

Stretchable and Modular Electronics

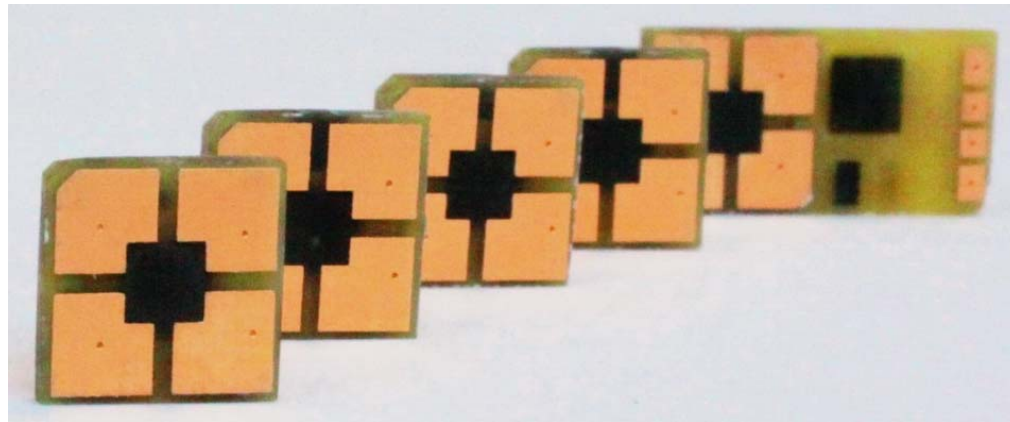
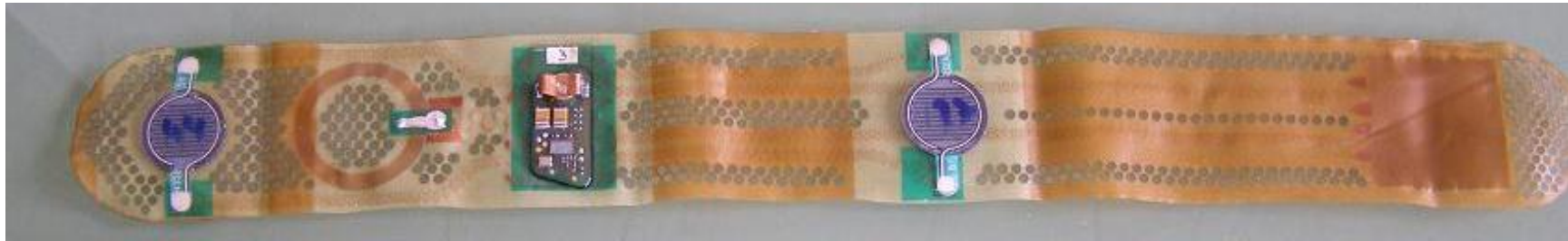
Andreas Ostmann

Fraunhofer Institute for Reliability and Microintegration (IZM)

Andreas.Ostmann@izm.fraunhofer.de



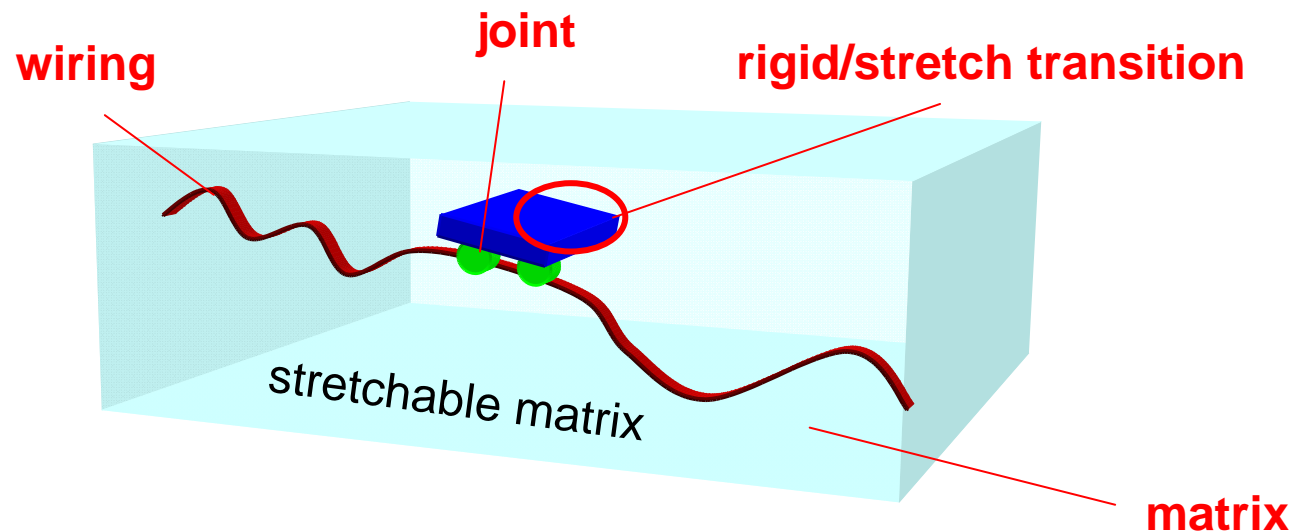
Interconnection Technologies – Stretchable & Modular



Soft Robotics

Stretchable Electronics – Challenges

→ Combination of stretchable and rigid parts to form a stretchable system



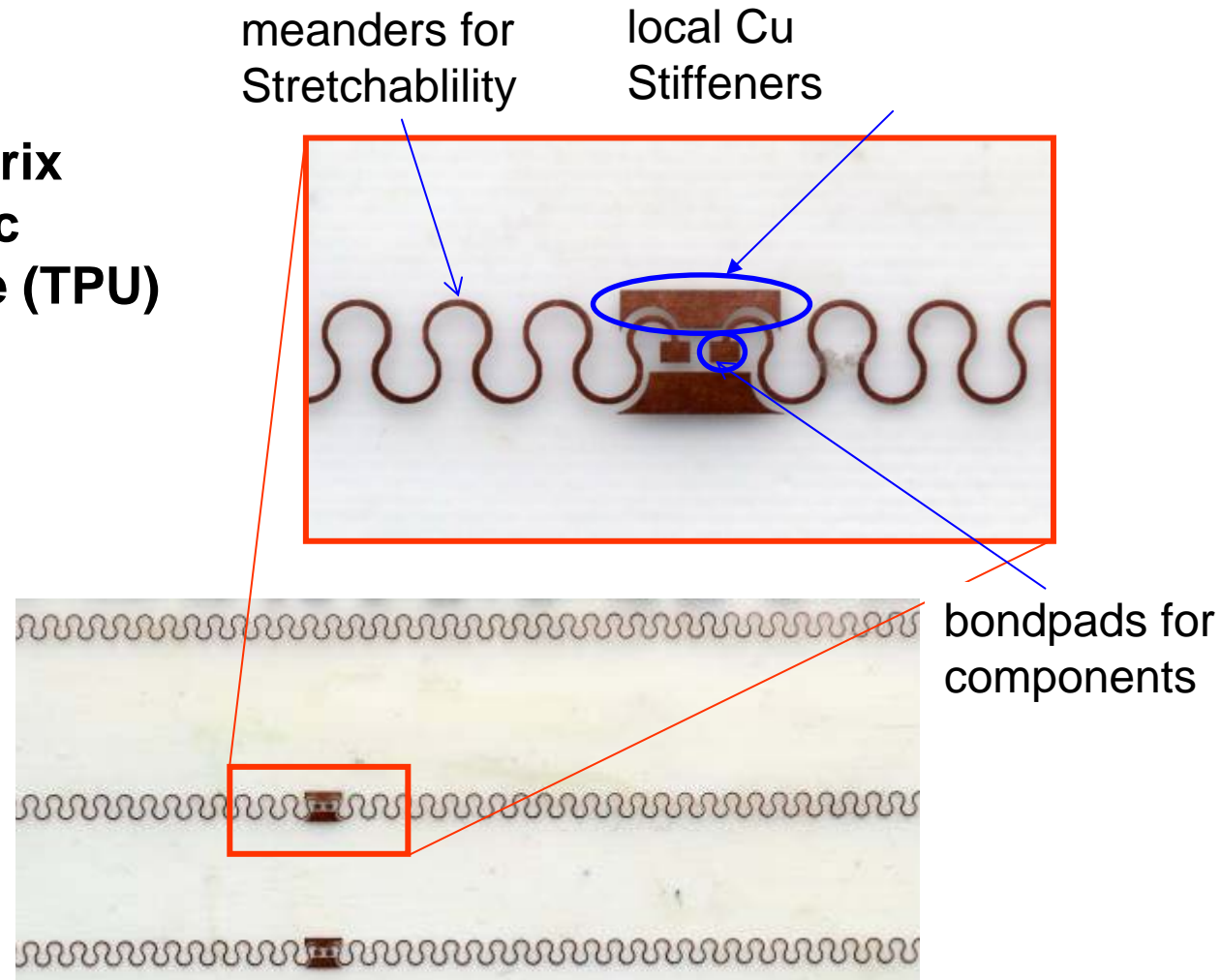
Challenge:

- Fabricate conductors on / in a stretchable matrix
- Provide a robust interconnection of stretchable wires with rigid components

Stretchable Electronics – Polyurethane & Conductor Shape

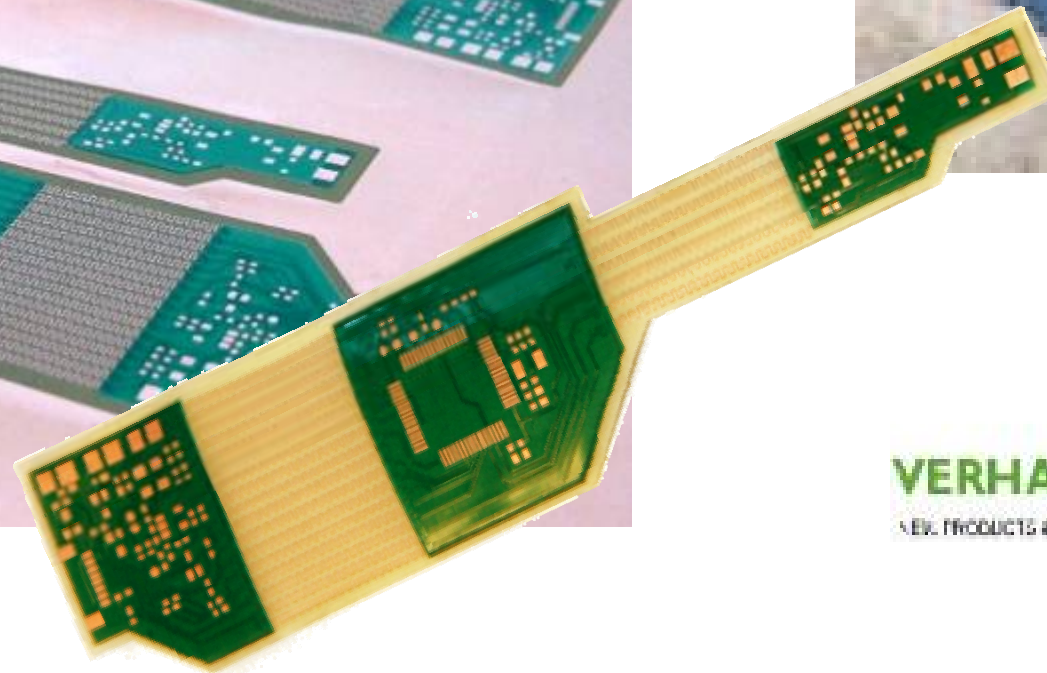
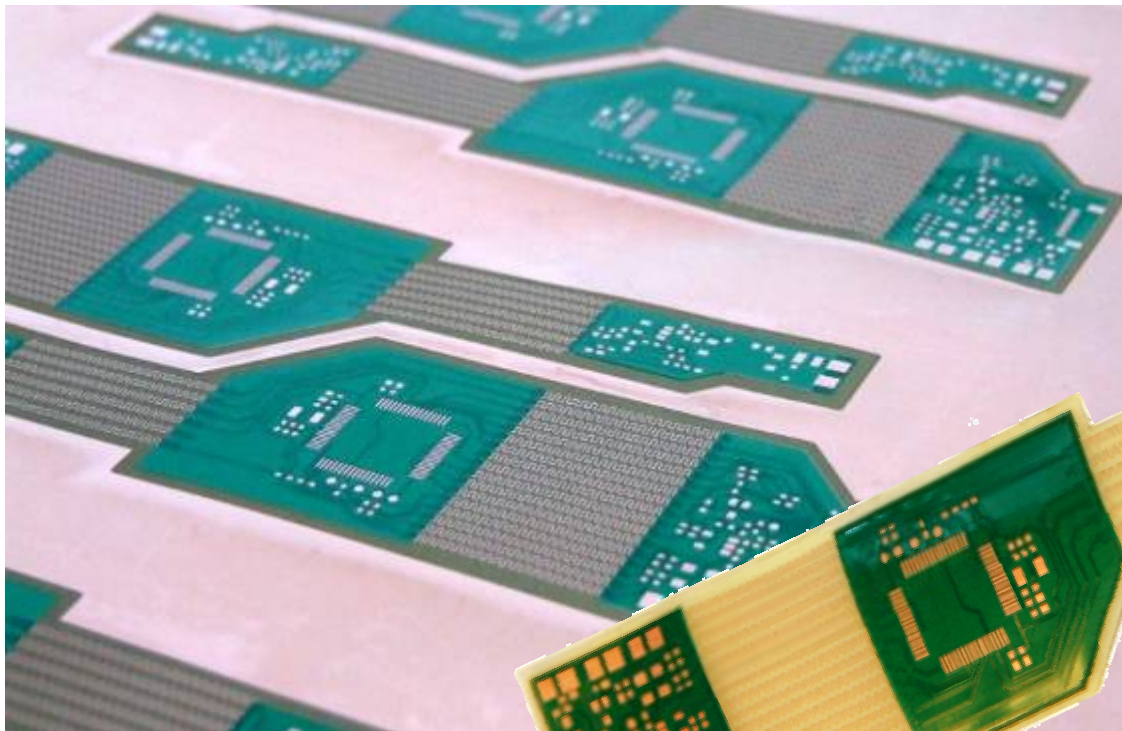
How to manage the rigid - stretch transition ?

Stretchable matrix
→ thermoplastic
polyurethane (TPU)



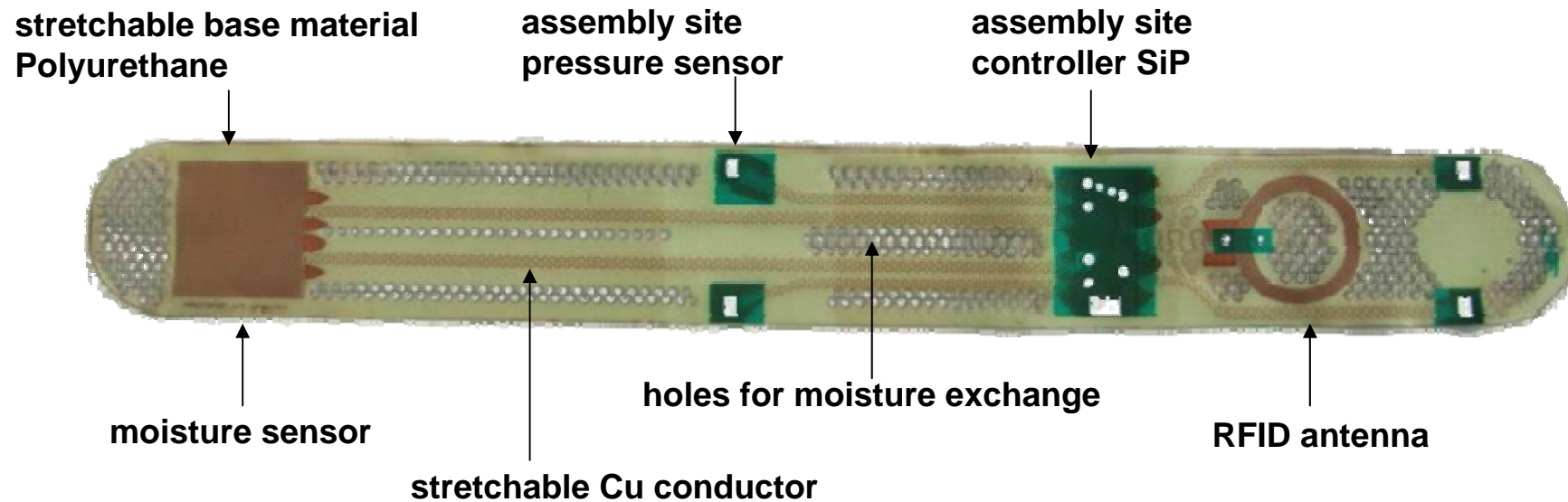
Application - Infant Respiratory Monitor

- detection of baby breezing
- integration into baby clothing
- 3 bendable sub-modules connected by TPU conductor



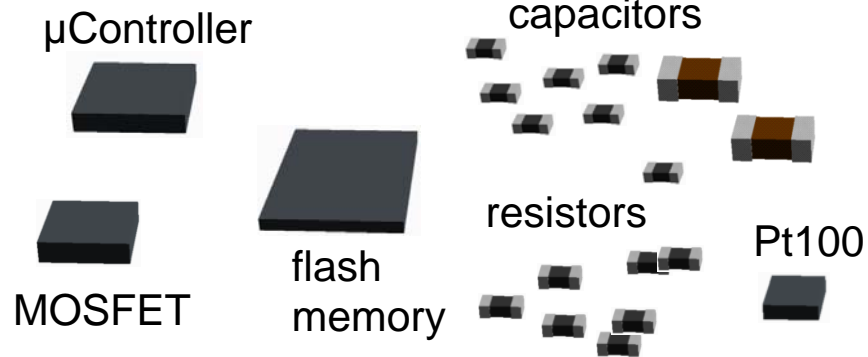
Application – Wound Healing Bandage

→ stretchable interposer for medical bandage



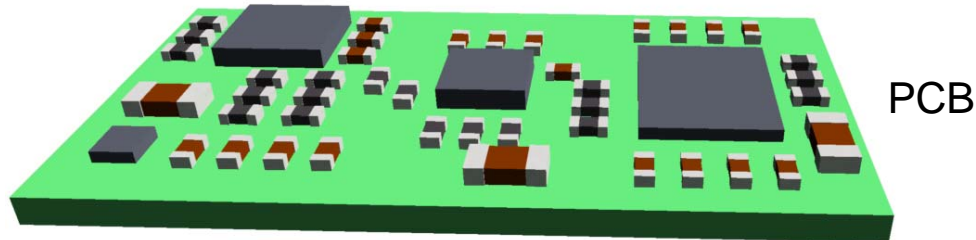
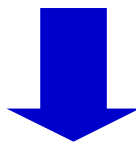
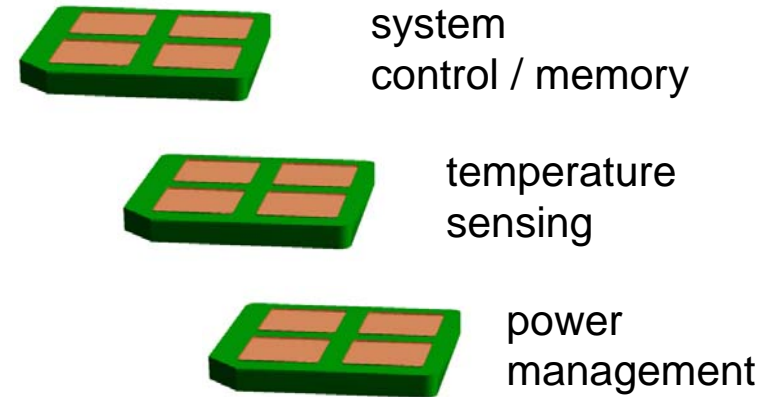
Modular Microelectronics - System Assembly Concept

Traditional electronic system

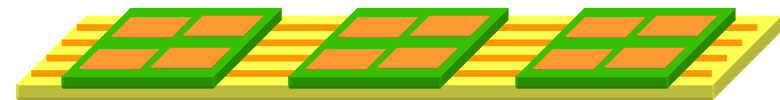
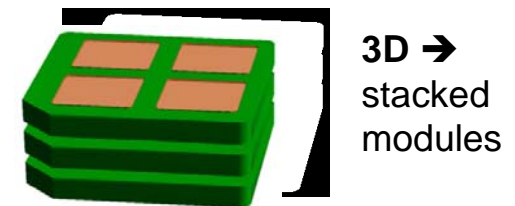
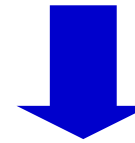


Vision

Modular System



components on a PCB



2D → modules on Stretch connector

Modular Microelectronics - 1st Level (inside Modules)

Requirements on Modules:

- easy to handle
 - stackable \Rightarrow planar
 - reliable
- \rightarrow Embedding Technology**



Embedded SMD System-in-Packages

- embedding of packaged SMDs
- required if bare dies are not available
- thicker modules (1-2 mm)

Embedded Chips System-in-Packages

- planar modules with embedded dies and thin passives
- thin modules (ca. 150 μm)

Embedded Thin Chip

- all functions integrated in a SoC
- ultra-thin ($< 100 \mu\text{m}$) / CSP form factor

Interconnects - Serial Data Bus

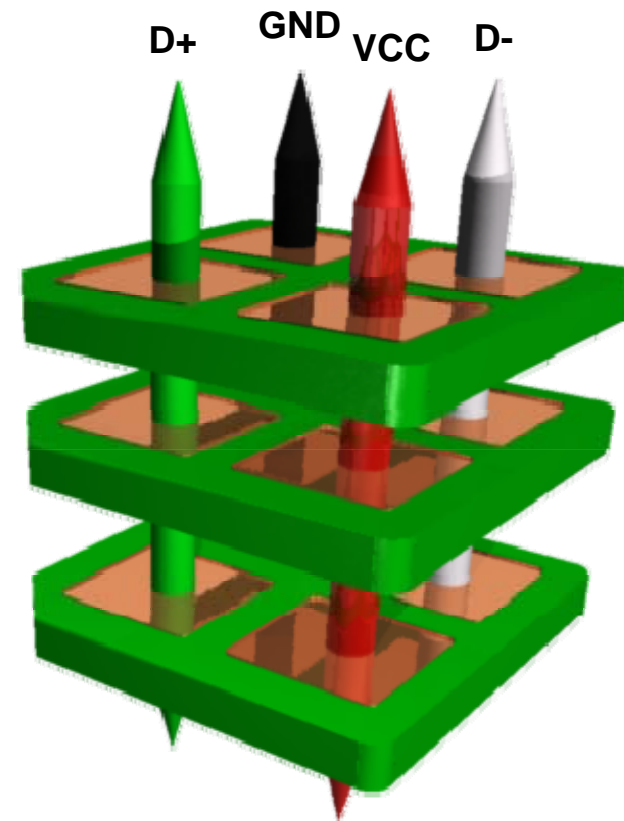
→ Serial bus connection between modules

Bus Systems

Name	max. Speed	no. of I/Os
LIN	0.02 Mbit/s	2
CAN	1 Mbit/s	4
I ² C	3,4 Mbit/s	4
USB 2.0	480 Mbit/s	4
USB 3	5000 Mbit/s	6

Low number of contacts between modules

- simplified assembly process
- high assembly yield
- high reliability

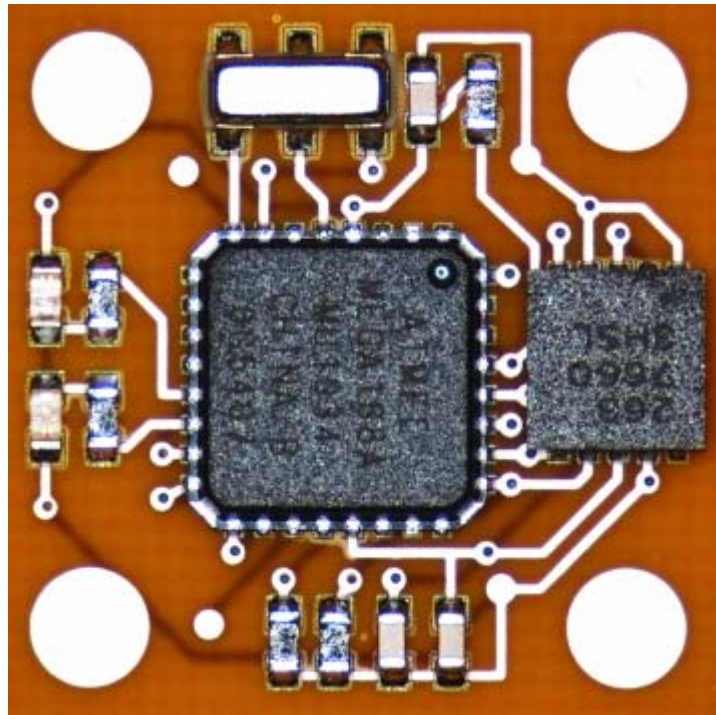


Modular Sensor – Module Packaging

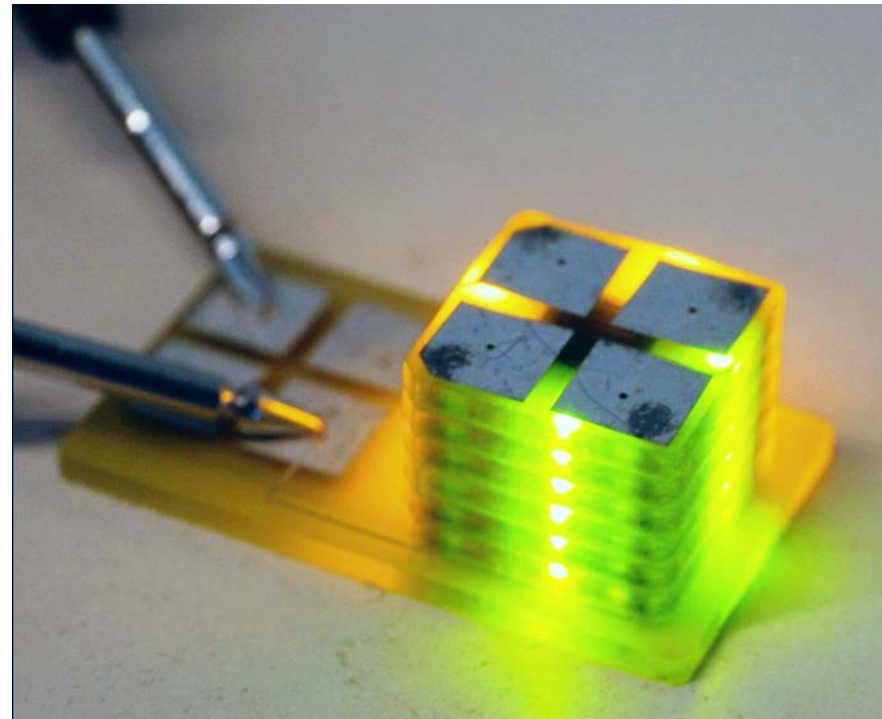


Module realisation

- module size: 12 x 12 mm²
- SMD assembly on 2-layer core PCB
- build-up of outer layers
- SMDs embedded into top layer



module after SMD assembly before embedding



stack of test modules with embedded LEDs

A close-up photograph of a blue fabric with red and white stripes and small white rectangular accents. The fabric is draped and folded, creating a sense of depth and texture. The red stripes are prominent, and the white accents are scattered throughout. The overall appearance is that of a decorative or functional textile.

Thank You