantom format), AVI, h.264 mp4, .mov, TIFF, JPEG, BMP, DNG, Cine Compressed, Cine RAW, Apple ProRes, Multipage TIFF, MXF PAL, MXF NTSC, Uncompressed QuickTime, Windows OS/2 BMP, PCX, TGA, LEAD, JTIF, RAW, DPX

Compatible Software

Direct cine import to DaVinci Resolve, Adobe Premiere Pro, Final Cut Pro X, ImageJ

Camera Controls & Software

Control Interfaces

PC via Ethernet with "Phantom Camera Control", "Phantom Video Player"

On Camera Controls standard, optional menu overlay on image via SDI video monitor

Phantom Remote Control Unit (RCU2) or 3rd party controllers

RS232 serial port

Telnet protocol available for integration

SDK available for integration

API available for integration into Matlab and Labview

"Set and Forget" functionality available through multiple feature arrangements

Camera and Capture settings retained on power off and reboot

External Data Acquisition

Compatibility, software interface and graphing for National Instruments M & X series DAQ units

Range Data port for direct data collection (128bits/frame) including azimuth and elevation data

GPS port for collection of GPS time and position data (with Garmin 18X)

Exposure

1µs

142ns (FAST option, export controlled)

Minimum 490ns straddle time

Signalling

Direct BNC fixed signals

Trigger, Timecode (Irig / SMPTE), x2 Video (HD-SDI)

Direct BNC programmable signals

Fsync, Strobe, Timecode, Ready, Event, Memgate, Multistrobe, Autotrigger, Software Trigger, Recording, pretrigger, Runstop, Auxtrigger

Direct BNC programmable duplicated (core) signals

Trigger, Event, Memory Gate, Frame Sync, Pretrigger, Runstop, Auxtrigger

Capture Port Signals (via 16pin Amphenol - BNC cable)

Event, Trigger, Strobe, Ready, IRIG In, IRIG Out, Video Out, Serial Port

Specifications

Mechanical

Dimensions 11 x 7.5 x 7.43 inches, 28 x 19 x 18.88 cm (L, W, H) (without handle or accessories)

Weight 17 lbs, 8 oz, 8.1 kg

Cooling

TE Peltier combined with heat pipes and user-replaceable fans

Connectivity

1Gb Ethernet, 10Gb Ethernet (rugged), x2 20-28VDC power Inputs (auto-switching), GPS, Range Data, Remote, USB, Capture

Memory

72 GB, 144 GB, 288 GB high-speed internal RAM
CineMag IV and V for non-volatile storage (up to 8TB)

Environmental

Operating Temperature	-10 to +50 C
10Gb Ethernet Operating Temp	+5 - +50 C
Storage Temperature	-20 to + 70 C
Humidity	95% non-condensing
Regulatory	EMI/EMC/ESD
Emissions Tests	EN 61326-1, FCC part 15
Immunity Tests	EN 61326-1
Random Vibration	Operational: 7.5 Grms, 3axes, IAW MIL-STD-202G. Non-Operational: 5.5G, 11mSec saw-tooth, 3 axes, 60 pulses total.
Shock	Non-Operational: 30G, 11mSec saw-tooth, 3 axes, 60 pulses total.
Safety	IEC 60950

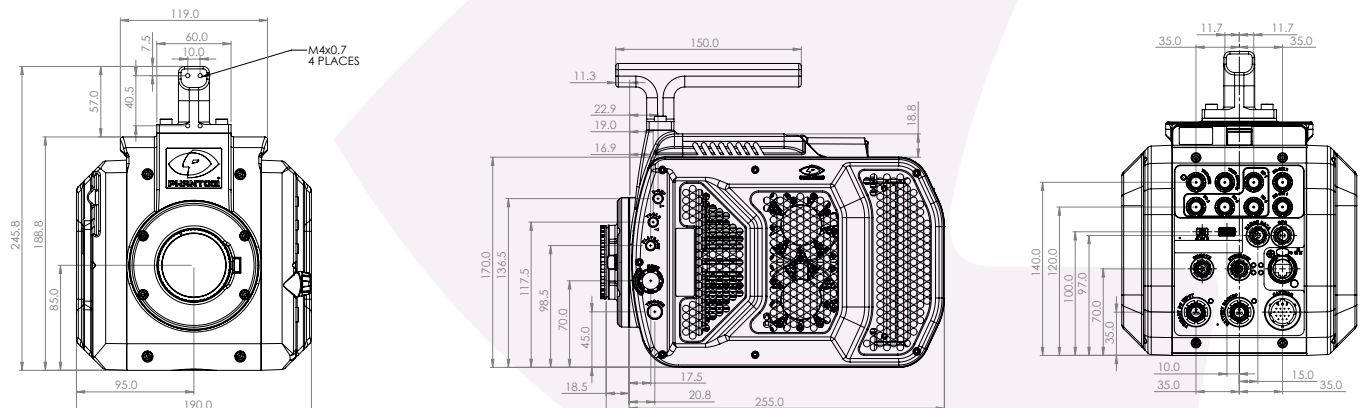


Figure 6: Camera Mechanical Drawing.

Click links to download drawing details. [CineMag Compatible Mechanical Drawing](#) [Non-CineMag Compatible Mechanical Drawing](#)

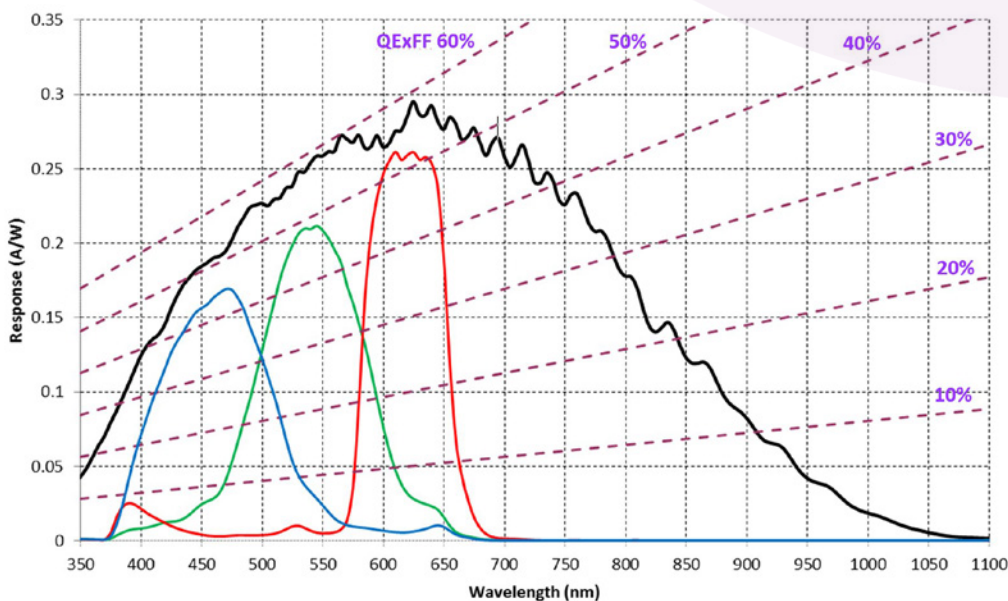
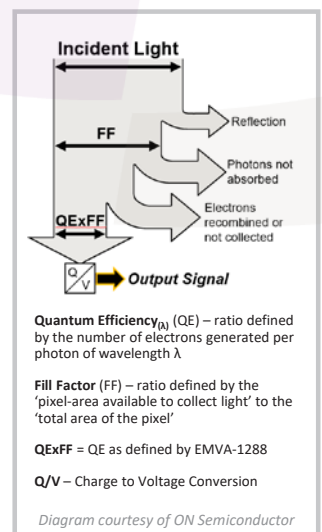


Figure 7: Spectral Response Curve (Color and Monochrome).



Accessories



CineMag

The CineMag V is a proprietary storage device incorporating secure, removable, non-volatile flash memory for high-speed Phantom raw footage. At speeds up to 1.4Gpx/sec the CineMag V is the fastest data transfer solution for Phantom cameras.

Mount

- I. Ships with Nikon F/G Mount.
- II. Canon EOS Lens Mount.
 - Provides electronic aperture and focus control.
- III. C Lens Mount.
- IV. PL Mount.

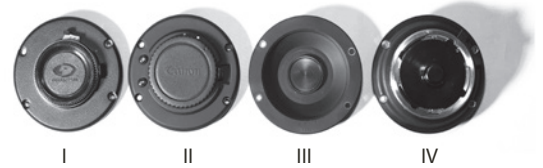


Figure 8: Mounts.

Scheimpflug compatible front panel

Scheimpflug is the ability to tilt the plane of focus. PIV application can make own mounts which allow lenses to tilt or swing to achieve this. Vision Research created a special front panel which gives more room to do this and still maintain correct back-focus distances.

Other Suggested Accessories

Please consult your Vision Research sales contact, application engineer or sales partners for an appropriate solution to your imaging needs. A stable mounting platform is highly advantageous. For high magnification applications, geared mount movements and suitable lensing will provide a trouble-free approach to your photography. High-speed specific lighting is often required to avoid flicker and provide appropriate light quality in a practical form factor.

Mounting

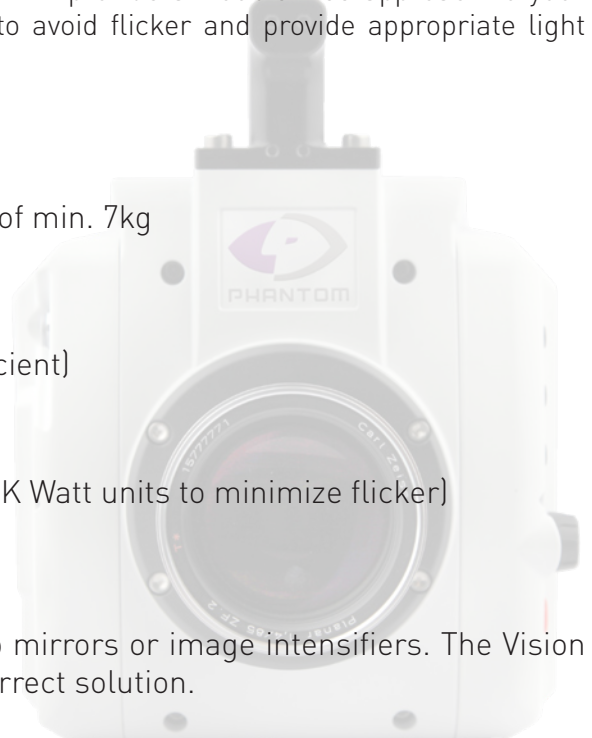
- Tripod with safety payload weight of min. 15Kg
- 3 axis or geared tripod head with safety payload weight of min. 7kg
- Camera Stand with safety payload weight of min. 5kg

Lighting

- High-Speed Compatible LED (practical form, highly efficient)
- Plasma (Large output efficiency with high CRI)
- Continuous Xenon-arc (High CRI, flicker-free)
- Tungsten-Halogen (cost effective, good CRI. Use min 10K Watt units to minimize flicker)
- Laser (for specialist applications such as PIV)

Optics

Optics can range from traditional SLR lenses through to mirrors or image intensifiers. The Vision Research sales team will work with you to provide the correct solution.



Max Rate (fps)	X Res	Y Res	Mode
4,860	2048	1952	S
5,000	2048	1896	S
5,000	2048	1952	H
6,000	2048	1568	S
6,000	2048	1952	H
6,600	2048	1952	H
7,020	2048	1832	H
8,020	2048	1600	H
8,070	2048	1152	S
8,070	1920	1696	H
8,580	2048	1080	S
8,580	1920	1080	S
8,580	1920	1592	H
9,000	1792	1624	H
9,020	2048	1024	S
9,020	1920	1512	H
10,000	1920	1360	H
10,060	2048	912	S
10,060	1920	1352	H
11,010	1920	1232	H
12,000	1920	1128	H
12,510	1920	1080	H
13,000	1792	1112	H
14,010	1920	960	H
14,070	2048	896	H
15,090	1792	952	H
16,000	2048	784	H
17,010	1920	784	H
17,820	1280	800	H
18,070	1920	736	H
19,050	1920	696	H
20,120	2048	616	H
21,020	1792	672	H
22,010	2048	560	H
23,070	1920	568	H
24,020	1920	544	H
25,030	1024	976	B
26,180	1920	496	H
26,230	1024	928	B
27,100	1024	896	B
28,020	1024	864	B
29,020	1024	832	B
30,080	1024	800	B
30,250	1920	424	H

Max Rate (fps)	X Res	Y Res	Mode
31,230	1024	768	B
32,220	896	848	B
34,420	1920	368	H
34,510	1024	688	B
36,030	2048	328	H
36,030	1024	656	B
38,120	1792	352	H
38,120	896	704	B
40,470	2048	288	H
40,470	1024	576	B
42,440	896	624	B
44,450	1792	296	H
44,450	896	592	B
45,530	896	576	B
46,170	2048	248	H
46,170	1024	496	B
48,830	1920	248	H
48,920	1024	464	B
49,110	896	528	B
50,230	1920	240	H
50,430	1024	448	B
52,030	1024	432	B
53,290	1920	224	H
53,290	896	480	B
53,290	640	480	B
55,550	1024	400	B
56,510	1792	224	H
56,510	896	448	B
58,260	1792	216	H
58,260	896	432	B
60,130	1792	208	H
60,130	896	416	B
64,250	2048	168	H
64,250	1024	336	B
66,870	1024	320	B
70,460	1920	160	H
71,620	896	336	B
72,810	1024	288	B
74,460	896	320	B
76,190	2048	136	H
76,190	1024	272	B
79,900	2048	128	H
79,900	1024	256	B
80,150	1920	136	H

Max Rate (fps)	X Res	Y Res	Mode
80,890	896	288	B
84,000	2048	120	H
84,000	1024	240	B
88,230	1920	120	H
88,530	1024	224	B
92,920	1920	112	H
92,920	896	240	B
97,760	896	224	B
99,240	1024	192	B
103,140	1792	104	H
103,140	896	208	B
105,630	1024	176	B
109,140	896	192	B
110,520	1920	88	H
112,900	1024	160	B
121,240	2048	72	H
121,240	1024	144	B
130,920	2048	64	H
130,920	1024	128	B
142,270	2048	56	H
142,270	1024	112	B
147,880	1920	56	H
153,950	1792	56	H
153,950	896	112	B
155,780	2048	48	H
155,780	1024	96	B
161,530	1920	48	H
167,730	896	96	B
172,130	1024	80	B
184,210	1792	40	H
184,210	896	80	B
192,300	1024	64	B
204,280	1792	32	H
204,280	896	64	B
217,840	1024	48	B
223,400	1920	24	H
229,250	896	48	B
251,190	2048	16	H
251,190	1024	32	B
261,190	896	32	B
296,610	1024	16	B
300,000	1920	8	H
303,460	896	16	B
303,460	128	16	B

Mode:

S = Standard Mode
 H = High Speed Mode
 B = Binned Mode

Other frame rates are available.

Go to www.phantomhighspeed.com/calculators for more information.

Contact phantom.apac@ametek.com for application support from our Global application engineer team.

*Certain Phantom cameras are held to export licensing standards. Details available at: www.phantomhighspeed.com/export

ABOUT VISION RESEARCH

Since 1950, Vision Research has been designing, and manufacturing high-speed cameras. Our single focus is to invent, build, and support the most advanced cameras possible.

ViSiON
RESEARCH

AMETEK[®]
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