
RACOCO

Radiation characterization and functional verification of **COTS** components for space applications

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ESA contract 4000127569/19/NL/FE



ACCEDE | Workshop on COTS
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Fraunhofer INT

Overview



Hauptstandorte ●
Nebenstandorte ○



- Employees: about 110 (incl. about 50 scientists)
- Budget: approx. 10.0 million € (incl. approx. 4.0 million € contract research)

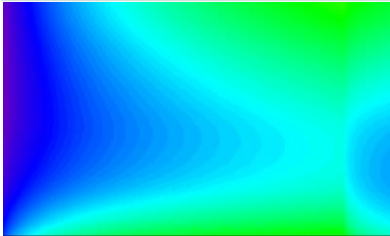
Nuclear Effects in Electronics and Optics (NEO)

Main areas of activity

Investigation and application of the effects of ionizing radiation on optical and electronic components and systems

Experimental Investigations

- Planning, execution and analysis of irradiation tests
- Characterization of the radiation sensitivity
- Extensive measurement equipment for optics and electronics



Radiation effects consulting

- Consulting on the execution of standard conform tests
- Consulting on the selection of appropriate parts
- Consulting on the hardening of components and systems



Operation of irradiation facilities

- Three Co-60 facilities in-house for TID tests
- Neutron generator in-house for SEE and displacement tests
- Pulsed Laser system for SEE tests



Simulation of radiation environment

- Radiation transport
- Model calculations
- Definition of environment
- Determination of mission dose
- Calculation of shielding



The RACOCO project

<http://s.fhg.de/racoco>

- Radiation characterization and functional verification of COTS components for space applications
- ESA contract 4000127569/19/NL/FE
- GSTP activity supported by Germany (DLR)
- Awarded to Fraunhofer INT (represented by the Fraunhofer Gesellschaft)
- Technical officer: Gianluca Furano (ESA)
- Budget 1.2 M€
- Timeline: 2019-2022



Aim of RACOCO

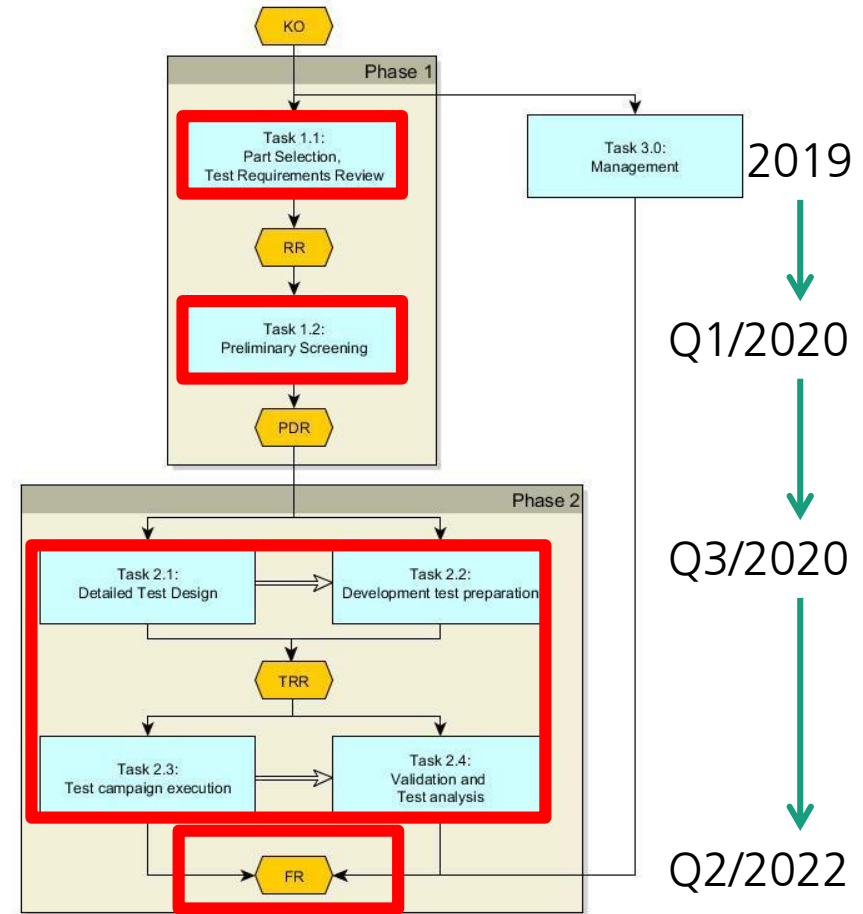
<http://s.fhg.de/racoco-survey>



- Identify available COTS components
 - Functionality or properties should greatly benefit the space community
 - **Call for participation!**
 - Will make use of spin-in approach (e.g. AEC-Q)
- Preliminary functional verification and radiation testing of a “long” list of components
- In-depth radiation testing on smaller but comprehensive subset
- Assess test methods and methodology for COTS components in general
 - Data and experience on the specific parts/lots can serve as input to guidelines for future COTS testing. This will be in support of the ESA COTS initiative recommendations.

Timeline of RACOCO

- The project is currently in the first phase of test candidate identification.
- The basic suitability is then checked in a preliminary screening campaign
- Components that pass this will be subjected to in-depth testing.
- Suitable devices will be recommended for further qualification tests beyond radiation to enable use in space.



Candidate identification

- Build a „long“ list of candidate devices
 - Functionality or properties should greatly benefit the space community
 - Focus on high integration / high performance / reduced power?
 - **Call for participation!**
<http://s.fhg.de/racoco-survey>
- Why a „long“ list? Examples encountered:
 - Target 100 krad(Si) → Failing at < 10 krad(Si)
 - Target no SEL for LET < 60 MeVcm²/mg → failing with low LET to SEL
 - Decapsulation issues etc.

What type of COTS components would you expect to exhibit the most promising potential for space projects?

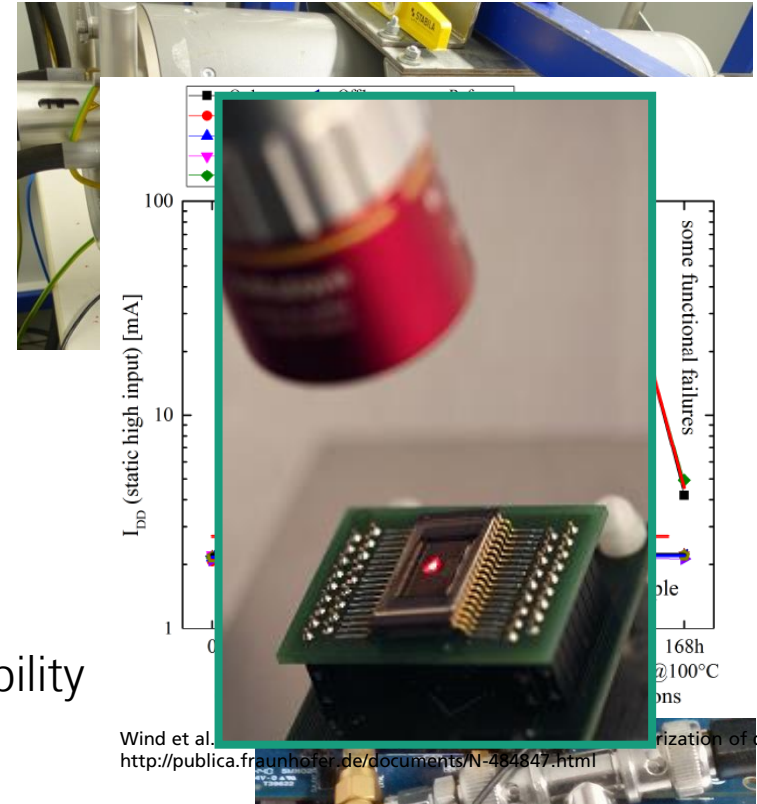
	Not at all	Somewhat	Moderate	Very much
Simple analog components	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Complex analog ICs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Simple digital components	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Complex digital components	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Power components	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Are there concrete devices or component families that you would consider as most important to be replaced with COTS (and why)?

BACK NEXT

Preliminary screening

- The „long“ list of test candidates will be preliminary screened
 - focusing on SEL and TID to identify components which allow for a full characterization
 - If possible using evaluation boards and reference designs
- „short“ list of components with proven feasibility for further testing



A. Menicucci et al., 2018 IEEE REDW
10.1109/NSREC.2018.8584279

Radiation testing campaign

- All parts passing the preliminary screening will be subjected to in-depth testing
 - Baseline: SEE, TID according to ECSS 25100 / 22900, DD,
- Some components will be subjected to additional tests:
 - Board level or assembly tests: How do component effects scale to a board level test?
 - Array of SEE test campaigns:
 - Assess alternative test methods more suitable for COTS testing.
 - Could a proton test be enough? Or UHE ions, Neutrons?
 - What would the reliability be? (e.g. How applicable is the figure of merit?)
 - TID: Statistics on large data sets
 - Lot to lot, part to part variations, (hopefully pre- and post- a process change)

Output of RACOCO

- Data and experience on an array of COTS components for space
- Eligible COTS Components that have passed all comprehensive radiation and functional tests shall be proposed for further upscreening for wide application areas
 - Radiation is the focus of this project, but not the only issue with COTS
- Experiences gained during testing shall be submitted to relevant stakeholders in the form of guidelines
 - for possible inclusion in European normative standards

What we also want to learn from RACOCO

- How can we apply „cheap and easy“ preliminary test methods to first assess radiation hardness on unknown components?
 - Avoid „trial and error“ full-scale tests up to standards
- How representative and reliable can these preliminary test methods be?
 - Can they replace „full scale tests“ for „high-risk“ missions?
- How representative are radiation tests for samples from another lot/date code?
 - Links heavily to the use of heritage information and/or COTS databases

Summary

- In RACOCO we will put both COTS components and COTS test strategies to a test (<http://s.fhg.de/racoco>)
- The project is currently in its initial phase of device selection
 - **Call for participation!** <http://s.fhg.de/racoco-survey>
- Test preparations and preliminary screening in 2020
- „Short“ list of components assembled in Q3/2020
- In-depth testing from Q4/2020 to Q1/2022
- Final report and Guidelines Q2/2022