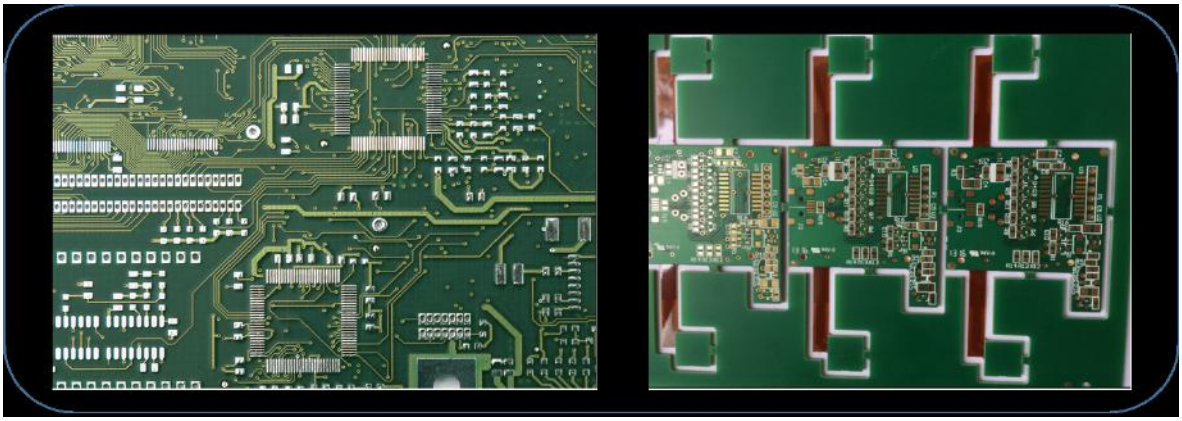
4-16 Layer PCB Stackup

In this pdf file, you can see the most common 7 kinds of multilayer PCB configurations.

There is really no limit to the number of layers that can be fabricated in a multilayer PCB. Of course, the board thickness increases as the layer count goes up to accommodate the minimum thickness of materials used. Also the aspect ratio (board thickness to smallest hole diameter) has to be considered. Generally this is 10:1 for boards thicker then 100MIL.

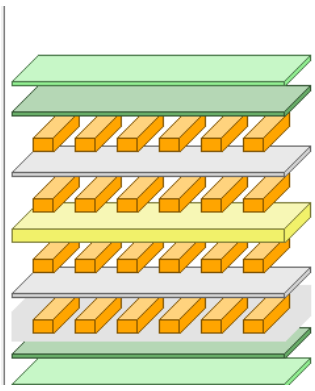


4 Layer PCB Stackup

A typical 4 layer PCB board stackup includes two routing layers and two internal planes, one for ground and the other for power.

It is common to see 4 layer boards stacked evenly. Another common mistake is to have the planes closely coupled in the centre with large dielectrics between the signal layers and planes.

To improve the EMC performance of a 4 layer PCB board, it is best to space the signal layers as close to the planes as possible (< 10 MIL), and use a large core (~ 40 MIL) between the power and ground plane keeping the overall thickness of the substrate to ~ 62 MIL.

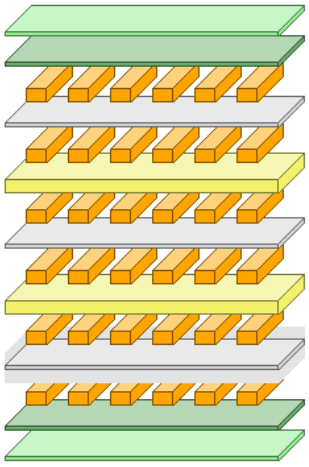


Layer Name	Type	Material	Thickness (mm)	Dielectric Material	Dielectric Constant
Top Overlay 1	Overlay				
Top Solder 1	Solder Mask/...	Surface Mate...	0.01016	Solder Resist	3.5
Top Layer	Signal	Copper	0.035		
Dielectric1	Dielectric	Prepreg	0.185		4.2
Signal Layer 1	Signal	Copper	0.035		
Dielectric 3	Dielectric	Core	1.15	FR4	4.2
Signal Layer 2	Signal	Copper	0.035		
Dielectric 2	Dielectric	Prepreg	0.185		4.2
Bottom Layer	Signal	Copper	0.035		
Bottom Solder 1	Solder Mask/...	Surface Mate...	0.01016	Solder Resist	3.5
Bottom Overl...	Overlay				

4 Layer PCB Stackup

6 Layer PCB Stackup

The classic 6 layer PCB stackup includes 4 routing layers (two outer and two internal) and two internal planes (one for ground and the other for power). This improves the EMI dramatically as it provides two buried layers for high-speed signals and two surface layers for routing low speed signals.

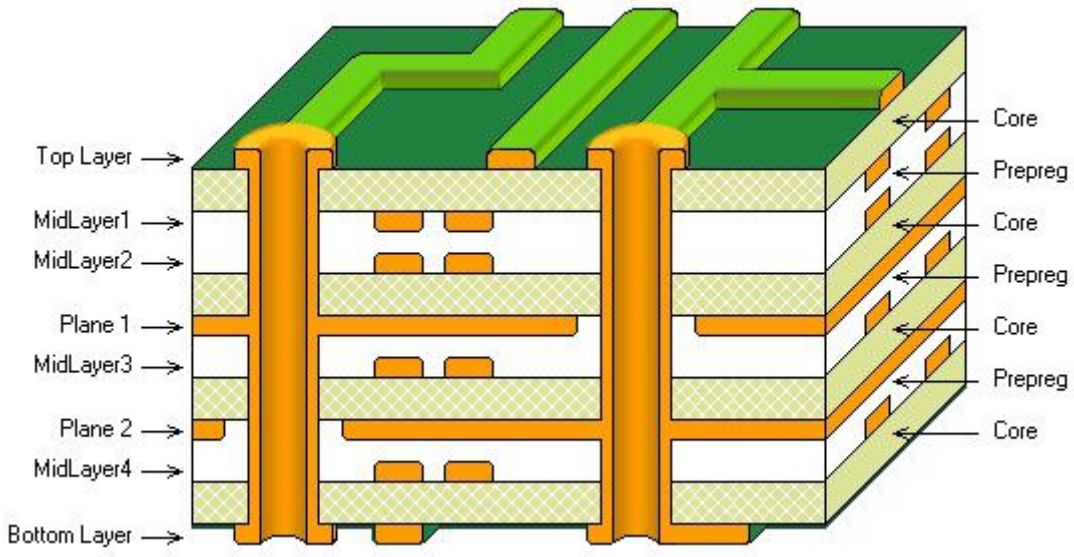


Layer Name	Type	Material	Thickness (mm)	Dielectric Material	Dielectric Constant
Top Overlay 1	Overlay				
Top Solder 1	Solder Mask/...	Surface Mate...	0.01016	Solder Resist	3.5
Top Layer	Signal	Copper	0.035		
Dielectric1	Dielectric	Prepreg	0.185		4.2
Signal Layer 1	Signal	Copper	0.035		
Dielectric 3	Dielectric	Core	0.4	FR4	4.2
Signal Layer 2	Signal	Copper	0.035		
Dielectric 2	Dielectric	Prepreg	0.185		4.2
Signal Layer 3	Signal	Copper	0.035		
Dielectric 5	Dielectric	Core	0.4	FR4	4.2
Signal Layer 4	Signal	Copper	0.035		
Dielectric 4	Dielectric	Prepreg	0.185		4.2
Bottom Layer	Signal	Copper	0.035		
Bottom Solder 1	Solder Mask/...	Surface Mate...	0.01016	Solder Resist	3.5
Bottom Overl...	Overlay				

6 Layer PCB Stackup

8 Layer PCB Stackup

To improve EMC performance, add two more planes to the 6 layer PCB stackup. It is not recommended to have more then two adjacent signal layers between the planes as this creates impedance discontinuities (~20 ohms difference in impedance of signal layers) and increases crosstalk between these signal layers.



8 Layer PCB Stackup

10 Layer PCB Stackup

A 10 layer PCB board should be used when 6 routing layers and 4 planes are required and EMC is of concern. This typical 10 layer PCB stackup is ideal because of the tight coupling of the signal and return planes, the shielding of the high speed signal layers, the existence of multiple ground planes, as well as a tightly coupled power/ground plane pair in the center of the board. High speed signals normally would be routed on the signal layers buried between planes (layers 3-4 and 7-8 in this case).

UNITS: MIL											Total Board Thickness: 62
Layer		Material	Dielectric		Copper	Trace		Current	Impedance	Edge Coupled	Broadside Coupled	
Number	Name	Type	Constant	Thickness	Thickness	Clearance	Width	(Amps)	Characteristic(Zo)	Differential(Zdiff)	Differential(Zdbs)	Description
		Dielectric	3.3	0.5								Soldermask
1	Top	Conductive			1.4	7	4	0.31	53.53	98.54		Signal
		Dielectric	4.3	3								Prepreg
2	GND	Conductive			1.4							Plane
		Dielectric	4.3	5								Core
3	Inner 3	Conductive			1.4	7	4	0.31	50.69	90.13	66.78	Signal
		Dielectric	4.3	5								Prepreg
4	Inner 4	Conductive			1.4	7	4	0.31	50.69	90.13	66.78	Signal
		Dielectric	4.3	5								Core
5	VDD	Conductive			1.4							Plane
		Dielectric	4.3	12								Prepreg
6	GND	Conductive			1.4							Plane
		Dielectric	4.3	5								Core
7	Inner 7	Conductive			1.4	7	4	0.31	50.69	90.13	66.78	Signal
		Dielectric	4.3	5								Prepreg
8	Inner 8	Conductive			1.4	7	4	0.31	50.69	90.13	66.78	Signal
		Dielectric	4.3	5								Core
9	VCC	Conductive			1.4							Plane
		Dielectric	4.3	3								Prepreg
10	Bottom	Conductive			1.4	7	4	0.31	53.53	98.54		Signal
		Dielectric	3.3	0.5								Soldermask

10 Layer PCB Stackup

12 Layer PCB Stackup

12 layers is the largest number of layers that can usually be conveniently fabricated in a 62MIL thick board. Occasionally you will see 14 to 16 layer boards fabricated as a 62MIL thick board, but the numbers of fabricators capable of producing them are limited to those that can produce HDI boards.

Layer		Material	Dielectric		Copper	Trace		Current	Impedance	Edge Coupled	Broadside Coupled	
Number	Name	Type	Constant	Thickness	Thickness	Clearance	Width	(Amps)	Characteristic(Zo)	Differential(Zdiff)	Differential(Zdbs)	Description
		Dielectric	3.3	12.7								Soldermask
1	Top	Conductive			33	100	100	0.22	54.13	90.76		Signal
		Dielectric	4.3	76								Prepreg
2	GND	Conductive			17							Plane
		Dielectric	4.3	127								Core
3	Inner 3	Conductive			17	100	100	0.13	51.77	89.6	65.26	Signal
		Dielectric	4.3	127								Prepreg
4	Inner 4	Conductive			17	100	100	0.13	51.77	89.6	65.26	Signal
		Dielectric	4.3	127								Core
5	VDD	Conductive			17							Plane
		Dielectric	4.3	127								Prepreg
6	Inner 6	Conductive			17	100	100	0.13	52.04	89.94	70.54	Signal
		Dielectric	4.3	150								Core
7	Inner 7	Conductive			17	100	100	0.13	52.04	89.94	70.54	Signal
		Dielectric	4.3	127								Prepreg
8	GND	Conductive			17							Plane
		Dielectric	4.3	127								Core
9	Inner 9	Conductive			17	100	100	0.13	51.77	89.6	65.26	Signal
		Dielectric	4.3	127								Prepreg
10	Inner 10	Conductive			17	100	100	0.13	51.77	89.6	65.26	Signal
		Dielectric	4.3	127								Core
11	VCC	Conductive			17							Plane
		Dielectric	4.3	76								Prepreg
12	Bottom	Conductive			33	100	100	0.22	54.13	90.76		Signal
		Dielectric	3.3	12.7								Soldermask

12 Layer PCB Stackup

14 Layer PCB Stackup

The 14 layer PCB stackup is used when 8 routing (signal) layers are required plus special shield of critical nets is required. Layers 6 and 9 provide isolation for sensitive signals while layers 3 & 4 and 11 & 12 provide shielding for high speed signals.

Layer		Material	Dielectric		Copper	Trace		Current	Impedance	Edge Coupled	Broadside Coupled	
Number	Name	Type	Constant	Thickness	Thickness	Clearance	Width	(Amps)	Characteristic(Zo)	Differential(Zdiff)	Differential(Zdbs)	Description
		Dielectric	3.3	12.7								Soldermask
1	Top	Conductive			33	100	100	0.22	54.13	90.76		Signal
		Dielectric	4.3	76								Prepreg
2	GND	Conductive			17							Plane
		Dielectric	4.3	127								Core
3	Inner 3	Conductive			17	100	100	0.13	51.14	88.83	48.98	Signal
		Dielectric	4.3	76								Prepreg
4	Inner 4	Conductive			17	100	100	0.13	51.14	88.83	48.98	Signal
		Dielectric	4.3	127								Core
5	VDD	Conductive			17							Plane
		Dielectric	4.3	100								Prepreg
6	Inner 6	Conductive			17	100	100	0.13	46.19	74.69		Signal
		Dielectric	4.3	127								Core
7	VCC	Conductive			17							Plane
		Dielectric	4.3	76								Prepreg
8	GND	Conductive			17							Plane
		Dielectric	4.3	127								Core
9	Inner 9	Conductive			17	100	100	0.13	46.19	74.69		Signal
		Dielectric	4.3	100								Prepreg
10	VSS	Conductive			17							Plane
		Dielectric	4.3	127								Core
11	Inner 11	Conductive			17	100	100	0.13	51.14	88.83	48.98	Signal
		Dielectric	4.3	76								Prepreg
12	Inner 12	Conductive			17	100	100	0.13	51.14	88.83	48.98	Signal
		Dielectric	4.3	127								Core
13	VCC	Conductive			17							Plane
		Dielectric	4.3	76								Prepreg
14	Bottom	Conductive			33	100	100	0.22	54.13	90.76		Signal
		Dielectric	3.3	12.7								Soldermask

14 Layer PCB Stackup

16 Layer PCB Stackup

A 16 layer PCB provides 10 layers of routing and is normally used for extremely dense designs. Generally, you see 16 layer PCBs where the routing technology used in the EDA application.

Layer		Material	Dielectric		Copper	Trace		Current	Impedance	Edge Coupled	Broadside Coupled	
Number	Name	Type	Constant	Thickness	Thickness	Clearance	Width	(Amps)	Characteristic(Zo)	Differential(Zdiff)	Differential(Zdbs)	Description
		Dielectric	3.3	12.7								Soldermask
1	Top	Conductive			33	100	100	0.22	54.13	90.76		Signal
		Dielectric	4.3	76								Prepreg
2	GND	Conductive			17							Plane
		Dielectric	4.3	127								Core
3	Inner 3	Conductive			17	100	100	0.13	51.14	88.83	48.98	Signal
		Dielectric	4.3	76								Prepreg
4	Inner 4	Conductive			17	100	100	0.13	51.14	88.83	48.98	Signal
		Dielectric	4.3	127								Core
5	VDD	Conductive			17							Plane
		Dielectric	4.3	127								Prepreg
6	Inner 6	Conductive			17	100	100	0.13	51.14	88.83	48.98	Signal
		Dielectric	4.3	76								Core
7	Inner 7	Conductive			17	100	100	0.13	51.14	88.83	48.98	Signal
		Dielectric	4.3	127								Prepreg
8	VCC	Conductive			17							Plane
		Dielectric	4.3	127								Core
9	GND	Conductive			17							Plane
		Dielectric	4.3	127								Prepreg
10	Inner 10	Conductive			17	100	100	0.13	51.14	88.83	48.98	Signal
		Dielectric	4.3	76								Core
11	Inner 11	Conductive			17	100	100	0.13	51.14	88.83	48.98	Signal
		Dielectric	4.3	127								Prepreg
12	VSS	Conductive			17							Plane
		Dielectric	4.3	127								Core
13	Inner 13	Conductive			17	100	100	0.13	51.14	88.83	48.98	Signal
		Dielectric	4.3	76								Prepreg
14	Inner 14	Conductive			17	100	100	0.13	51.14	88.83	48.98	Signal
		Dielectric	4.3	127								Core
15	VCC	Conductive			17							Plane
		Dielectric	4.3	76								Prepreg
16	Bottom	Conductive			33	100	100	0.22	54.13	90.76		Signal
		Dielectric	3.3	12.7								Soldermask

16 Layer PCB Stackup

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