Design of Multilayer PCBs, SMDs and mounting techniques.

Multilayer PCB is a Printed Circuit Board with more than 2 layers. A Double-Sided PCB has two conductive layers on top and bottom of the PCB substrate. A Multilayer PCB must have a minimum of 3 conductive layers of conductive material or copper layer. All the layers are interconnected with copper plated holes. The layers can be 4, 6, 8…upto 40 layers.

A multilayer PCB is complex by design. The top and bottom layers look same as a double sided PCB but has staked layers on both sides of the core. All the layers are compressed to form a single Multilayer PCB where all the layers are interconnected via copper plated holes. All the active and passive electronic components are assembled on top and bottom layers. All the inner stacked layers are meant for routing. Both through-hole electronic components and Surface Mount Components (SMD) can be soldered on either side of this type of PCB. SMD components can be soldered with Surface Mount Technology.

A general Multilayer PCB has following layer stacking:

- Top Layer (Electronic Components)
- Inner Layer-1 (Routing)
- Inner Layer-2 (Routing)
- Inner Layer-3 (Routing)
- Bottom Layer (Electronic Components)

Multilayer PCB Manufacturing Process

1. The process starts with designing Layout of the PCB using any PCB designing software / CAD Tool (Proteus, Eagle, OrCAD).
2. Next step is to make the Inner Layer Core. Laminate of desired thickness is treated with Copper foil, dry film resist and UV light to make the inner layer core.

3. Next step is lamination. This process include: Inner layer core, prepeg sheets and copper foil sheets. The sheets of material are staked on each other and holes are used to align them as they are stacked up. For a 4 layer board, Staking of layers is as follows: Bottom Layer of Copper Foil – Prepeg Sheets – The Inner Layer Core – More Prepeg Sheets – Finally Copper Foil Sheet on Top.

4. Next step is to apply pressure, heat and vacuum using a heated hydraulic press. Vacuum is important to make sure there is no air trapped between the layers. This process ends over 2 hours depending on number of layers.

5. Once cured, resins from the prepegs join the sheets, core, and foil together forming a multilayer PCB.

**Benefits of Multilayer PCB**

1. Reduced PCB Size / small size (Saves space).
2. Lightweight
3. High quality and density
4. Better durability and flexibility
5. Powerful with Single Connection Point

**Disadvantages of a Multilayer PCB**

1. Higher manufacturing and production cost
2. Complicated design and production
3. Limited manufacturers
4. Highly skilled and trained designer are required
5. Increased production time

**Uses of Multilayer PCB**

Multilayer Printed Circuit Boards offer more flexibility and increased circuit density with reduces size. This is why many electronic companies in the world use these boards in several electronic devices and gadgets:

- Computers and Laptops
- Telecommunications Equipment – Mobile Phone, Tablets and other Hand Help Devices
- File server and Data storage
- Signal transmission, mobile phone repeaters, GPS
- Satellite
- Medical Equipment: Testing, X-Ray, Heart Monitor, CAT Scan
- Industrial Equipment
- Atomic and Nuclear Systems
- Military and Defense Equipment
- Automotive
- Aerospace
- Anywhere, where complex Circuitry is needed.

**SMD and Mounting Techniques**

Surface-mount technology (SMT) is a method for producing electronic circuits in which the components are mounted or placed directly onto the surface of printed circuit boards (PCBs).
An electronic device so made is called a surface-mount device (SMD). In the industry it has largely replaced the through-hole technology construction method of fitting components with wire leads into holes in the circuit board.

Fig: Various SMD components

Fig: SMD components on PCB

Both technologies can be used on the same board for components not suited to surface mounting such as large transformers and heat-sunked power semiconductors. An SMT component is usually smaller than its through-hole counterpart because it has either smaller leads or no leads at all. It may have short pins or leads of various styles, flat contacts, a matrix of solder balls (BGAs), or terminations on the body of the component.

Surface mount components, active and passive, when attached to the SMT PCB, form three major types of SMT assembly – commonly referred to as Type I, Type II and Type III. The process sequences are different in each type, and all the three types need different equipment.

- **Type III SMT** assembly contains only discrete surface mount components (*SMD Resistors, SMD capacitors, and transistors*) glued to the bottom side.
- **Type I SMT** assembly contains only surface mount components. The assembly can be either single-sided or double-sided.
- **Type II SMT** assembly is a combination of Type III and Type I. It generally does not contain any active surface mount devices on the bottom side but may contain discrete surface mount devices on the bottom side.