



# Chapter 4

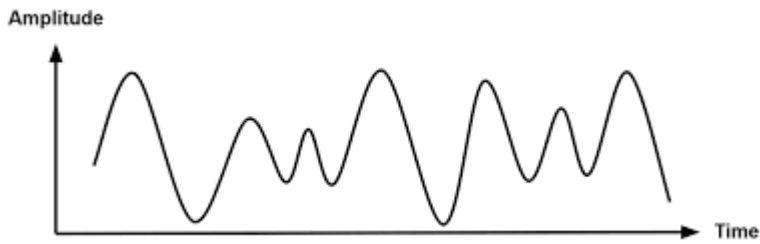
## DIGITAL SIGNALS

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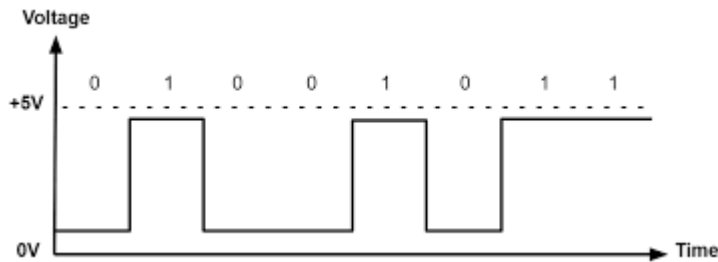
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## Digital Signals

An analogue signal is a signal that changes in amplitude over time when impacted by an external data.



A digital signal represents data as discrete values.



## Conversion

### A to D and D to A

A method to convert analogue signals to digital and reconvert them back to analogue is needed.

The analogue to digital conversion is referred to as the **ADC**.

The digital to analogue conversion is referred to as **DAC**.

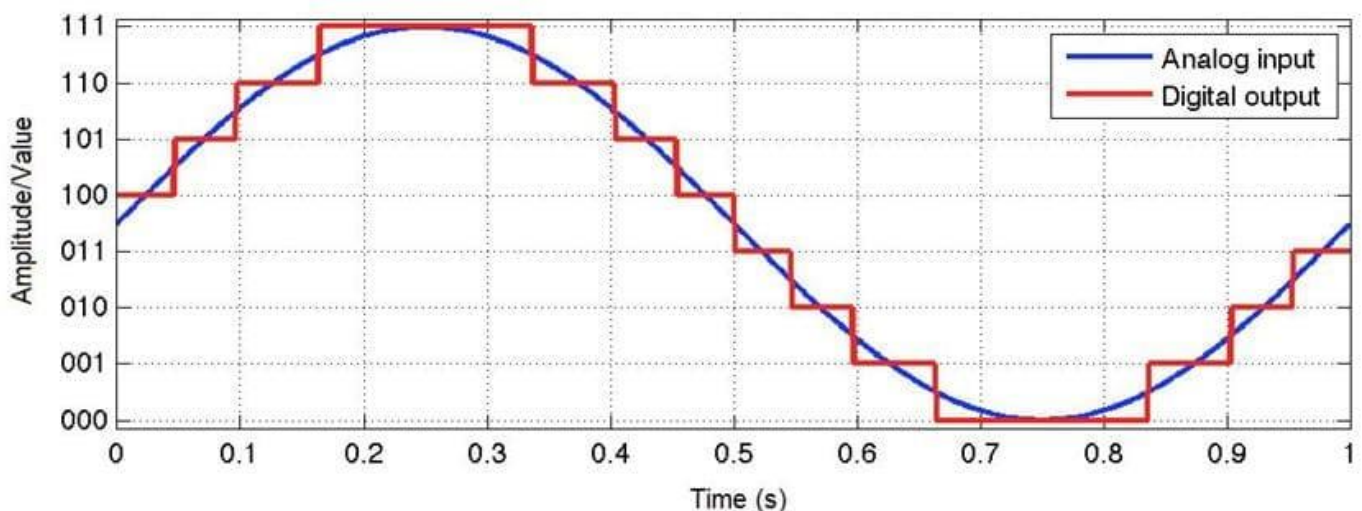
A **CODEC** (coder/decoder) performs both ADC and DAC functions in one.

## Sampling

### A to D Conversion

The analogue signal is sampled at given periods. The sampling rate or sampling frequency.

Each sample given a digital value.



(Source: Waqas Akram – Quantization in ADCs)

## Nyquist Theorem

The sampling rate of an analogue signal, for conversion to digital, should be at least twice the highest frequency of the analogue signal. This is called the Nyquist Theorem.

**Example:** The highest frequency for conversion was 20 kHz, what is the sampling rate?

$$2 \times 20\text{k} = 40 \text{ kHz}$$

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## Duty Cycle

Duty cycle, or duty factor, is the ratio of time ON compared to the time OFF. Expressed as a percentage of ON time.

**Example** A 60% duty cycle means the signal is on for 60% and off for 40 %.

### 50% duty cycle



### 75% duty cycle



### 25% duty cycle



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*Have fun and stay safe.*