Microsystem technology and printed circuit board technology

competition and chance for Europe

Prof. Udo Bechtloff, KSG Leiterplatten GmbH

Knowledge
Stability
German efficiency

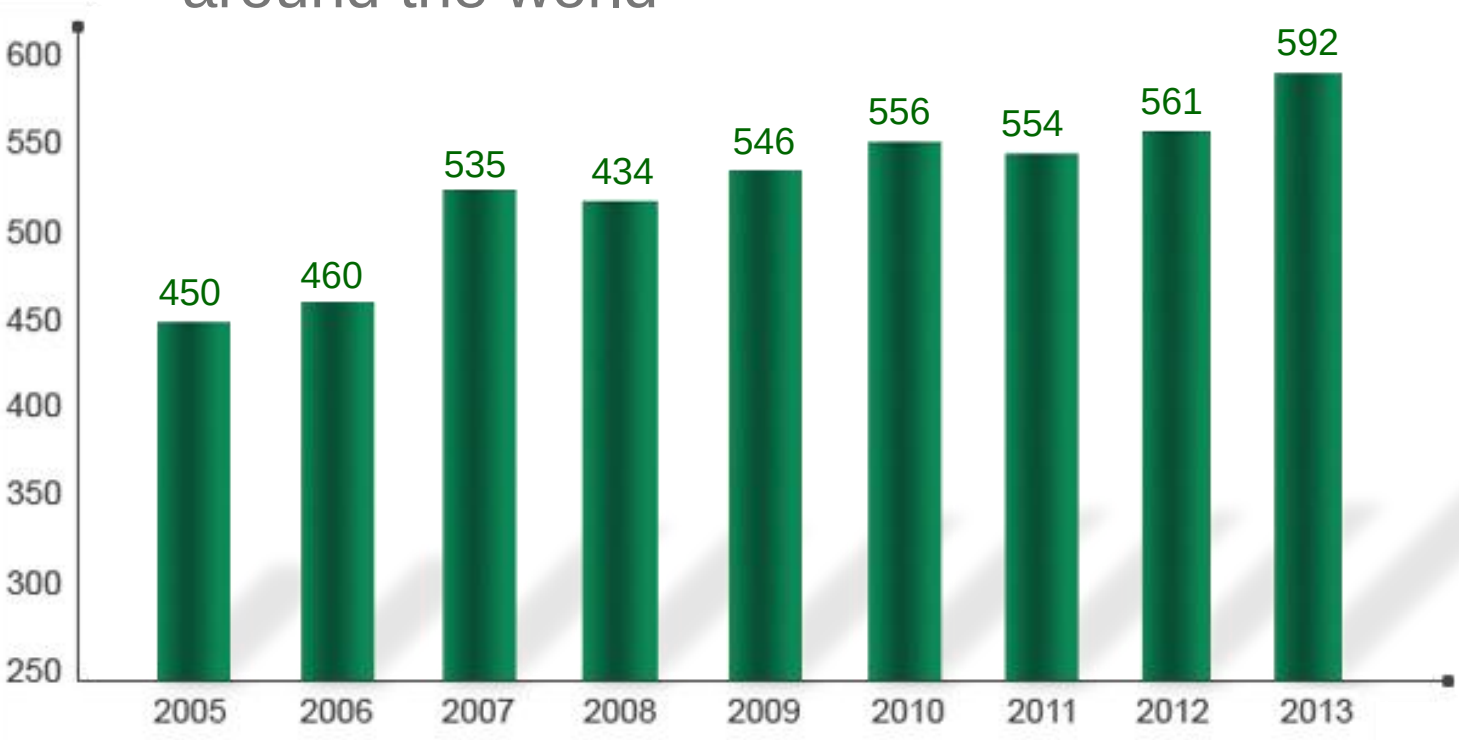
Content

- KSG – a continuously growing company
- PCB based Microsystems
- Application-oriented PCB-Technologies
- Future PCB world at KSG
- On the way to a nano-world

Knowledge
Stability
German efficiency

KSG - Growing the European PCB business with diversity

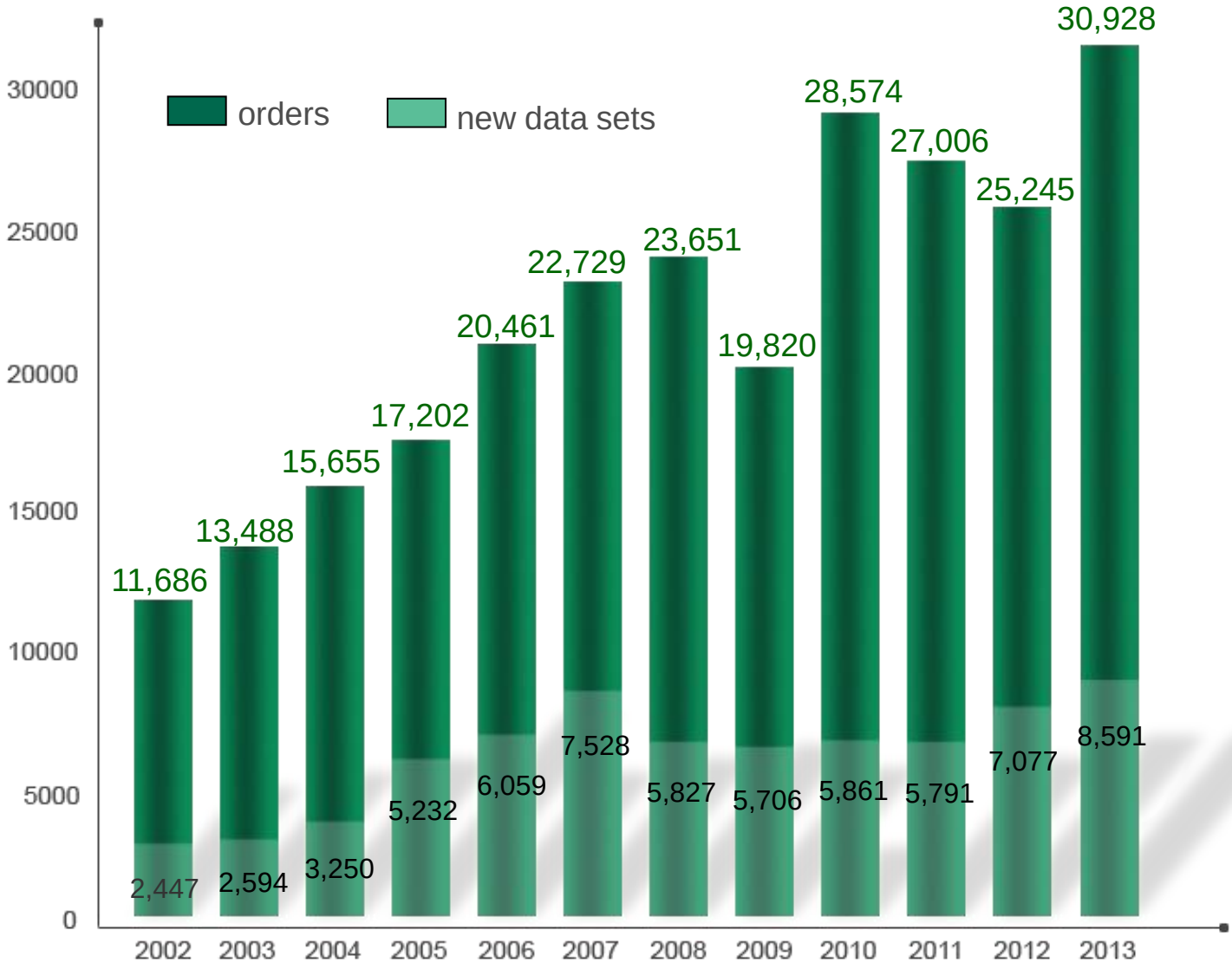
- 85% of our customers come from Germany
- we’re serving customers in 21 countries around the world



Number of customers as of December 2013

Knowledge
Stability
German efficiency

KSG - Growing the European PCB business with diversity



Knowledge
Stability
German efficiency

KSG Leiterplatten

PCB based Microsystems

Knowledge
Stability
German efficiency

PCBs in electronic systems

mechanical carrier

the two functions of a printed circuit board

electrical circuit distribution

System-in-package

lower cost
higher volume

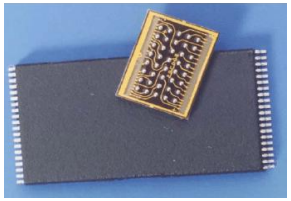
technology based on PCBs

higher cost
lower volume

technology based on Microsystems

Knowledge
Stability
German efficiency

driving force from IC-Package

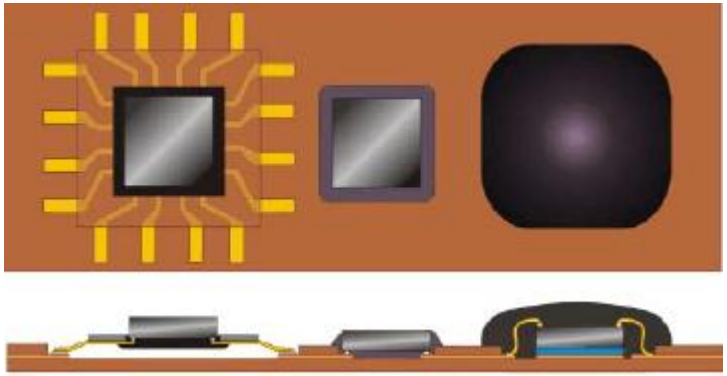


PCB technologies are depending on the success of chip packages

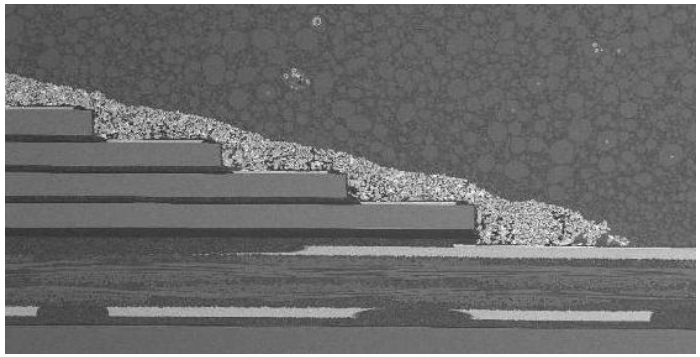
→ **matching of connections between IC-packages**

Microsystems technologies are depending on the success of the availability of micro and nano materials

→ **input and output for the surrounding micro world**



Leadframe Flip-Chip COB

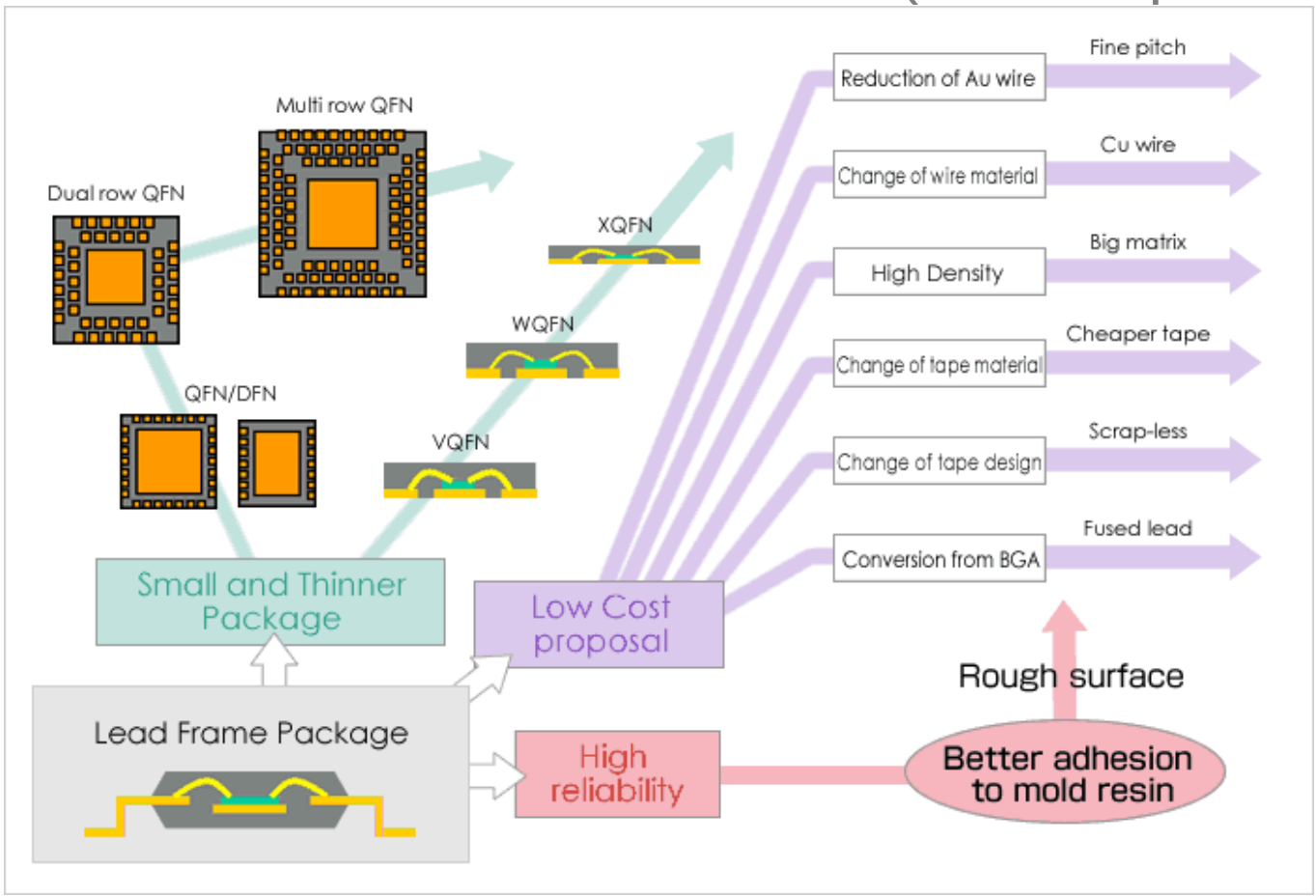


conductive paste for IC stack connections

Knowledge
Stability
German efficiency

Leadframe - limited in the number of connections

→ increases the chance for additional market shares of PCB substrates (like interposers)



Knowledge
Stability
German efficiency

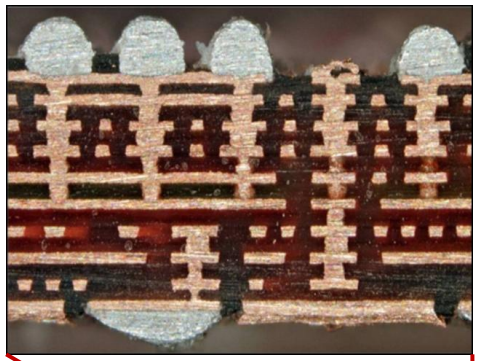
origin Mitsui High-tec

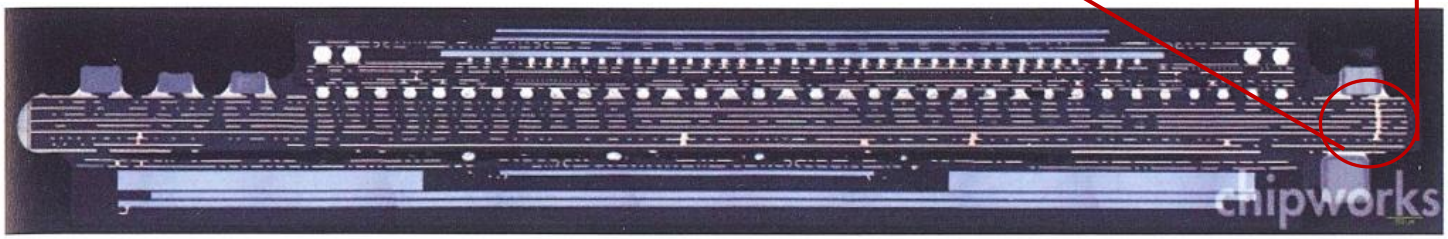
High Density Interconnection
- cost sensitive application -

- **A**ny **L**ayer **I**nner **V**ia **H**oles, **F**ree **V**ia **S**tacked-up **S**tructure, ...
  → many innovative ideas for layer connections
- a very thin and light PCB is the basis for products like high performance smart phones and other mobile devices

cross section of an interconnect detail

→ realized with **copper paste** instead of plating processes



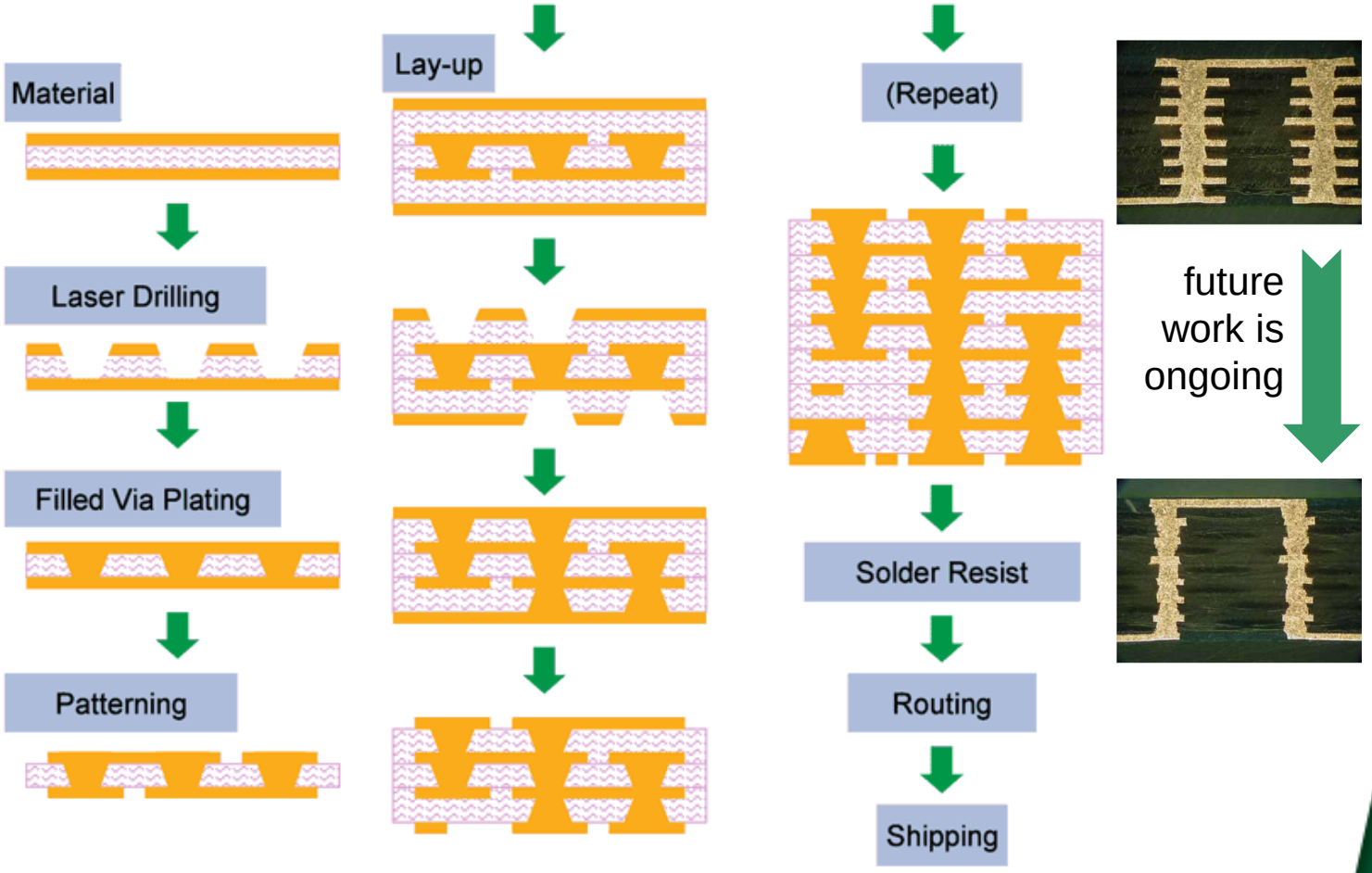


cross section of iPhone5 (6 Layer Flip-Chip Interposer +10 Layer PCB + Display with touch screen)

origin of Matsushita

Knowledge
Stability
German efficiency

High Density Interconnection
- cost pressure on processing -



Materials: copper foil, isolation sheet (prepreg), Cu plating or conductive paste
Equipment: Laser drill, screen printer, vacuum press, direct imaging, etching

KSG
Knowledge
Stability
German efficiency

more and more **E**lectronic **C**ontrol **U**nits inside

- about 80% of automotive innovations come from electronics and software
- the vehicle's value of electronics is now at 30% and will be growing to 50% by 2030

a fast growing business

System-in-package

lower cost
higher volume

PCB based

higher cost
lower volume

Microsystem based

Knowledge
Stability
German efficiency

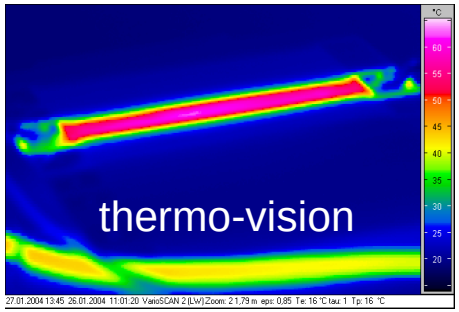
KSG LEITERPLATTEN

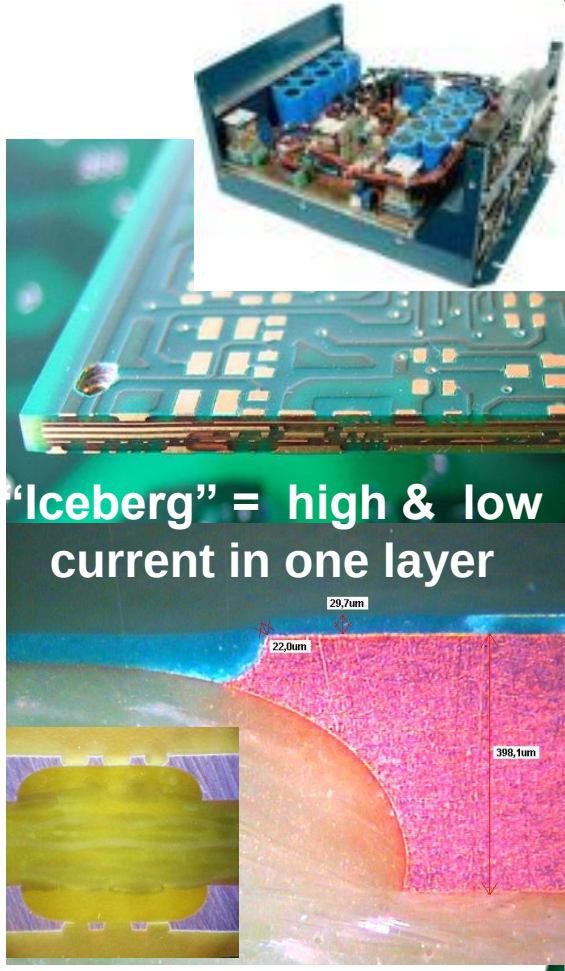
- High current demands
- Hotspot thermal dissipation
- High frequency substrates
- Optical interconnections
- Flexible & rigid flexible connections

Application-oriented PCB-Technologies

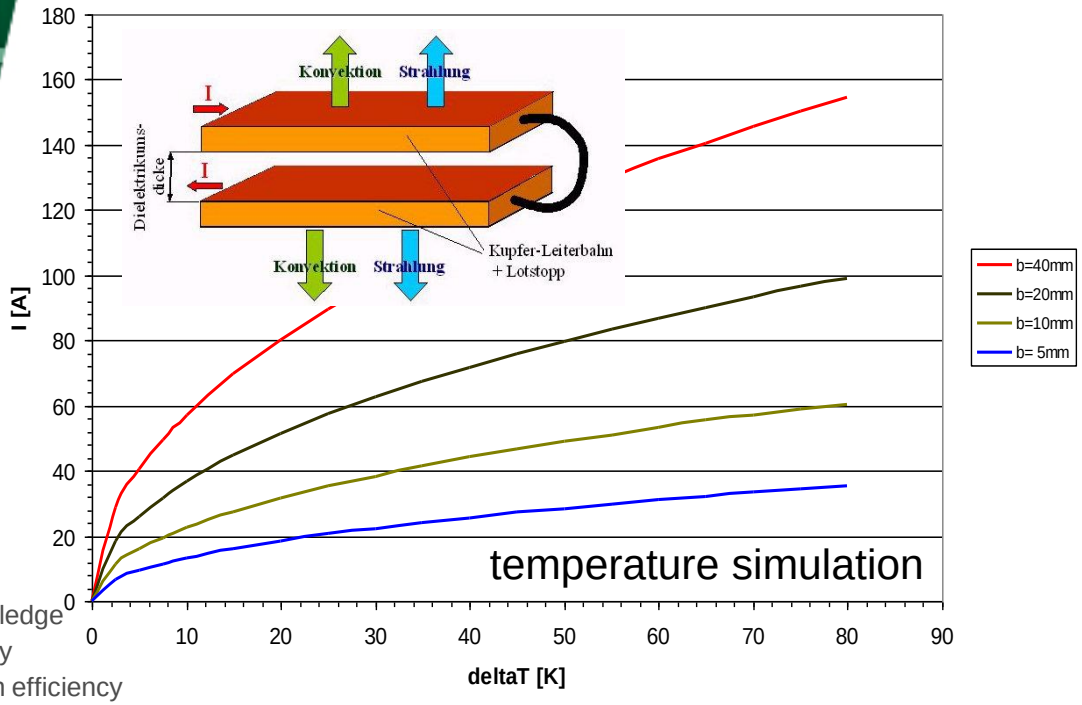
Knowledge
Stability
German efficiency

High current demands, Hotspot thermal dissipation

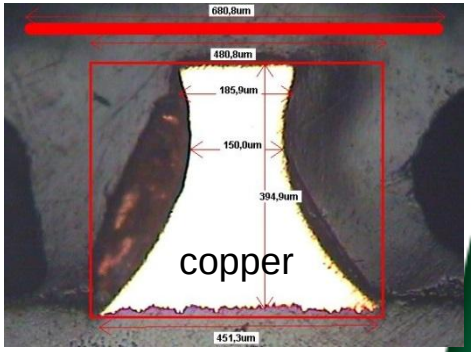




deltaT = f (I, b) für h = 400 µm bei einseitiger Wärmeabgabe



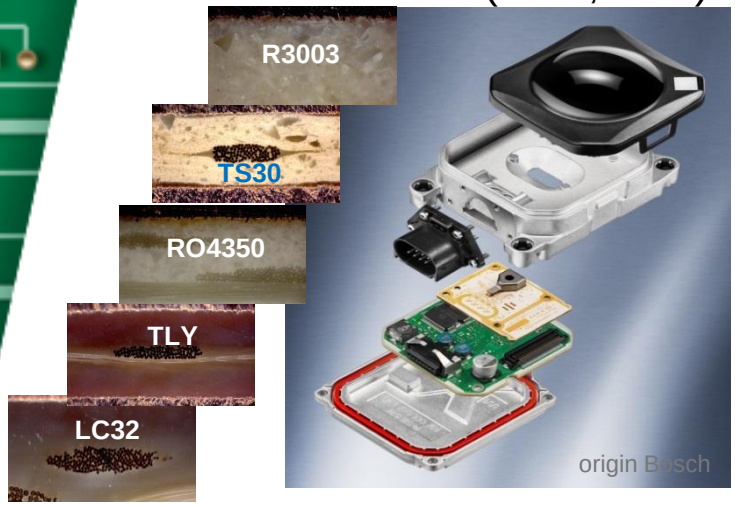
400 x 400 µm²
cross section



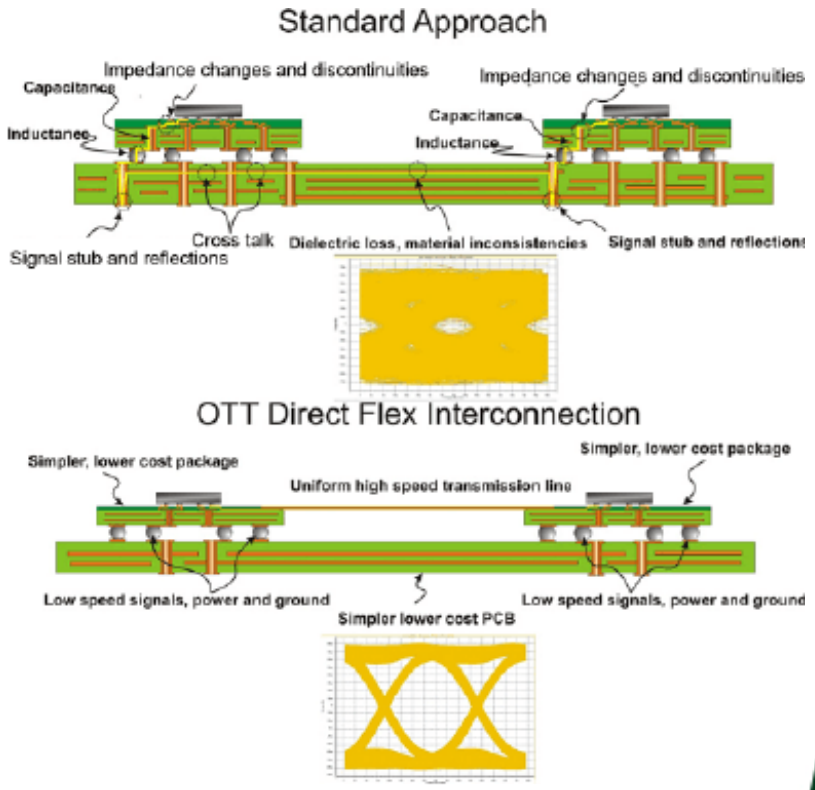
Knowledge
Stability
German efficiency

High frequency substrates optical interconnections

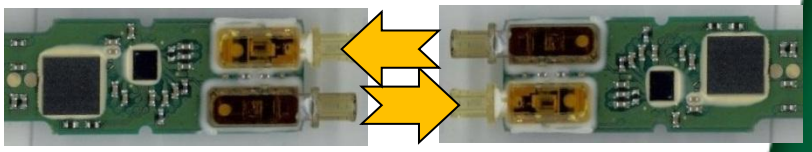
dielectric materials for anti-collision radar (ACC, AEB)



→ realized with COB in PCB cavities



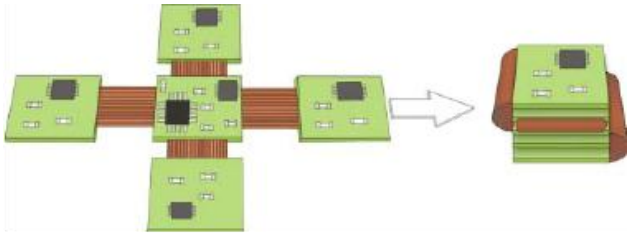
low-cost 100 Mbit Transceiver



→ realized with DCA, COB and plastic optics on PCB

Knowledge
Stability
German efficiency

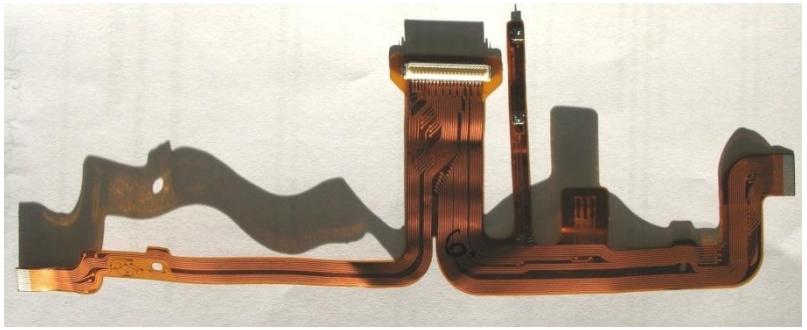
Flexible & Rigid-Flex Connections

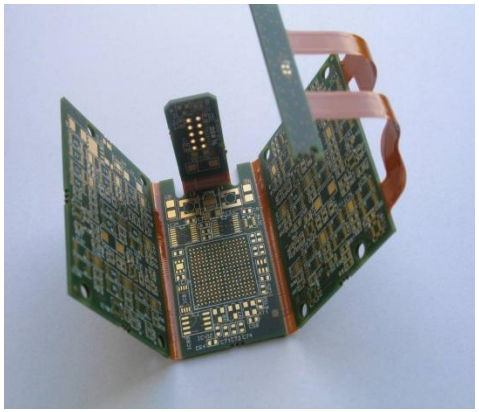


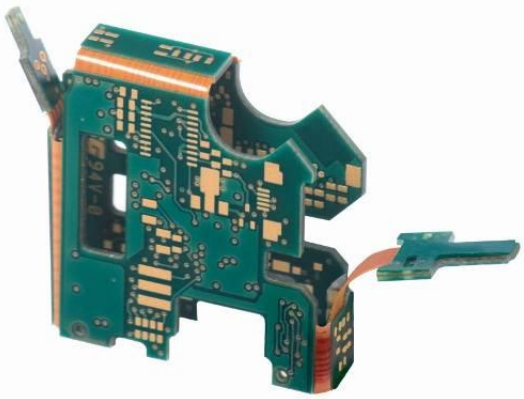
→ a solution to a packaging problem

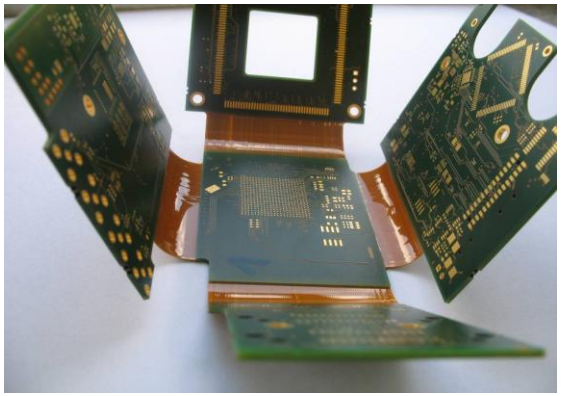
Advantages of using flexible & rigid-flex circuitry

- solution to three dimensional spacing limitations
- have mobility (if movement is required)
- much thinner and lighter in weight









Knowledge
Stability
German efficiency

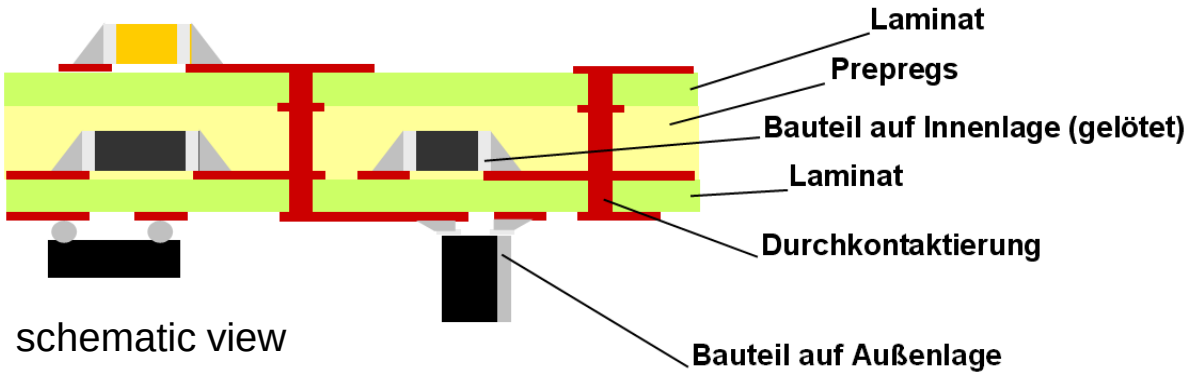
KSG Leiterplatten

Future PCB World at KSG

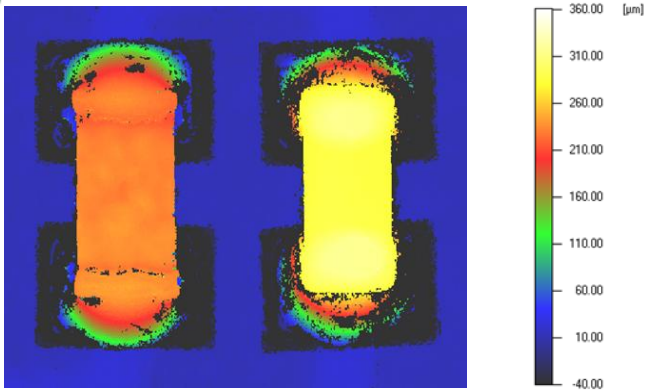
Knowledge
Stability
German efficiency

PCBs with embedded passive devices

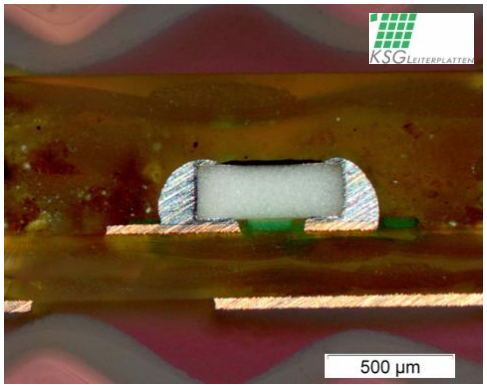
Type1 - Pad Bonding Via Connection



schematic view



surface profile of two passive components

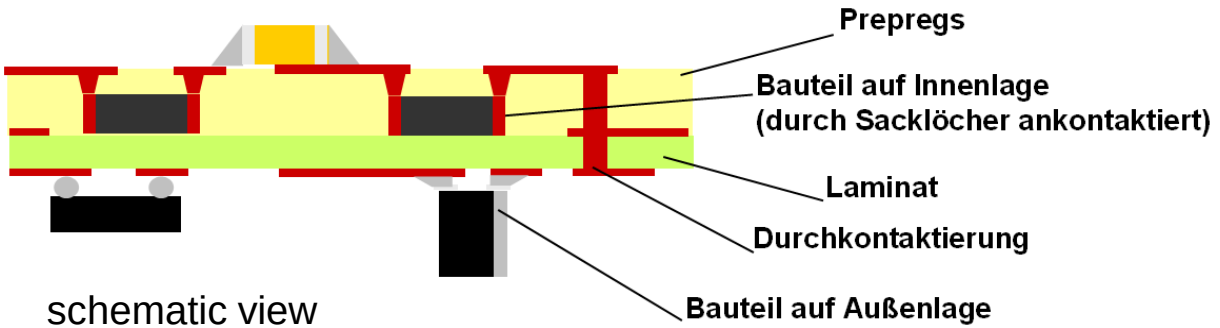


cross section view of a bonded buried resistor

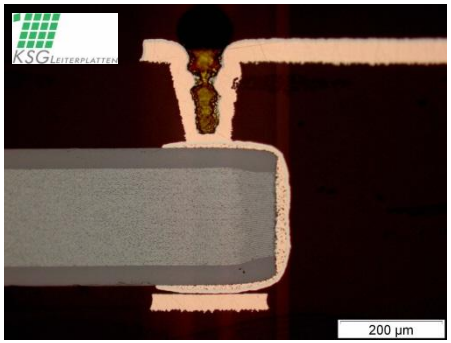
Knowledge
Stability
German efficiency

PCBs with embedded passive devices

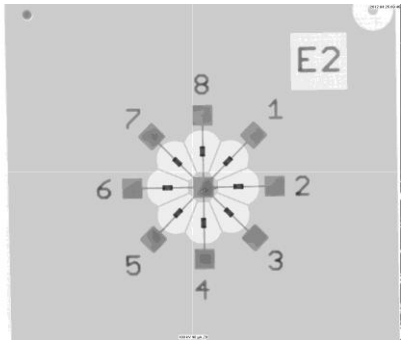
Type 2 - Laser Via Connection

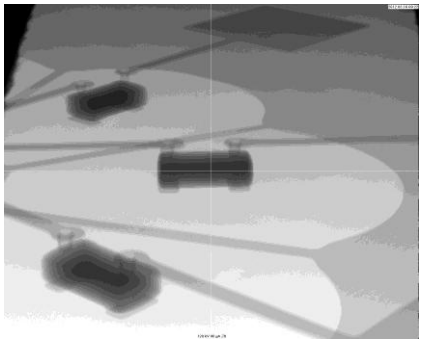


schematic view



cross section of a buried capacity with connection





X-ray sections of a prototype construction with 8 buried capacitors

Knowledge
Stability
German efficiency

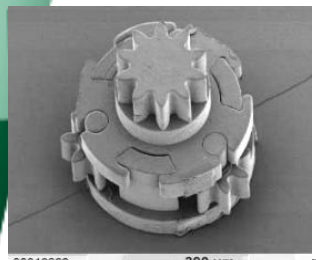
PCBs with thinned chip devices

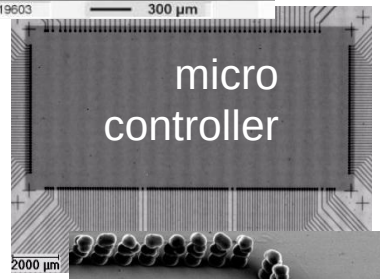
Type 3 - special Via Connection

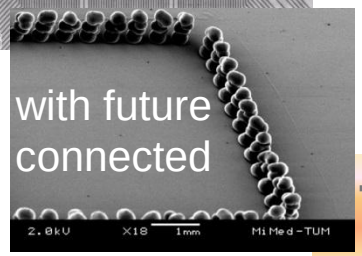
Knowledge
Stability
German efficiency

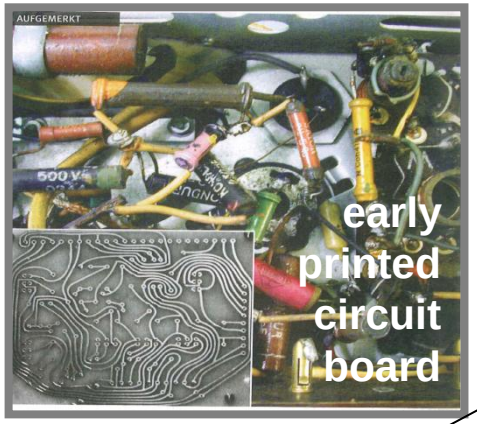
on the way to nano-world

micro epicyclic gears









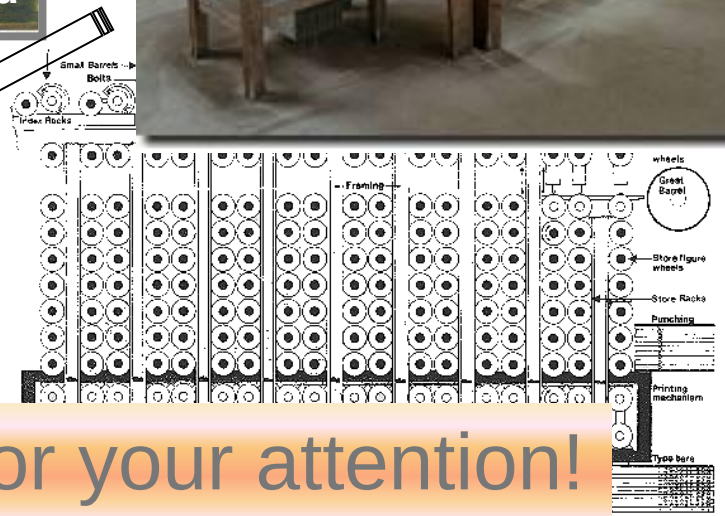


Fig. 2. Plan of Analytical Engine with grid layout, 1858 Redrawn

KSG Leiterplatten

Knowledge
Stability
German efficiency

Thank you for your attention!