PRODUCT DATASHEET

NOVA S20

FASTCAM series by Photron



FASTCAM NOVA S20

1-Megapixel CMOS Image Sensor:
1024 x 1024 pixels at 18,750fps (10-bit)
1024 x 992 pixels at 20,000fps (10-bit)
1024 x 1024 pixels at 16,500fps (12-bit)

Maximum Frame Rate:
1,100,000fps (Nova S20 type 1100K)
550,000fps (Nova S20 type 550K)
220,000fps (Nova S20 type 220K)

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 / 10-bit monochrome - selectable
36-bit / 30-bit color - selectable

Compact and Lightweight:
120mm (H) x 120mm (W) x 217.2mm (D)
4.72″ (H) x 4.72″ (W) x 8.55″ (D)
Weight: 3.5kg (7.7 lbs.)

Internal Recording Memory:
32GB, 64GB, 128GB

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

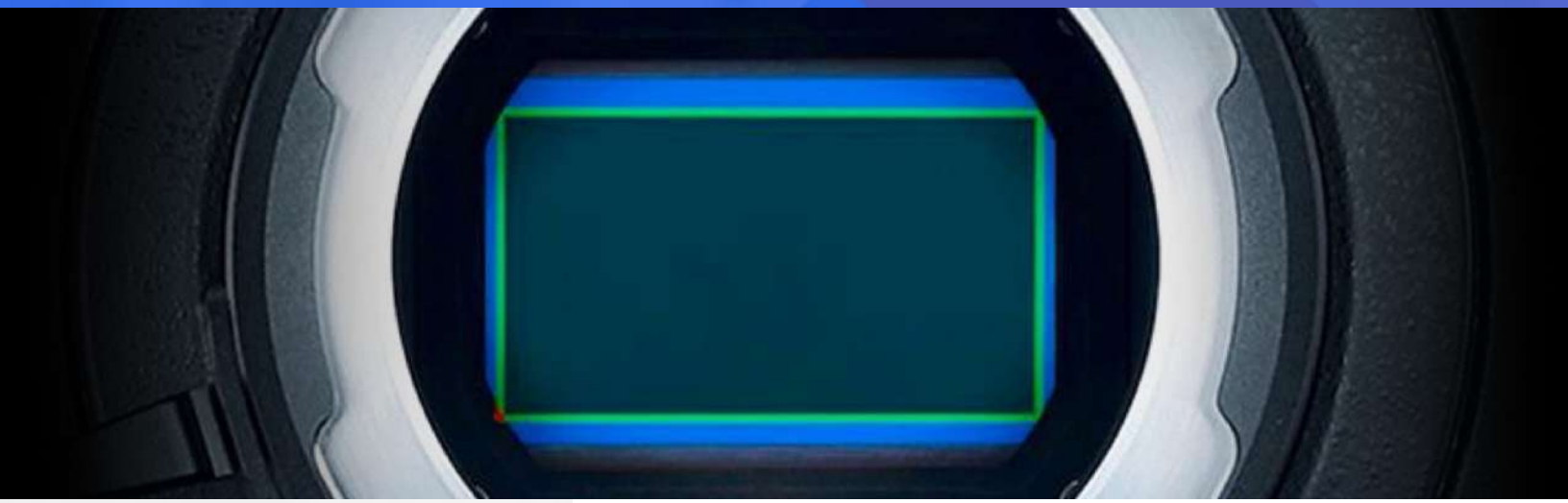
COMPACT AND VERSATILE HIGH PERFORMANCE CAMERA SYSTEM

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. The FASTCAM NOVA S20 offers the user freeedom to select between 10-bit and 12-bit operation to enhance performance, with megapixel recording rates up to 20,000 frames per second (fps) and 16,500 fps respectively. Both modes support a 0.2µs minimum exposure and a maximum recording rate up to 1,100,000fps at reduced resolution. All of this is available from a camera that is rugged, compact, light-weight and provides the best light sensitivity in its class.

Standard features of the FASTCAM NOVA S20 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 S20 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 S20 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

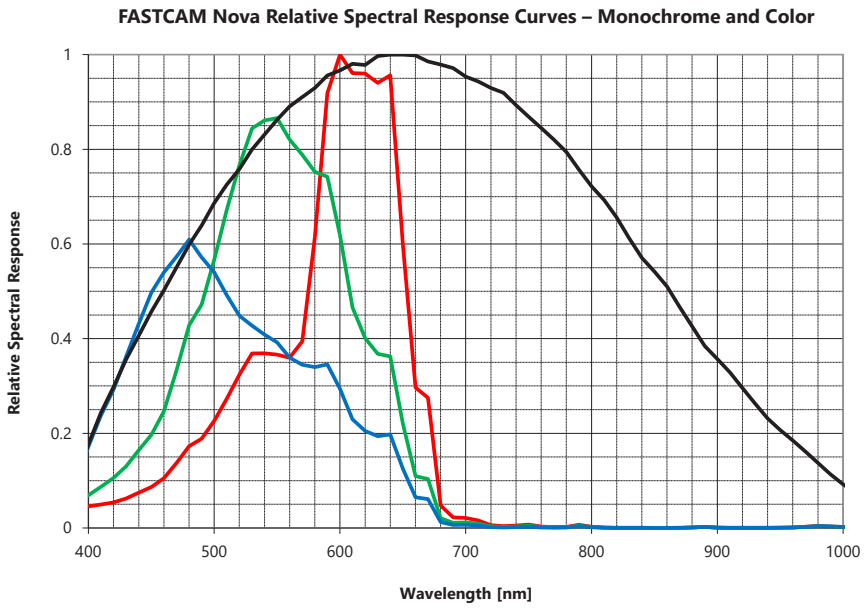
Monochrome sensors used in the FASTCAM NOVA S20 are supplied without an IR absorbing filter, extending the camera spectral response beyond 900nm. When the sensitivity of the FASTCAM NOVA S20 is measured to tungsten light including near IR response an equivalent value of ISO 160,000 is obtained.

Image Sensor:
The FASTCAM NOVA S20 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 S20 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

Model	FASTCAM NOVA S20	
Bit Version	**10- bit**	**12- bit**
Full Frame Performance	18,750fps 1024 x 1024 pixels	16,500fps 1024 x 1024 pixels
Dynamic Range (ADC)	10-bit monochrome 30-bit color	12-bit monochrome 36-bit color
Maximum Frame Rate	1,100,000fps* (128 x16)	
Minimum Exposure Time	Global electronic shutter to 0.2µs selectable independent of frame rate (subject to export control)	
Ruggedized Mechanical Calibration Shutter	Standard feature	
Memory Capacity Options	32GB, 64GB, 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 input (may be configured 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, shutter speed, trigger mode, date/time, status, real time / IRIG time, frame count, resolution	
Saved Image Formats	BMP, TIFF, JPEG, PNG, RAWW, MRAW, AVI, MOV	
Supported OS	Microsoft Windows operating system including: 8.1, 10, 11 (32/64-bit)	

* **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 S20 can be supplied with the Photron FASTDrive high capacity removable SSD. The ultra-high data rate FASTDrive allows a 128GB camera recording to be transferred to a removable SSD drive in approximately 2 minutes. 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 supporting NO, NC operation 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 S20 camera allows sensor black balance calibration to be carried out remotely from the system control software.

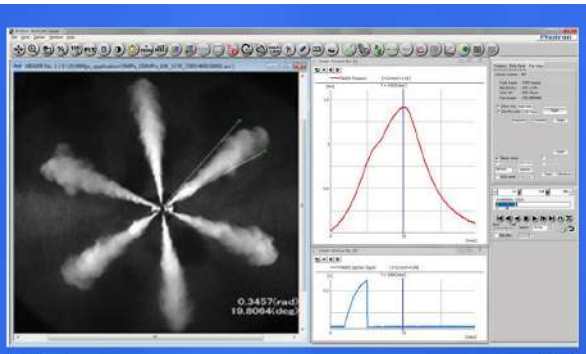
Optional C-Mount and Canon EF Lens Mounts:
In addition to the standard Nikon G type lens adapter, all FASTCAM Nova models support an optional C-mount lens adapter and an optional Canon EF lens adapter which, through Photron FASTCAM Viewer (PFV), not only enables remote operation of lens focus and aperture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

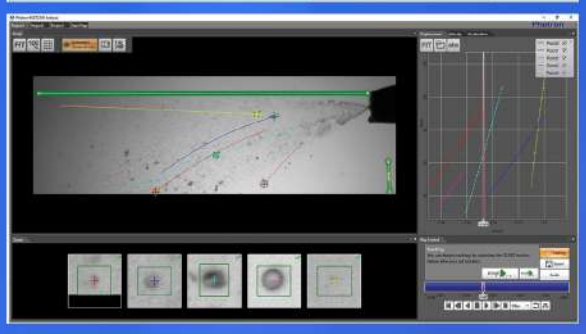
Camera Operation Features

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 S20 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.

Frame Rate / Image Resolution

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 S20 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 S20 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 S20 can be fully synchronized with an external source 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 S20 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 S20 12-bit	Nova S20 10-bit	Nova S16 12-bit	Nova S12 12-bit	Nova S9 12-bit	Nova S6 12-bit
1024 x 1024	16,500	18,750	16,000	12,800	9,000	6,400
1024 x 768	22,000	25,000	20,000	18,000	12,000	9,000
1024 x 512	33,010	37,500	30,000	25,000	18,000	12,800
896 x 896	20,000	24,750	20,000	16,000	10,000	8,000
768 x 768	28,125	33,000	26,400	22,500	15,000	10,000
640 x 480	52,800	56,250	48,000	40,000	25,000	20,000
512 x 512	56,250	62,500	52,800	40,000	30,000	22,500
512 x 384	75,000	82,500	66,000	50,000	38,400	30,000
384 x 384	93,750	100,000	82,500	64,000	45,000	36,000
384 x 256	137,500	137,500	100,000	80,000	57,600	45,000
256 x 256	165,000	165,000	144,000	115,200	80,000	64,000
256 x128	300,000	300,000	264,000	225,000	160,000	125,000
128 x 128	375,000	375,000	330,000	288,000	200,000	160,000
128 x 96	440,000	440,000	396,000	320,000	250,000	200,000
128 x 64	660,000	660,000	600,000	500,000	400,000	320,000
128 x 48	750,000	750,000	660,000	576,000	480,000	400,000
128 x 32	900,000	900,000	825,000	750,000	576,000	500,000
128 x 16	1,100,000	1,100,000	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	
	10-bit	12-bit	10-bit	12-bit	10-bit	12-bit
1024 x 1024	104,828	87,357	52,399	43,666	26,185	21,821
1024 x 768	139,771	116,476	69,866	58,222	34,914	29,095
1024 x 512	209,657	174,714	104,800	87,333	52,370	43,642
896 x 896	136,919	114,099	68,441	57,034	34,201	28,501
768 x 768	186,361	155,301	93,155	77,629	46,552	38,793
640 x 480	357,815	298,179	178,858	149,048	89,380	74,483
512 x 512	419,315	349,429	209,599	174,666	104,742	87,285
512 x 384	559,086	465,905	279,466	232,888	139,656	116,380
384 x 384	745,448	621,207	372,622	310,518	186,208	155,173
384 x 256	1,118,173	931,811	558,932	465,777	279,312	232,760
256 x 256	1,677,260	1,397,717	838,399	698,666	418,969	349,141
256 x128	3,354,521	2,795,434	1,676,800	1,397,333	837,938	698,282
128 x 128	6,709,043	5,590,869	3,353,599	2,794,666	1,675,878	1,396,565
128 x 96	8,945,390	7,454,492	4,471,466	3,726,222	2,234,504	1,862,087
128 x 64	13,418,086	11,181,738	6,707,200	5,589,333	3,351,756	2,793,130
128 x 48	17,890,781	14,908,984	8,942,933	7,452,444	4,469,009	3,724,174
128 x 32	26,836,172	22,363,477	13,414,399	11,178,666	6,703,513	5,586,261
128 x 16	53,672,345	44,726,954	26,828,800	22,357,333	13,407,026	11,172,522

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.

** 16GB and 8GB charts are available on our website.

Mechanical and Environmental Specifications

Mechanical and Environmental Specifications	
Mechanical	
Lens Mount	F-mount (G-type lens compatible) Optional 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	3.5kg (7.7lbs)
Environmental	
Operating Temperature	-10 to 40C, 14˚ to 104˚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 10 times/axis
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 S20 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 S20 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 S20 camera has been extensively tested to ensure operation for extended periods in ambient temperatures up to 40C.

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 S20 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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