Unit III
Electrical and Electronic Skills

Content

- Use of Multimeter
- Discrete components
- ICs
- Soldering/Desoldering of electrical components
- PCB (Printed circuit board)
- Regulated power supply

Multimeter

Multimeter: A multimeter is a portable electronic measuring instrument that combines several measurement functions in one unit. Multimeters are of two types, viz, analog and digital. Multimeter is used to measure current, voltage, resistance, continuity, capacitance, and semiconductor components such as diodes and transistors.

Analog Multimeter

The first type of multimeter is the analog multimeter. An analog multimeter works on the principle of d' Arsonval galvanometer. The key disadvantages are, lower accuracy & resolution, complex reading, fragile design, low input resistance, manual calibration, and limited features.

Multimeter

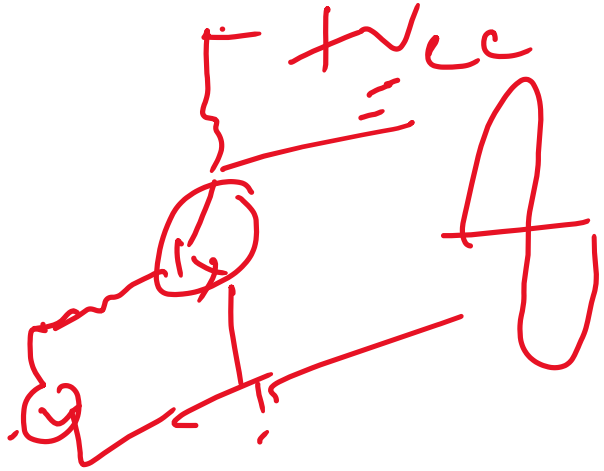
The digital multimeter replaces the analog multimeter due to its ability to measure with greater accuracy, reliability, and higher input impedance. Although most of the measurements are the same with analog multimeters, there are some additional measurement options making them more sophisticated and advanced.

Discrete Components

Discrete components are individual electronic components that perform a single basic function in an electronic circuit, which includes resistors, capacitors, inductors, etc. Discrete components are of two types: passive and active.

Passive: It does not change or modify the power of an applied signal, for example, resistor, capacitor, inductor, etc.

Active: It requires a power source and changes or modifies the power of the applied signal, for example: transistor, OPAM, etc.



Integrated Circuits (ICs)

An assembly of electronic components, fabricated as a single unit, in which active devices (e.g., transistors and diodes) and passive devices (e.g., capacitors and resistors) and their interconnections are built up on a thin substrate of semiconductor material (typically silicon).

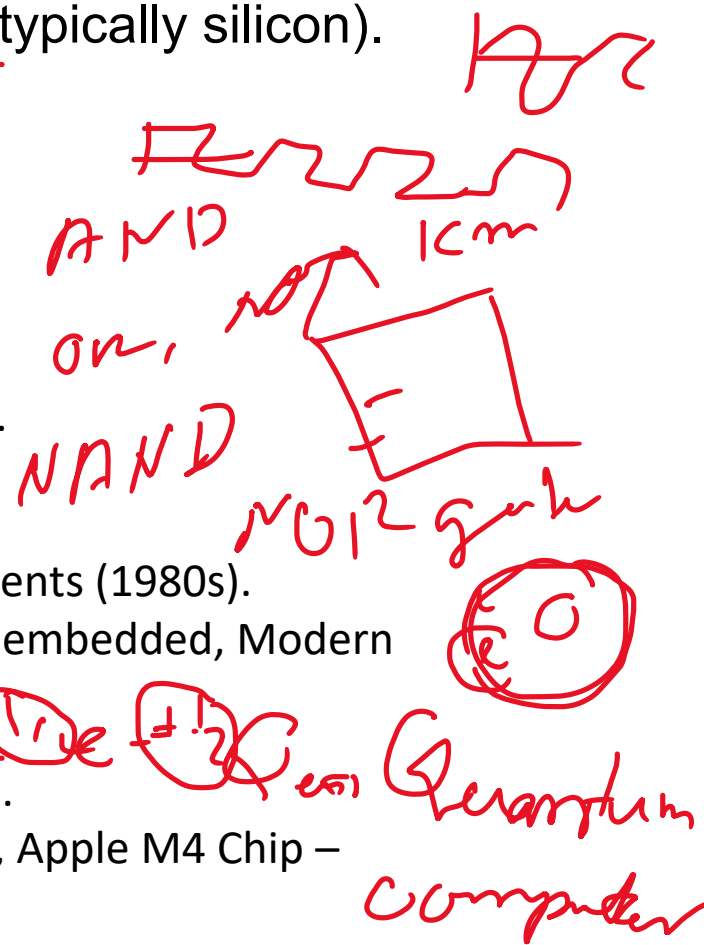
SSI (Small-Scale Integration): 2–10 gates, or up to 100 components per chip (early 1960s).
(e,g): IC7400 (NAND gate), IC 7404 (Inverter gates), IC 7408 (AND gates)

MSI (Medium-Scale Integration): 30–300 gates, or 100–3,000 components (1966–1970).
(e,g): Counters, multiplexers, adders, and decoders

LSI (Large-Scale Integration): 300–3,000 gates, or 3,000–100,000 components (1971–1979).
(e.g): Intel 8085 – Microprocessor, 16-bit Microprocessor, RAM Chip

VLSI (Very Large-Scale Integration): 20,000–50,000+ gates, or 100,000–1,000,000+ components (1980s).
(e,g): ntel Pentium Processor – Microprocessor, ARM Processor – Used in smartphones and embedded, Modern Microcontroller – Advanced embedded controller ICs systems

ULSI (Ultra Large-Scale Integration): Over 1,000,000 components to billions (1985–present).
(e.g): Intel Core i9 Processor – Advanced CPU, AMD Ryzen Processor – Multi-core processor, Apple M4 Chip – High-performance system-on-chip



Soldering/Desoldering

Soldering is a process that is used to join metal parts of different electrical components to form a mechanical or electrical bond. Soldering a common practice in the electrical industry where a metal alloy is melted by means of a heating source called a soldering rod. The melted part is applied to the metal parts is to be joined. When the solder cools and solidifies, it connects the metal parts.

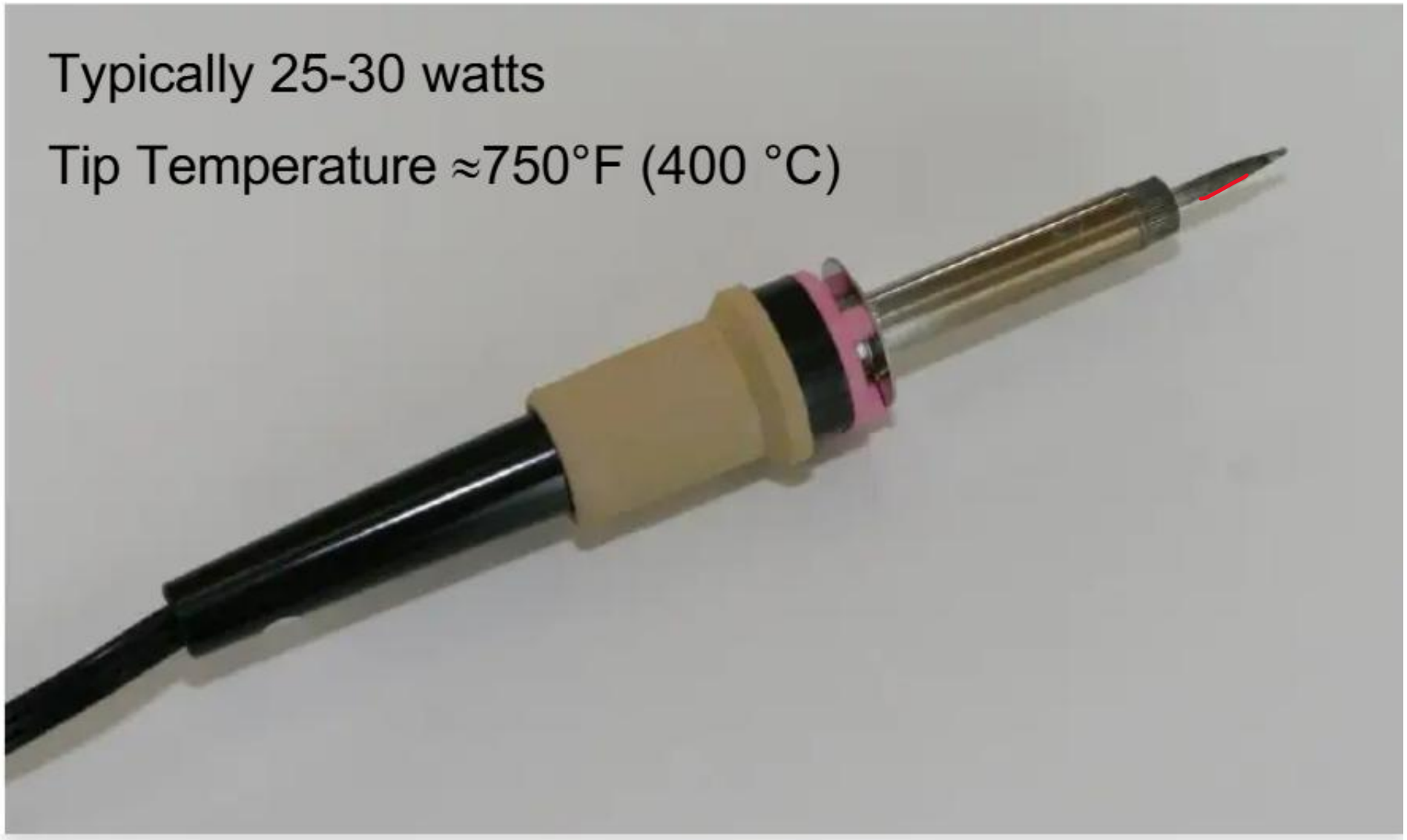
Tools for soldering:

(a) Soldering iron:

(b) Solder:

(c) Flux or soldering paste:

Alloy = Pb + Sn
40:60


Typically 25-30 watts
Tip Temperature ≈750°F (400 °C)

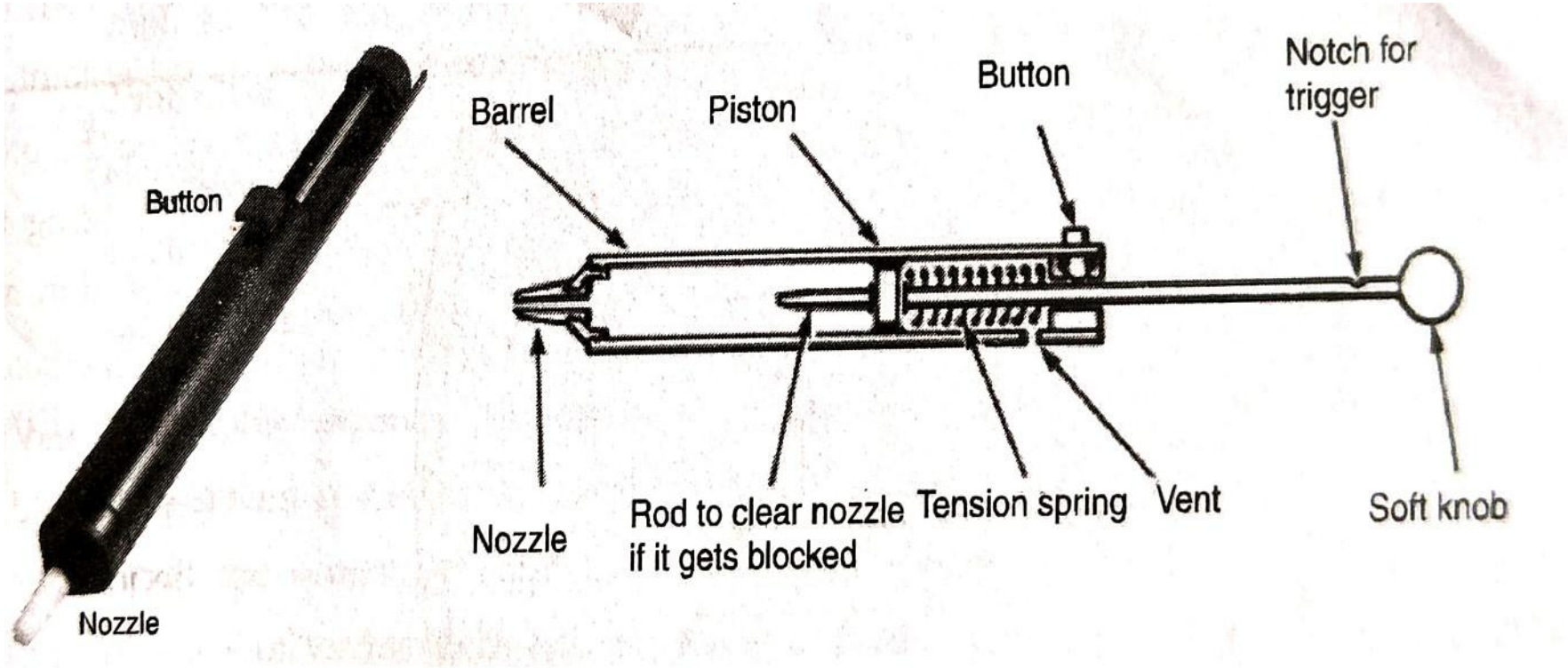
- Solder is an alloy of tin and lead.
- The solder used for electronics is frequently called 60/40 solder because it is made of 63% tin and 37% lead.
- 60/40 solder melts at 361° F.
- Lead-free solder: As of July 1st, 2006, European laws mandated that new electronics be entirely lead-free.

pb is toxic

S. 1

$\frac{C}{5} = \frac{F-32}{9}$

Flux or soldering paste is a chemical purifying agent, and both the solder wire and solder paste contain flux. Flux helps to clean the surfaces being soldered and prevent oxidation of the hot solder. Solder wire usually contains a flux called rosin that produces fumes when the solder is heated. These fumes are harmful to health. Solder flux can also cause spatter and therefore, eye protection should be taken during soldering.



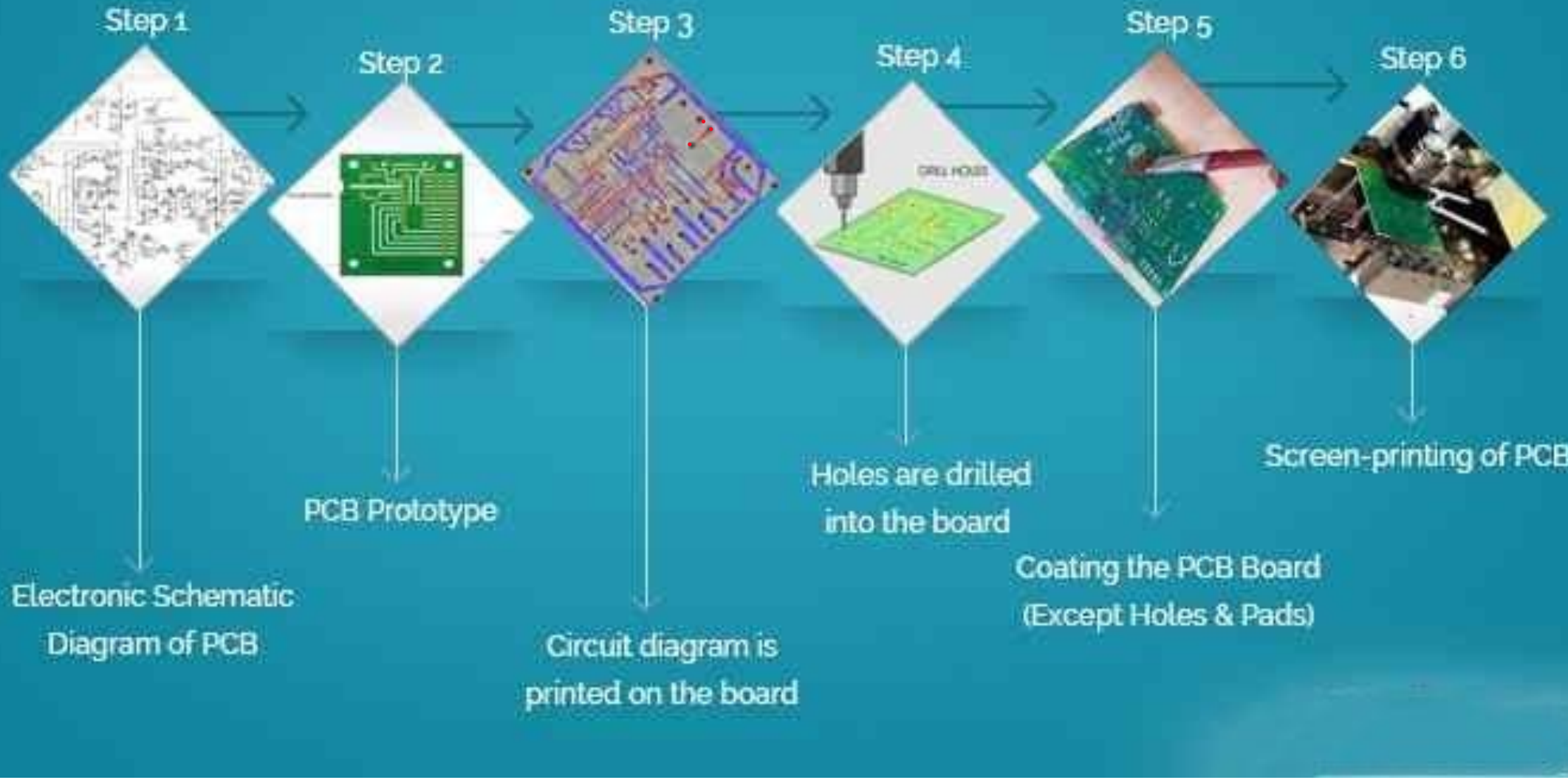
Desoldering is the process of removal of solders and circuit componenets from a circuit board. Sometimes, one might have to desolder a joint due to bad soldering of electronic components or repositioning them on PCB. To do so, a desoldering pump or solder removal board is used. A desoldering pump is a manually operated device used to remove solder from a joint. While desoldering, the nozzle of the pump and the hot iron tip are placed near the joint. Once the solder melts, press the pump button to release the plunger, and thus the pump sucks the molten solder and removes it from the joint. On the other hand, when desoldering is done with a copper braid, the braid acts as a wick for the molten solder, which readily flows onto the braid. Both the braid and the iron tip should be applied together on the solder joint, and as the solder melts, it flows directly on the braid. Once the desoldering is done, one should remove the braid and the tip.

Printed Circuit Board (PCB)

- *A **Printed Circuit Board (PCB)** is a flat board used to mechanically support and electrically connect electronic components using conductive pathways printed on the board.*
- *A PCB is a board on which electronic components like resistors, capacitors, ICs, and transistors are mounted and connected together.*
- ***Main parts of a PCB.***
  - ***Base material:** insulating board (usually fiberglass)*
  - ***Copper tracks:** conducting paths for current flow*
  - ***Electronic components:** soldered onto the board.*
- ***Functions of a PCB:***

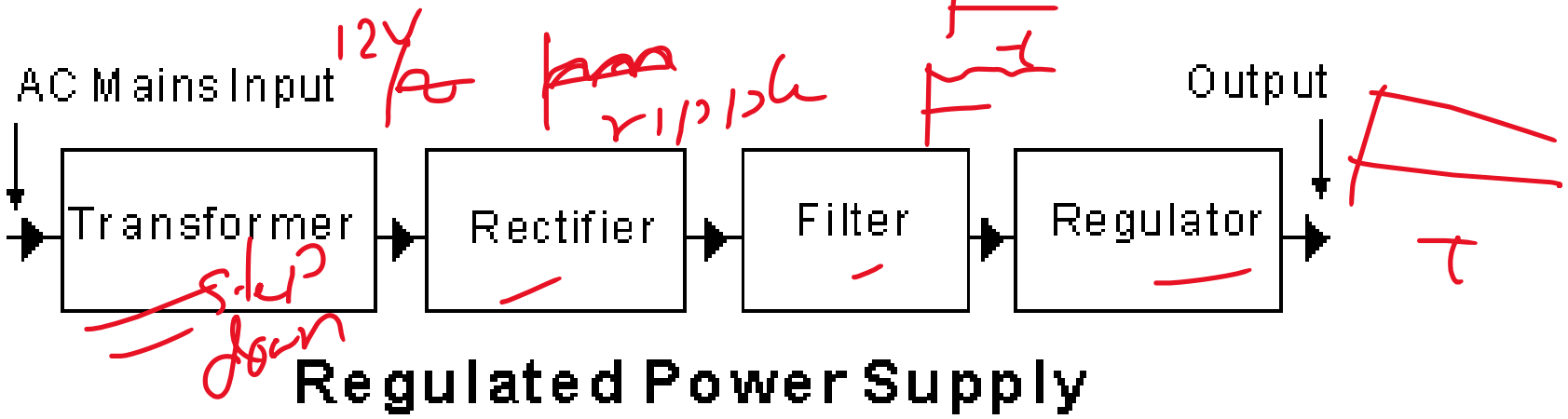
- Provides electrical connections between components
- Holds components firmly in place
- Makes electronic circuits compact and reliable

PCB Manufacturing Process Overview



Regulated Power Supply

A **Regulated Power Supply** is an electronic circuit that provides a **constant DC output voltage** even when the input voltage or load current changes.

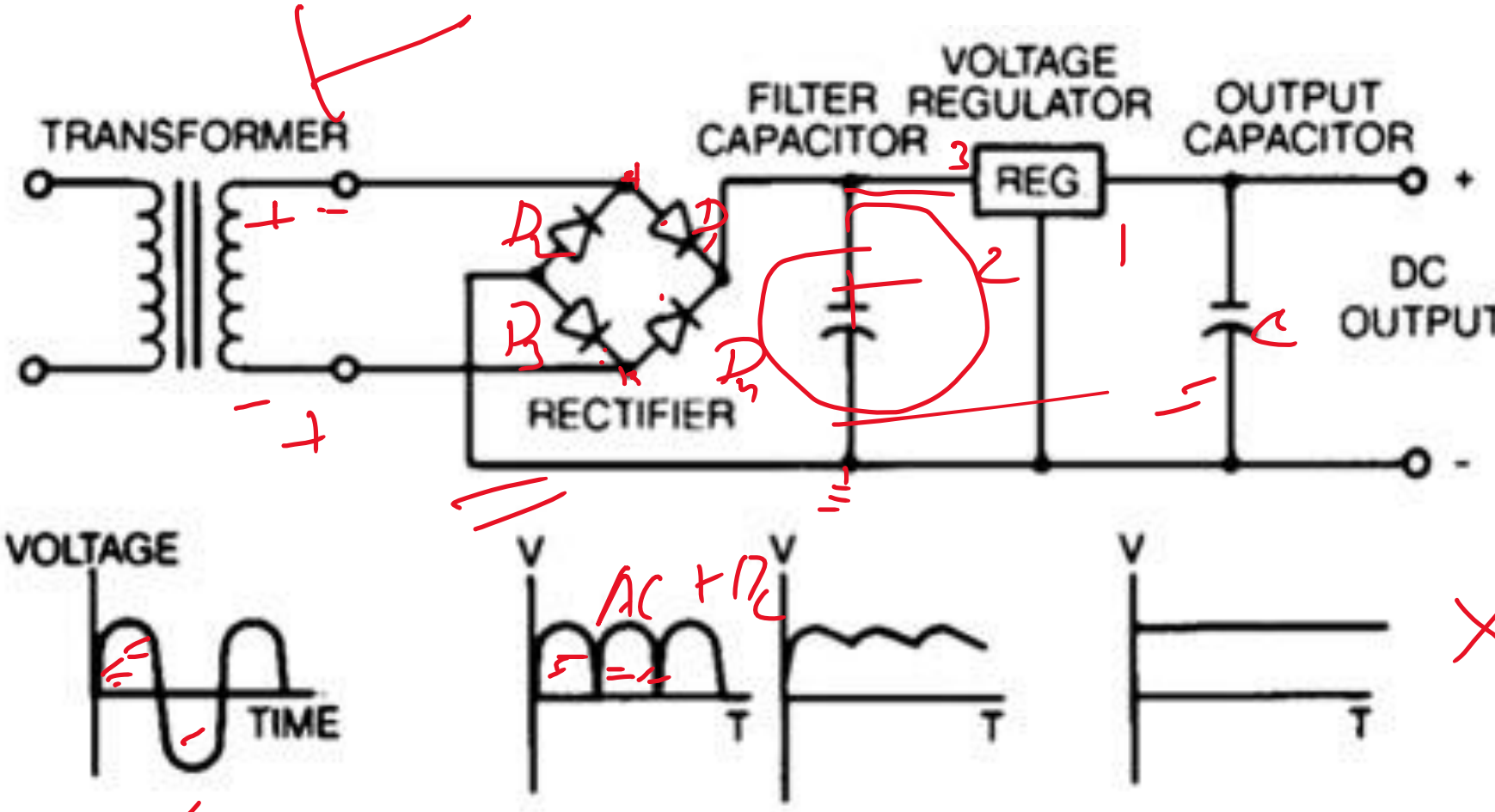


Transformer: Steps up or steps down AC voltage

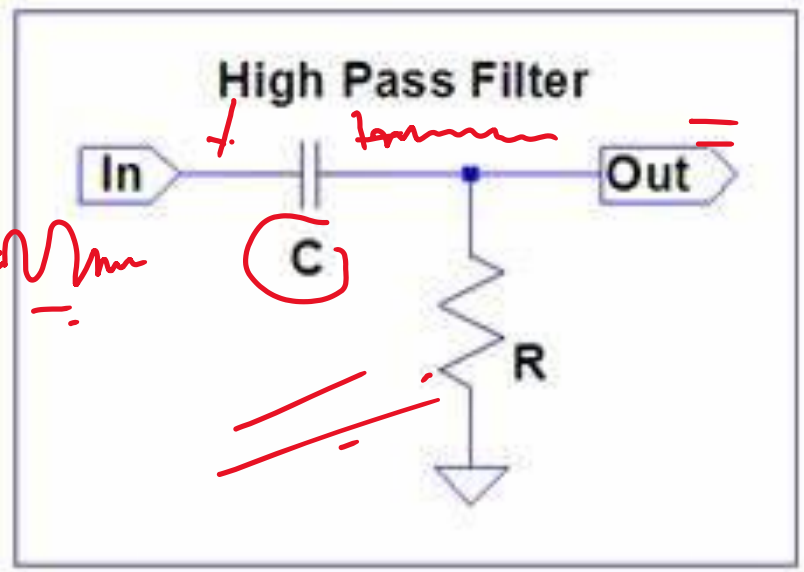
Rectifier: Converts AC into pulsating DC

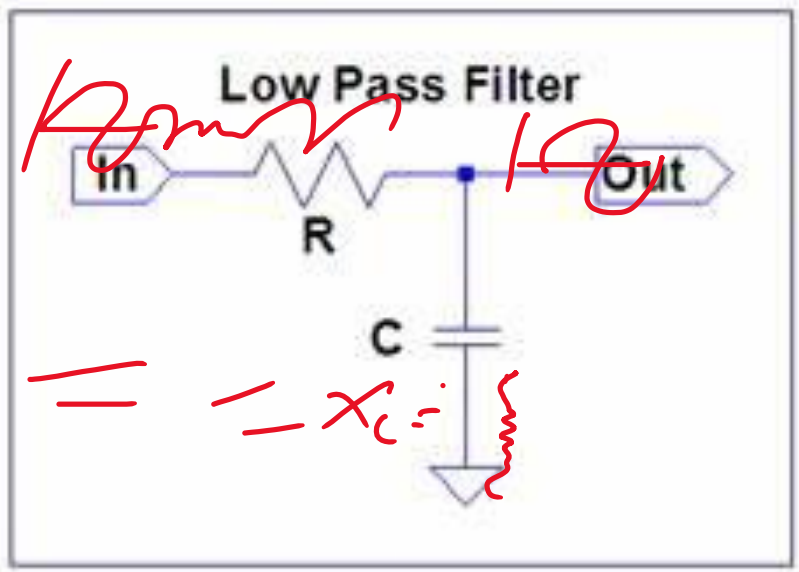
Filter: Removes ripples from DC output

Voltage Regulator: Maintains constant output voltage



Regulated Linear Power Supply





$$X_C = \frac{1}{2\pi f C}$$

C = Capacitance

f = frequency