PRODUCT DATASHEET

NOVA S

FASTCAM series by Photron



FASTCAM NOVA S16 / S12 / S9 / S6

1-Megapixel CMOS Image Sensor:
1024 x 1024 pixels at 16,000fps (Model S16)
1024 x 1024 pixels at 12,800fps (Model S12)
1024 x 1024 pixels at 9,000fps (Model S9)
1024 x 1024 pixels at 6,400fps (Model S6)

Maximum Frame Rate:
1,100,000fps (Nova S16 type 1100K)
1,000,000fps (Nova S12 type 1000K)
900,000fps (Nova S9 type 900K)
800,000fps (Nova S6 type 800K)
500,000fps (Nova S16 / S12 / S9 / S6 type 500K)
200,000fps (Nova S16 / S12 / S9 / S6 type 200KS)

Class Leading Light Sensitivity:
ISO 64,000 monochrome
ISO 16,000 color

Global Electronic Shutter:
1ms to 0.2µs independent of frame rate (sub-microsecond shutter available subject to export control)

Dynamic Range (ADC):
12-bit monochrome
36-bit color

Compact and Lightweight:
120mm (H) x 120mm (W) x 217.2mm (D)
4.72″ (H) x 4.72″ (W) x 8.55″ (D)
Weight: 3.3kg (7.2 lbs.)

Internal Recording Memory:
16GB, 32GB, 64GB, 128GB (models S6 and S9)
32GB, 64GB, 128GB (models S12 and S16)

Optional FASTDrive Removable High Capacity Data Storage:
4TB High-speed Solid State Drive

Fast 10-Gigabit Ethernet Interface:
Provides camera control and high-speed image download to standard PC

Fan Stop Function:
Remotely switch off cooling fans to eliminate vibration when recording at high magnifications

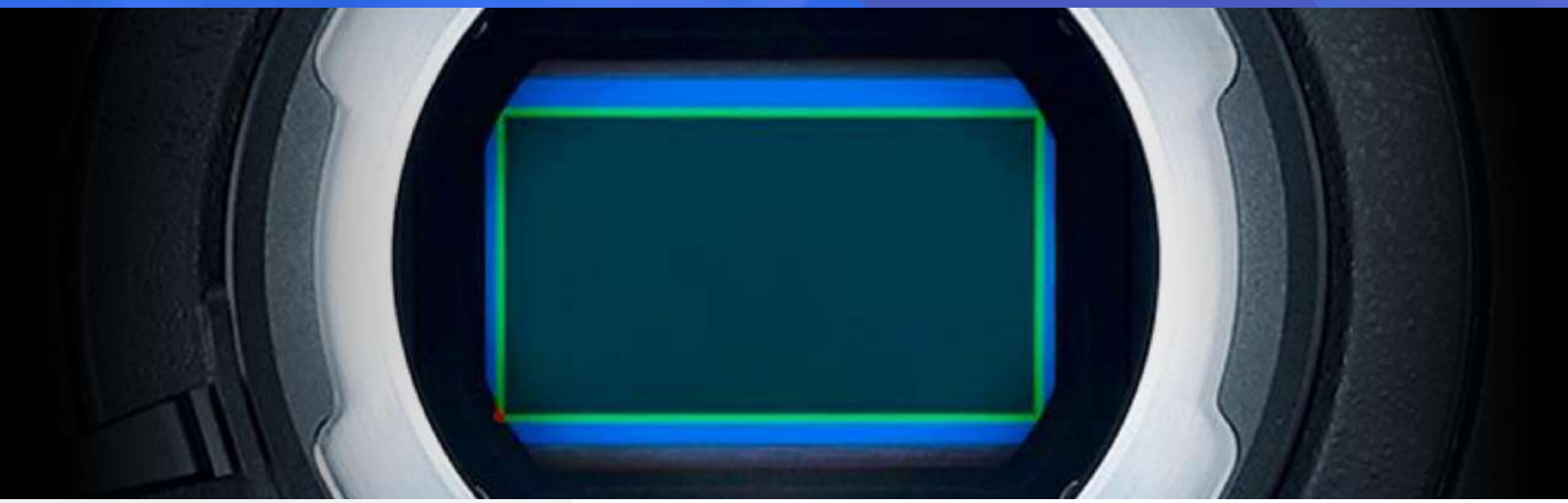
COMPACT AND VERSATILE HIGH PERFORMANCE CAMERA SYSTEM

The FASTCAM NOVA brings together unique CMOS image sensor technologies and extensive high-speed digital imaging expertise to provide a camera with the flexibility to be used in a wide variety of applications. Available in four different models, the FASTCAM NOVA offers 12-bit image recording rates up to 16,000 frames per second (fps) at megapixel image resolution, and shutter speeds to 0.2µs. Recording rates to 1,100,000fps are available at reduced image resolution. All of this available from a camera that is rugged, compact, lightweight and provides the best light sensitivity in its class.

Standard features of the FASTCAM NOVA include an internal mechanical shutter to allow remote system calibration, a high-performance 10-Gigabit Ethernet interface for camera control and high-speed image download, memory segmentation that allows recording into one memory partition while downloading from another, and compatibility with a number of industry standard lens formats to allow the use of Nikon G-Type, C-mount and Canon EF lenses.

The FASTCAM NOVA also features a “sealed body” design that prevents dust and corrosive particles from contaminating sensitive electronics. An optional FASTDrive SSD can be used for the download of images at up to 1GB per second.

Intuitive and feature rich Photron FASTCAM Viewer (PFV) software is included with each FASTCAM NOVA camera. Also included is a Photron Device Control SDK that allows integration of the camera with user-specific software, and libraries for controlling the camera within a MATLAB® or LabView environment.



Light Sensitivity:

FASTCAM NOVA	
Monochrome models	ISO 64,000
Color models	ISO 16,000

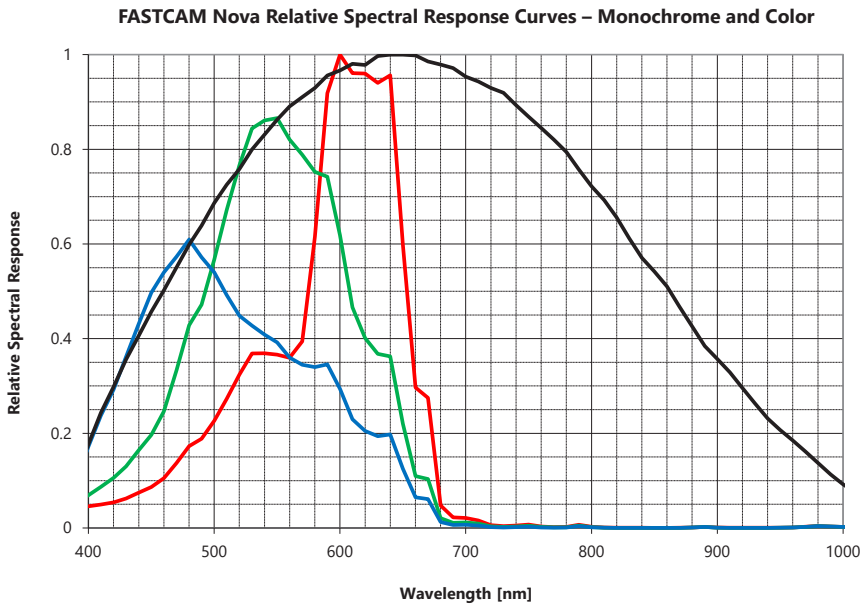
Monochrome sensors used in the FASTCAM NOVA are supplied without an IR absorbing filter, extending the camera spectral response beyond 900nm. When the sensitivity of the FASTCAM NOVA is measured to tungsten light including near IR response an equivalent value of ISO 160,000 is obtained.

Image Sensor:
The FASTCAM NOVA uses an advanced CMOS image sensor optimized for light sensitivity and high image quality that is unique to Photron.

A 20-micron pixel pitch gives a sensor size at full image resolution of 20.48 x 20.48mm (diagonal 28.96mm).

Lenses designed for both FX (35mm full frame) and also DX (APS-C digital SLR) formats are fully compatible with the FASTCAM NOVA at full image resolution.

Sensor Type	Proprietary Design Advanced CMOS
Maximum Resolution (pixels)	1024 x 1024 pixels
Sensor Size / Diagonal	20.48 x 20.48mm / 28.96mm
Pixel Size (microns)	20µm x 20µm
Quantum Efficiency	78.5% at 590nm
Fill Factor	Effective Fill Factor 94.5%
Color Matrix	Bayer CFA (single sensor)
Light Sensitivity	ISO 64,000 monochrome ISO 16,000 color (monochrome sensor equvilant ISO 160,000 including near IR response)
Shutter	Global Electronic Shutter 1ms to 0.2µs independent of frame rate (sub-microsecond shutter available subject to export control)



Specifications subject to change.

Camera Performance Specifications

Camera Performance Specifications

Model	FASTCAM Nova S16	FASTCAM Nova S12	FASTCAM Nova S9	FASTCAM Nova S6
Full Frame Performance	16,000fps 1024 x 1024 pixels	12,800fps 1024 x 1024 pixels	9,000fps 1024 x 1024 pixels	6,400fps 1024 x 1024 pixels
Maximum Frame Rate	1,100,000fps (128 x 16 pixels)*	1,000,000fps (128 x 16 pixels)*	900,000fps (128 x 16 pixels) *	800,000fps (128 x 16 pixels) *
Light Sensitivity	ISO 64,000 monochrome, ISO 16,000 color			
Minimum Exposure Time	Global electronic shutter to 0.2µs selectable independent of frame rate (subject to export control)			
Ruggedized Mechanical Calibration Shutter	Standard feature			
Dynamic Range (ADC)	12-bit monochrome 36-bit color			
Memory Capacity Options	Model Nova S6 and S9: 16GB, 32GB, 64GB, or 128GB Model Nova S12 and S16: 32GB, 64GB, or 128GB			
Memory Partitions	Up to 128 memory segments			
Region of Interest	Selectable in steps of 128 pixels (horizontal) x 16 pixels (vertical)			
Trigger Inputs	Selectable TTL (+/- 5V) and Switch (NO or NC)			
Trigger Delay	Programmable on selected input / output triggers: 100ns resolution			
Input / Output	Input: Trigger (TTL/Switch), sync, ready, event, IRIG Output: trigger, sync, ready, rec, exposure			
Trigger Modes	Start, end, center, manual, random, random reset, record on command			
Time Code Input	IRIG-B (selectable at beginning or end of frame exposure)			
External Sync	+/- TTL 5Vp-p Variable frequency sync			
Camera Control Interface	High-speed 1/10 Gigabit Ethernet			
Image Data Display	Frame rate,resolution, shutter speed, trigger mode, date/time, status, real time / IRIG time, frame count			
Saved Image Formats	BMP, TIFF, JPEG, PNG, RAWW, MRAW, AVI, MOV - Images can be saved with or without image data and in 8-bit, 16-bit or bit depth of sensor			
Supported OS	Microsoft Windows operating system including: 8.1, 10, 11 (32/64-bit)			
Lens Mount	F-mount (G-type lens compatible) and C-mount Options: Canon RF or EF offering remote operation, M42			
External Storage	Optional FAST Drive 4TB high-speed SSD			

* **Frame rates above 225,000fps and exposure times below 1µs may be subject to export control regulations in some areas**

Optional Removable Data Storage:
The FASTCAM NOVA can be supplied with the Photron FASTDrive high capacity removable SSD. The ultra-high data rate FASTDrive allows a 64GB camera
recording to be transferred to a removable SSD drive in approximately 1 minute. Recorded data can then be directly accessed while coupled to the camera or the drive may be removed and inserted into the portable FASTDock station connected to any Windows PC.

High-Speed 10-Gigabit Ethernet Interface:
The FASTCAM NOVA S20 camera system is equipped with a high-speed Gigabit Ethernet Interface to provide reliable camera control and fast download of image data.

Dedicated I/O:
A dedicated BNC connection for a contact closure hardware trigger input is provided. In addition, two programmable inputs and two programmable output channels provide direct connection for common tasks such as synchronization of multiple cameras and operation in conjunction with Data Acquisition (DAQ) hardware.

Ruggedized Mechanical Calibration Shutter:
The ruggedized mechanical shutter fitted as standard to the FASTCAM NOVA camera allows sensor black balance calibration to be carried out remotely from the system control software.

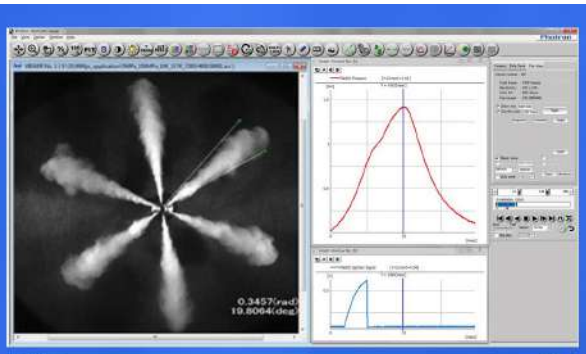
Optional C-Mount and Canon EF Lens Mounts:
In addition to the standard Nikon G type lens adapter, all FASTCAM Nova models support an optional C-mount lens adapter and an optional Canon EF lens adapter which, through Photron FASTCAM Viewer (PFV), not only enables remote operation of lens focus and aperture but also adds Auto-Focus capability.

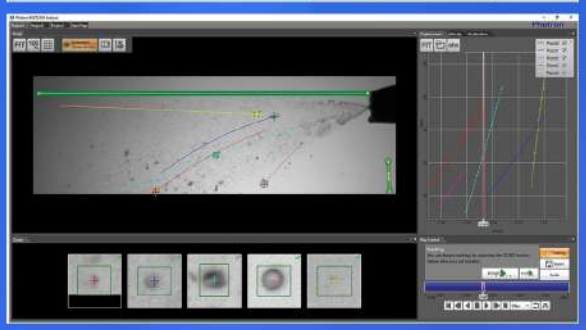
Camera Operation Features

Frame Synchronization	Accurate frame synchronization with other cameras and with external and unstable frequencies.
Dual Slope Shutter (Extended Dynamic Range)	Selectable in 20 steps (0 to 95% in 5% increments) to prevent pixel overexposure without post processing.
Memory Partitions	Up to 128 memory segments allow multiple events to be stored in camera memory before downloading, with automatic progression to the next available partition.
Low Light Mode	Operation at minimum frame rate with separately adjustable shutter time to allow easy camera set-up and focus in ambient lighting.
Video Output (optional)	1080p live and playback via HD-SDI output.
IRIG Phase Lock	Enables multiple cameras to be synchronized together with other instrumentation equipment or to a master external time source.
Internal Time Delay Generator	Allows programmable delays to be set on input and output triggers; 100ns resolution.
Event Markers	Up to ten user-entered event markers to define specific events within the recorded image sequence .
Download While Recording	FASTCAM NOVA supports Partition Recording Mode, allowing image data captured in one memory partition to be downloaded while at the same time recording into another partition.
Automatic Download	The system can be set to automatically download image data to the control PC and, when download is complete to re-arm in readiness for the next trigger with automatically incremented file names.
Software Binning	Virtual pixel binning (2x2, 4x4 etc.) allows increased light sensitivity with reduced image resolution without changing camera field of view.
FASTDrive	4TB solid state drive (SSD) memory pack provides ultra high data rate transfer to removable media.

Operation Software Features

Image Calibration	2D image calibration allows the measurement of distance and angle from the image. A calibration grid overlay can be superimposed on the image.
Image Overlay	A stored reference image may be overlaid on the live image to allow accurate camera positioning to achieve the same view as a previous test.
Import of Multiple Image Sequences	Multiple image sequences can be loaded and simultaneously replayed. Timing of image sequences can be adjusted to create a common time reference. Time based synchronization allows images captured at different frame rates to be synchronized.
High Dynamic Range Mode	Making use of the full sensor dynamic range, HDR mode allows enhanced detail in both light and dark areas of an image to be displayed simultaneously.
Background Subtraction	In order to highlight subtle changes in an image, Background Subtraction allows a reference image to be subtracted from a recorded sequence. Details including propagation of shock waves and surface changes during impact can be visualized using the feature.
Line Profile	A line profile representing grey levels along a line drawn across any region of the image is displayed. In live mode the Line Profile can be used to ensure optimum image focus is achieved.
Histogram	A histogram displaying grey levels within a user-defined image area is displayed. In live mode the Histogram can be used to ensure that optimum exposure levels are set for the scene being recorded.





Photron FASTCAM Viewer:
Photron FASTCAM Viewer software (PFV) has been designed to provide an intuitive and feature rich user interface for the control of Photron high-speed cameras, data saving, image replay and simple motion analysis. Advanced operation menus provide access to features for advanced camera operation and image enhancement. Tools are provided to allow image calibration and easy measurement of angles and distances from image data. Also included are a C++ SDK and wrappers for LabView and MATLAB ®.

An optional software plug-in module provides synchronization between Photron high-speed cameras and data acquired through National Instruments data acquisition systems. Synchronized data captured by the DAQ system provides waveform information which can be viewed alongside high-speed camera images.

Photron FASTCAM Analysis:
PFV software allows image sequences to be exported directly to optional Photron FASTCAM Analysis (PFA) Motion Analysis software. This entry level Motion Analysis software with an on screen ‘step by step guide’ function provides automated tracking of up to 5 points using feature or correlation tracking algorithms for the automated analysis of motion within an image sequence.

Variable Region of Interest:
Region of Interest (ROI) or sub-windowing allows a user-specified portion of the sensor to be defined to capture images. By using a reduced portion of the image area, the frame rate at which images are recorded can be increased. FASTCAM NOVA allows the ROI to be set in increments of 128 pixels horizontal and 16 pixels vertical.

Square Image Sensor Format:
Unlike broadcast and media applications where image formats such as 16:9 have now become standard, in scientific and industrial imaging applications an image sensor with a 1:1 image format is generally accepted to be advantageous. To capture the maximum useful image data in applications including microscopy, detonics, combustion imaging and many others, a 1:1 sensor format provides greater flexibility than 'letterbox' image formats. The FASTCAM NOVA image sensor allows the user to choose either square or rectangular image formats in order to obtain the maximum subject information.

External Frame Synchronization:
The FASTCAM NOVA can be fully synchronized with an external event to allow the timing of when each individual image is captured to be precisely referenced. The camera can be accurately synchronized to unstable frequencies allowing complex events such as combustion in rapidly accelerating or decelerating engines to be recorded and studied.

Record During Download Operation:
FASTCAM NOVA recording memory can be divided into multiple active sections. The user can record an on-going event in one memory partition while at the same time downloading a previously recorded image sequence in order to improve workflow and optimize camera operation.



FASTCAM NOVA Model Comparison - Frame Rate

Resolution	Frame Rate			
(h x v pixels)	Nova S16	Nova S12	Nova S9	Nova S6
1024 x 1024	16,000	12,800	9,000	6,400
1024 x 768	20,000	18,000	12,000	9,000
1024 x 512	30,000	25,000	18,000	12,800
896 x 896	20,000	16,000	10,000	8,000
768 x 768	26,400	22,500	15,000	10,000
640 x 480	48,000	40,000	25,000	20,000
512 x 512	52,800	40,000	30,000	22,500
512 x 384	66,000	50,000	38,400	30,000
384 x 384	82,500	64,000	45,000	36,000
384 x 256	100,000	80,000	57,600	45,000
256 x 256	144,000	115,200	80,000	64,000
256 x128	264,000	225,000	160,000	125,000
128 x 128	330,000	288,000	200,000	160,000
128 x 96	396,000	320,000	250,000	200,000
128 x 64	600,000	500,000	400,000	320,000
128 x 48	660,000	576,000	480,000	400,000
128 x 32	825,000	750,000	576,000	500,000
128 x 16	1,100,000	1,000,000	900,000	800,000

* Specifications subject to change without notice.

FASTCAM NOVA Model Comparison - Recording Memory

Resolution	Recording Duration (frames)				
(h x v pixels)	128GB	64GB	32GB	16GB	8GB
1024 x 1024	87,357	43,666	21,821	10,898	5,437
1024 x 768	116,476	58,222	29,095	14,531	7,249
1024 x 512	174,714	87,333	43,642	21,797	10,874
896 x 896	114,099	57,034	28,501	14,234	7,101
768 x 768	155,301	77,629	38,793	19,375	9,666
640 x 480	298,179	149,048	74,483	37,200	18,559
512 x 512	349,429	174,666	87,285	43,594	21,749
512 x 384	465,905	232,888	116,380	58,126	28,999
384 x 384	621,207	310,518	155,173	77,501	38,665
384 x 256	931,811	465,777	232,760	116,252	57,998
256 x 256	1,397,717	698,666	349,141	174,378	86,997
256 x128	2,795,434	1,397,333	698,282	348,757	173,994
128 x 128	5,590,869	2,794,666	1,396,565	697,514	347,989
128 x 96	7,454,492	3,726,222	1,862,087	930,019	463,985
128 x 64	11,181,738	5,589,333	2,793,130	1,395,029	695,978
128 x 48	14,908,984	7,452,444	3,724,174	1,860,039	927,971
128 x 32	22,363,477	11,178,666	5,586,261	2,790,058	1,391,957
128 x 16	44,726,954	22,357,333	11,172,522	5,580,117	2,783,914

Note: Recording duration (sec) = Recording duration (frames) **/** Frame rate (fps)

** Recording time is an estimate and may be different depending on recording conditions and settings.

Mechanical and Environmental Specifications

Mechanical and Environmental Specifications	
Mechanical	
Lens Mount	F-mount (G-type lens compatible) lens mounts include C-mount, Canon EF remote control, and M42 adapter.
Camera Mountings	3/8 - 16 UNC, 1/4 - 20 UNC & 4 x M6 (base and side), 2 x 1/4 - 20 UNC (top)
External Dimensions	
Camera Body (excluding protrusions)	120mm (H) x 120mm (W) x 217.2mm (D) 4.72" (H) x 4.72" (W) x 8.55" (D)
Weight	
Camera Body	3.3kg (7.2lbs)
Environmental	
Operating Temperature	0 to 45C, 32˚ to 113˚F
Storage Temperature	-20 to 60C, -4˚ to 140˚F
Humidity	85% or less (non-condensing)
Cooling	Internal fan cooling (fan-off mode supported)
Operational Shock	30G, 11ms, 6-axes 1000 times
Power	
AC Power (with supplied adapter)	100 to 240V, 50 to 60Hz
DC Power (primary input)	22 to 32V, 150VA
DC Power (battery input)	22 to 32V, 150VA



Nikon G-Type Compatible Lens Mount:
The FASTCAM NOVA camera is equipped with an objective lens mount compatible with readily available Nikon G-type lenses. Controls provided within the lens mount allow the control of lens aperture on lenses without external iris control.

Optional C-Mount and Canon EF Lens Mounts:
In addition to the standard Nikon G type lens adapter, all FASTCAM Nova models support an optional C-mount lens adapter and an optional Canon EF lens adapter which, through Photron FASTCAM Viewer (PFV), not only enables remote operation of lens focus and aperture but also adds Auto-Focus capability.

Operation Environments:
The 'sealed body' design of the FASTCAM NOVA ensures optimum air flow and prevents dust and corrosive particles from being ingested within the internal camera body where they can damage sensitive electronics. The fans may be disabled during recording for any vibration sensitive measurements.

The FASTCAM NOVA camera has been extensively tested to ensure operation for extended periods in ambient temperatures up to 50C.

Auto-sensing Secondary DC Input:
Two power supply connectors "DC IN" and "BATTERY" are provided. "DC IN" is the primary input and has priority. The camera automatically senses when the power supply to "DC IN" fails and switches without interruption to the secondary "BATTERY" connection.

Versatile Mounting of Camera:
The FASTCAM NOVA has equal mounting positions on the base and one side. This permits the camera to be rotated through 90 degrees for those applications requiring maximum resolution with a vertical aspect ratio e.g. tensile testing.

Specifications subject to change without notice.

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