**Microprocessor Systems Design**

**EEE42101**

**Experiment 4: Analog Digital Conversion ADC**

# Objectives:

* Get experience with analog digital conversion peripheral.
* Apply analog processing in thermistors.
* Measure temperature.

# Tools:

1. PC
2. Arduino Nano board
3. Testing board
4. MiniB-USB cable

# Components:

1. NTC thermistor
2. 10kΩ resistor.

Note: all material and sources of this course will be available on:

<https://github.com/ashrafmalraheem/Microprocessor_Course>

Feel free to download, study and modify for your own projects.

# Analog to digital converter:

Introduction:

In the previous experiments, we have been dealing with digital signals. However, real world applications don’t have digital signals only. Physical systems can generate values that have infinite value range. Therefore, it is necessary for a microcontroller or any embedded system to be able to convert physical values into digital form. That job is performed by analog to digital conversion module.

The ADC reads analog values in range of 0 – Vcc. Any signal out of this range will cause the ADC to malfunction. The converted values in between (0)b – (2n-1)b where n is the number of digits.

## Analog to digital conversion:

In order to perform analog to digital conversion, there are three steps:

1. Sampling (sample and hold): take a sample of the analog input signal, because it is continuously varying.
2. Quantization: Convert the sampled signal into digital representation. Usually this is done by comparator, counter and a DAC which compare the result of DAC to the input sample.

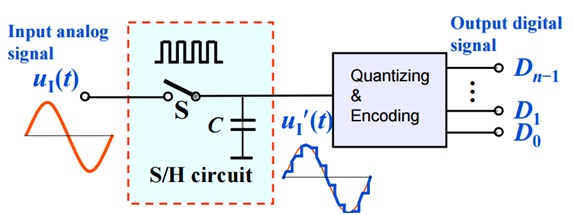


Figure ADC steps: sampling and quantization[[1]](#footnote-1)

1. Conversion result: convert the quantized value into its analog value. The ADC will return a value between 0b – (2n-1)b. To obtain the actual reading it needs to be converted to corresponding voltage:

# Experiment 1: Configure the ADC

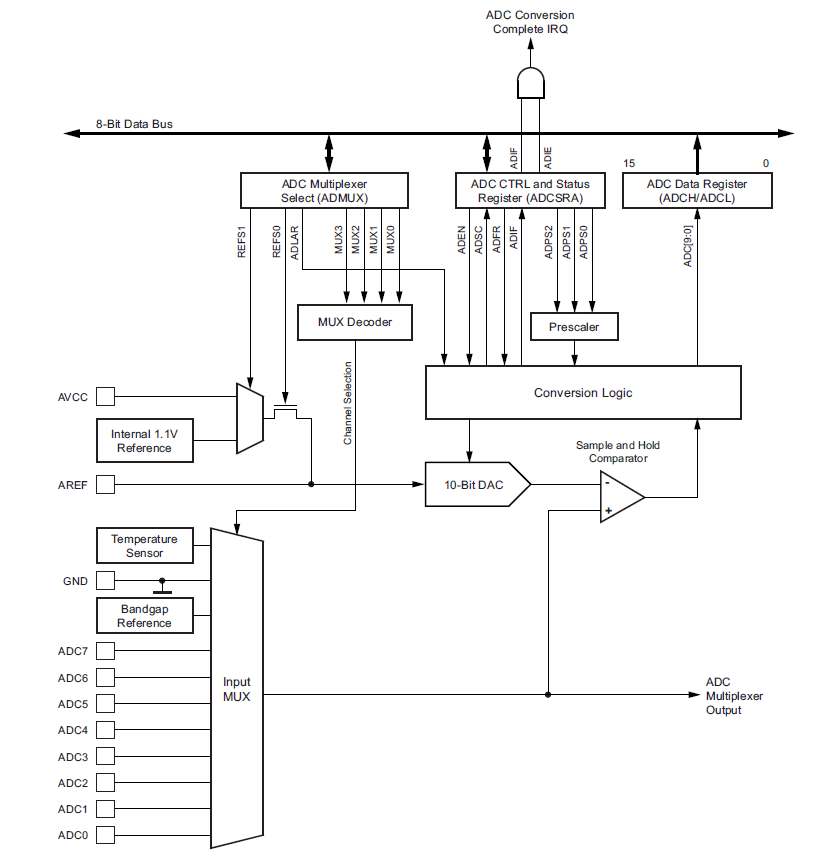


Figure ADC block diagram ATmega328P[[2]](#endnote-1)

1. <https://microcontrollerslab.com/analog-to-digital-adc-converter-working/> [↑](#footnote-ref-1)
2. ATmega328P data sheet [↑](#endnote-ref-1)