VISION RESEARCH

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

Phantom® v1210
Phantom® v1610
Phantom® v2010

The world's fastest 1 Mpx

digital ultra high-speed

camera line

Phantom v2010

Key Benefits:

The **Phantom v1210 digital high-speed camera is capable of capturing 12 gigapixels-per-second (Gpx/s) of data** from our proprietary CMOS sensor. That means at its full megapixel resolution of 1280 x 800 **you can achieve 12,000 frames-per-second (fps).**

Its more powerful sibling, the **Phantom v1610 boasts 16 Gpx/s throughput and 16,000 fps at full resolution.**

And, the **new v2010 boosts that performance to over 22 Gpx/s and greater than 22,000 fps at full resolution.**

High throughput is important. At any given resolution, a camera with the highest throughput will provide the fastest frame rates at that resolution. Or, if your application requires a specific frame rate, you can achieve the highest possible resolution at that frame rate. **High throughput means top performance and maximum flexibility** to adapt to any shooting requirement.

But, the story is not just about speed. These cameras also have a long list of **unique features** that let you take full advantage of their speed and flexibility.

Image Storage:

At ultra-high speeds memory can become a limitation to recording duration. The **cameras can be equipped with 24GB, 48GB or 96GB** of high-speed memory. A camera with 96GB of memory, recording at 10,000 fps at 1280 x 800 can record a single high-speed shot (called a *cine*) for up to 6.2 seconds. Or, **segment memory** into up to 63 segments and record shorter cines into each segment.

Key Features:

1 Megapixel sensor (1280 x 800)

12Gpx/s throughput (v1210)

16Gpx/s throughput (v1610)

22Gpx/s throughput (v2010)

1us minimum exposure

500ns minimum exposure with FAST option*
   * Export controlled feature

ISO (ISO 12232 SAT method):
   Mono: 64,000 T and 25,000 D (v1210 and v1610)
          64,000 T and 20,000 D (v2010)
   Color: 6400 T and 5000 D

Up to 96GB memory

Phantom CineMag compatible

Weight (without lens): 16 lbs, 14 oz. (7.7 Kg)

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v1210, v1610 & v2010

The standard Capture Cable, which attaches to the Capture Port provides the following signals:

- Ready (is high when camera is in capture mode, can be combined with other cameras to provide a "system ready" signal)
- Strobe (is low during frame exposure time)
- Auto-Trigger (a hardware trigger signal supplied by Image-Based Auto-Trigger)
- Pre-trigger /Memgate (a falling edge causes the camera to start acquiring pre-trigger frames and wait for a trigger – the camera goes into "capture" mode; or, if used in Memgate mode, frames acquired while low are discarded and not saved to memory allowing for selective recording)
- Video Out (NTSC or PAL composite video signal)

Or, use the optional Break-out-Box (BoB) connected to the Capture Port and have access to the following signals on the BoB.

- IRIG-In
- IRIG-Out
- Video Out
- Trigger
- Event (if low when Strobe goes high, the frame is marked with an event marker)
- Strobe
- Auto-Trigger (goes low when this camera is triggered by Image-Based Auto-Trigger allowing one camera to trigger other cameras based on an event detected in the live image)
- Pre-trigger/Memgate
- Ready

Phantom v1210 - Right Side View

Minimize cine save times with the Phantom CineMag feature that is standard on both models. With the ability to save 1GB/s of data to an attached CineMag, a 96 GB shot can be saved in about 1.5 minutes. The resulting **cine is securely stored in non-volatile memory.**

The contents of a CineMag can later be viewed on a PC, trimmed, played to video, and saved either by placing the CineMag back on the camera, or using our offline Phantom CineStation – a simple CineMag reader that connects to your PC with Gb or 10Gb Ethernet.

Sensor Characteristics:

The Phantom v1210, v1610 and v2010 are based on a Vision Research designed **custom CMOS sensor**. The **28 micron pixel size means high light sensitivity**. Each pixel has a **bit depth of 12 bits** yielding 4,096 gray levels with high dynamic range. Each camera comes in monochrome and color versions. Using the ISO 12232 SAT method, the monochrome ISO is 64,000 T and the color ISO is 6400 T.

Sensor resolution is 1280 x 800 "widescreen" 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.

These cameras have a **global electronic shutter** capable of exposures as fast as 1 µs on a standard camera, or, 500 ns with the export controlled FAST option, to truly **"freeze motion" and eliminate motion blur** in the most demanding of applications.

Connectivity:

The Phantom v1210, v1610 and v2010 are **our most "connected" cameras ever!**

On the back panel of the camera you will find:

1 **Trigger BNC**
(trigger the camera on either a rising or falling TTL signal)

2 **F-SYNC BNC**
(as an output, this provides a frame sync signal to slave cameras, as an input, the camera is slaved to an external frame sync signal)

3 **Timecode In BNC (IRIG, SMPTE)**

4 **Timecode Out BNC (IRIG, SMPTE)**

5 **Power Switch**

6 **HD-SDI 1 BNC**

7 **HD-SDI 2 BNC**

8 **10Gb Ethernet** (UTP copper interface, RJ45 connector)

9 **1Gb Ethernet**

10 **Primary DC Power** (20 - 28VDC)

11 **Backup DC Power**

12 **GPS** (input GPS time, location from an external GPS receiver)

13 **Range Data** (input azimuth and elevation data from a tracker)

14 **Remote Control Port**

15 **Capture Port**

The two HD-SDI ports can be configured in several ways. The two ports can act as identical 4:2:2 HD-SDI ports where one port can be set up to provide an (optional) on-screen display for monitoring the on-camera controls and camera operation. Or, they can be configured as a "single" 4:4:4 Dual-Link HD-SDI port.

Command & Control:

You can set up and control your Phantom camera using several different tools.

The most obvious way to use your Phantom v1210, v1610 or v2010 camera is with the standard **on-camera controls**. Simply connect a video monitor to the camera and use the intuitive user interface to control most common camera settings.

Our **Phantom Camera Control (PCC) software** is full-featured and easy to use. Set up and control one or many cameras from a single interface with easy access to even the most complex camera features. PCC even has a basic motion analysis and measurements package built-in.

PCC also connects to our Phantom CineStation for offline work with our popular CineMag storage devices. View, trim, and save slow-motion movies based on Phantom cine raw files into a variety of formats.

The **Phantom Remote Control Unit** (RCU) is a small full-featured camera controller that connects to the Remote port on the camera (or connects via Bluetooth to using a Bluetooth adapter on the camera for wireless control). The bright LCD touchscreen gives you access to all popular camera features with the tap of a finger. Connect the RCU to one of the HD-SDI video ports and use it as a monitor, too!

LabView and Matlab development environments are also available.

Environmental Specs:

Operating Temperature:	-10 to +50 C
Storage temperature:	-20 to + 70 C
Humidity:	95% non-condensing
Altitude:	
Operational	0 to 10 k feet above sea level
Non-Operational	-500 to 50 k feet above sea level
Magnetic Field Immunity:	500 amp-meter
Regulatory EMI/RFI	
Emissions	*EN 55022A, FCC part 15*
Conducted	*EN 55024A*
Immunity	*EN 55024A*
ESD:	8kv air discharge
Random Vibration:	
Operational	0.25G, 5 –500 – 5Hz, 1.0 Octave/min 10 Sweeps (5 Cycles).
Non-Operational	1.2G, 5 – 500Hz, 1.0 Octave/min 10 Sweeps
Shock:	
Operational	5.5G, 11mSec half-sine with 10 shocks in all axis.
Non-Operational	33G, 11mSec half-sine with 10 shocks in all axis
Natural Frequency:	Operational 5-200 hz
Safety:	IEC 60950

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Advanced Features:

- **Image-Based Auto-Trigger:** trigger the camera (or even a number of connected cameras) from motion detected within the live image. This makes it easier to catch events that are not predictable and may occur infrequently.

- **Internal Mechanical Shutter:** all digital high-speed cameras require an occasional black reference if they are to provide the highest quality images. A black reference is obtained by sampling a perfectly black image. With an internal mechanical shutter, the black frame can be obtained by simply closing the shutter. No physical access to the camera is needed.

- **Multi-Cine:** partition internal memory into segments and make shorter recordings back-to-back without missing any action.

- **Continuous Recording:** Do you need to record many occurrences of an event, especially an event that happens rarely or is unpredictable? Continuous recording is a mode that automatically saves a recorded cine to a disk drive on a connected PC immediately after it is recorded then re-arms the camera and waits for the next cine to be recorded. A recording can be triggered manually, electronically from an event detection system, or even by our Image-Based Auto-Trigger. The number of recordings is limited only by the amount of disk storage you have available.

- **PIV features:** Particle Image Velocimetry and similar measurement techniques like Particle Tracking Velocimetry (PTV), Laser Induced Florescence (LIF), and Digital Image Correlation (DIC) require extremely accurate timing and the ability to take images is a very stable and predictable way. The straddle time on the v1210 is 725ns, on the v1610 is 525ns and on the v2010 is 500ns.

- **Burst Mode:** Many experiments require taking images at precisely the same time during the experiment. For example, combustion studies may require images at each 1° turn in a crankshaft. Our unique burst mode allows you to trigger the camera at 0° and then take a burst of images at precise time delays.

- **Quite Fans:** During recording, turns the fans off to eliminate vibration which might interfere with some applications, especially when image magnification is required.

Phantom v1210, v1610 & v2010 - Top View

Phantom v1210, v1610 & v2010

RESOLUTION				
		v1210*	v1610*	v2010*
H	V	Max FPS	Max FPS	Max FPS
1280	800	12,600	16,600	22,500
1280	720	14,000	18,400	25,100
1024	800	15,000	19,700	26,900
1024	512	23,400	30,700	41,800
896	800	16,600	21,800	29,800
768	768	19,300	25,300	34,700
640	480	34,700	45,500	62,600
512	512	37,500	49,100	67,800
512	384	46,500	65,000	89,600
384	256	85,700	112,300	155,500
256	256	103,600	135,400	188,900
256	128	193,900	253,000	349,500
128	64	415,500	538,400	734,700
128	32	653,000	840,000	1,000,000
128	16	820,000	1,000,000	1,000,000

*Assumes FAST option is installed
Maximum v1210 standard: 570,000 fps
Maximum v1610 standard: 646,000 fps
Maximum v2010 standard: 658,000 fps

ISO SAT	v1210	v1610	v2010
Mono			
ISO SAT T	64,000	64,000	64,000
ISO SAT D	25,000	25,000	20,000
Color			
ISO SAT T	6400	6400	6400
ISO SAT D	5000	5000	5000

Focused

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

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