Lecture 2

Industry Standards

In this lecture

- Definitions
- Standards Organizations
- Classes and Types of PCB
- Standard Dimensions

Definitions

PCB

- Printed Circuit Board
- Electronic Board that connects circuit components
- PCB populated with electronic components is a printed circuit assembly (PCA)
- PCBs are rugged, inexpensive, and can be highly reliable
- Mass manufacturing
- Professional

Definitions

Elements of A PCB

- Components
- Footprints
- Pads
- Traces
- Vias
- Conducting Layers
- Non-Conducting Layers

Definitions

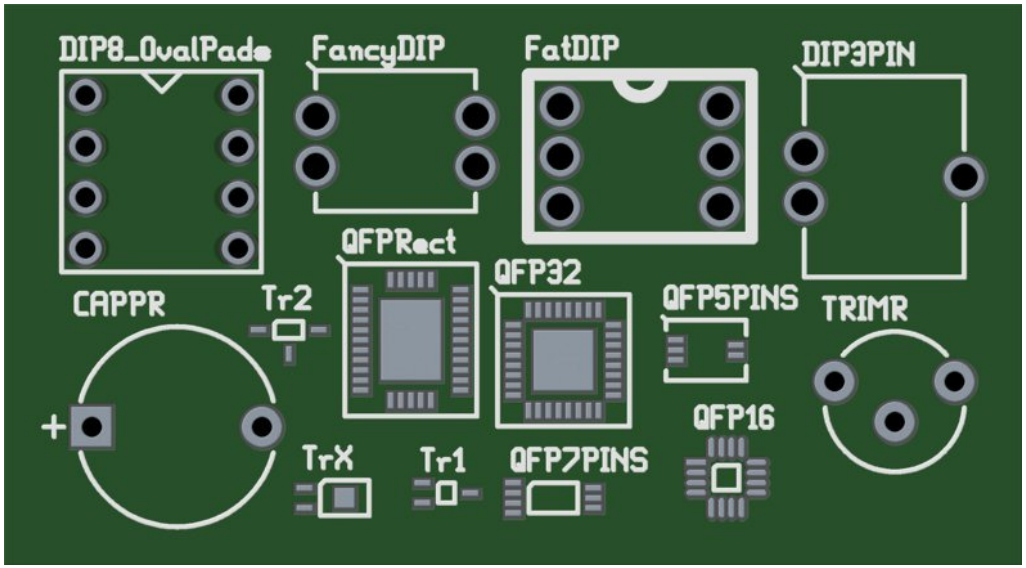
Components

- Components are the actual devices used in the circuit.
- This includes input/output connections.
- I/O ports, including power supply connections, are also important in the PCB design.

Definitions

Footprints

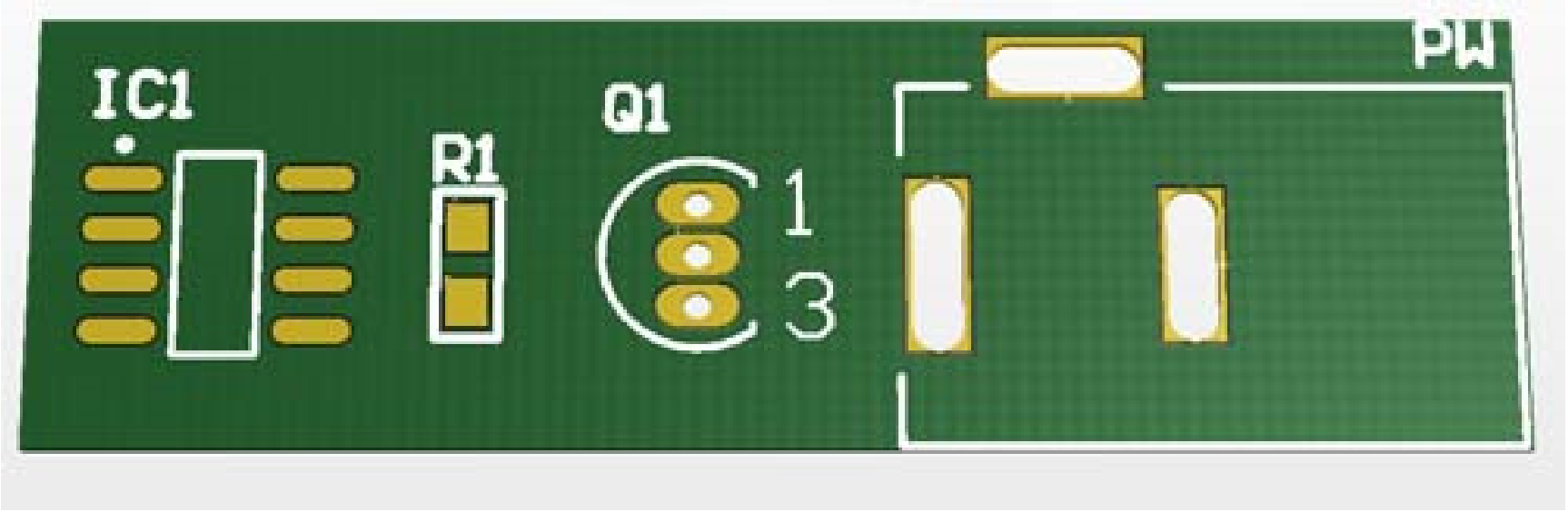
- Footprints are land patterns on PCB Where components are placed and soldered
- Includes pads for I/O pins and metal surfaces
- May include non-metal structures



Definitions

Pads

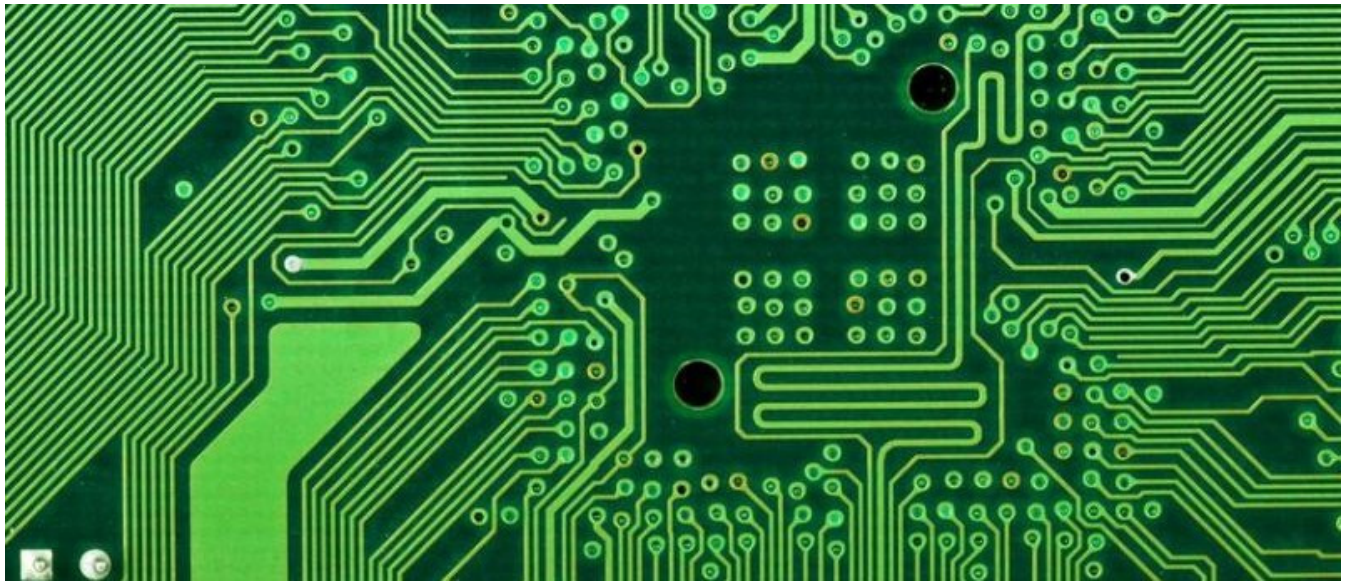
- Location that components connect to.
- You will solder components to the pads on the PCB.
- Pads will connect to traces.
- Pads can be surface pads or through pads.
- Pads have standard types and dimensions



Definitions

Traces

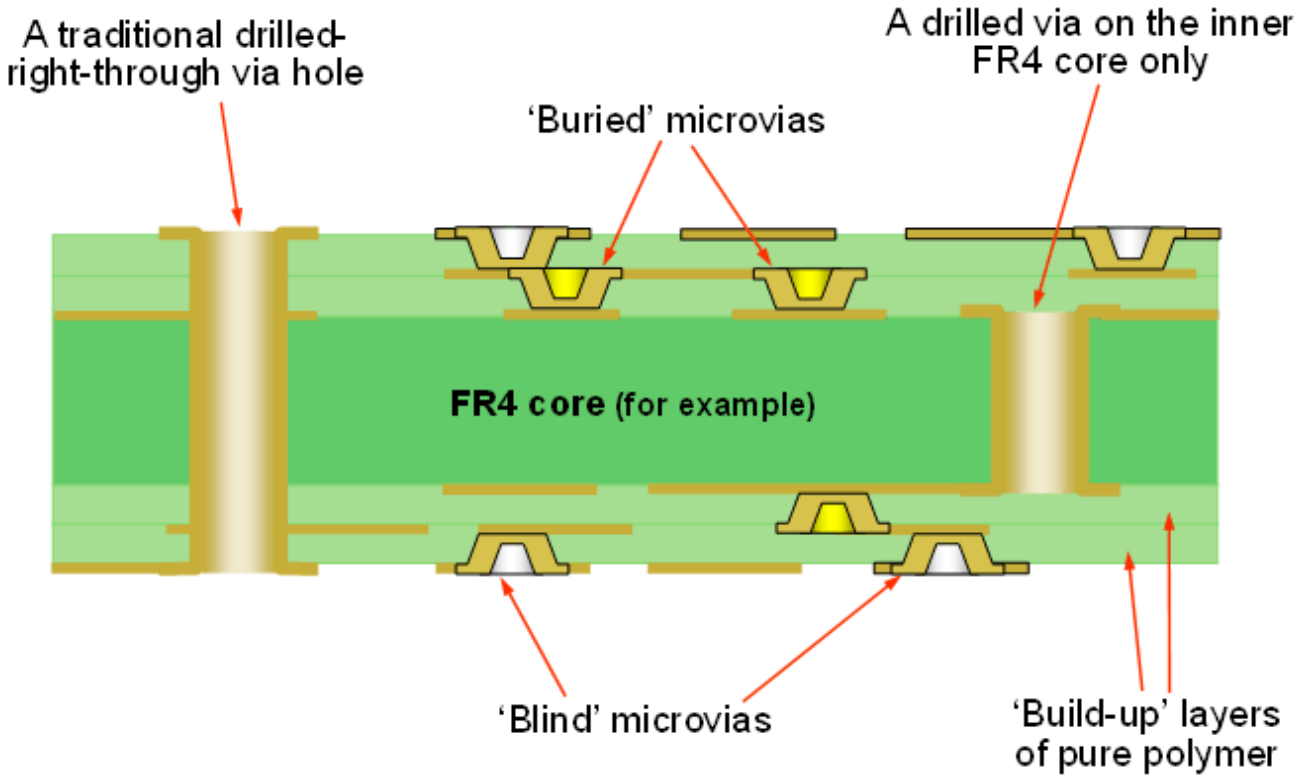
- Traces connect pads together.
- Traces are essentially the wiring of the PCB.
- Traces sometimes connect to vias.
- High current traces should be wide and high voltage traces should be places far apart



Definitions

Via

- Pad with a plated hole connecting traces from one layer of board to other layers.
- Vias can be thru, Blind or buried



Definitions

Metal Layers

- Layers where electrical connections can be made
  - Top Layer (component Layer)

    many components, few traces

  - Bottom Layer (Solder Layer – for single layer board)

    few or no components, many traces, soldering

  - Inner copper Layers (Multi-layer Board)

    usually solid coper planes for power and ground

Definitions

Non-conducting Layers

- Layers where no electrical connections can be made
  - Substrate (core)

    Paper, fiber glass epoxy, special materials
  - Prepeg (thin, unsolidified substrate layer – for ML)

    will be cured and solidified with high pressure press
  - Solder Mask

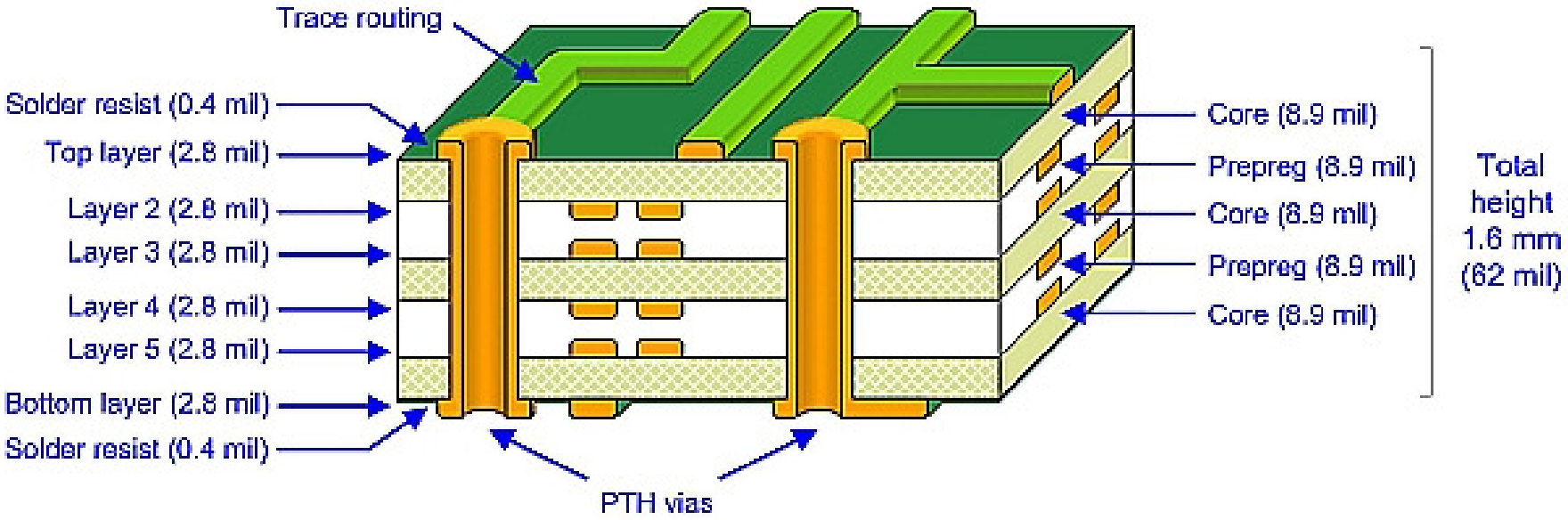
    Thin solder resistant layer (protection and appearance)
  - Silk Screen

    For labeling and putting text on finished PCB

Definitions

Layer Stack-up

- Cross sectional structure of a PCB
- Always in even number of layers



Measurements

Standard Units

- Metric system: mm
- Imperial system: mil (mili-inch)

1 mm = ~ 40mil

PCB Copper weight

- Measured in ounce per square feet (oz/ft2) or simply oz
- 1oz Cu board is roughly 35um thickness of copper cladding

5 - Questions

- ✓How big and what shape?
- ✓Where should the parts be Placed?
- ✓What kind of layer stack-up?
- ✓How wide and how far should traces be?
- ✓What grounding and shielding techniques?

What is the “right” way ?

Standards Organizations

- Institute for Printed Circuits (IPC)

  The main and governing body – 2400+ members
- Electronic Industries Alliance (EIA)

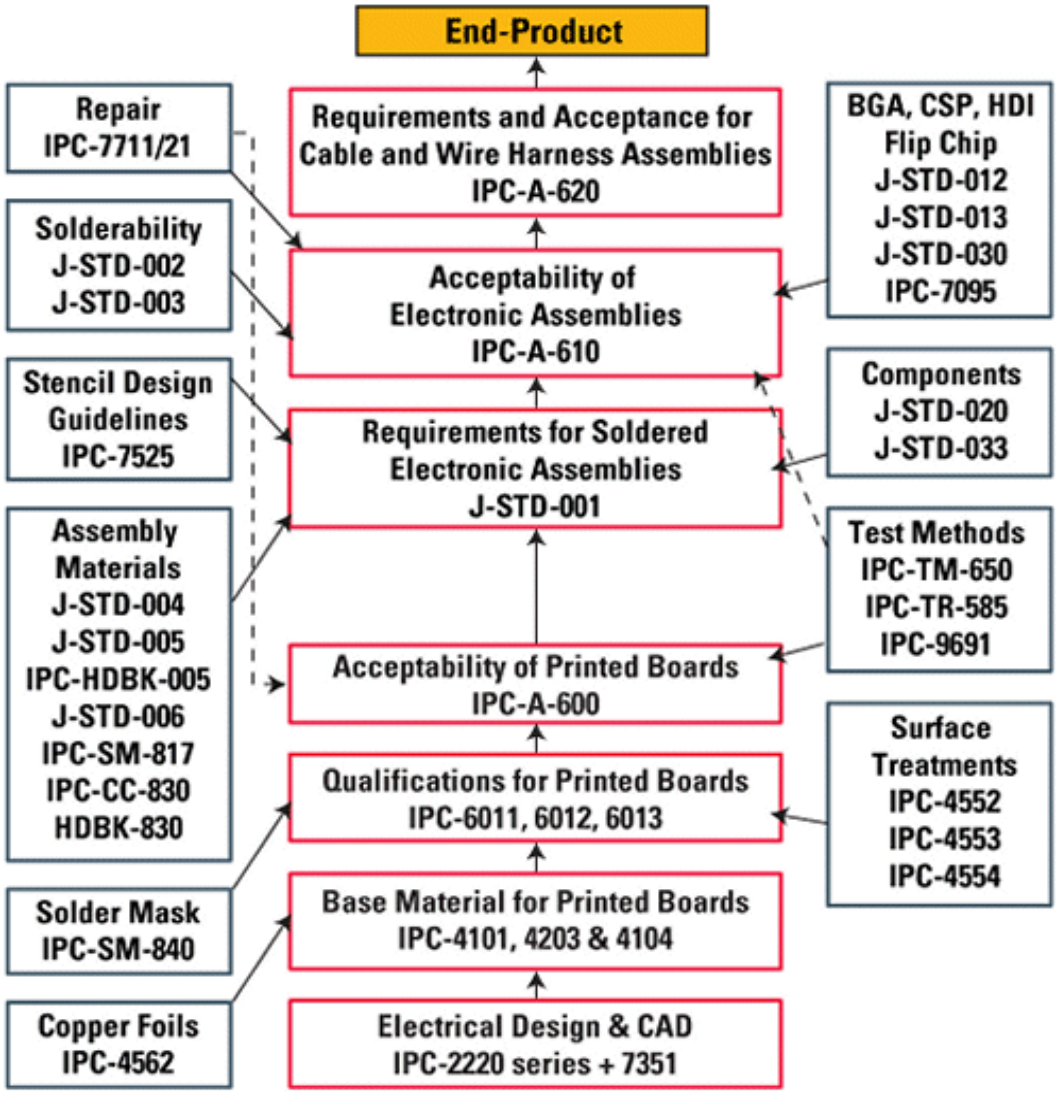
  Umbrella organization for standards like JEDEC
- Joint Electron Device Engineering Council (JEDEC)

  Standard for semiconductor devices and packaging
- International Engineering Consortium (IEC)

  Focus on Research, publication and education
- And Many Others

  ANSI, IEEE, NEMA, etc.

IPC STANDARDS –
EVERYTHING YOU NEED FROM START TO FINISH



Classes of PCBs

Performance Classes

Class 1 – General Electronics Products

- *Consumer Products (TV, PC, games, …)*
- *Not expected to have extended service time and requirements*

Class 2 – Dedicated Service Electronics Products

- *Specific Function (Telecom, Instrumentation, …)*
- *High-perf. Is expected for a longer period of time*

Class 3 – High Reliability Electronics Products

- *High reliability under stress conditions is expected*
- *Medical, military, space… (mission critical applications)*

IPC-7351; IPC-D-330; IPC-CM-770E

Classes of PCBs

Producibility Levels

Level A – General Design

- *Proffered complexity (1/2 layers, thru-via only, …)*

Level B – Moderate Design

- *Standard complexity (up to 6-layer, blind/buried vias,…)*

Level C – High Design

- *Reduced Producibilty design*
- *Intricate designs for specialized systems*

IPC-7351; IPC-D-330; IPC-CM-770E

Classes of PCBs

Fabrication Classes

Type1/2 – Single Sided PCB/Double sided PCB

Type3 – ML PCB without blind or buried vias

Type4 – ML PCB with blind and/or buried vias

Type5 – ML metal-core PCB without blind or buried vias

Type6 – ML metal-core PCB with blind or buried vias

IPC-CM-770E, Sec 1.2.3

Classes of PCBs

Assembly Sub-Classes

Subclass A – Through-hole device (THD) only

Subclass B – Surface Mount device (SMD) only

Subclass C – Mixed THD and SMD (simple)

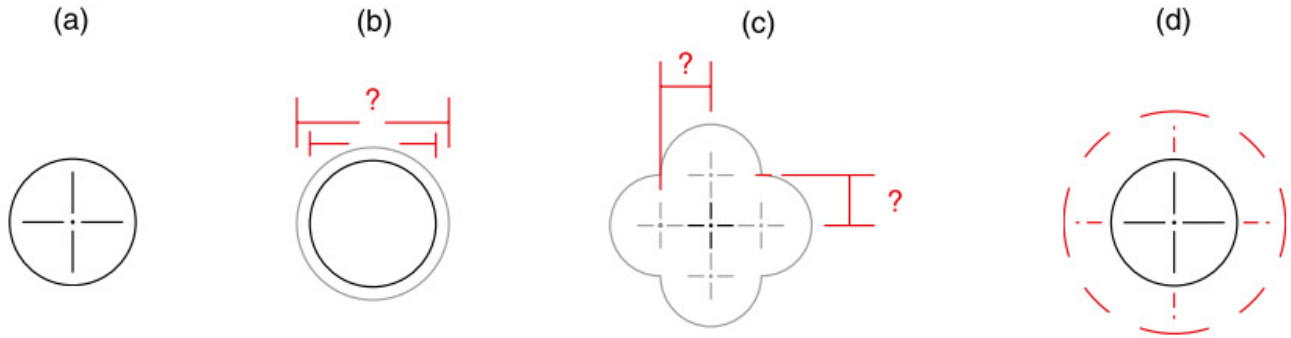
Subclass X – Complex mixed with fine pitch BGA packages

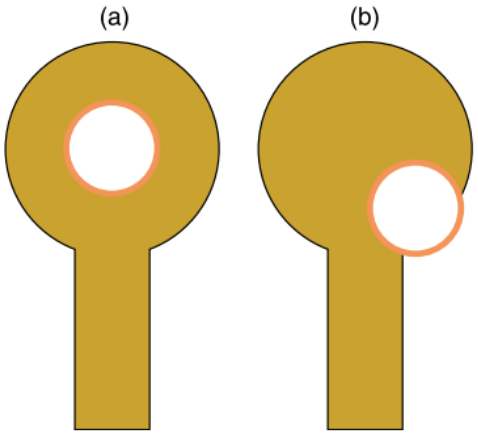
Subclass Y – Complex mixed with ultrafine pitch CSP components

Subclass z – Complex mixed with fine pitch flip-chip packages

IPC-CM-770E, sec 1.2.2

Standard Dimensions





Standard Dimensions

Panel Area

Table 4-1 Standard Copper Clad Panel Sizes

	Number			
Letter	**1**	**2**	**3**	**4**
A	2.4 × 3.2	2.4 × 6.7	2.4 × 10.2	2.4 × 13.8
B	4.7 × 3.2	4.7 × 6.7	4.7 × 10.2	4.7 × 13.8
C	7.1 × 3.2	7.1 × 6.7	7.1 × 10.2	7.1 × 13.8
D	9.5 × 3.2	9.5 × 6.7	9.5 × 10.2	9.5 × 13.8

Sizes are given in inches.

Standard Dimensions

Finished Board Thickness

Table 4-2 Typical Finished Board Thicknesses

Inches	Mils	Millimeters
0.020	20	0.51
0.030	30	0.76
0.040	40	1.02
0.062	62	1.6
0.093	93	2.4
0.125	125	3.2
0.250	250	6.4
0.500	500	12.7

Standard Dimensions

Table 4-6 Nominal and Finished Copper Thickness by Weight and Gauge (±10%)

Area wt (oz/ft^2)	Nominal thickness		Internal minimum finished thickness		External minimum finished thickness	
	(mils)	(mm)	(mils)	(mm)	(mils)	(mm)
0.148 ($^1/_8$)	0.20	0.005	0.12	0.0031	0.91	0.0231
0.25 ($^1/_4$)	0.34	0.009	0.24	0.0062	1.03	0.0262
0.35($^3/_8$)	0.47	0.012	0.37	0.0093	1.15	0.0293
0.50 ($^1/_2$)	0.68	0.017	0.45	0.0114	1.32	0.0334
0.75 ($^3/_4$)	1.01	0.026	0.76	0.0193	1.62	0.0410
1	1.35	0.034	0.98	0.0249	1.89	0.0479
2	2.70	0.069	2.19	0.0557	3.10	0.0787
3	4.05	0.103	3.41	0.0866	4.32	0.110
4	5.40	0.137	4.63	0.118	5.49	0.139
5	6.75	0.171	5.92	0.150	6.32	0.160
6	8.10	0.206	7.13	0.181	7.28	0.185
7	9.45	0.240	8.35	0.212	8.22	0.209
10	13.5	0.343	12.0	0.305	10.9	0.277
14	18.9	0.480	16.9	0.428	14.3	0.364

Standard Dimensions

Etching Tolerance