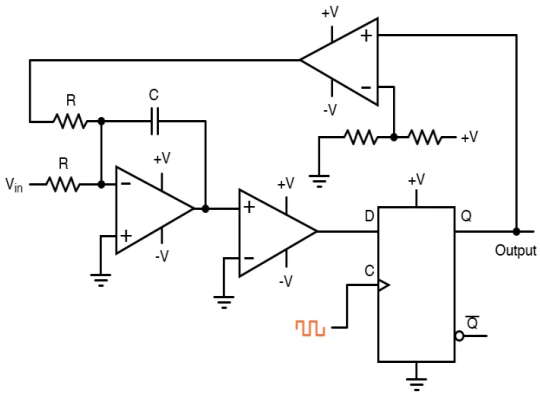
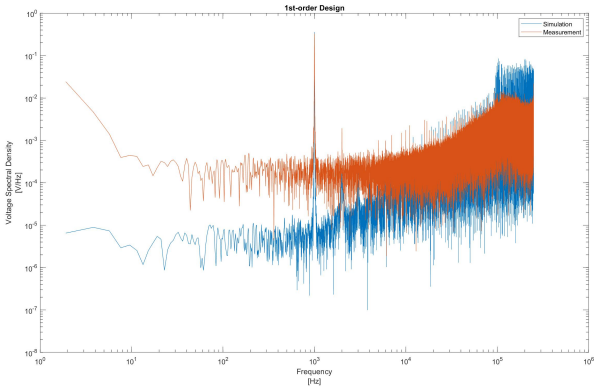
# Analogue Circuits with Microcontrollers

Microcontrollers (uC) nowadays often include analogue components to minimise additional parts required on circuit boards. As these components are simply a 'nice-to-have', they lack proper documentation and their characteristics are of low quality.




Basic circuit for a ΣΔ-ADC




The spectra of simulation and real-life measurement

## The Goal

The components inside these microcontrollers had to be used in a mixed-signal circuit to determine their capabilities, namely in a ΣΔ-analogue-to-digital-converter (ΣΔ-ADC) application. The digital data received by the ADC was then sent to the PC, where several calculations in code could be conducted to extract information from the data received.

## The Procedure

To build a ΣΔ-ADC, it first needs to be dimensioned. This is done with a Matlab-tool that provides certain characteristics that can be approached by choosing the corresponding resistors and capacitors. After that, the circuit is simulated and built on a breadboard to test it in real-life.

## Results

While the circuit that was built worked, it was not of a very high quality. The components' bad characteristics negatively impacted the circuit in such a way that it was clearly disadvantaged compared to the simulation. However, while not optimal compared to industry standards, it can be said that these components can be used in hobby applications and still provide a satisfying performance.

## ΣΔ-ADC

The ΣΔ-ADC is a 1-bit ADC. It works by comparing the input voltage to a certain fixed voltage (normally 0 V) and providing the user with a 1 or a 0 depending on whether the voltage difference is negative or positive. This happens multiple million times in one second. The 1 s and 0 s in the picture were recorded in 0.6 ms:

*1kHz_long.txt - Editor

Datei Bearbeiten Format Ansicht Hilfe

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=========== PuTTY log 2023.07.28 17:13:43 ===========
1101110111101101111011011110111

1101110101110110111011011101101

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0010010001100011000110001101001

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