Short Bio Kevin Hermanns

Co-Founder & Managing Director PE-SYSTEMS

Research Engineer: Distortions of High Power Converters

Document & Configuartion Management for large scale rail automation projects SIEMENS

Bachelor & Master Degree in Electrical Engineering: Focus Electrical Power Engineering

Kevin Hermanns

Born 1984 in Germany

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Founding Chair of Technical Committee 10 (Design Methodologies)

Member of TC47/SC47E/WG03 Power Devices: Standards in scope IEC 60747-2, -6, -7, -8, -9, -15

Contribution on Distortions for CLC/TS 50654: HVDC Grid Systems and connected Converter Stations - Guideline and Parameter Lists for Functional Specifications

Growing Complexity

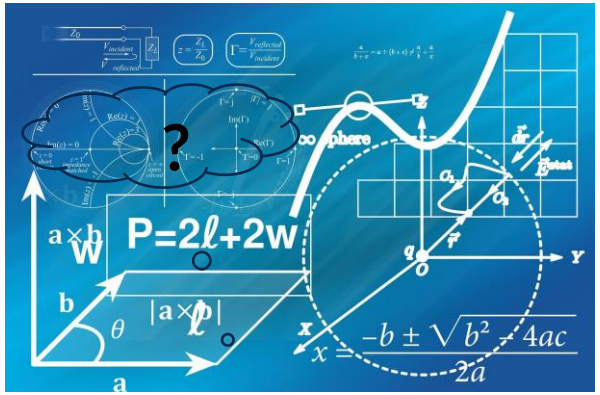
New Technologies

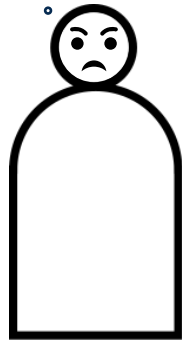
Silicon Carbide

Gallium Nitride

Silicon

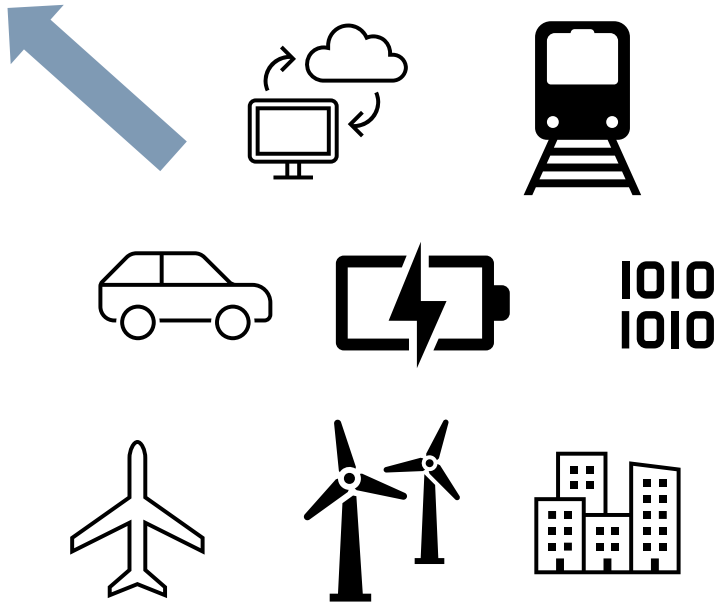
Shorter Time-to-Market





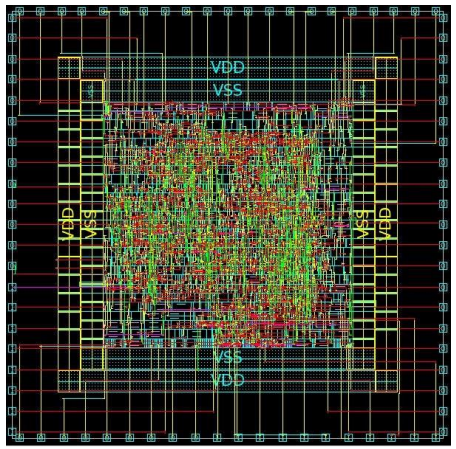
R&D and Design Engineer

New Applications

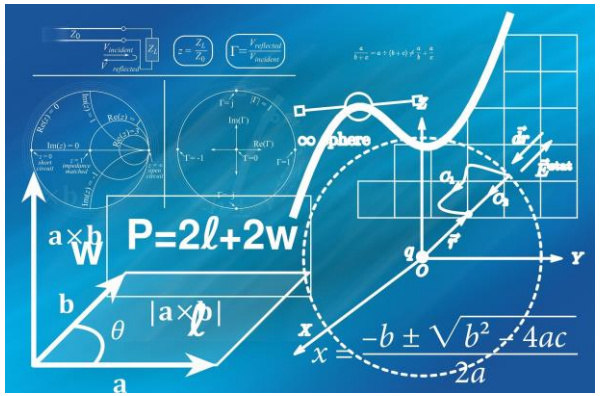


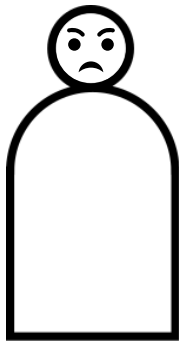
Growing Complexity

Integrated Circuits 1980‘s



Growing complexity mastered by Electronic Design Automation (EDA)





R&D and Design Engineer

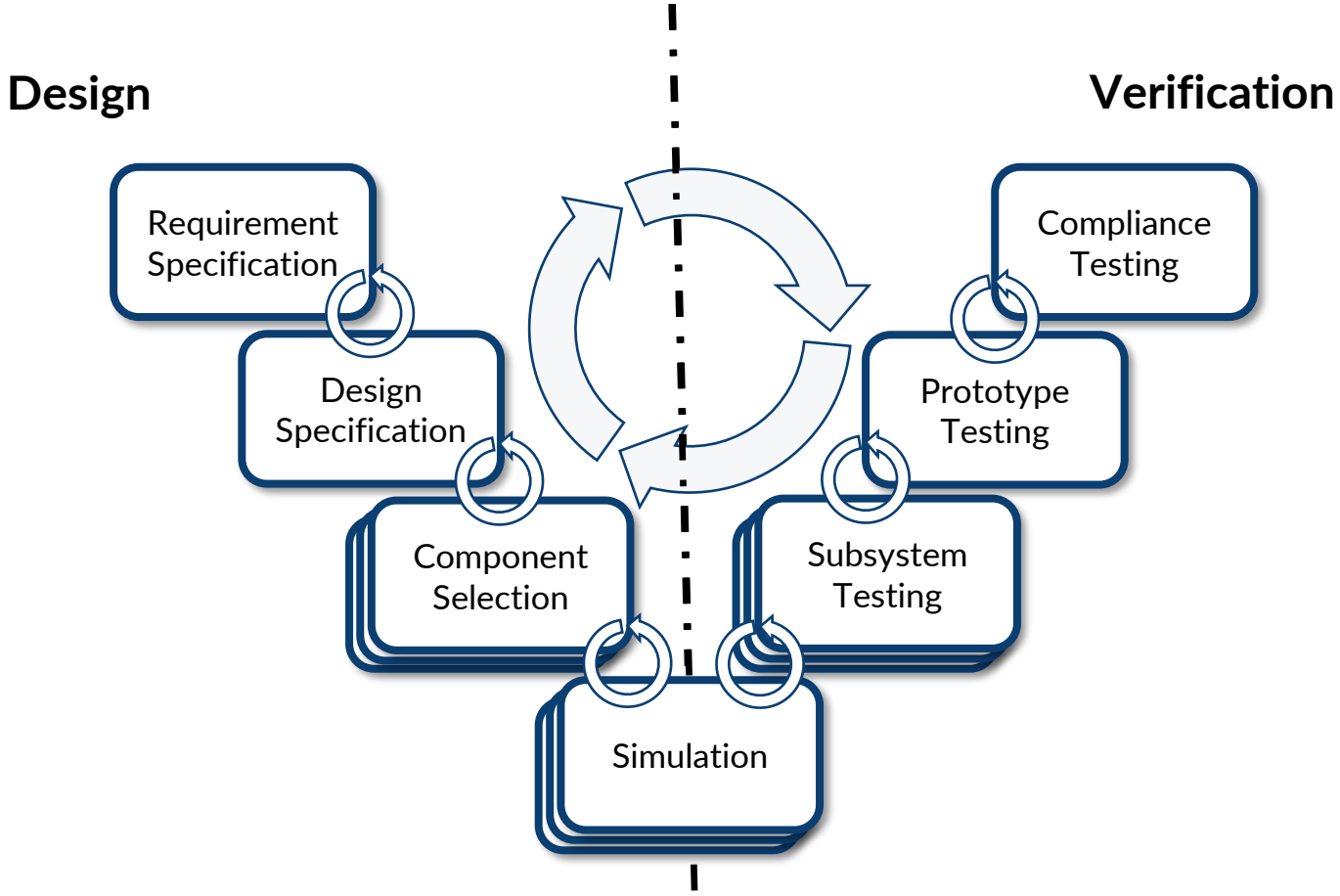
Power Electronics 2020’s

Component data are not available in the required quantity and quality

Power Electronics Conversion system involves supply of multiple vendors

More degrees of freedom

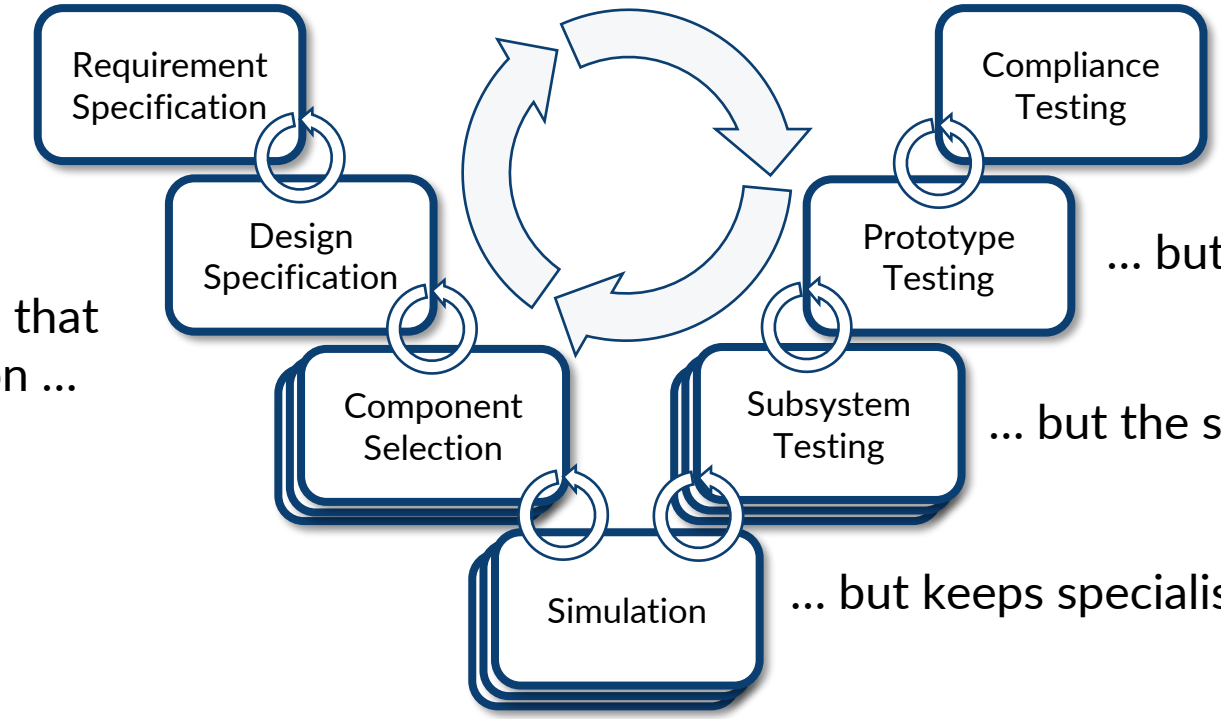
Power Electronics Design Process



Where can double pulse test measurements help?

Current Power Electronics Design Process

Iterative design process, that always leads to a solution ...



... but is very cost-intensive.

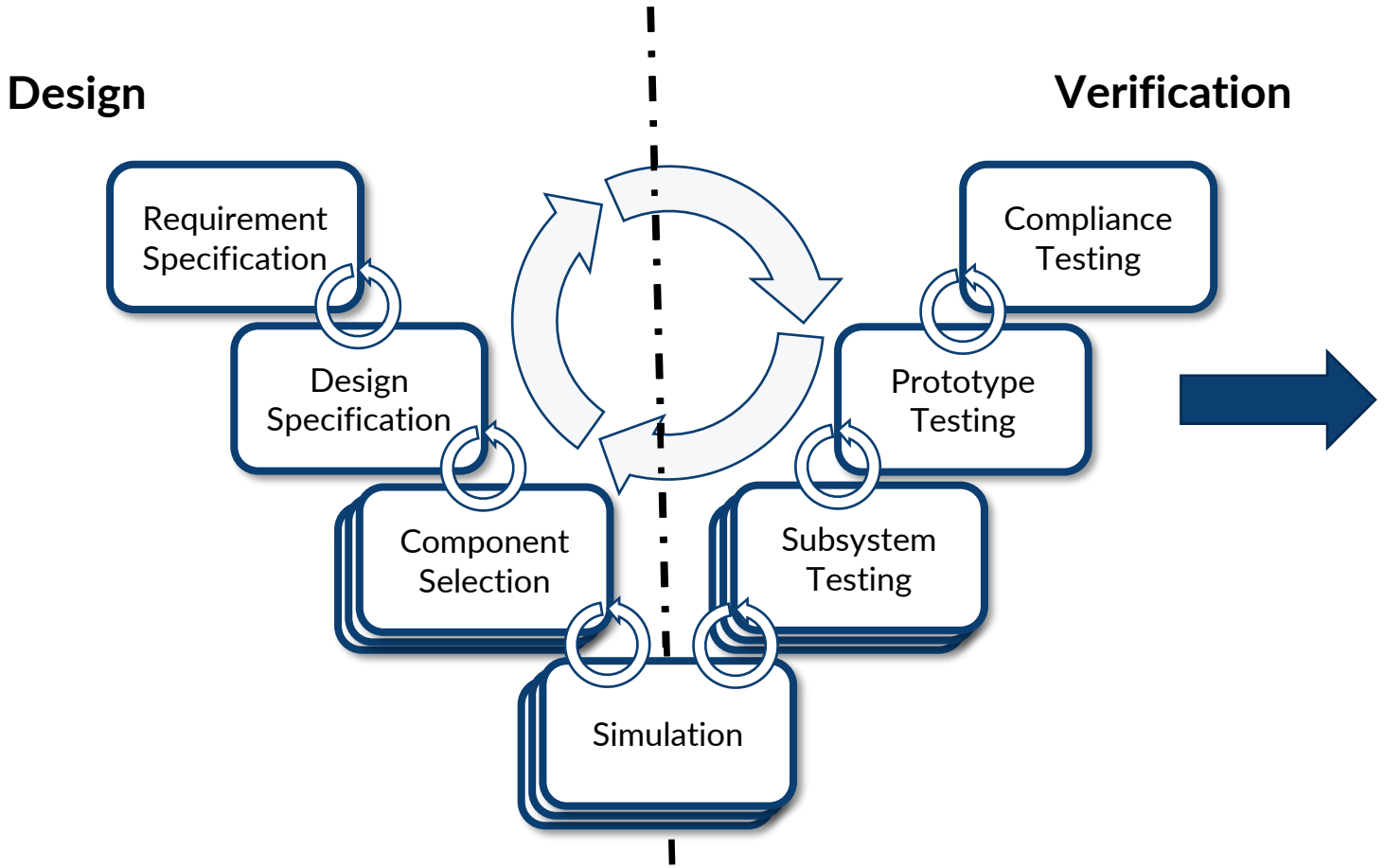
... but is very time consuming.

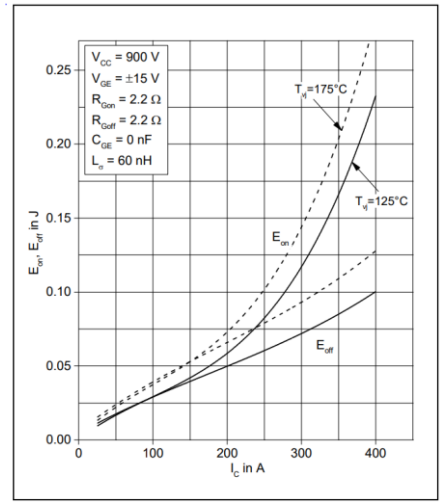
... but the solution is never optimal.

... but keeps specialists unnecessarily engaged.

... but customers' requirements might be unsatisfied.

Device Vendor View

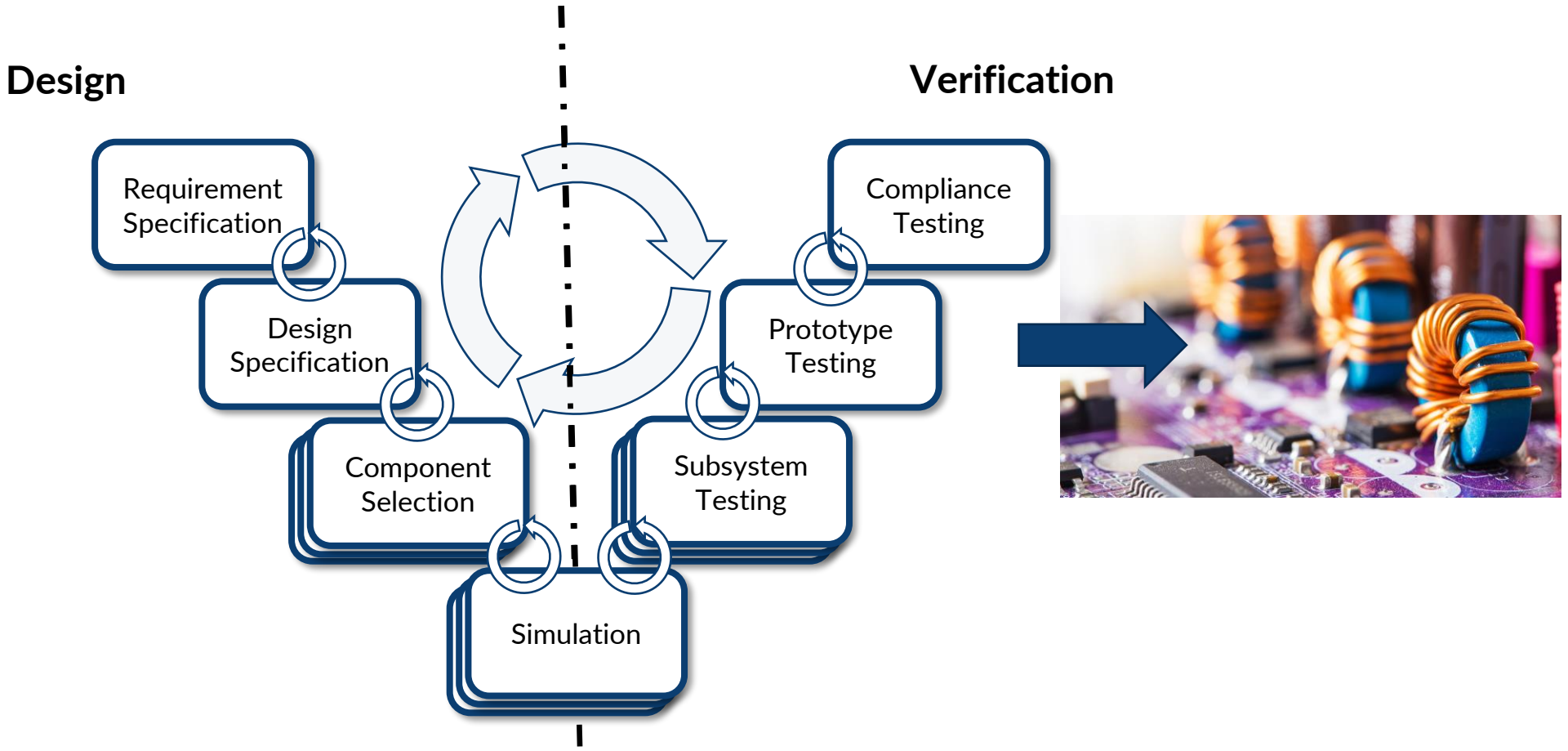




Data sheet creation

Where can double pulse test measurements help?

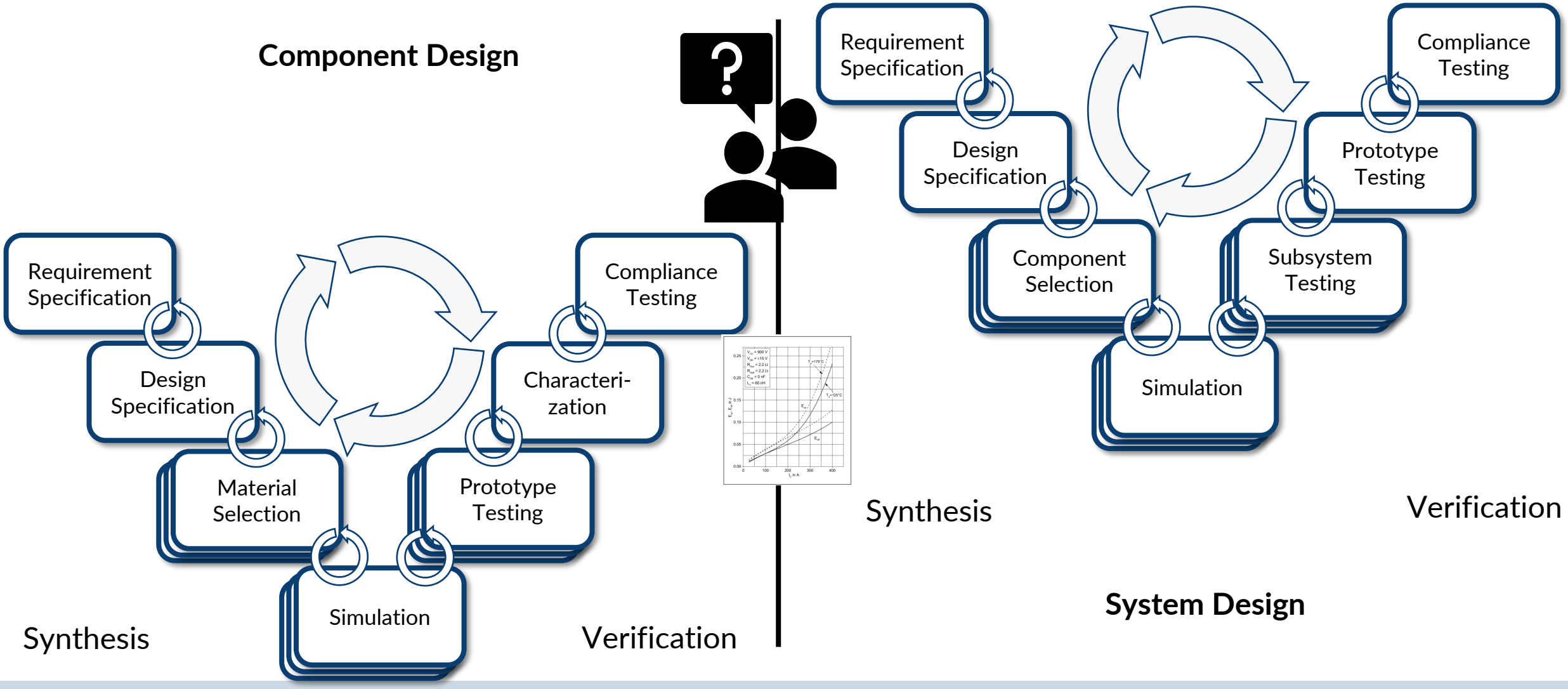
System Integrator View



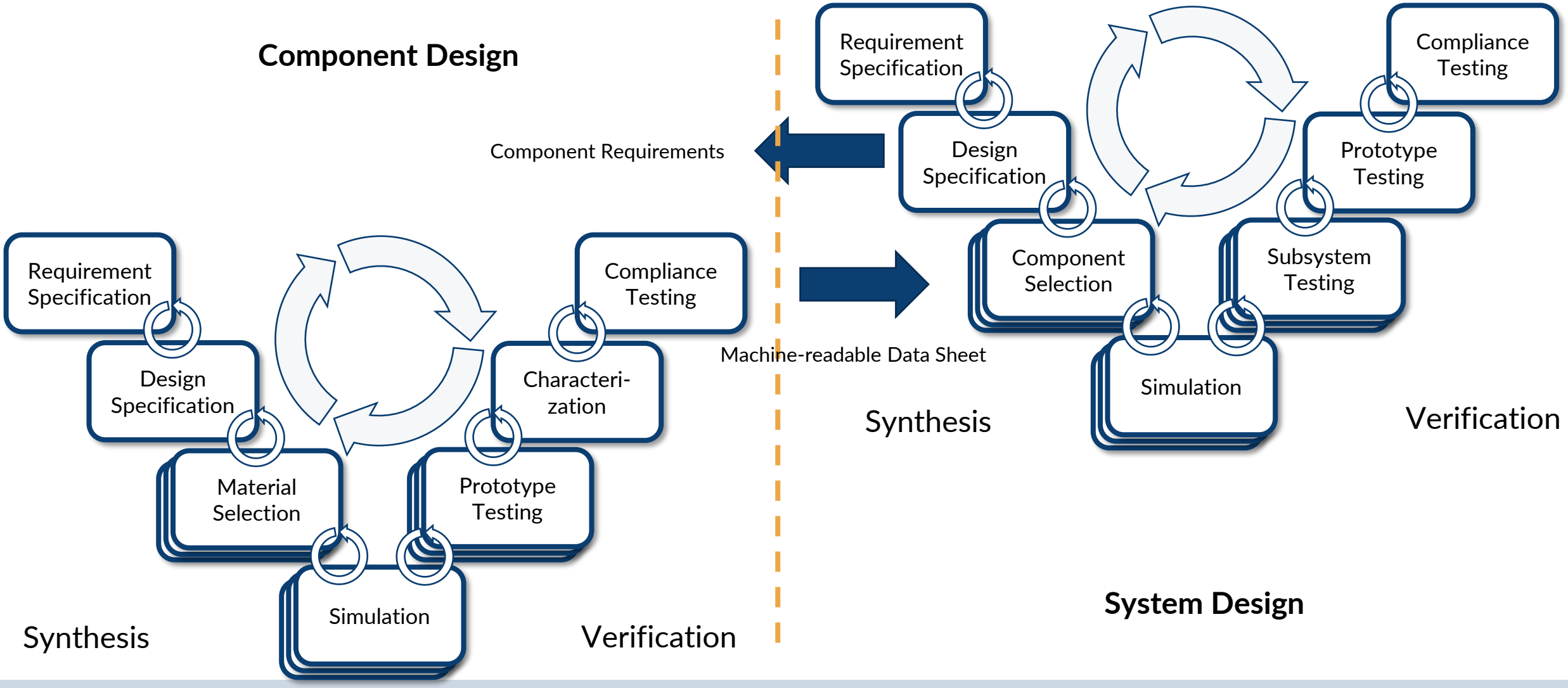
Where can double pulse test measurements help?

How do we get shorter time-to-market?

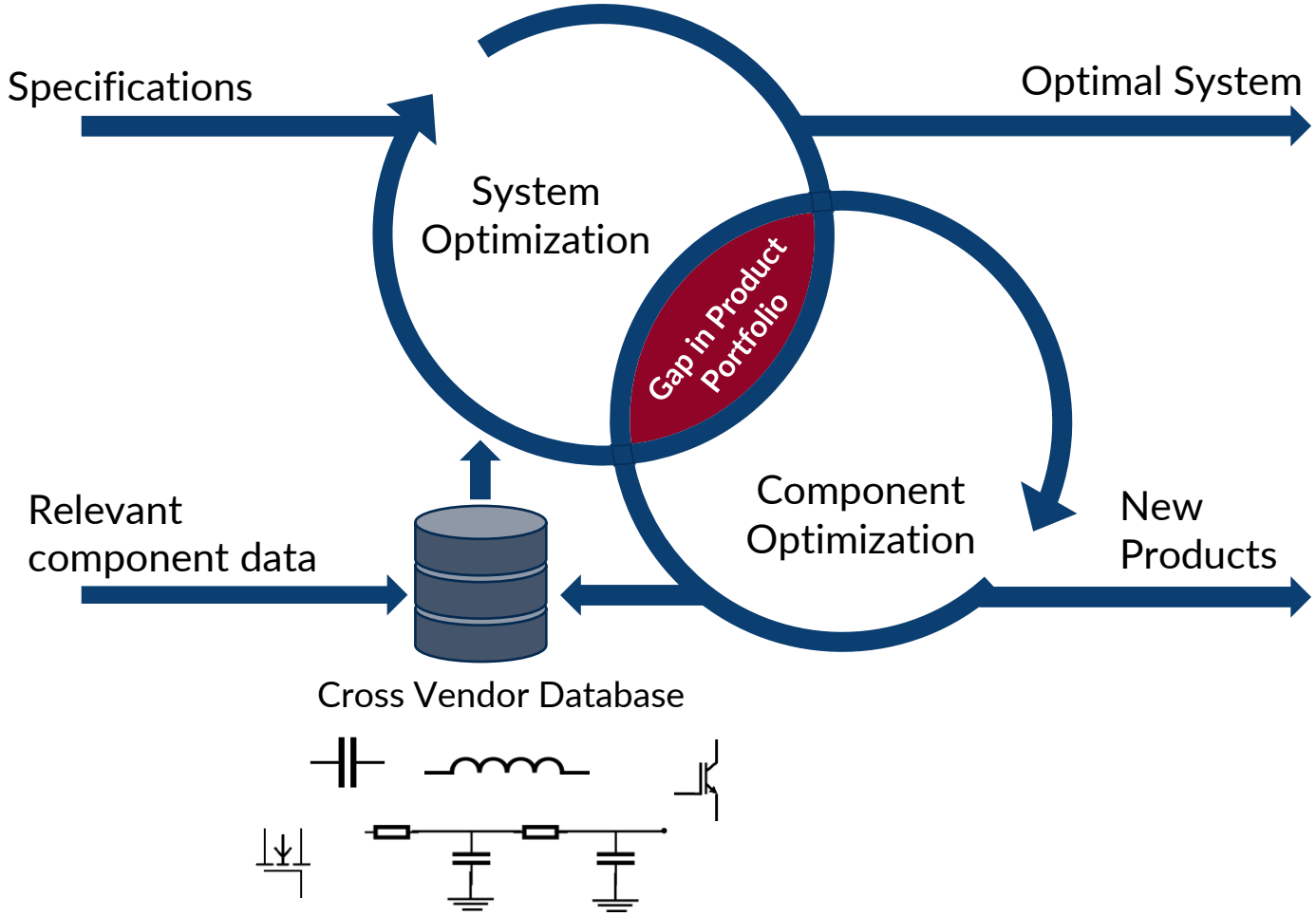
Two Un-linked Process Flows



Design Automation

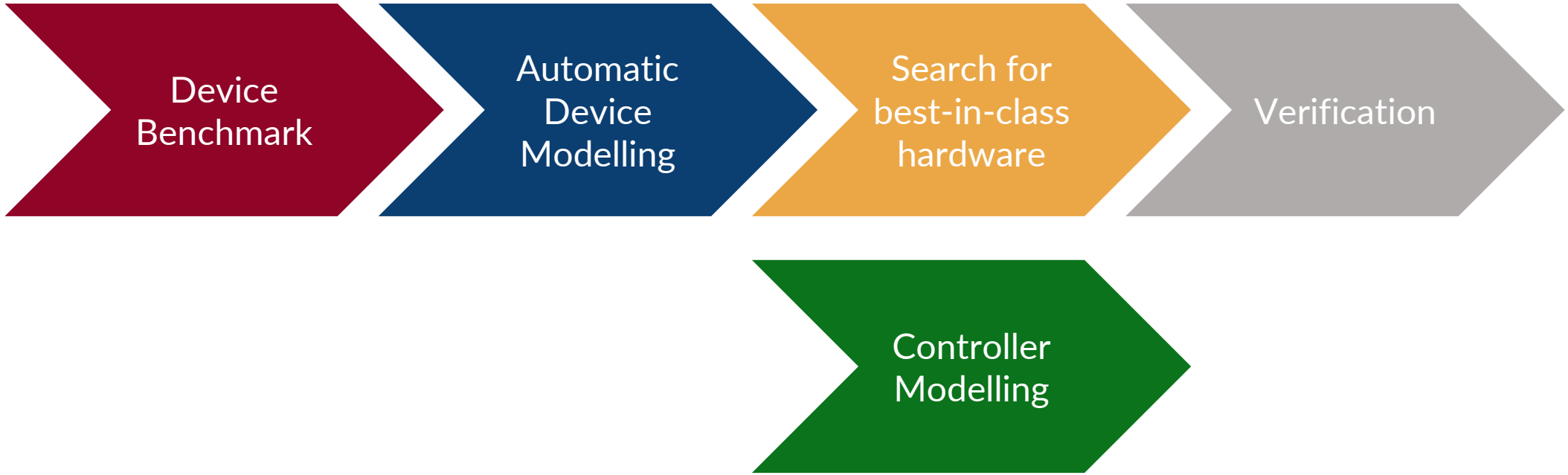


Design Automation is Collaborative

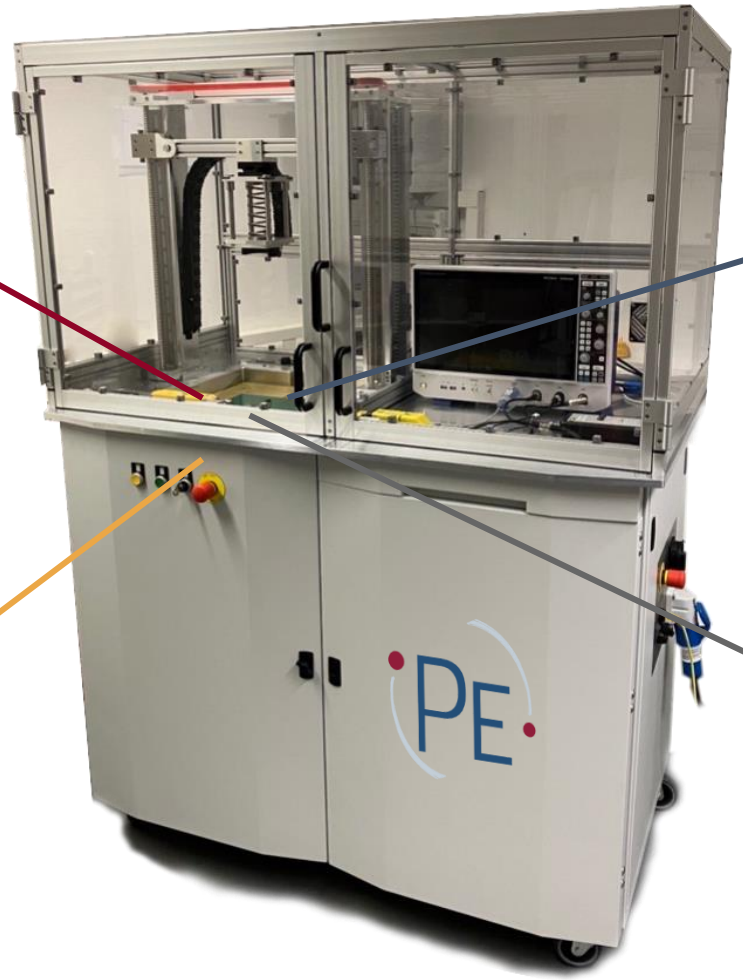


What can we do now?

Shorter Design Flow

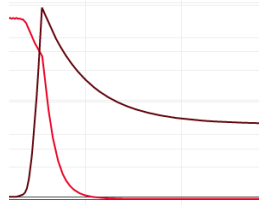


Use Cases

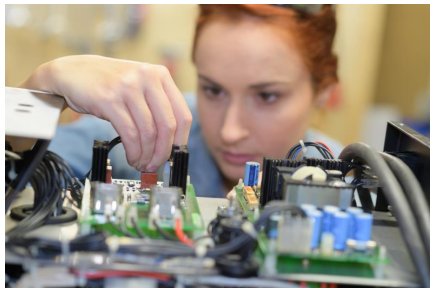


Device Benchmark & Component Selection

Search for Driver Settings

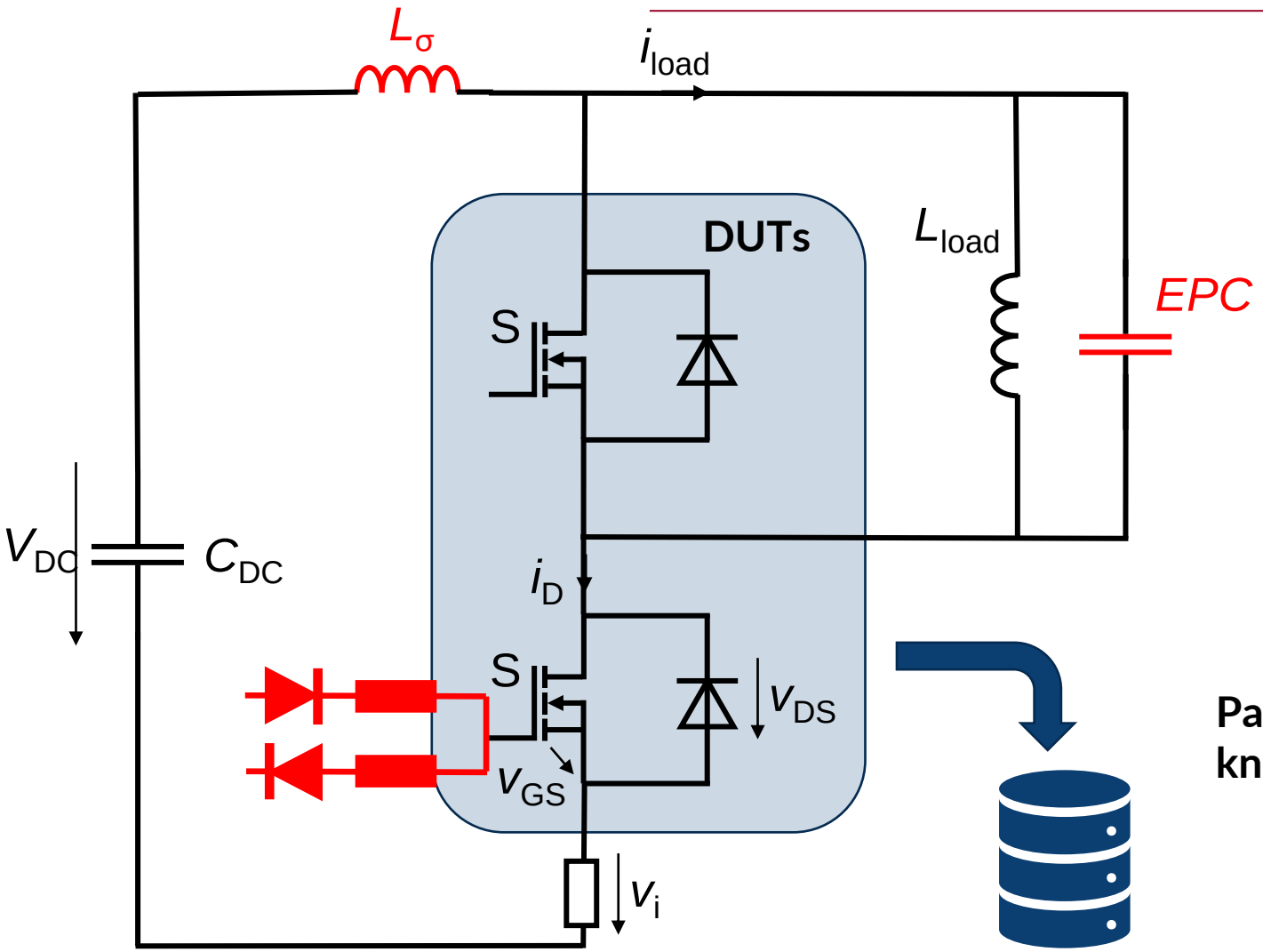


Automatic Model Generation



System Verification

Use Case - Benchmark

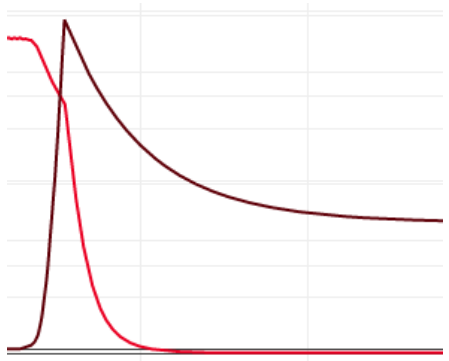


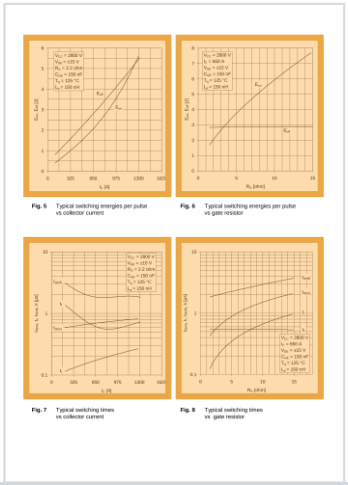
- Measurement environment well known
- De-embedding of imperfections results in “real” device performance
- Measurements are repeatably
- Comparison of different devices easy

Parasitics of DPT must be well known and taken into account

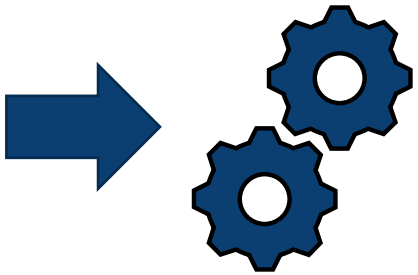
Use Case – Model Generation

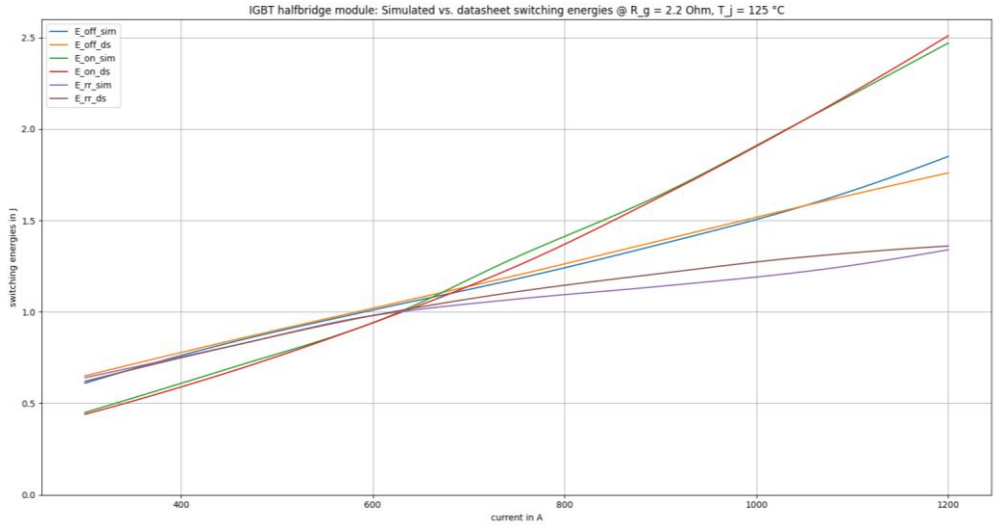
- Accurate measurements allow better device models
- Automatic generation possible
- Quality metrices can be developed and applied (accuracy information)



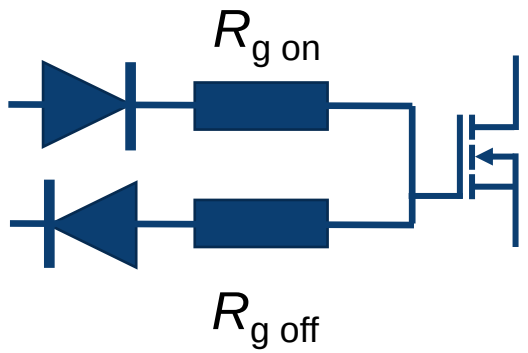


Static information can be obtained with DataSheetVision

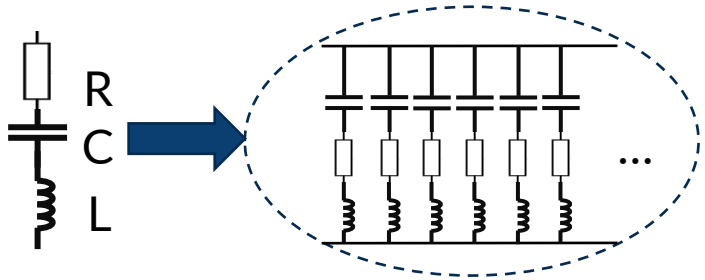




Use Case – Search Best-in-class Hardware

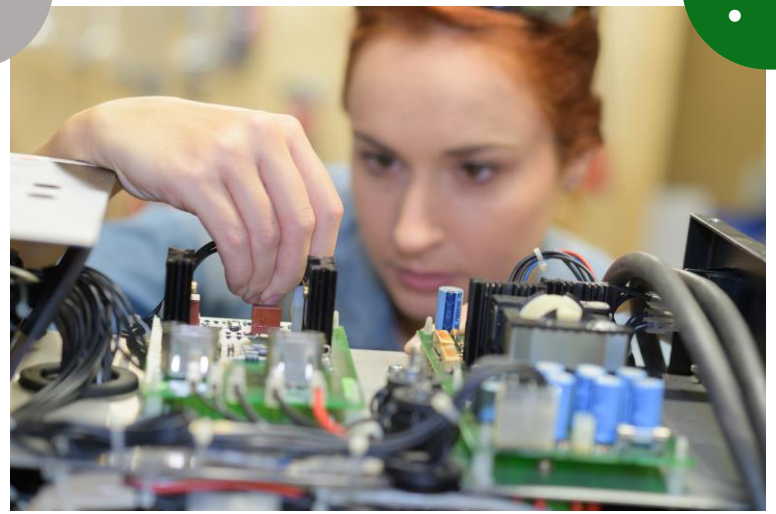


- For ideal DC-Link designer has various options
- Driver parameters are compromise with various options
- Contingency operations may require design margin
- For programmable gate drives parameter search automated



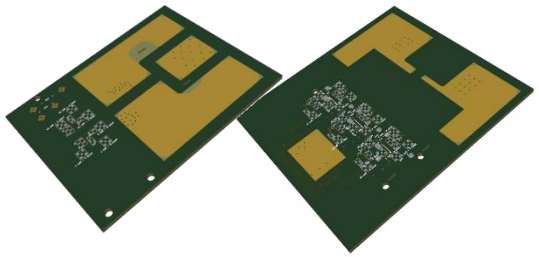
Use Case – Design Verification

- Measurements on real setup for verification purposes
- Allow further optimization but in the region of model uncertainty
- Close of “control loop” points out shortcomings in modelling
- Shortcomings can be addressed and models become better



- For design of controllers circuit simulations are quite simple (ideal switch and look-up table)
- The commonly used look-up tables described in XML files can be generated according to operation parameters
- Improved accuracy

Modularity



Optimized Test Fixtures

High Performance Measurement Equipment

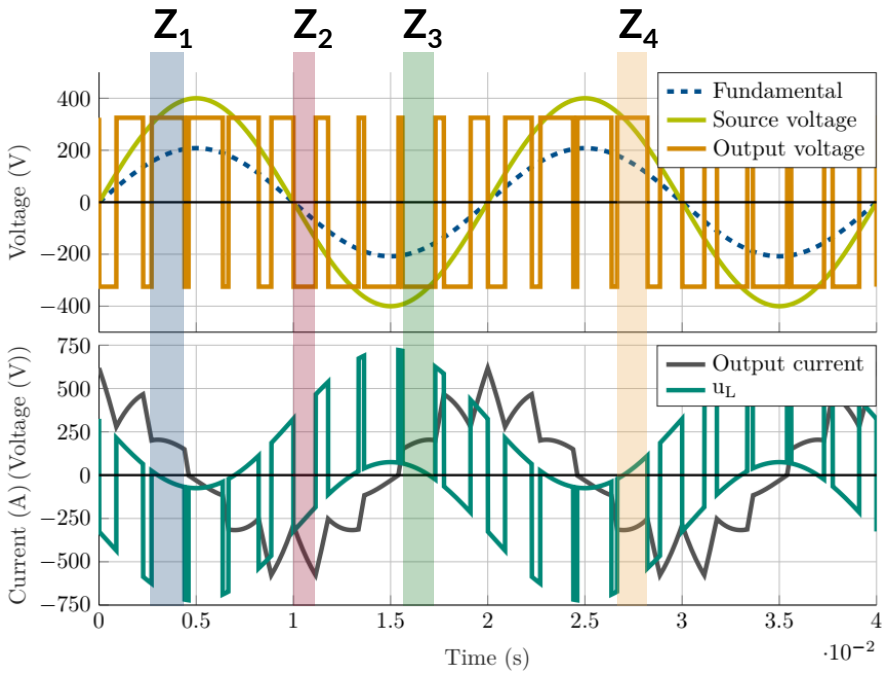
Flexible Driver

Different Load Inductors

Modular Double-Pulse Tester

Testing Close to Application

- Allows testing with highly optimized characterization setups
- Allows testing of in-site device performance
- Accompanies systems development from first comparisons to system verification tests on prototypes.

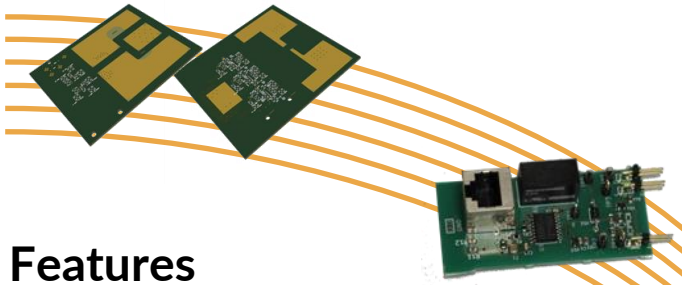


Benefits for the Lab Engineers

- Automatic parameter extraction
- Automatic de-skew
- Plausibility checks of measurement results
- Automatic model generation
- Ergonomic workbench

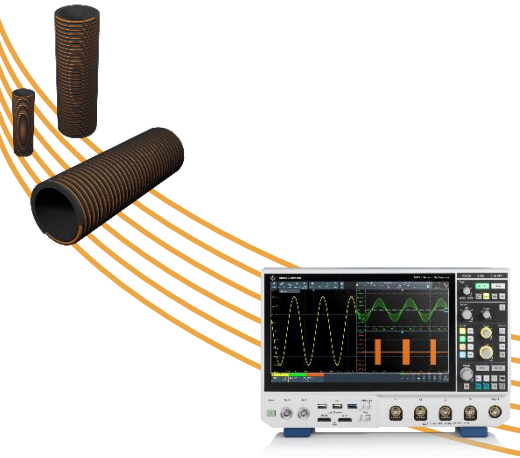
Figure e.g. 62 mm module fixture

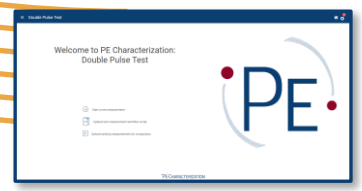
Modular Double-Pulse Tester



Features

- Test voltage up to 2 kV
  (higher voltage on request)
- Test current up to 3.6 kA
- Test temperature -40 to 250 °C
- Optimized test fixtures for all packages
- Universal gate drivers
- Different load inductors and DC-links
- Very low stray inductance
- High performance scope and probes of multiple vendors or integration of pre-existing equipment





Benefits

- Modules, discretes, silicon, SiC and GaN – one tester for all devices
- Fast setup times
- Avoidance of human errors through error-detecting software
- Fast amortization due to reduction of required human resources
- Use of existing infrastructure (compatibility)

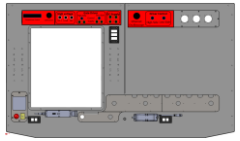
Be prepared for upcoming challenges!

DPT Solutions - Overview

Base frame:

Base cabinet

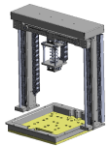
Sliding hood



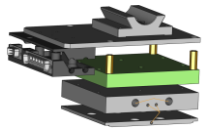
Worktop

Safety Circuit

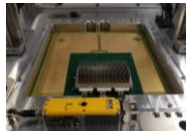
+ Additional Equipment



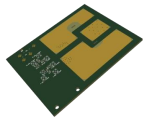
Contacting Unit



Temperature Unit



DC Link



Optimized Test Fixtures

Flexible Driver

Different Load Inductors

High-Performance Measurement Equipment

Laboratory Source

High Voltage Source

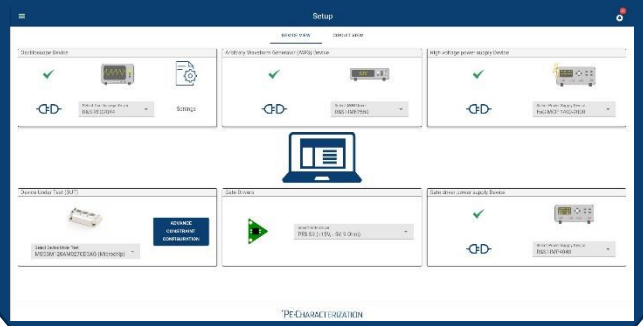
ThermoStream

Automatization Software

Software is the Key

Setup Configuration

- Probe Selector
- Connection Manager
- Conflict Manager

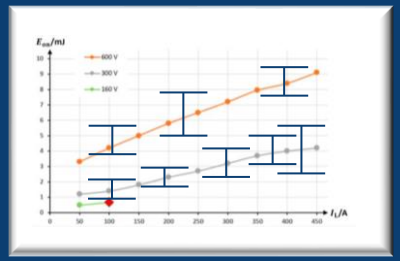


Conduction of Measurement

- Parameter sweeps
- Automatic de-skew
- Measurement campaign saving
- Plausibility checks

Post Processing

- Smoothing
- Parameter extraction (IEC standard)
- Error quantization
- Local Data management
- Interfaces ext. tools?



Conflict Manager – Human Error Reduction

Cross-checking of all user settings to prevent damage at DUT or measurement devices

Pre-processing:

- Voltage & current limit checks:
  - Sweep definition
  - Probe selection
- Signal generation (prevent overheating)
- Instrument settings
- …

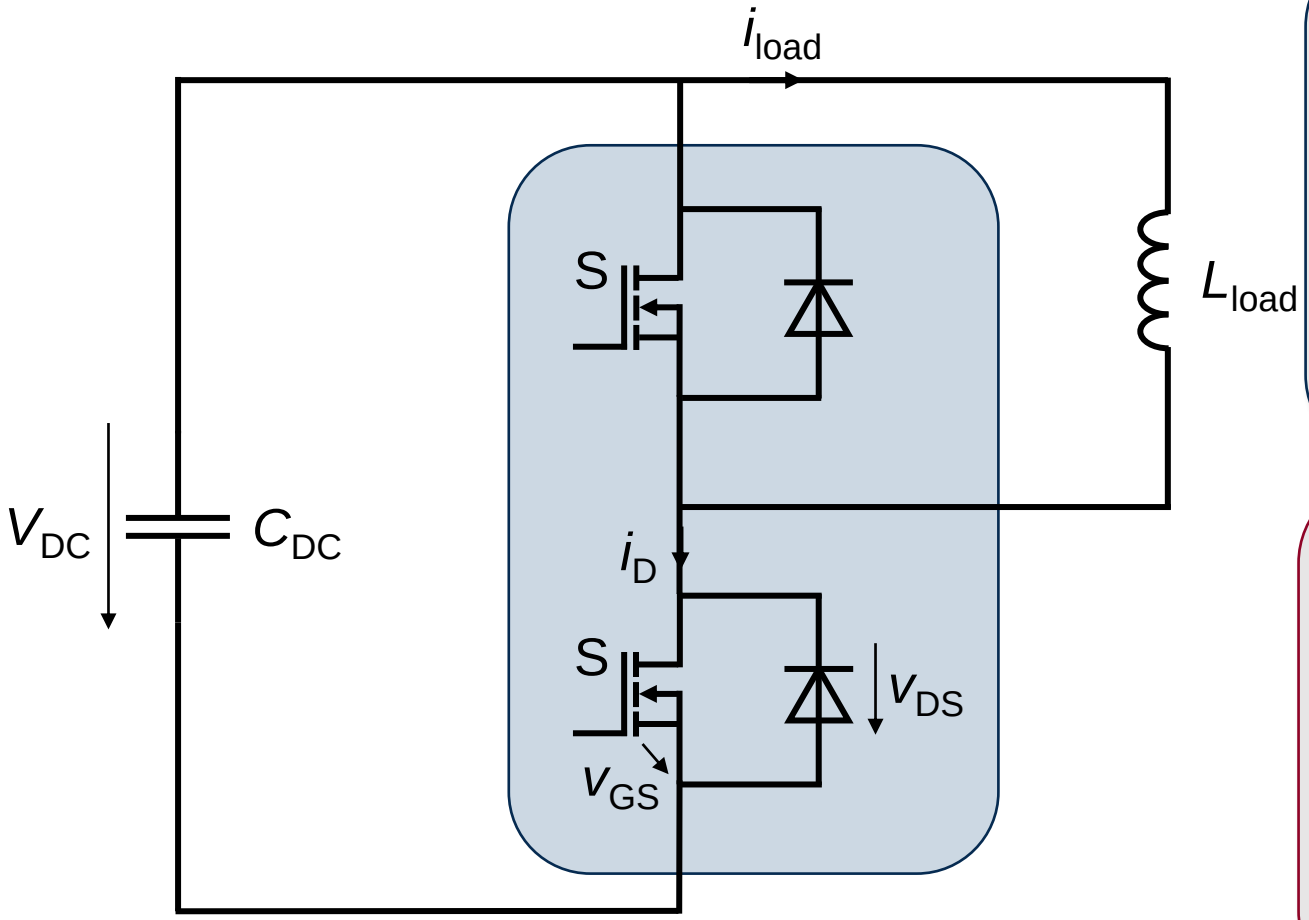
Conduction of Measurement:

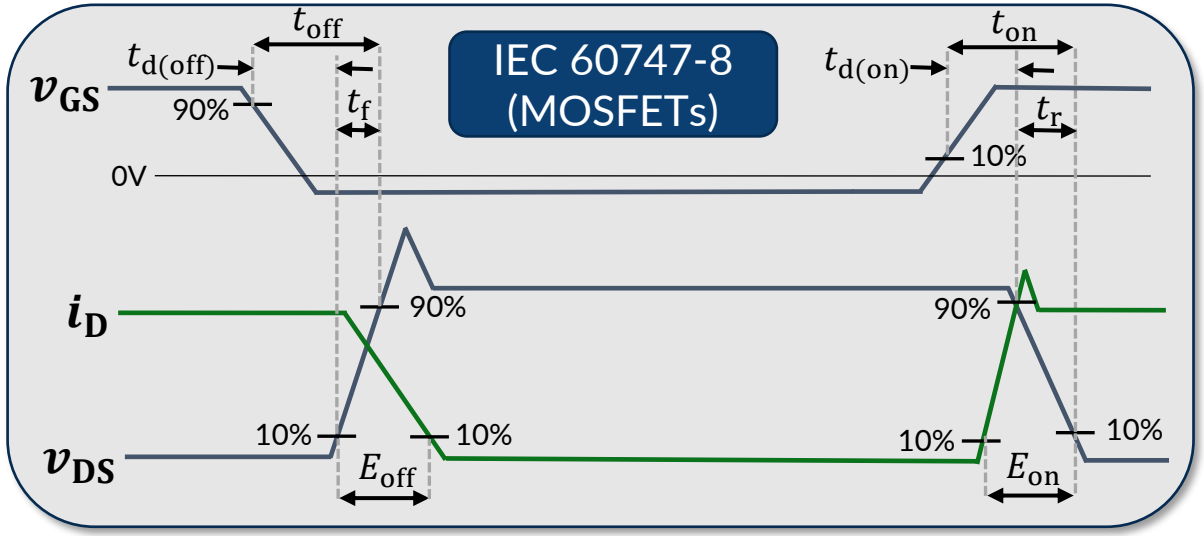
- Connectivity checks
- Adjust instrument settings to operation point in case of clipping
- Signal plausibility checks for trigger faults
- …

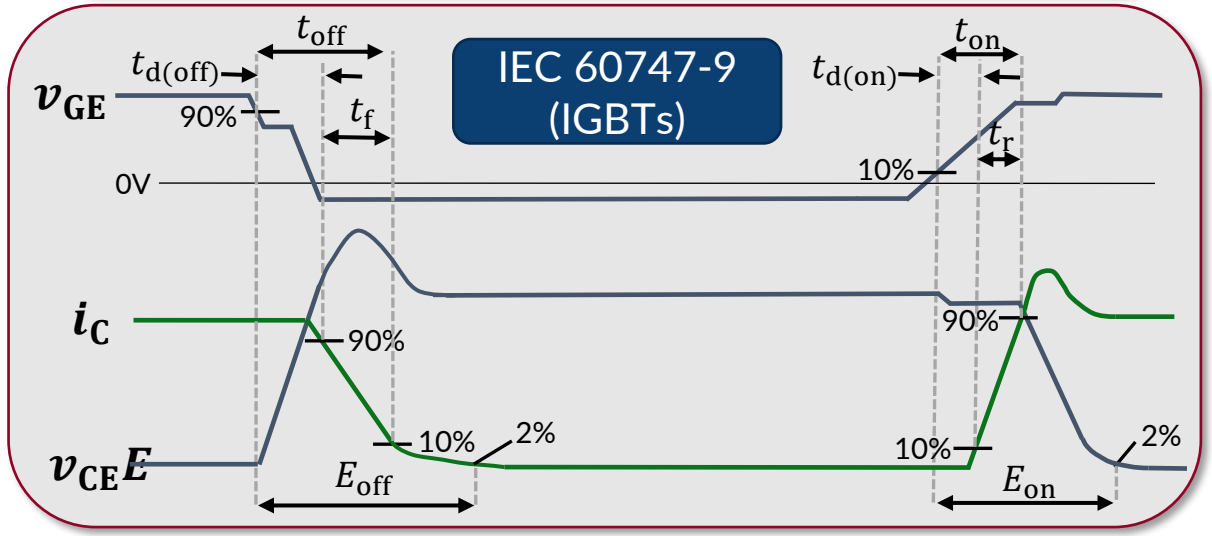
Post-processing:

- Plausibility checks for extracted parameters
- Noise filtering
- De-skew
- Error quantification (error calculation package)
- Statistical evaluation (math package)
- …

Testing of Inductive Switching - Standard

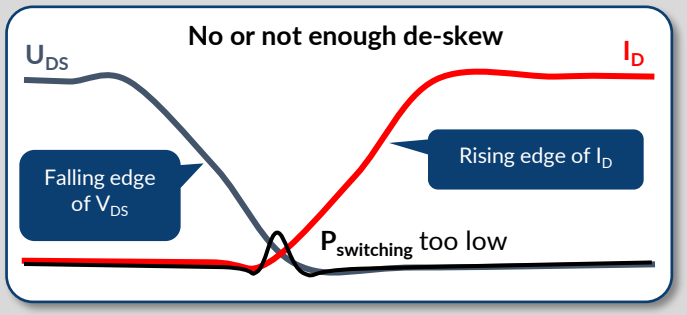


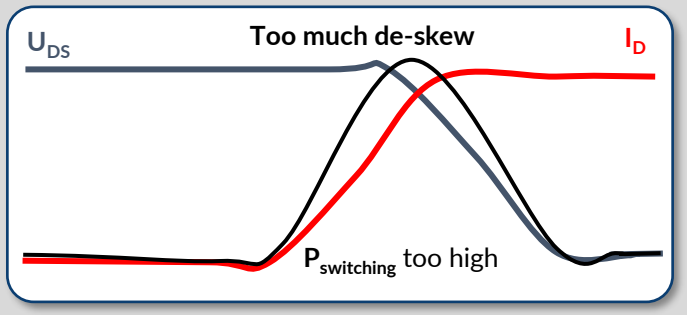


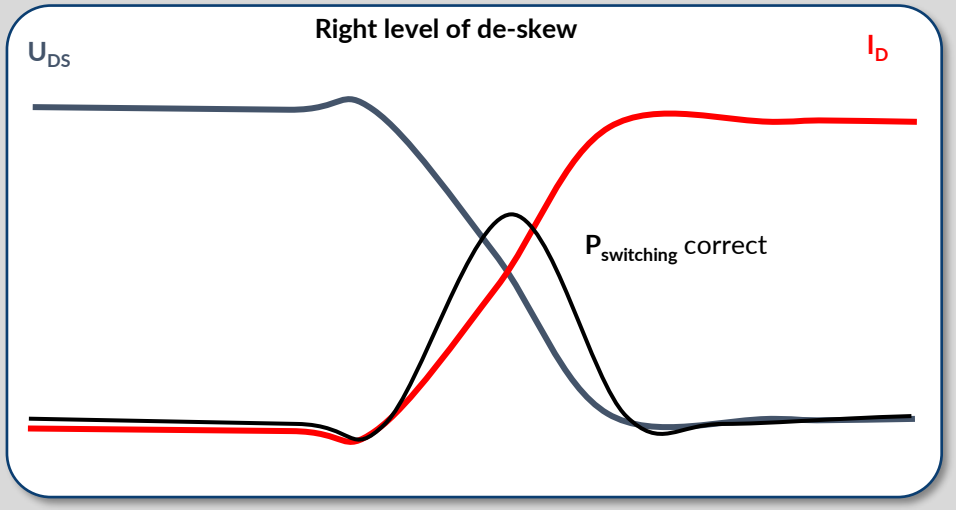


Automatic De-Skew

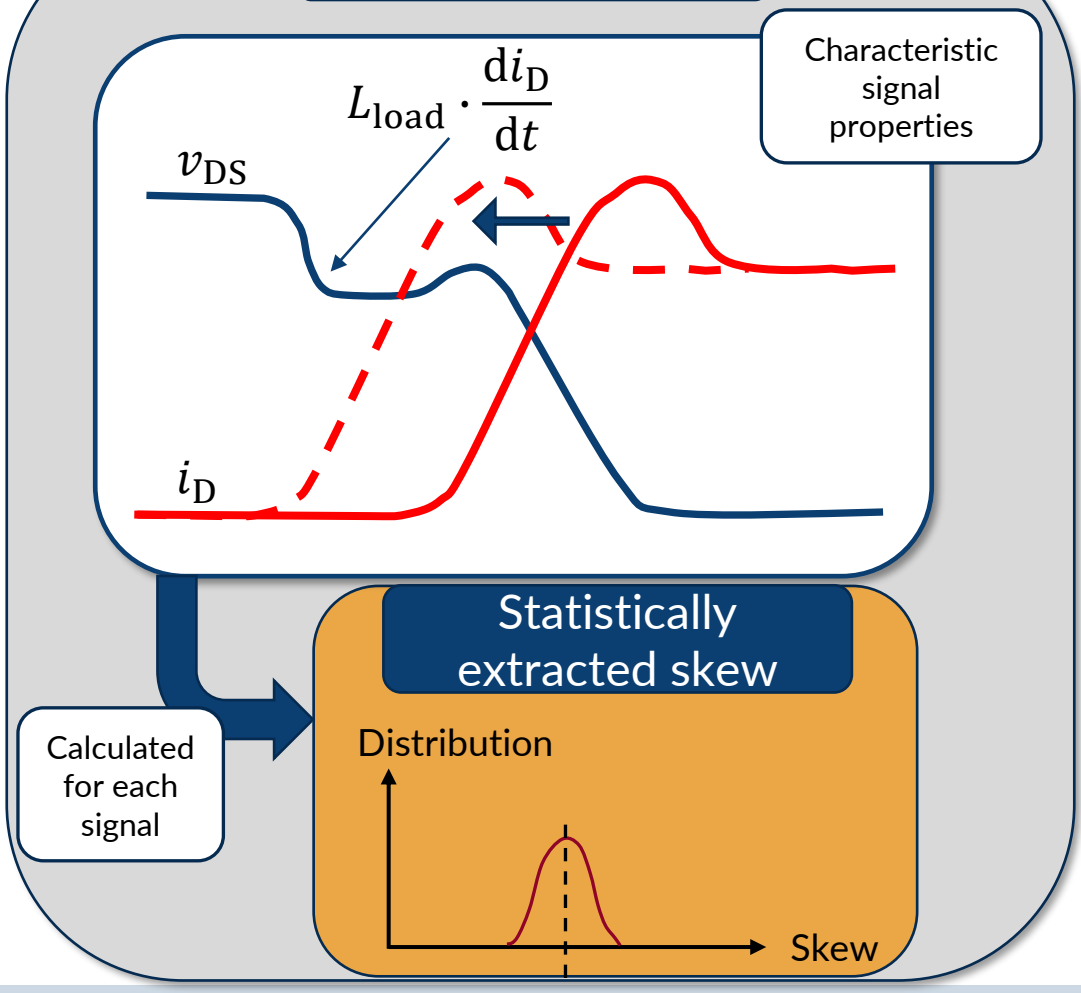
De-skew issue







Automatic de-skew



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