PGT104 – Digital Electronics

Course Outcomes

- **CO1**: Ability to DESCRIBE numbering systems and boolean algebra
- **CO2**: Ability to ANALYZE Boolean expressions and logic circuits for a simple digital system
- **CO3**: Ability to DESIGN combinational or sequential logic circuits for a simple digital system

Course Assessment

	Examinations		Course Work		
Total Contribution	60%		40%		
Assessment	Mid-Term	Finals	Assignments	Lab Assessments	Lab Project
Contribution	10%	50%	10%	20%	10%

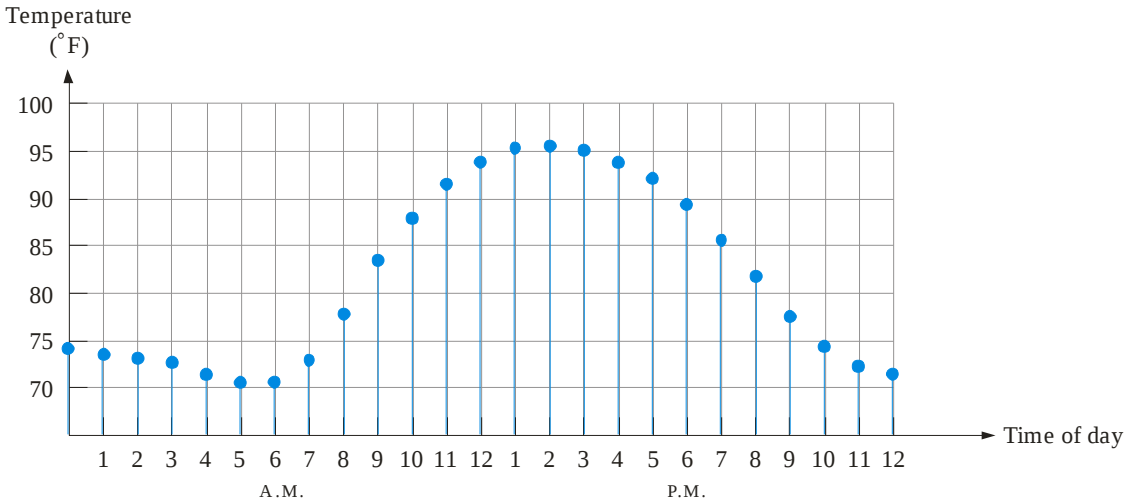
Course Reference

- Textbook: Digital Fundamentals 11th Edition
  - Thomas J. Floyd (Global Edition)
  - http://www.pearsonglobaleditions.com/Sitemap/Floyd/
- Official Course Site:
  - http://azman.unimap.edu.my/dokuwiki/doku.php?id=pgt104
- Supplementary: Any book / online resource on digital electronics or digital logic
- Disclaimer:
  - The following contents are extracted from resources available for Digital Fundamentals 10th Edition

The REAL World

Analog Quantities

Most natural quantities that we see are **analog** and vary continuously. Analog systems can generally handle higher power than digital systems.

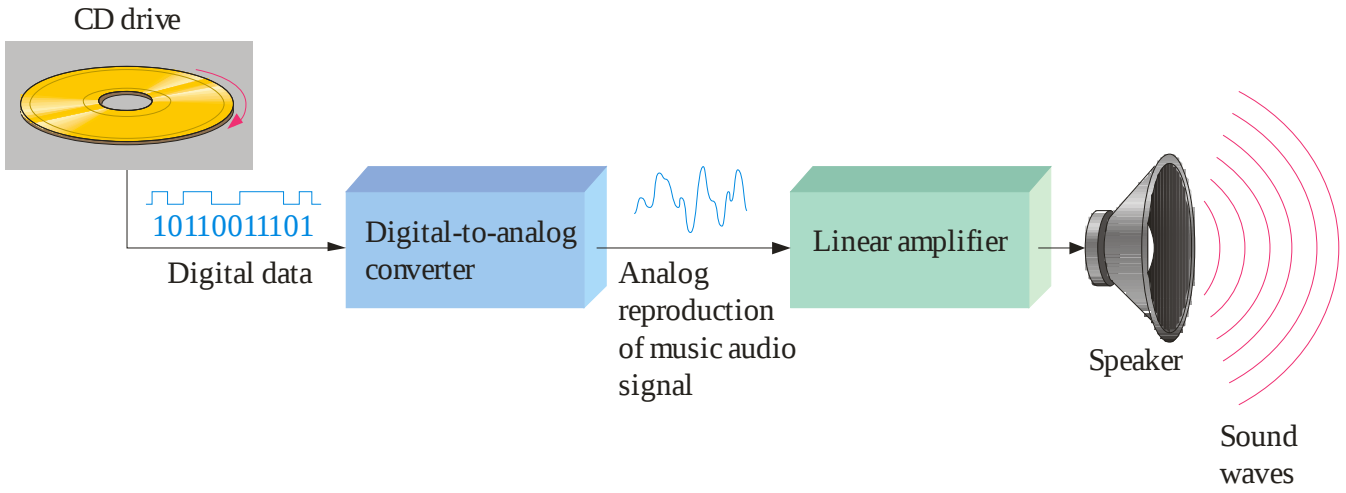


Digital systems can process, store, and transmit data more efficiently but can only assign discrete values to each point.

The Digital World

Analog and Digital Systems

Many systems use a mix of analog and digital electronics to take advantage of each technology. A typical CD player accepts digital data from the CD drive and converts it to an analog signal for amplification.

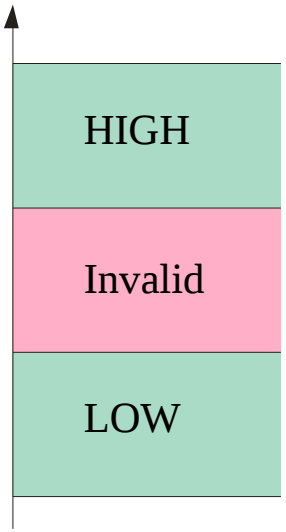


Digital Logic... Electronics?

Binary Digits and Logic Levels

Digital electronics uses circuits that have two states, which are represented by two different voltage levels called HIGH and LOW. The voltages represent numbers in the binary system.

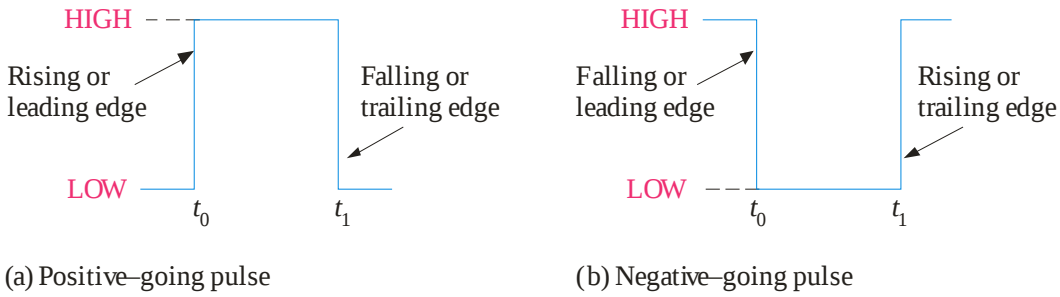
In binary, a single number is called a *bit* (for *b*inary dig*it*). A bit can have the value of either a 0 or a 1, depending on if the voltage is HIGH or LOW.



(Voltage) Waveforms

Digital Waveforms

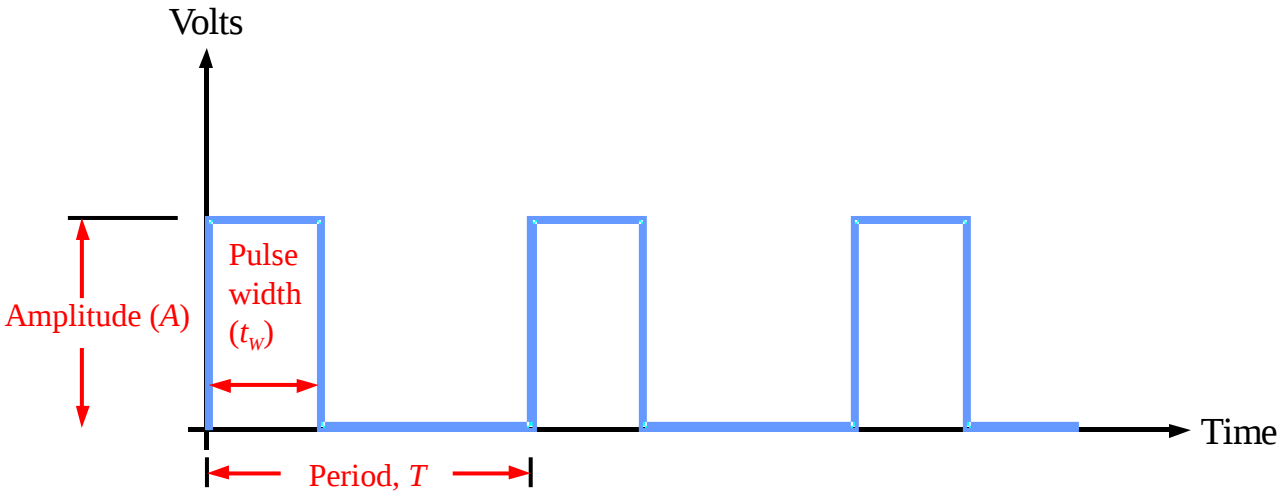
Digital waveforms change between the LOW and HIGH levels. A positive going pulse is one that goes from a normally LOW logic level to a HIGH level and then back again. Digital waveforms are made up of a series of pulses.



Square Waves

Pulse Definitions

In addition to frequency and period, repetitive pulse waveforms are described by the amplitude (A), pulse width (t_W) and duty cycle. Duty cycle is the ratio of t_W to T.



Periodic Signal (Clock!)

Periodic Pulse Waveforms

Periodic pulse waveforms are composed of pulses that repeats in a fixed interval called the **period**. The **frequency** is the rate it repeats and is measured in hertz.

$$f = \frac{1}{T} \qquad T = \frac{1}{f}$$

The **clock** is a basic timing signal that is an example of a periodic wave.

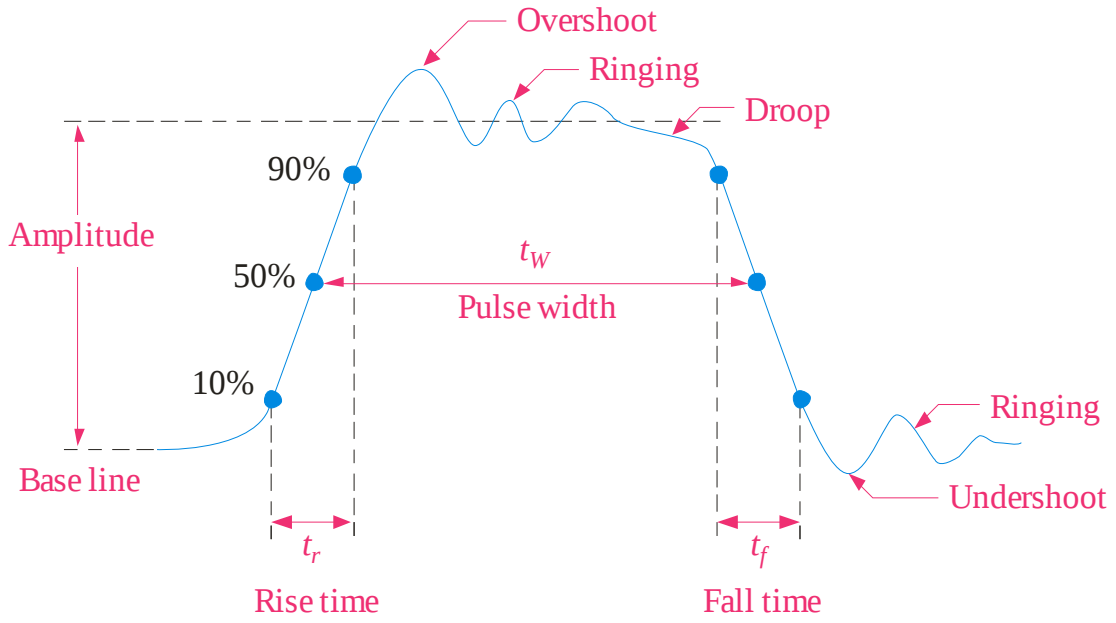
What is the period of a repetitive wave if f = 3.2 GHz?

$$T = \frac{1}{f} = \frac{1}{3.2\,\text{GHz}} = 313\ \text{ps}$$

Signal Characteristics

Pulse Definitions

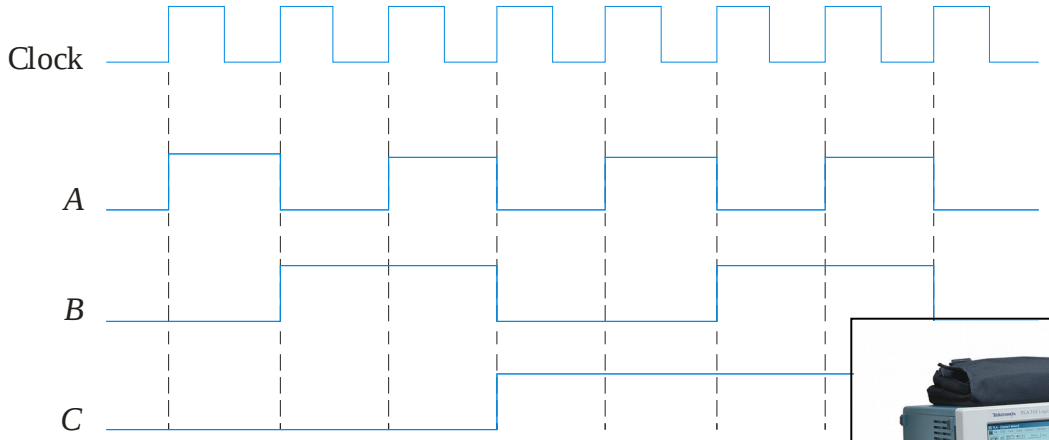
Actual pulses are not ideal but are described by the rise time, fall time, amplitude, and other characteristics.



Timing is everything!

Timing Diagrams

A timing diagram is used to show the relationship between two or more digital waveforms,



A diagram like this can be observed directly on a logic analyzer.

Quiz

Compared to analog systems, digital systems

a. are less prone to noise

b. can represent an infinite number of values

c. can handle much higher power

d. all of the above

Quiz

The number of values that can be assigned to a bit are

a. one

b. two

c. three

d. ten

Quiz

The time measurement between the 50% point on the leading edge of a pulse to the 50% point on the trailing edge of the pulse is called the

a. rise time

b. fall time

c. period

d. pulse width

Quiz

The time measurement between the 90% point on the trailing edge of a pulse to the 10% point on the trailing edge of the pulse is called the

a. rise time

b. fall time

c. period

d. pulse width

Quiz

The reciprocal of the frequency of a clock signal is the

a. rise time

b. fall time

c. period

d. pulse width

Quiz

If the period of a clock signal is 500 ps, the frequency is

a. 20 MHz

b. 200 MHz

c. 2 GHz

d. 20 GHz