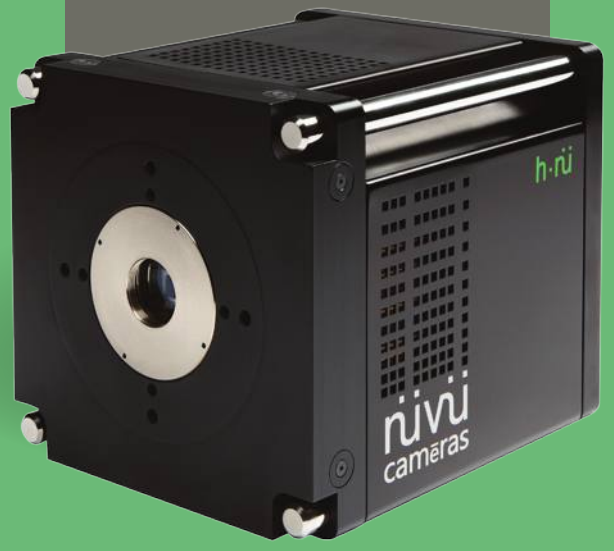
nüvü cameras

every photon counts

h·nü 1024

BUILT FOR RESOLUTION

WIDE FIELD OF VIEW COMBINED WITH PHOTON-COUNTING CAPABILITIES



RETHINK EMCCD

A NEW STANDARD FOR LOW LIGHT IMAGING

OUTSTANDING SNR THANKS TO

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

Largest commercial EMCCD camera with single photon detection capabilities

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

Made for applications requiring a large field of view along with photon counting capabilities 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 OPERATION RATE up to 25 fps in full frame at 30 MHz 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 Conventional CCD output to best match your acquisition requirements

MULTIPLE REGION OF INTEREST (mROI)

☐ Instead of imaging an object with the entire EMCCD detector area, a user can set multiple smaller portions of the detector to perform the same task faster.

☐ Selecting a particular region of interest (ROI) or multiple ROI (mROI) is a trade-off that offers higher frame rates at the cost of a reduced field of view. A ROI is subject to the same limitations as binning, namely that the speed gain occurs with smaller vertical regions but is restricted by the horizontal pixel rate.

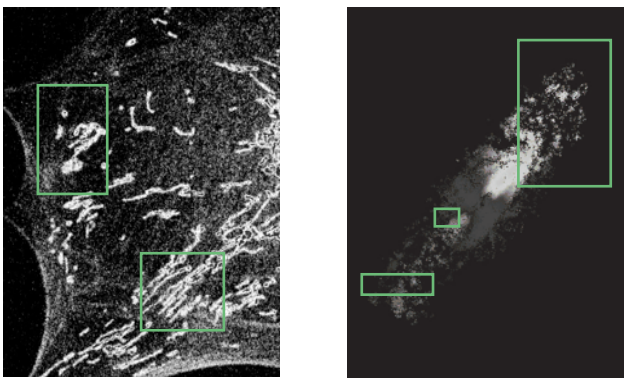


Figure 1

Example of mROI selections during the imaging of mitochondria and a galaxy

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·nü 1024

CHARACTERISTICS	SPECIFICATIONS
Digitization	16 bits
Electron-multiplying gain	1 - 5000
Minimum cooling T⁰ via air cooling[1]	-80⁰C
Minimum cooling T⁰ via liquid cooling[1]	-90⁰C
On-chip temperature stabilization	± 0,01⁰C
Quantum efficiency	> 90% at 600 nm (see Fig. 2)
EM register pixel well depth[2]	800 kē
Spectral range	250 - 1100 nm
Triggering	Internal or external Selectable signal polarity
Exposing time range[3]	25 ns - days
Timestamp resolution	4 ns
Readout noise through:	EM < 0.1ē @ 20 MHz Conv 3ē @ 100 kHz
Vertical clock speed	EM 1 – 10 µs Conv 1 – 10 µs
Dark current[4,5,6] (All operating modes)	0.0004 ē/pixel/s
Charge transfer efficiency[7]	> 0.999989
Single photon detection at 10MHz probability (EM gain = 5000)	> 91%
Imaging area	1024 × 1024 pixels 13 µm × 13 µm pixel area 13.3 mm × 13.3 mm effective area

Table 1 HNü 1024 general characteristics and specifications

FEATURES	BENEFITS
EM gain range of 1 – 5000	Lowest effective readout noise Unmatched single photon detection capabilities
Lowest clock-induced charges levels (CIC)	Highest SNR as a result of lowering the CIC, the dominant noise source of EMCCDs
Patented technology optimized for true photon counting	Linear and photon counting modes are available in EM operation
Highest horizontal charge transfer efficiency	Clearer images No pixel leaking
Ultimate cooling performance	Negligible dark noise Superior charge transfer efficiency
Highest quantum efficiency	Best sensitivity available thanks to back-illuminated grade 1 EMCCD detector (see Fig. 2)
Pixel readout rate up to 30 MHz	Fastest acquisition speed for a 1024 x 1024 EMCCD camera
Selectable output	Fast and easy switching between conventional CCD and EMCCD operations
Time stamping	High-precision time-labelling of every acquisition GPS input for absolute time tagging (optional)
mROI	Select multiple customizable regions of interest on the detector to increase acquisition rates
Cropped-sensor mode	Faster acquisition rates for a region of interest by masking part of the EMCCD detector[8] Greater acquisition versatility using customizable size and position for the cropped region of interest
Low latency	Low Latency between end of exposure and 1st pixel
External trigger modes	Multiple modes available to optimize versasility on frame rate

Table 2 HNü 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·nü 1024 MODELS

SPECIFICATIONS	HNü 1024	HNü 1024IS	HNü 1024HS
Max frame rate[1] Frames per second (fps)	16.7	16.7	25
Readout rate through EM channel (MHz)	10,20	10,20	30
Readout rate through Conventionnal channel (MHz)	0.1, 1, 3	0.1, 1, 3	0.1, 1, 3
Clock-induced charges[9] Electron/pixel/frame (e^-/p/f)	0.002	0.002	0.005

Table 3 HNü 1024 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.

MODEL	REGION OF INTEREST							
	1024 × 1024	1024 × 512	1024 × 256	1024 x 128	1024 x 64	1024 x 32	1024 x 16	1024x8
HNü 1024 & HNü 1024IS	16.7	32.7	62	116	202	320	453	572
HNü 1024HS	25	46	88	159	265	400	535	644

Table 4 HNü 1024 frame rates for different binning values and regions of interest
Frame rates are measured at 20 MHz in EM mode and 30MHz 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 chiler accesories
› 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 longest vacuum lifetime without maintenance. Nüvü Camēras uses at least λ/10 quality windows, essential for optimal image quality.

COMPUTER REQUIREMENTS:

› Communication interface: PCIe Camera Link (min. 1X) or GigE Vision (Gigabit Ethernet)

› Operating system: Windows (XP, 7 & 10), Linux (CentOS & Ubuntu)

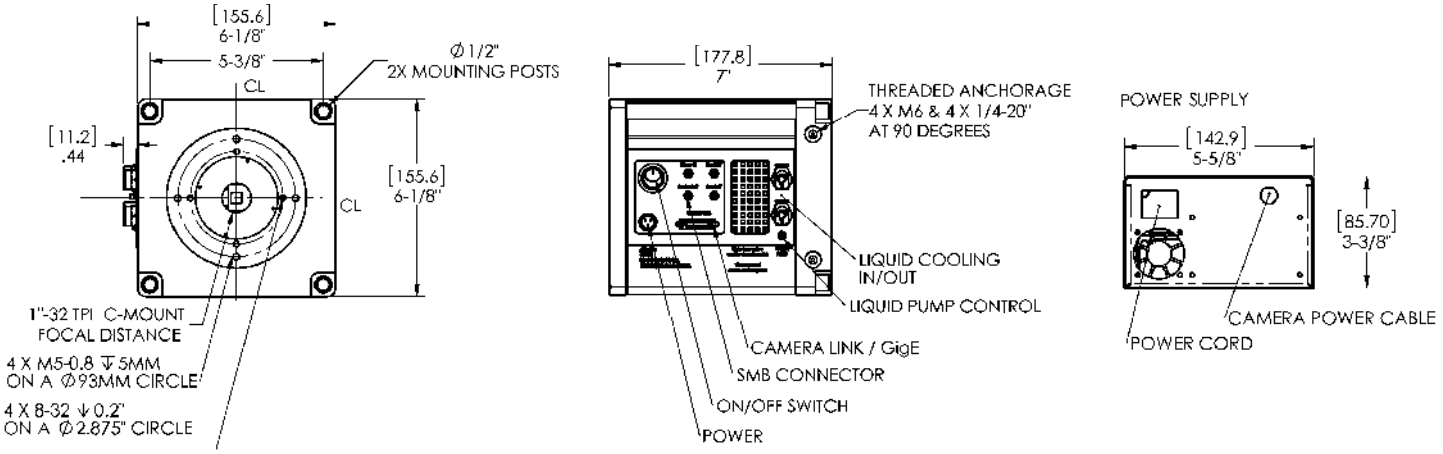
CAMERA ENVIRONMENT:

› 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 At maximum horizntal speed, full frame readout.

2 As per the EMCCD detector manufacturer's datasheet. Other configurations may exist.

3 Minimum 25 ns exposure time available in controlled illumination conditions due to pixels clearing prior to readout.

4 Below -95°C, charge transfer efficiency degrades while improvement on the dark current decreases slowly.

5 These numbers may slightly vary depending on the EMCCD detector.

6 Dark current measured at -85°C. The HNü can also operate down to -90°C with liquid cooling.

7 Mean horizontal charge transfer efficiency measured with an EM gain of 1000 at -85°C and 10 MHz readout rate.

8 Optical mask not included.

9 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) and 20 MHz (HS model).

TYPICAL QUANTUM EFFICIENCY

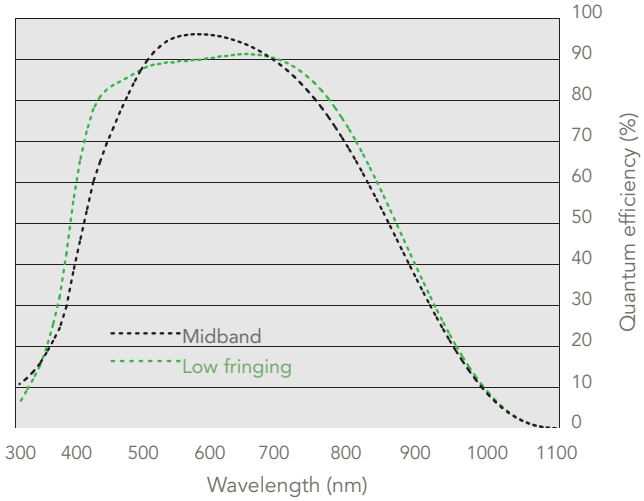


Figure 2

Typical spectral response as a function of wavelength, as specifed by the EMCCD detector manufacturer

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HNü 1024 Specification Sheet 3.0

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