Fraunhofer

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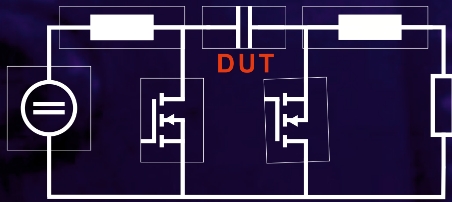
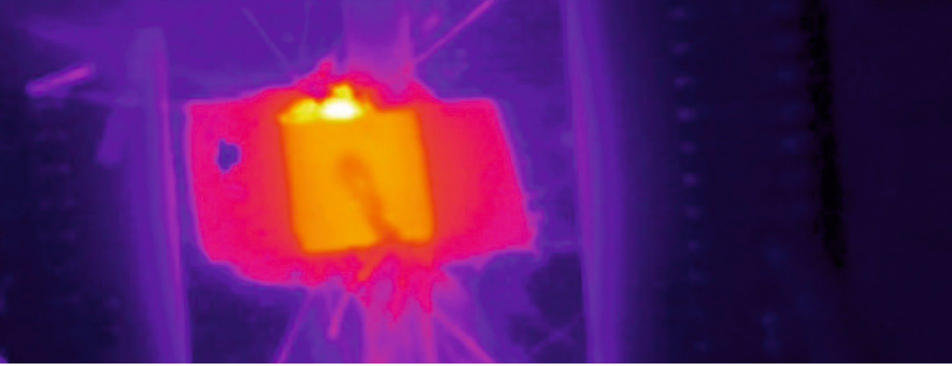
FRAUNHOFER INSTITUTE FOR INTEGRATED SYSTEMS AND DEVICE TECHNOLOGY





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1 *Thermography Image of a failing capacitor and schematic of a Ćuk converter*

2 *Capacitance and stored energy of a ferroelectric capacitor over bias voltage*

3 *Leakage current over temperature of different types of ceramic capacitors*

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CAPACITORS

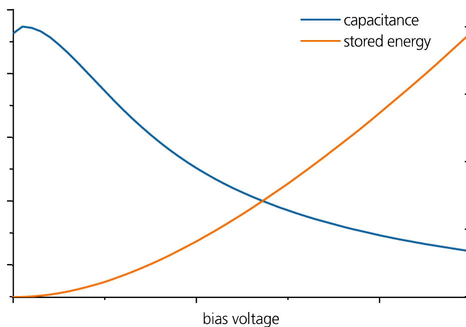
CHARACTERIZATION AND LIFETIME TESTING

Our goals

- Lifetime testing of capacitors (ceramic, film, electrolytic)
- Electrical characterization of capacitors
- Thermal characterization of capacitors
- Evaluation of their potential for power electronic applications
- Development of an active power cycling test

Characterization

- Impedance characterization dependent on frequency, bias voltage and temperature
- Leakage current characterization dependent on temperature and bias voltage
- Thermal characterization under different load and environmental conditions



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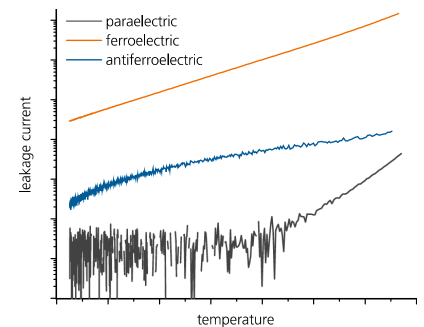

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Reliability test

- Temperature humidity bias test (THB)
- Highly accelerated life test (HALT)
- Passive thermal cycling
- Active heating of capacitors
- Power cycling of capacitors (current research)

Failure analysis

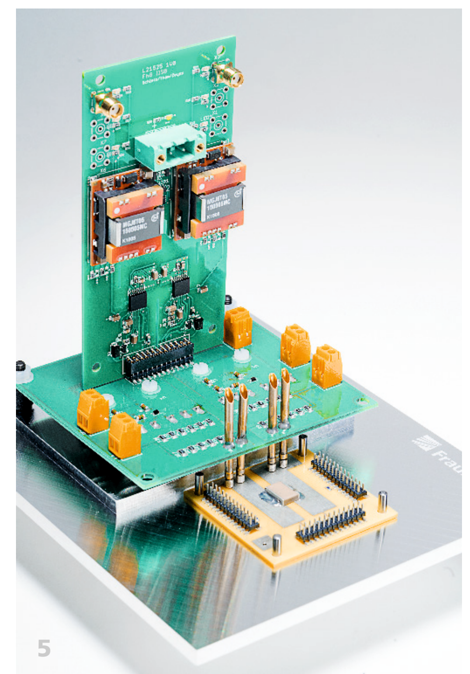
- Cross section analysis and optical inspection
- Scanning electron microscopy and material analysis via EDX
- Lock-In thermography
- Focused ion beam preparation

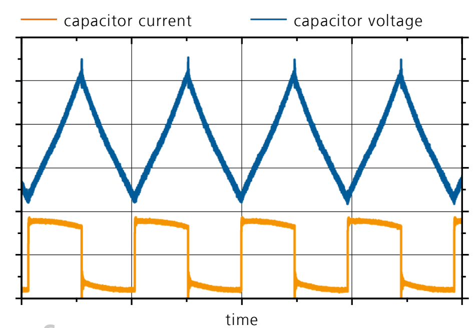
Halt test system

- Simultaneous testing of up to 196 devices
- Online capacitance and leakage current measurement
- Voltages up to 1kV; Temperatures up to 175°C

Static aging by active heating

- Active heating of capacitors in an Ćuk converter
- Rectangular current; triangular voltage shape
- Online temperature and capacitance measurement
- Electrical, thermographical and optical recording of failures





4 *Crack in a failed capacitor*

5 *Ćuk converter test setup*

6 *Voltage and current waveform of at the capacitor during test*