



1 PV power plant.

2 Megawatt Laboratory at Fraunhofer ISE.

TESTLAB POWER ELECTRONICS

Renewable Power Generating Units (PGUs) play a crucial role in a stable and reliable electrical power grid. Their efficiency, quality and compliance with standards are decisive for their acceptance by investors and grid operators.

The TestLab Power Electronics is accredited to DIN EN ISO / IEC 17025 and offers a wide range of testing services to its customers. Our services include the characterization of various kinds of power electronic devices, such as PV inverters and Combined Heat and Power (CHP) generators up to several MW. Our modern lab equipment combined with our long-term experience allows us to test the compliance of PGUs with applicable standards and guidelines and measure their efficiency. In addition, we provide a professional assessment of the test results and give advice on how to make further improvements.

Furthermore, since detailed modeling and simulation of PGUs are mandatory today, we provide support in this field. We can simulate both single inverters and large-scale power plants.

Lab Equipment

- 1.4 MW PV simulator (max. 2,000 V / max. 1,760 A)
- "Low Voltage Ride Through" (LVRT) test facility up to 1 MVA
- medium-voltage connection (20 kV)
- 20 kV / 255 V – 1,120 kV / 1.25 MVA adjustable transformer
- 30 kW three-phase grid simulator

Field Test Equipment

- mobile 4.5 MVA LVRT test container
- 1 MWp ground-mounted PV array

Measurement Equipment

- high-precision power analyzers up to 5 kA / 1 kV
- 60 – 5,000 A current transducers

Simulation and Analysis Software

- MATLAB® / Simulink®, PLECS®
- PowerFactory
- evaluation tools for inverter models
- advanced analyses tools for harmonic and LVRT

Fraunhofer Institute for Solar Energy Systems ISE

Heidenhofstr. 2
79110 Freiburg, Germany

TestLab Power Electronics

Roland Singer
Phone +49 761 4588-5948

testlab-pe@ise.fraunhofer.de

www.ise.fraunhofer.de
www.testlab-pe.de



3



4



5

Measurements of Grid Conformity

In general, national and international grid connection guidelines (Germany, Italy, Spain, China, South Africa, etc.) require all power generators to contribute to the safety and stability of the power grid. Therefore, not only PV inverters and CHP systems, but all grid-connected generators must fulfill multiple requirements, such as:

- active power control
- reactive power control
- limits for harmonics and flicker
- "Low Voltage Ride Through" (LVRT)

The TestLab Power Electronics at Fraunhofer ISE represents an ideal infrastructure, with all of the required testing equipment for the compliance of PGUs to various guidelines. A specially designed LVRT test facility allows inverter tests up to 1 MVA with real shorts on the medium-voltage side and precise measurements.

Our test engineers regularly take part in specialist workshops and standardization committees. Therefore, we can offer first-hand expertise on standardization issues and guide our clients and partners through tests. In addition, we work with leading national and international certification agencies in the field of grid connection guidelines.

Based on our strong experience from the testing and characterization of PGUs, we also provide hardware and software support for the development of converters compliant with various guidelines.

Furthermore, the business area Energy Efficient Power Electronics at Fraunhofer ISE has access to outdoor facilities for the testing of PV inverters, CHP and other large-scale PGUs. These facilities include a direct medium-voltage point of connection, a 1 MWp PV generator, fast internet access and space for all kinds of devices and systems to be tested.

In addition, a mobile 4.5 MVA LVRT test container and a sophisticated, flexible measurement system allow us to carry out numerous R&D activities and grid conformity tests with various PGUs.

Efficiency Measurements

Measuring the overall efficiency of a PV inverter according to the EN 50530 includes the determination of:

- the conversion efficiency (power electronics circuit)
- the MPPT efficiency (accuracy of the inverter's Maximum Power Point Tracker)

In order to measure the efficiency of large PV inverters, we have developed an automatic measurement system. It includes a highly dynamic and controllable DC source as a PV array simulator. This makes it possible to simulate PV generators up to 1.4 MW both under static and dynamic irradiance conditions. In order to reach the greatest measurement accuracy, we use highly precise and calibrated power measurement devices.

Simulation Services

Computer simulations are helpful for the simulation of single PGUs and entire Power Generating Systems (PGS). For example, understanding the electrical active and reactive power flows within a large-scale PV power plant and evaluating the interaction between PV inverters for different types of grid connections are very important for the performance analysis.

Furthermore, dynamic PGU und PGS simulation models are required for grid connections in accordance with medium-voltage directives. Our team offers a wide range of simulation services for all these specific needs. These services include:

- performance analysis of power electronic circuits and control algorithms
- development of generic and non-generic inverter models for certification processes (in compliance with FGW-TG4, etc.)
- validation of inverter models
- simulation of PV power plants for certification processes
- even more detailed simulation of PV power plants for performance analysis and troubleshooting

Our team uses several simulation environments such as MATLAB® / Simulink®, PLECS®, and PowerFactory.

- 4 PV array simulators.
- 5 High current busbars (2,500 A).
- 6 Mobile 4.5 MVA LVRT test container.