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ETI Double Pulse test bench for measurement and qualification of power semiconductors

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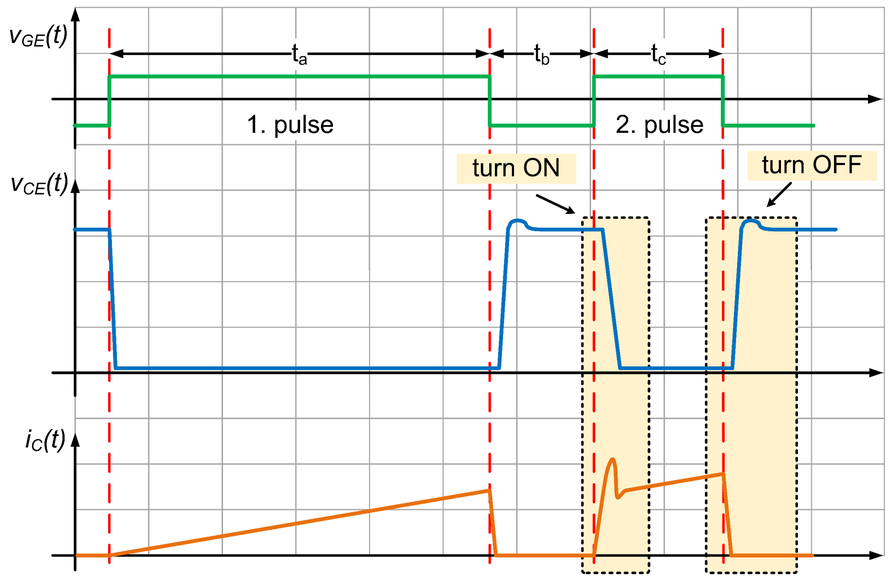
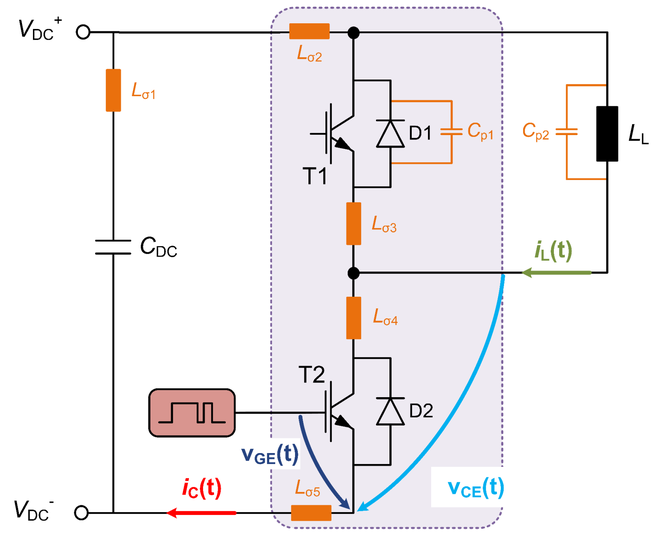
Double Pulse Test Operating Principle

- Single phase module setup, testing the IGBT T2
- Characteristic waveforms of the double pulse test
- Control (Gate) Signal green
- Measuring turn ON and OFF behavior at the second pulse
- Measuring at the same time two different operating points





Loss Calculation and Definition

- Calculation of switching energies

$$E_{ON} = \int_{t_1}^{t_2} v_{CE}(t) \cdot i_C(t) dt$$

$$E_{OFF} = \int_{t_3}^{t_4} v_{CE}(t) \cdot i_C(t) dt$$

$$E_{rr} = \int_{t_5}^{t_6} i_{rr}(t) \cdot v_D(t) dt$$

$$i_{rr}(t) = i_C(t) - I_{C,nominal}$$

- Used integration limits

t_1: $v_{GE}(t) = 0.1 \cdot V_{GE,on,static}$

t_2: $v_{CE}(t) = 0.02 \cdot V_{DC-Link}$

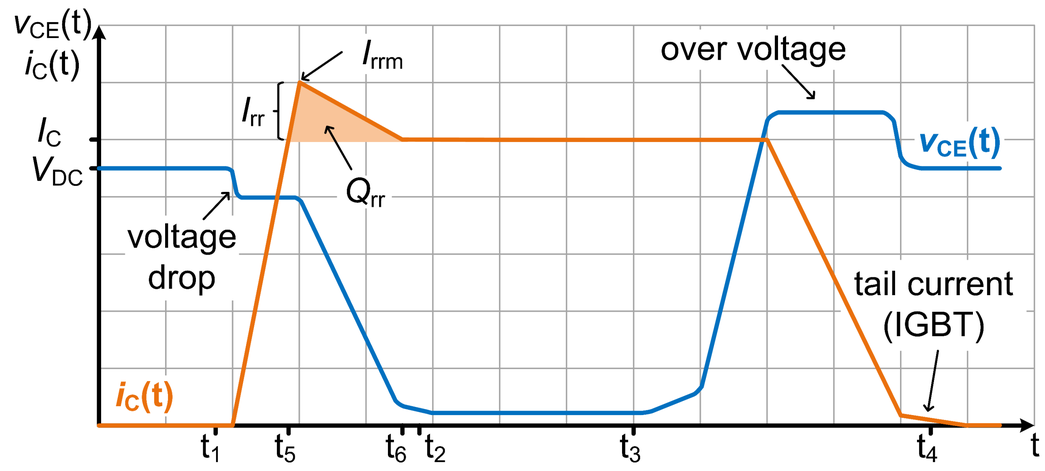
t_3: $v_{GE}(t) = 0.9 \cdot V_{GE,on,static}$

t_4: $i_C(t) = 0.02 \cdot I_{C,nominal}$

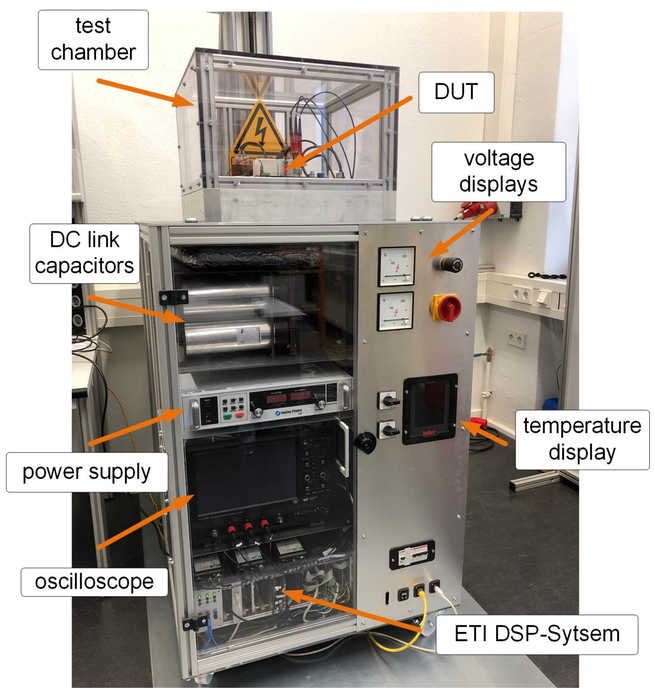
t_5: $i_C(t) = I_{C,nominal}$

t_6: $i_D(t) = 0.02 \cdot I_{rr}$

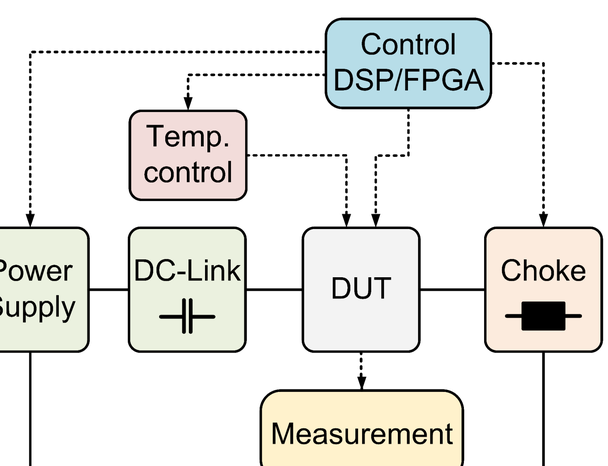
- Typical switching characteristics of an IGBT



Novel Developed Fully Automated Test Bench



- Fully automated test bench (LabVIEW and ETI DSP-System based)
- Max. DC-Link voltage: $\boldsymbol{V_{max} = 1,8\ kV}$
- Maximal current pulse: $\boldsymbol{I_{max} = 4\ kA}$
- Maximal measurable current slope: $^{di}/_{dt} = 6\,\frac{kA}{\mu s}$
- Adjustable junction temperature: $-20\ °C < T_J < +160\ °C$
- Measurement of conduction characteristics
- Measurement of switching behavior
- Evaluation of the measured data with Matlab and LabVIEW



- **Fully automated switchable choke**
  - Configurable choke with seven different effective inductances
  - Selection of desired inductivity via thyristors
  - ensuring safe operation