PHANTOM HIGH-SPEED CAMERAS FOR

SCIENTIFIC IMAGING

Includes tips for getting started

TMX

The Phantom TMX series introduces a groundbreaking evolution in ultrahigh-speed imaging, featuring a revolutionary back side illuminated (BSI) CMOS sensor for clear, high-quality images at previously unattainable speeds. The TMX 7510, the world's first high-speed camera with back side illumination, ensures true high-speed performance. Offering features like FAST mode and binning mode for flexibility, along with a focus on streamlined data management, TMX cameras are ideal for applications ranging from ballistics testing to combustion imaging.

TMX 7510

- 76,000 fps at 1280 x 800
- 1.75M fps with FAST option at reduced resolutions.
- 95 ns minimum exposure with FAST option
- Highest sensivitiy available
- Binning Mode for resolution flexibility

T-SERIES

The Phantom T-Series cameras, exemplified by the T4040 with a 4.2 Mpx back side illuminated sensor, combine high resolution and speed within a compact design, suitable for applications like material impact testing and long-distance range testing. The T-Series platform, including the T2410, supports advanced imaging techniques such as Particle Image Velocimetry (PIV) and Digital Image Correlation (DIC), making it well-suited for industrial and scientific purposes. Both cameras, equipped with on-camera controls and CineMag capability, facilitate remote, standalone operation while providing detailed images of moving objects across a larger field of view.

T4040

- New 4.2 Mpx BSI Sensor
- 9,350 fps at 2560 x 1664
- 250 ns minimum exposure with FAST option
- SDI and HDMI video outputs

T2410

- 24,270 fps at 1280 x 800
- 190 ns minimum exposure with FAST option

VEO SERIES

The Phantom VEO Series of cameras offers a broad range of cameras for imaging at a variety of resolutions and throughputs allowing for customized solutions for the task at hand. Two body styles increase flexibility, the L-style offers standard connections and a lower price point while the S-style includes ruggedized connectors, battery option, and removable media. The full range of VEO cameras can be found aiding in shock and vibration analysis and compliance testing.

- 1, 4, and 9 Megapixel versions
- VEO 710 up to 7,400 fps at 1280 x 800
- Nikon F, C-mount, and Canon EF mount options
- Up to 72 GB RAM
- 10Gb Ethernet Option*
- Untethered battery control option

**does not include VEO-E*

Miro C321

The Miro C series cameras, known for their lightweight design, cater to spaces inaccessible to standard cameras and find applications in automotive, microscopy, and destructive testing environments. Specifically, the C321 model is designed for auto crash testing and various scientific applications, offering high-quality HD resolution in a compact body. Notably, the C321 provides very high-quality, low-noise images with high sensitivity, and its on-camera battery and non-volatile Flash combination ensures data safety during power loss, making it ideal for scenarios with repeat setups or experiments.

- •1,480 fps at 1920 x 1080
- •Internal battery for data protection
- •1 µs minimum exposure

SDK is available for all Phantom cameras, includes drivers for MatLab, LabView and Python

ICON KEY

HIGH FRAME RATES · RESOLUTION · IMAGE · BSI SENSOR ARCHITECTURE · PRICE · SIZE · LIGHTWEIGHT · MEMORY · CONNECTIVITY

KEY ATTRIBUTES FOR HIGH-SPEED IMAGING

SPEED

How fast is the subject moving?

The faster the object moves, the higher the frames-per-second (fps) needs to be for effective imaging. Some examples are:

- **Biomechanics.** Human or animal movement is often recorded within the 500–2,000 fps range.
- **Fluid Dynamics.** Fluid and gas flow analysis often requires frame rates over 5,000 fps.
- **Spray Dynamics.** Usually captured with a minimum of 20,000 fps for the droplets to be viewed clearly.
- **Ballistics.** Bullets and other projectiles are typically recorded at a minimum of 28,000 fps.
- **Glass Crack Propagation.** As fast as possible, ideally over 300,000 fps for measurable results.

RESOLUTION

What level of detail is needed?

Speed and resolution are always a tradeoff. As speed goes up the pixel resolution (active sensor area) goes down. If you need to record a small object within a large area, or if the subject has intricate detail, choose a Phantom camera that can provide adequate pixel resolution for the event.

ILLUMINATION

How much external light is needed?

Sufficient lighting is critical to high-speed camera work, as the higher the frame rate the less light each image receives. Considerations for high-speed lighting are flicker and intensity, and the best solution is often found with recent advances in LED and Plasma technology. The higher the ISO rating the more sensitive the camera is and the less extra light is needed, but keep in mind that most of the time some sort of supplemental lighting is needed.

SIZE & PROXIMITY

How close must the camera be from the subject?

Often, a smaller body style is better for enclosed or specialized applications. The Phantom Miro C and N Series offer the smallest sized cameras and are often the most convenient for such experiments. If you are looking for a camera with durability, because it may end up in the fray of a high-impact event, Phantom cameras are notoriously built tough and excel in difficult environments.

ONLINE RESOURCES

Academic Advantage:
Program for educational institutions.
https://www.phantomhighspeed.com/applications/sector/academia

Case Studies:
www.phantomhighspeed.com/casestudy

Speed Calculator:
www.phantomhighspeed.com/speedcalc

How to Pick a High-Speed Camera:
https://www.phantomhighspeed.com/products/toolsandaccessories/comparecameras

Rental Information:
https://www.phantomhighspeed.com/contactus/phantom-rentals/rentals

APPLICATIONS

Digital Imaging Correlation (DIC):
www.phantomhighspeed.com/DIC

Laboratory:
www.phantomhighspeed.com/LAB

Microfluidics:
www.phantomhighspeed.com/Microfluidics

Particle Image Velocimetry:
www.phantomhighspeed.com/PIV

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Phantom High-Speed Cameras