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Paper 10

Embedding Components: No Business as Usual

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About the Author

Markus Riester is founder and owner of Maris TechCon, a technology and business strategy consultancy for the electronics industry.

Markus served as Head of Research of AT&S from 2005-07, where he was influential on the technology development of HDI PCBs, alternative process technologies and materials such as embedding components and high-volume semi-flexible PCBs. Previously, Markus held positions as Senior Scientist at Motorola Labs, Germany, developing Printed Electronics and optical PCB technology, and with IBM, as Process engineering team leader in magnetic slider production.

Markus Riester holds degrees in Chemical Technology from the Fachhochschule Darmstadt and in Chemistry from the University of Osnabrück; he finished his doctorate studies at the University of Osnabrück in 1998.

Abstract

The developments in the consumer electronics industry, in particular mobile phones, are driven by the relentless quest for miniaturized solutions, using less power for providing long-term service without recharging the device, minimizing heat dissemination, and providing more functionality, at lowest cost. The challenges for materials, processes and design could lead to a situation where the time might be right for a change in the value chain in the electronics industry.

The technological developments for processes allowing the embedding of components into Printed Circuit Boards (PCBs) have been going on for a number of years. Many different approaches for embedding components have been elaborated, for different applications ranging from industrial, automotive and also consumer products. Some of the embedding processes are actually used for building products, albeit mostly in small volume. So, while from a technical perspective embedding technology seems to be here, further challenges remain.

Three major topics need to be addressed in addition to allow embedding technologies to be added as a Standard production process variant to the portfolio of the electronics supply chain.

1. Definition of the value chain
Technical feasibility has been demonstrated in products, now the challenge is to identify the value chain that will allow harvesting the advantages of embedded components.
2. Enable the designers
Key to the implementation of a technology is that the designers are aware of the opportunities provided and use it in the design phrase of the product.
3. Innovation on shop floor
Depending on the technology, embedding components might require major changes on the shop floor, technical as well as organizational.

Finding convincing answers to these technical and organizational challenges within the industry will be critical for a large-scale success of embedding technology. The presentation discusses the topics, showing possible alternatives and suggesting feasible settings.

For your comments

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Embedding components – no business as usual

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Company outline

Background

2005 - March 2007 **AT&S AG**

Head of Research with the largest European Printed Circuit Board manufacturer responsible for Technology Development of HDI PCB solutions, alternative production processes and materials.

2000-2005 **Senior Scientist with Motorola Labs**

Development of Printed Electronics and optical PCB solutions; Technology scout for Medical Telematics, nanotechnology and MEMS.

1998-2000 **Process engineer with IBM Storage Systems GmbH**

Development of cleaning processes for magnetic slider fabrication; Engineering team leader

1994-1998 **Doctorate studies at Universität Osnabrück /**

IBM Storage Systems GmbH

Development of thin film analytics and thin film processes. Masters in Physical Chemistry (Univ. Osnabrück/ Germany) and Chemical Technology FH Darmstadt



maris TechCon supports companies in

- optimizing business processes in Research & Development
- the development of their key technologies in the fields of
 - PCB technology
 - Embedding, Optical integration
 - Printed Electronics

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Agenda

- Embedding components
 - state-of-the-art and “ready for production”?
- No business as usual!
- Need for change
- Instead of conclusions

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Why this analysis?

Questions

How will embedding technologies be scaled to higher volumes?

→ **How can value be generated** out of embedding components technology using PCB fabrication as the underlying technology base?



Embedding Technology

- This talk covers
 - Embedded Discrete Components (EDC) into PCB arrangements
- This talk will not cover
 - In-situ manufacturing of Embedded Components (like resistors)
 - Ink-jetting
 - Screen printing
 - Thin film technology
 - Sheet material-based components



Embedding Technology

- This talk covers
 - An insight into the state-of-the-art of embedding components
 - Some of the insights into what will be important if your embedding endeavor is targeted to be successful
- This talk will not cover
 - Specific Embedding technologies
 - Why is embedding an interesting opportunity
 - Which embedding technology will be the technology of choice
 - Who is actually building product and is making money

For your comments

[illegible]

[illegible]

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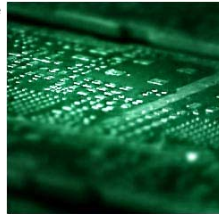
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Thinking and Doing Differently

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New Assembly Challenges

New Challenges driven by the convergence of Assembly with PCB Manufacturing

- **Expertise in component and board-level reliability** needs to migrate to PCB MFGers
- **Board-Level Manufacturing and Yield Issues** migrate to a PCB Manufacturing environment
- **Unique Equipment Requirements**
 - Higher accuracy than typical Surface Mount Equipment typically needed
 - Large Board Capability
 - Adhesive deposition



Taken from: www.imbera.biz

Unovis Solutions uniquely positioned by:

- Leveraging Assembly Level Process and Reliability Expertise through its Advanced Process Laboratory
- Leveraging Consortium Research On Interconnect Reliability
- Leveraging Automation Expertise in High Accuracy Advanced Semiconductor and Advanced Surface Mount.

8/13/2007

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Innovative Process and Assembly Solutions

What needs to change?

- PCB manufacturers are well prepared to supply electrical interconnects, not components
- IC packaging can accommodate multiple chips, passives in one package ... but the package is usually not the complete application
- PCB assembly is set to assemble components onto the PCB, not within

**Supply chain needs to be changed
for building products using
embedded component technologies.**

Who can drive the change?

Potential candidates
PCB manufacturers
Component manufacturers
PCB Assembly
IC packing
Final assembly
OEM

For your comments

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For your comments

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Supply Chain Gap analysis

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	Standard supply chain	Embedded Components supply chain
Components	Components specified by OEM	Different components might be necessary (thinner smaller, higher integration, different I/Os)
Design	Done by OEM, with specific support of supply chain members in the various development phases	Designers need to incorporate embedding into their technology portfolio
Packaging	Packaged components may be used, either from IDM or packaging house	Some components will be integrated into the PCB: Value chain disruption
Assembly	Assembly done at OEM, PCBA, CEM	Assembly for embedded components needs to be tightly integrated with PCB manufacturer: Value chain disruption
Test	Each supply chain partner has the specific tests for assuring product functionality and quality.	Testing of some components (e.g. bare die) might not be under the control of the manufacturer → Yield accountability issue, Product liability
Sourcing	Specified by OEM	(1) Component sourcing responsibility unclear; (2) Sourcing of boards with ECs: treated as modules, components, PCBs, assemblies ???
Procurement	Specified by OEM	Roles unclear, different possibilities; example exists e.g. in the automotive industry: System supplier vs. manufacturer
Design tools	Standard processes and buildups are reflected in software products	Support from leading design tool software mfgs established

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EDA tools for Embedded Components

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November 27-29, 2007
Maritim Bonn
Bonn, Germany



Weblink:

http://www.zuken.com/news/events_z-dac07.asp

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Instead of conclusions

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Question

How will embedding technologies be scaled to higher volumes **when the supply chain is not yet prepared to charge ahead?**

- **How can value be generated** out of embedding components technology using PCB fabrication as the underlying technology base?
- Identify the decisions that you need to make for leveraging the opportunity.



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Risto Tuominen, Imbera
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