Unit.1 Introduction

What is Signal?

- ✓ A signal is a physical quantity (sound, light, voltage, current) that carries **information**
  - The power cable supplies power but no information (not a signal)
  - A USB cable carries information (files)
- ✓ Examples of quantities used as digital information signals
  - Voltage: 5V (logic 1), 0V (logic 0) in digital circuits
  - Magnetic field orientation in magnetic hard disks
  - Pits and lands on the CD surface reflect the light from the laser differently, and that difference is encoded as binary data

Analog Vs Digital

Analog Signal

- Continuous
- Infinite range of values
- More exact values, but more difficult to work with

Digital Signal

- Discrete
- Finite range of values (2).
- Not as exact as analog, but easier to work with

Example:

A digital thermostat in a room displays a temperature of 30 degree(in celcius). An analog thermometer measures the room temperature at 72.482 degree(in celcius). The analog value is continuous and more accurate, but the digital value is more than adequate for the application and significantly easier to process electronically.

Example of Analog Vs Digital System

Digital advantages:

Battery life

Programmability

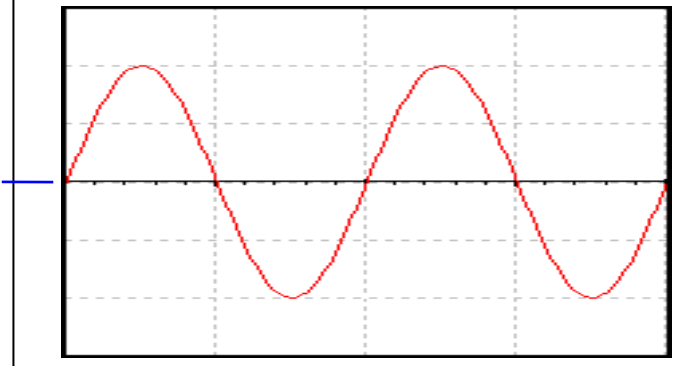
Accuracy

The World is Analog

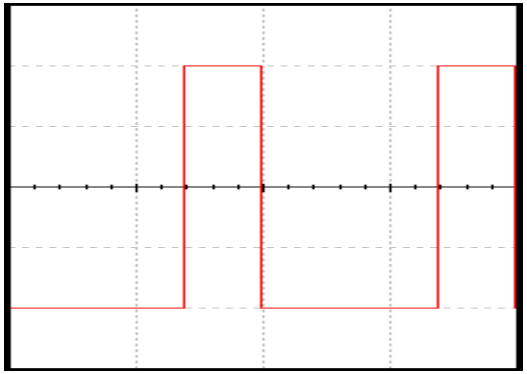
- ✓ The world we live in is analog.
- ✓ We are analog.
- ✓ Any inputs we can perceive are analog.
- ✓ For example,
  - sounds are analog signals; they are continuous time and continuous value.
  - Our ears listen to analog signals and we speak with analog signals.
  - Images, pictures, and video are all analog at the source and our eyes are analog sensors.
  - Measuring our heartbeat, tracking our activity, all requires processing analog sensor information.

Examples of Analog Signal

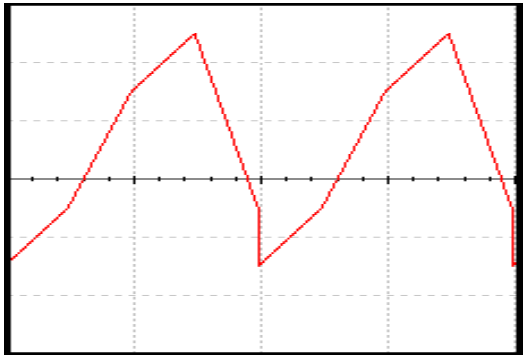
- ✓ An analog signal can be any time-varying signal.
- ✓ Minimum and maximum values can be either positive or negative.
- ✓ They can be periodic (repeating) or non-periodic.
- ✓ Sine waves and square waves are two common analog signals.
- ✓ Note that this square wave is not a digital signal because its minimum value is negative.
- ✓ Video and Audio



Sine wave

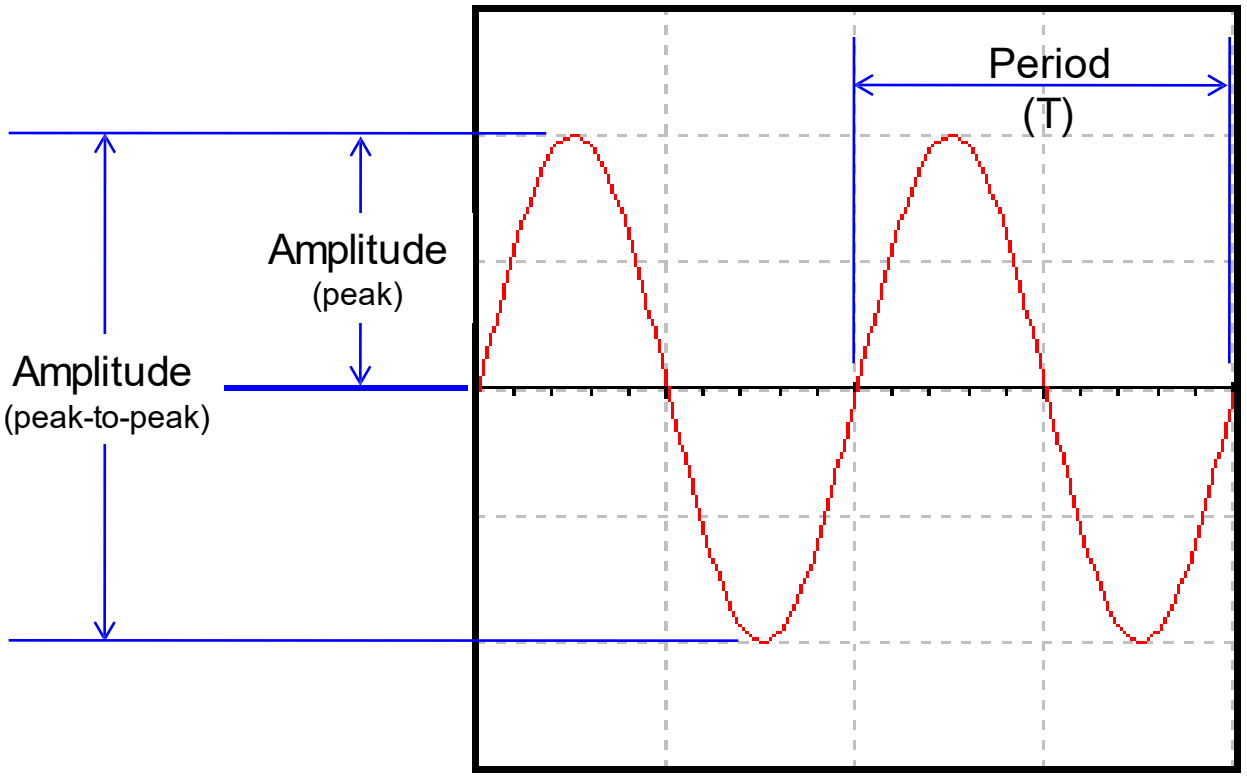


Square wave(not digital)



Random-Periodic

Parts of Analog Signal



Frequency:

$$F = \frac{1}{T} Hz$$

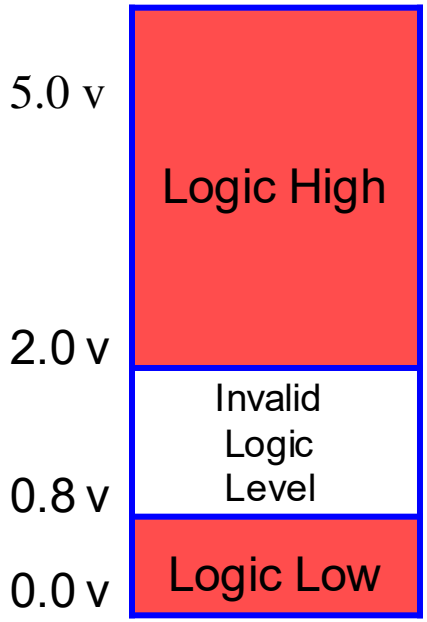
Pros and Cons Analog Signal

- **Advantages**
  - ✓ Major advantages of the Analog signal is infinite amount of data.
  - ✓ Density is much higher.
  - ✓ Easy processing.
- **Disadvantages**
  - ✓ Unwanted noise in recording.
  - ✓ If we transmit data at long distance then unwanted disturbance is there.
  - ✓ Generation loss is also a big con of analog signals.

Logic Levels

Before examining digital signals, we must define logic levels. A logic
level is a voltage level that represents a defined digital state.

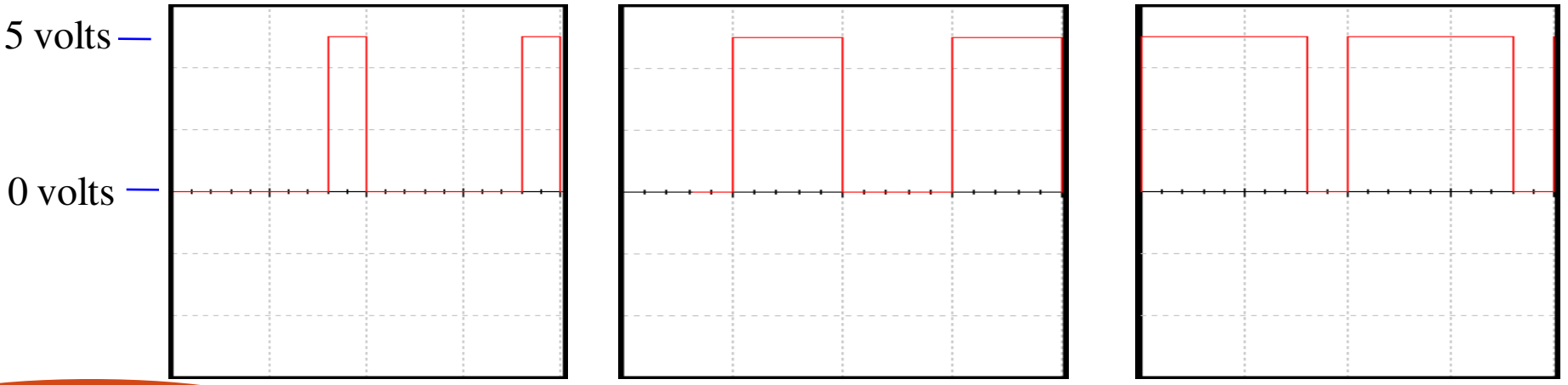
- ✓ Logic HIGH: The higher of two voltages, typically 5 volts
- ✓ Logic LOW: The lower of two voltages, typically 0 volts



Logic Level	Voltage	True/False	On/Off	0/1
HIGH	5 volts	True	On	1
LOW	0 volts	False	Off	0

Examples of Digital Signal

- ✓ Digital signal are commonly referred to as square waves or clock signals.
- ✓ Their minimum value must be 0 volts, and their maximum value must be 5 volts.
- ✓ They can be periodic (repeating) or non-periodic.
- ✓ The time the signal is high (t_H) can vary anywhere from 1% of the period to 99% of the period.
- ✓ Text and Integers.



Parts of Digital Signal

Amplitude:
For digital signals, this will ALWAYS be 5 volts.

Period:
The time it takes for a periodic signal to repeat. (seconds)

Frequency:
A measure of the number of occurrences of the signal per second. (Hertz, Hz)

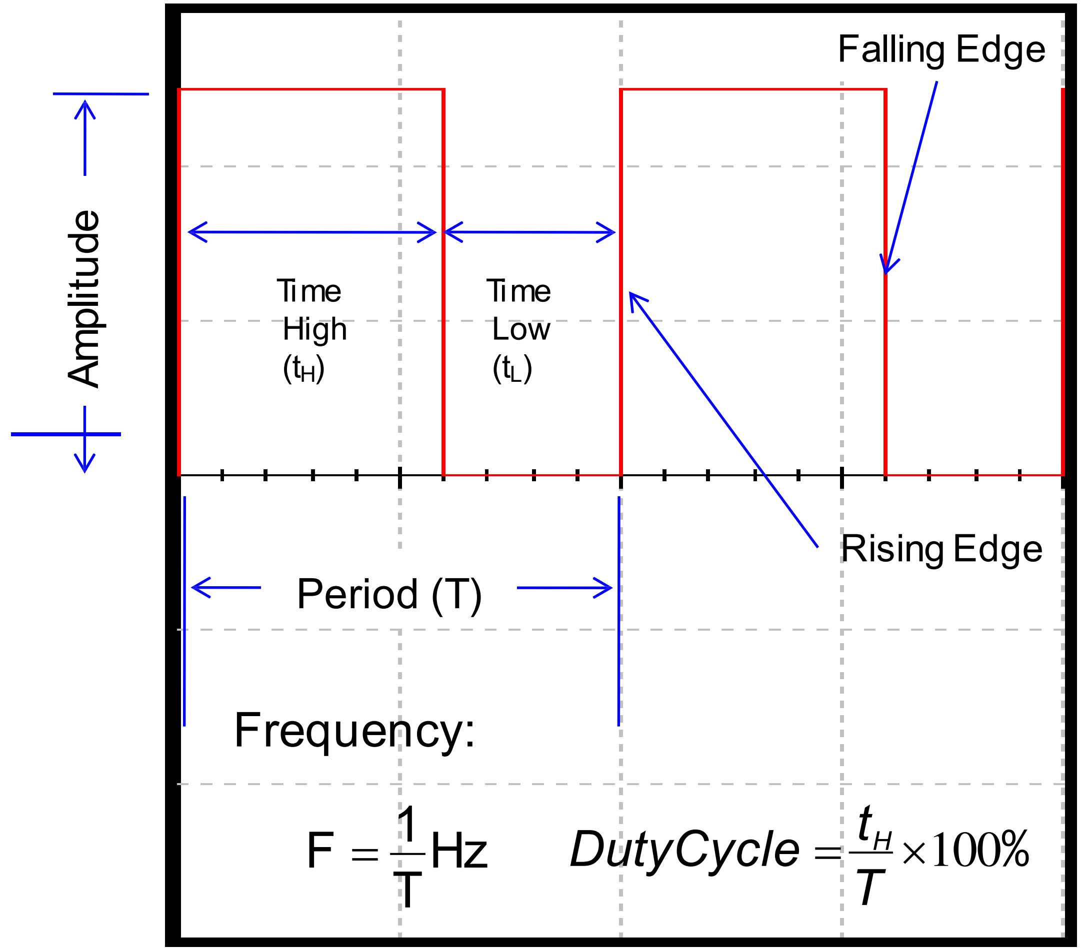
Time High (t_H):
The time the signal is at 5 v.

Time Low (t_L):
The time the signal is at 0 v.

Duty Cycle:
The ratio of t_H to the total period (T).

Rising Edge:
A 0-to-1 transition of the signal.

Falling Edge:
A 1-to-0 transition of the signal.



Pros and Cons Digital Signal

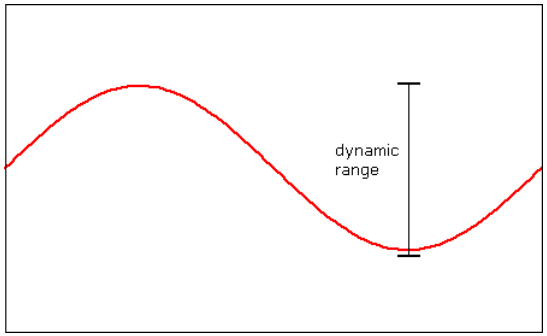
➢ Advantages

- ✓ Because of their digital nature they can travel faster in over digital lines.
- ✓ Ability to transfer more data as compared to analog.

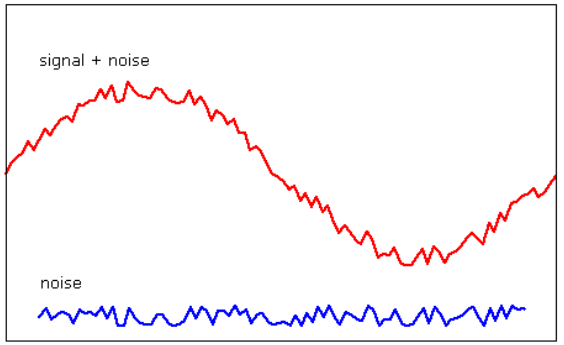
➢ Disadvantages

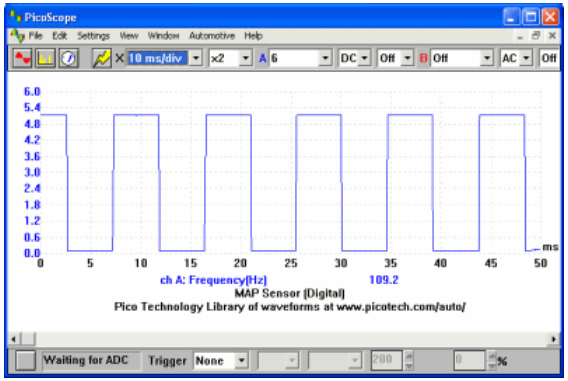
- ✓ Greater bandwidth is essential.
- ✓ Systems and processing is more complex.

Advantages of using digital over analog:

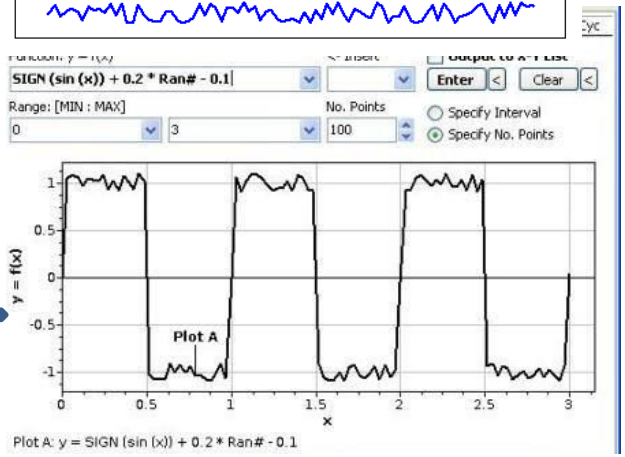


Noisy channel





Noisy channel

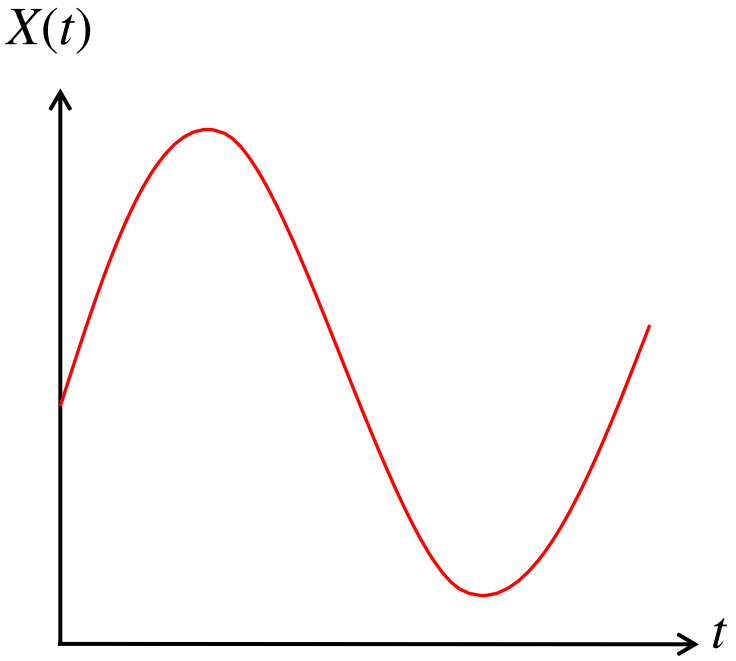


- ✓ Digital systems are less sensitive to noise
- ✓ As long as 0 is distinguishable from 1

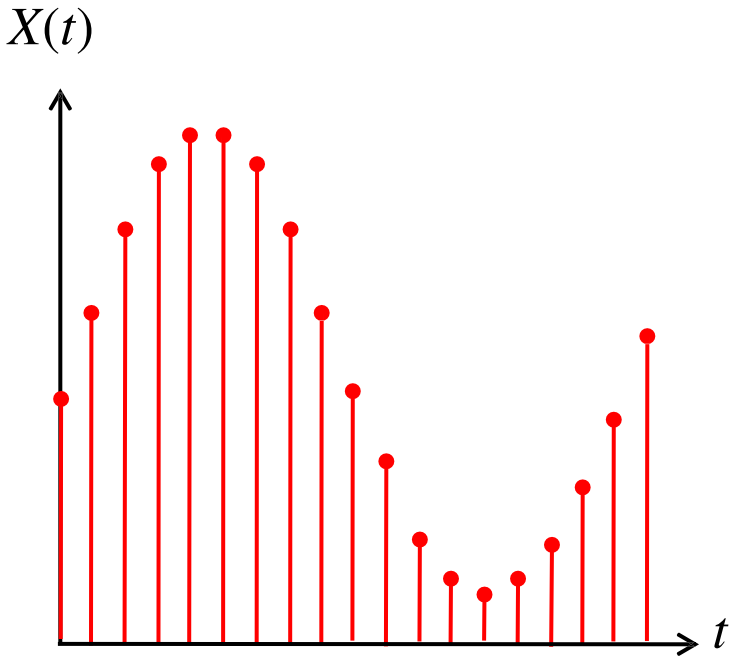
Analog Vs Digital

- Analog system
  - ✓The physical quantities or signals may vary continuously over a specified range.
- Digital system
  - ✓The physical quantities or signals can assume only discrete values.
  - ✓Greater accuracy

Analog Vs Digital



Analog signal



Digital signal

Advantages of Digital System over Analog System

- ✓ Digital Systems are easier to design
- ✓ Information storage is easy
- ✓ Accuracy & Precision are greater
- ✓ Digital systems are more versatile
- ✓ Digital circuits are less affected by noise
- ✓ More digital circuitry can be fabricated on IC chips
- ✓ Reliability is more

Thank You!