
Fraunhofer Institute for Wind Energy and Energy System Technology

Department Network Technology and Integration

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- Infrastructure
 - Test Laboratories



Department Network Technology and Integration

Department
Network
Technology and
Integration

Head: Dr. Thomas Degner

Power Quality and
Grid Connection

Dr. Gunter Arnold

Power System Control
and Dynamics

Dominik Geibel

Protection and
Controls for Power
Distribution

Dr. Thomas Degner
(temporary)

Rural Electrification
and Hybrid systems

Dr. Thomas Degner
(temporary)

Topics

- Grid Code and Grid Connection Requirements
- Conformance Tests
- Model Validation
- Measurements of Grid Characteristics
- Grid-Design, Grid Planning and Consulting

Topics

- Power System
 - Simulation
 - Stability Analysis
- Control development
 - Grid Control
 - Micro Grids
 - Hybrid Grids
 - DER units
- Hardware in the Loop
 - CHiL and PHiL

Topics

- Network Protection
- Communication and Control Technologies for Power Systems
- Grid Operation

Topics

- Rural Electrification
- Hybrid Systems (Planning and Design)
- Pilot- and Demonstration-projects

Department Grid Technology and Integration: Experimental Infrastructure



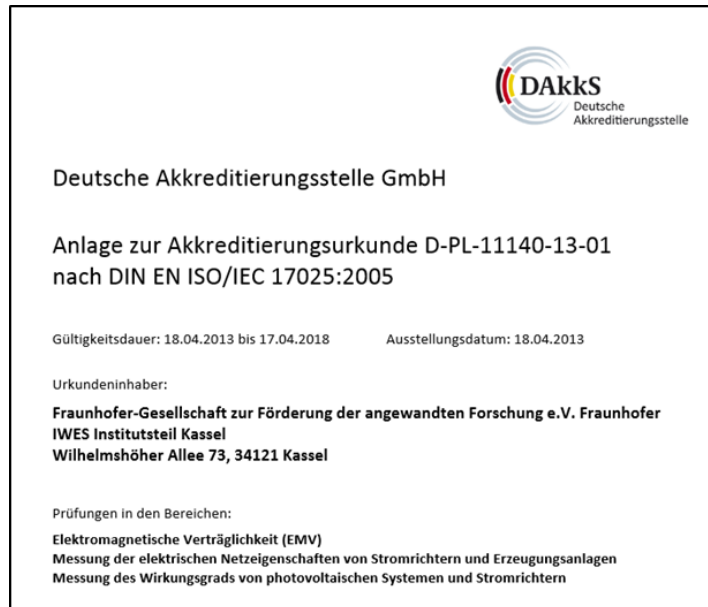
- DeMoTec – Design-Center for modular system technology
- Accredited Test Laboratory for Electromagnetic Compatibility (EMC) according to IEC 17025
- European Network of DER Laboratories - DERlab

- SysTec – Test Centre for smart grids and electro-mobility

SysTec - Test Centre for Smart Grids

Testing Capacity

- Accredited for grid code compliance testing

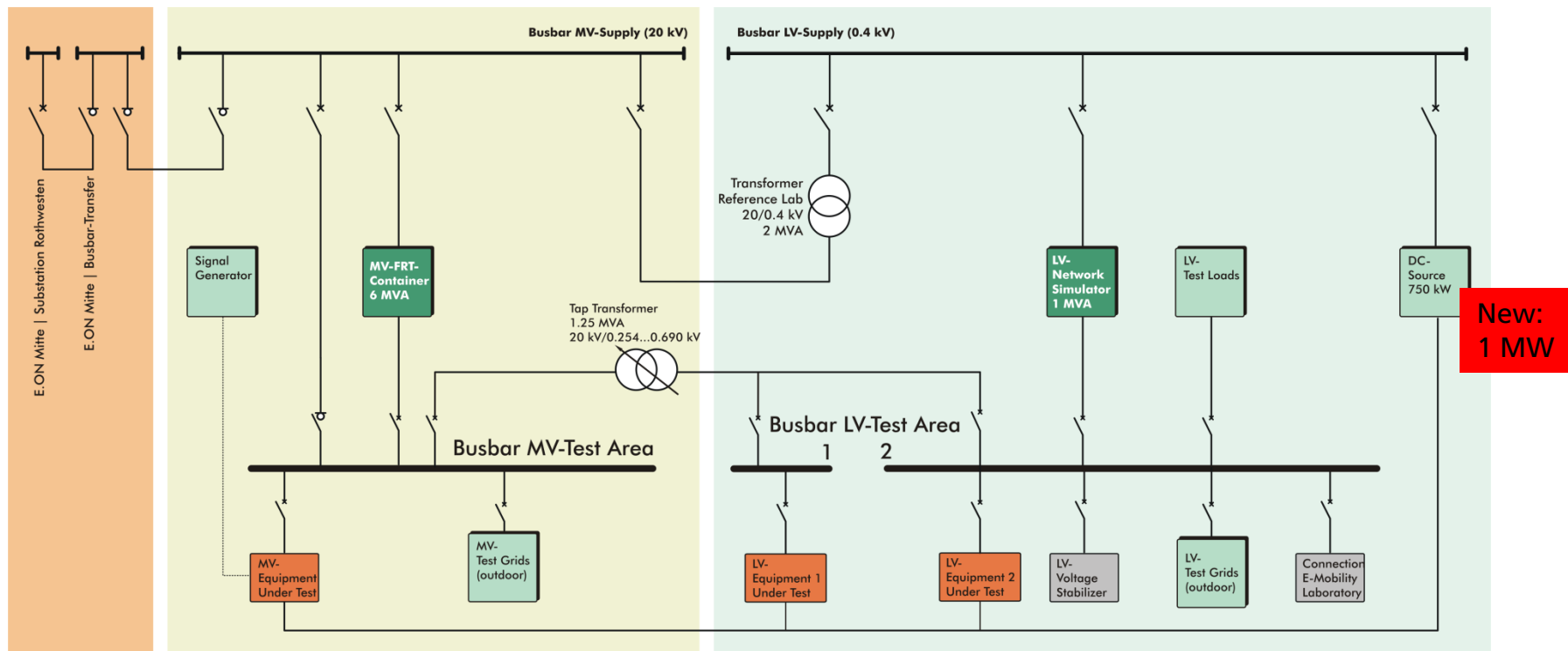


- Measurements of static and dynamic properties of the grid interface of generation units and plants
 - Low Voltage up to 1.25 MVA
 - Medium Voltage up to 6 MVA
- Bidirectional AC Supply up to 1 MVA
 - 100 – 900 V @ 650 A/ 100 – 450 V @ 1300 A, frequency range 45 – 65 Hz
- Controllable DC source up to 1 MVA
 - 1000V@(5*150+1*250) A, interconnection up to 4 kV

SysTec - Testing Laboratory for Grid Integration (PNI)

Electrical Set-up

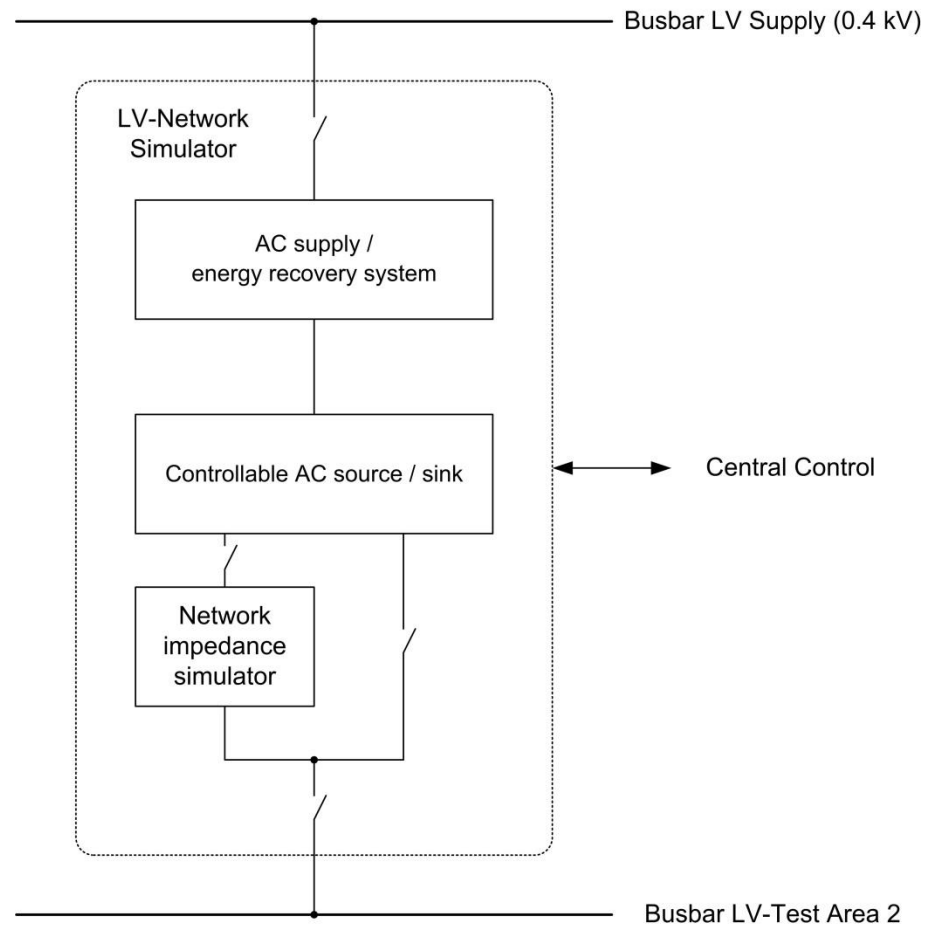
- Development- and Test Facility for quasi-stationary and dynamic testing of the grid interface of DER units and Systems (low- and medium voltage)



Testing Laboratory for Grid Integration (PNI)

Quasi-stationary Properties Low Voltage

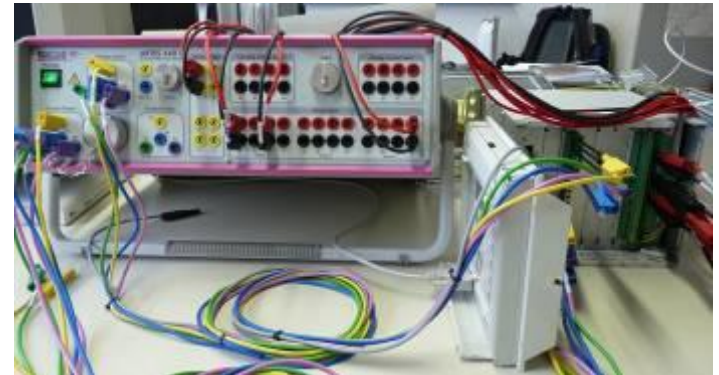
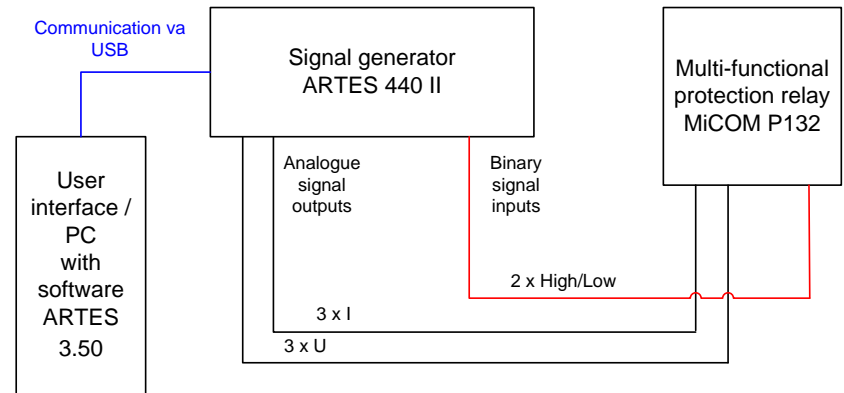
- Control of voltage and frequency at LV level
 - Connection of single DER units
 - Connection of LV grid sections
 - Interfaces for integration in a HIL System
- Bidirectional High Power AC Supply from Gustav Klein
 - Power Range ≤ 1 MVA
 - 100 – 900 V @ 650 A
 - 100 – 450 V @ 1300 A
 - Range of frequency 45 – 65 Hz



Testing Laboratory for Grid Integration (PNI)

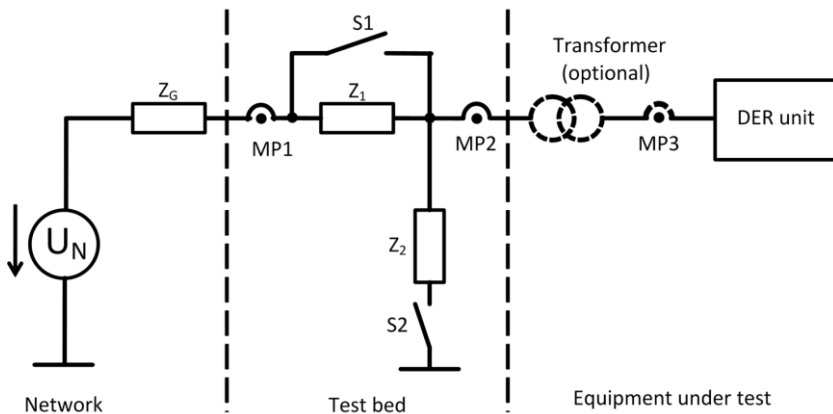
Quasi-stationary Properties Medium Voltage

- Utilization of signal generators
- Defined generation of signals given to the secondary technology of the developed and tested equipment
- No need for complex grid simulators to simulate quasi-stationary MV operating states



Testing Laboratory for Grid Integration (PNI) Dynamic Properties LV and MV (1)

- Rating of the mobile test system
 - Power range: 0.25 MVA to 6 MVA
 - Voltage levels: 10 kV, 20 kV
 - Frequency: 50 Hz
 - Short circuit power range: 80 MVA to 350 MVA
 - Ambient Temperature : -25 to $+60$ °C
 - Operation temperature: 0 to $+50$ °C
 - 40-foot sea container



Testing Laboratory for Grid Integration (PNI)

Dynamic Properties LV and MV (2)

■ Utilization of MV LVRT container also for testing of LV equipment

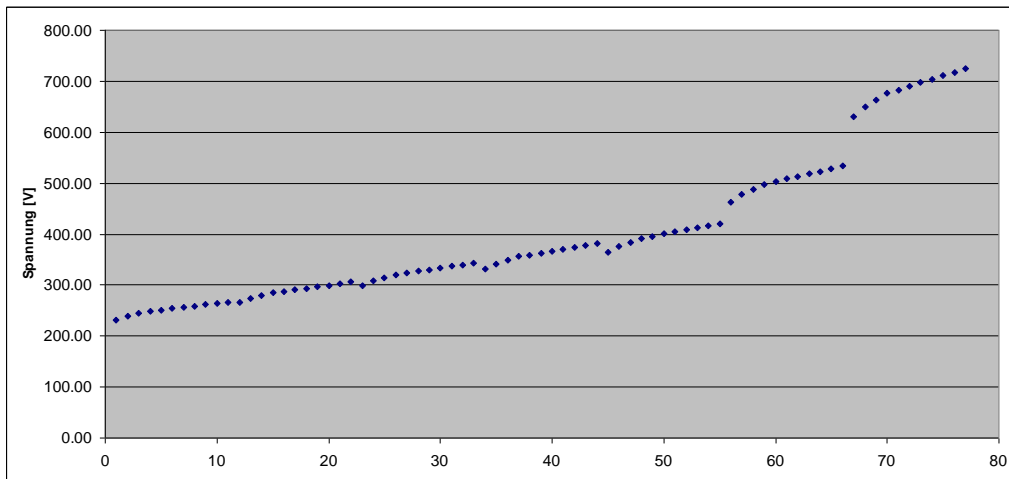
- Different tested LV equipment may have differing rated voltages

■ Tap transformer for coupling

- **Rated power:** 1.25 MVA

■ Voltage tapings

- 7 voltage steps at secondary side and primary tapings of $\pm 5 \cdot 1\%$
- 230 V – 725 V



Testing Laboratory for Grid Integration (PNI)

Lab facilities – DC source for supply of EUT

■ DC supply for equipment under test (EUT)

- PV inverters
- Batteries
- Fuel cells

■ Controllable DC source

- Magna Power Electronics MT Series V
- Modular set-up
 - 5 units of 150 kW (1000V @ 750 A)
 - 1 unit of 250 kW (1000V @ 250A)
- Variable parallel and serial interconnection possible (up to 4 kV)



Testing Laboratory for Grid Integration (PNI)

Central Control and Data Acquisition

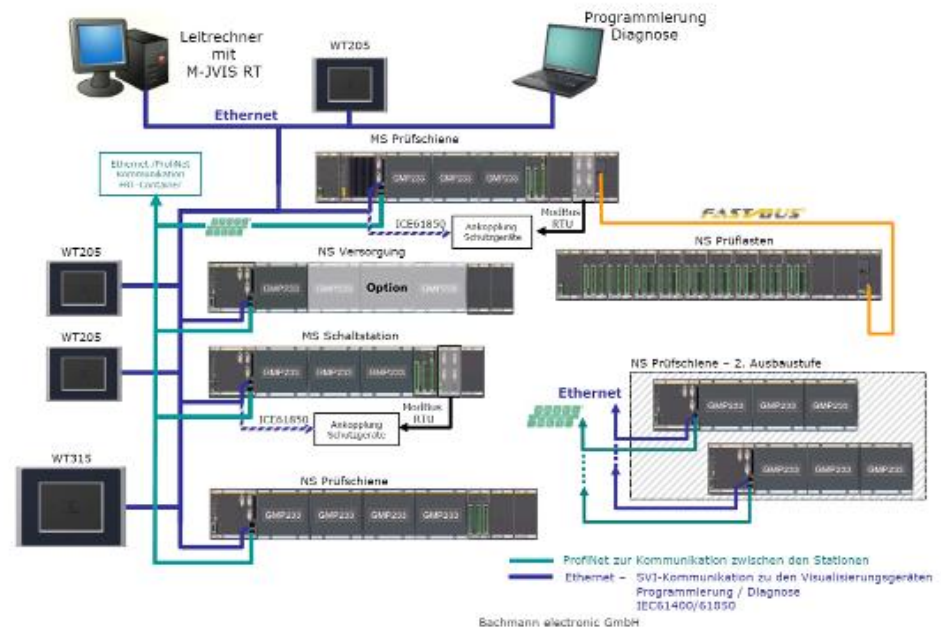
Control of the Facility from a central room

- Control of the MV switch gear via IEC 61850

Central Data acquisition

- Application of a new measurement module with extended power quality recording possibilities

Interface for the Integration of Matlab / Simulink Applications e.g. for Online-Simulations



Department Grid Technology and Integration: Services (Selection)

- Accredited testing of generation units and certification of generation plants according to grid connection guidelines
- Metrological examination of performance (tripping characteristic) of protection devices for distribution grid components
- Measurements of power quality and analysis of performance
- Investigation of new network control systems
- Investigation of network control characteristics of photo-voltaic systems, grid-integrated storage systems, biogas plants, CHP plants etc.
- Generation of defined network conditions in low voltage electricity networks
- Test of devices and components in a system context (in combination with power hardware in the loop systems)
- Modeling and simulation of grid characteristics of generation units and generation plants