PRODUCT DATASHEET

# NOVA S

FASTCAM series by Photron

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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.

# Image Sensor Technical Data

**Light Sensitivity:**

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

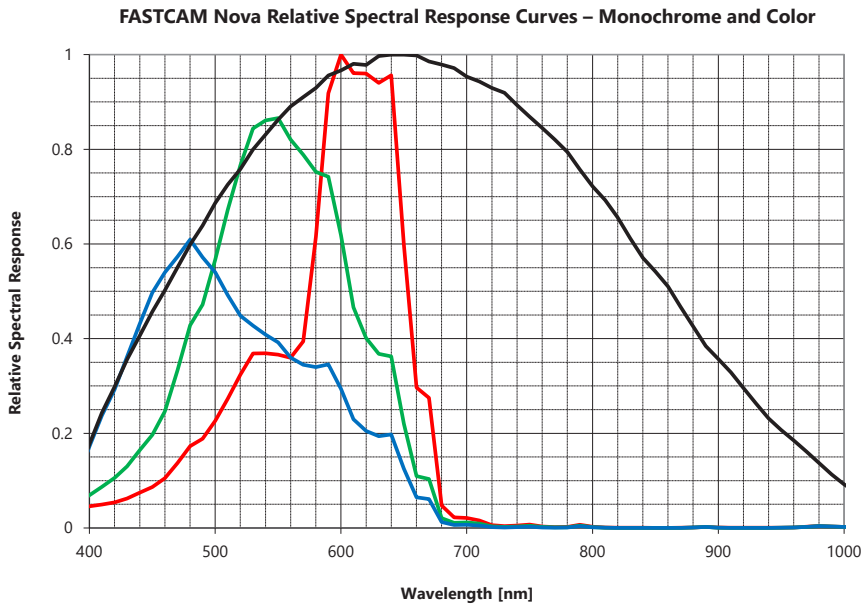
Monochrome sensors used in the FASTCAM NOVA are supplied without an IR absorbing filter, extending the camera spectral response beyond 900nm. When the sensitivity of the FASTCAM NOVA is measured to tungsten light including near IR response an equivalent value of ISO 160,000 is obtained.

**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<br>ISO 16,000 color<br>(monochrome sensor equvilant ISO 160,000 including near IR response) |
| Shutter | Global Electronic Shutter 1ms to 0.2µs independent of frame rate<br>(sub-microsecond shutter available subject to export control) |




Specifications subject to change.

**Camera Performance Specifications**

| Model | FASTCAM Nova S16 | FASTCAM Nova S12 | FASTCAM Nova S9 | FASTCAM Nova S6 |
|---|---|---|---|---|
| Full Frame Performance | 16,000fps<br>1024 x 1024 pixels | 12,800fps<br>1024 x 1024 pixels | 9,000fps<br>1024 x 1024 pixels | 6,400fps<br>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<br>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<br>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<br>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.

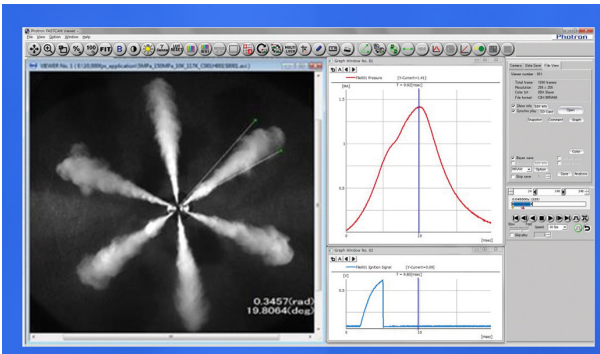
**Optional C-Mount and Canon EF Lens Mounts:**
In addition to the standard Nikon G type lens adapter, all FASTCAM Nova models support an optional C-mount lens adapter and an optional Canon EF lens adapter which, through Photron FASTCAM Viewer (PFV), not only enables remote operation of lens focus and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

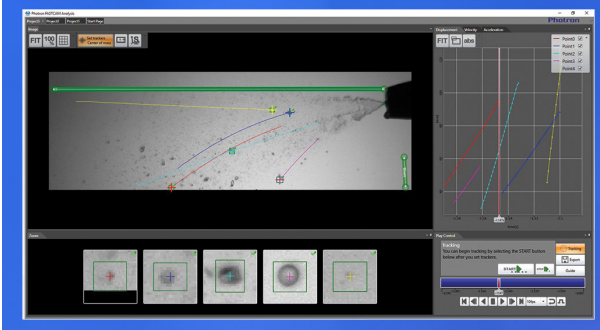
## Camera Operation Features

| | |
|---|---|
| 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** | |
| Lens Mount | F-mount (G-type lens compatible)<br>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<br>(excluding protrusions) | 120mm (H) x 120mm (W) x 217.2mm (D)<br>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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