Module 7
Electronics Systems Packaging

Component Assembly, materials for assembly and joining methods in electronics

-Surface Mount technology- design, fabrication and assembly;
-failures library;
-materials for assembly and joining methods in electronics;
-lead-free soldering and green issues
Through-hole Technology

Through-hole component assembly

Surface Mount Technology

Surface Mount Device Assembly
SMD benefits and limitations

- **SMD Benefits**
  - PCB area is reduced considerably.
    - Size and weight reduction
  - Double-sided assembly possible.
  - Simple assembly technique- no bending and cutting of wires.
  - High yield % in first pass
  - High packaging density; product size diminishes.
  - Fairly good resistance to mechanical shock and vibration
  - Solder joints in SMD are well understood; reliability is fairly high.
  - No drilling and metallization
  - Thin pads and tracks; better electrical performance
  - Low manufacturing cost

- **SMD Limitations**
  - Using ICs with high pin density makes placing tracks between ICs impossible
  - Design of SMD circuit depends on soldering technology to be used
  - High packing density brings thermal problems. No through-hole to take care of this.
  - Not all SMD passive components are labeled with a clear text. Some have no labels at all.
  - Repair is more complex and difficult than conventional through-hole components.
  - Some class of components not yet in SMD form; price of components is an issue.
  - Amortization of old installation
A. Size and weight reduction

Smaller size components

Ability to populate on both sides of the board

Additional space savings from elimination of component mounting holes
B. Better performance

1. Smaller or no leads

2. Reduced circuit propagation delay- 60% of propagation delay is attributed to lead length/package material

3. Noise immunity; leads act as antennas; no lead means no noise pick up

4. Less cross talk- less overall package inductance

Figure source: Wikimedia Commons
C. Manufacturing advantage

Good first pass yield …93 - 98 %

Less floor space …less brick and mortar

CIM capability…all steps are automated
D. Increased reliability

Every “joint” is a potential source of failure. *Reduced solder joints give inherent reliability*

Vibrations “work harden” the solder joints..become weak

Low component mass is an advantage to withstand greater vibrations//
SMT - The Manufacturing Steps

1. Attachment media dispensing
2. Component placement
3. Attachment media curing
4. Soldering- attachment, joining
5. Cleaning the joints
6. Testing - shuts, opens

Components known
Design guidelines for SMT

Type 1: Components mounted on one side of the board
Design guidelines for SMT

Type 2: Components mounted on both sides of the board

Sketch A: Through-hole (not recommended)

Sketch B:

Sketch C:

SMT/TH
Methods of Soldering

1. Manual Soldering
2. Machine Soldering
Hand Soldering

Hand soldering cannot be eliminated....required for all heavy components, connectors, transformers, repair and rework

Flux cored “solder wires” are used along with a hand tool called “Solder iron or Solder gun”

Tips
1. Apply solder to the bit; not component
2. Never emery the bit
3. Do not “spread” the solder
4. Use right type of flux
5. Do not move component during soldering

Figure source: Wikimedia Commons
Soldering

Manual soldering - not possible for fine-pitch

Machine soldering

Wave soldering
solder is added - adhesive attachment of components

Reflow soldering
existing solder is fused - no adhesive attachment

Vapour phase soldering
existing solder is fused - with adhesive attachment

✓ Laser Reflow Soldering - used for special devices

The type of soldering depends on the DESIGN
Methods of SMD and mixed boards assembly

- **Wave Soldering**
  - Adhesive application
    - Screen printing
    - Stencil printing
    - Syringe dispensing
  - Pick and Place component
  - Curing adhesive
    - Curing at specified temperature; ~100°C
  - Fluxing
    - Foam
    - Spray
    - Wave
  - Wave Soldering

- **Reflow Soldering**
  - Application of solder paste
    - Screen printing
    - Syringe dispensing
    - Stencil printing
  - Pick and place component
  - Tacky cure
  - Reflow Soldering
    - IR reflow
    - Thermal convection
    - Vapor phase reflow
  - Clean
  - Test

Cleaning and Testing
Reflow for SMD Assembly

Mounting and Reflow 230~250°C

Circuit board FR4

Solder paste (creamy mixture of solder powder and flux)