Measurements Lab

Analog-to-digital converter
ADC

NC State University

Principle of analog to digital voltage conversion

An analog-to-digital converter samples an input analog voltage and converts it to digital form. The conversion requires quantization of the input, which introduces a small amount of error. Instead of doing a single conversion, an ADC often performs the conversions periodically. In other words it samples the voltage. The result is a sequence of digital values that have been converted from a continuous-time and continuous-amplitude analog signal to a discrete time and discrete amplitude digital signal. Since the output is digital the voltage is converted into an N-bit value where the number of bits is a binary number with a value 2^N.

Full scale voltage and the resolution of an ADC

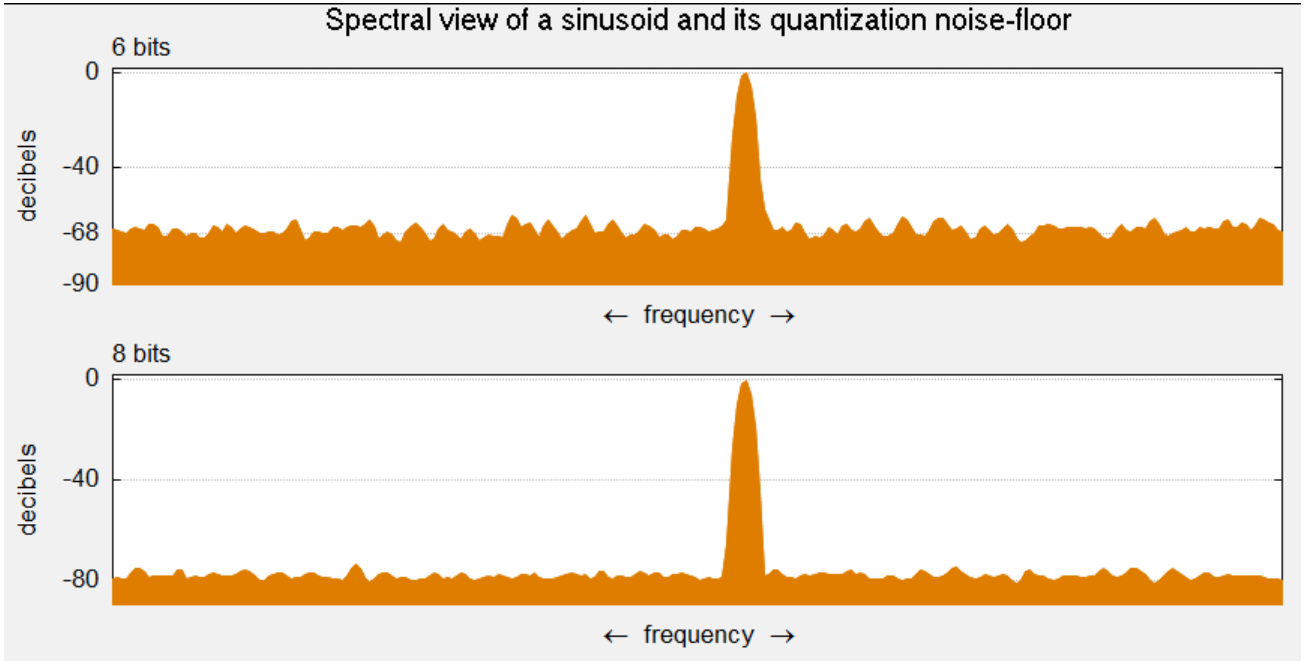
A digital output is a binary number an, by definition, has a number of digits equal to a power of 2. Therefore, the number of bits in a ADC can be:

$$2^N$$

Where N = 6, 8, 12 or 16 as the most common values. The analog input has some value in volts that must be within the limits of the full scale voltage. A common value is 10 volts, The ADC then digitizes from 0 to 10 volts (or sometimes from -5 to 5 volts. The digital resolution of the ADC is:

$$R = \frac{E_{full\ scale}}{2^N}$$

Signal-to-noise ratio of an ADC (6-bit/8-bit comparison)



Comparison of a 6-bit and 8-bit ADC. For the sample full range voltage the noise is less for the 8-bit ADC.