nüvü cameras

every photon counts

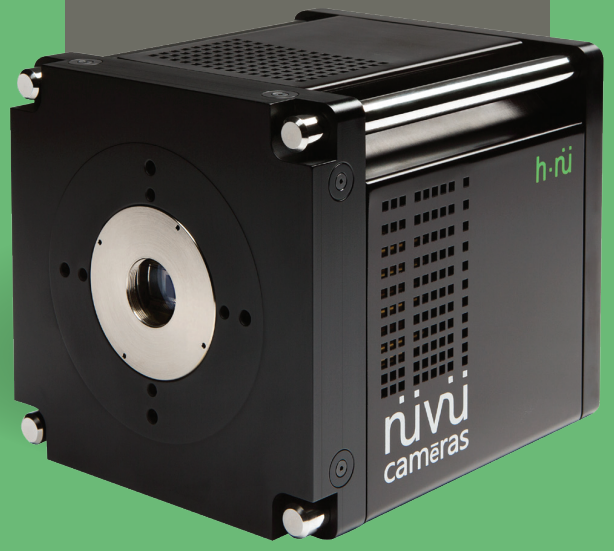
h·nü 128

BUILT FOR SPEED

UP TO **1500** FPS FULL FRAME, IMAGING EVEN IN NEAR-TOTAL DARKNESS

RETHINK EMCCD

A NEW STANDARD FOR LOW LIGHT IMAGING



OUTSTANDING SNR THANKS TO

Patented electronics decreasing inherent EMCCD camera noise for true photon counting

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 air cooling for minimal background signal and stabilized EM gain

Made for applications such as Adaptive Optics (AO), Neural Imaging, Cardiac Imaging and more

ULTIMATE SENSITIVITY enabling highly efficient low-flux imaging, hence FASTER ACQUISITIONS, with frame rates exceeding 1460 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

PERFORMANCE COMPARISON

- HNü 128 (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.)

10x less noise and nearly 3 times faster

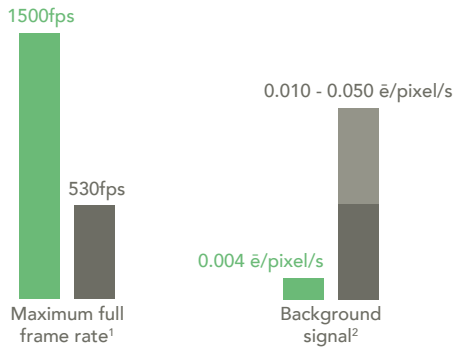


Figure 1
h·nü 128 benefits for Photon Counting imaging.

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·nü 128

CHARACTERISTICS	SPECIFICATIONS
Digitization	16 bits
Electron-multiplying gain	1 - 5000
Minimum cooling T^0 via air cooling[1]	-60^{0}C
Minimum cooling T^0 via liquid cooling[1]	-70^{0}C
On-chip temperature stabilization	± 0,01^{0}C
Quantum efficiency	> 90% at 600 nm (see Fig. 2)
EM register pixel well depth[3]	800 kē
Spectral range	250 - 1100 nm
Triggering	Internal or external Selectable signal polarity
Exposing time range[4]	25 ns - days
Timestamp resolution	4 ns
Readout noise through: EM channel with electron multiplication	< 0.1ē @ 20 MHz
Vertical clock speed	EM 0.1 – 0.5 µs
Dark current[5,6,7] (All operating modes)	0.005 ē/pixel/s
Charge transfer efficiency[8]	> 0.999980
Single photon detection probability (EM gain = 5000 at 10MHz)	> 91%
Imaging area	128 × 128 pixels 24 µm × 24 µm pixel area 3.1 mm × 3.1 mm effective area

Table 1 HNü 128 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 (Fig. 2)[9]
Pixel readout rate up to 30 MHz	Fastest acquisition speed for a 128 x 128 EMCCD camera
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[10] Greater acquisition versatility using customizable size and position for the cropped region of interest
Low latency	Low latency between end of eposure and 1st pixel
External trigger modes	Multiple modes available to optimize versatility or frame rate

Table 2 HNü 128 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 128 MODELS

SPECIFICATIONS	HNü 128AO	HNü 128HS
Max Frame Rate[1] (Frames per second)	1004	1460
Readout rates through EM Channel (MHz)	10,20	20,30
Typical clock-induced charges[11] (Electron/pixel/frame)	0.004	0.01

Table 3 HNü 128 specifications for each model

FASTER FRAME RATES FOR SENSITIVE IMAGING

Crop mode included 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				
	128 × 128	128 × 64	128 × 32	128 x 16	128 x 8
HNü 128AO	1004	1893	3304	5267	7493
HNü 128HS	1460	2651	4574	7174	10025

Table 4 HNü 128 frame rates at maximum readout rate

Features

FOR FASTER ACQUISITION:

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

FOR MORE VERSATILITY:

› UV solutions
› Liquid chiller accessory
› Vacuum compatible cooling
› GPS time-stamping

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.

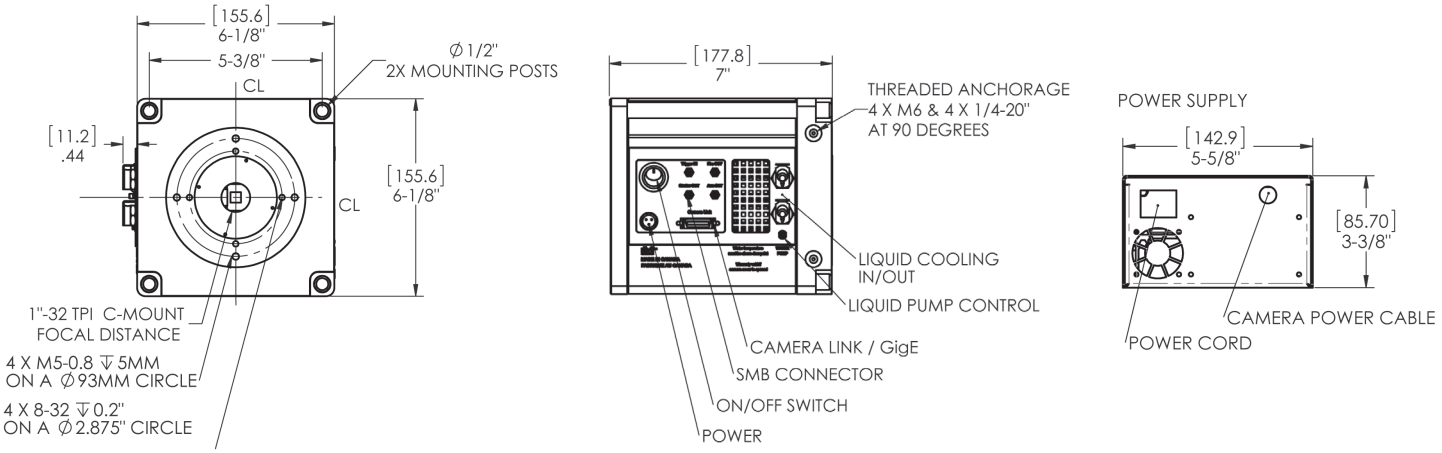
COMPUTER REQUIREMENTS:

- Communication interface: PCIe Camera Link (min. x1) or GigE Vision (Gigabit Ethernet)
- Operating system: Windows (XP, 7 & 10) and 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 horizontal speed, full frame readout.

2 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.

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

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

5 Below -85°C, charge transfer efficiency degrades while improvement on the dark current decreases slowly.

6 Typical values measured with liquid cooling.

7 These numbers may vary depending on the EMCCD detector.

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

9 Nüvü gives only the specifications of the EMCCD detector's manufacturer for grade 1 sensors (e.g. Quantum efficiency, aesthetic specifications, blemishes).

10 Optical mask not included.

11 Typical 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 (HNü AO), or 20 MHz (HNü HS).

TYPICAL QUANTUM EFFICIENCY

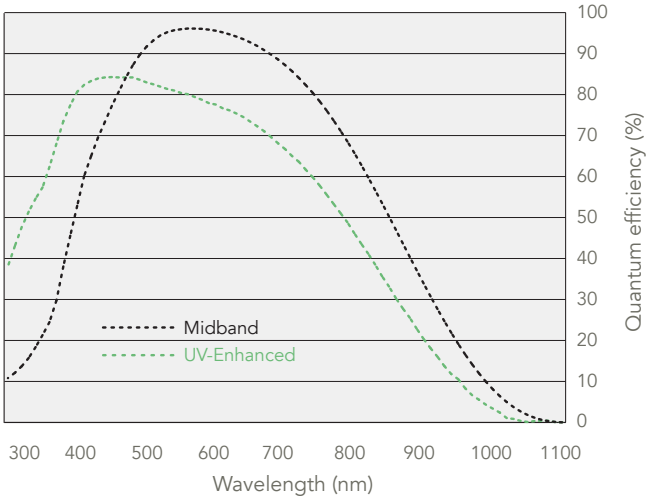


Figure 2

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

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HNü 128 Specification Sheet 3.1

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