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Advanced Technologies

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- Embedded Components
- 2.5D Technology Platform
- Rigid Flex

Embedded Components

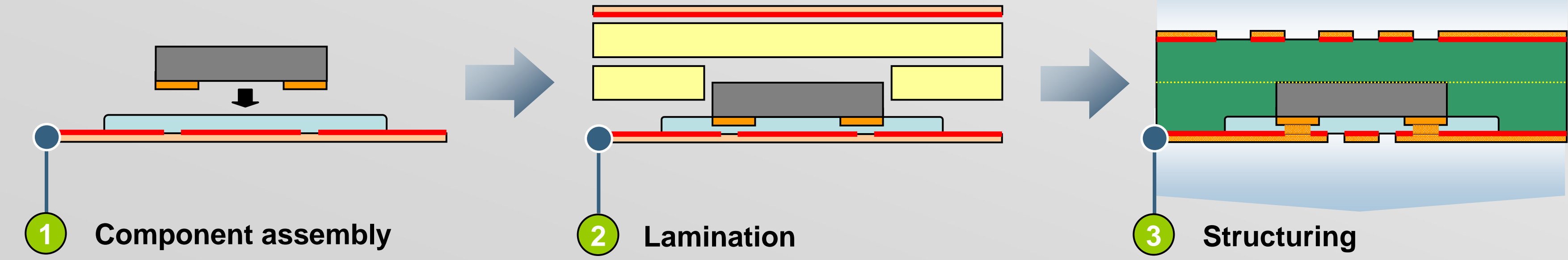
2.5D Technology Platform

Rigid Flex

What is Embedded Components Technology?

Components are embedded inside an organic substrate / PCB core by combination of

- Component Assembly
- Component Packaging
- PCB Manufacturing



Main benefits by using Embedding Component Technology

- Miniaturization
- Improved electrical performance and thermal management
- Improved reliability and mechanical stability
- High flexibility in design

Adobe Acrobat
Document

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Boards and Modules

	Boards	Modules
Definition	PCB Boards • Embedding releases surface space for other components or allows the overall PCB size to be reduced	Single Chip and High Functionality Modules • Next generation packaging concept • Substitute for existing packaging
Applications	• Mobile phone engine boards • Portable devices boards • Industrial boards • Automotive boards	• ESD/EMI protection network • Power Modules • Amplifier Modules • RF Modules • Camera Modules • Sensor Modules • ...
Benefits	• Miniaturization • Improved electrical performance • Improved reliability and mechanical stability • Improved thermal performance • High flexibility in design • Cost-efficiency	• Improved electrical performance • Improved reliability and mechanical stability • Improved thermal performance • High flexibility in design • Lower cost potential
Embedded Components	• Discrete passives • Actives • Low to medium I/O count	• Actives • Discrete passives • Low to high I/O count

Benefits of Embedded Components Technology

Feature	Benefit
Miniaturization	Embedding releases surface space for other components or allows the overall PCB size to be reduced
Improved electrical performance	Short copper interconnections reduce parasitics compared to e.g. bonding structures leading to minimal signal distortions. This means better RF performance for high-frequency applications, better signal quality for e.g. audio applications, higher speed for data transfer or higher efficiency levels. EMI shielding
Improved reliability and mechanical stability	High mechanical system stability. No soldering or bonding – high reliable copper interconnections
Improved thermal performance	Copper vias or other thermal structures can be contaced directly with the front or back side of the component – heat can be efficiently conducted away
High flexibility in design	Components are located between PCB conductor layers and not on top of the PCB: Contacting can be done from either side
Cost-efficiency	Standard materials and high-volume manufacturing equipment. Robust processes. Large production format Compared to standard packages: Laser-drills and copper vias substitute bonding, no over-molding or underfill needed Inductances can be solved with copper lines
Copy protection	Components inside PCB – improved security for e.g. stored data

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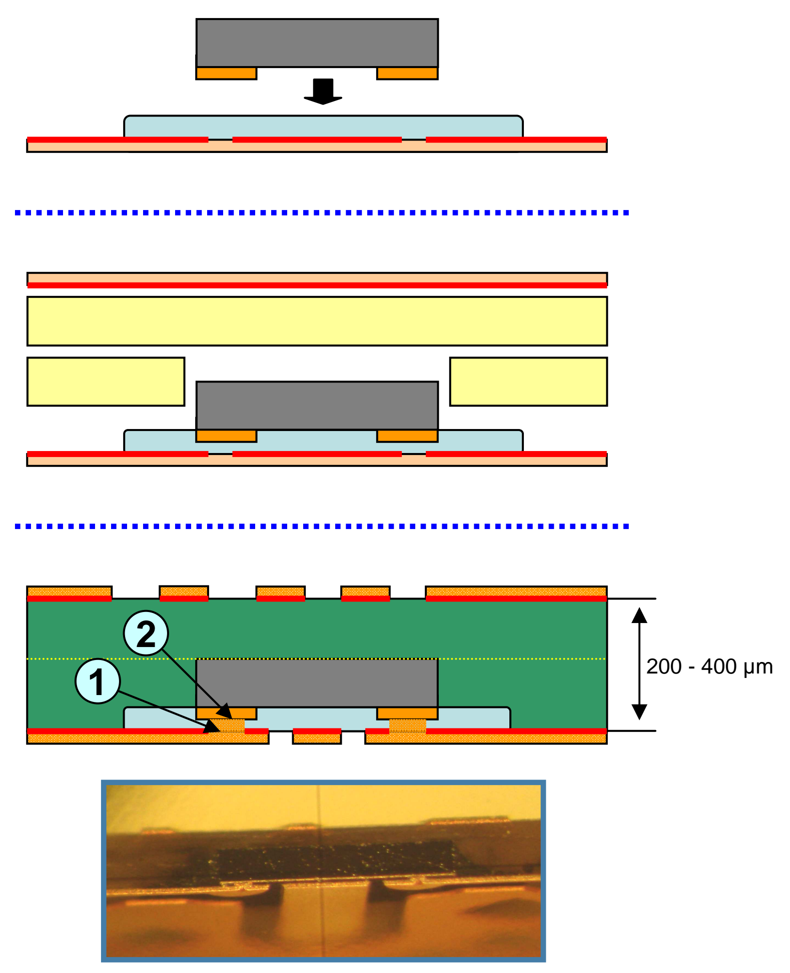
Design Guidelines 1/2 – March 5th, 2009



Build up	
Number of layers	min 2
Line / Space	60 / 60 µm
Buried vias in embedding layer	Not preferred but possible
Stacked vias	Possible
Laser via diameter (1)	min 75 µm
Laser via land size (2)	min 200 µm
Component	
Availability	Mid volumes now, high volumes end 2009
Component pad size	min 200 µm
Component pad Cu thickness	min 3 µm
Distance between components	min 200 µm within cavity
AVAILABLE PASSIVES – Component thickness	100 – 350 µm
AVAILABLE PASSIVES – Capacitors and resistors	mainly sized 0402 (1 x 0,5 mm)
AVAILABLE PASSIVES – Resistors	10 < R < 10M Ohm (E24) @(+/-5 % Tolerance)
AVAILABLE PASSIVES – Capacitors	up to 100 nF (X5R)
AVAILABLE ACTIVES – Starting from ESD protection diodes to more complex dies (30 to 50 I/Os)	
AVAILABLE ACTIVES – Component thickness	120 – 150 µm
AVAILABLE ACTIVES – Spacing between pads	min 60µm (without line between)

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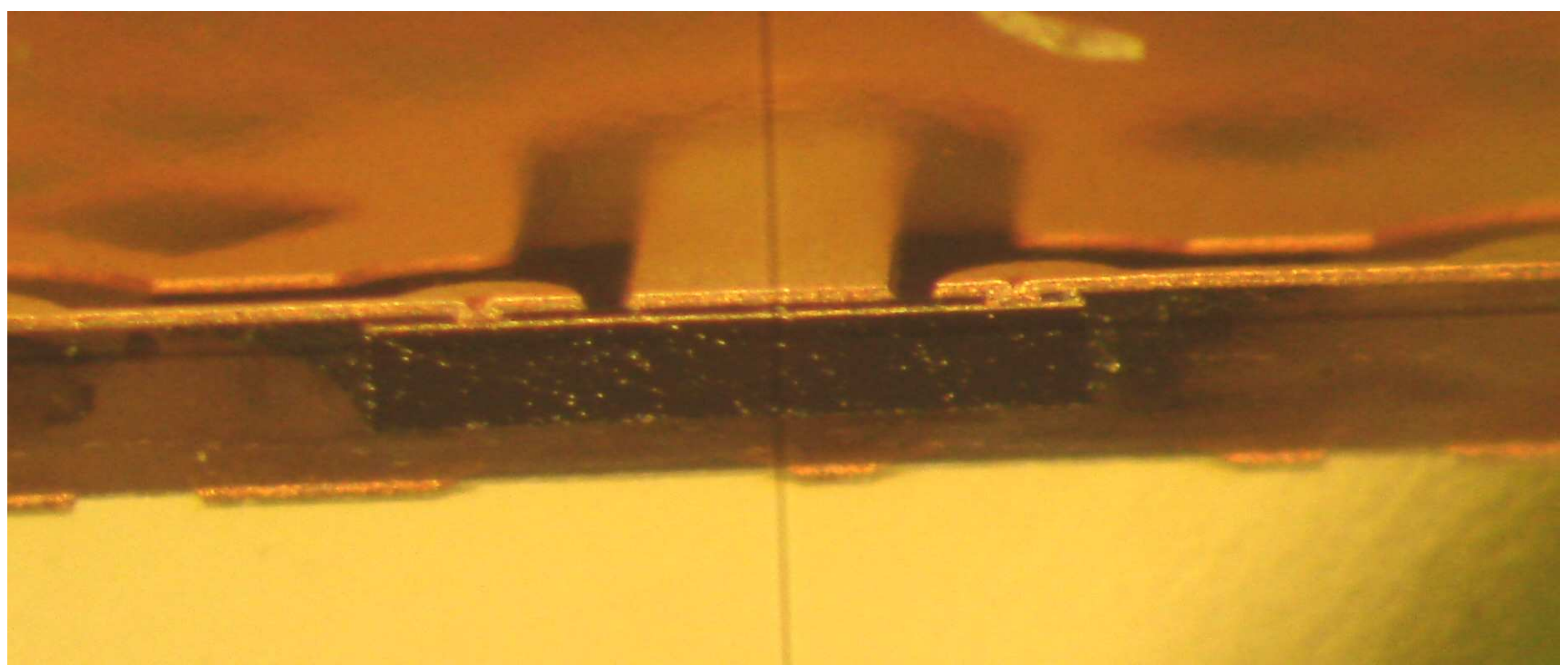

Cross-section of embedded component (cavity-method)
- Track above component

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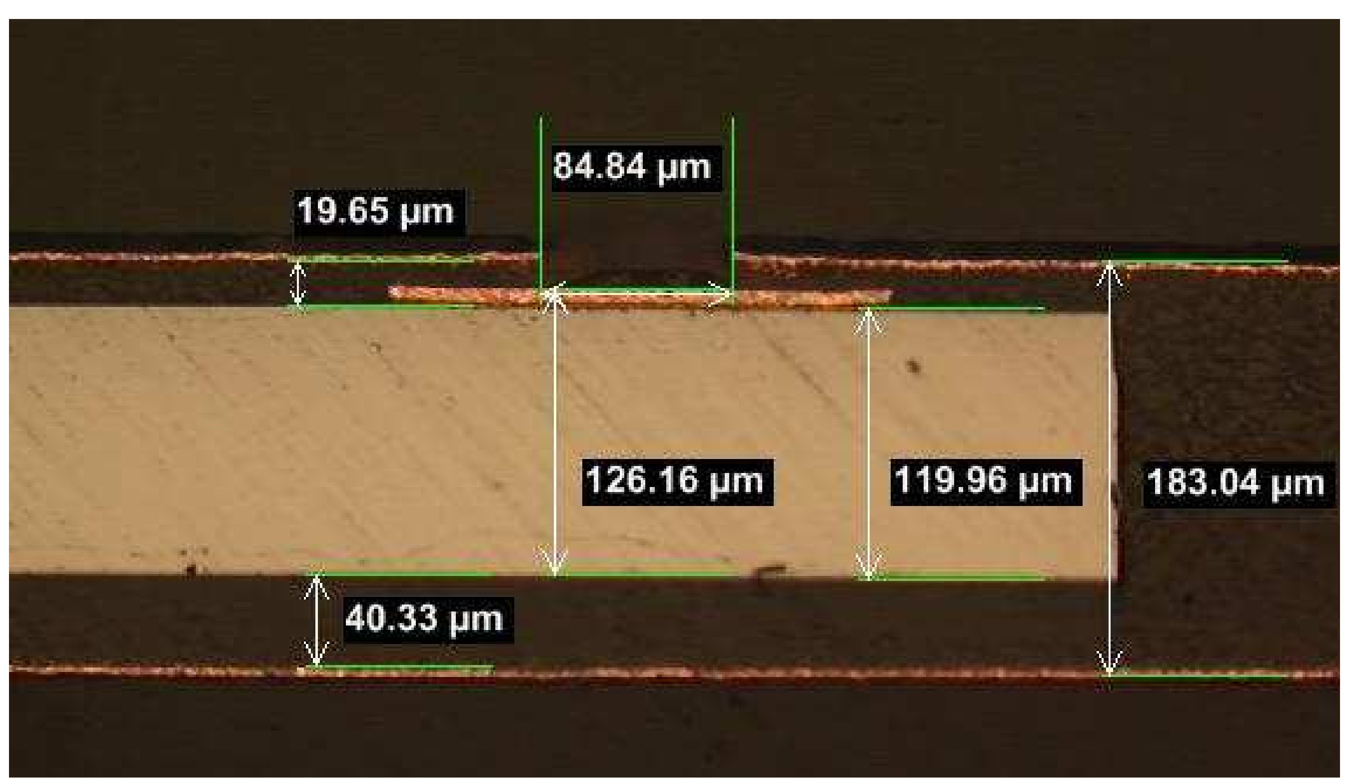

Cross-section of embedded component (cavity-method)

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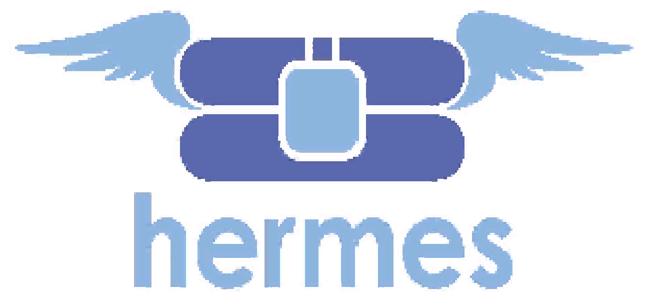
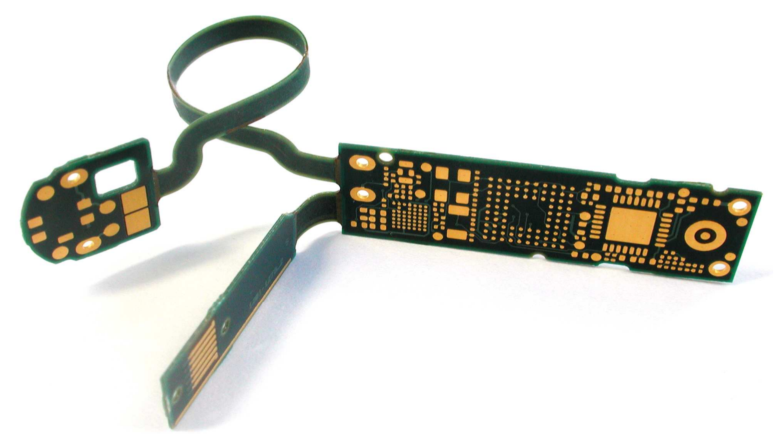


High density integration by embedded chips for reduced size modules and electronic systems

- Embedded Components
- **2.5D Technology Platform**
- Rigid Flex

- Basic Principle 2.5D
- Applications 2.5D
  - Cavity
  - HDI Rigid-flex
  - Special Applications
- Cost comparison



2.5D = 2D manufacturing

for 3D application

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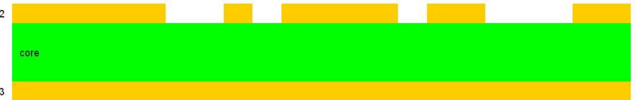
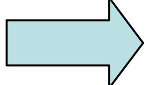
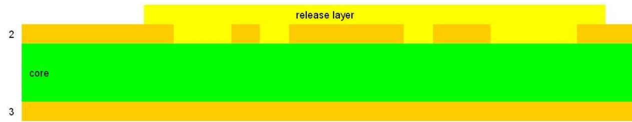
Step 1: Starting off with an structured core

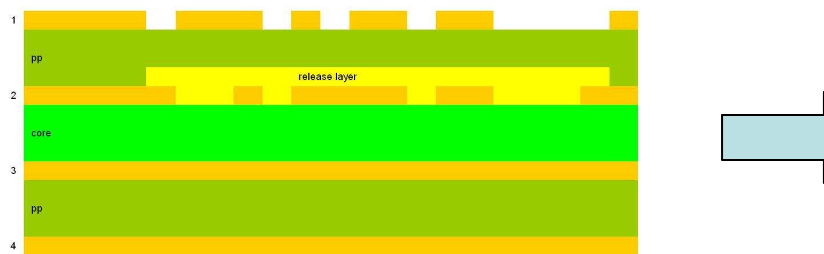




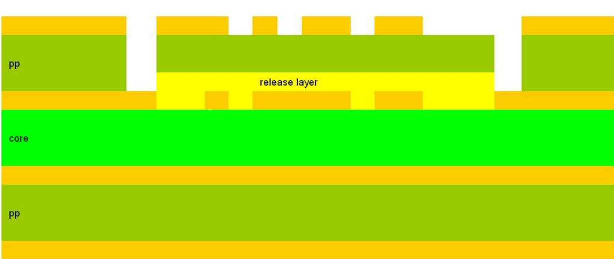
Step 2: screen printing release layer



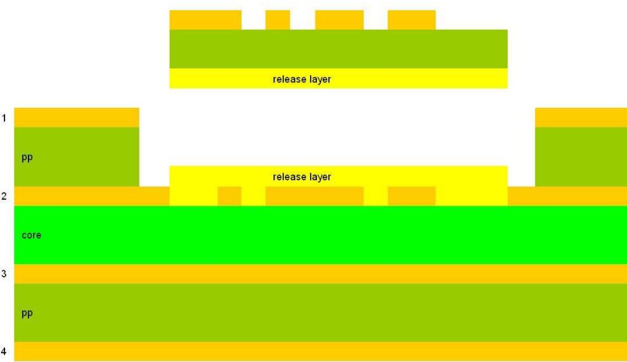
Step 3: lamination and structuring



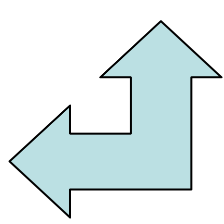
Step 4: laser cutting



Step 5: inlet removal



Conveniently the copper stops the laser from penetrating further



AT&S, 2 utility model applications filed, 2007

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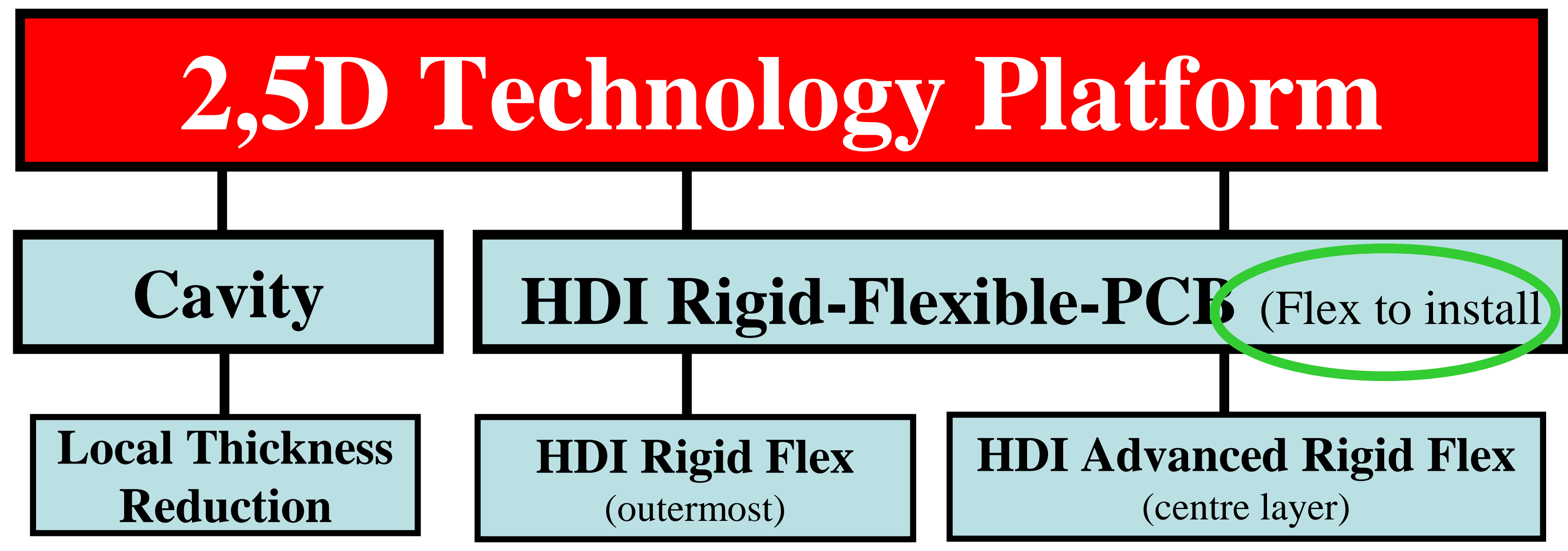
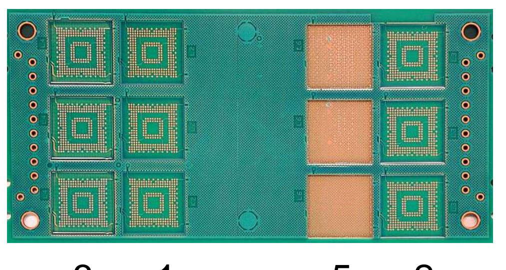
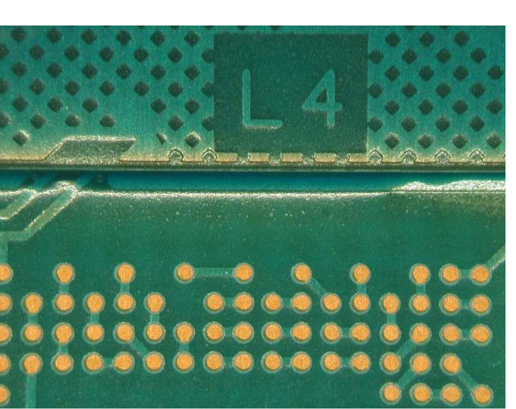


- **Solder mask in cavity**
  - Standard design rules

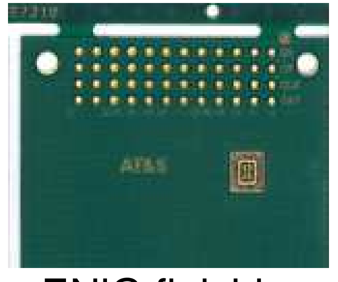


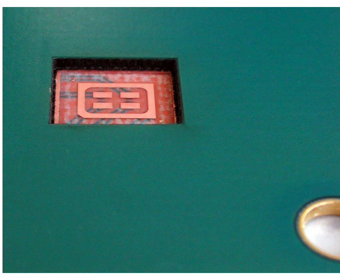
3-2-3 with
stacked vias

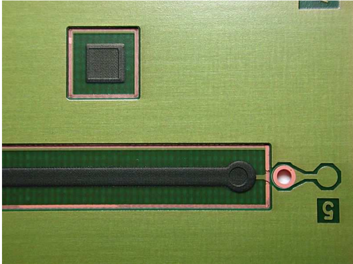
3 1 5 2 …layers removed



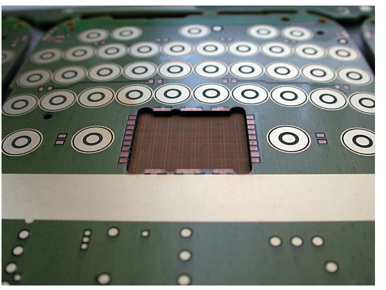
- **Surface in Cavity**
  - ENiG, OSP, Hard gold, Carbon


ENiG finishing

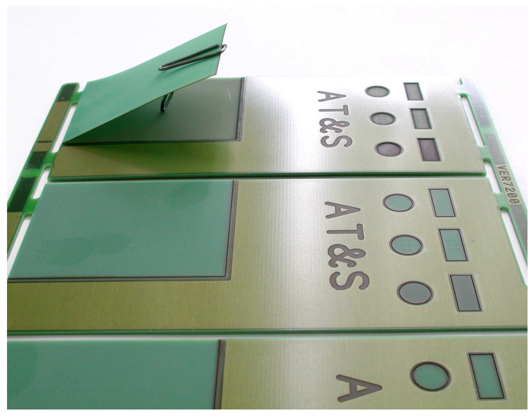

OSP finishing


Carbon

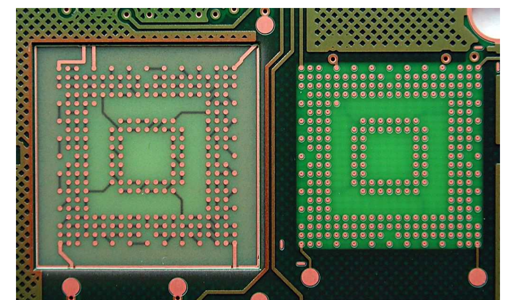
- **Local thickness reduction**



5 of 12 layers removed
→ 700µm depth



- **Placement of electronic components**
  - Assembly in cavity (500µm BGA)
  - With and w/o solder mask
  - Fan out in assembled layer



500µm BGA
Filled vias
2 layers removed →180µm depth

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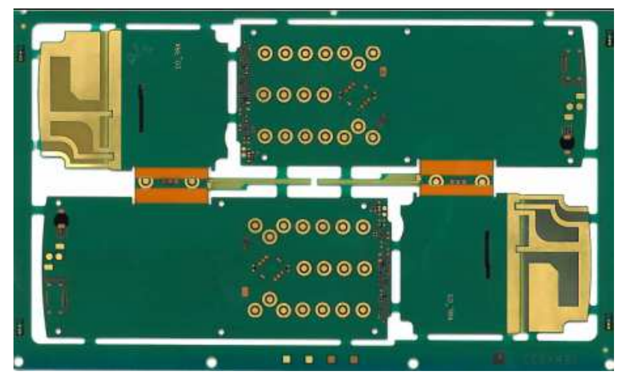
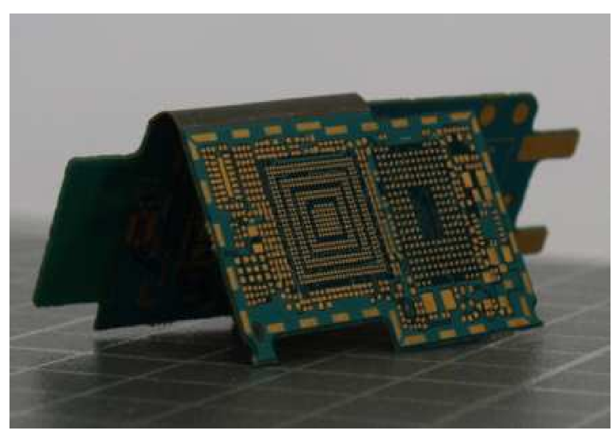


2-4-2 with filled vias
2 flexible outer layers
75µm L/S
800µm thickness



3-2-3 with filled vias
2 flexible centre layers
400µm BGA
250µm Pad size
75µm L/S
Impedance controlled

Standard R/F vs 2.5D

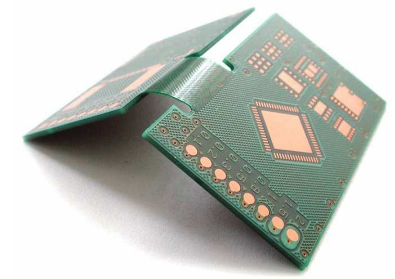
[%]

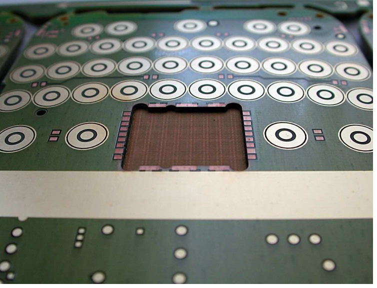
	[%]
R/F	100
2.5D	~85

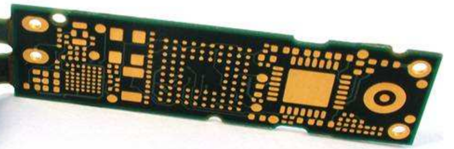
15% cost reduction

Depending on build up

Creating 2.5 dimensional electro-mechanical structures utilising PCB Technology



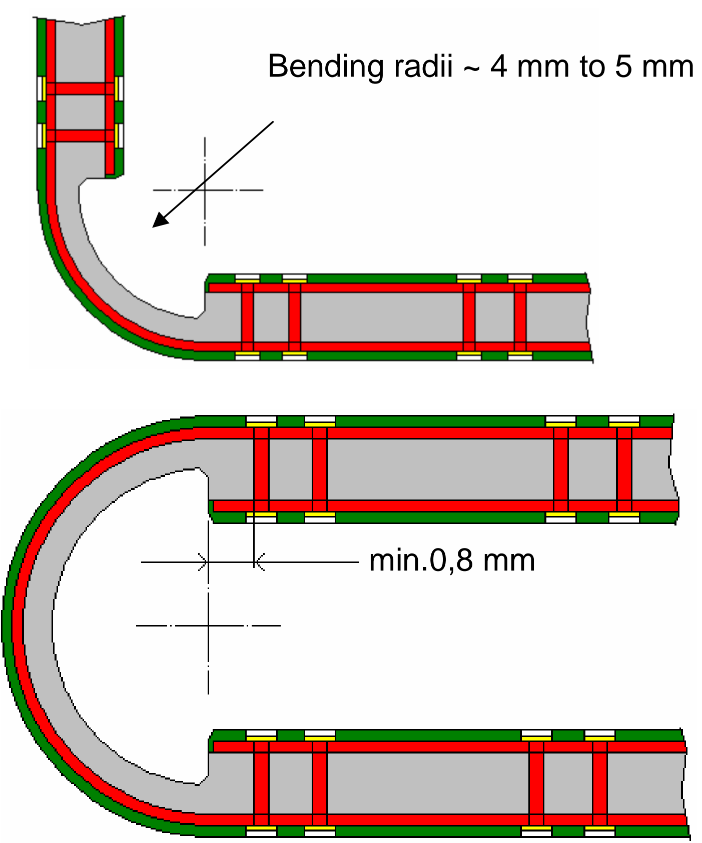




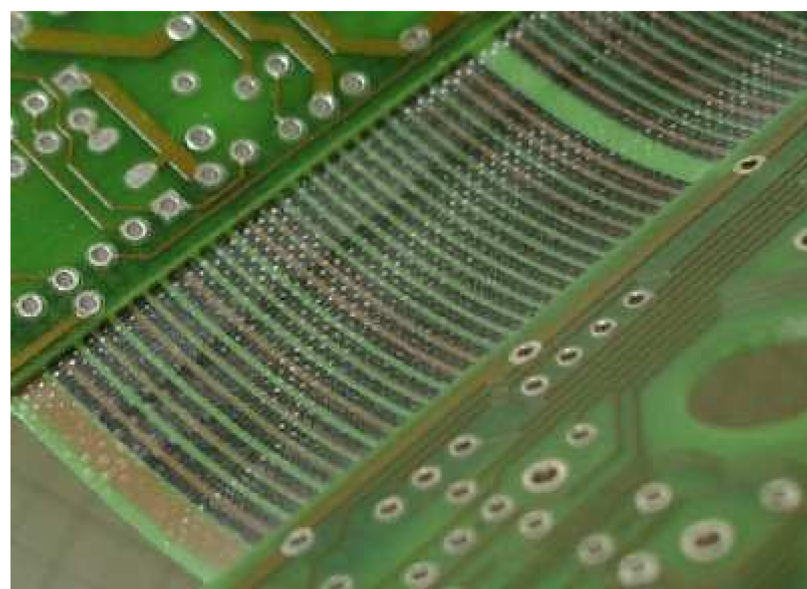
- **Very high z-axis accuracy**
- **Cost advantage over conventional cavity and rigid flex concepts**
  - Replace costly connectors and flex printed circuits
- **Full HDI stacked via design rule available**
- **Proven reliability for flex-to-install applications**
- **Use of standard materials & processes**
  - Fully qualified materials
  - Symmetrical build ups
- **Different technologies can be combined**
- **Mass volume production capability**

- Embedded Components
- 2.5D Technology Platform
- **Rigid Flex**

Typical assembly at 90° or 180° bending radii. The fl exible solder mask should be in outer radius (preferred bending direction)



Bending area after level routing.



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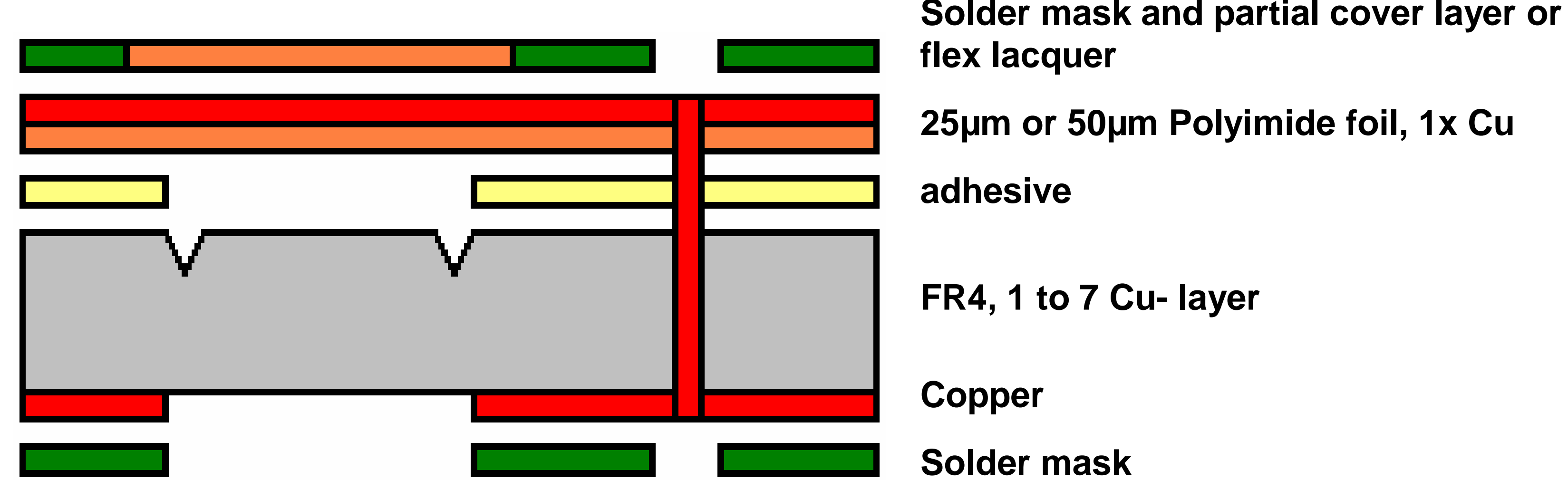
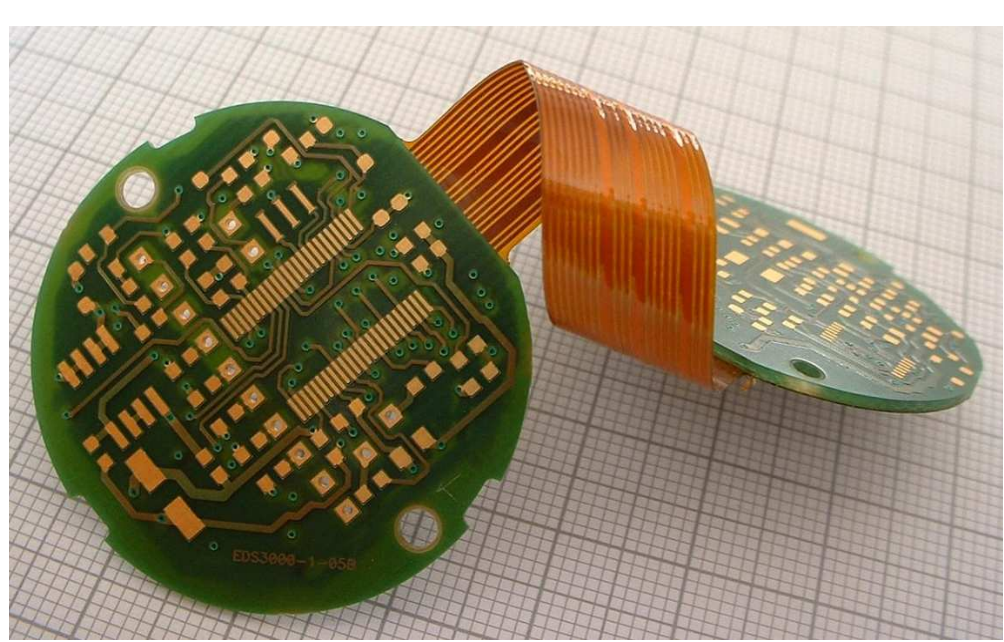
Standard build up

RFPC 2- to 8- layer; 1 layer Flex, outside, asymmetric



Standard build up

RFPC 2- to 8- layer; 1 layer Flex, outside, asymmetric



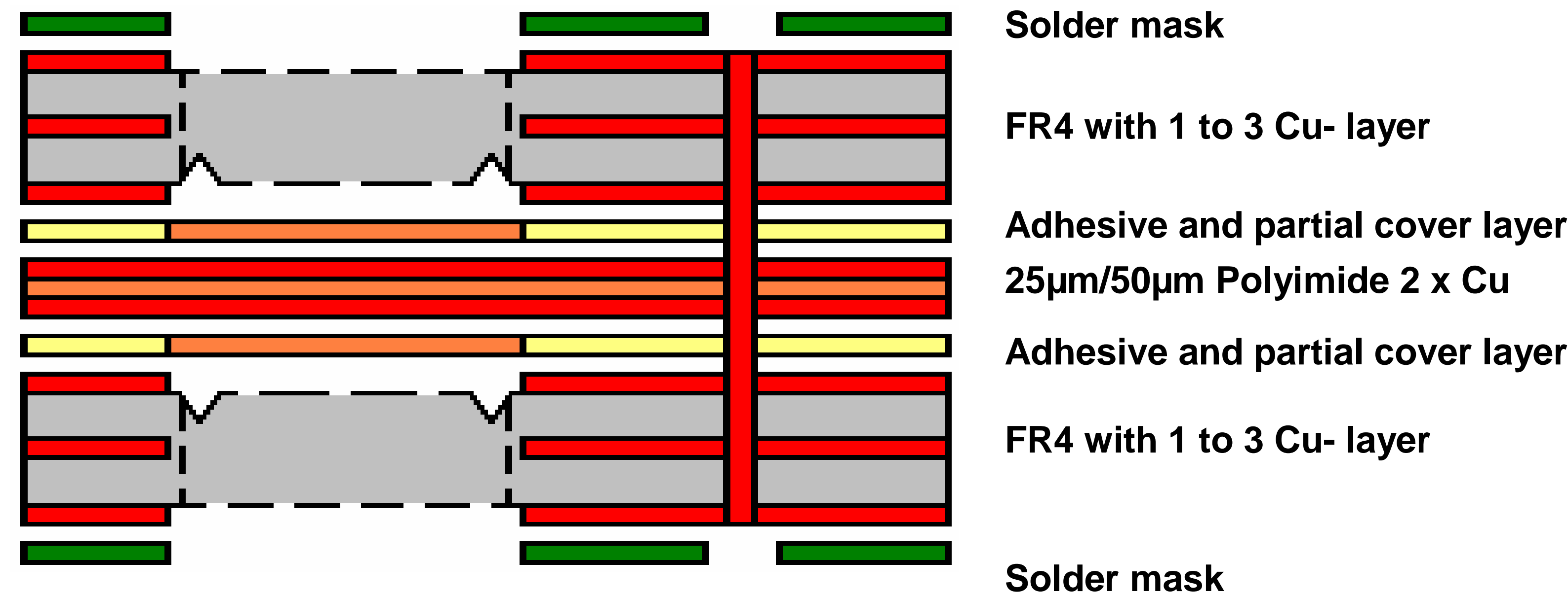
4-layer, asymmetric

Market segment: Industry

Standard build up

RFPC 4 to 8 layer, 1- or 2 flex layer, inside,

complete / partial cover layer in bending area, symmetric



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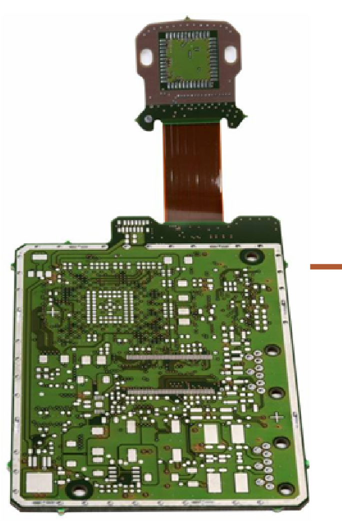
Rear View Camera



Assembled in the middle rearlight

Market Segment

- Automotive

Application

- Rear View Camera

Technology

- 8 Multilayer Rigid-Flexible