A method for measuring the effect of total ionising dose on temperature coefficients of semiconductor devices

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Agenda

- Motivation of this work
- Proposed in-situ test method
- Preliminary experimental results
- Conclusion & future work

PhD research objective

"How to design a high precision data acquisition system for space applications?"

"How to do metrology?"

Ideal AD converter signal chain



Real AD converter signal chain



Real AD converter signal chain under ground environment conditions



Real AD converter signal chain under space environment conditions



How to measure changes of TC?

- Standard bench total ionizing dose test:
 - 1. Devices irradiated to a certain dose
 - Environmental chamber or thermal tester used to measure TC
 - 3. Go to step 1
 - Simple method, low total dose resolution, thermal annealing can have significant impact on the test results accuracy
- In-situ method:
 - Devices are TC tested during the irradiation
 - Annealing suppressed, superb dose resolution
 - Complex system, lots of engineering challenges (long cables, radiation tolerant design, cooling...)

Test container mechanical design









Temperature controller stability



Pilot experiment: PMOS transistors

PMOS transistors: temperature profile

PMOS transistors: V_T shift

PMOS transistors: V_T shift ripple

PMOS transistors – total dose induced change of $V_T TC$

PMOS transistors – total dose induced change of V_T MTC point

Voltage references: total dose induced output voltage degradation

Voltage references: total dose induced output voltage degradation

Voltage references: total dose induced output voltage TC change

Conclusions, future plan

- o new test method developed
- o promising results of pilot experiments

• Next steps:

- PMOS transistors and RADFETs
- Confirm voltage reference test results
- A/D converters

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Thank-you for listening.

