



every photon counts

h·nivi 512

BUILT FOR PERFORMANCE

INDUSTRY-LEADING LOW-LIGHT SNR, BALANCING SPEED AND FIELD OF VIEW



RETHINK EMCCD

A NEW STANDARD FOR LOW LIGHT IMAGING

OUTSTANDING SNR THANKS TO

Patented electronics eliminating inherent EMCCD camera noise for true photon counting imaging

Lowest background signal and highest electron-multiplying (EM) gain, up to 5000, in inverted mode of operation (IMO) for optimal results in ultra low-light conditions

Optimal on-chip thermoelectric cooling for minimal background signal and stabilized EM gain

Made for applications requiring the ultimate sensitivity for the fields of Space and Defense, Life Science, Physics, Industrial and more.

ULTIMATE SENSITIVITY enabling highly efficient low-flux imaging, hence faster acquisitions, with frame rates exceeding 90 fps in full frame at 30MHz readout rate

SUPERIOR IMAGE QUALITY thanks to greater charge transfer efficiency

NO NOISE-FILTERING ALGORITHMS the amount of noise generated is simply lower, eliminating the risk of removing genuine photoelectrons

VERSATILITY to choose between EM or Convention CCD output to best match your acquisition requirements

PHOTON COUNTING PERFORMANCES COMPARISON

- HNü 512 (All specifications measured in IMO)
- Best achievable performance with other EMCCD cameras

(Other manufacturers do not specify the mode of operation – IMO or NIMO – used to measure one specific characteristic. These are two mutually exclusive EMCCD operation modes whose benefits cannot be combined.)

At least 15% more genuine photons counted

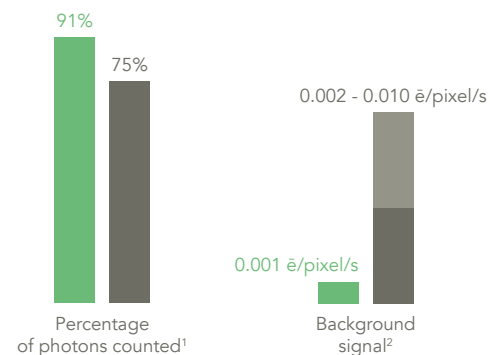


Figure 1
h·nivi 512 Benefits for Photon Counting Imaging

SIMPLE INTEGRATION INTO A WIDE VARIETY OF SOFTWARE SYSTEMS

Nüvü Camēras offers the highest standard of EMCCD technology in a compact thermoelectrically cooled camera. The technology at the heart of the HNü was originally designed for space exploration, where the need for state-of-the-art instruments drives innovation. Now optimized and extended to a broad range of applications, the user-friendly HNü provides many advantages to efficiently bridge the gaps between purchase, setup, discoveries, and publications.

- › NüPixel control, acquisition and analysis software
- › Software development kit (SDK) for customizable programming
- › Windows & Linux Compatibility
- › Various drivers available for commercial software
- › Worldwide professional customer support

Consultation services are available on demand.

h·nū512

CHARACTERISTICS	SPECIFICATIONS
Digitization	16 bits
Electron-multiplying gain	1 - 5000
On-chip temperature stabilization	± 0,01°C
Minimum Cooling T ⁰ via air cooling ³	-85°C (HNü 512) -60°C (HNü 512IS)
Minimum cooling T ⁰ via liquid cooling ³	-90°C (HNü 512) -70°C (HNü 512IS)
Quantum efficiency	> 90% at 600 nm (see Fig. 2)
EM register pixel well depth ⁴	800 kē
Spectral range	250 - 1100 nm
Triggering	Internal or external Selectable signal polarity
Exposing time range ⁵	25 ns - days
Timestamp resolution	4 ns
Readout noise through:	EM < 0.1 ē @ 20 MHz Conv 3 ē @ 100 kHz
Vertical clock speed	EM 0.3 – 5 μs Conv 0.3 – 5 μs
Dark current ^{6,7} (All operating modes)	0.0004 ē/pixel/s 0.005 ē/pixel/s (HNü 514IS & HS)
Charge transfer efficiency ⁸	> 0.999993
Single photon detection at 10MHz probability (EM gain = 5000)	> 91%
Imaging area	512 × 512 pixels 16 μm × 16 μm pixel area 8.19 mm × 8.19 mm effective area

Table 1 HNü512 General Characteristics and Specifications

FEATURES

EM gain range of 1 – 5000

Lowest clock-induced charges levels (CIC)

Patented technology optimized for true photon counting

Highest horizontal charge transfer efficiency

Ultimate cooling performance

Highest quantum efficiency

Pixel readout rate up to 30 MHz

Selectable output

Time stamping

mROI

Cropped-sensor mode

Low latency

External trigger modes

BENEFITS

Lowest effective readout noise

Unmatched single photon detection capabilities

Highest SNR as a result of lowering the CIC, the dominant noise source of EMCCDs

Linear and photon counting modes are available in EM operation

Clearer images

No pixel leaking

Negligible dark noise

Superior charge transfer efficiency

Best sensitivity available thanks to back-illuminated grade 1 EMCCD detector (see Fig. 2)

Fastest acquisition speed for a 512 x 512 EMCCD camera

Fast and easy switching between conventional CCD and EMCCD operations

High-precision time-labelling of every acquisition

GPS input for absolute time tagging (optional)

Select multiple customizable regions of interest on the detector to increase acquisition rates

Faster acquisition rates for a region of interest by masking part of the EMCCD detector⁹

Greater acquisition versatility using customizable size and position for the cropped region of interest

Low Latency between end of exposure and 1st pixel

Multiple modes available to optimize versatility on frame rate

Table 2 HNü 512 features and benefits



WHEN EVERY PHOTON COUNTS

The EMCCD technology is perfectly suited for low-light applications requiring minimal background noise due to its negligible effective read-out noise enabled through high EM gain. In linear mode of operation, the EM gain cannot be precisely determined on a per-pixel basis because of its stochastic nature. It however generates an excess noise factor (ENF) that, for high EM gains, leads to a degraded SNR. In fact, it affects the SNR the same way halving the quantum efficiency would. With photon counting (PC) mode of operation, Nüvü Camēras efficiently suppresses the ENF, thus allowing single photon sensitivity.

Nüvü™'s ultra-sensitive cameras successfully operate in PC mode thanks to their high EM gains and minimal background noise. Although attaining large EM gains is simple, the electron-multiplying process entails more clock-induced charges (CIC), a dominant EMCCD noise source. The innovative electronics driving HNü cameras virtually eliminates CIC and lowers the total background signal while providing the highest gain on the market. The results: better data in low lighting conditions.

h·n̄ü 512 MODELS

SPECIFICATIONS	HNü 512	HNü 512IS	HNü 512HS
Max frame rate ³ Frames per second (fps)	63	63	90
Readout rate through EM channel (MHz)	1,5,10,20	1,5,10,20	20,30
Readout rate through Conventional channel (MHz)	0.1,1,3	0.1,1,3	0.1,1,3
Clock-induced charges ¹⁰ Electron/pixel/frame (e-/p/f)	0.001	0.001	0.002

Table 3 HNü 512 Specifications for different models

FASTER FRAME RATE FOR SENSITIVE IMAGING

Crop mode available for applications requiring higher readout rates.
Other readout speeds and frame rates are also available, as are different EMCCD detector sizes.

MODELS	REGION OF INTEREST						
	512 × 512	512 × 256	512 × 124	512 × 64	512 × 32	512 × 16	512 × 8
HNü 512 & HNü 512IS	63	125	242	454	810	1330	1959
HNü 512HS	90	176	337	620	1068	1673	2333

Table 4 HNü 512 Frame rates at maximum readout rate
Frame rates are measured at 20 MHz in EM mode and 30 MHz in HS mode.

Features

FOR FASTER ACQUISITION:

- › Crop Mode
- › Fast Kinetics Mode
- › Time-Delay Integration (TDI) Mode
- › Multiple Region of Interest (mROI) & ROI

FOR MORE VERSATILITY:

- › UV-enhance coating
- › Liquid chiller accessory
- › Vacuum compatible cooling
- › Low readout noise mode (1-2 MHz)

QUALITY PRIORITY

All parts are treated in compliance with high vacuum requirements, including all metal sealed in a Class 10,000 cleanroom to ensure the best cooling performances without maintenance. Nüvü Camēras uses at least $\lambda/10$ quality windows, essential for optimal image quality.

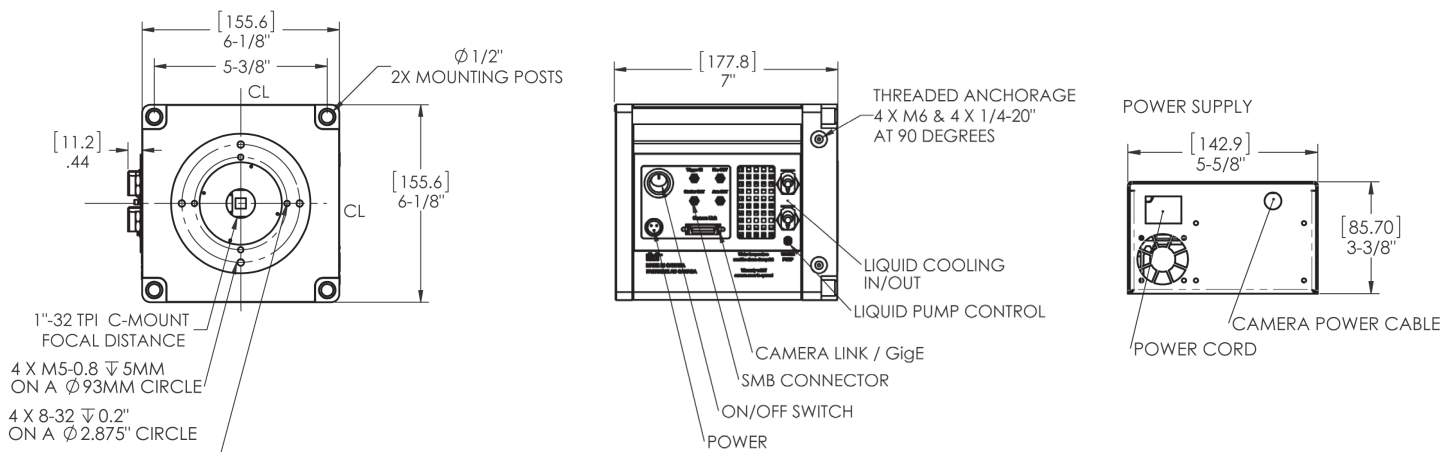
COMPUTER REQUIREMENTS:

- › Communication interface: PCIe Camera Link (min. x1) or GigE Vision (Gigabit Ethernet)
- › Operating system: Windows (XP, 7 & 10), Linux (CentOS & Ubuntu)

CAMERA ENVIRONMENT:

- › Operating temperature: 0°C to 30°C
- › Humidity: < 90 % (non-condensing)
- › Power Input: 100 – 240 V, 50 – 60 Hz, max. 3 A

TECHNICAL DRAWINGS



- 1 Detected events with signal 5 times greater than readout noise in photon counting mode. Measured data.
- 2 Expected signal level at an EM gain of 1000 at -85°C and maximum frame rate in continuous exposure at 10 MHz.
- 3 At maximum horizontal speed, full frame readout.
- 4 As per the EMCCD detector manufacturer's datasheet. Other configurations may exist.
- 5 Minimum 25 ns exposure time available in controlled illumination conditions due to pixels clearing prior to readout.
- 6 Below -95°C, charge transfer efficiency degrades while improvement on the dark current decreases slowly.
- 7 Dark current measured at minimum cooling temperature via air cooling. The HNü can also operate down to -90°C with liquid cooling.
- 8 Mean horizontal charge transfer efficiency measured with an EM gain of 1000 at -85°C and 10 MHz readout rate.
- 9 Optical mask not included.
- 10 Expected signal level at an EM gain of 1000 at minimum cooling temperature via air cooling and maximum frame rate in continuous exposure at 10 MHz (all models except HS), or 20 MHz (HS).

TYPICAL QUANTUM EFFICIENCY

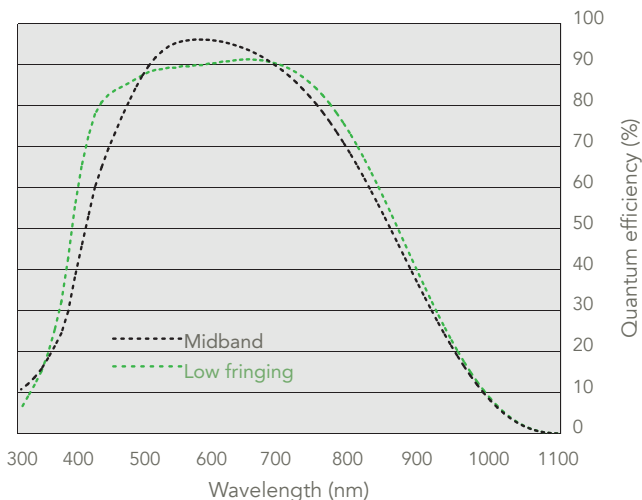


Figure 2
Typical spectral response as a function of wavelength, as measured by the EMCCD detector manufacturer

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 HNü 512 Specification Sheet 3.0
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