Prevention of Attacks on Electronic Systems Innovative Ceramic Multilayers and PCBs

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Vertrauenswürdige Elektronik

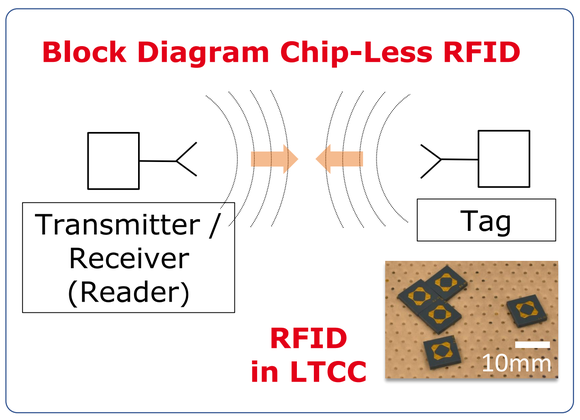
VE-CeraTrust

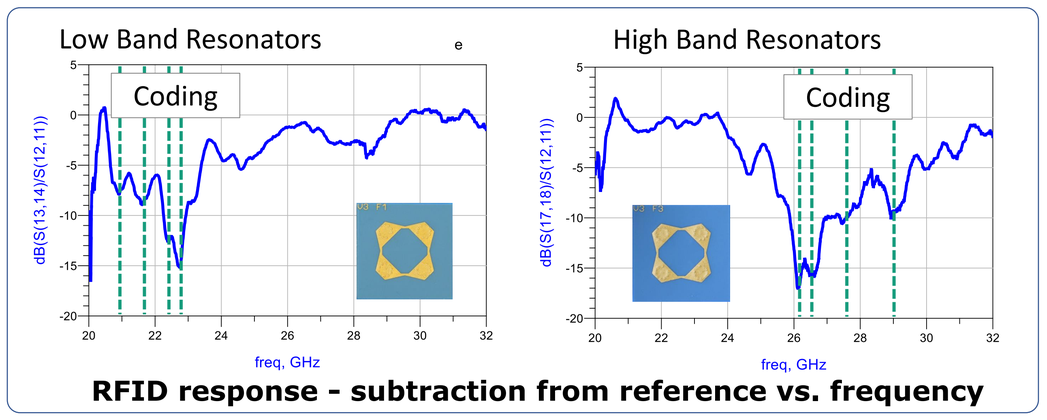
Motivation and Objectives

Trustworthy electronics gain importance in many safety-relevant sectors (e.g. automotive, home appliances, smart devices). New safety functions based on multilayer ceramic circuits (LTCC) as well as safety elements have been developed and integrated into conventional printed circuit board (PCB).

Results

1. Chip-less RFID in LTCC



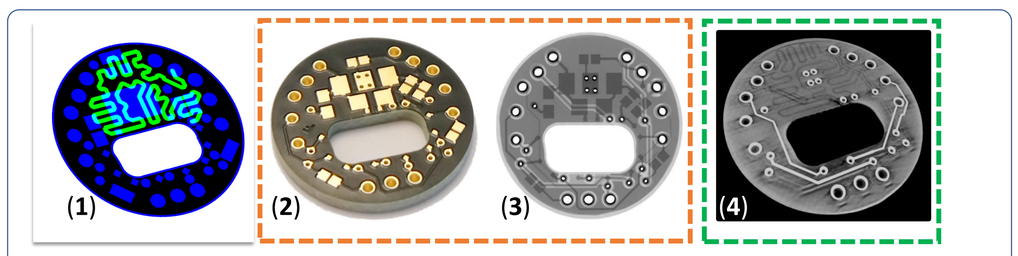


RFID response - subtraction from reference vs. frequency

- In addition to avoiding the use of chips, the LTCC-RFID has the advantage of the circuit carrier being marked very early in the process chain and surviving further thermal and chemical steps.

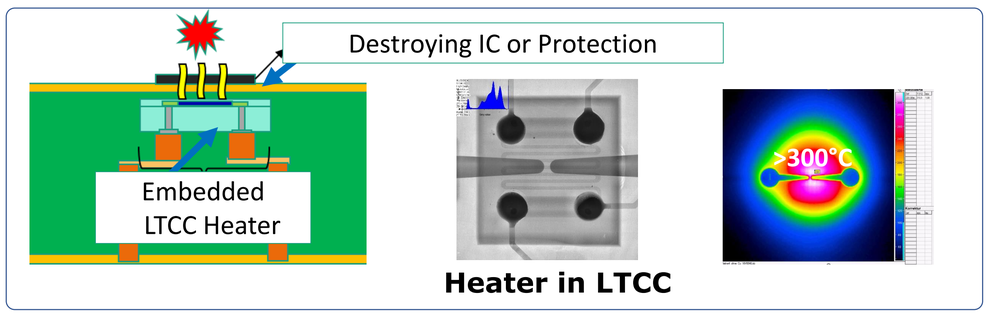
2. Polymer Conductor ID on PCB

- Cost-effective structures of conductive polymers integrated in the PCBs (1), non-detectable by optical inspection (2) and 2D X-ray (3), electrically readable in the application and detectable by 3D X-ray (4).



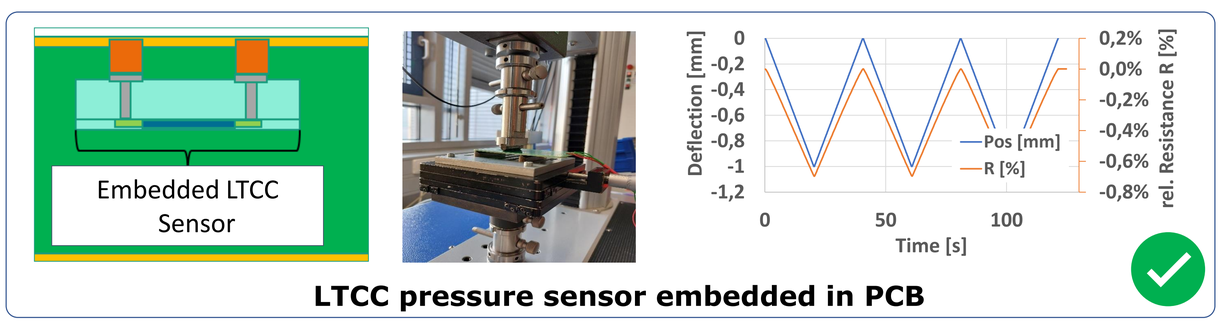
Hidden identification structures to distinguish original and reverse engineering

3. LTCC Heaters and Sensors in PCB for Tamper Protection



Heater in LTCC

- The meander-shaped heater in LTCC can be placed near or under the IC to protect and influence or destroy the semiconductor (ΔT > 250 K) or the PCB.

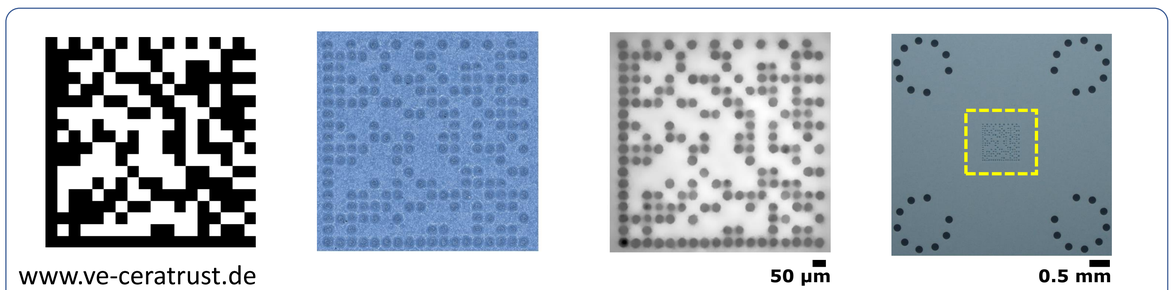


LTCC pressure sensor embedded in PCB

- Integrated ceramic pressure sensor in PCB for detection of mechanical deformations.
- Measured sensitivity: ≈50 Ω/mm, linearity error:<0.6%, hysteresis error:<0.4%

4. Identification for Multilayer Production

- Additional security features (obvious/hidden) by embossing of DMC with Ø 50 µm stamp.
- Transfer of identification functions into production lines (punching, stacking/laminating, final inspection, tracking).



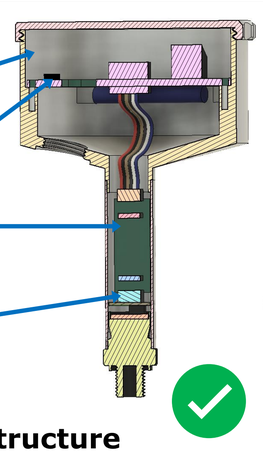
Security features, e.g. data matrix codes (DMC, marked in yellow) embossed in LTCC-RFID, transferred to production lines

Demonstrator and Outlook

- A demonstrator (pressure sensor of PMST) was realized with identification and tamper elements.
- With a suitable combination of new security functions, electronic applications can be made more secure so that production chains are traced better, attacks will be detected, data and electronic systems are protected as a contribution to trustworthy electronics.

Security Features:

- Unique identification
- Monitoring of lid opening
- Internal logging of events
- Monitoring of hardware and software integrity



Pressure transmitter (demonstrator) for critical infrastructure

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