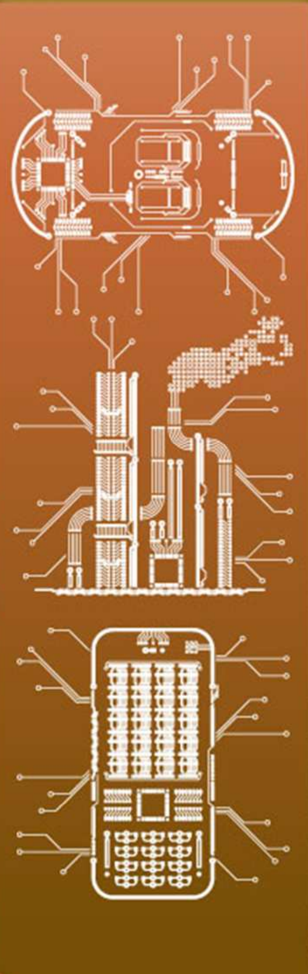
AT&S



2.5D® Technology Platform
The New Dimension

® Registered Trademark AT 257759

www.ats.net

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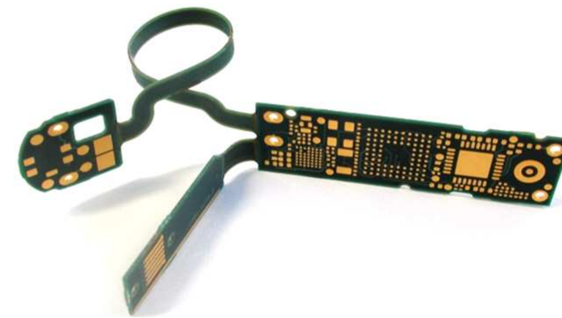
Agenda

Basic Principle 2.5D®

Applications 2.5D®

- Cavity 2.5DC
- Rigid-flex 2.5DR
- Pipe 2.5DP



2.5D® = 2D manufacturing

for 3D application

What is 2.5D® Technology

2.5D® = Core competence + Feature + Benefit

Core Competence AT&S

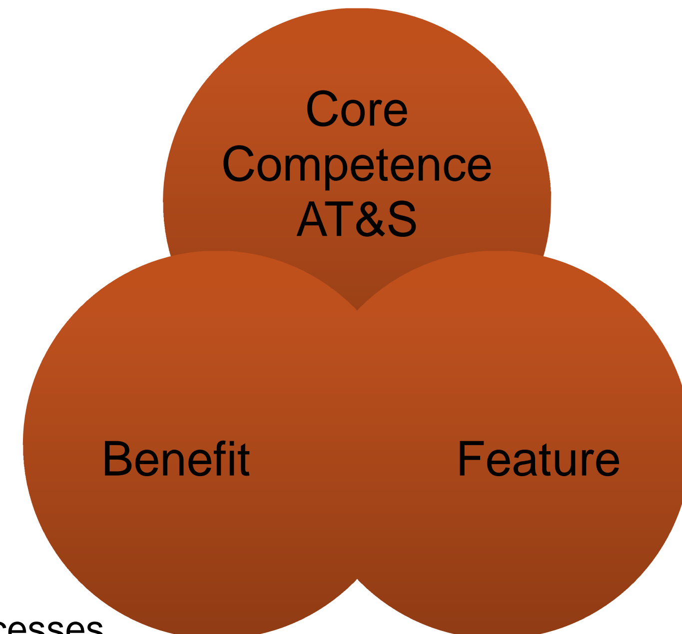
- HDI Design rules
- High thermal reliability (Reflow, TCT)
- High mechanical reliability (Drop Test)

Feature

- Cavities
- Rigid-flex (flex-to-install)
- 3D Channel
- Etc.

Benefit

- Cost advantage by using rigid PCB materials and processes



Source: AT&S

Basic Principle

1. Starting with Laminate

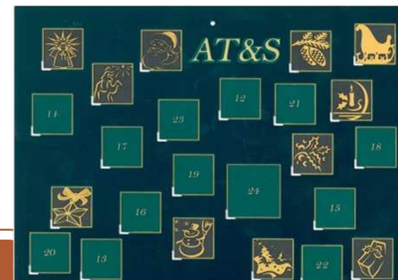
2. Printing Release Layer

3. Construct PCB

4. Laser Cutting

5. Cap Removal

6. Stripping Release Layer



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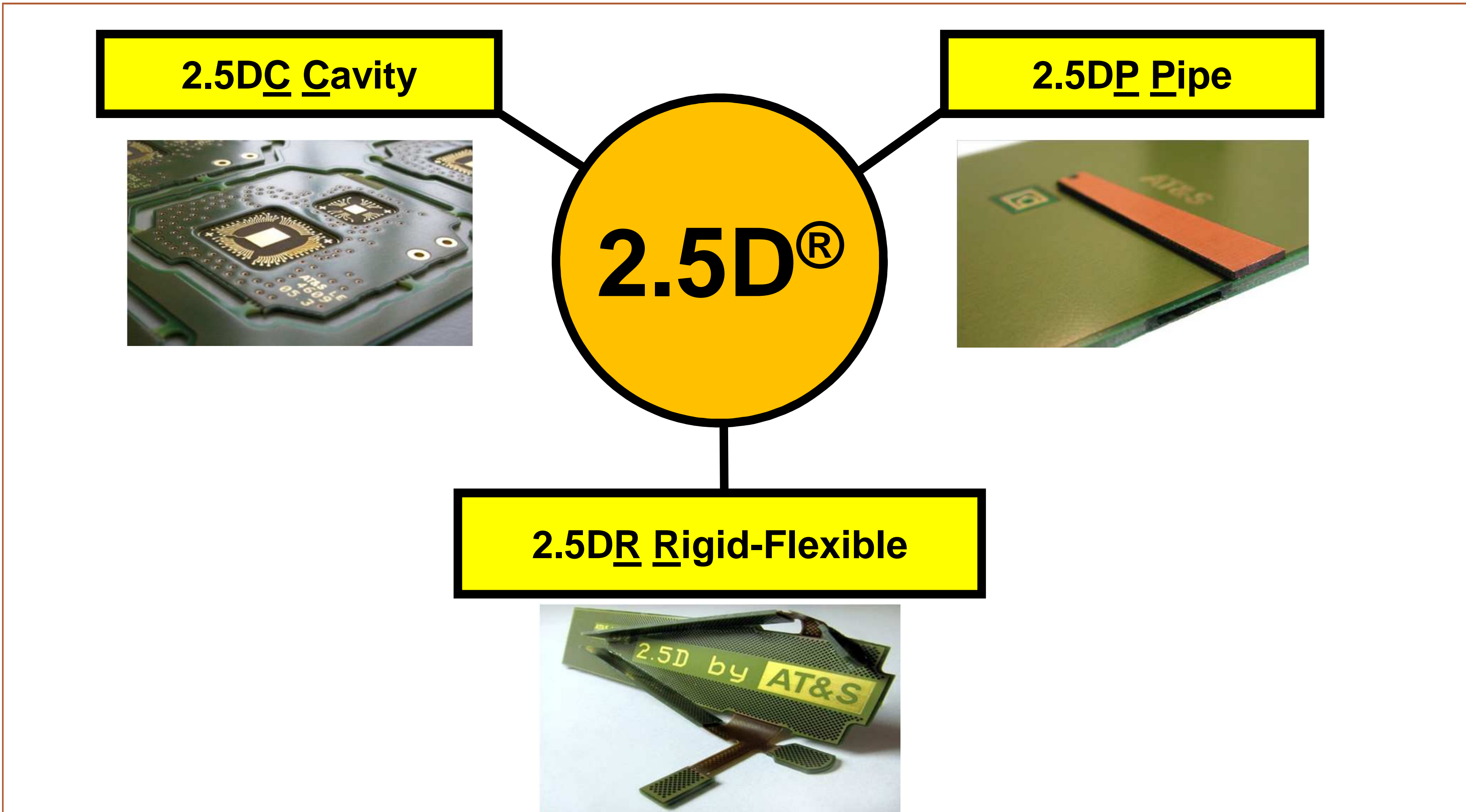
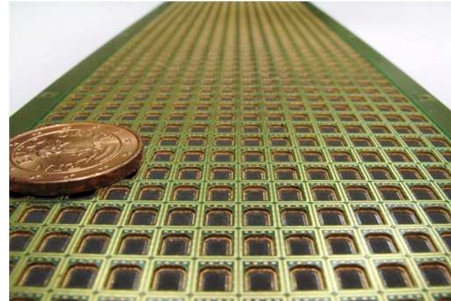
Technology Platform



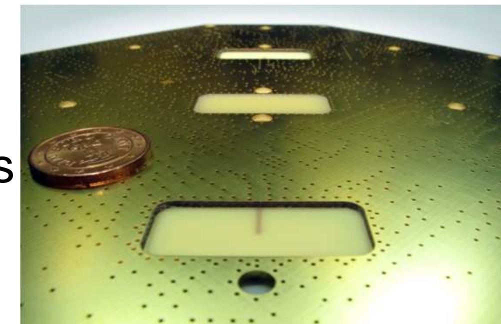
2.5DC Cavity Formation

Reasons for Cavities

Enhance thermal management
by removing PCB material



Enhance radio performance
by removing PCB material below antennas

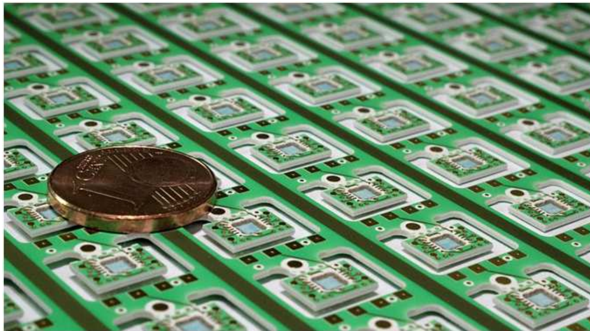


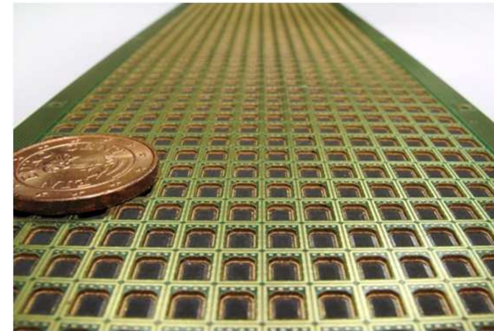
Reduce the thickness of an assembled device
by recessing "thick" components

2.5DC Cavity Formation

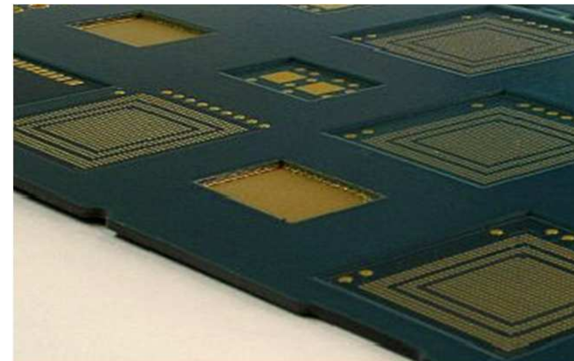
Advantages

No limitations in base materials (eg. High Frequency, High Tg halogen reduced)





No limitations in shape and depth of cavity

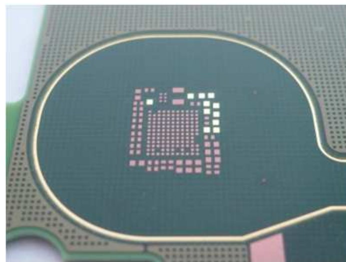


Source: AT&S

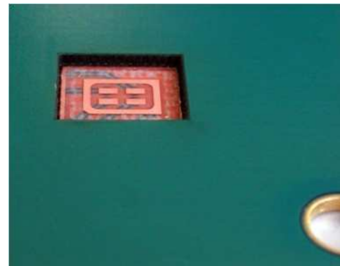
2.5DC Cavity Formation

Advantages

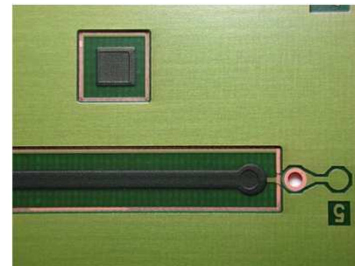
No limitations in surface finish (eg. ENiG, OSP,…)



SIT finishing

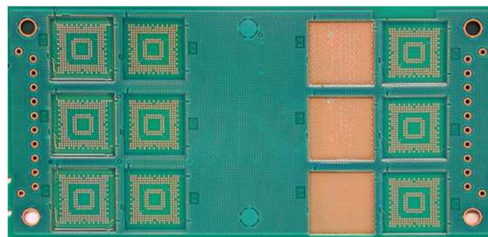


OSP finishing



Carbon

Much higher accuracy in depth control - Several depths can be achieved in 1 card



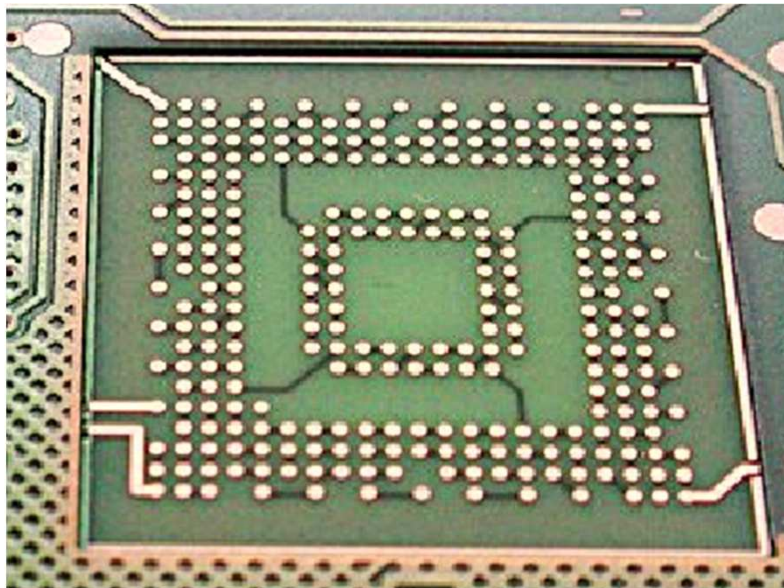
3-2-3 with stacked vias

3 1 5 2 layers removed

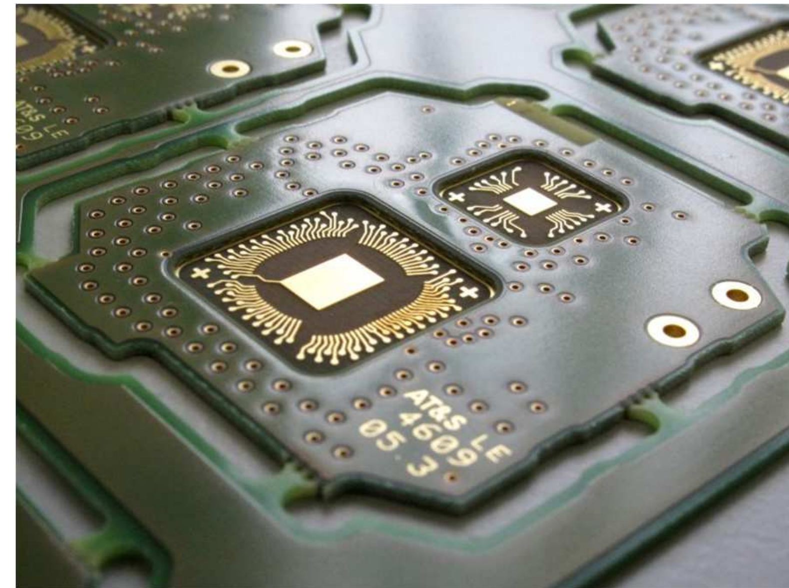
2.5DC Cavity Formation

Advantages

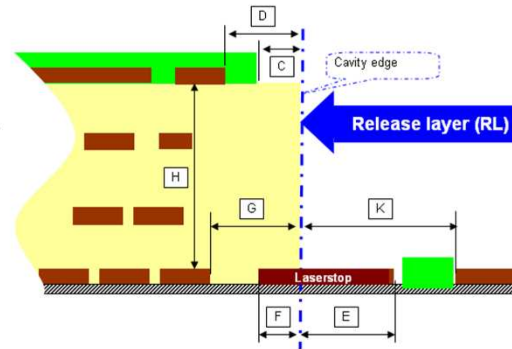
Solder mask in cavity



Fan out of cavity layer with vias



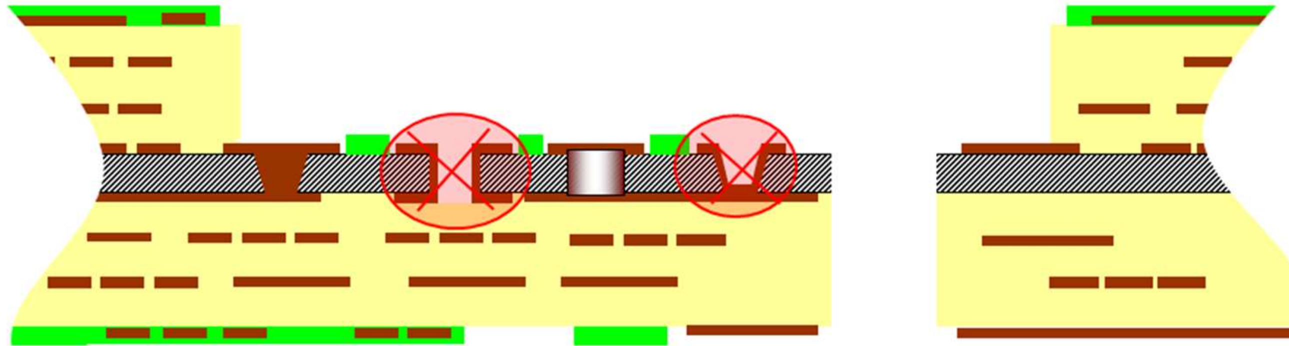
2.5DC Design Rules



Item	Description	Value [µm]
A	Min. Trace Width (inside cavity)	60
B	Min. Spacing (inside cavity)	60
C	Min. Space between SM and Cavity edge(outside cavity)	75
D	Min. Space between Cavity edge to Cu edge (EP outside Cavity)	150
E	Min. Laser Stop Width inside Cavity	350
F	Min. Laser Stop Width outside Cavity	100
G	Min. Space between Cavity edge to Cu edge (Outside Cavity)	250
H	Min. Cavity Depth	50
	Max. Cavity Depth	750
K	Min. Space between Cavity edge to Cu edge (Inside Cavity)	1000
X	Min. Cavity Width	1000
	Max. Cavity Width	no limitation
	Tolerance (+/-)	-0,25
Y	Min. Cavity Width	1000
	Max. Cavity Width	no limitation
	Tolerance (+/-)	-0,25

Source: AT&S

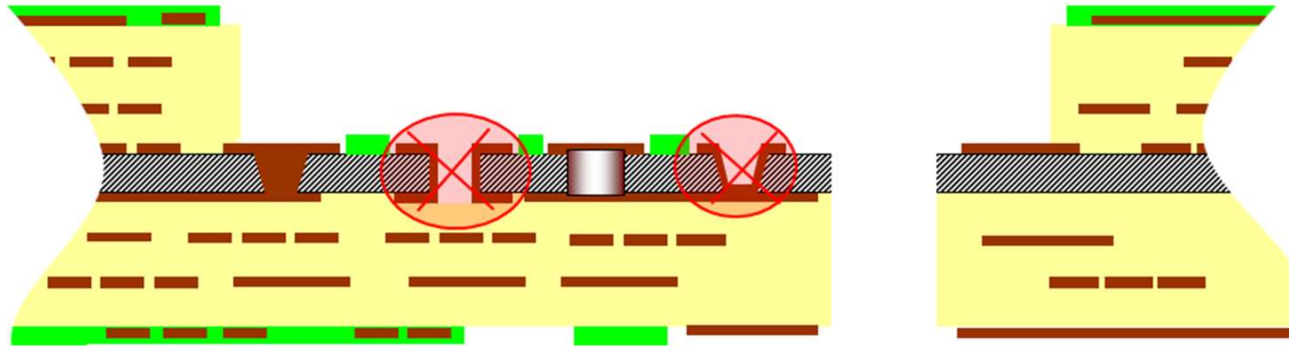
2.5DC Design Rules



Technical Feature	Status	Comment
Cavity design (Laminate)	approved	---
Cavity design (full copper)	approved	---
Cavity design (cross hetched copper)	approved	---
Cavity design (BGA pad with track)	approved	---
Cavity design (SMT pad with track)	approved	---
Track through laserstop layer	not recommended	Laserstop layer under Track in next lower layer needed
Min. Cu Thickness of Cavity Layer	15µm	---
Max. Cu Thickness of Cavity Layer	35µm	---

Source: AT&S

2.5DC Design Rules



Technical Feature	Status	Comment
Copper Filled Laservias in Cavity	approved	---
Standard plated Laservias in Cavity	not approved	---
Buried Holes in Cavity	approved	have to be filled (plugged or copper filled buried)
Non Plated Mechanical Holes and Slot	not recommended	position tolerance +/- 75µm
Plated Mechanical Holes in Cavity	not recommended	---
Routing from Inside to Outside Cavity	approved	---
Routing Inside Cavity	approved	600µm mininum spacing cavity to design
Min. Spacing Outside Cavity to Mechanical Hole	diameter of hole + 400µm	---
Min. Spacing Outside Cavity to Laser Via	diameter of hole + 330µm	---

Source: AT&S

2.5DR Rigid-flexible

Flexible outer layer(s)

Usage of standard material

- Developed for "thin" build up layers (40-60µm)

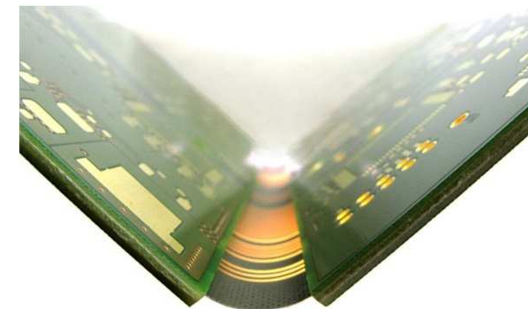
Symmetrical build up with 1 or 2 flexible layers

Polyimide PI free → **No baking process needed**

No Damage of Flexible layers →**Increased Bending Performance**

No special materials →**Cost advantage**

HDI design rules remain the same (also in flexible layers)



2.5DR Rigid-flexible

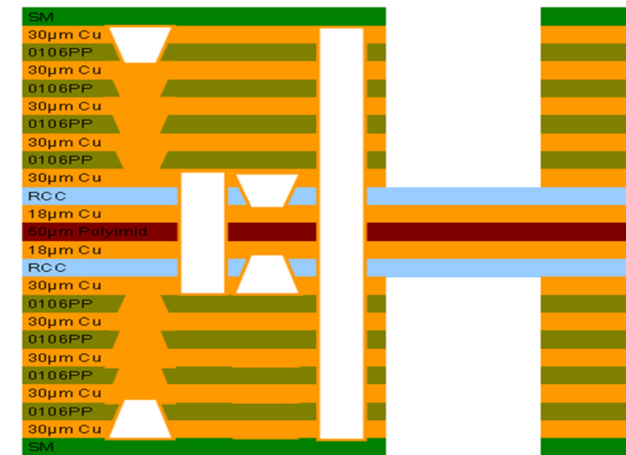
Flexible inner layer(s)

Combination of Polyimide and FR4 materials
- 100% FR4 solution in place
- → No baking process needed

High potential for miniaturization with full Polyimide build up

Symmetrical build up with Prepregs, RCC-foils

HDI design rules remain the same



2.5DR Desgin Rules

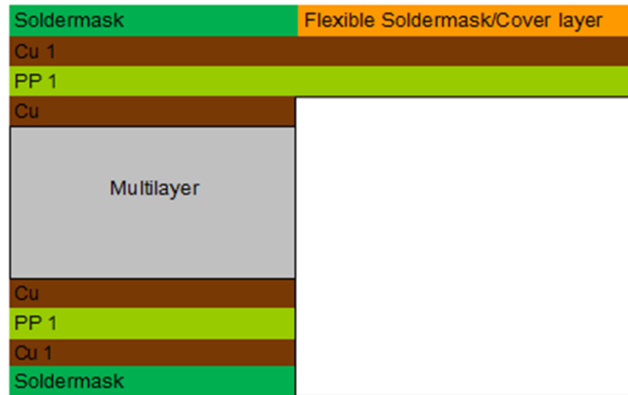
2 center layers

Feature	Value	Comment
Flexible Core	Polyimid: >=50µm	
	FR4: 50-75µm	Polyimid-free Build up
Cu 1	18-35µm	
RCC- Foil	55-75µm	
Cu RCC	18-35µm	can be used for Design has to be adjusted according laser cut depth
PP X	According Stack up	maximum 4 relaminations maimum total thickness: 1,6mm
Cu X	According Design	
Bending Diameter (5x Bending 180°)	Polyimid 50µm: > 2mm	No dynamic bending or folding, no airgap
	FR4 50-75µm: > 3mm	

Source: AT&S

2.5DR Desgin Rules

1 outer layer

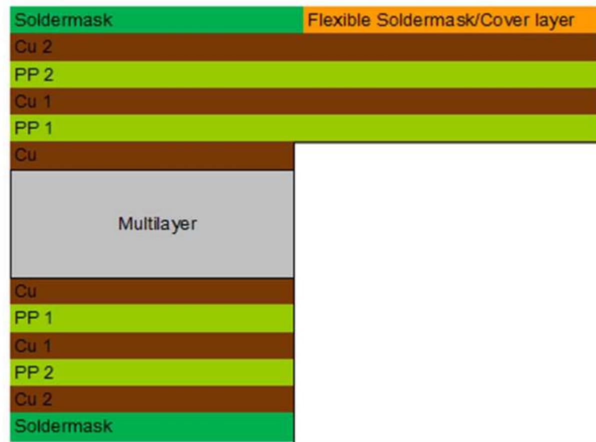


Feature	Value	Comment
Multilayer	>=2 Layers	
PP 1	Glass cloth 106 or 1080	
Cu 1 / Lötstoppmaske	<50µm: Flexible Soldermask >50µm: Cover Layer	flexible Soldermask --> Polyimide-free Build No cross hatched design in flexible area
Bending radius (5x Bending 180°)	> 3mm	

Source: AT&S

2.5DR Desgin Rules

2 outer layers

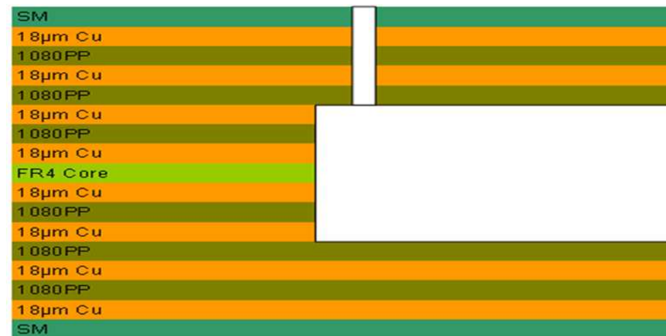


Feature	Value	Comment
Multilayer	>=2 Layers	
PP 1	Glass cloth 106 or 1080	
Cu 1	<50µm	
PP 2	Glasgewebe 106 oder 1080	
Cu 2 / Soldermask	<50µm: Flexible Soldermask >50µm: Cover Layer	flexible Soldermask --> Polyimide-free Build No cross hatched design in flexible area
Bending radius (5x Bending 180°)	> 3mm	

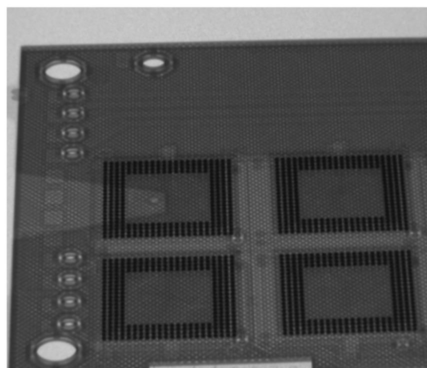
2.5DP Pipe

Lateral non-electrical connection

Integration of lateral non-electrical connection



Transport of gases, acoustics,…



2.5D® = Mechanical and electrical miniaturization

Very high z-axis accuracy

Cost advantage over conventional cavity and rigid flex concepts

Full HDI stacked via design rule available

Proven reliability for flex-to-install applications

Use of standard materials & processes

- Fully qualified materials
- Symmetrical build ups

Different technologies can be combined

Mass volume production capability