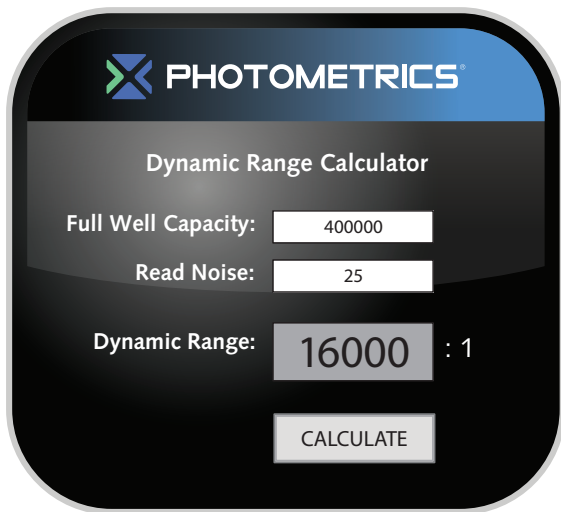


Dynamic Range Calculator



PHOTOMETRICS

Dynamic Range Calculator

Full Well Capacity:

Read Noise:

Dynamic Range: : 1

Dynamic Range is a measure of the sensitivity of a camera. It defines how many different levels of signal a camera can quantitatively detect. A higher dynamic range corresponds to a better ability of the camera to differentiate between levels of light.

Every CCD placed in a camera has what is called a Full-Well Capacity. This full-well capacity defines the amount of electrons that each pixel can detect. In an ideal world, each electron detected would be translated into the image; however, in real world applications, we have to deal with the effects of noise. Read noise is a measurement of the noise generated by the camera electronics while making a read of the electron levels in a CCD. In essence, read noise is the minimum amount of electrons that can be detected at any point from the CCD.

How does this affect the dynamic range? Let's say a CCD has a full-well capacity of 1000 electrons per pixel, and the read noise is 50 electrons. Since the minimum amount of electrons you can detect at any point is 50, you will only be able to detect 20 unique levels of signal, resulting in a dynamic range of 20:1.

Following this logic:

$$\text{Dynamic Range} = \frac{\text{Full Well Capacity}}{\text{Read Noise}} : 1$$

Therefore, lower read noise and higher full-well capacity correspond to a higher dynamic range.

The dynamic range corresponds to the required bit-depth of the camera. Bit depth is defined as $2^N - 1$ where N is the number of bits. If a camera is able to differentiate between 4000 levels of electrons, it requires a bit-depth high enough to be able to account for all 4000 levels. Since a 12-bit camera would be able to detect $2^{12} - 1 = 4096 - 1 = 4095$ different levels of signal, the camera would need to have a bit-depth of 12bits.

Essentially, Dynamic range is the ability of a camera to differentiate between unique levels of signal, and it directly corresponds to the bit-depth of the camera. A higher dynamic range will allow you to detect a higher range of signals and is a good measurement of how sensitive your camera is.

The Dynamic Range Calculator is available at <http://www.photometrics.com/resources/imaging-tools/dynamic-range-calculator.php>