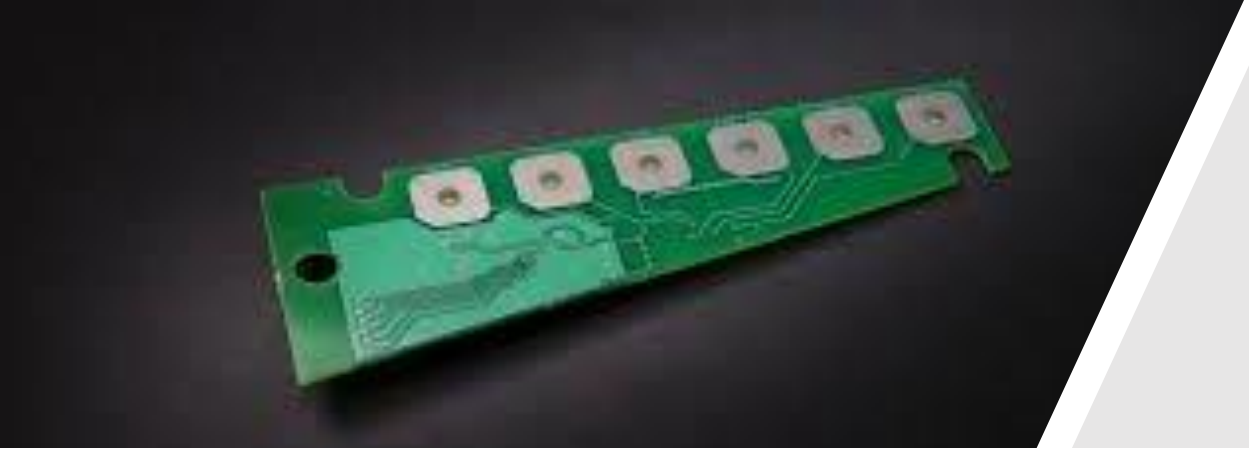


MCL Bootcamp

Attributes of a PCB

Classes of Boards

Attributes of a PCB

- What does a printed circuit board do?
  - Mechanically supports and electrically connects electronic components using conductive tracks, pads, and other features etched from copper sheets laminated onto a non-conductive substrate

Attributes of a PCB

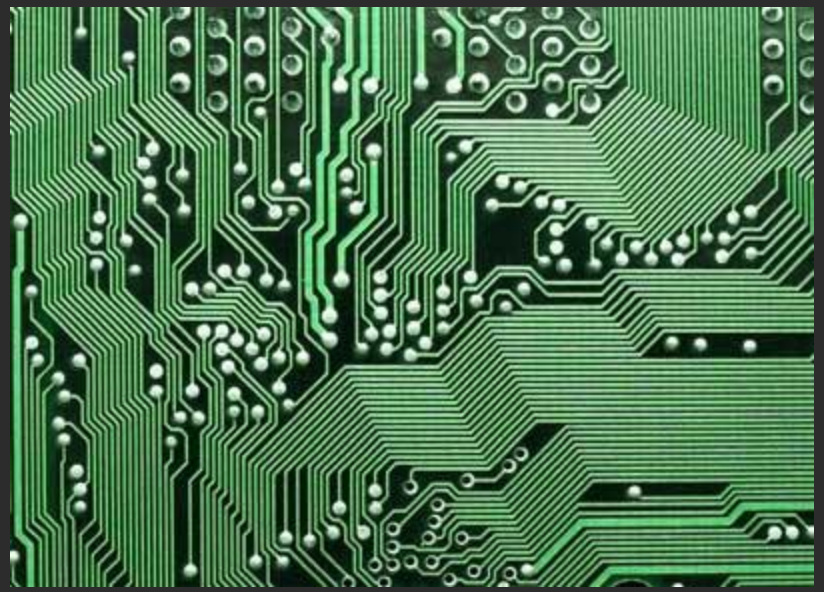
- Because PCBs and their specs are so diverse, PCB manufacturers generally don’t design or specify the boards they produce
- All the specifications (shape of the board, its mechanical and electrical properties, its surface finish, and its material composition) are usually provided by designers who work for an OEM, a design service, or CM

Who Uses PCBs?

- OEM – Original Equipment Manufacturer
- CM – Contract Manufacturer
  - A business that takes the PCB and the components and assemblies the unit
- Design Service

Circuit Properties of the PCB

- Trace: a common term for a conductor, also known as a track
- Each trace consists of a flat, narrow part of the copper foil that remains after etching
- The resistance, determined by width and thickness, of the traces must be sufficiently low for the current the conductor will carry



Essential Parts of a PCB

Base – a thin board of insulating material, rigid or flexible

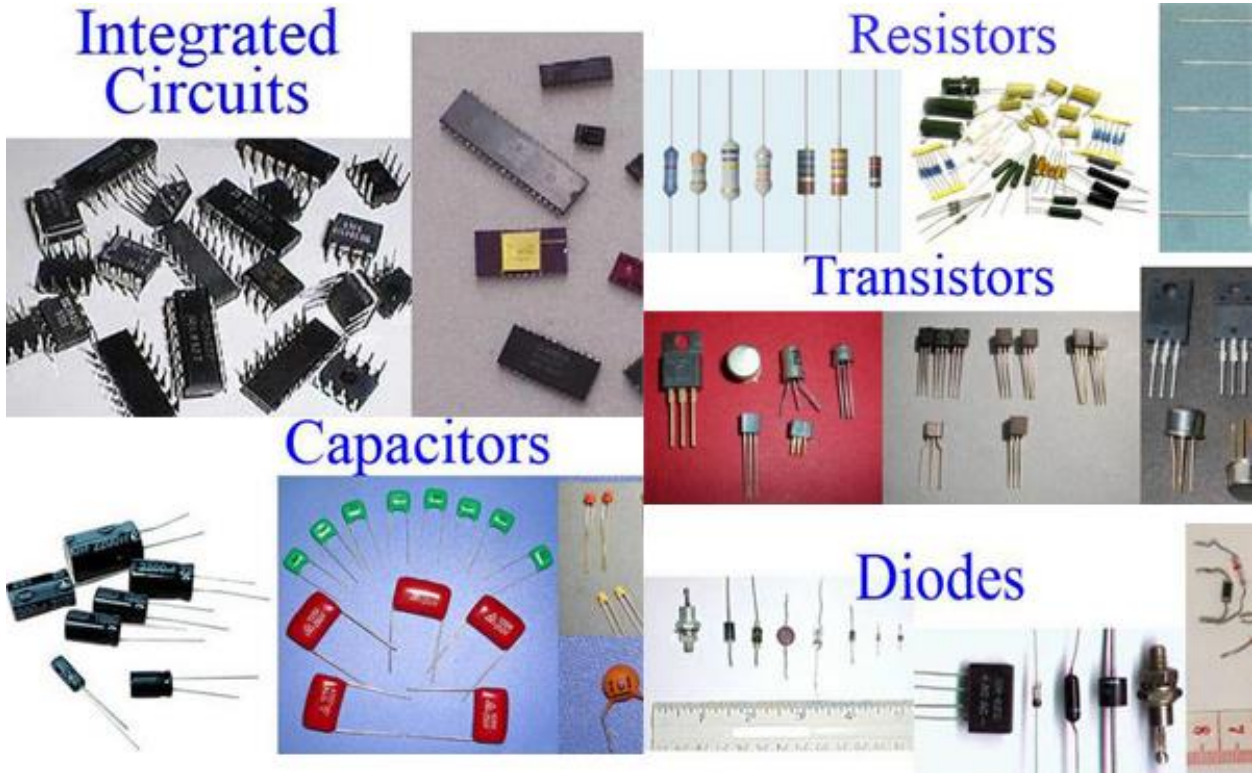
- Provides mechanical support all copper areas and all components attached to the copper
- The electric properties of the completed circuit depend upon the dielectric properties of the base material and must be known and appropriately controlled

Conductors – high purity copper in the form of thin strips of appropriate shapes firmly attached to the base material

- Provide not only the electrical connections between components but also solderable attachment points

Why it is called a Printed Circuit Board?

- The conductive areas are usually generated by means of a printing process like screen printing or photo-engraving



- Component: an electronic device, typically a resistor, capacitor, inductor, or integrated circuit, that is mounted to the circuit board and performs a specific electrical function
- Components are generally soldered on the PCB
  - advanced PCBs may contain components embedded in the substrate
- PCBs can be single-sided, Double-sided, or mutli-layered
- Conductors on differed layers are connected with vias

Components of a PCB

PCB Standards & Specifications - IPC

- The IPC is an international trade association of fabricators, assemblers, OEMs, and suppliers
  - Founded as the Institute of Printed Circuits in 1957
  - Taken the lead in establishing new standards for raw materials, design, qualification and performance, processing, testing, and overall acceptability of PCBs

PCB Specifications & Standards

- IPC-A-600- Acceptability of Printed Boards
- IPC-6012 – Qualification and Performance Specific for Rigid Printed Boards
- Specification – a document that defines and quanitifies the mechanical, chemical, and electrical properties of a PCB
  - Define raw materials, appearance, workmanship standards, and methods of testing
- Standard – a document written, published, and governed by a trade association that is made up of sub-committees in collaboration with industry professionals that are agreed upon and accepted as industry guidelines
- Both serve to set criteria and to establish uniform quality for finished products

IPC-A-600 Acceptability of Printed Boards

- An inspection criterion setting the level of acceptance criteria for each class of product
- Workmanship standard describes preferred, acceptable, and nonconforming conditions for PCBs
- It represents the visual interpretation of minimum requirements set forth in the various printed board specifications
- Tool for internal and external sections for PCBs
- Ex: includes the acceptable condition the gold fingers must have to meet the class requirements but does not state the required thickness of nickel and gold for edge connectors

IPC-6012 – Qualification and Performance Specification for Rigid Printed Boards

- Establishes and defines the qualification and performance requirements for the fabrication of rigid boards
- Establishes the types of rigid boards and describes the requirements to meet during fabrication for three performance classes of boards, Class 1, 2, and 3 and 3A.
- Class assignment is set by the designer and usually determined by the end use of the product
  - Classes reflect the complexity of the PCB as well as reliability, performance, and required testing

Class 1

- Lowest performance class
- Little to no inspection or testing is done on these circuits
- Choice to manufacture this class board is almost exclusively based on its low cost
  - Example of product: musical greeting card, garage door opener
- Boards that would have a limited life

Class 2

- Middle class performance – continued performance, extended life and uninterrupted service is desired but not critical
- Moderate to high level of inspection and testing is done on these circuits, but to slightly lower standards than Class 3 boards for certain features
  - For many features Class 2 circuitry is held to the same standards as Class 3
- Typical application: high-end consumer electronics and medical diagnostic equipment
  - Vast majority of flex applications fall into this class
- Moderate cost

Highest performance class – end use where continued high performance on demand is critical, failure of circuit board assemblies cannot be tolerated, and the product must function when required

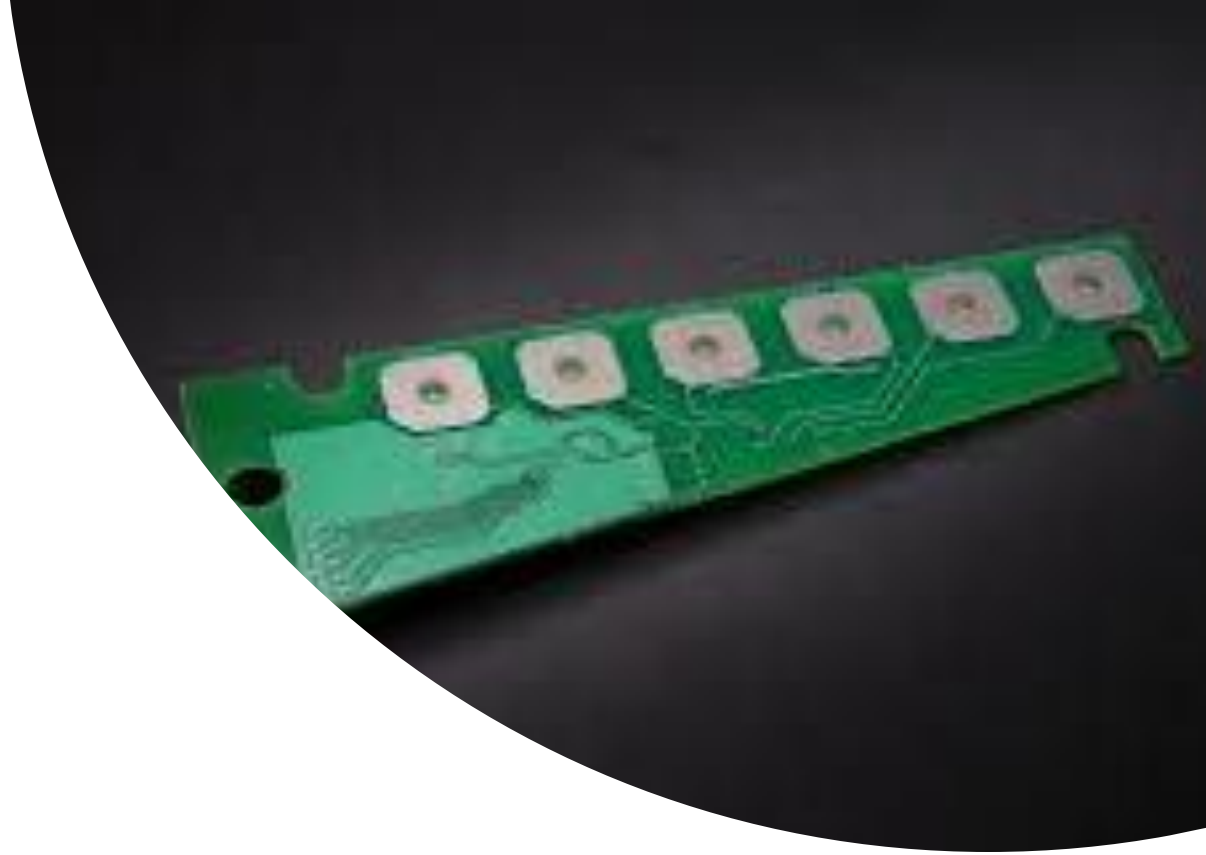
High level of inspection and testing is performed on these circuits and to very stringent standards

Typical applications: implantable medical devices, military and aerospace applications (3A)

Usually invoked when a circuit failure is quite literally the difference between life and death

This level of inspection and testing comes at a great cost

Class 3 & Class 3A



- Distinction between Class 1 and Class 2 is very clear
- Distinction between Class 2 and Class 3 has more gray area
  - The majority of Class 2 circuits will actually meet all the performance requirements of Class 3 circuits, but the level of testing and inspection is not done
- Class 2 still offers very high reliability with a much lower price tag
- Difference in classes is achieved by requiring tighter tolerances and controls that result in a more “reliable” product

Classes of Boards based on IPC-6012

PCB Standards & Specifications – Underwriters Laboratories

- Underwriters Laboratories (UL): an independent laboratory, performs site inspections and laboratory testing, checks documentation, equipment, calibration, and test records, and verifies that samples and tests are being performed properly
- Most fabricators have UL-issued cards that list their particular symbols and test ratings. These yellow cards are often the first documents that potential customers ask to see
- Obtain a UL symbol for different layer counts

PCB Standards & Specifications – U.S. Dept. of Defense (DoD)

- The Defense Supply Center Columbus (DSCC) is the controlling government agency that defines the manufacturing of mil spec PCBs used in military and other government related applications
- Maintains a list of those PCB fabricators that have passed an audit and allowing only those manufactures certificates to supply the DoD

PCB Standards & Specifications – U.S. Dept. of Defense (DoD)

- MIL-PRF-31032
- MIL-PRF-55110
- MIL-PRF-50884

- Any PCB fabrication print that calls out for these specifications must be produced by a government-approved PCB manufacturer
- MCL does not quote any Mil-spec boards at this time

Questions?
Thoughts?
Ideas?