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

PRELIMINARY

WEB DATA SHEET

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Phantom® v1210
Phantom® v1610

The world's fastest 1Mpx digital high-speed camera

Phantom v1610

Key Benefits:

WHEN IT'S TOO FAST TO SEE, AND TOO IMPORTANT NOT TO®

The new **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.**

Both cameras are capable of frame rates of 650,000 fps at reduced resolution. With the FAST option (export controlled), available for both cameras, **frame rates of 1,000,000 fps are possible.**

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.

Key Features:

1 Megapixel sensor (1280 x 800)

12Gpx/s throughput (v1210)

16Gpx/s throughput (v1610)

650,000 fps at reduced resolution

1,000,000 fps with FAST option*

1us minimum exposure

500ns minimum exposure with FAST option*

Up to 48GB memory on the v1210

Up to 96GB memory on the v1610

Phantom CineMag compatible

* Export controlled feature.

Phantom v1210 - Right Side View

Image Storage:

At ultra-high speeds memory can become a limitation to recording duration. The **Phantom v1610 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.

The **Phantom v1210 can be equipped with 12GB, 24GB or 48GB** of high-speed memory.

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 on a v1610 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 and v1610 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.

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.

Both 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 and v1610 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** (18 - 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**

Phantom v1210 & v1610 - Back Panel

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.

Advanced Features:

In addition to some of the unique Phantom features mentioned above, these cameras have a number of advanced features that set Phantom cameras apart. Here are just a few of those 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 many cameras, this black image requires manually capping the lens on the camera, meaning the user need physical access to the camera (and a lens cap!). With an internal mechanical shutter, the black frame can be obtained by simply closing the shutter. No physical access to the camera is needed. And, the black reference can be obtained automatically before each shot or manually when needed.

Environmental Specs:

Weight is 17.4 lbs or 7.9 kg

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
- Genlock
- Adapter cable required to power these cameras from the BoB

- **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. This feature is great for capturing lighting strikes, for example.
- **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. Straddle time is the shortest time allowed on a camera between two back-to-back frames. The straddle time on the v1210 and v1610 is 400ns. Since many PIV applications are pulse laser illuminated, the Shutter Off feature allows you to easily capture images using pulsed illumination without complex synchronization and triggering.
- **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.
- **10Gb Ethernet:** These cameras come equipped with a standard 10Gb Ethernet port for faster download times.

Command & Control:

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

The most obvious way to use your Phantom v1210 or v1610 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.

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Phantom v1210
Phantom v1610

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.

Phantom v1210 & v1610 - Top View

		v1210 with FAST option*, maximum speed is 650,000 without FAST						
RESOLUTION		**v1210**	**RECORD TIME (SEC)**			**FRAMES**		
Horizontal	**Vertical**	**Max FPS**	**12GB**	**24GB**	**48GB**	**12GB**	**24GB**	**48GB**
1280	800	12,000	0.65	1.30	2.60	7,800	15,600	31,200
1280	720	13,400	0.65	1.29	2.59	8,668	17,336	34,672
1024	800	14,500	0.67	1.35	2.69	9,752	19,504	39,008
1024	512	22,600	0.67	1.35	2.70	15,237	30,474	60,948
896	800	16,200	0.69	1.38	2.75	11,145	22,290	44,580
768	768	19,100	0.71	1.42	2.84	13,544	27,088	54,176
640	480	35,000	0.74	1.49	2.97	26,000	52,000	104,000
512	512	38,700	0.79	1.57	3.15	30,474	60,948	121,896
512	384	51,200	0.79	1.59	3.17	40,632	81,264	162,528
384	384	62,200	0.87	1.74	3.48	54,176	108,352	216,704
256	256	110,000	1.11	2.22	4.43	121,897	243,794	487,588
128	128	275,000	1.77	3.55	7.09	487,588	975,176	1,950,352
128	64	450,000	2.17	4.33	8.67	975,176	1,950,352	3,900,704
128	32	725,000	2.69	5.38	10.76	1,950,351	3,900,702	7,801,404
128	16	1,000,000	3.90	7.80	15.60	3,900,703	7,801,406	15,602,812

		v1610 with FAST option*, maximum speed is 650,000 without FAST						
RESOLUTION		**v1610**	**RECORD TIME (SEC)**			**FRAMES**		
Horizontal	**Vertical**	**Max FPS**	**24GB**	**48GB**	**96GB**	**24GB**	**48GB**	**96GB**
1280	800	16,600	0.94	1.88	3.76	15,600	31,200	62,400
1280	720	18,400	0.94	1.88	3.77	17,336	34,672	69,344
1024	800	19,700	0.99	1.98	3.96	19,504	39,008	78,016
1024	512	30,600	1.00	1.99	3.98	30,474	60,948	121,896
896	800	21,700	1.03	2.05	4.11	22,290	44,580	89,160
768	768	25,200	1.07	2.15	4.30	27,088	54,176	108,352
640	480	45,200	1.15	2.30	4.60	52,000	104,000	208,000
512	512	48,700	1.25	2.50	5.01	60,948	121,896	243,792
512	384	64,300	1.26	2.53	5.06	81,264	162,528	325,056
384	384	75,500	1.44	2.87	5.74	108,352	216,704	433,408
256	256	130,000	1.88	3.75	7.50	243,794	487,588	975,176
128	128	300,000	3.25	6.50	13.00	975,176	1,950,352	3,900,704
128	64	500,000	3.90	7.80	15.60	1,950,352	3,900,704	7,801,408
128	32	750,000	5.20	10.40	20.80	3,900,702	7,801,404	15,602,808
128	16	1,000,000	7.80	15.60	31.21	7,801,406	15,602,812	31,205,624

** FAST option is export controlled*

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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