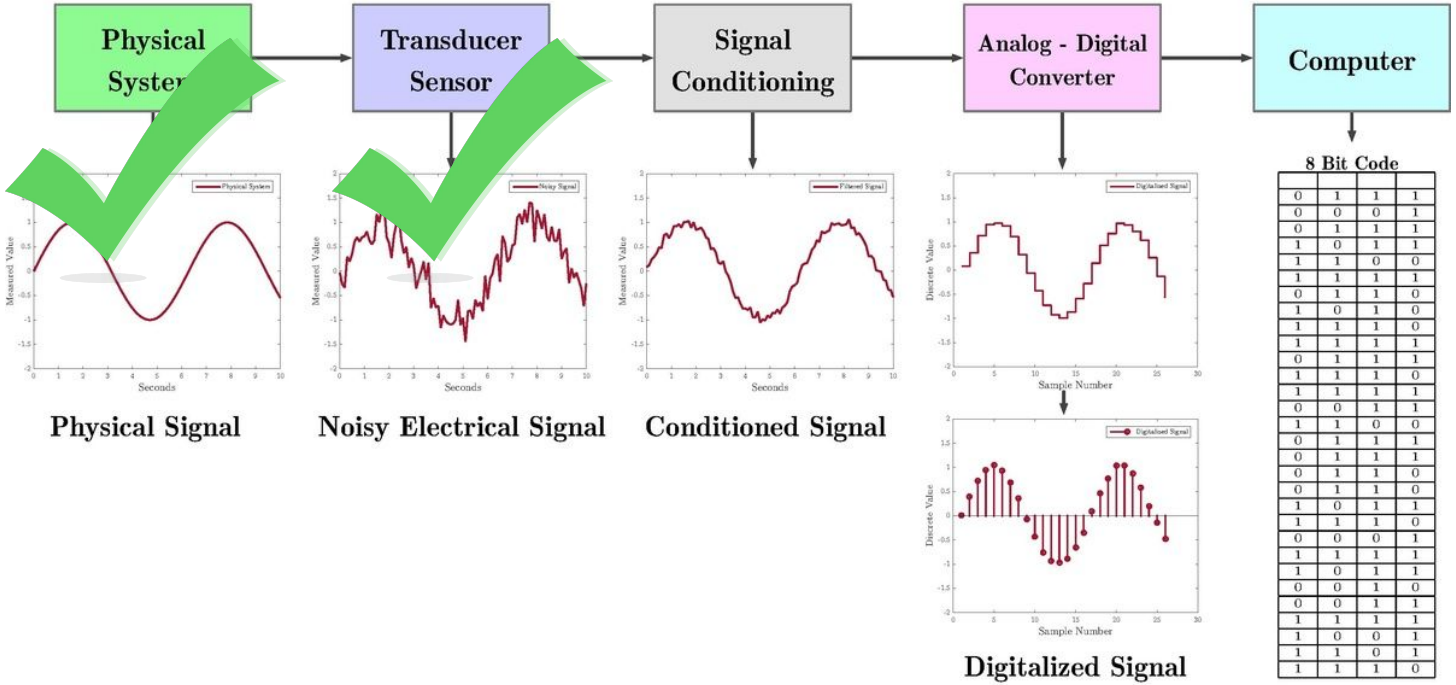
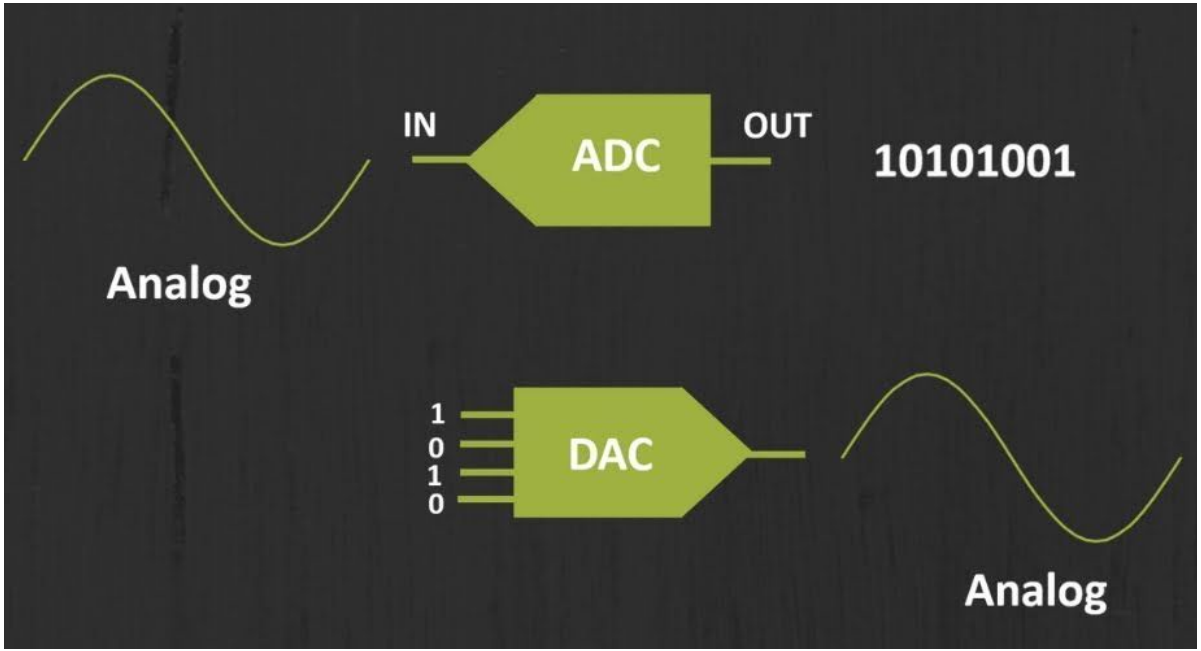
Digital Data Acquisition System



LEEMANGEOPHYSICAL LLC
CONSULTING & INSTRUMENTATION

Image: WikiPedia

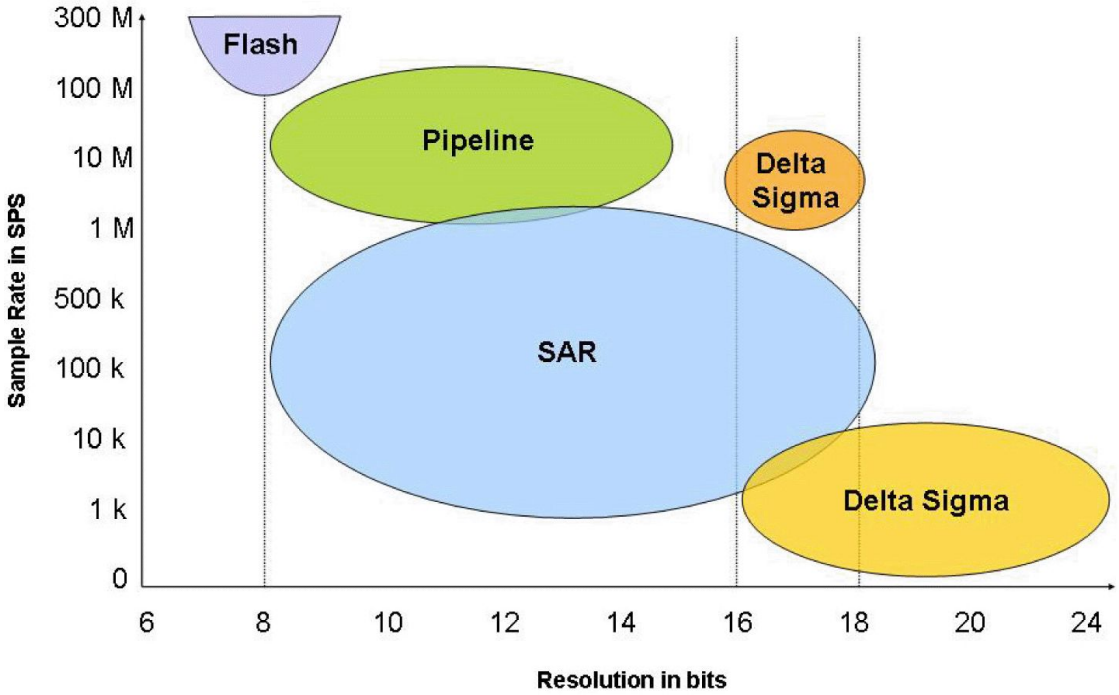
DAQ, ADC, DAC, and more alphabet soup



LEEMAN GEOPHYSICAL LLC
CONSULTING & INSTRUMENTATION

Image: All About Electronics

Analog to Digital Converters (ADCs) take a analog (continuous) signal and create a digital representation of it



LEEMAN GEOPHYSICAL LLC
CONSULTING & INSTRUMENTATION

Image: EDN

Let’s look at some of the effects of ADC bit depth and sampling rate

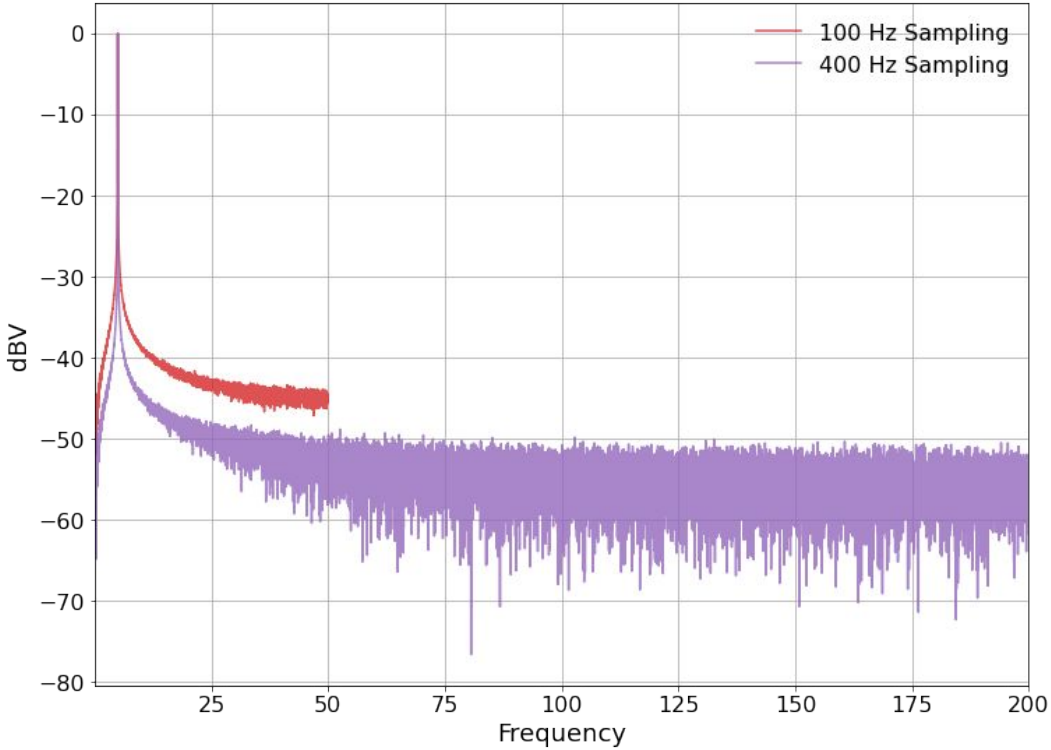
$$\text{volts per bit} = \frac{\text{range}}{2^n - 1}$$

We often look at the SNR and ENOB

$$\mathrm{SNR_{qe}} = (6.02 N_{\mathrm{bits}}) + 1.76\mathrm{dB}$$

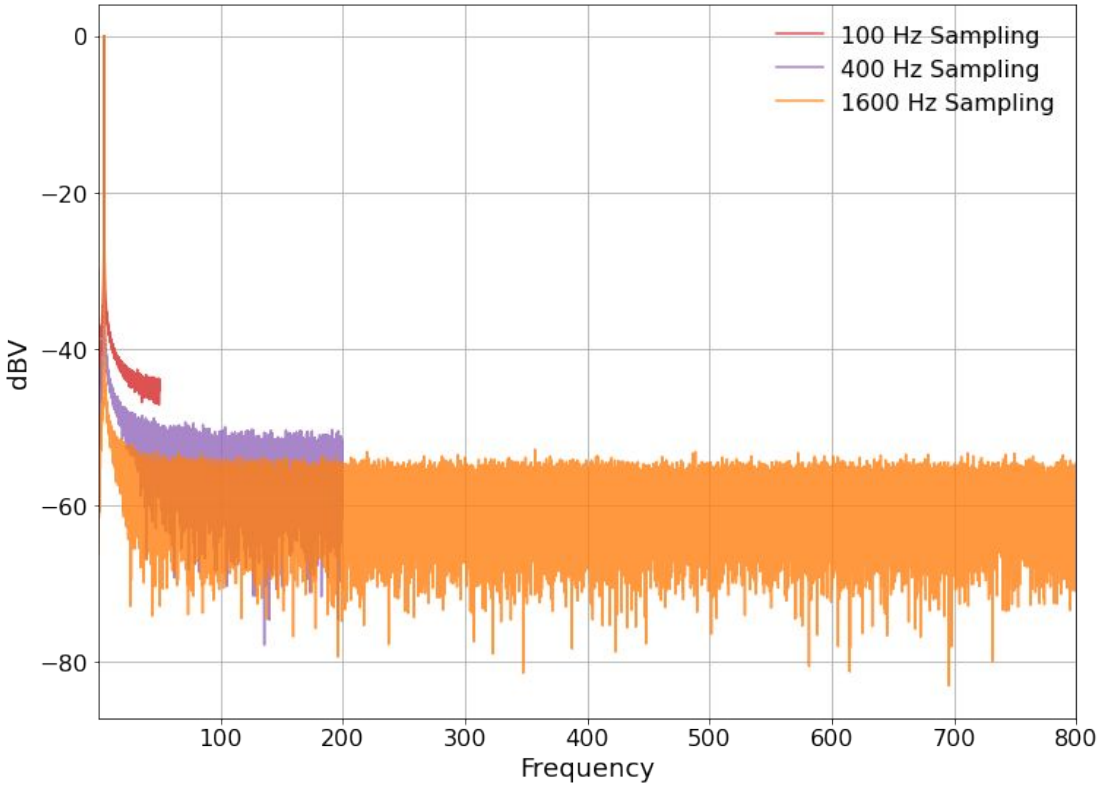
$$\mathrm{ENOB} = \frac{\mathrm{SNR} - 1.76\mathrm{dB}}{6.02\mathrm{dB}}$$

Oversampling is an effective strategy to increase the effective number of bits



LEEMAN GEOPHYSICAL LLC
CONSULTING & INSTRUMENTATION

Oversampling is an effective strategy to increase the effective number of bits



LEEMAN GEOPHYSICAL LLC
CONSULTING & INSTRUMENTATION

Noise shaping is another way many ADCs reduce the noise you see in your signal

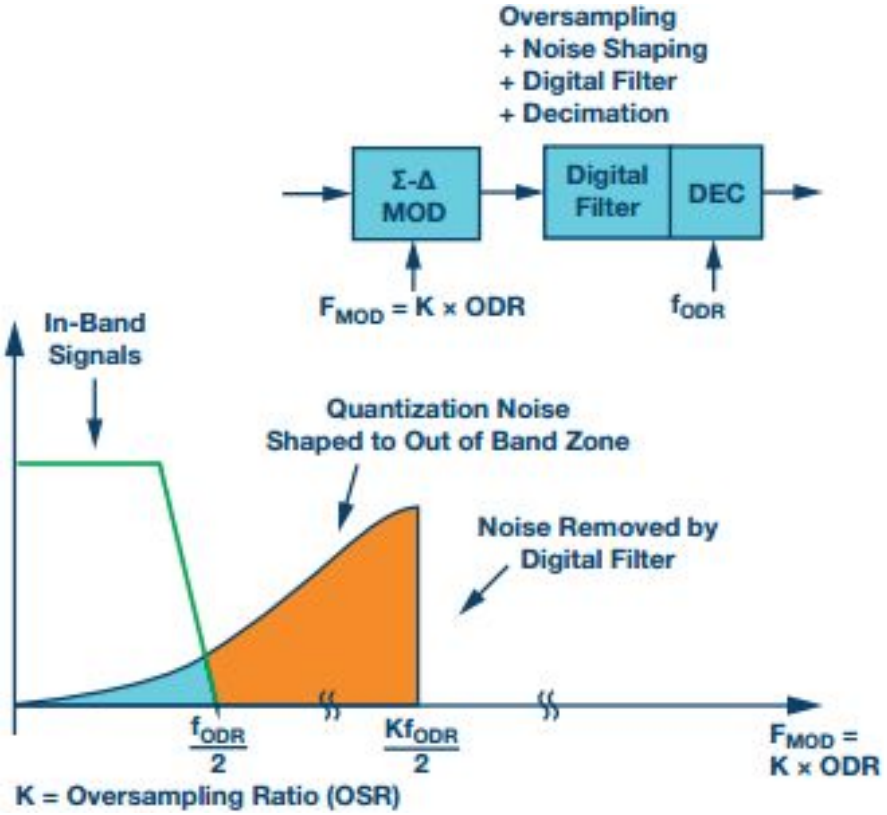
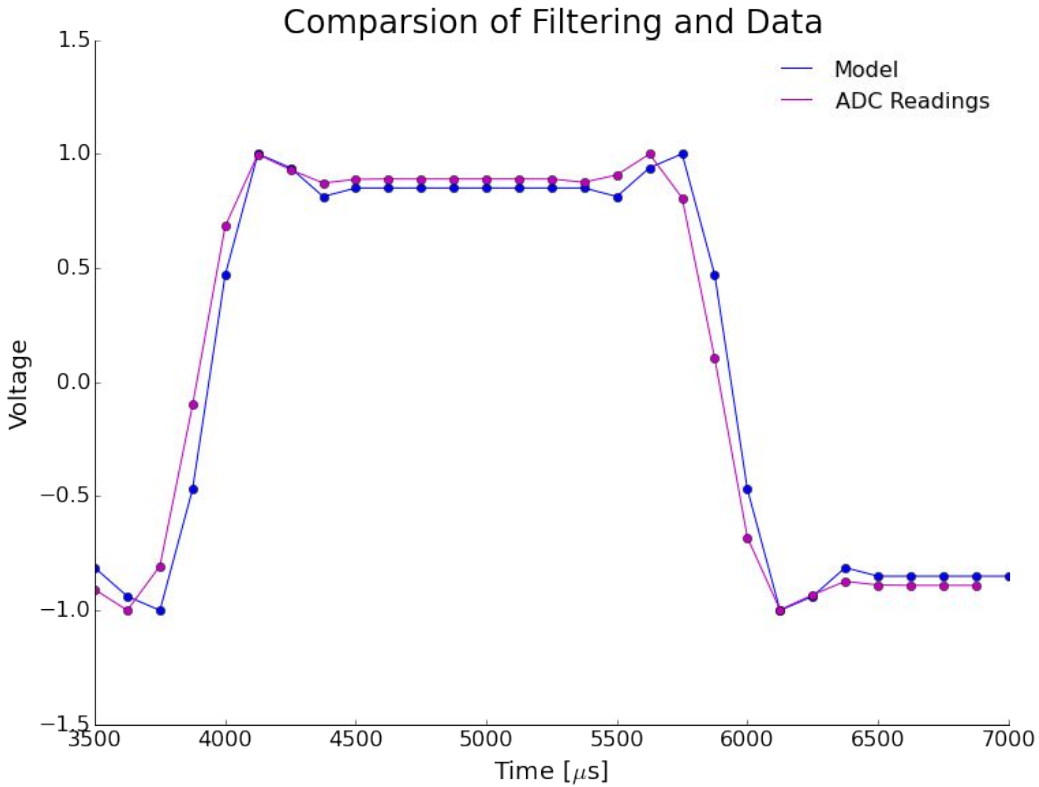


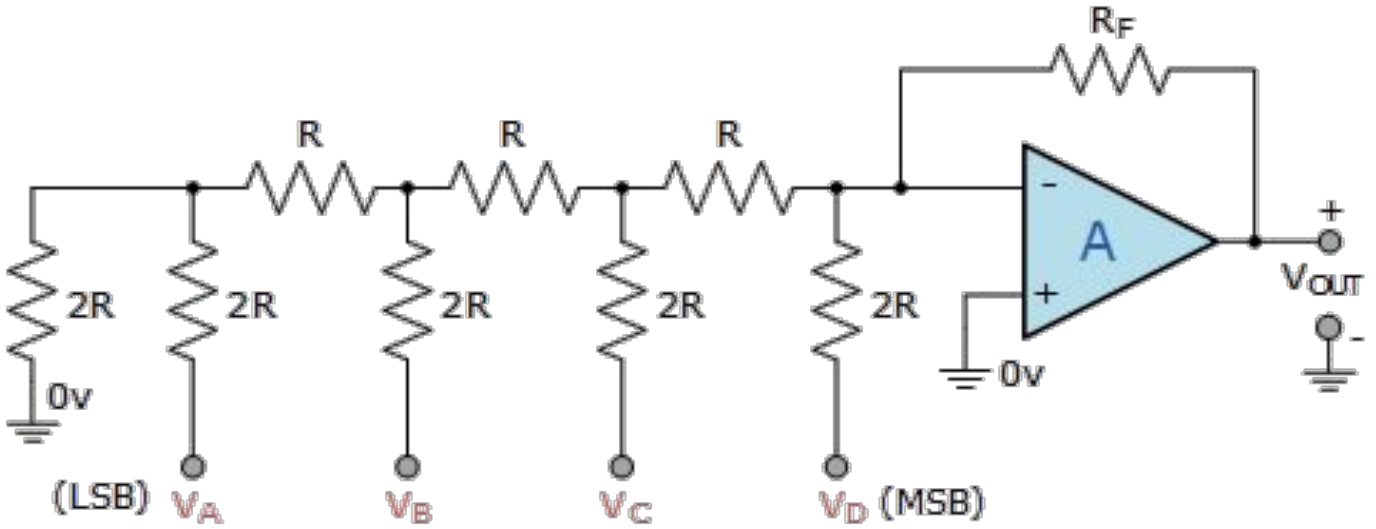
Image: Analog Devices

Be careful of filters in the ADC introducing artifacts though!



LEEMAN GEOPHYSICAL LLC
CONSULTING & INSTRUMENTATION

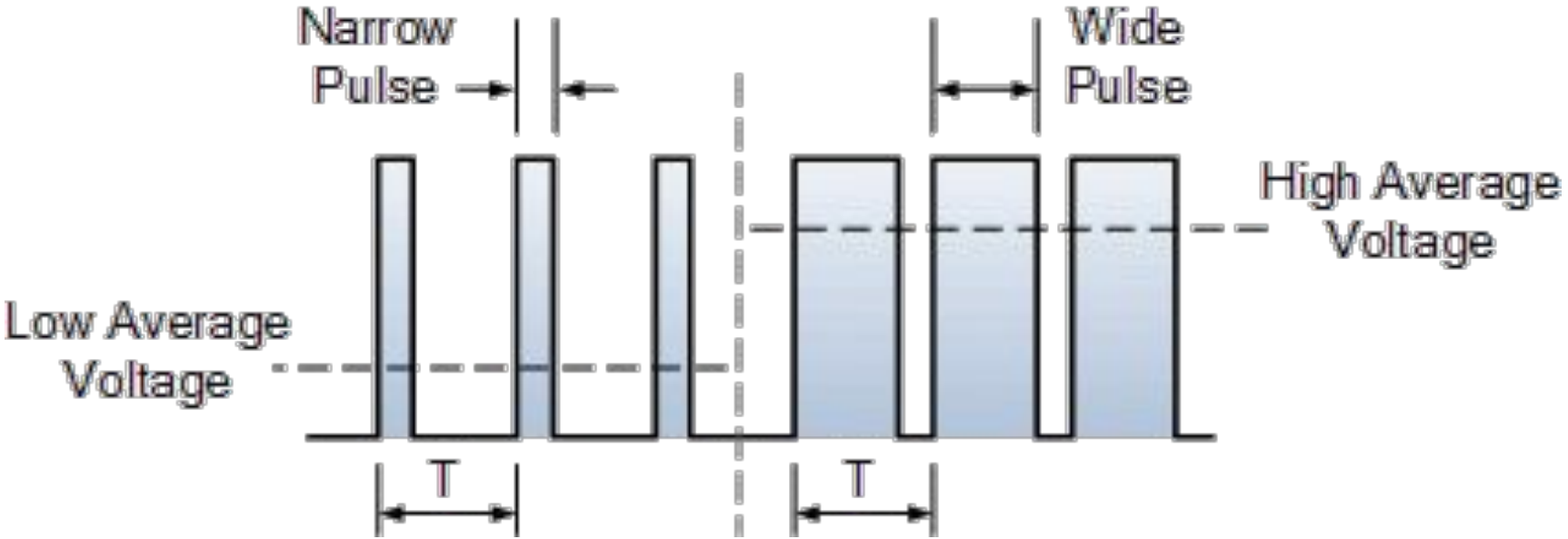
DACs go the other way, creating a voltage for a digital input value



LEEMAN GEOPHYSICAL LLC
CONSULTING & INSTRUMENTATION

Image: Electronics Tutorials

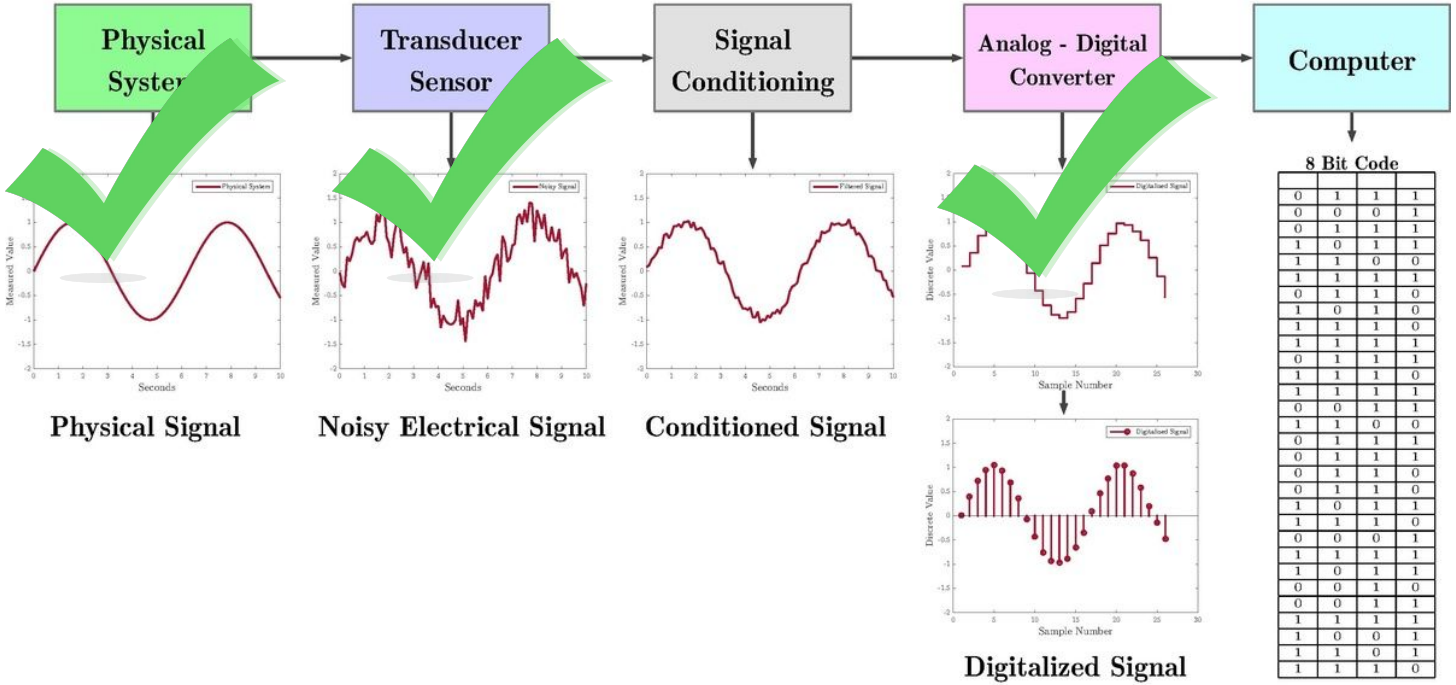
Pulse width modulation



LEEMAN GEOPHYSICAL LLC
CONSULTING & INSTRUMENTATION

Image: Electronics Tutorials

Digital Data Acquisition System

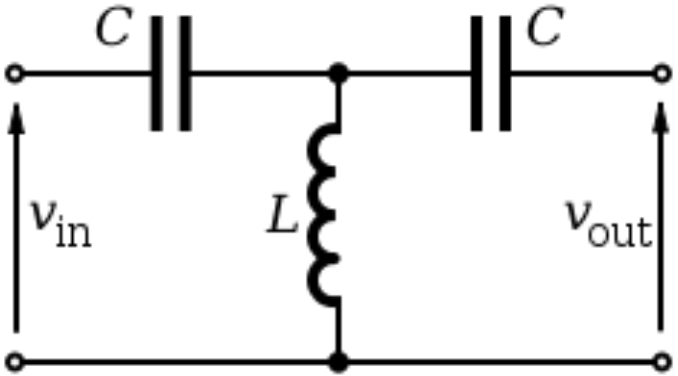


LEEMANGEOPHYSICAL LLC
CONSULTING & INSTRUMENTATION

Image: WikiPedia

Signal conditioning is amplification and filtering of the signal to get the best SNR possible

Analog Filters



Digital Filters

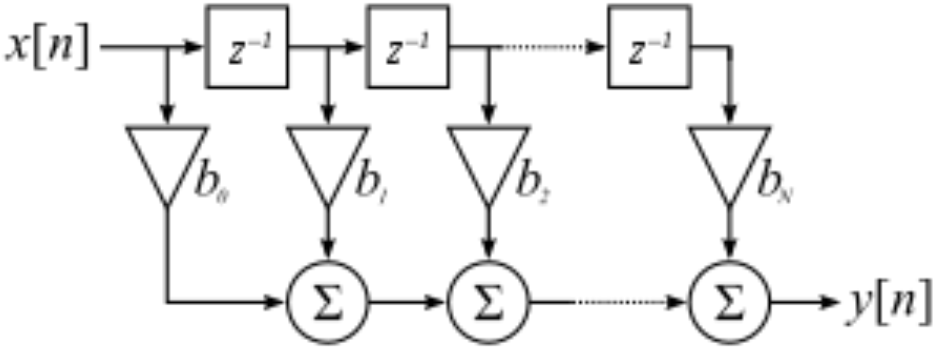
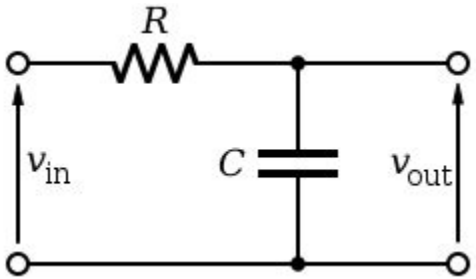


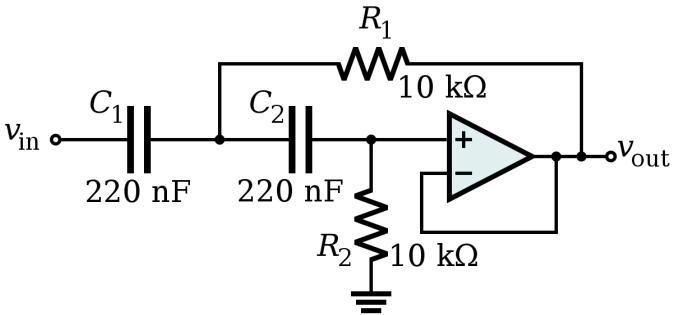
Image: WikiPedia

You'll explore analog filters in the labs, but we classify them into two main categories with a third "fake" category

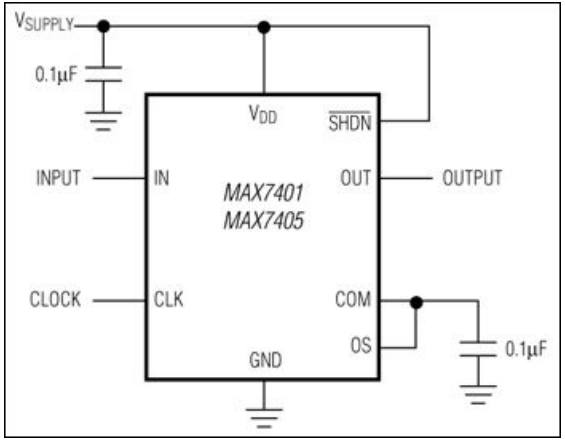
Passive



Active



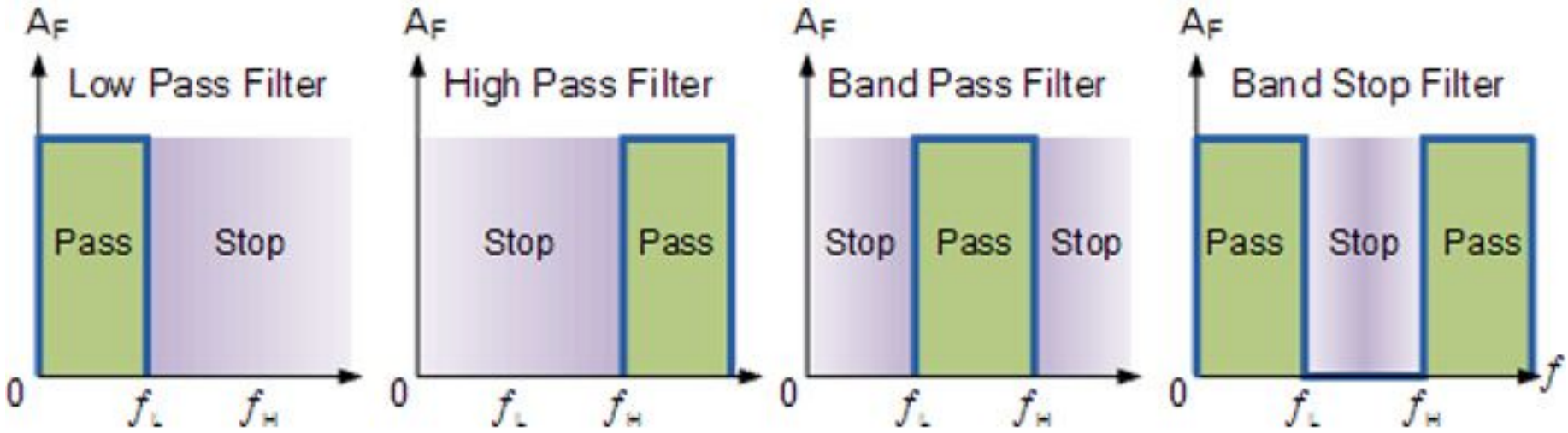
ASIC



LEEMAN GEOPHYSICAL CONSULTING & INSTRUMENTATION LLC

Image: WikiPedia, Maxim Integrated

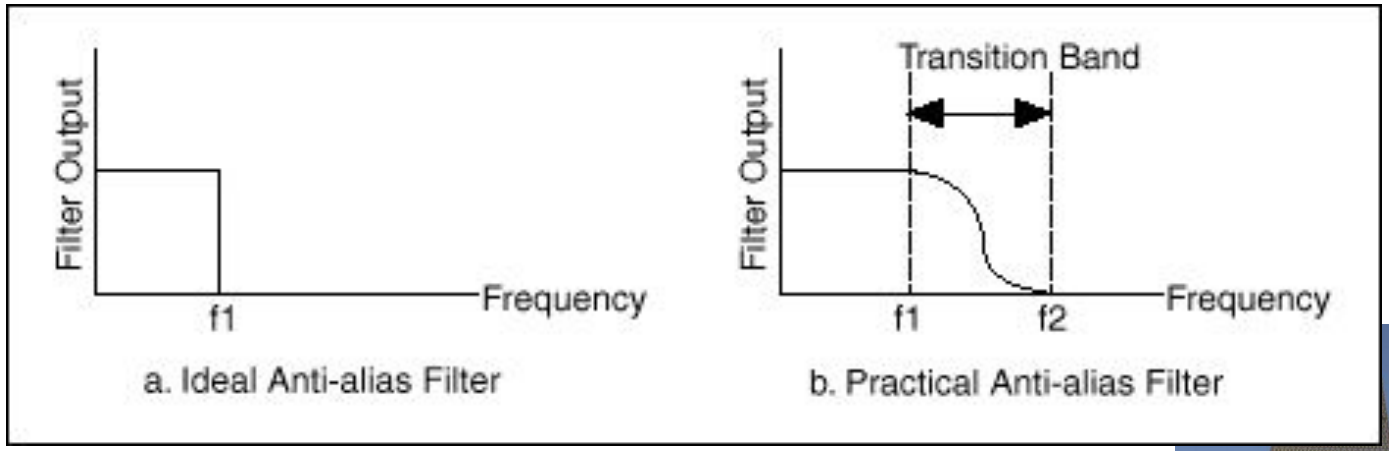
It is helpful to remember the basic types of filters that we generally employ though



LEEMAN GEOPHYSICAL LLC
CONSULTING & INSTRUMENTATION

Image: Electronics Tutorials

The most common filter you'll apply is the anti-aliasing filter



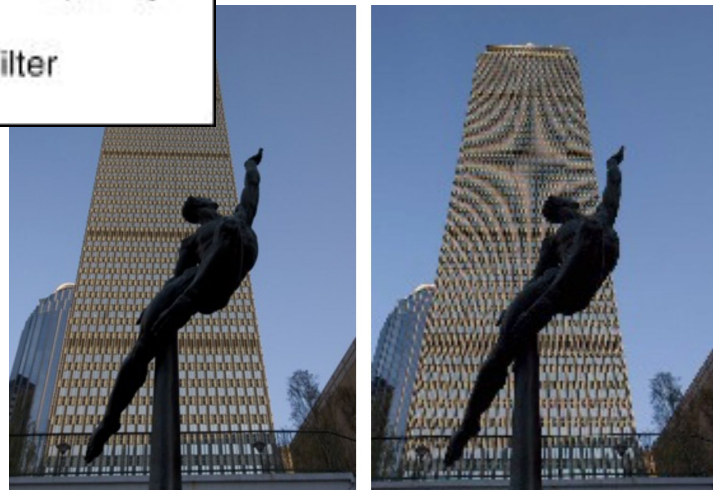


Image: National Instruments, mrpc

LEEMAN GEOPHYSICAL LLC
CONSULTING & INSTRUMENTATION