

# Radiation hardness testing (SEE): Challenges and Perspectives

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*Bendy Tanios*

*b.tanios@altertechnology.fr*



# Agenda

1. Few words on Alter Technology France
2. Trends on EEE parts
3. SEE testing Challenges
4. Perspectives

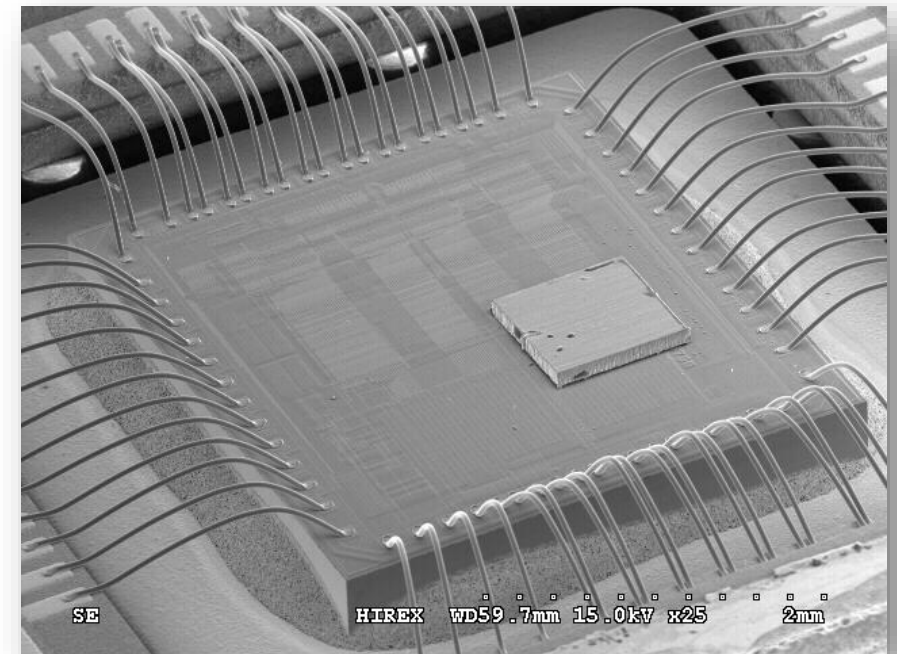
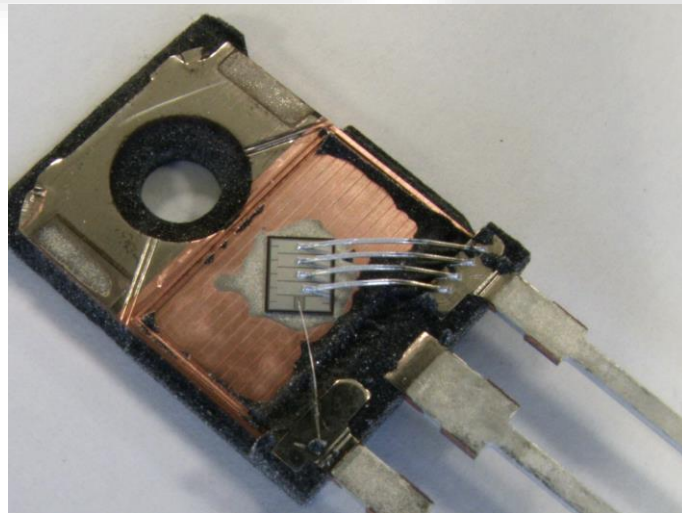
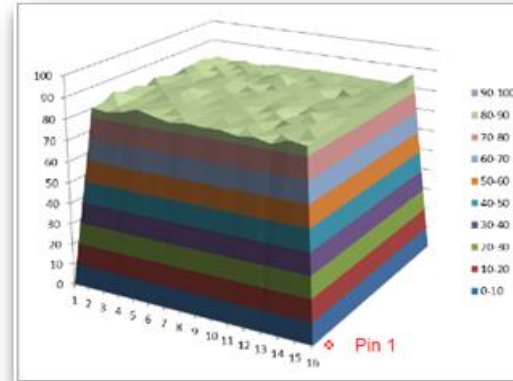
## Business sectors - Expertise domains



Alter Technology France is an industry leader in providing radiation services since 1993 (TID and SEE), from sample preparation to test report.



Sample preparation for radiation test with **backside thinning** or **front side access** on isolated part and on part-on-board. All specific requests are covered with innovative solutions.

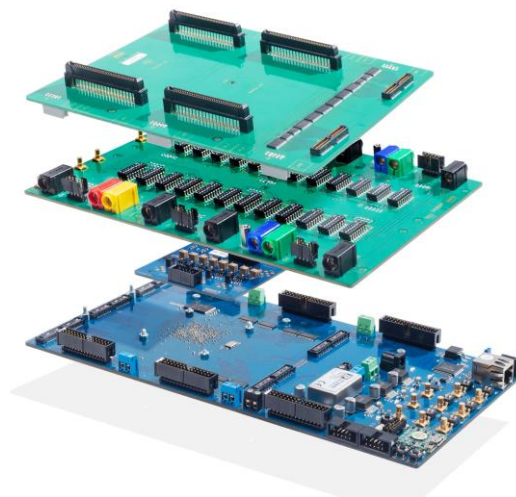
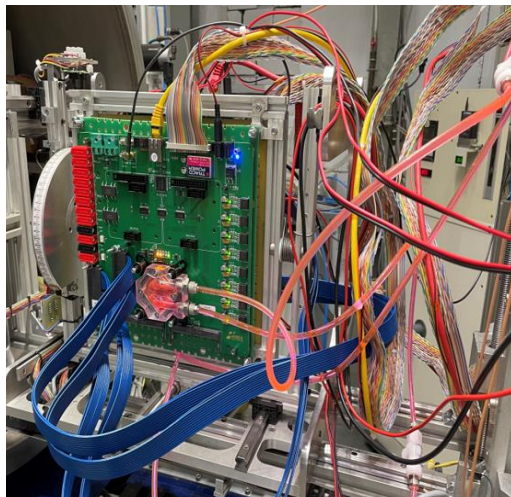


# ALTER France Radiations services

# ALTER

## Electronic component testing:

- Test bench development
- Test campaigns (SEE)
  - SEL, SET, SEU, SEFI, etc. (internally-designed test systems)
  - SEB, SEGR (tested using laboratory equipment)
- Component/system radiation characterization
  - Digital devices (memories, CPUs, logic gates, ...)
  - Analog devices (regulators, OpAmps, transistors, ...)
  - Mixed/complex devices (ADC, DAC, SOCs, ...)
  - RF devices (PLLs, oscillators, ...)



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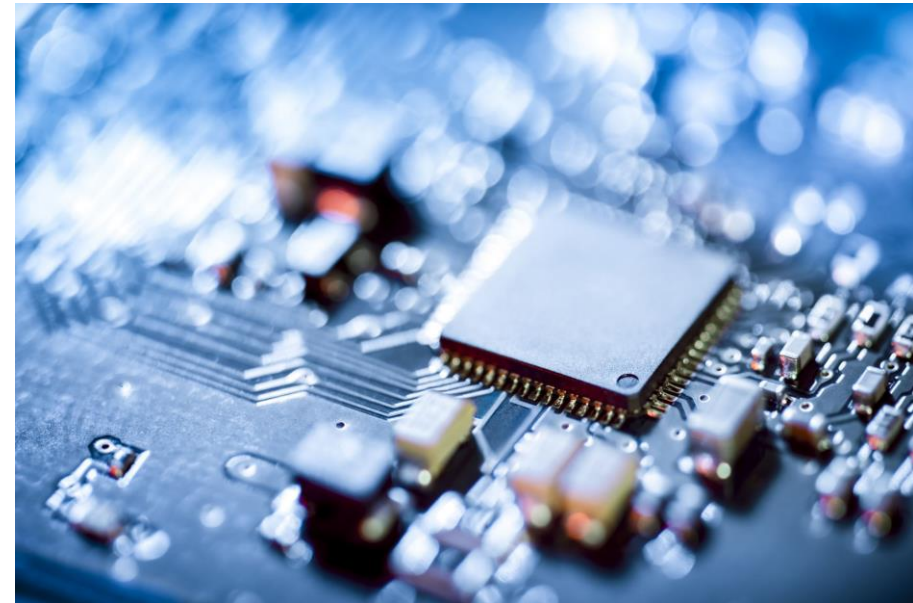


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# EEE parts → Trends

“Newspace” business use high performance electronic devices and COTS.  
But COTS are not designed to survive to space.

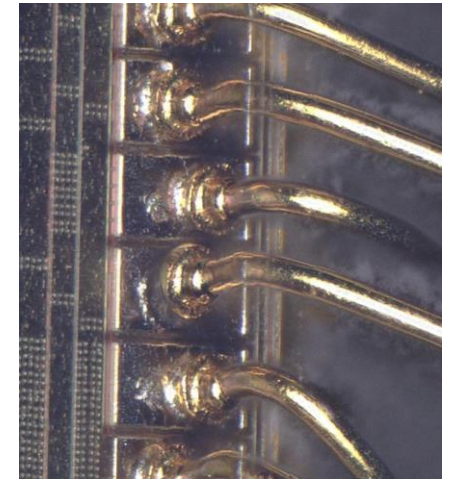
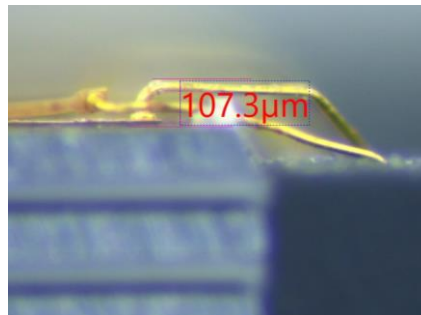
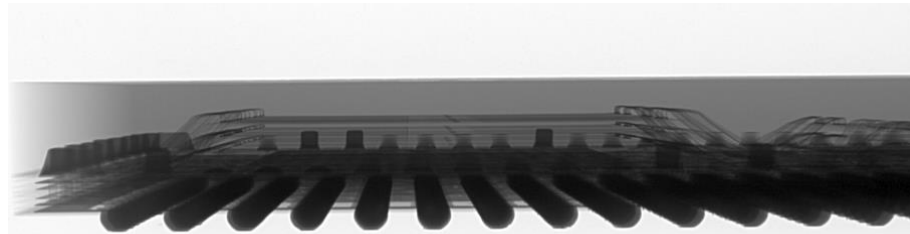
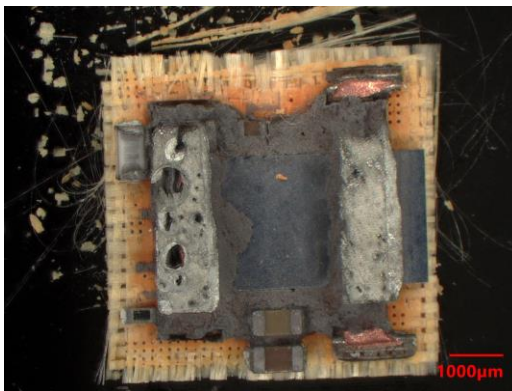
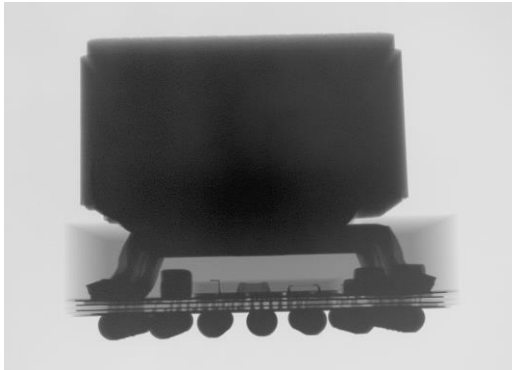
- Complex and versatile digital products
  - SoC, FPGA, high speed data converters
- Wide band gap products
  - SiC power transistors, GaN HEMTs
- Power modules with or without PCB embedded power devices
- Stacked multichip modules with different die types
- Photonics
  - Optical transceivers
- Systems
  - Flight control computer
  - Complete electronic boards
  - Subsystems



# EEE parts → SEE Testing Challenges (1)

## Sample preparation

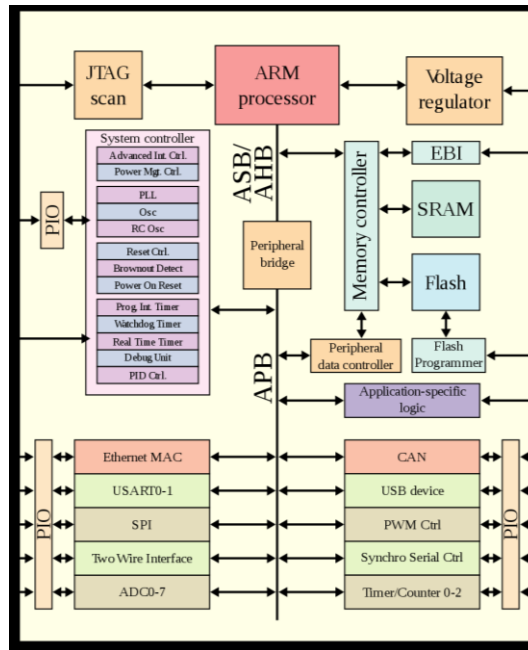
- Keep the mechanical integrity and the functionality of the part
- Sample preparation may perturbate proper device functionality  
MRAM,  $\mu$ Module, Opto-devices



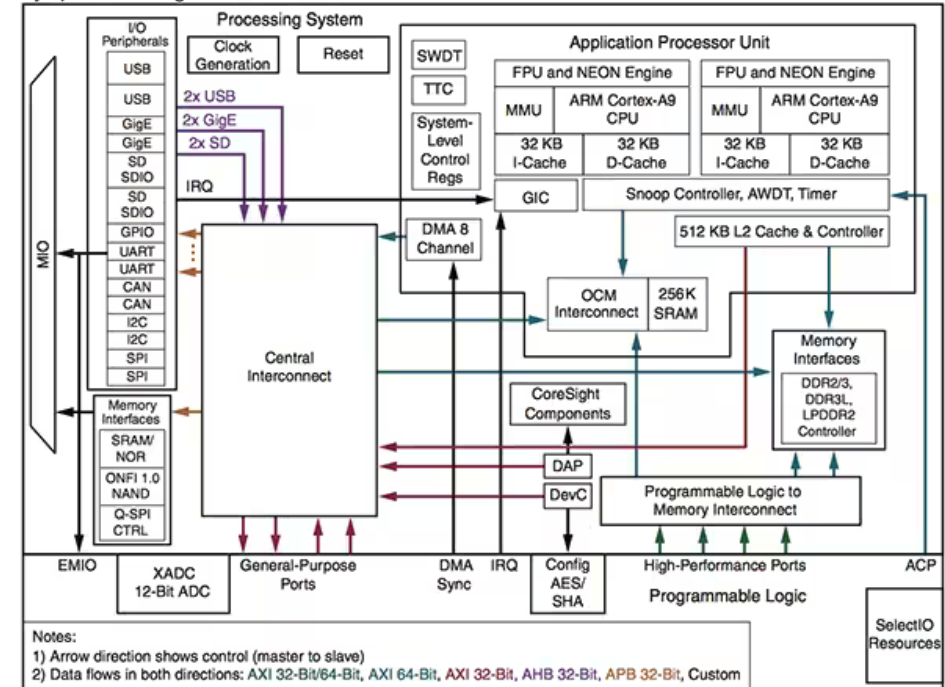
# EEE parts → SEE Testing Challenges (2)

Test set-up complexity

- Test coverage
- Data acquisition
- Data post processing



Zynq-7000 All Programmable SoC

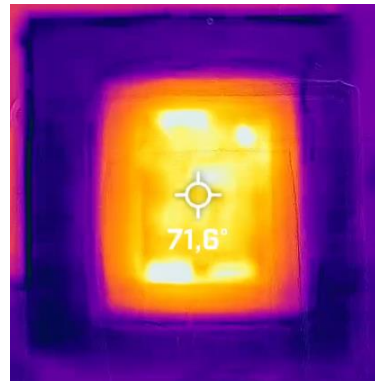
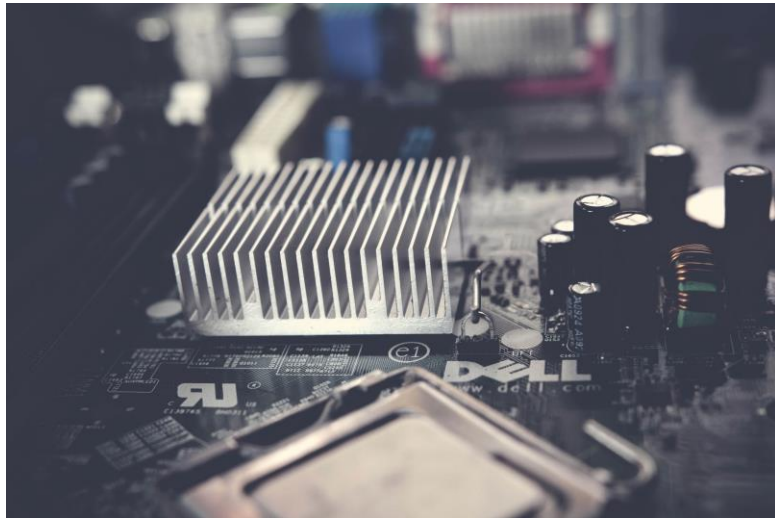




# EEE parts → SEE Testing Challenges (3)

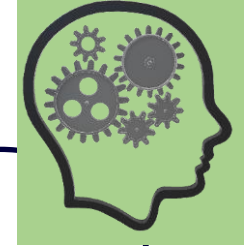
## Thermal constraints

- Power dissipation in vacuum
- Power dissipation in air
- Test at low temperature



# Perspectives (1)

## Test development



- More samples to identify device opening best procedure
  - Cost issues for expensive devices
  - Time to try different opening procedures
- A better understanding of the customer's need
  - To identify vital needs
  - To help customers to identify vital needs
- A better customer interaction
  - Complex device can be hard to apprehend (co-development ?)

# Perspectives (2)

## Test Facility

### Beam Time

More complex devices requires **more beam time**

More fluence, more events or more samples requires more beam time

→ Mitigate beam time needs by reducing “dead time”

Optimize experiment installation time

Reduce ion/cocktail changes

Reduce access to irradiation chamber

### Test time optimization

### Beam features

Bigger (adjustable) beam size : irradiate many components at the same time

Higher ions range (to secure/avoid sample preparation) at all LET

Higher LET than  $60 \text{ MeV.mg.cm}^{-2}$

Higher fluxes (e.g. non-sensitive devices, memory descrambling)

# Perspectives (3)

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## Beam line optimizations



- Faster setup installation (easy access to vacuum chamber, providing standard equipment, vacuum chamber connections, connections between irradiation area and control room, ...)
- Cooling and Heating systems, e.g. air compressor cooling/heating system, water cooling, hot air blower
- Reduce beam calibrations time
- Faster ion changes
- Faster pumping (vacuum chamber)
- Faster shutters
- Remote experiments
  - To take benefit from unexpected beam time availability (test slot cancelled by a customer)
  - Need to prepare in anticipation ready-to-use experiment (with prepared samples available)
  - Feasible with an easily automated experiment set-up
  - Need of a “trained” operator in remote (at accelerator facility)

# Thank You

## Contact

*Dr. Bendy Tanios*

*b.tanios@altertechnology.fr*

