



# Embedded Components in PCB

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Imbera Electronics

# Agenda

- Imbera Electronics Introduction
- Evolution in Electronics Production Technologies
- Imbera Integrated Module Board Technology Solution
- Applications
- Summary





# Imbera Electronics



# Imbera Electronics - Overview

- Imbera Electronics provides novel and innovative manufacturing solutions for advanced consumer electronics
  - Imbera's core process enables further product level miniaturization and improved performance with attractive production cost levels
- Imbera solution embeds standard components inside a PCB structure
  - Currently Imbera is building a supply base for high volume manufacturing utilizing it's 3<sup>rd</sup> generation technology
- Imbera development team has a long history in component embedding technology development
  - First embedded modules manufactured in late 90's in Helsinki University of Technology
  - Technology concept industrialization launched in 2001 / 2002
    - Company established in spring 2002 by Elcoteq Network and Aspocomp Group
  - Proto and small volume manufacturing in 2005 / 2006
  - High volume supply base development in 2008 / 2009
- New funding collected in 2007 for technology commercialization
  - Strong and long term investors; leading European investors with strong development commitment



**Index**  
VENTURES

**NZ: Northzone Ventures**

CONOR



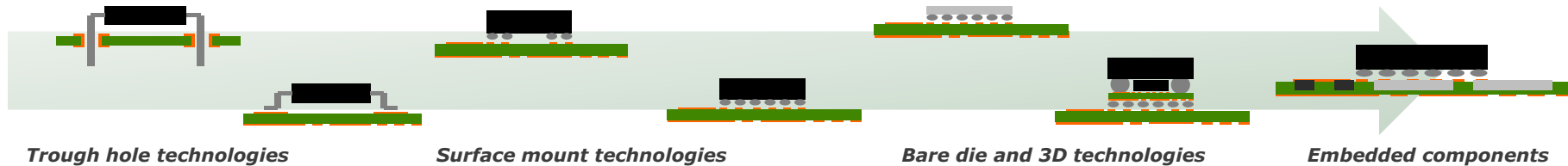


# Evolution in Electronics Production Technologies



# Electronics production technologies

## TECHNOLOGY INNOVATIONS



Imbera Electronics  
Integrated Module Board

new technology evolution must provide

- ✓ Significant technological benefits and strong road map to further improve the technology competitiveness
- ✓ Solid and robust manufacturing process with excellent quality and yield levels
- ✓ A path for the Customer to easily adopt the technology with existing applications
- ✓ Credible value chain to support the high volume manufacturing
  - Open technology platform with multiple manufacturing service providers
- ✓ Lower total cost of ownership when the technology reaches maturity





# Integrated Module Board Technology Solution

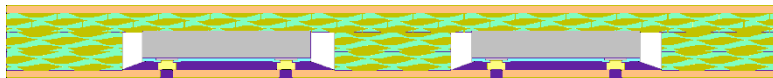


# Imbera Integrated Module Board (IMB) Technology

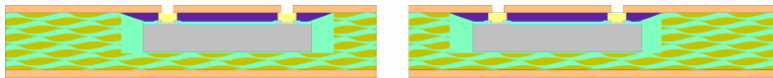
## *Imbera Integrated Module Board Production Process for Discrete Component Embedding*



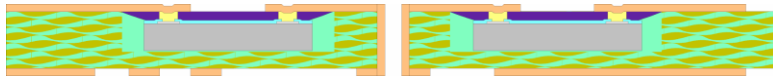
***Active and Passive Component Attachment***



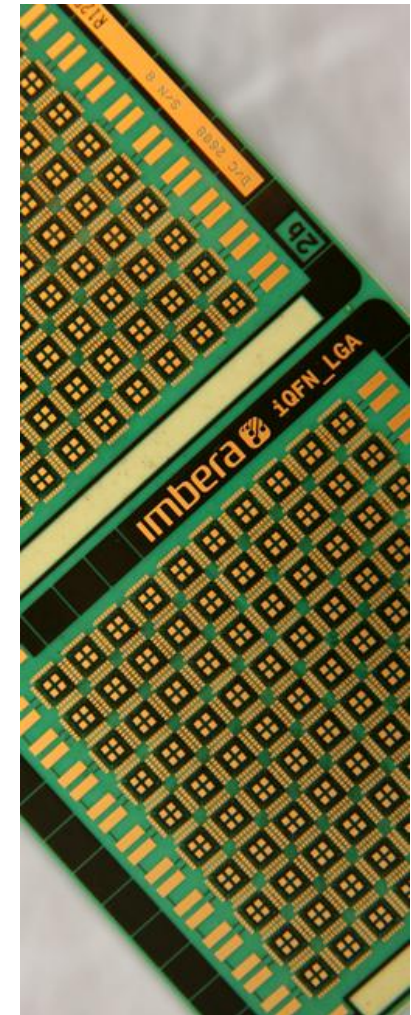
***Core Board Stack-up***



***Core Pressing and Via Formation***



***PCB processing;  
Plating, Patterning***



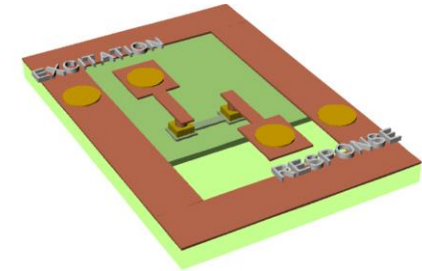
**iQFN**



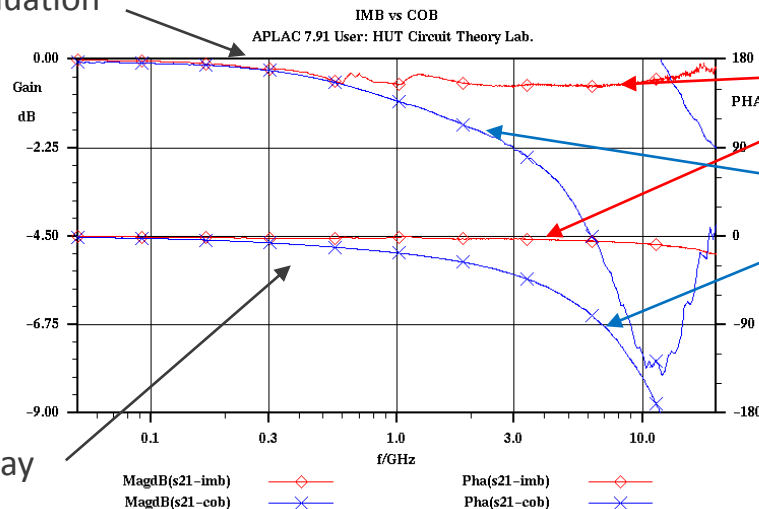


# Electrical Features

- Electrical Modelling: S-parameter Measurements (IMB vs. COB)
  - The measurements from 50 MHz to 20 GHz
  - Signal passing through two IMB interconnections and an on-chip aluminium conductor



Attenuation

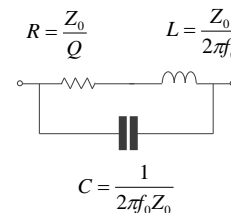
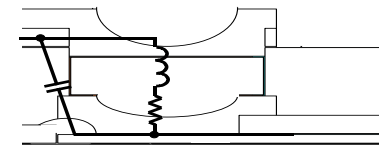


IMB interconnection - attenuation less than 0.7dB

Wire bond interconnection

Delay

- Model of the IMB interconnection



$$R = \frac{Z_0}{Q} < 10 \text{ m}\Omega$$

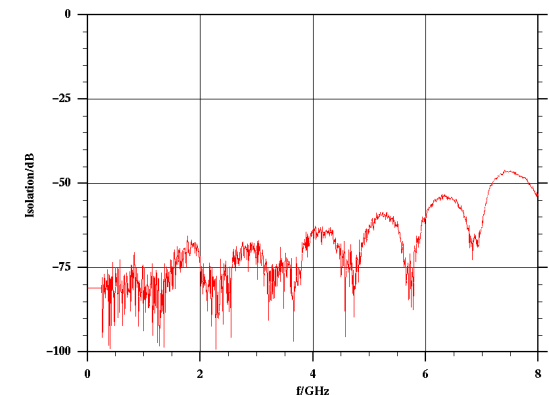
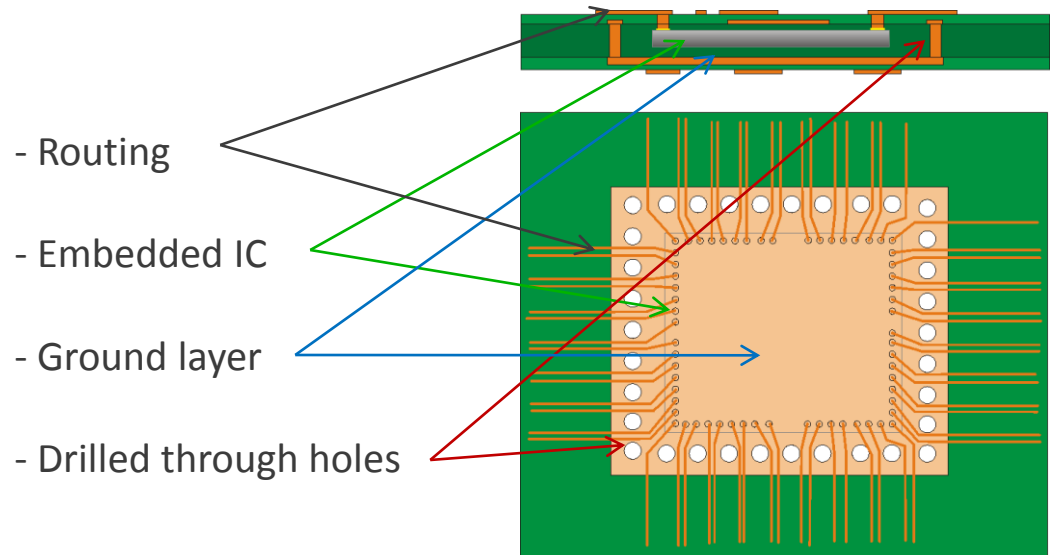
$$C = \frac{1}{2\pi f_0 Z_0} \approx 1 \text{ nF}$$

$$L = \frac{Z_0}{2\pi f_0} \approx 24 \text{ pH}$$



# Integrated EMI shield

- Cross-section and top view schematics of the integrated EMI shield
  - Routing
  - Embedded IC
  - Ground layer
  - Drilled through holes
- Measurements on a demo-board showed excellent isolation from both capacitively and inductively coupled noise on a wide frequency range.
  - Shield efficiency was measured with response probe, which was EMI shielded and excited with a nearby noise-source.
  - The signal-level received inside the shield is shown in the figure below.



Inductive coupling of the isolation measurements

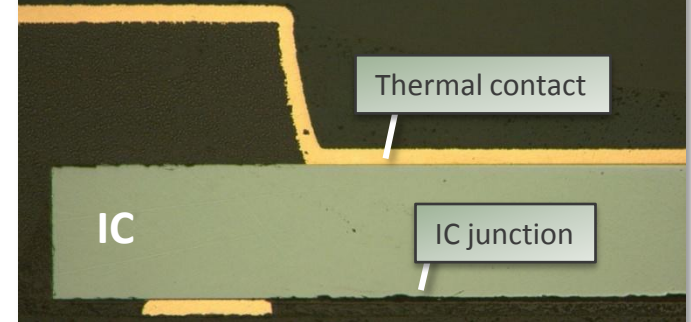


# Thermal Features - Direct thermal contact

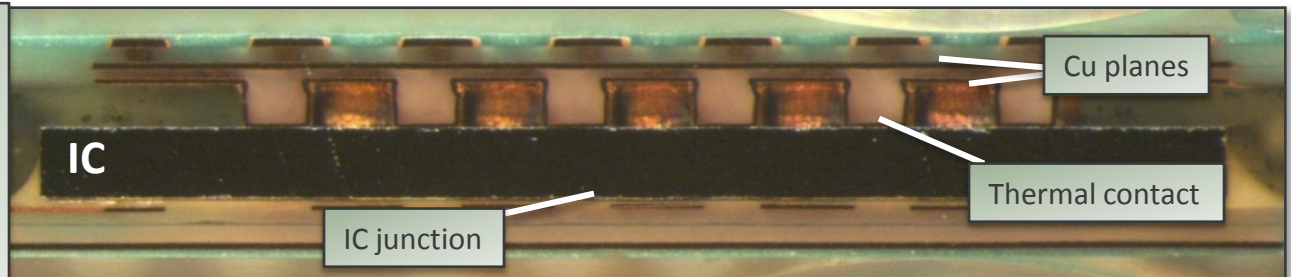
- IMB technology offers novel solutions to manage thermal issues
  - Thermal copper structures (vias, planes...) can be manufactured to reach from the IC to edges of the package

Direct thermal contact between die and copper ensures effective heat conduction from the critical areas.

Cross-section of thermal contact from back side of the IC to the heat conducting copper structures



Cross-section of thermal via and copper plane structure of BGA type module. Thermal vias on rear side of the IC.



# IMB reliability

SIB, motherboard level products PCB structure: 1+2+1

65/65 L/S design

Material; standard FR4

Embedded

Silicon

Thick

Pitch

SIP, Single IC, package level products PCB structure: 1+2+1

Material: High Tg FR4

Embedded component:

Silicon component, Cu bump

Thickness: 150  $\mu\text{m}$

Pitch: 250  $\mu\text{m}$

## Reliability Test

Reflow Moisture Sensitive

Thermal Cycling

High Temperature Storage

Low Temperature Storage

Preconditioning	Reliability Test	Test Standard (Jedec)	Package Level Conditions	Pass/Fail
	Reflow Moisture Sensitive	J-STD-020	level 3 60°C/60% RH 40h + reflow 3 times	Pass
J-STD-020, level 3 60°C/60% RH 40h + reflow 3 times	Thermal Cycling	JESD22-A104	Condition: M (-40 °C - +150 °C) Soak mode: 3 (10 min) Cycles per hour: 2 Cycle count: 1000 cycles	Pass
	High Temperature Storage	JESD22-A103	Condition A: 125°C, 500 h	Pass
	Low Temperature Storage	JESD22-A119	Condition A: -40°C ± 3 °C, 168 h	Pass



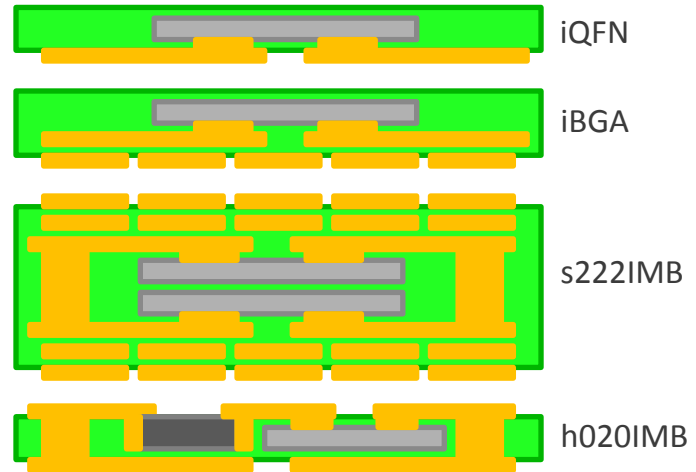
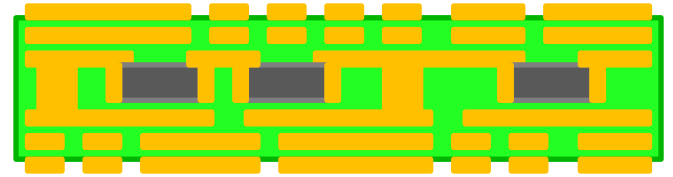


# Applications



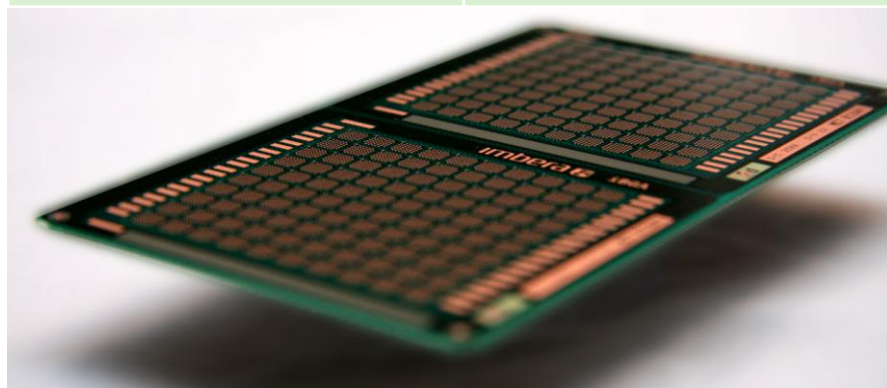
# Imbera Product Families

- System – In – Board motherboard applications
  - Embedded discrete passives; capacitors & resistors
  - Embedded actives; standard ASICs, low I/O WLCSPs
- Module applications
  - Single IC packages
    - Si or GaAs die
  - SiP packages
    - Multiple ICs
  - Hybrid modules
    - Embedded active and passive components

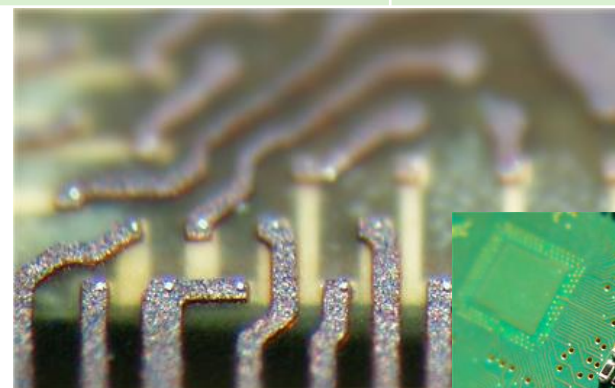


# Summary of applications

	System in Board (SIB)	System In Package (SIP)	Single IC Package
Features	<ul style="list-style-type: none"> <li>•Cost driven process; component placement with chip shooter</li> <li>•Motherboard PCB process</li> </ul>	<ul style="list-style-type: none"> <li>•Accuracy driven process; component placement with FC bonder</li> <li>•Substrate PCB process</li> </ul>	<ul style="list-style-type: none"> <li>•Accuracy driven process; component placement with FC bonder</li> <li>•Substrate PCB process</li> </ul>
Embedded components	<ul style="list-style-type: none"> <li>•Low to medium I/O count Si, GaAs</li> <li>•Discrete passives and IPDs; capacitors, resistors, inductors</li> </ul>	<ul style="list-style-type: none"> <li>•Low to medium high I/O count Si, GaAs</li> <li>•IPDs</li> </ul>	<ul style="list-style-type: none"> <li>•Low to medium high I/O count Si, GaAs</li> <li>•IPDs</li> </ul>
Benefits	<ul style="list-style-type: none"> <li>•Miniaturization</li> <li>•Free utilization of surface area</li> <li>•Lower profile</li> </ul>	<ul style="list-style-type: none"> <li>•Miniaturization</li> <li>•Free utilization of surface area</li> <li>•Excellent electrical and thermal performance</li> <li>•Embedded EMI shield</li> </ul>	<ul style="list-style-type: none"> <li>•Full array solder lands on the back side</li> <li>•Embedded EMI shield</li> <li>•Excellent electrical and thermal performance</li> </ul>
Applications	<ul style="list-style-type: none"> <li>•Embedded discrete passives, digital ICs</li> </ul>	<ul style="list-style-type: none"> <li>•High frequency, high heat producing analog devices, digital component</li> </ul>	<ul style="list-style-type: none"> <li>•POP, iQFN, iBGA, high frequency, high heat producing analog devices, digital component</li> </ul>



iBGA



SIB with two embedded ICs

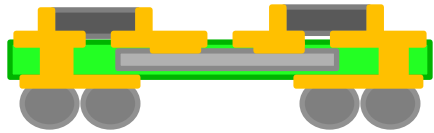


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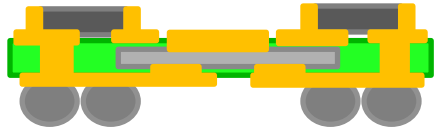
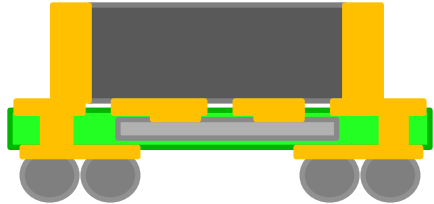
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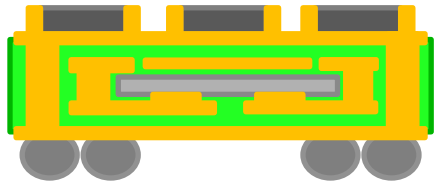
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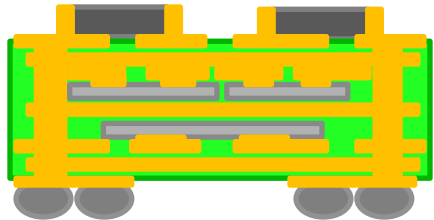
- Two layer interposer with capacitors and / or inductors on top



- Two to four layer interposer with heat conductor structure and capacitors and / or inductors on top



- Four layer interposer with embedded shield and capacitors and / or inductors on top



- 8 layer interposed with 3 embedded ICs in 3D arrangement, embedded shield for both layers



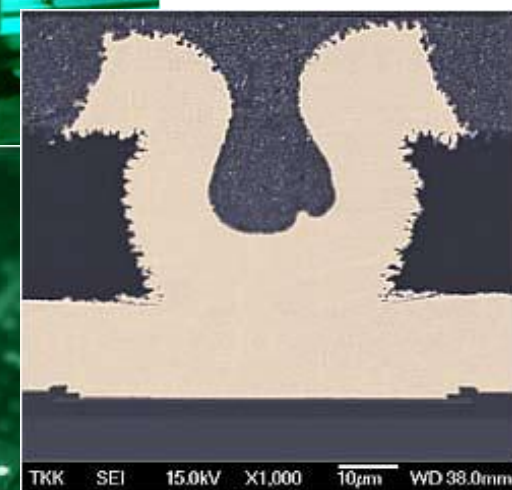
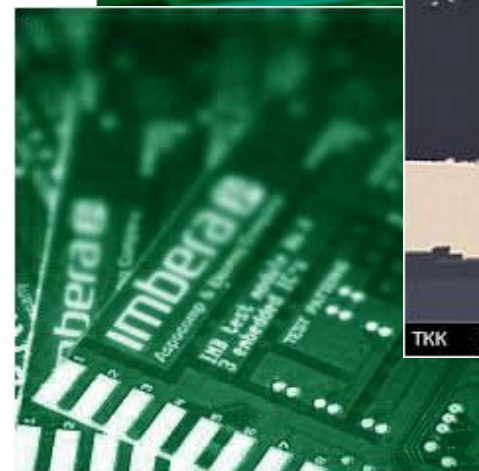
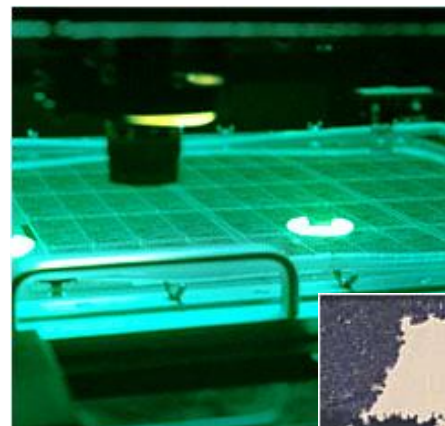




# Summary



- Short and robust manufacturing process
  - For passive and active components
  - Standard materials and equipments used in the process enable good scalability to high volumes
  - Fulfills all today's environmental requirements
  - Enables high yield levels in embedding
- Novel structure designs
  - 3D ground for EMI shielding
  - 3D component assembly
- Excellent electrical performance – ideal for high frequency applications
  - No gold wire bond interconnection
- Excellent thermal performance – ideal for high power applications
  - Thermal vias on front and back side of the component to improve heat conductivity
- Proven reliability in telecom and handheld area



IMB interconnection

