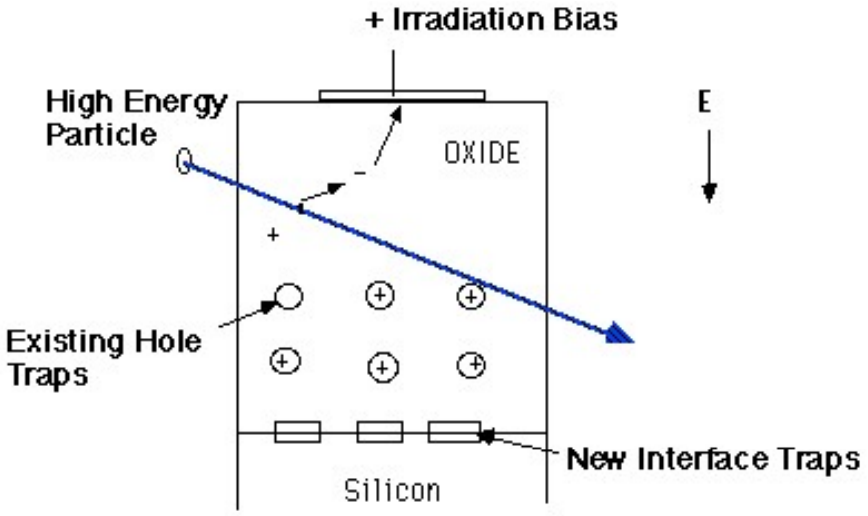
Detailed characterisation of Tyndall RADFETs for commercial applications in various fields

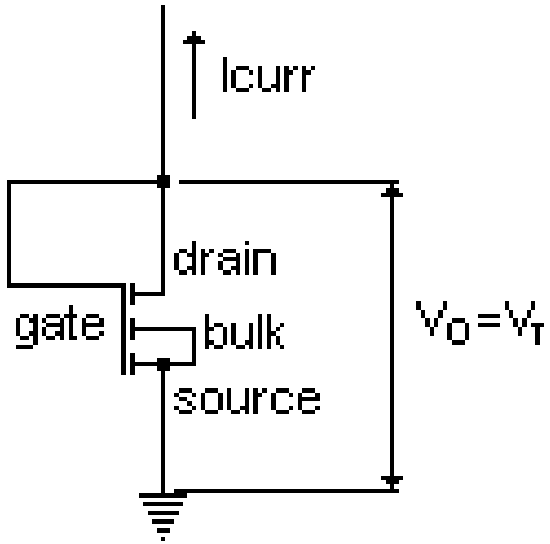
Aleksandar Jaksic, Nikola Vasovic, Srboljub Stankovic, and Russell Duane

How RADFET works?

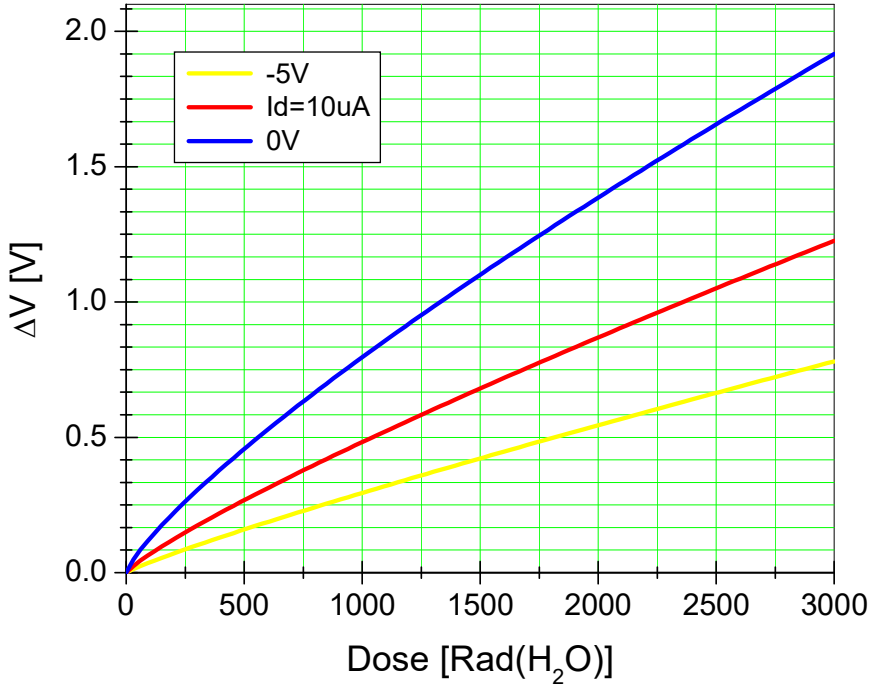


- Radiation creates electron-hole pairs
- Initial recombination of electrons and holes happens
- Non-recombined electrons leave the oxide;
  holes are trapped in the vicinity of the oxide/silicon interface
- RADFET threshold voltage (V_T) changes (ΔV_T ~ Dose)

RADFET read-out and calibration



Read-out circuit

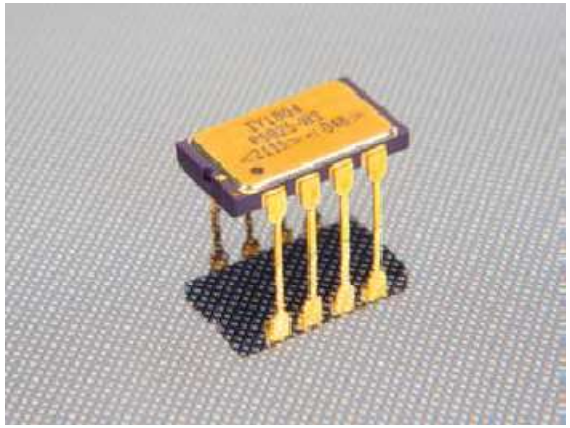


Calibration curves

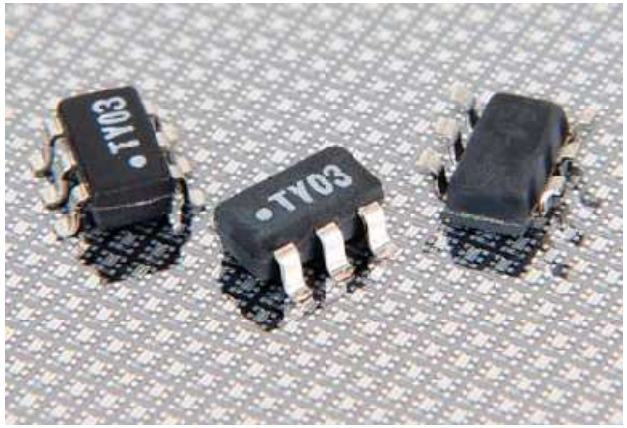
RADFET features

- Active, integrating dosimeter
- Sensitive to electrons, X-rays, protons
- Immediate read-out without destroying the data
- Easy to integrate into automated systems
- **Extremely small sensor chip**
- **Very low or zero power consumption**
- **Low cost**

Varadis RADFET Types



RADFET in ceramic package (VT02)

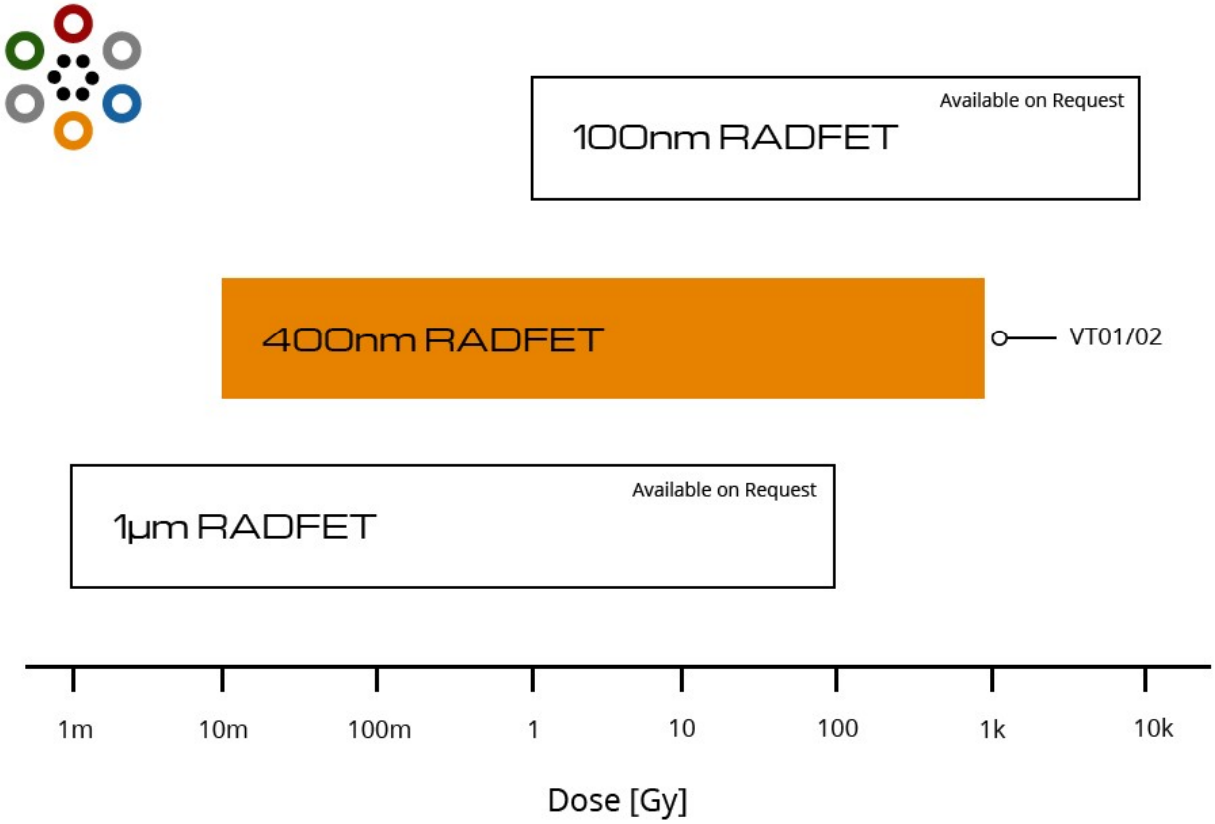


RADFET in plastic package (VT01)

- Two package types:
  - DIL-8 ceramic side braze package
  - SOT-23 plastic package

- Three main RADFET types (gate oxide):
  - 100 nm
  - **400 nm Implanted (IMPL)**
  - 1 μm Implanted (IMPL)

Varadis RADFET Dose Ranges



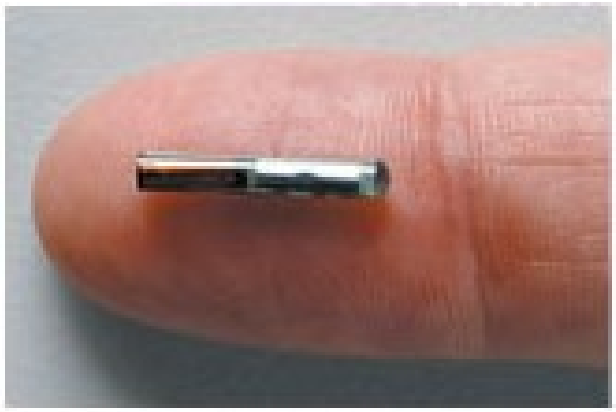
RADFET applications

- Radiotherapy
- Personal dosimetry (accidental)
- High energy physics laboratories
- Space exploration
- Radiology
- Personal dosimetry (workers' health and safety)

- 3.3 million EUR of industry contracts so far
- Start-up company Varadis Ltd. founded in June 2019

Radiotherapy: OneDose and DVS

OneDose system: dosimeter patch and the reader



DVS: implantable capsule and wireless reader

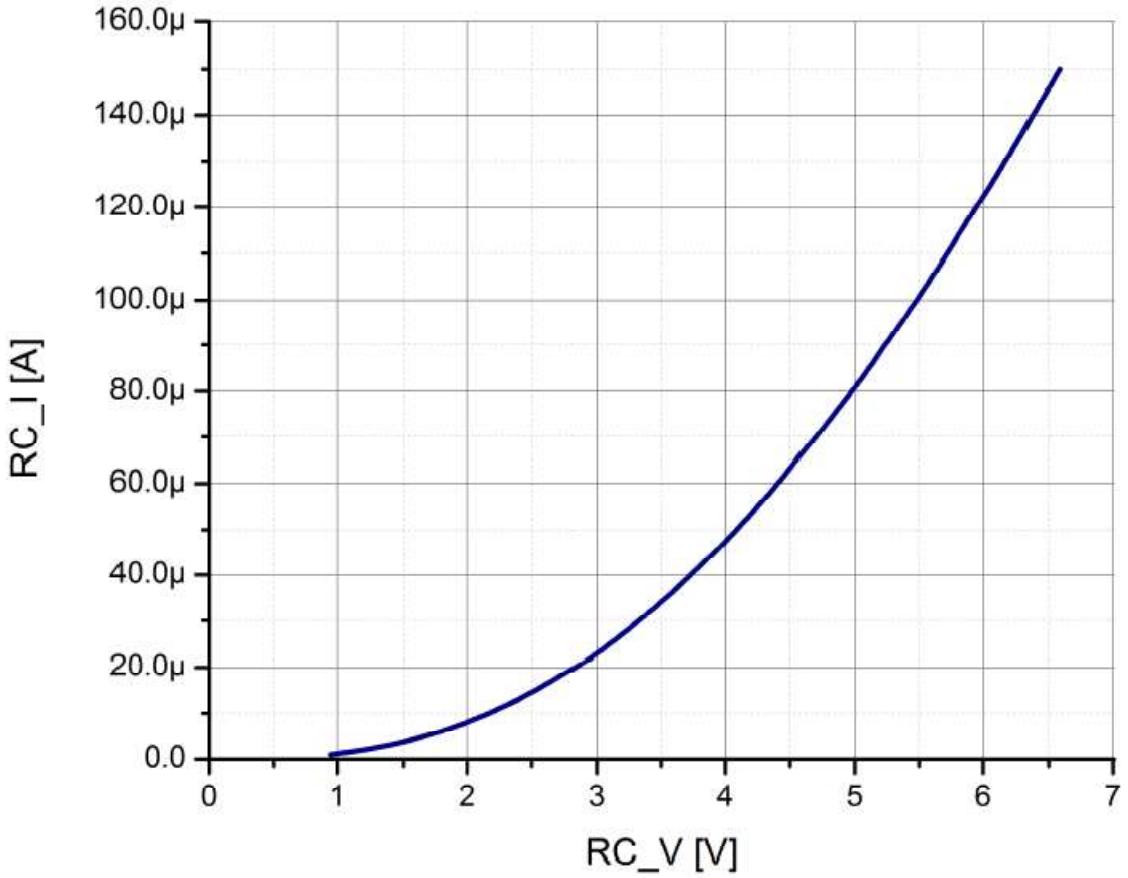
Other applications

GEASi's accidental dosimeter for first responders

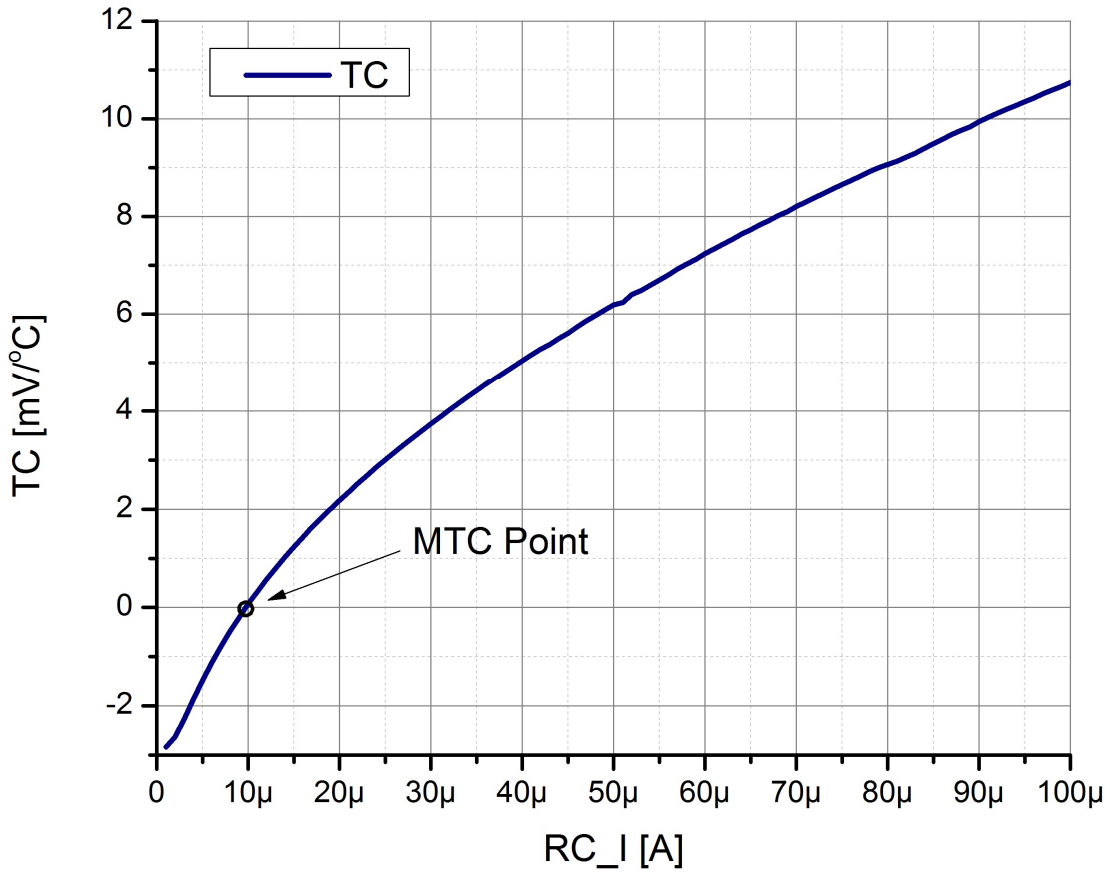
EuCPAD dosimeter for ESA astronauts

>3,000 RADFETs installed in the LHC ring at CERN

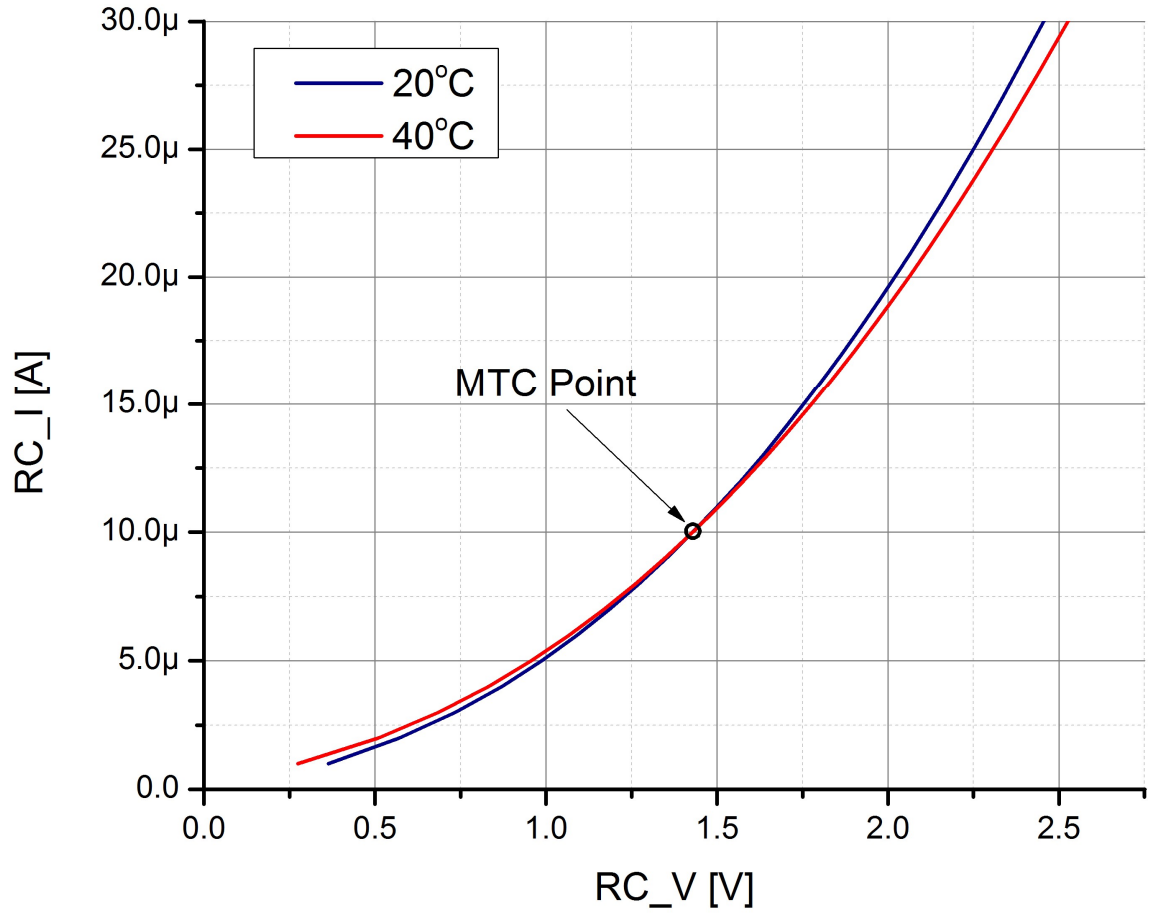
Virgin Device I-V curve



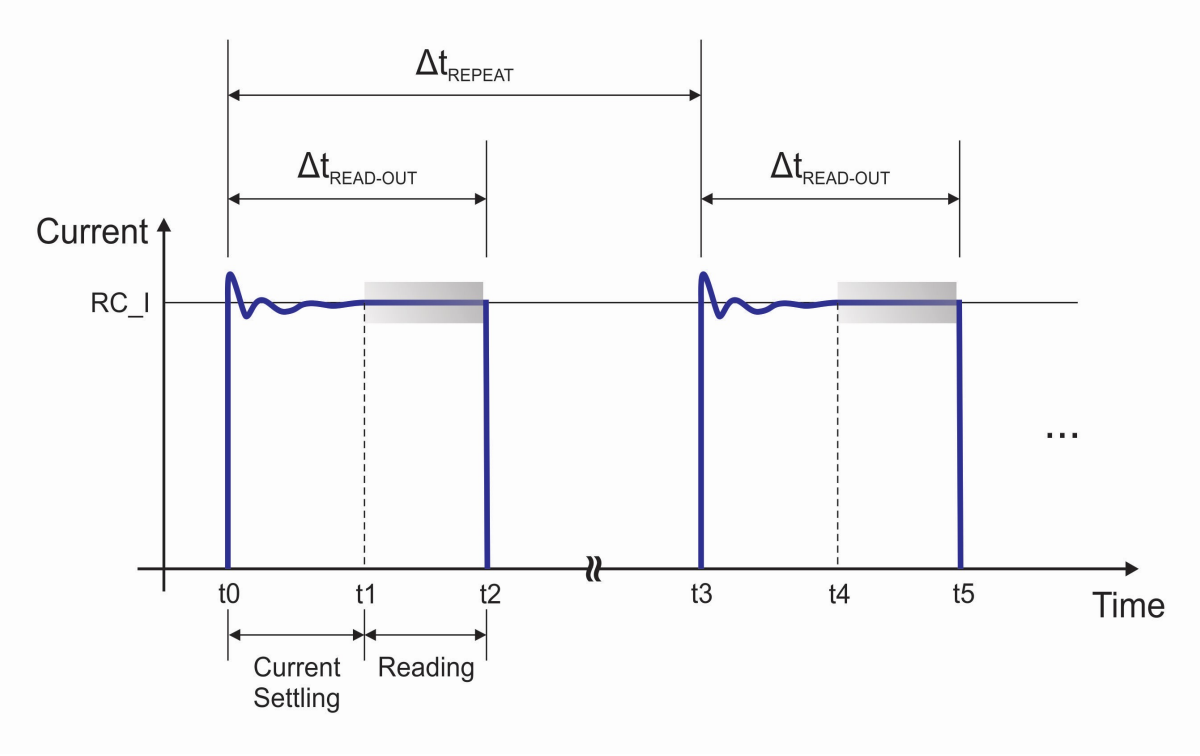
Temperature Coefficient vs. Current



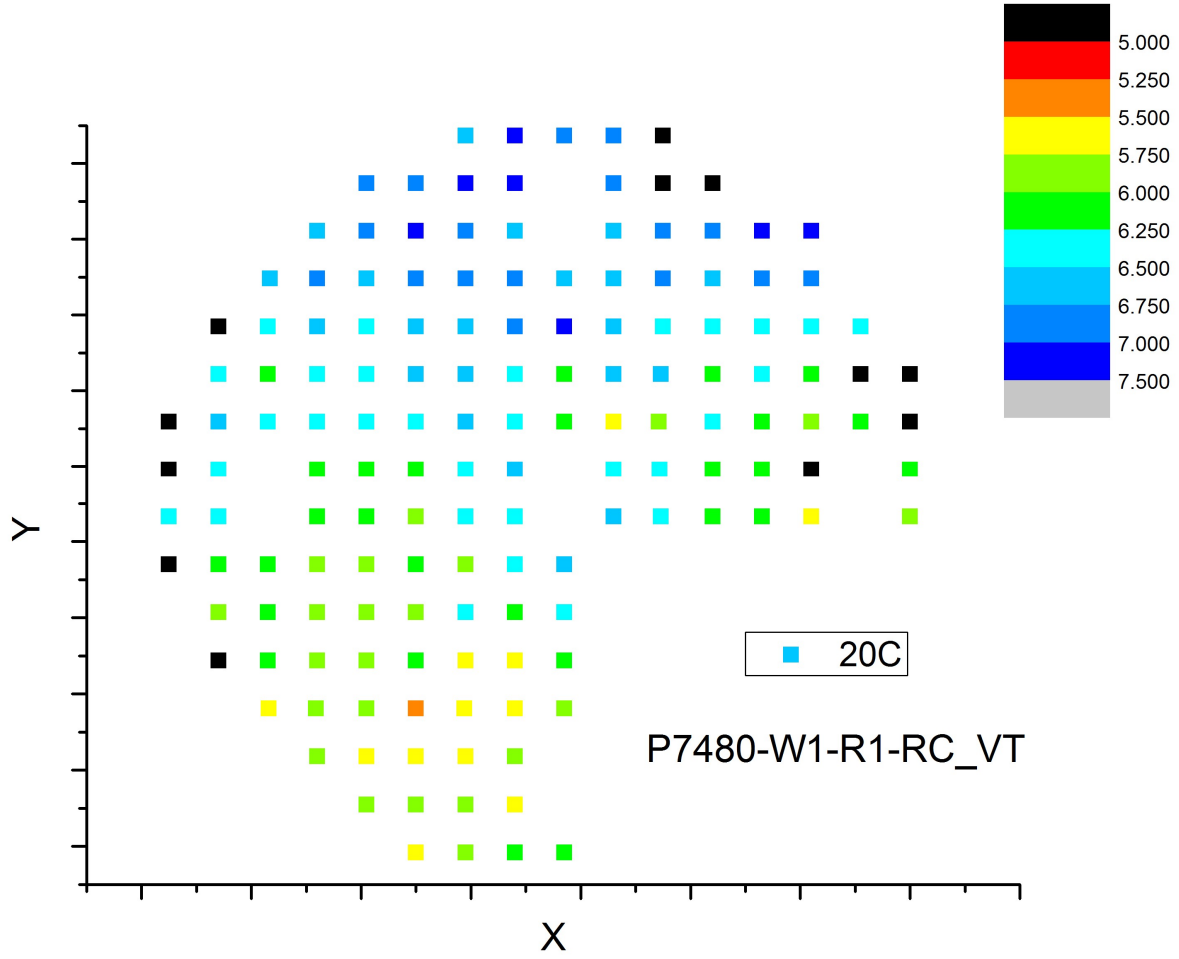
How to find MTC current?



RADFET Read-out Sequence



Electrical Characterisation on Wafer



Calibration curve