Introduction to Digital Design

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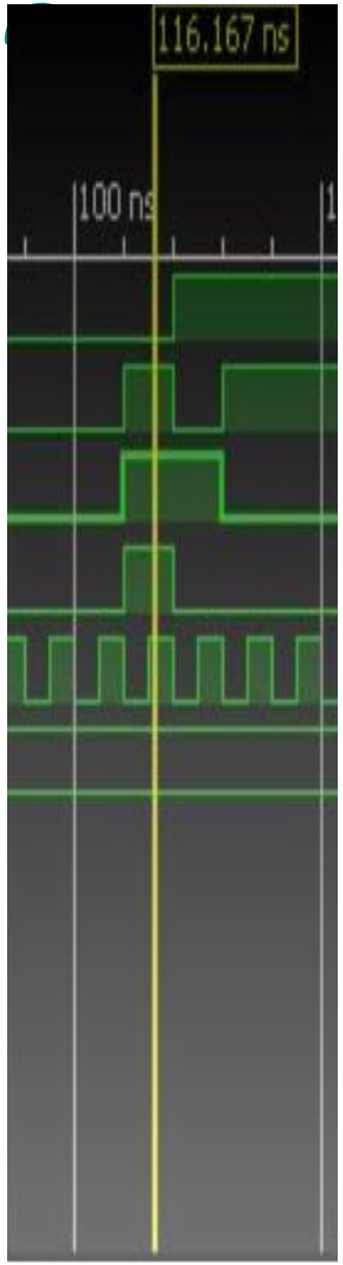
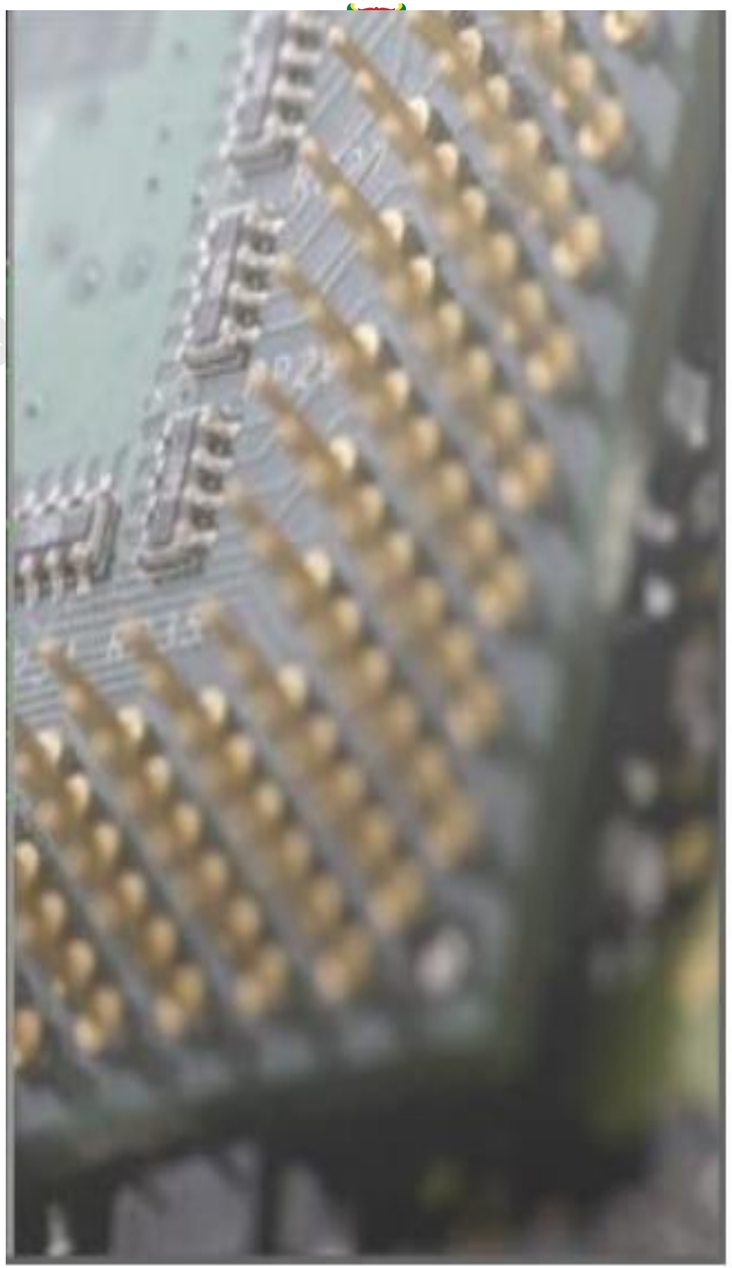
Agenda

- Managing complexity
- Digital and analog signals
- Waveforms
- Data transmission



Managing complexity



Managing complexity

A characteristic that distinguishes engineers is their ability to address complex issues in a systematic manner.

Modern digital systems are built from millions of transistors. No one could understand such a complex system just by knowing the way in which the transistors are connected, let alone model the way in which electrons move through the circuit.

One way to understand complex systems is through **abstraction** and the management of **disciplines.**

Abstraction level (for computers)

Abstraction levels	Examples
Application software	Programs
Operating Systems	Device drivers
Architecture	Instructions
Micro architecture	Datapath
Logic	Adders
Digital Circuits	Logic gates
Analog circuits	Amplifiers
Devices	Transistors, Diodes
Physics	Electrons

Abstraction level (for computers)

This course

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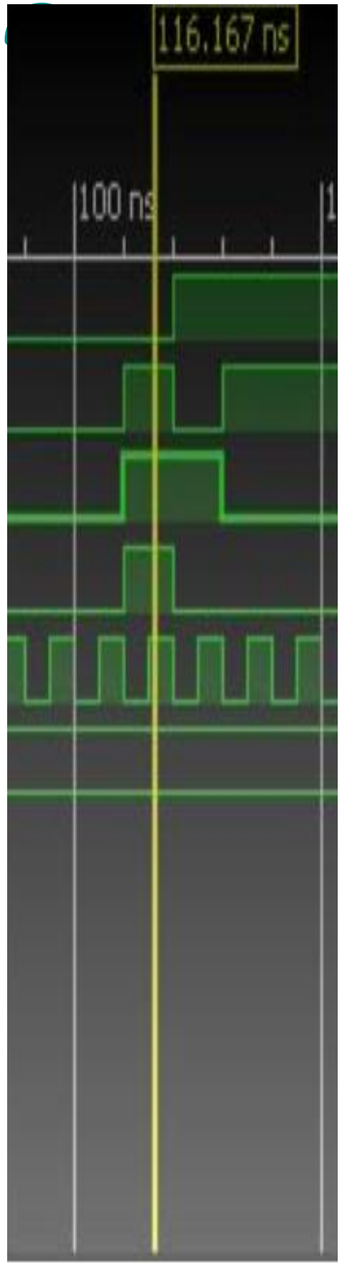
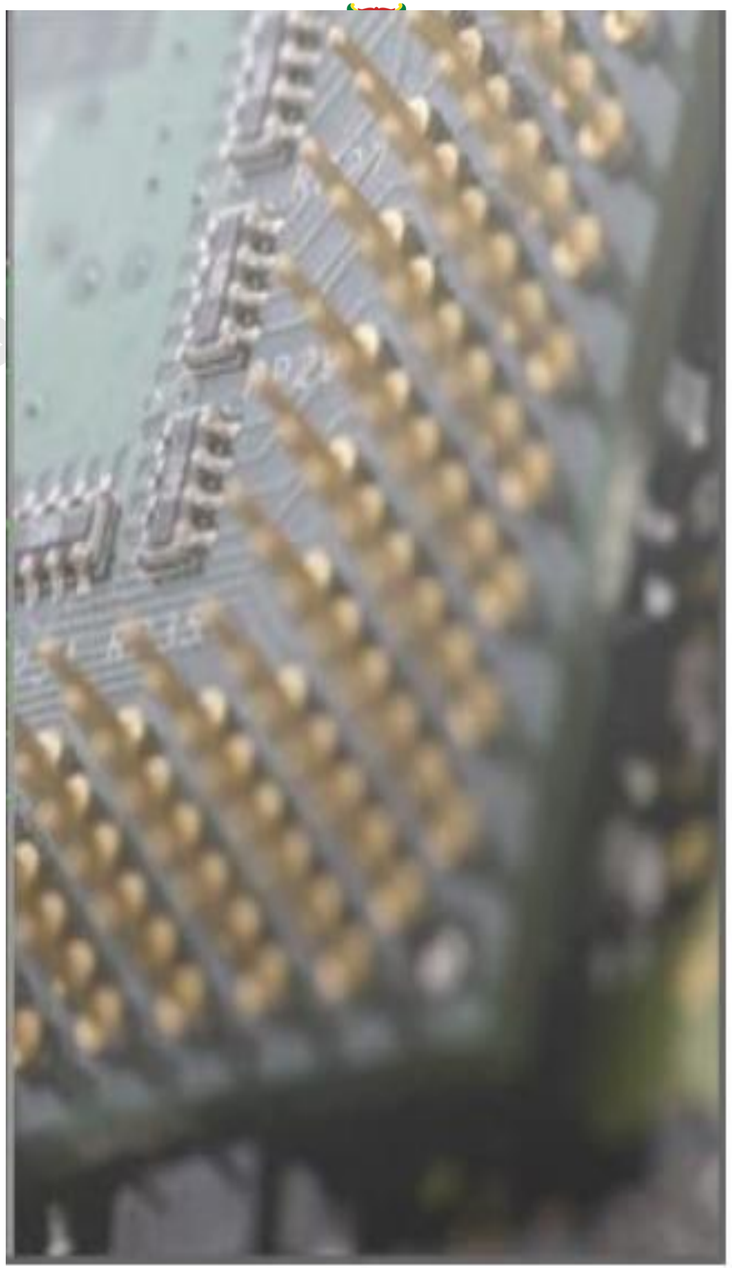
Discipline

Discipline is the act of intentionally restrict your design choices so the you can work more productively at a higher level of abstraction.

For example: Digital discipline only work with discrete values instead of continuous voltages as analog electronic.



Digital and analog signals



Digital an analog quantities

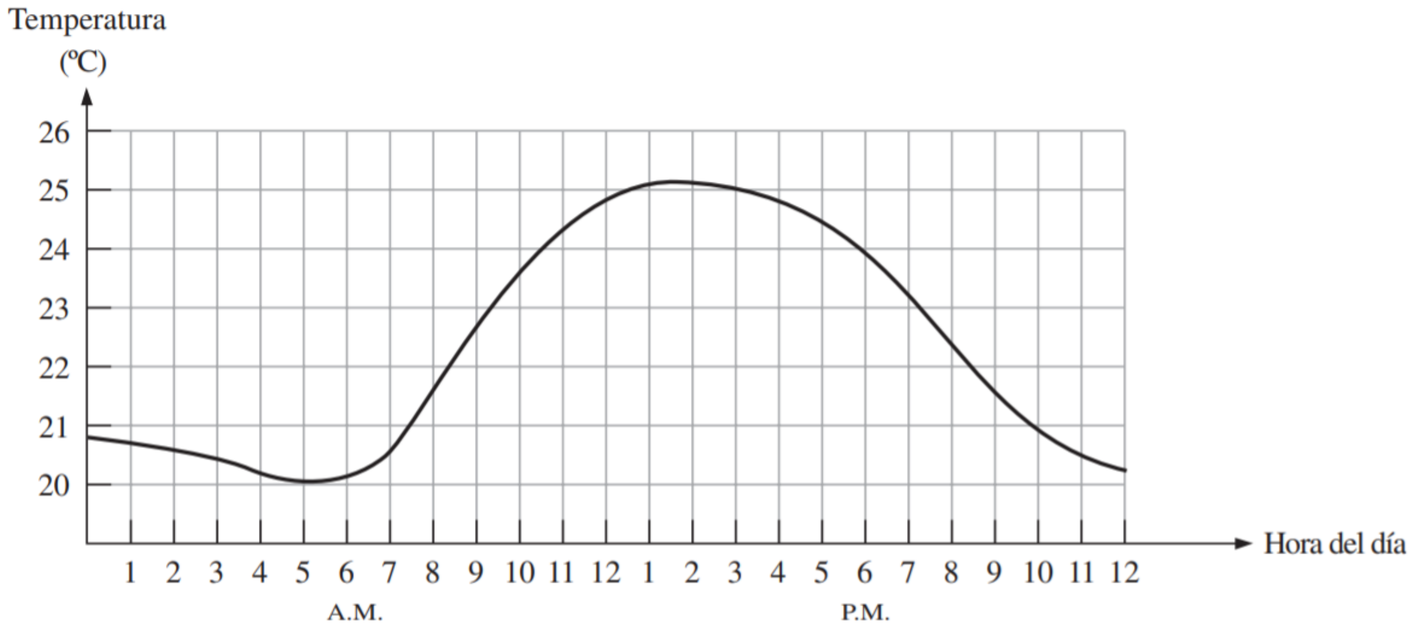
Electronic circuits can be divided in two categories, digital and analog.

Analog electronics involves quantities with continuous values.

Digital electronics involves quantities with discrete values.

Analog quantities

For example, the air temperature changes over a continuous range of values. During a given day, the temperature does not go from, say, 20°C to 25°C instantaneously; it takes on all the infinite values in between.

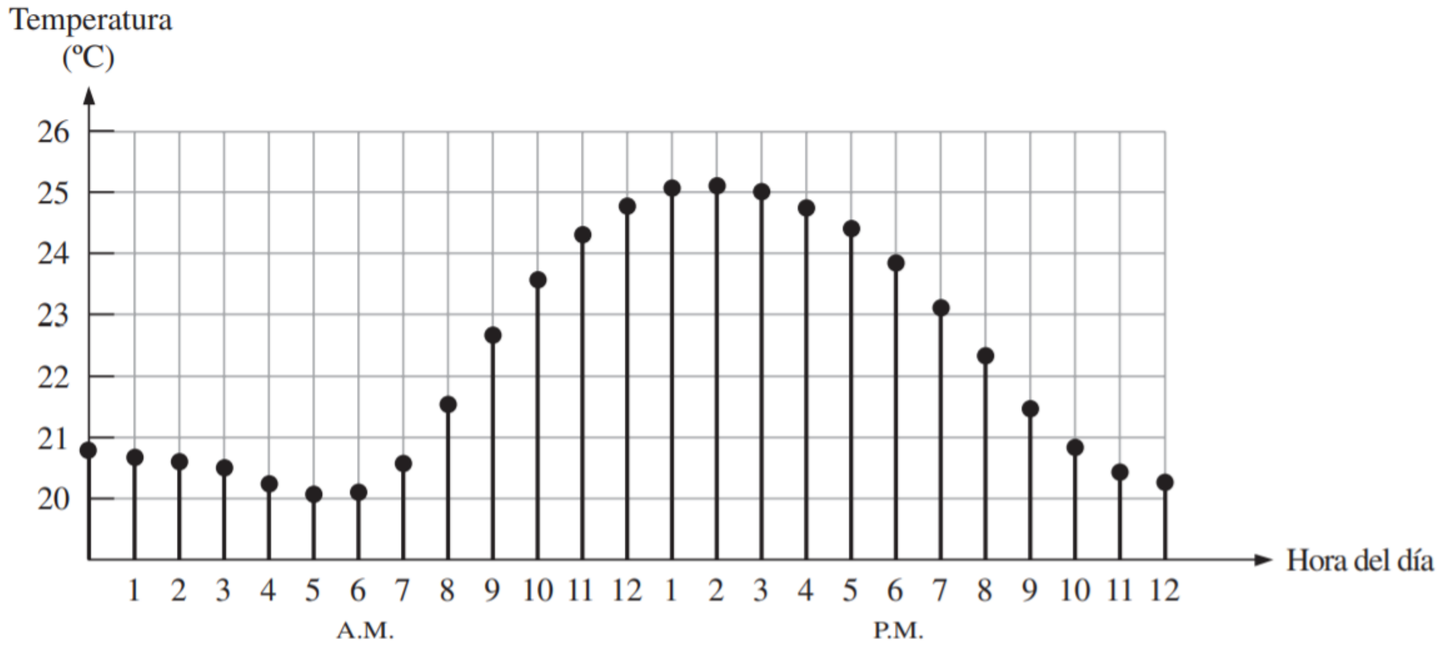


Digital quantities

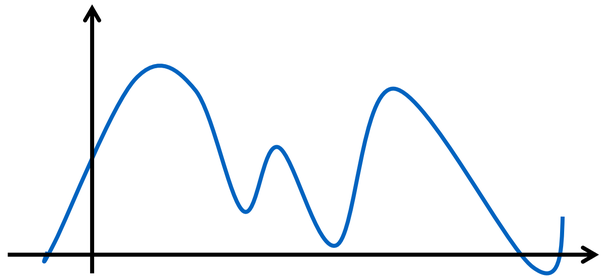
Rather than graphing the temperature on a continuous basis, suppose you just take a temperature reading every hour. Digital quantities are stored in binary format using 0's and 1's.

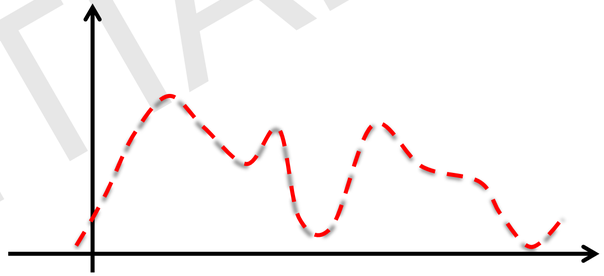
Benefits of digital quantities

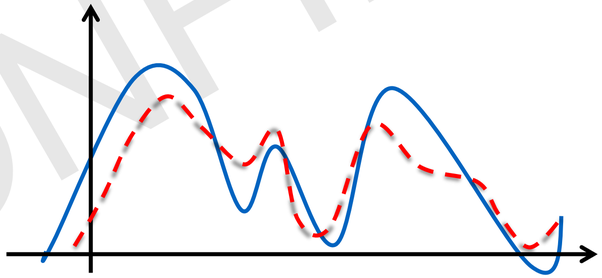
- Can be stored more efficiently
- Can be processed
- Can be transmitted more reliably



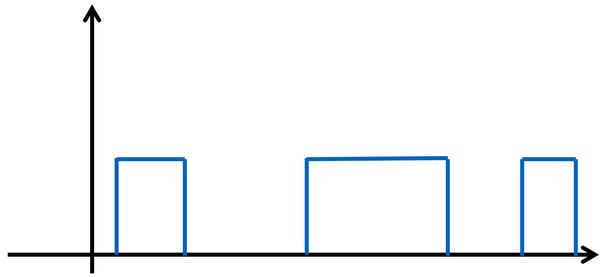
Transmission of signals

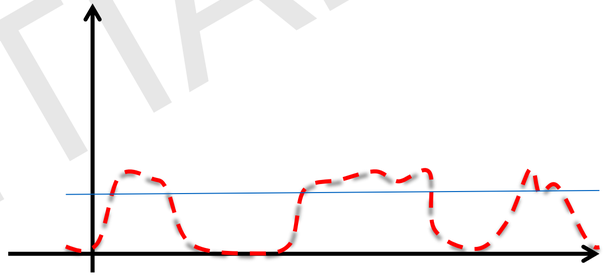




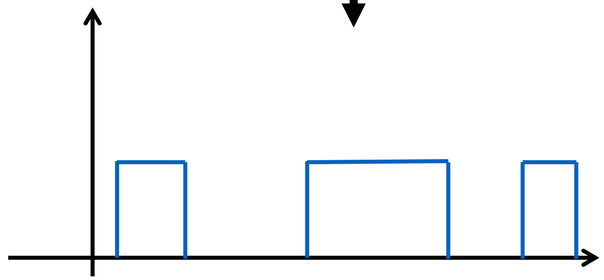


Transmission of signals

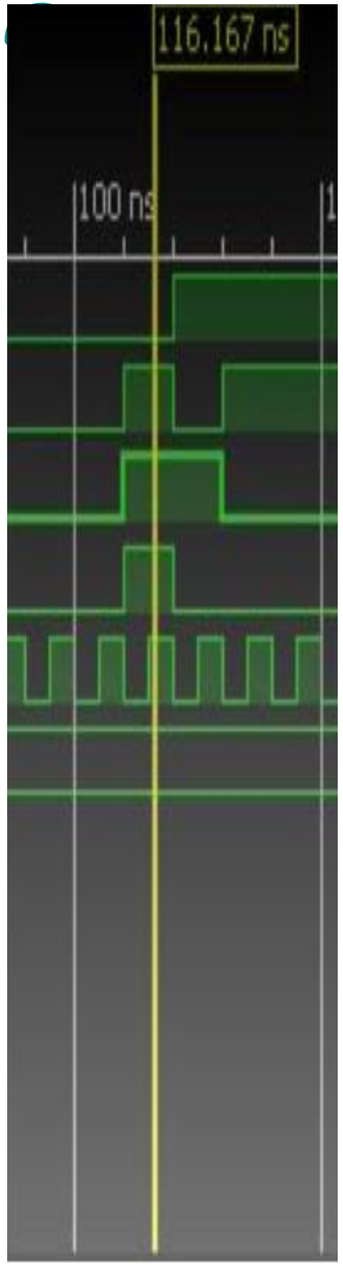




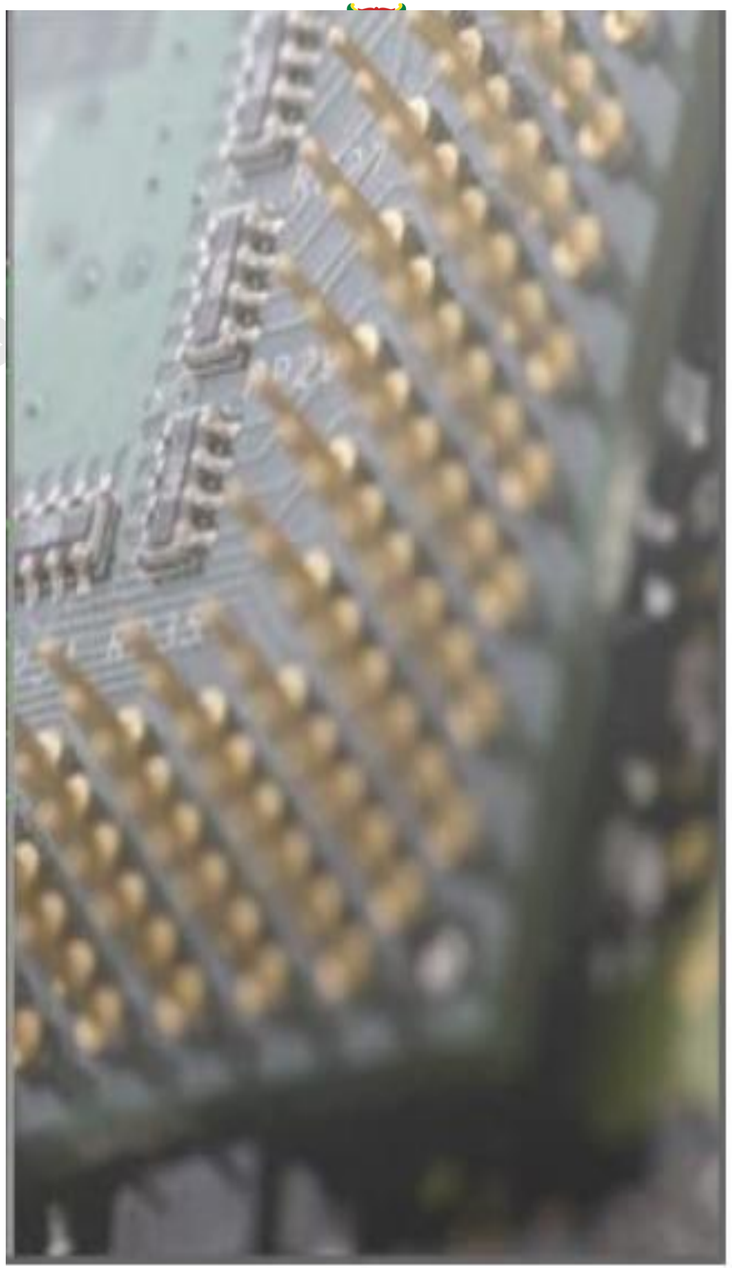
Restored



Transmition is more reliable!!

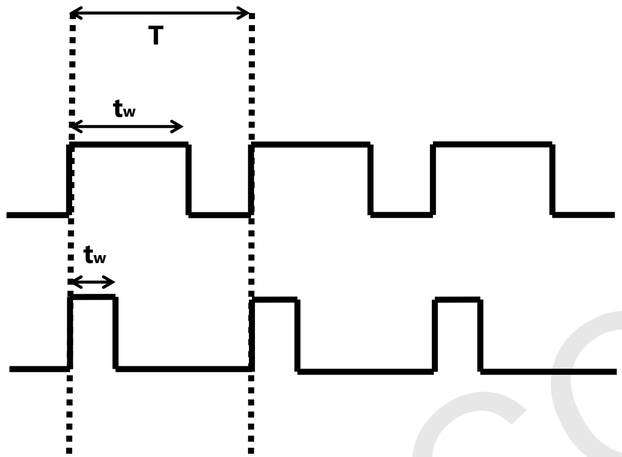


Waveforms



Waveforms

Most of the waveforms that can be found in digital systems are composed of series of pulses, sometimes also called pulse trains, and can be classified into periodic and non-periodic.



Periodic waveform

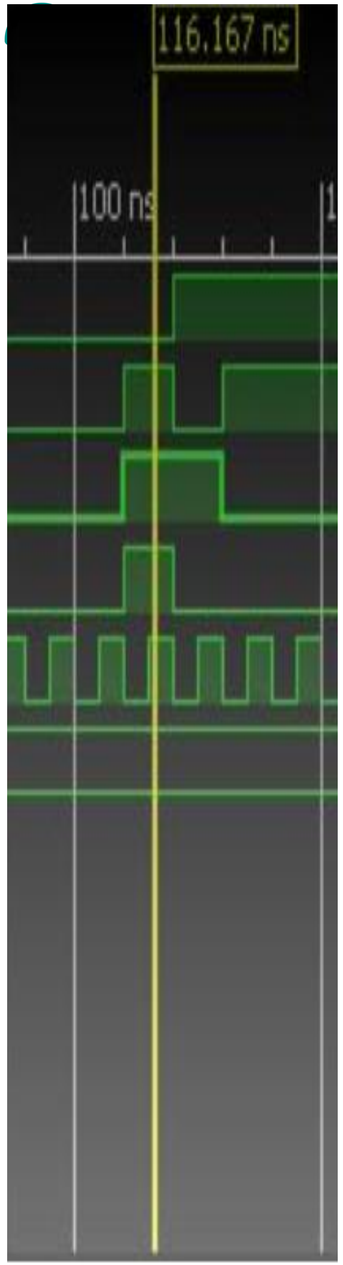
Non periodic waveform

t_w=Pulse width

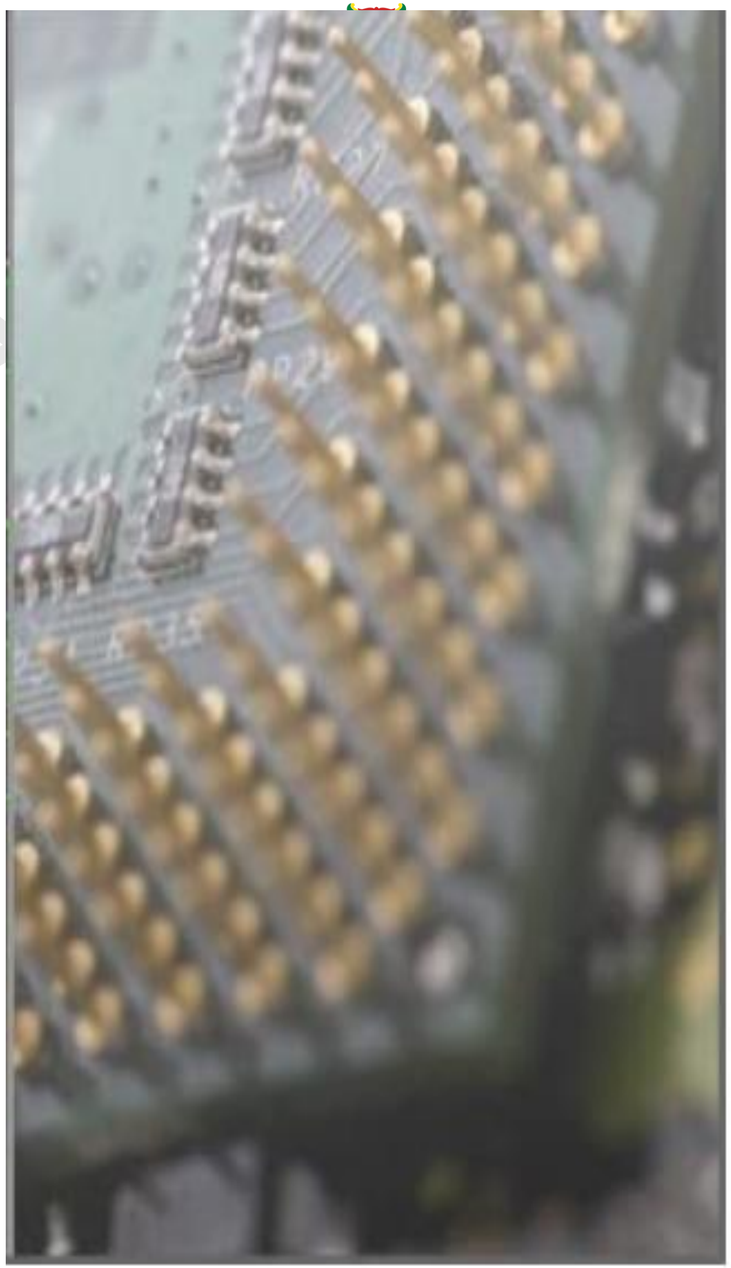
T = period

$f = 1/T$

100%(t_w/**T**) = Duty cycle



Data transmission

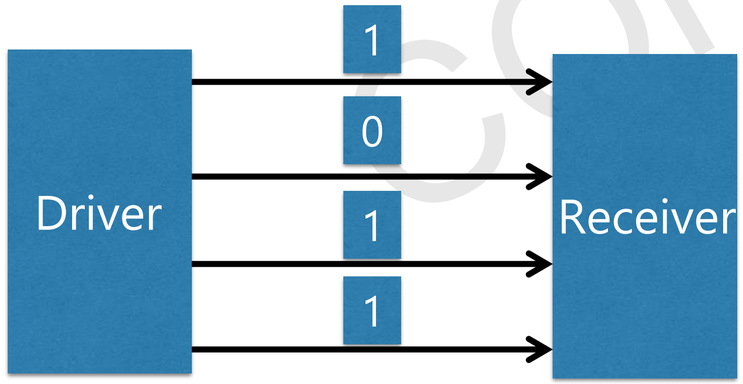


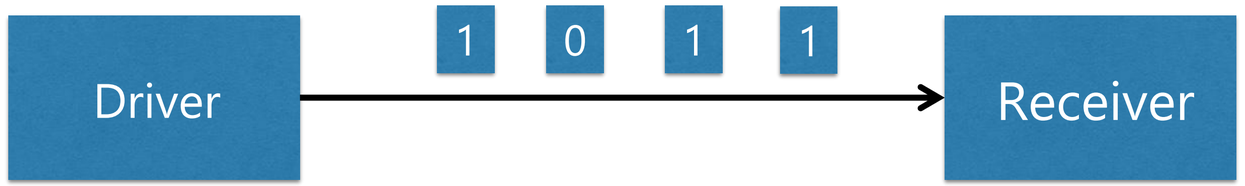
Data transmission

Data can be transmitted from one system to another through two ways, serial and parallel.

Serial transmission is sent through a single wire, this method need **n** clock cycles to transmit a **n** bits data.

Parallel transmission is sent through a multiple wire, this method need transmit **n** bits (where n is the number wires in the interface) in a single clock cycle.





Data transmission