



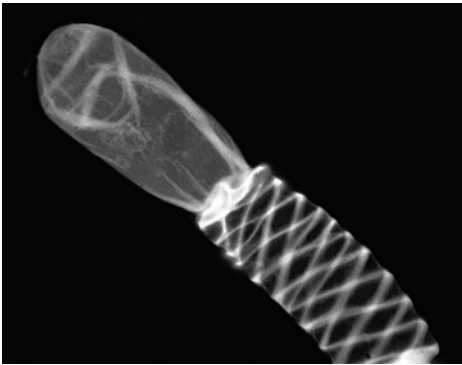
ORCA[®]-fusion

HAMAMATSU
PHOTON IS OUR BUSINESS

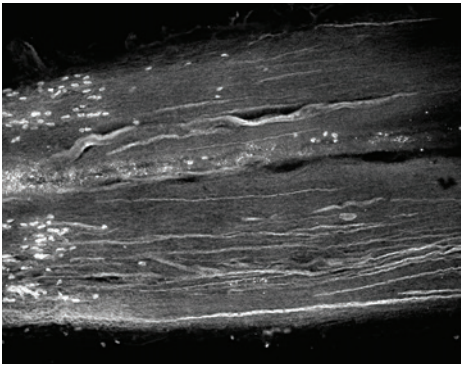
The ORCA-Fusion, built from the sensor up, balances the complex nuances of camera features to provide beautiful images and robust data at all lights levels, but especially in tough low-light conditions. The exceptionally low and highly uniform readout noise of the ORCA-Fusion means that when the sample emits even just a handful of photons, either by default or by experimental design, they are not lost in the noise, but detected and reliably quantified. After all, when you want to hear a whisper it’s best to be in a quiet place.



A. Regenerated lamprey spinal cord.
(E. Guadarrama and J. Morgan, MBL).

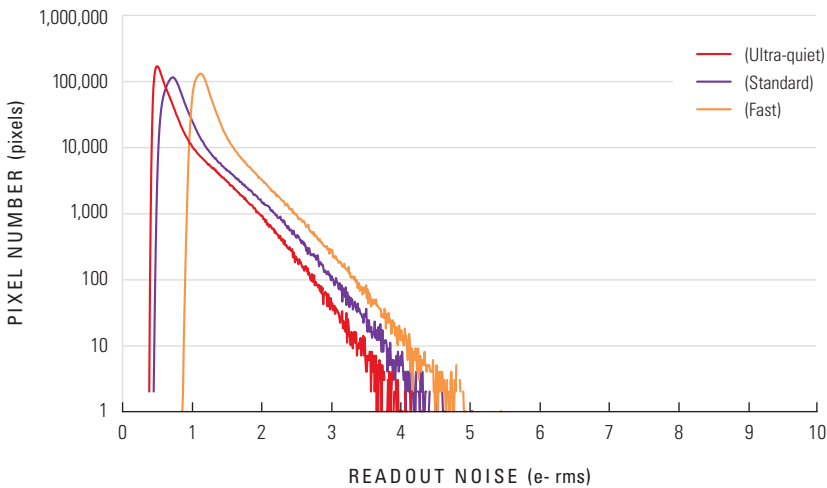


B. Plant tissue culture induced to make xylem.
(CT. Baskin, UMass Amherst, R. Oldenbourg, MBL).



C. Regenerated lamprey spinal cord.
(E. Guadarrama and J. Morgan, MBL)

Readout noise distribution



Having a narrow readout noise distribution improves image data for everything from auto scaling and deconvolution to advanced computational algorithms.

Frames per second

READOUT MODE		AREA READOUT MODE				LIGHTSHEET READOUT MODE	
Scan mode		Fast scan		Standard scan	Ultra-quiet scan	Fast scan	
X (pixels)	Y (pixels)	CoaXPress	USB 3.0 (16 bit)	CoaXPress and USB 3.0 (16 bit)	CoaXPress and USB 3.0 (16 bit)	CoaXPress	USB 3.0 (16 bit)
2304	2304	89.1	31.6	23.2	5.4	88.9	31.6
2304	2048	100	35.5	26.1	6.1	100	35.5
2304	1024	200	71.1	52.3	12.1	199	71.1
2304	512	400	142	104	24.3	397	142
2304	256	799	284	208	48.6	787	284
2304	128	1590	569	415	96.8	1540	569
2304	8	22 800	9330	5950	1380	15 800	9330
2304	4	41 000	18 600	10 700	2500	22 800	18 600

Camera
ORCA-Fusion

Product Number
C14440-20UP

Pixel Size
6.5 µm x 6.5 µm

Effective number of pixels
2304 x 2304

Effective Area
14.976 mm x 14.976 mm

Readout noise (electrons, rms) ^{*1}	
Fast scan	1.4
Standard scan	1.0
Ultra-quiet scan	0.7
Quantum efficiency ^{*1}	
@ 400 nm	65 %
@ 550 nm	80 %
@ 700 nm	70 %
@ 800 nm	50 %
Full well capacity ^{*1}	
15 000 electrons	
Dynamic range ^{*1}	
21 400:1 ^{*2}	
Conversion factor ^{*1}	
0.24 electrons / count	
Cooling Temperature	
With forced-air	-5 °C (Ambient temperature: +25 °C) ^{*3}
Water cooled	-5 °C (Water temperature: +25 °C) ^{*3}
Dark current (electrons/pixel/second) ^{*1}	
@ -5 °C	0.5
@ -15 °C	0.2
Dark offset	
100 counts	
Dark signal non-uniformity (DSNU)	
0.3 electrons rms	
Photo response non-uniformity (PRNU)	
@7500 electrons	0.06 % rms
Linearity error ^{*1} (EMVA 1288 standard)	
0.5 %	
Readout modes	
Full resolution, digital binning (2x2, 4x4), sub-array, lightsheet	
Readout times at full resolution ^{*4}	
Fast scan	11.22 ms (89 fps with CoaXPress or 31.6 fps with USB 3.0)
Standard scan	42.99 ms (23.2 fps with CoaXPress or USB 3.0)
Ultra-quiet scan	184.4 ms (5.4 fps with CoaXPress or USB 3.0)
Lightsheet readout (fast scan)	
Row interval time	4.868 µs to 963.8 µs ^{*4}
Readout time at full resolution	11.22 ms to 2.221 s ^{*4}
Readout modes	Full resolution, sub-array
Readout directions	Top to bottom readout / Bottom to top readout
Exposure times	
Fast scan	17 µs to 10 s (4.87 µs step)
Standard scan	65 µs to 10 s (18.65 µs step)
Ultra-quiet scan	280 µs to 10 s (80.00 µs step)
Trigger modes	
Edge, Level, Sync readout, Start, Global reset edge, Global reset level, programmable	
Trigger delay function	Yes
Trigger output	Global exposure timing, trigger ready, low, high
Input trigger connector	SMA x1
Output trigger connectors	SMA x3
Master pulse mode	
Free running / start trigger / burst	
Digital output	
16 bit ^{*5} / 12 bit / 8 bit	
Interface	
CoaXPress (6.25 Gbpsx2 lane) and USB 3.0 Super Speed ^{*6}	
Lens mount	
C-mount (Standard) / F-mount (Part Number C14440-20UP01)	
Software	
HCLImage, LabVIEW, MATLAB, µManager	
Ambient operating temperature	
0 °C to + 40 °C	
Ambient operating humidity	
30 % to 80 %, with no condensation	

^{*1} Typical value

^{*2} Calculated from the ratio of the full well capacity and the readout noise

^{*3} Dark current depends on cooling temperature

^{*4} Valid to 4 digits and rounded up to 5th digit

^{*5} With standard scan, A/D = 14 bits + 2 bits for linearity correction

^{*6} USB 3.1 Gen 1 compatible

ORCA-Fusion

CAMERA SPECS

LOW NOISE AND EXCEPTIONAL
READOUT NOISE UNIFORMITY



HIGH RESOLUTION
2304 x 2304
5.3 Megapixels

HIGH SPEED
100 fps
At 2304 x 2048 ROI

DYNAMIC RANGE
21 400:1

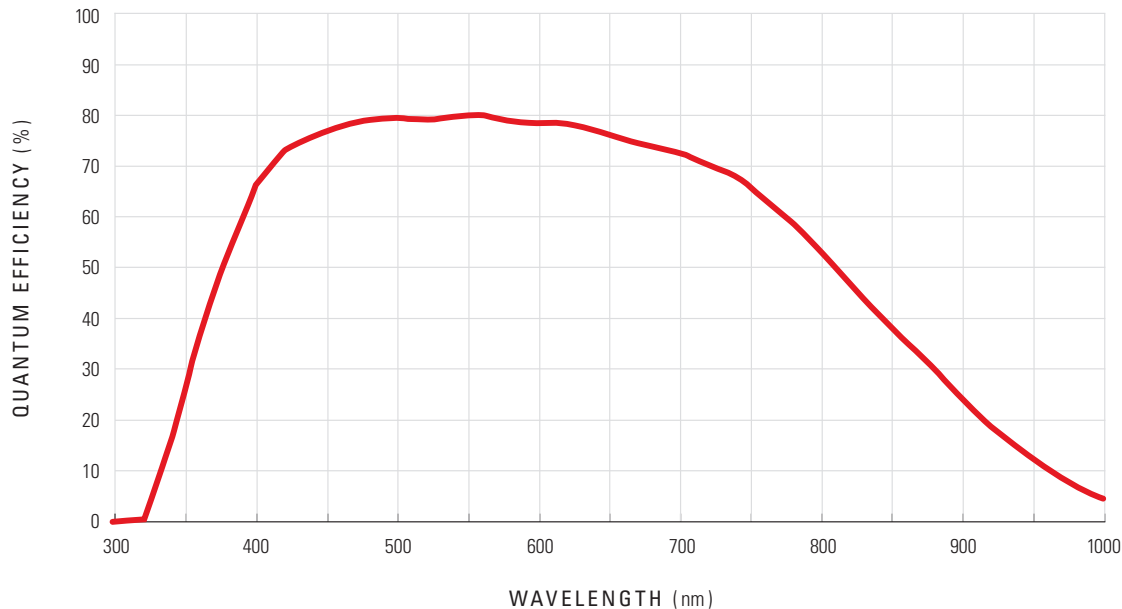
PIXEL SIZE
6.5 μm x 6.5 μm

READOUT NOISE
0.7 electrons rms
Ultra-quiet Scan

PRNU
0.06% rms
@ 7500 electrons

DSNU
0.3 electrons rms

PEAK QE
80%



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