FAILURE ANALYSIS INVESTIGATION. SAMPLE PREPARATION

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ACCEDE | ESCCON

2025

Seville - Spain

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ESA MATERIALS AND ELECTRICAL COMPONENTS LABORATORY

ASSESS WHETHER EEEE COMPONENTS ARE FIT TO FLY TO SPACE

OUR CUSTOMERS:

- ESA projects
- External companies

- FA (Failure Analysis)
- DPA (Destructive Physical Analysis)
- CA (Constructional Analysis)

OUR POLICY:

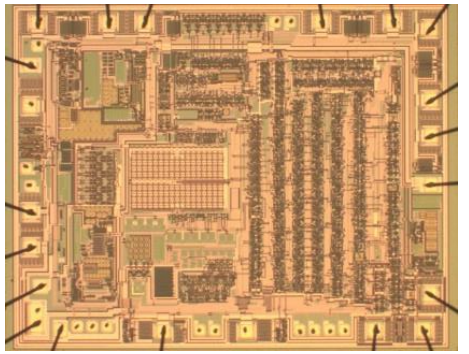
- Non-routine work
- Confidentiality
- Time critical activities
- Impartial approach
- Always according to project requirements

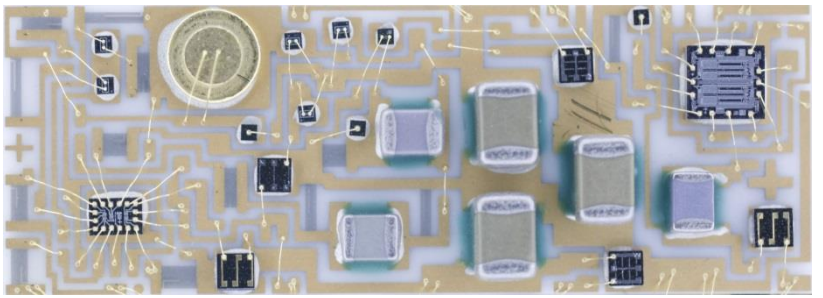
ESTEC -TEC LABORATORIES
FAILURE ANALYSIS INVESTIGATION

OPTICAL MICROSCOPY

Non destructive technique used in EVI, IVI

Stereo / High magnification microscopes - Bright field, dark field, UV





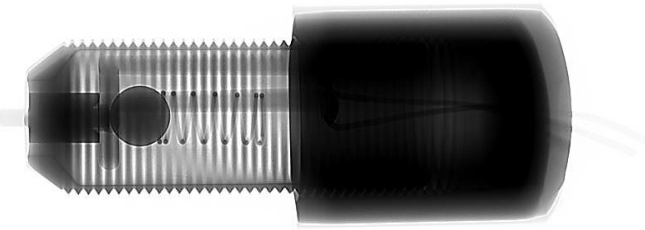
RADIOGRAPHIC INSPECTION

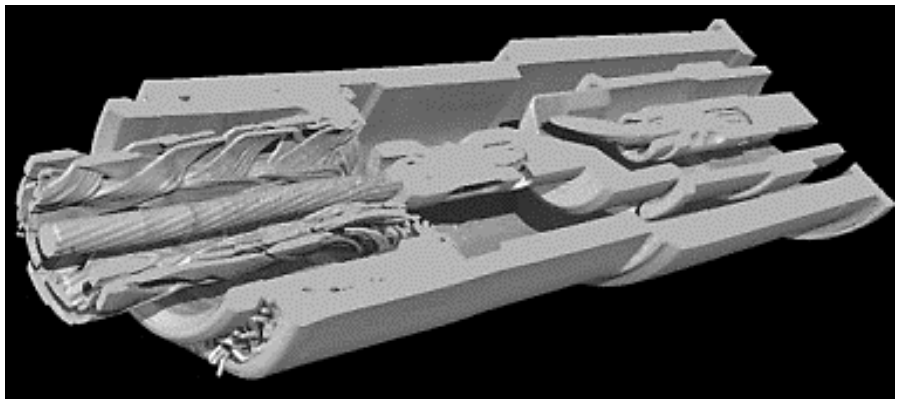
2D-Xray

3D-Xray: Computed Tomography (CT) scan

160KV / 300KV

4000x4000 pixel detector



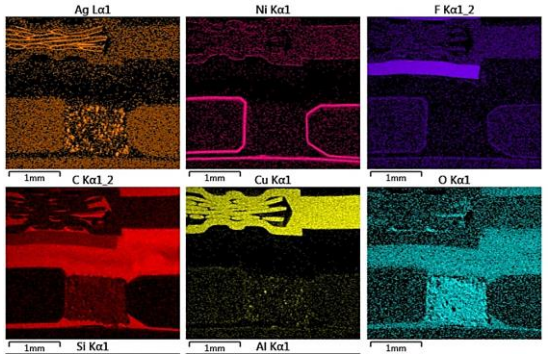


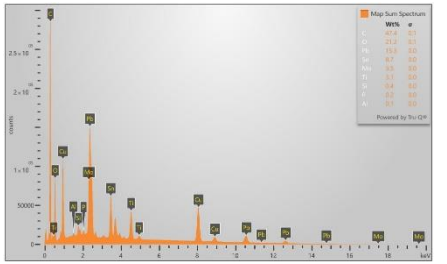
SCANNING ELECTRON MICROSCOPE (SEM). ENERGY DISPERSIVE X-RAY SPECTROSCOPY (EDX OR EDS)

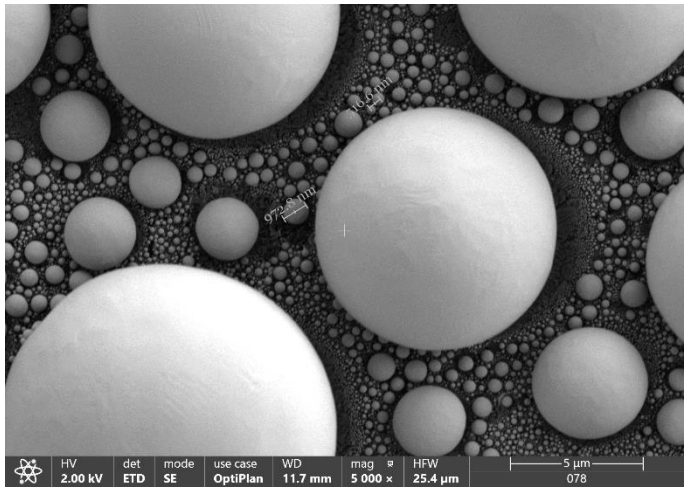
Non destructive technique used in IVI

Secondary Electron Detector for high definition images, topography

Backscattered Electrons: materials discrimination





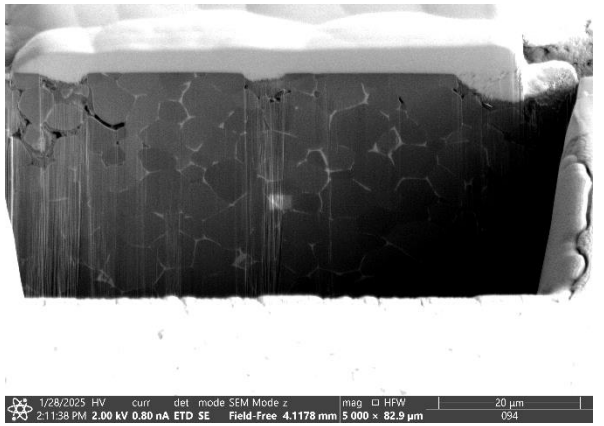


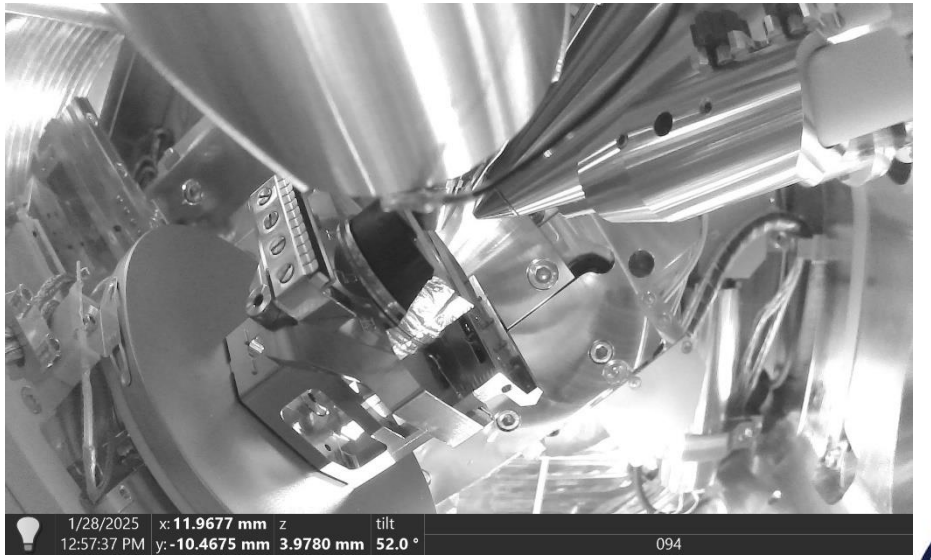
FOCUSED ION BEAM (FIB)

Dual beam Ga FIB, SEM and FIB on one same instrument

Fine sections, Lamella preparation

Dual beam Xe PFIB, designed for faster material removal

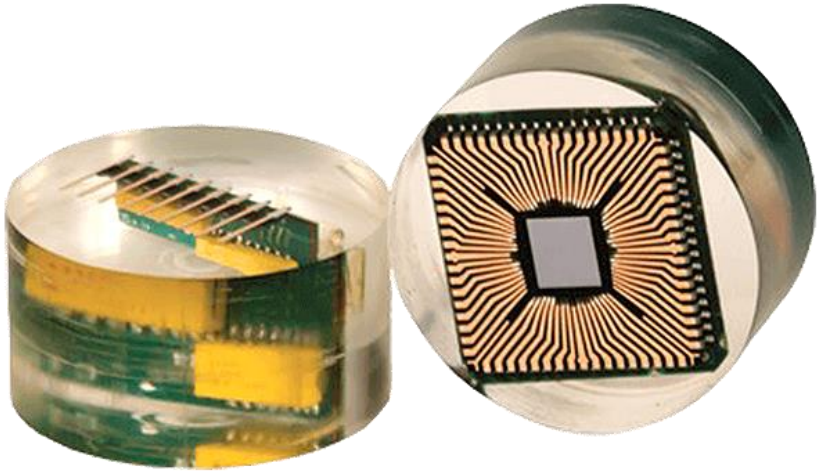


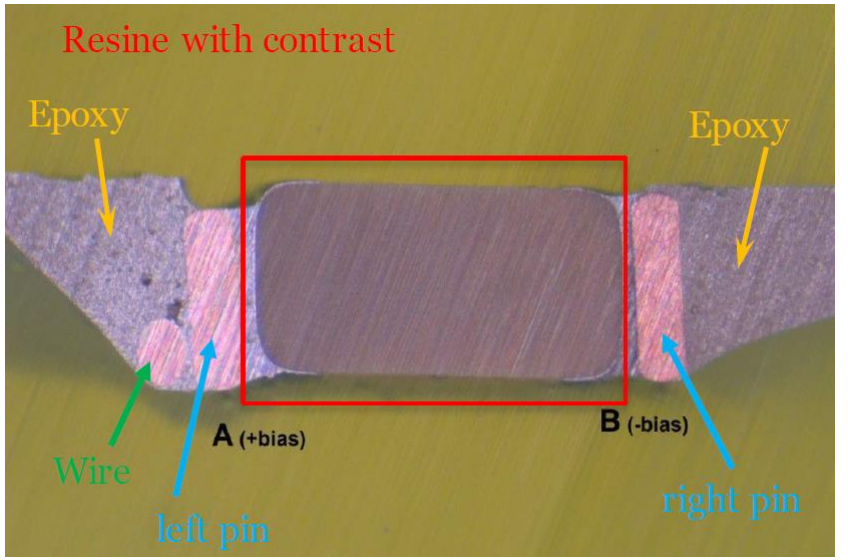


MICROSECTION

Sample preparation to mechanically expose a plane of interest for further analysis.

Grinding, polishing, and staining the specimen until the plane of interest is ready for inspection by optical or electron microscopy





MECHANICAL AND ENVIRONMENTAL TESTING

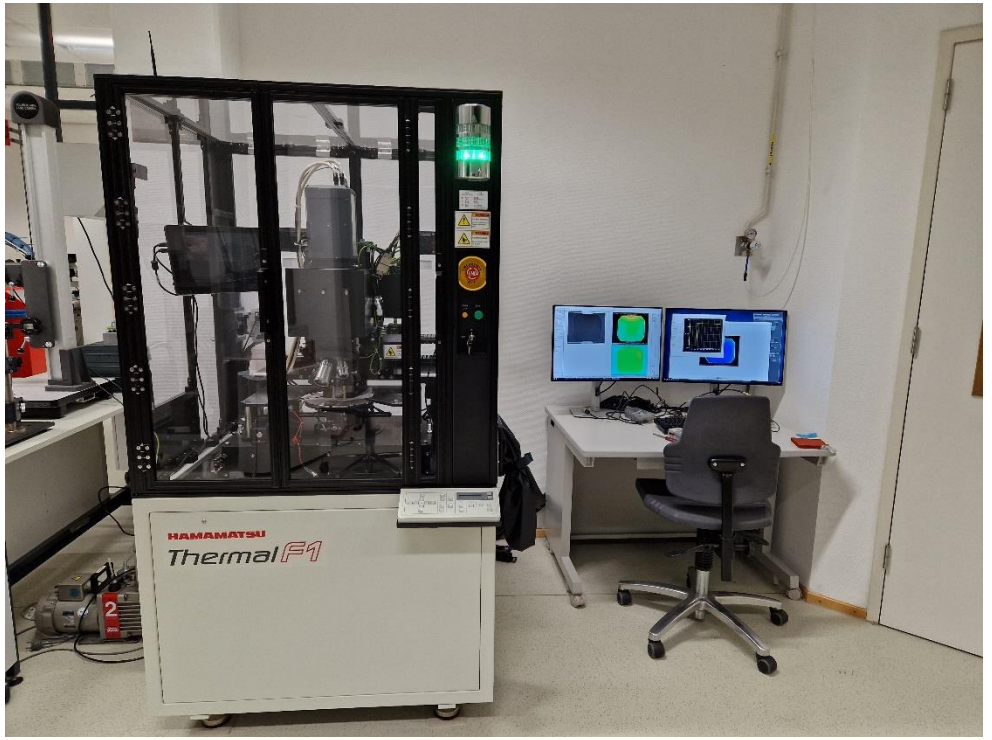
Mechanical, Vibration, Temperature cycling, Humidity test, Shock test

ELECTRICAL TESTING

Lock in thermography: Detects leakage current defects on the device based on heat distribution

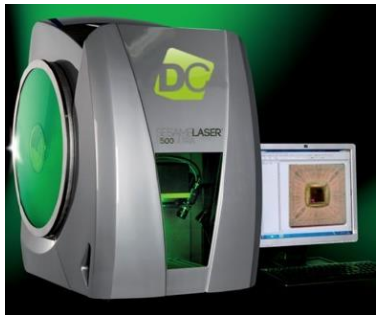
OBIRCH: Finds anomalies at the exact location based on current variation

Characterisation and bespoke test set ups for electrical performance



ESTEC -TEC LABORATORIES SAMPLE PREPARATION AND RADIATION TESTS

TOOLS AND TECHNIQUES FOR SAMPLE PREPARATION



Acid Wet Etching

- Partially selective etching
- Material dependant
- Coarse opening
- Works fine with Gold Bonding Wires
- Resin Mold (plastic) components only

LASER Ablation

- Allows removal of plastic material very fast
- Destructive on the die
- Plastic / Metal / Ceramic

Plasma Etching

- (Microwave Induced Oxygen Plasma)
- Slow process
- Not destructive
- Highly selective etching between plastic and metal/semiconductor
- Safe for most structures
- Plastic Only

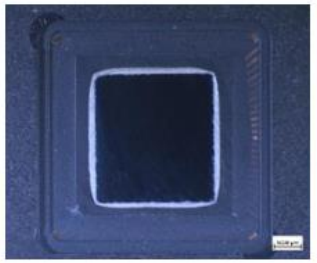
Mechanical Milling, Grinding and Polishing

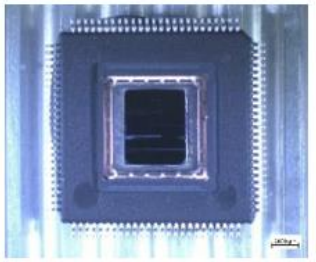
- Very high precision (µm range)
- Precise dimensions needed
- Plastic / Metal / Ceramic
- Can perform Silicon backside thinning of the die

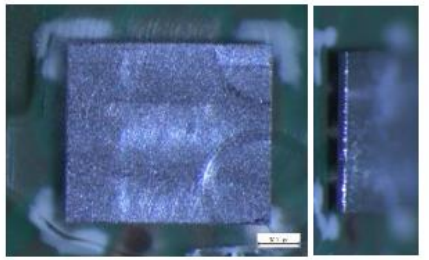
Reactive ion etching (RIE)

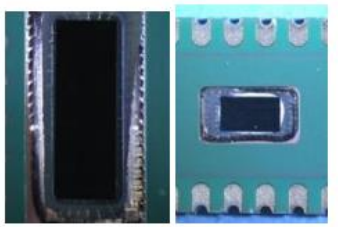
- (Type of plasma etch technology used in specialty semiconductors)
- Removal of material from surfaces via plasma processes.
- Wide range of materials can be etched by RIE technology (Si02, Si3N4, Si, A Si, poly-Si)
- Metals (Al, Cr, Ti), III-V materials (GaAs, InP, GaN)

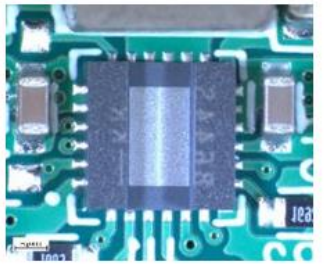
EXAMPLES OF SAMPLE PREPARATION

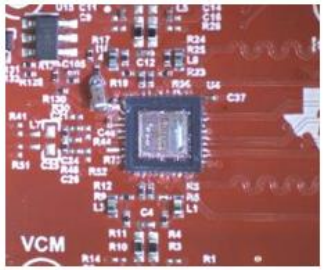

PIC24FJ256GA110


STM32F427VIT6TR

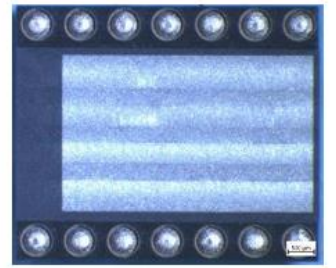

MAX20313


PWM, Vclamp and PoL


LT8644



ADC3683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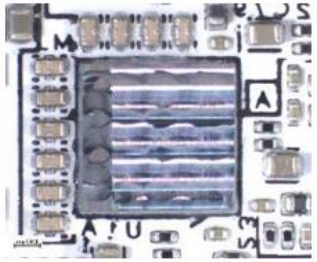
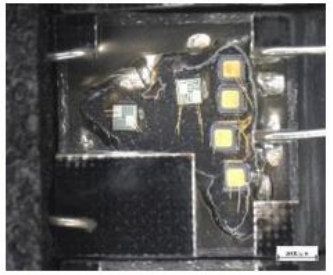
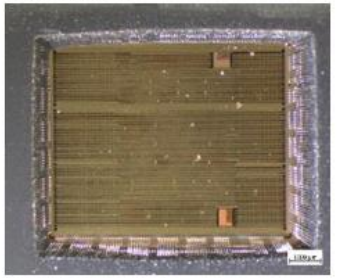
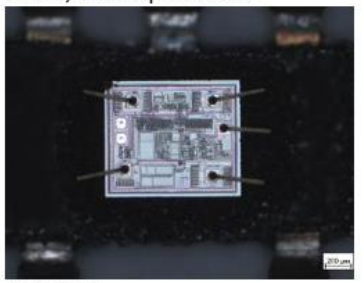
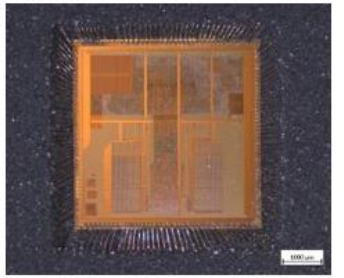

Coral Edge TPU


PICO 5AV100


HIMA-HICore2


MAX823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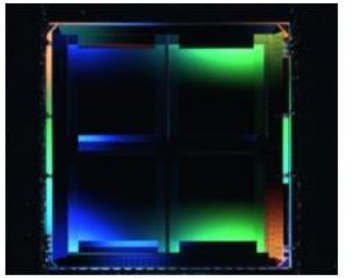
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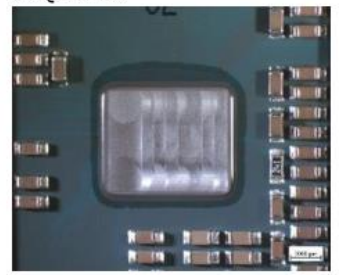
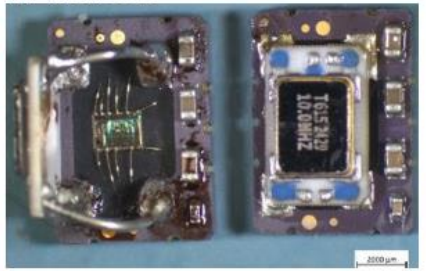
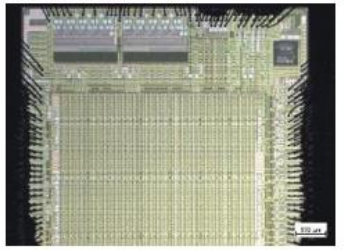

D65-XX-LGA635-1224

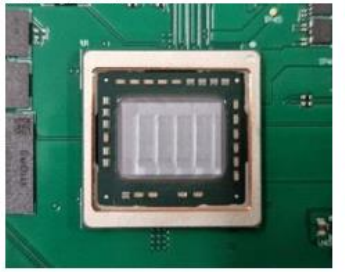

IS46TR1625


NT1068-23


TCXO T615-010-0M

Myriad-X and LPDDR4


FPGA


TE0950 AMD Versal VE2302

AMD Versal SoC TE0950

Overall yield rate in 2024 of around 90%

Contact us if you have interesting and challenging components for preparation: Co60.Facility.ESTEC@esa.int

ESTEC-TEC. RADIATION TESTS OVERVIEW

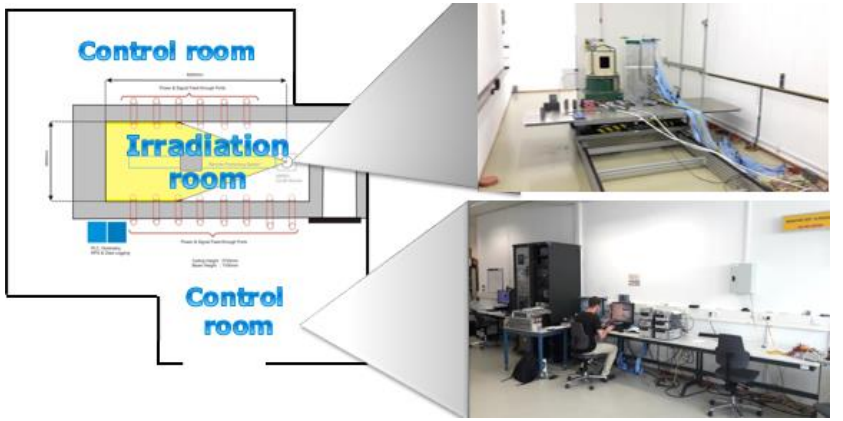
Co60 Facility

80 TBq Co60 source for Total Ionising Dose tests

Dose rate window compliant with the ESCC22900 standard

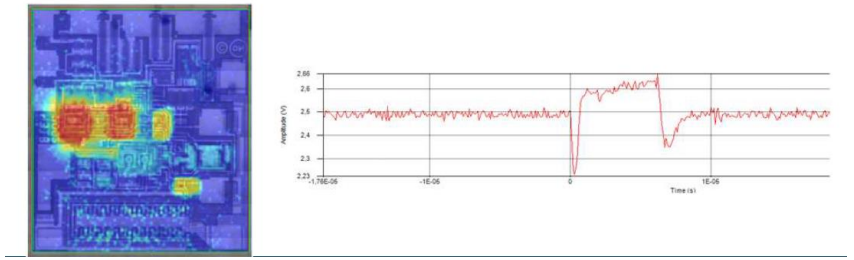
(from 0.01 rad/s [Si] to 3rad[Si]/s)

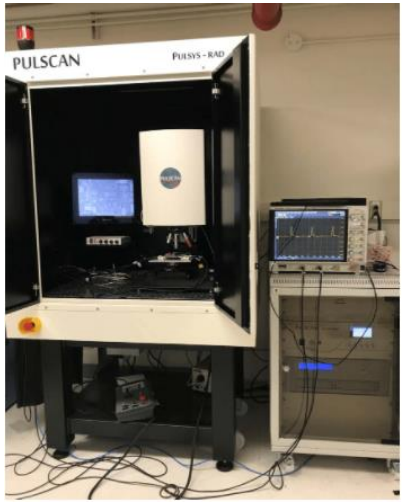
ISO17025 accredited dosimetry



Single and Two Photon Absorption Laser (SPA/TPA)

Single and Two Photon Absorption Laser System for SEE qualitative investigations





INFO AND CONTACTS

Materials & Electrical Components Laboratory
https://technology.esa.int/lab/materials-electrical-components-laboratory

Third Parties Activities (external requests of services at ESTEC TEC-Laboratories)

https://tpa.esa.int/

Contacts for Radiation tests and Components analysis :

Sample preparation and components analysis:
EEElabs@esa.int

TID tests: Co60.Facility.ESTEC@esa.int

ESA Website for Radiation Test data

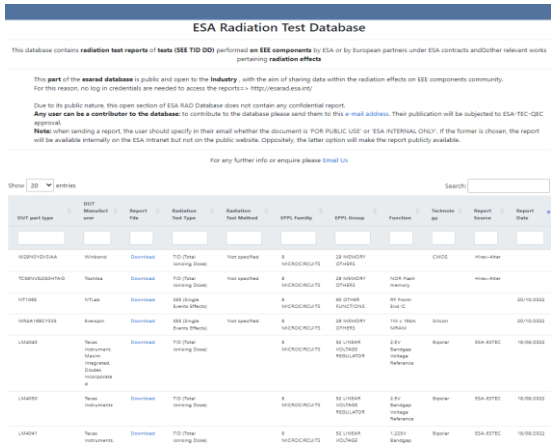
https://esarad.esa.int/

Which EEE components would you like to see in the ESA Radiation Test Database?

Pilot survey (link) Please submit your inputs here:

https://forms.office.com/e/hV6sytgsTu

The requests shall remain confidential with ESA and test data from selected components will be shared on esarad.esa.int

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