PCB stackup

[Olney_2010, https://jhdpcb.com/blog/ipc-class-standards/, https://www.ourpcb.com/ipc-class.html]

4 layer stackup

ICD Stackup Planner – www.icd.com.au 20/9/2010

Layer		Material	Dielectric		Copper	Trace		Impedance	Edge Coupled	Broadside Coupled	
Number	Name	Type	Constant	Thickness	Thickness	Clearance	Width	Characteristic(Zo)	Differential(Zdiff)	Differential(Zdbs)	Description
		Dielectric	3.3	0.5							Soldermask
1	Top	Conductive			0.7	12	8	52.21	99.41		Signal
		Dielectric	4.3	5							Prepreg
2	GND	Conductive			1.4						Plane
		Dielectric	4.3	47							Core
3	VCC	Conductive			1.4						Plane
		Dielectric	4.3	5							Prepreg
4	Bottom	Conductive			0.7	12	8	52.21	99.41		Signal
		Dielectric	3.3	0.5							Soldermask

- Most common dielectric material for PCB: FR4
- two forms (often with copper foil on one or both sides):
  - core (cured fiberglass epoxy resin)
  - prepreg (fiberglass with uncured epoxy resin)
    - prepreg is then cured at high temperature and pressure
- some typical PCB stackups are shown in the following

- correct PCB stackup is fundamental for
  - reduced EMI radiation
  - reduced crosstalk
  - improved signal integrity

6 layer stackup

Buried layers: high speed signals
Surface layers: low speed signals

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Layer		Material	Dielectric		Copper	Trace		Impedance	Edge Coupled	Broadside Coupled	
Number	Name	Type	Constant	Thickness	Thickness	Clearance	Width	Characteristic(Zo)	Differential(Zdiff)	Differential(Zdbs)	Description
		Dielectric	3.3	0.5							Soldermask
1	Top	Conductive			0.7	8	12	54.82	89.48		Signal
		Dielectric	4.3	8							Prepreg
2	GND	Conductive			1.4						Plane
		Dielectric	4.3	14							Core
3	Inner 3	Conductive			0.7	8	12	52.64	84.43	76.95	Signal
		Dielectric	4.3	12							Prepreg
4	Inner 4	Conductive			0.7	8	12	52.64	84.43	76.95	Signal
		Dielectric	4.3	14							Core
5	VCC	Conductive			1.4						Plane
		Dielectric	4.3	8							Prepreg
6	Bottom	Conductive			0.7	8	12	54.82	89.48		Signal
		Dielectric	3.3	0.5							Soldermask

8 layer stackup

For improved EMC performance wrt 6 layer stackup

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Layer		Material	Dielectric		Copper	Trace		Impedance	Edge Coupled	Broadside Coupled	
Number	Name	Type	Constant	Thickness	Thickness	Clearance	Width	Characteristic(Zo)	Differential(Zdiff)	Differential(Zdbs)	Description
		Dielectric	3.3	0.5							Soldermask
1	Top	Conductive			0.7	5	5	50.05	90.4		Signal
		Dielectric	4.3	3							Prepreg
2	GND	Conductive			1.4						Plane
		Dielectric	4.3	6							Core
3	Inner 3	Conductive			0.7	5	5	48.25	85.81		Signal
		Dielectric	4.3	6							Prepreg
4	VDD	Conductive			1.4						Plane
		Dielectric	4.3	24							Core
5	GND	Conductive			1.4						Plane
		Dielectric	4.3	6							Prepreg
6	Inner 6	Conductive			0.7	5	5	48.25	85.81		Signal
		Dielectric	4.3	6							Core
7	VCC	Conductive			1.4						Plane
		Dielectric	4.3	3							Prepreg
8	Bottom	Conductive			0.7	5	5	50.05	90.4		Signal
		Dielectric	3.3	0.5							Soldermask

IPC standards

- IPC is the global association that helps manufacturers and electronics industry suppliers to build better electronics
- IPC issues several standards, among which
  - IPC-2221: the most commonly used PCB process standard guide in the IPC 2220 design standard series
    - it covers topics such as design layout, parts list, materials, mechanical and physical properties, electrical properties, thermal management, and more
  - IPC-6012: establishes qualification and performance specifications for rigid printed boards
    - it provides requirements for rigid PCB processes in various materials in the areas of structural integrity, solderability, and conductor spacing

Definitions of IPC Class 1, 2, or 3

In the production of electronic products, the IPC level of PCB is divided into three categories

- *CLASS 1 — General Electronics.* Boards with the lowest quality requirements, mostly found in products with an expected short life cycle
  - These products have simple functions and short lifespan
  - Day-to-day electronic products that we have at home and are easy to find: TV remote controls, LED lights, and children’s toys

Definitions of IPC Class 1, 2, or 3

- *CLASS 2 — Dedicated Service Electronic Products*. Electronics where continued performance and an extended life cycle is required — to a point
  - Uninterrupted service is desired, but not critical
  - extended lifespan, higher reliability
    - products go through stringent standards in their manufacturing
  - Boards are not highly critical
  - Devices such as tablets, communication equipment, laptops, and smartphones

Definitions of IPC Class 1, 2, or 3

- *CLASS 3 — High Reliability Electronics.* Circuit boards subject to strict guidelines due to their importance in the field
  - High-reliability electronic components to ensure uninterrupted service
  - Class 3 products undergo a high level of inspection to ensure that they are reliable and dependable
  - Electronic manufacturing systems, support systems, and military devices

Definitions of IPC Class 1, 2, or 3

- *IPC 6012 3 / A-Level - Advanced Electronic Products:* Military avionics and space equipment
  - A- Level is the highest Class of PCBs and undergoes a stringent manufacturing process
  - Much expensive to design and produce
  - Missile systems, military airborne systems, and aerospace applications