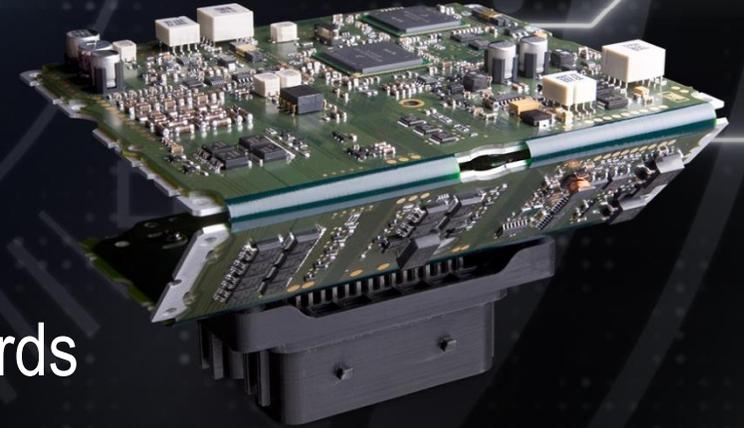


# ADVANCED SOLUTION CENTER

The solution to all special and unusual printed circuit boards  
using the example of stretchable printed circuit boards





# AGENDA

- 1** Introduction to the Advanced Solution Center
- 2** Insight into 1<sup>st</sup> stage of MORE.technology: DEVICE.embedding
- 3** Insight into 1<sup>st</sup> stage of MORE.technology: Technology Partner
- 4** Insight into 1<sup>st</sup> stage of MORE.technology: STRETCH.flex
- 5** Summary



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# YOUR SPEAKER

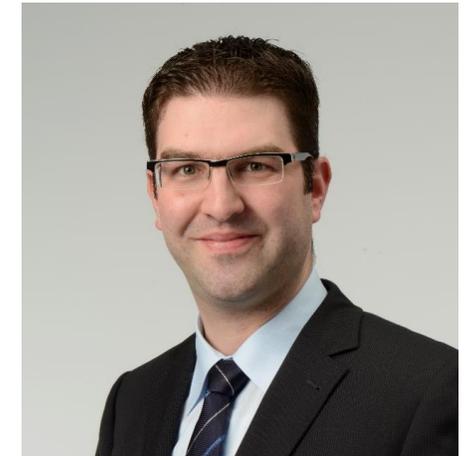


## Jürgen Wolf

- **Head of Advanced Solution Center**
  - Responsible for the technology of embedding of components/functions into the printed circuit board and for stretchable PCBs (STRETCH.flex)
  - Support of sales for the embedding technology and novel technologies
  - Qualification, planning and further development of the technologies
- **With Würth Elektronik Circuit Board Technology since 2008**

### How to contact me:

- **Phone:** +49 7940 946-1230
- **E-Mail:** [juergen.wolf@we-online.de](mailto:juergen.wolf@we-online.de)



Save my contact  
details directly in  
your address book!

# INTRODUCTION

## Advanced Solution Center – ASC



### What is the Advanced Solution Center?

- The Advanced Solution Center is
  - Technology-oriented
  - Customer-oriented
  - solution-oriented
  - Additionally the new “D” from our R&D



# INTRODUCTION

## Advanced Solution Center – ASC



### Why an Advanced Solution Center?

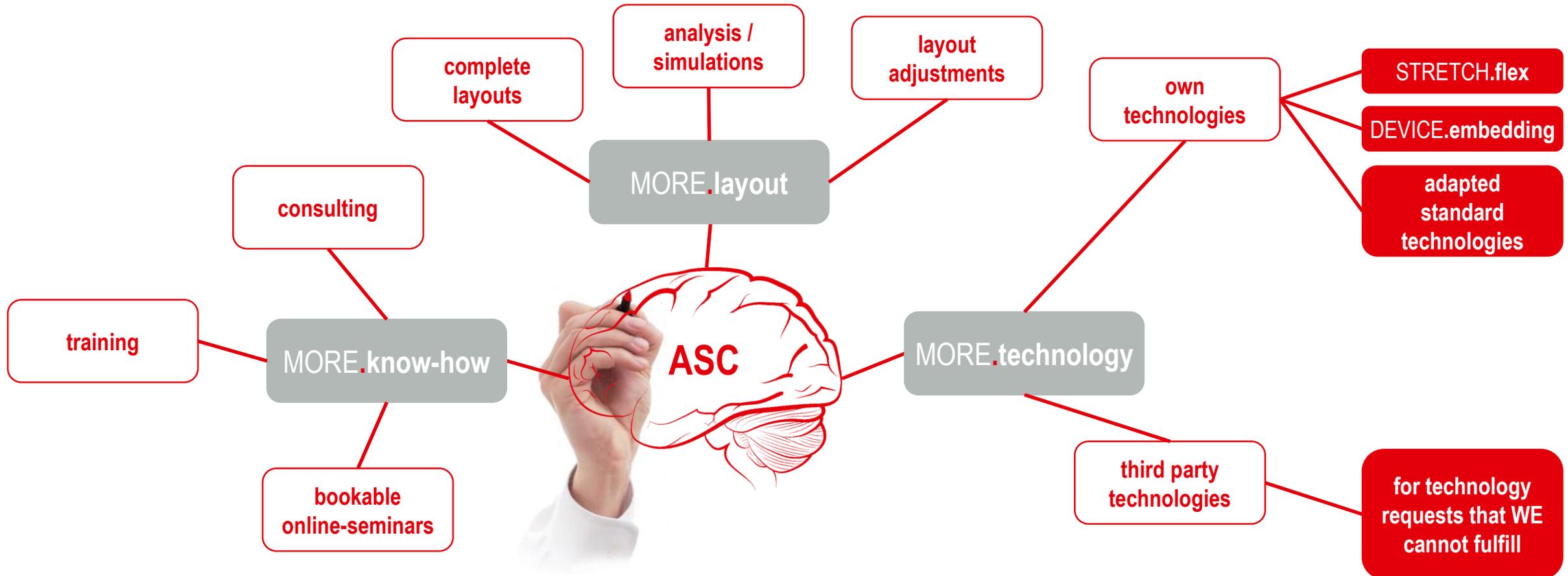
- We offer printed circuit board solutions for your complex, technological products
- The Advanced Solution Center evaluates the possibility of manufacturability in our German plants and, if necessary, transfers it to the technical project team (TPM) on site
- Even if it is not in WE's standard PCB portfolio
- If it cannot be manufactured at WE: we are looking for or may already have a competent partner who can manufacture these demanding PCBs on our behalf

### Your advantages

- You have fewer contacts for PCB-specific questions
- You can concentrate on what is most important to you
- You benefit fully from the enormous technological know-how at WE Circuit Board Technology

# INTRODUCTION

## Advanced Solution Center – ASC



# INTRODUCTION

## Advanced Solution Center – ASC



### Implementation

#### 1<sup>st</sup> stage – MORE.technology

- Start with the first cooperation partner for “high technologies” and advanced technologies
- Technology consulting

#### 2<sup>nd</sup> stage – MORE.layout

- Layout service via WE Systems Engineering Service India
- ASC as an European port of support

#### 3<sup>rd</sup> stage – MORE.know-how

- Establishing of training program

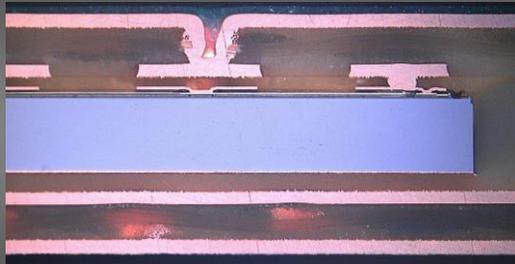


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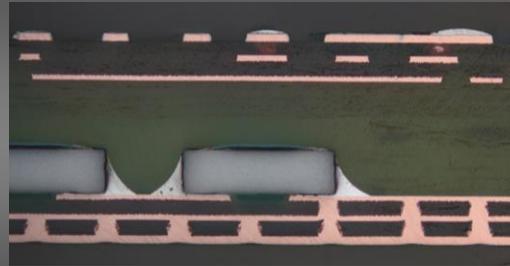
# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

## DEVICE.embedding



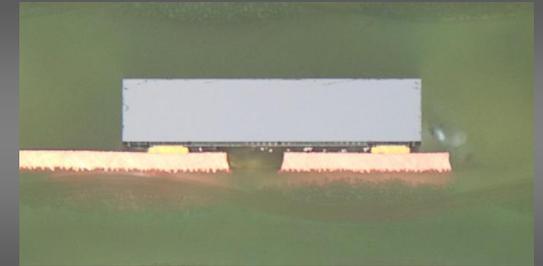
### MICROVIA.embedding

Bare Dies, dedicated passives  
 mounted onto inner layer  
 core or Cu-foil  
 electrical contact through microvias  
 highest reliability  
 large volumes



### SOLDER.embedding

SMD components  
 soldered onto  
 inner layer core  
 electrical contact by solder  
 high reliability  
 small, medium and large volumes



### FLIP-CHIP.embedding

Bumped Bare Dies  
 mounted onto inner layer  
 core  
 electrical contact by ACA  
 high reliability  
 small, medium and large volumes

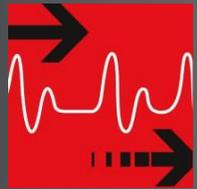
# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

## DEVICE.embedding



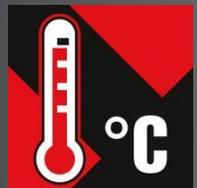
### Miniaturisation

- Package replacement
- Space savings of assembly area on the outer layers



### Performance/ Function

- Integrated shielding
- Short signal paths
- Protection against plagiarism



### Reliability

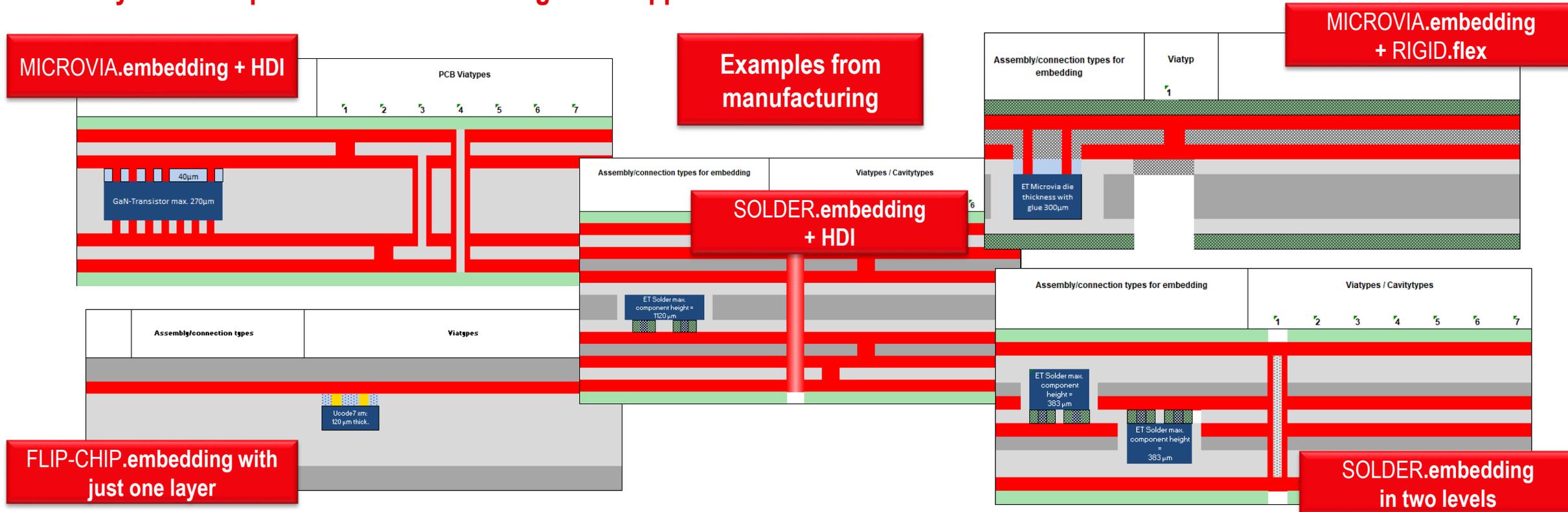
- Protection against environmental influences
- Secure and full-surface fixing
- Thermal management

# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

## Process flows - layer stack-ups



The layer stack-ups are created according to the application



# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

Which embedding variant should be used?



In 95% of the cases, this is being decided by the application or the components themselves 😊

Questions to be asked:

- **In which form are the components available?**
  - SMD components ⇒ SOLDER.embedding
  - Bare Dies or components offering pads to be connected with Cu ⇒ MICROVIA.embedding
  - Bare Dies with Au-Bumps ⇒ FLIP-CHIP.embedding
  
- **If you might want to use a different technology:**
  - Can the component be sourced or manufactured in the required configuration, e.g. an IC with copper pads instead of AlSiCu (common for wire bonding)?
  
- **Or do I have to mix the technologies?**
  - unfavourable but doable

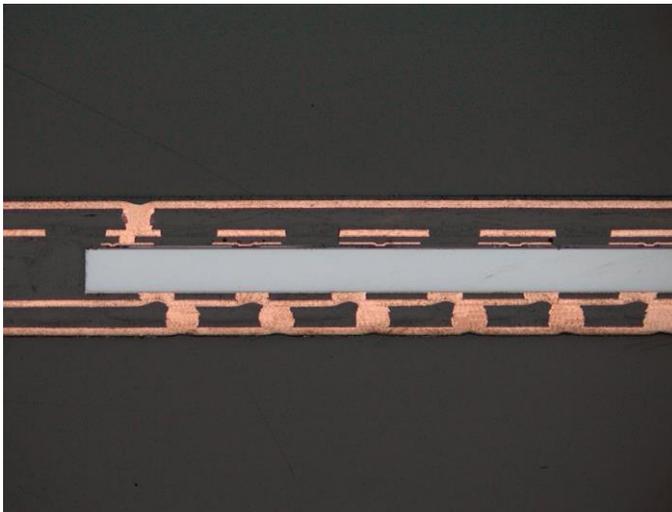
# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

## MICROVIA.embedding – Application Examples

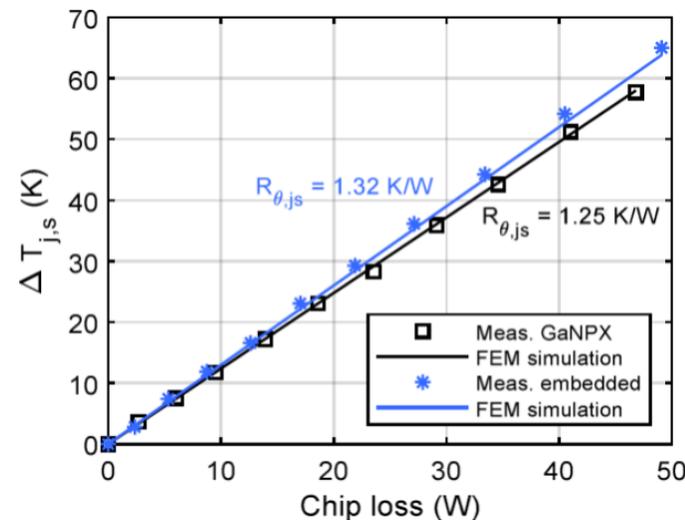


### Automotive: Embedded GaN Half Bridge Switching Cell

- GaN ICs embedded in 4-layer HDI-multilayer
- Contacts through microvias in all layers



Microsection of the printed circuit board



Simulated and measured Junction-Temperature

Source:  
Dechant et. al., »Performance of an Ultra Low Inductance GaN Half Bridge Switching Cell with Substrate Integrated Bare Dies”, PCIM 2019

For even better performance, the number of  $\mu$ Vias can be doubled

# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

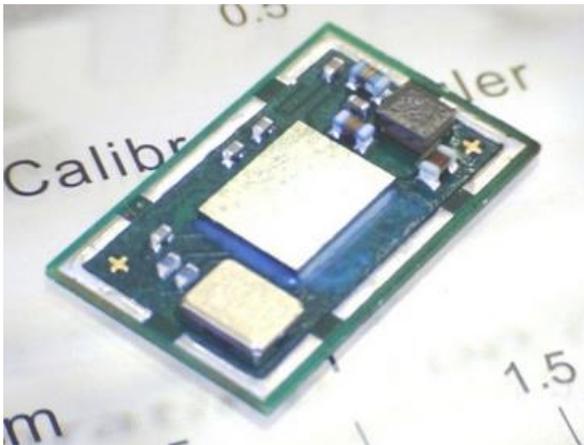
## SOLDER.embedding – Application Examples



### Medical Technology: embedded ASIC – radio module for implants



Complete radio solution for implant based on the MICS-Band (Medical Implant Communication Service)



Standard SIP –  $12 \times 7 \text{ mm}^2 = 84 \text{ mm}^2$

70%  
space saving



Embedded Die –  $5,5 \times 4,5 \text{ mm}^2 = 24,75 \text{ mm}^2$

Source: Microsemi

# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

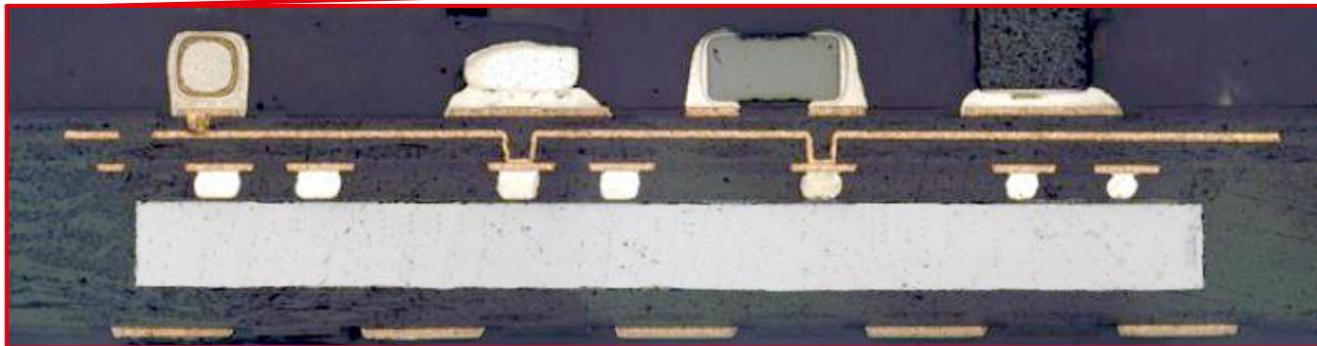
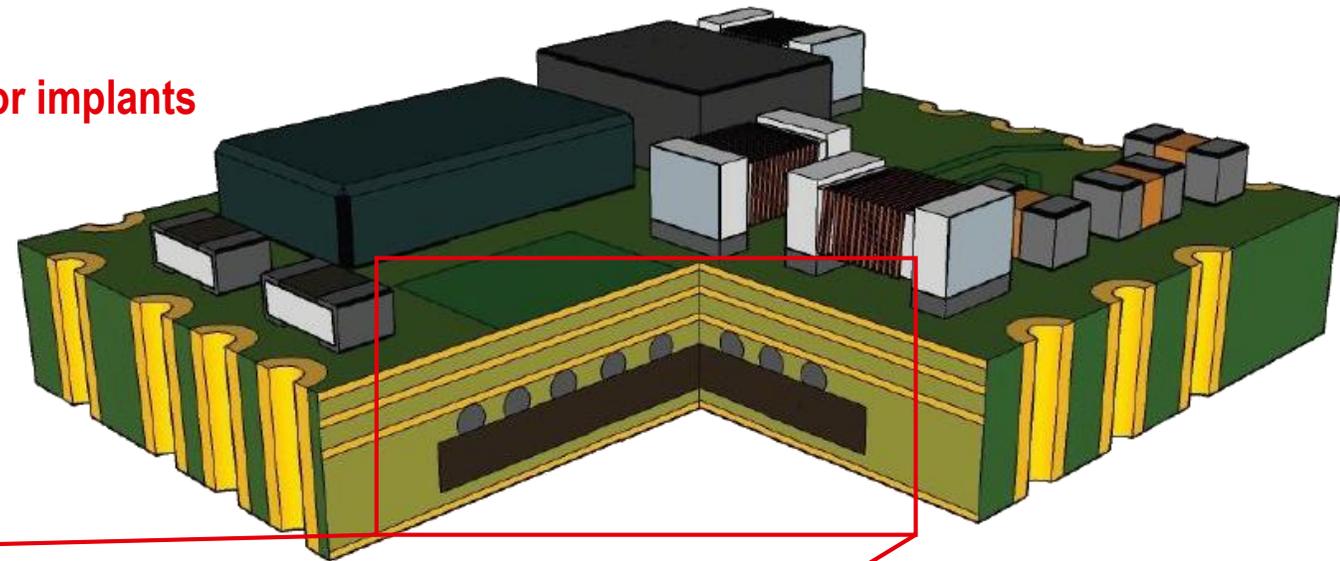
## SOLDER.embedding – Application Examples



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- 5 Summary

# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

## Technology Partner



- **Through close collaboration**

- with our technical project teams in the plants (TPM), or
- with technology partners

**we offer the possibility to have PCBs manufactured that do not comply with the standard portfolio**

- **Especially through cooperation, the options can be expanded:**

- Multilayer up to 60 layers
- Anylayer HDI with staggered and stacked microvias
- Heavy Copper (up to 210  $\mu\text{m}$  with UL, up to 400  $\mu\text{m}$  without)
- Cu-Busbars, Cu-Inlays resp. Cu-Coins
- High frequency and microwave circuits
- Depending on technology down to 50  $\mu\text{m}$  line/space

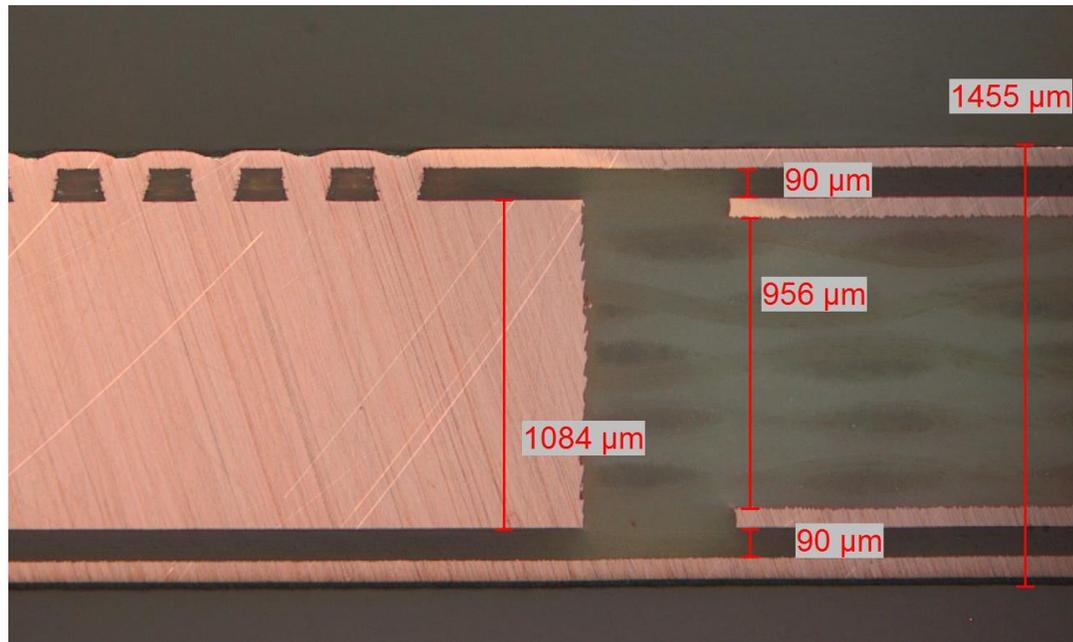
**Options are  
being further  
expanded**

# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

Technology Partner – Application Examples



## 1mm Cu-profile in PCB – contacted by Cu-filled microvias



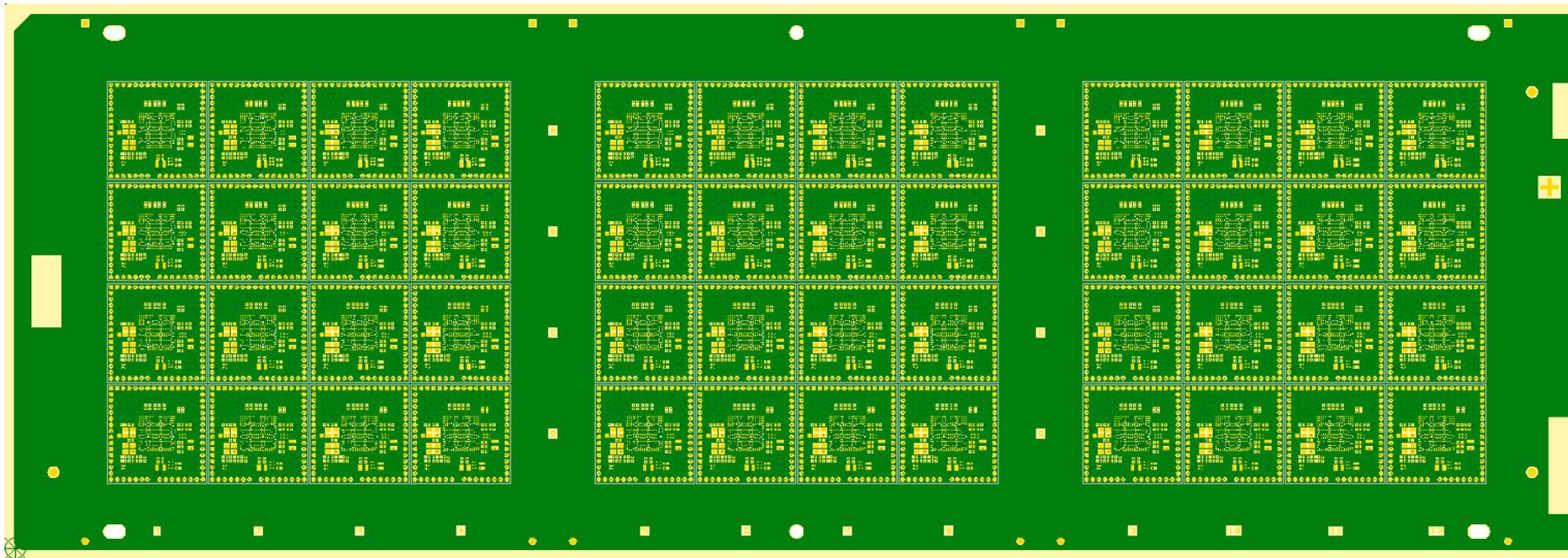
1 mm copper profile in FR4

# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

## Technology Partner – Application Examples



### Finest structures using the example of a customised FCBGA - IC Substrate



Custom FCBGA Panel - 4-layer anylayer with 50 $\mu$ m L/S on outer layers and inner layers / stacked, filled microvias



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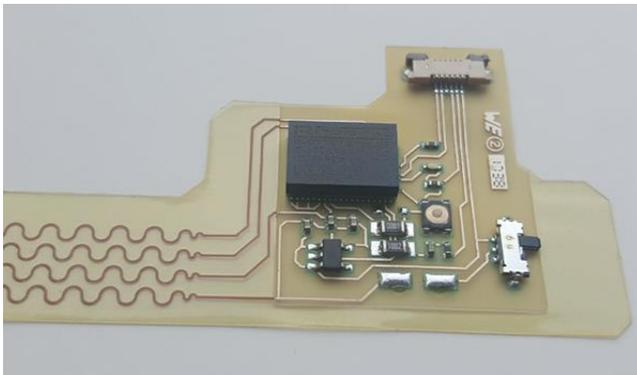
# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

## STRETCH.flex – Basics and Concept



### Concept – stretchable printed circuit board

- Thermoplastic polyurethane (TPU) acts as new copper clad substrate material
- Design of the tracks in meander form to realize the stretchability
- Use of established manufacturing processes
- Various further processing options e.g. thermoforming/deep drawing, back injection moulding, laminating, etc.:

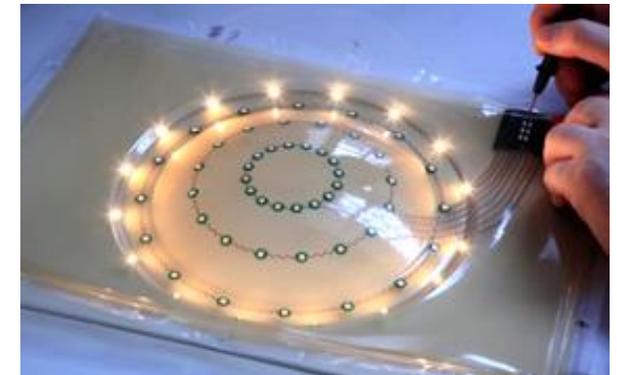


Assembly with SnBi-solder paste



Laminated onto textiles

Source: Fraunhofer IZM



Example „Conformable Electronics“

Source: Fraunhofer IZM

# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

## STRETCH.flex – Basics and Concept



### Advantages

- Depending on the layout: dynamic stretchability of 5 – 20%
- Wide property profile of TPU
- Very adaptable material – almost every shape is realizable
- Multiple rotation without influence on stability and electrical properties



Dynamic stretch



Multiple rotation (n x 180°)



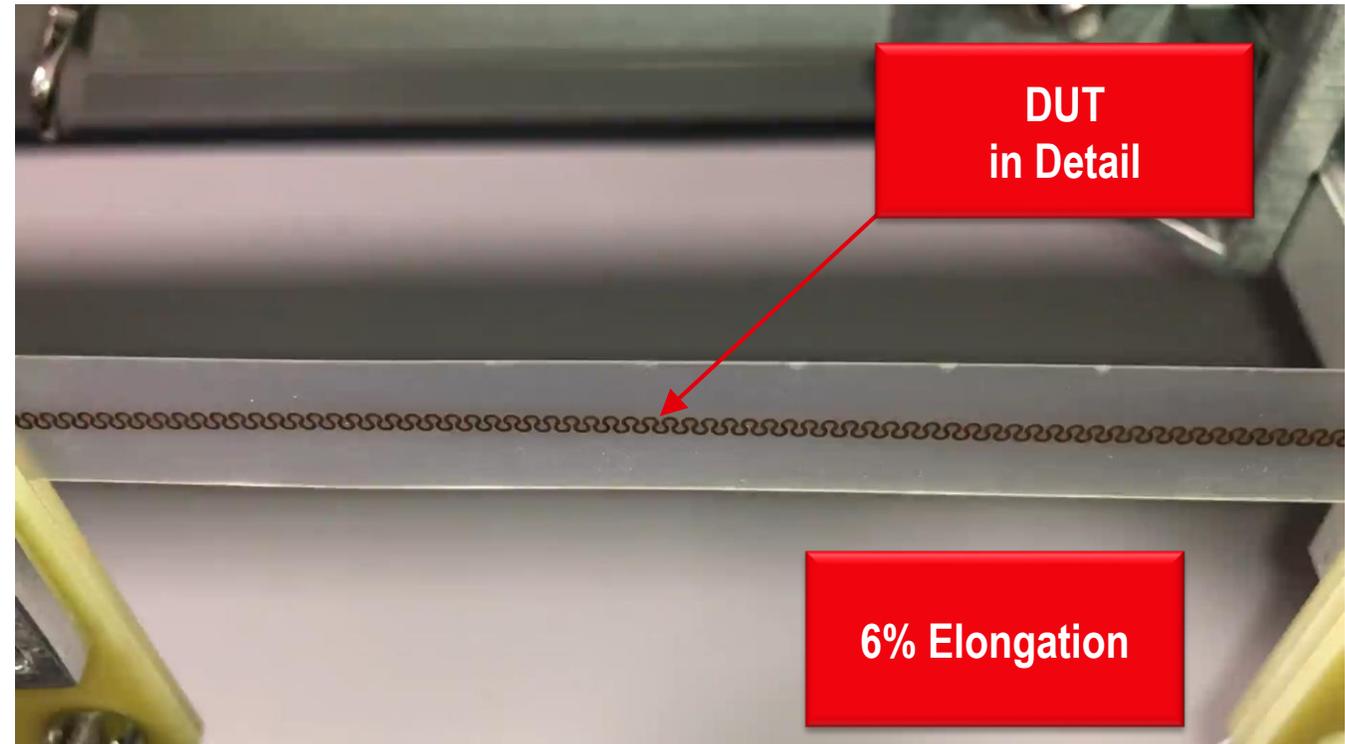
Adaptable material

# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

## STRETCH.flex – Elongation of Copper Structures



- Since TPU is a rather unknown material for PCBS: new reliability requirements must be identified and tested!
- Example:  
Cycling strength of different copper structures at defined elongation
- Approach:
  - production of dedicated samples
  - construction of a device for cyclic stretching with in-situ measurement
  - and measure, measure, measure....
- The resistance is measured at the min. and max. elongation points



# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

## STRETCH.flex – Properties



### Material properties

- Extensive testing necessary
- Multiple rotation (n x 180°) without influence on stability and electrical properties
- Dynamic stretchability of 5 – 20 %
- Skin-friendly material
- Softening area: 155 – 185°C
- Multiple processing options (assembly in reflow, thermoforming/deep drawing, laminating...)

### Fields of application

- Medical Technology
- Sensor Technology
- Smart Textiles
- (Soft-) Robotics
- IoT (Internet of Things)
- Wearable Technology



Samples available  
upon request

# INSIGHT INTO 1<sup>ST</sup> STAGE OF MORE.technology

## STRETCH.flex – Application Example



### Medical Technology

#### ▪ Sentec Co. – Neonatology Belt

- Treatment of new-borns and premature babies (neonatology)
- Chest strap to directly monitor the lung and heart function through electrical impedance tomography (EIT)
- Advantage against previous solution: Significantly reduced risk of injury to the sensitive skin





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# ADVANCED SOLUTION CENTER

## Summary



### **In future, the Advanced Solution Center will offer you**

- **PCB solutions to their complex, technological products**
- **Check and handover in our German plants with the support of the technical teams on site - if possible**
- **competent partner who manufactures these demanding PCBs on our behalf - if not possible at WE**
- **Management of PCB production**
- **Fewer contacts for PCB-specific questions**

### **This allows you to**

- **concentrate on what is essential for you**
- **benefit fully from the enormous technological know-how at WE**



# Thank you for your attention!

## JÜRGEN WOLF

Head of Advanced Solution Center

Würth Elektronik GmbH & Co. KG  
 Salzstraße 21  
 74676 Niedernhall / Germany  
 +49 79 55 38 88 07 - 220  
 juergen.wolf@we-online.de

**Merci de  
votre attention!**

**¡Gracias por  
su atención!**

**Tack för er  
uppmärksamhet!**

谢谢你的关注

**Köszönöm a  
figyelmüket!**

**Tak for deres  
opmærksomhed!**

**Děkuji Vám  
za pozornost!**

**Grazie per la  
vostra attenzione!**

**Kiitos  
mielenkiinnosta!**

**Dank u voor  
uw aandacht!**

**Dziękuję za  
uwagę!**

**Takk for  
oppmerksomheten!**

**Vielen Dank für Ihre  
Aufmerksamkeit!**

ご注目いただきありがとうございます  
ございます

Save my contact  
details directly:

