

PUSHPALATHA .B

LECTURER E & E DEPT.

BAPUJI POLYTECHNIC SHABANUR

DAVANGERE

## Unit 1: IC Logic families

10 marks

**syllabus:** IC logic families- . Definitions- threshold voltage, propagation delay, power dissipation, noise margin, logic voltage level, fan-in, fan-out, speed, operating temperature, positive and negative logic. General characteristics- TTL, ECL and CMOS, advantages and disadvantages, Definition- Tri-state logic. IC- definition, advantages of IC over discrete components.

### **Introduction to Digital Electronics**

**Digital electronics** deals with the **electronic** manipulation of numbers, or with the manipulation of varying quantities by means of numbers. Because it is convenient to do so, today's **digital** systems deal only with the numbers 'zero' and 'one', because they can be represented easily by 'off' and 'on' within a circuit.

**Digital electronics** is a field of [electronics](#) involving the study of [digital signals](#) and the engineering of devices that use or produce them. This is in contrast to [analog](#)

### **IC and the advantages of IC over discrete components.**

Integrated circuit is electronic package in which thousands of discrete components are fabricated in a single silicon chip.

OR

An integrated circuit is a package electronic circuit in which circuit components such as transistors, diodes, capacitors etc fabricated in a single silicon chip to perform completely electronic function

### **Advantages of IC:-**

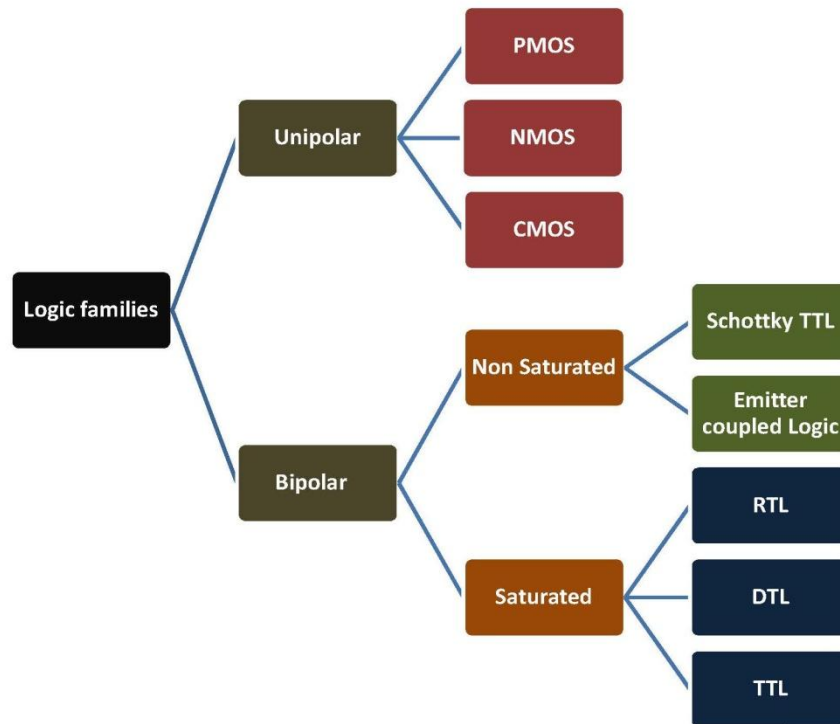
- Extremely smaller in size because of high packaging density.
- High reliable
- Less weight.
- Low power consumption.
- Easy replacement.
- Suitable for small single operations.
- The operating speed is high which makes them suitable for high speed operations
- The use of IC's reduces the number of wiring connection
- Greater ability of operating at extreme temperature
- Reduced cost

### **Disadvantages of IC**

- 1) They are delicate and cannot withstand rough handling and excessive heat
- 2) They operate at low voltages
- 3) They can handle only limited amount of power.
- 4) Coils and inductors cannot be fabricated

### **Classification of IC Family**

Most electronic systems which are responsible for modern advances are based on digital technology. All digital systems, computers and microprocessors are assembled from simple circuits called logic circuits. The basic building blocks of logic circuits are **logic gates**. And logic gates themselves are simple electronic circuits comprising of **diodes, transistors and resistors**



## Types of IC Packages

Integrated circuit is package electronics in which thousands of discrete components are fabricated on a single silicon chip.

- Single line package
- Dual line Package
- Flat Pack Package
- Metal can Package

## Characteristics of IC

1. Propagation Delay
2. Power Dissipation
3. Noise Margin
4. Fan in
5. Fan out
6. Operating Temperature
7. Logic voltage Levels

8. Tristate Logic

9. Threshold voltage

### **Propagation delay:**

- It is defined as time interval between application of input signal and occurrence of the resulting output signals.

### **Fan in :**

Fan in is defined as maximum number of inputs that logic gate can accept to handle.

### **Fan out:**

The fan-out is defined as maximum number of inputs that can be connected to output of gate without degrading the normal operation.

**Power dissipation:** The power dissipation of logic circuit is the product of DC supply voltage and current

- **Operating temperature:** All the gates or semiconductor devices are temperature sensitive in nature. The temperature in which the performance of the IC is effective is called as operating temperature. Operating temperature of the IC vary from 00 C to 700 c.
- **Noise margin:** It is the maximum noise voltage added to an input signal of a digital circuit that does not cause an undesirable change in the circuit output. It is expressed in volts. **OR**

**Noise** margin is a measure of noise immunity of logic circuit

**Noise immunity:** noise is an unwanted electrical signal try to interfere with wanted signals .noise immunity is the ability of logic circuit to tolerate noise without causing change in its output

- **Tristate logic:**

- The tristate logic refers to the digital logic circuit which exhibits 3 states.
  1. Logic 1
  2. Logic 0.
  - 3 High impedance state.
- The high impedance state means the output appears to be disconnected like an open circuit. in this state the circuit has no logic significance. The tri state has a control input that can place the gate in to high impedance state

**Threshold voltage:** The threshold voltage is defined as that voltage at the input of a gate which causes a change in the state of the output from one logic level to the other

### Characteristics of TTL

- 1) TTL is most successful bi polar logic family
- 2) High speed of operation
- 3) Superior driving capability that means good fan out
- 4) Moderate power consumption
- 5) Good noise immunity that means noise margin is 0.4 milivolts

### Advantages and disadvantages of TTL

#### **Advantages of TTL:-**

1. High speed operation, fastest among the saturated logic families.
2. The propagation delay time is 10ns.
3. Moderate power dissipation.
4. Available for wide range of functions.
5. Low cost.
6. Moderate packaging density.

### **Disadvantages of TTL:**

- High power dissipation than CMOS.
- Lower noise immunity than CMOS.
- Less fan out than CMOS.

### **Characterstics of ECL**

1) it is non saturated logic circuit it is much faster than TTL

2)it is very small propagation delay of the order 1 nanosecond

### **➤ Advantages of ECL:**

1. High speed therefore propagation delay is less used in superfast computers and high speed special purpose computers.
2. Large fan out.
3. ECL does not cause serve spikes an power supply since current drawn by this family is stable.
4. Produces an output and its complement there by eliminating need for inverters.

### **Disadvantages of ECL:-**

1. More expensive.
2. Not compatible with other logic families.
3. High power dissipation.
4. Low noise immunity. This makes ECL unreliable for use in high noise environments.
5. It's negative supply voltage and logic levels are compatible with other logic families.
6. Problem of cooling.

### **Characterstics of CMOS**

- The CMOS family uses a complementary pair (one Nchannel and one P-channel) of MOSFET devices. ☐
- The CMOS family has high input impedance and very low power consumption.
- CMOS logic is available in either NAND or NOR configurations
- It requires less chip area and it has greater packing density. it does not require other elements like resistors and diodes which occupies large space
- It is operated at high voltage and better noise margin.

### Advantages and disadvantages of CMOS

#### Advantages of CMOS

- It consumes less power
- It can be operated at high voltages resulting in improved noise immunity
- Better noise margin.
- Fan out is more

#### Disadvantages of CMOS

- Switching speed low
- Greater propagation delay

### Comparison of different logic family

# A Comparison of Logic Families



25.5

Parameter	CMOS	TTL	ECL
Basic gate	NAND/NOR	NAND	OR/NOR
Fan-out	>50	10	25
Power per gate (mW)	1 @ 1 MHz	1 - 22	4 - 55
Noise immunity	Excellent	Very good	Good
$t_{PD}$ (ns)	1 - 200	1.5 – 33	1 - 4

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