

Mallincam CCD Sensitivity Comparison

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Objectives:

There has been a lot of talk on the Mallincam Yahoo Group about the differences in sensitivity of the various CCD chips used by Rock in his cameras. The spectral sensitivity data provided by Sony in their technical specs provide some information about CCD performance, but that data is normalized and non-dimensional, so comparing one chip to another directly is not possible. Also, sensitivity data for the colour versions of the CCD's in the infrared band are not provided in the Sony data, but it is for the black and white (b+w) versions. The objective of this report is to take the available technical data for the CCD's used in Mallincam astro-video cameras, and process it into a form that will allow direct comparison between them.

Input Data:

There are three models of CCD chip used in Rock's cameras: ICX418AKL, ICX428ALL, and ICX428AKL. Model 428 chips are EXview HAD chips, generally more sensitive than the 418 model chips, as will be shown later.

Camera	B+W (standard)	Colour (standard)	Colour (optional)
JR	n.a.	ICX428AKL EXview HAD	n.a.
MCHP	ICX428ALL EXview HAD	ICX418AKL	ICX428AKL EXview HAD
VSS	ICX428ALL EXview HAD	ICX418AKL	ICX428AKL EXview HAD
VSS+	ICX428ALL EXview HAD	ICX418AKL	ICX428AKL EXview HAD
Xtreme	ICX428ALL EXview HAD	ICX418AKL	ICX428AKL EXview HAD
Signature	n.a.	unknown	n.a.

Table 1 CCD Model to Mallincam Model Cross Reference

I have also included Sony model 205 chips (ICX205AK & ICX205AL) in my report since that is the CCD that I believe is in my HD Toshiba security camera that I use for lunar and planetary observing (camera model IK-WB11A).

The Sony specs provide spectral sensitivity plots for each of the CCD models. The figures below are copies of the plots as they appear in the Sony documents.

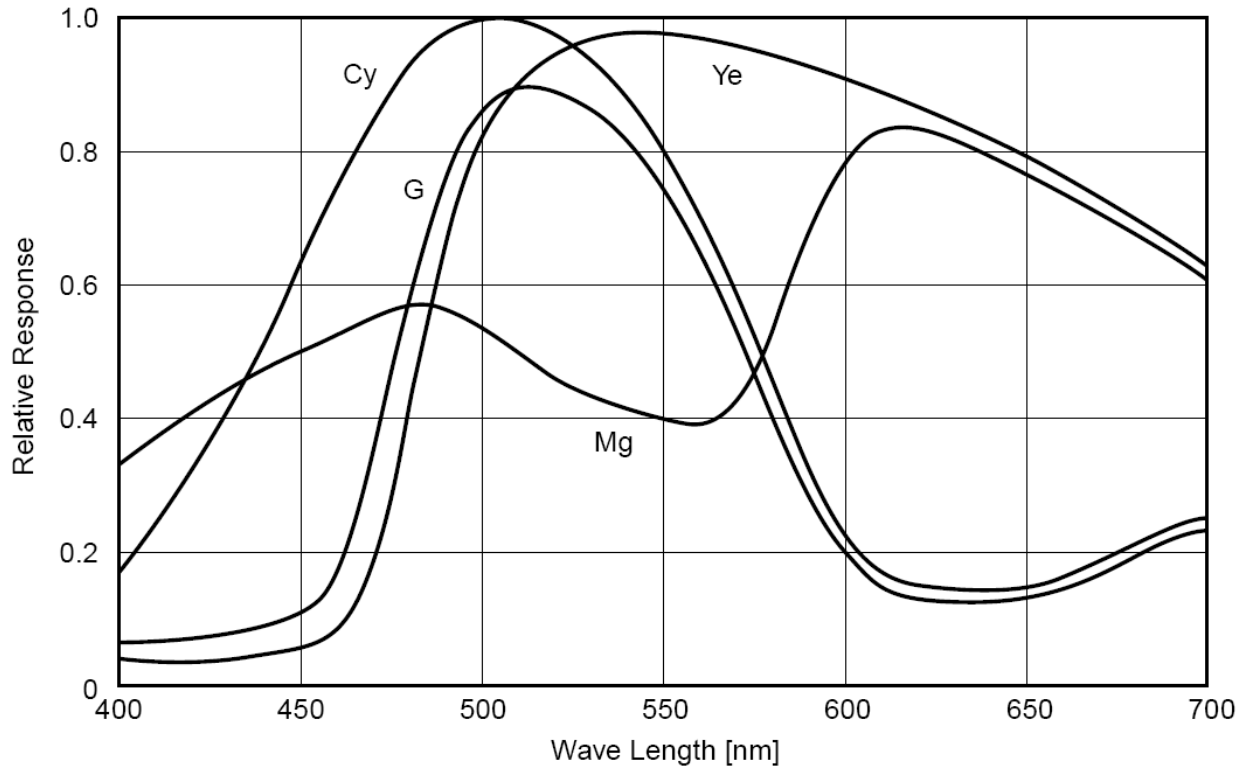


Figure 1 Spectral Sensitivity for ICX418AKL (colour)

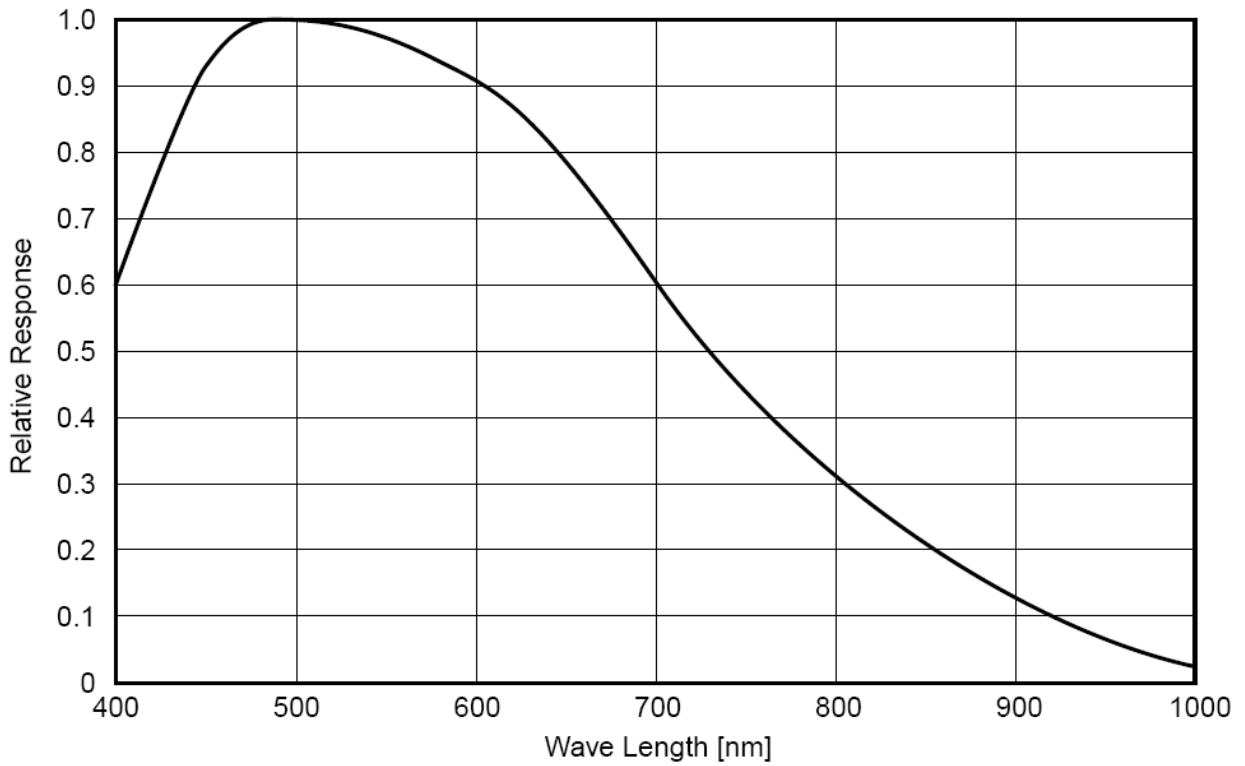


Figure 2 Spectral Sensitivity for ICX418ALL (b+w)

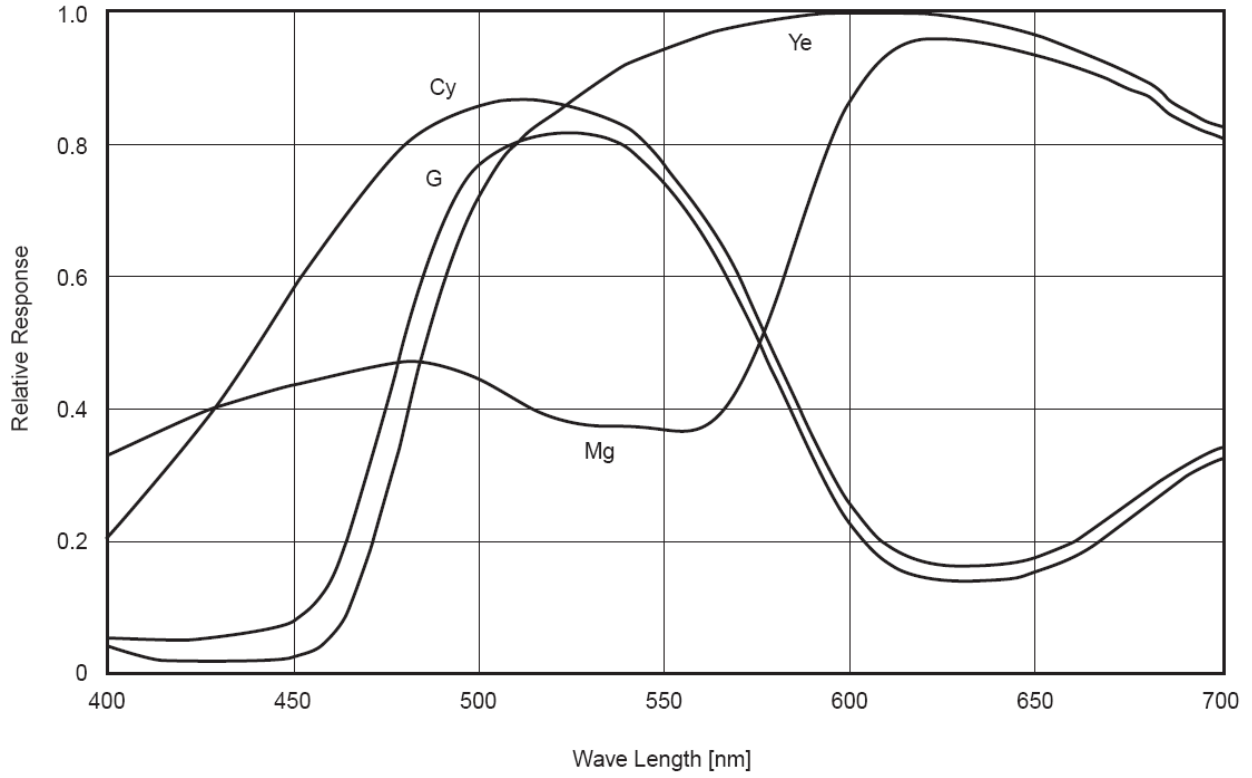


Figure 3 Spectral Sensitivity for ICX428AKL (colour)

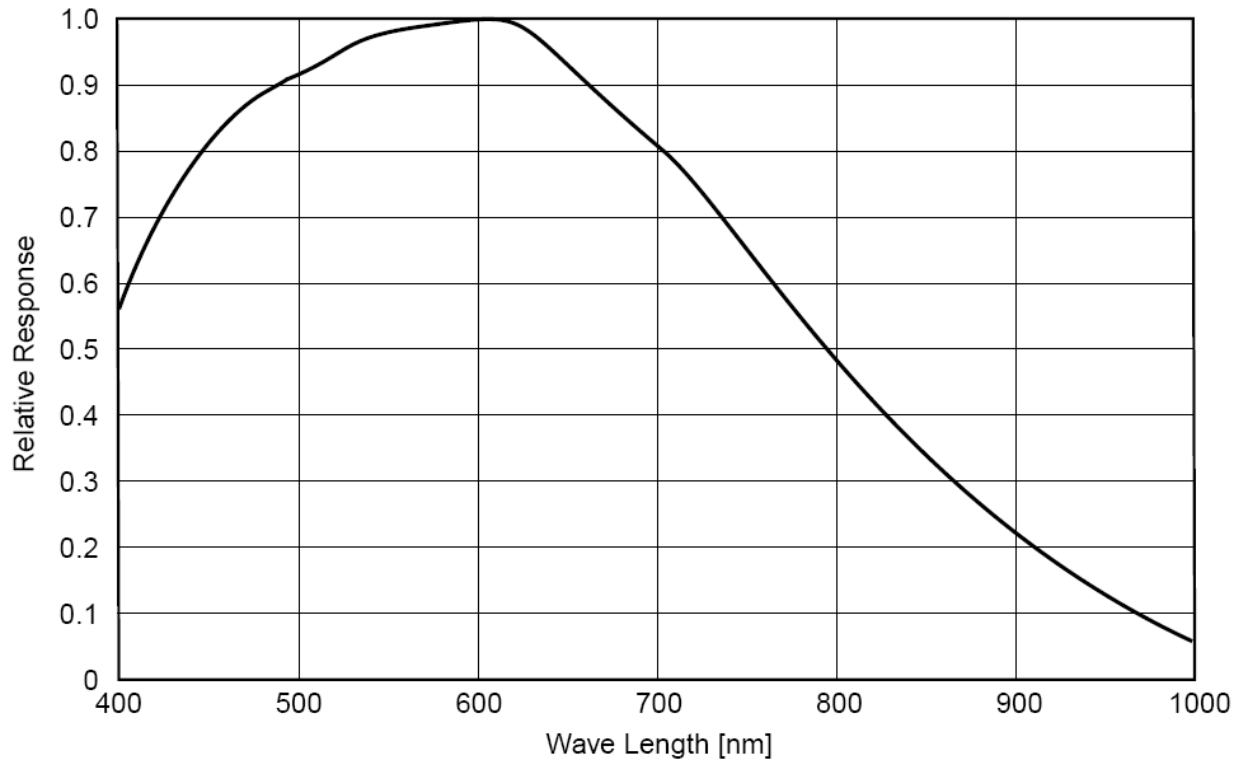


Figure 4 Spectral Sensitivity for ICX428ALL (b+w)

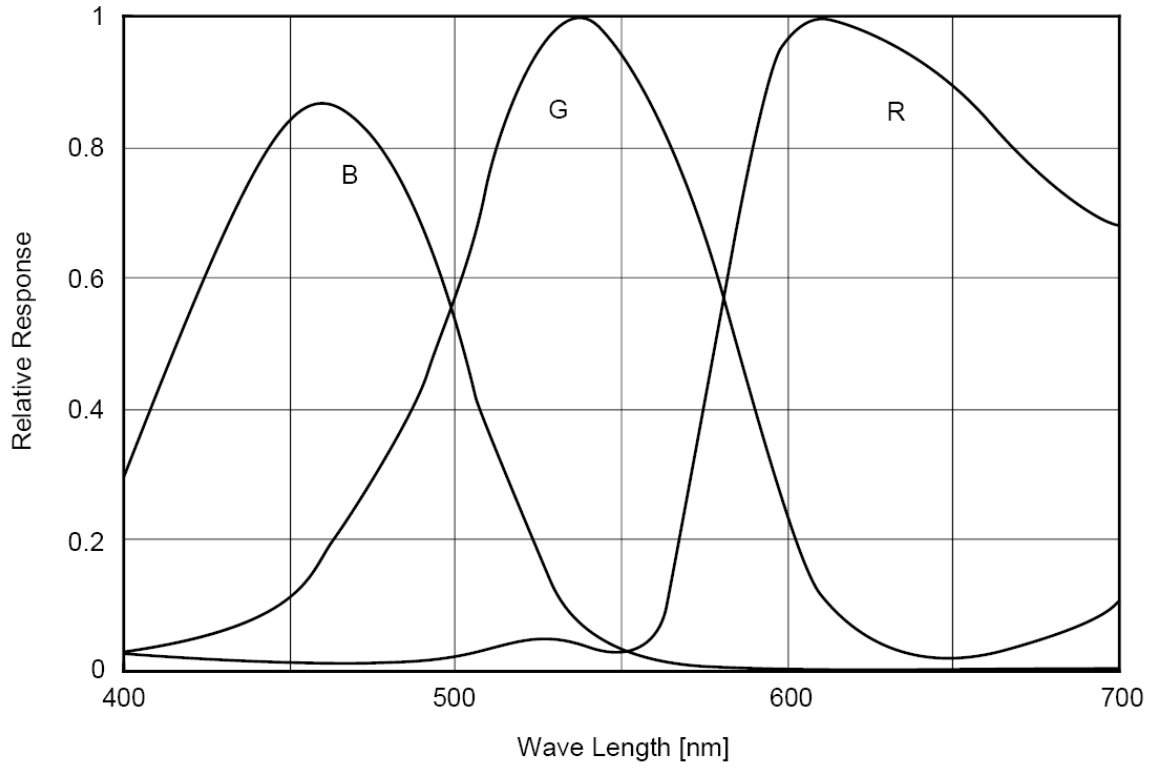


Figure 5 Spectral Sensitivity for ICX205AK (colour)

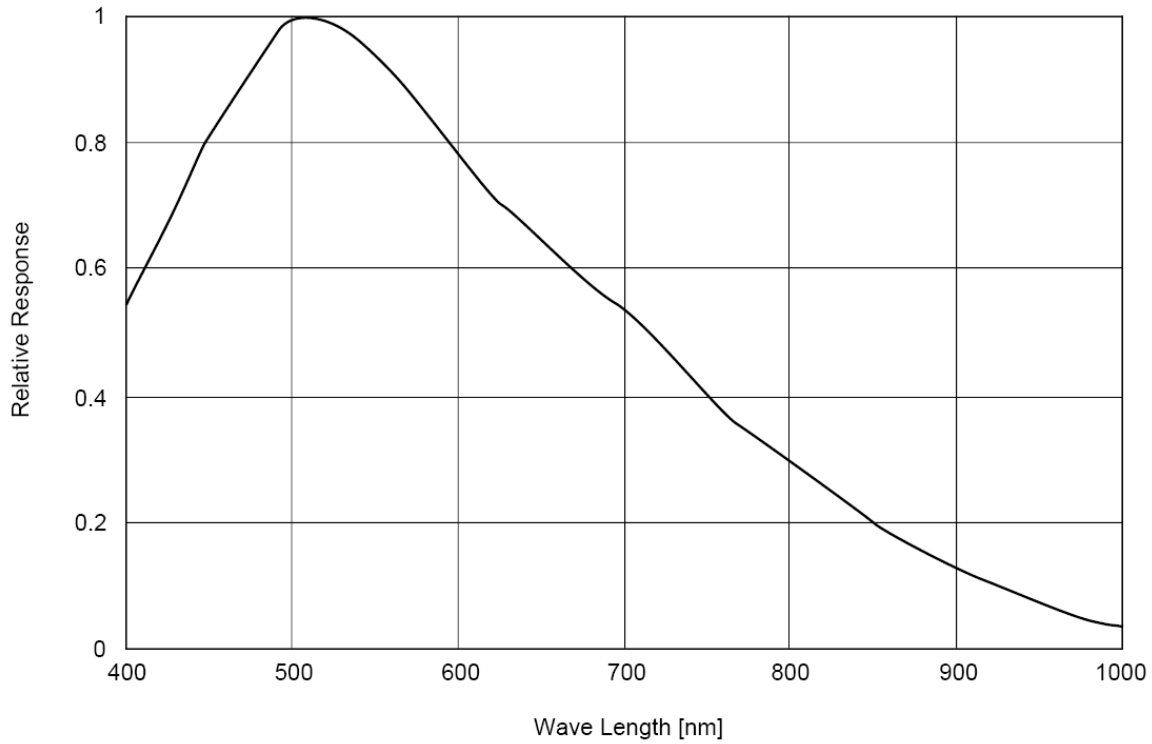


Figure 6 Spectral Sensitivity for ICX205AL (b+w)

Also provided in the Sony spec sheets are some basic sensor performance data. The most relevant values are listed below in Table 2.

CCD Model	Sensitivity (typical)	Dark Current
418AKL	1300 mV	2 mV
418ALL	1100 mV	2 mV
428AKL	1600 mV	2 mV
428ALL	1400 mV	2 mV
205AK	400 mV	16 mV
205AL	450 mV	16 mV

Table 2 Summary of CCD Performance Data

Methology:

The data provided by Sony is interesting, but it is not useful in the form presented in the tech specs. The method used to measure the sensitivity of each chip was slightly different in each case, and the definition of sensitivity changes depending on whether it is a colour or b+w chip. To convert the provided data into absolute sensitivity, which is directly comparable between sensors, I had to reproduce the conditions of Sony’s sensitivity measurement. Luckily Sony provided enough information to allow this to happen.

The measurement process consists of measuring the voltage output from the CCD when looking at a calibrated light source. In Sony’s case, they used a halogen light source with colour temperature 3200K (see Figure 7). Sony also uses an industry standard IR cut filter during their measurements called a CM500S, for which I was easily able to locate the spectral response (see Figure 7). The resulting voltage output is passed through a simple calculation that accounts for shutter speed and other CCD settings in order to give the sensitivity values quoted in Table 2.

To back out the original measured sensitivity for each chip, I first combined the colour and b+w spectral response curves to come up with the total sensor response across the full spectrum, from 200 to 1200nm. I assumed the b+w curve as the limit under which the colour curves had to be. I made educated guesses as to the shape of the curve where there was missing information. The resulting curves are shown below in Figures 8 to 10, where the thin dotted curves mark where I’ve sketched in the missing data. The average response of the colour CCD is also shown with the orange line. I then passed the emission spectrum from the halogen light through the IR filter and then finally through my CCD full spectrum curves. When I add up the area under the remaining curve, it equals the sensitivity values in Table 2 times some constant.

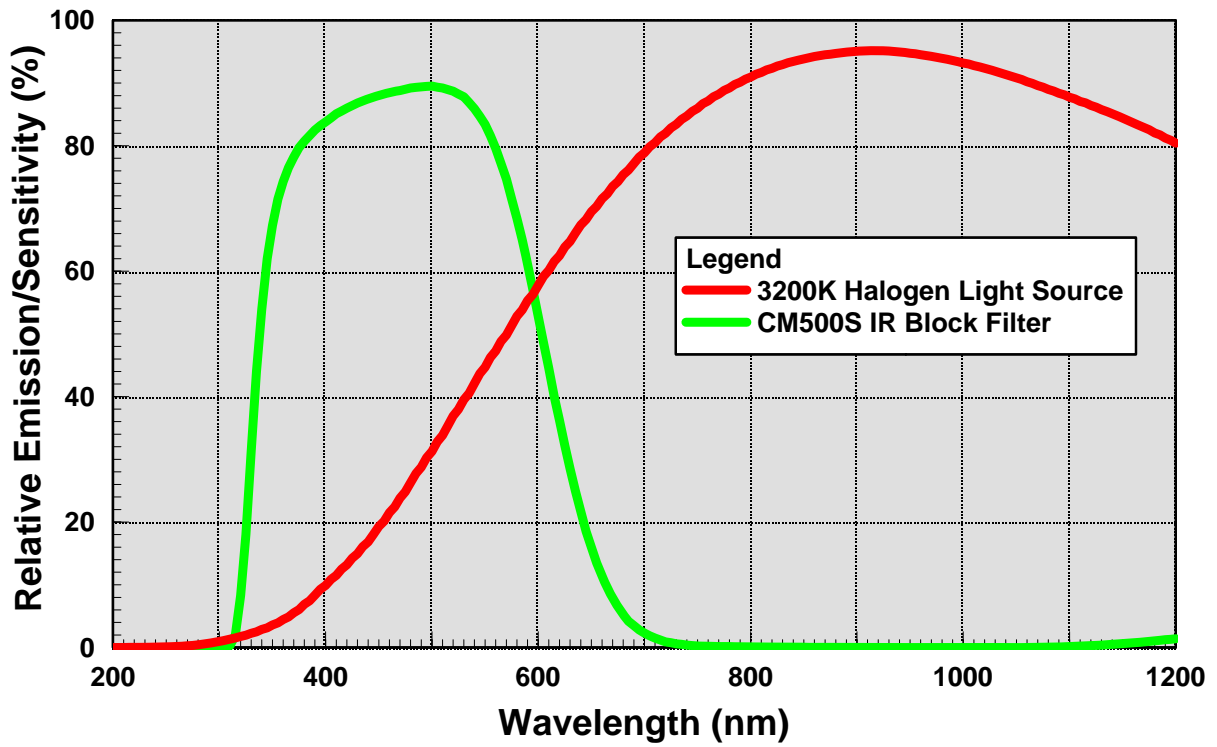


Figure 7 Spectral Emission from Halogen Light/Sensitivity of CM500S Filter

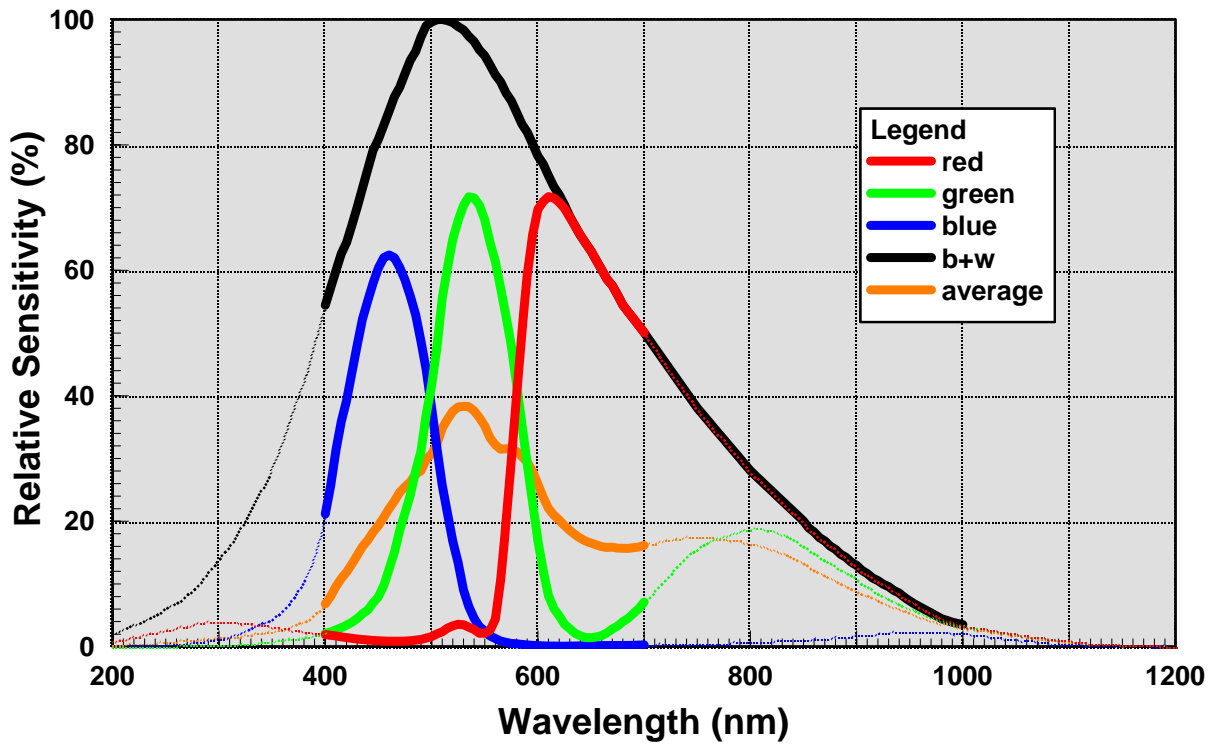


Figure 8 Full Spectral Sensitivity for ICX205AK & AL

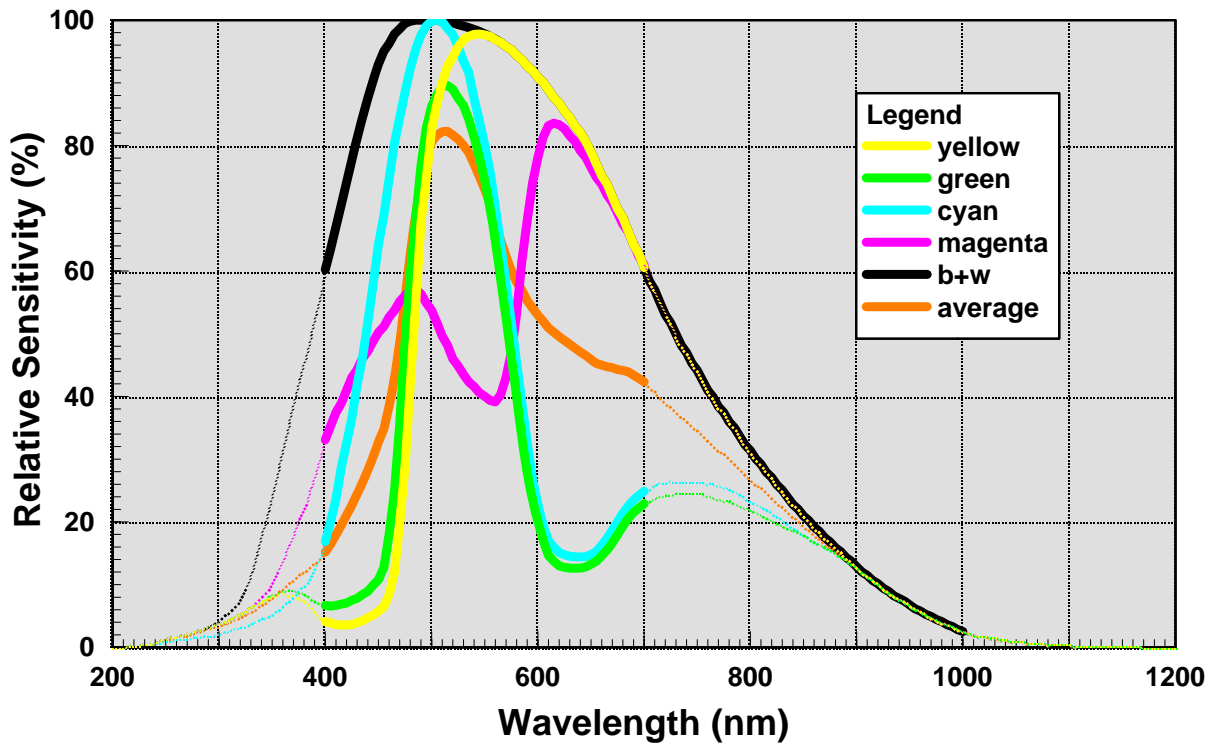


Figure 9 Full Spectral Sensitivity for ICX418AKL & ALL

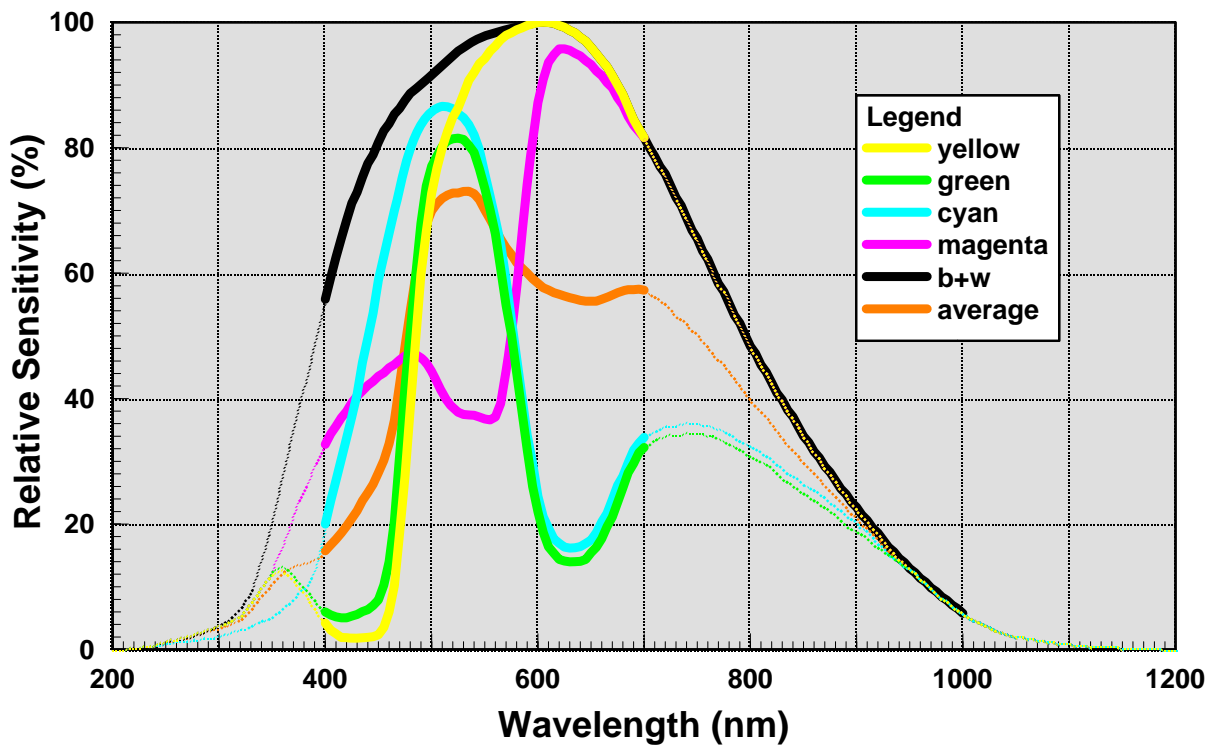


Figure 10 Full Spectral Sensitivity for ICX428AKL & ALL

Results:

The result of my calculation is shown in Figure 11. With this plot it is very easy to compare the different CCD chips. Note for example how the 428 model chips are clearly much more sensitive in the red and infrared end of the spectrum. Also note how much more sensitive the b+w chip is compared to the colour chip. Finally, for a chuckle note how small the sensitivity of my supposed “low light level” Toshiba security camera is compared to the Mallincam!

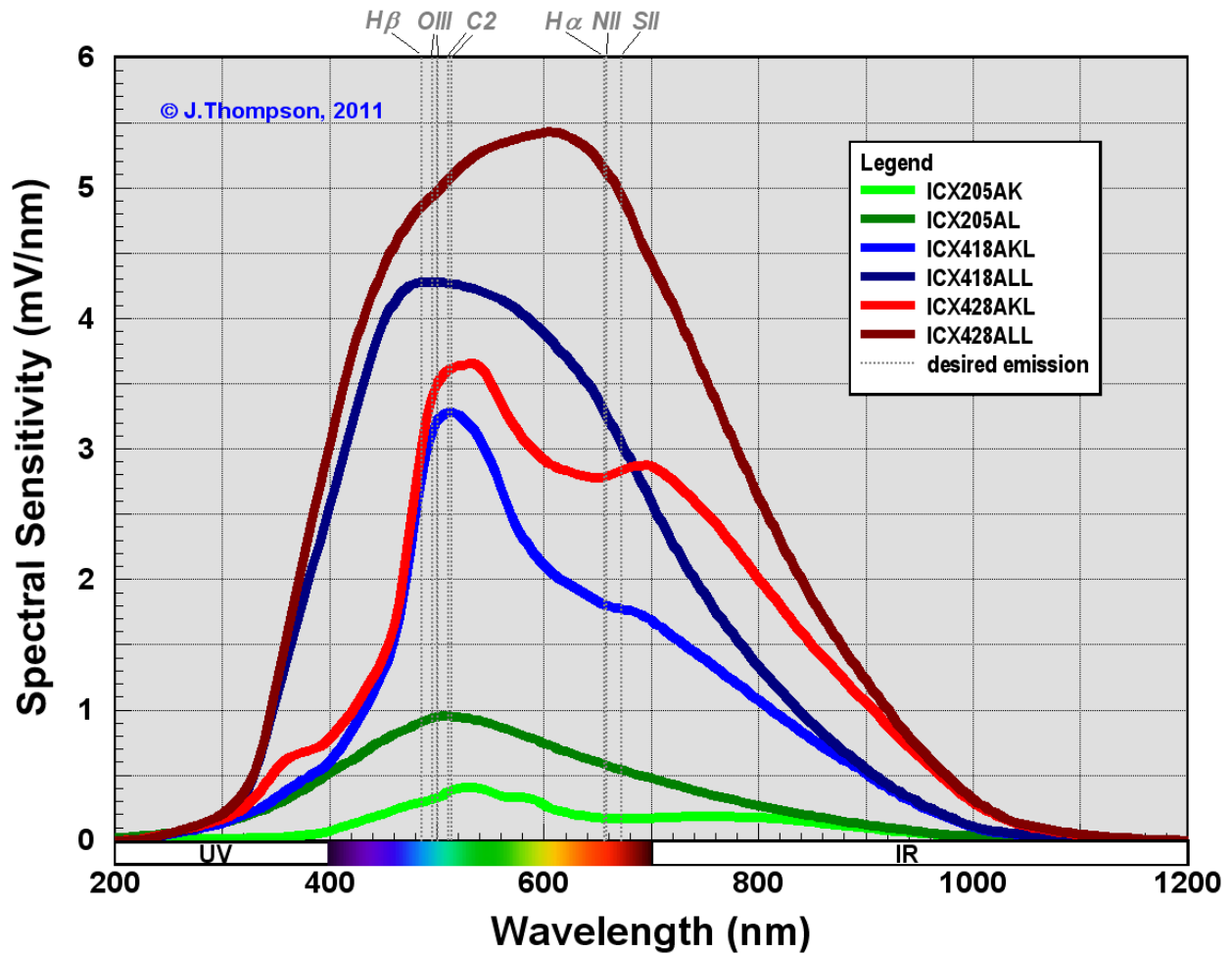


Figure 11 CCD Absolute Sensitivity Comparison

I hope my work is useful to the Mallincam community. If you have any questions, please feel free to contact me at: top-jimmy@rogers.com

Cheers,

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