

Detector arrays

The AvaSpec line of spectrometers can be equipped with several types of detector arrays. Presently we offer silicon-based CCDs, back-thinned CCDs, and CMOS Arrays for the 200-1100 nm range. A complete overview of each is given in the next section "Sensitivity" in Table 4. For the NIR range (1000-2500 nm) InGaAs arrays are implemented.

All detectors are tested in incoming goods inspection, before they are used in our instruments. Avantes offers full traceability on following detector specifications:

- Dark noise
- Signal to noise
- Photo Response Non-Uniformity
- Hot pixels

StarLine and CompactLine CMOS Detectors (2048CL/4096CL)

Both CCD (charge-coupled device) and CMOS (complementary metal-oxide semiconductor) detectors start at the same point -- they convert light into electrons, only with different technologies. In the last years CMOS sensors has improved up to a point where they reach near parity with CCD devices.

Looking to the future the CMOS detectors seem to definitely take over the standard CCD technology in general purpose spectrometers. In general the CMOS detectors have a good UV response (without the need of using UV enhancement coatings) and a higher response in the NIR region.

The overall sensitivity tends to be somewhat lower than with the CCD technology.



SensLine Back-thinned CCD Detectors (2048XL/2048x64/1024x58)

For applications requiring high quantum efficiency in the UV (200-350 nm) and NIR (900-1160 nm) range, combined with good S/N and a wide dynamic-range, back-thinned CCD detectors are the right choice.

Avantes offers cooled and uncooled versions. In case of a 2D-detection the vertical pixels are binned, giving effectively one high pixel to increase sensitivity.

- + Advantage of the back-thinned CCD detector is the good UV and NIR sensitivity, combined with good S/N and dynamic range.
- Disadvantage is the relatively higher cost.



nm we connected the 600 μm fiber to an AvaLight-DHS through a CC-VIS/NIR dif-fuser, equivalent to 2.7 μW power.

Peak Wavelength and QE @ peak

The peak wavelength is provided by the detector supplier as well as the Quantum Efficiency, defined as the number of electrons generated by one photon.

Signal/Noise

Signal/Noise is measured for every detector at Avantes' Quality Control Inspection and defined as the illuminated maximum Signal/Noise in Root Mean Square for the shortest integration time. The RMS is calculated over 100 scans.

Dark Noise

Dark noise is measured for every detector at Avantes' Quality Control Inspection and defined as the non-illuminated noise in

Root Mean Square for the shortest integra-

tion time. The RMS is calculated over 100 scans.

Dynamic Range

The dynamic range is defined as the (maximum signal level- baseline dark level)/dark noise RMS.

Photo Response Non-Uniformity

Photo Response Non-Uniformity is defined as the max difference between output of pixels when uniformly illuminated, divided by average signal of those pixels.

PRNU is measured for every detector at Avantes' Quality Control Inspection.

Frequency

The frequency is the clock frequency at which the data pixels are clocked out through the AD-converter.

Table 4 Detector Specifications (based on a 16-bit AD converter)

	StarLine			SensLine	
Detector	HAM-2048CL	HAM-4096CL	SONY-2048L	HAM-2048XL	HAM-1024x58
Type	CMOS linear array	CMOS linear array	CCD linear array	Back-thinned CCD array	Cooled Back-thinned CCD array
# Pixels, pitch	2048, 14 μm	4096, 7 μm	2048, 14 μm	2048, 14 μm	1024 x 58, 24 μm
Pixel width x height (μm)	14 x 200	7 x 200	14 x 200	14 x 500	24 x 24 (total height 1.4 mm)
Pixel well depth (electrons)	80,000	80,000	90,000	200,000	1,000,000
Sensitivity Photons/count @600 nm	2	2	2	4	16
Sensitivity in counts/μW per ms integration time	375,000 (AvaSpec-ULS2048CL)	218,000 (AvaSpec-ULS4096CL)	470,000 (AvaSpec-ULS2048L)	460,000 (AvaSpec-ULS2048XL)	445,000 (AvaSpec-HERO)
Peak wavelength	700 nm	700 nm	450 nm	650 nm	650 nm
QE (%) @ peak	80%	80%	40%	78%	92%
Signal/Noise	300:1	335:1	300 :1	525 :1	1200:1
Dark noise (counts RMS)	16	16	20	5	2
Dynamic Range	4000	4000	3300	13700	40000
PRNU*	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$	$\pm 3\%$	$\pm 3\%$
Wavelength range (nm)	200-1100	200-1100	200-1100	200-1160	200-1160
Frequency	6 MHz	6 MHz	2 MHz	1 MHz	250 kHz

* Photo-Responsive Non-Uniformity

Figure 3a Sensitivity Curve StarLine

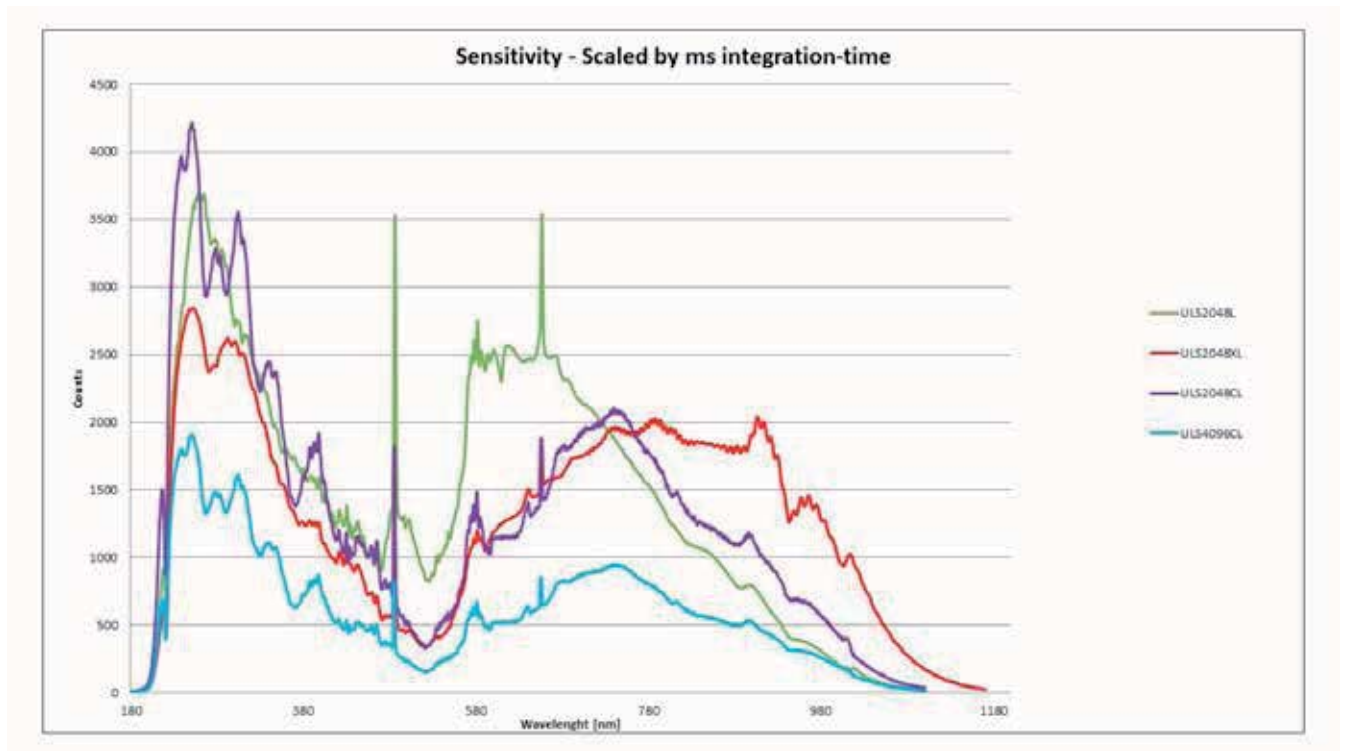


Figure 3b Sensitivity Curve SensLine

