

Distribution transformers are one of the most important and widest spread components of the power grid. To determine the state of health of distribution transformers typically, a series of tests comprising open-circuit tests, short-circuit tests, and partial discharge tests are required.

Traditional test setups—comprising rotating motor-generator (MG) sets—have a number of drawbacks and are slowly being replaced with voltage source inverter (VSI) technology.

Enerdrive, a power electronics control software company, was charged with the task of developing closed loop control software and of optimizing the filtering components of a 700kVA VSI to replace a traditional MG set. The key challenge was to reach very low levels of voltage THD and common mode currents with the smallest size filtering components.

enerdrive

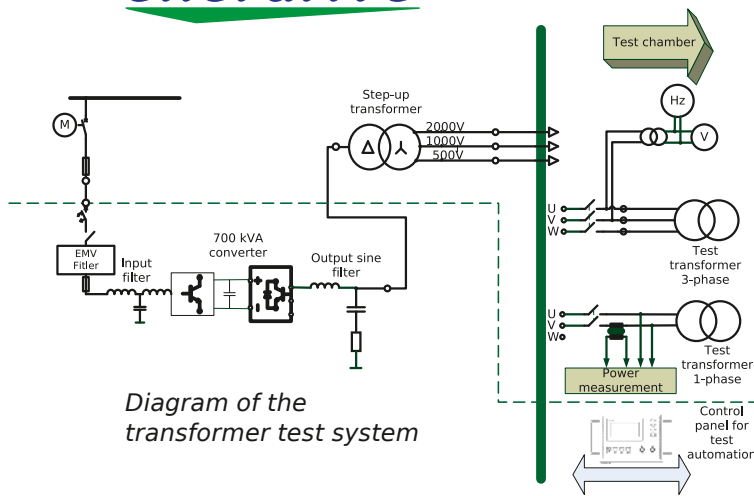


Diagram of the transformer test system

Typical distribution transformer

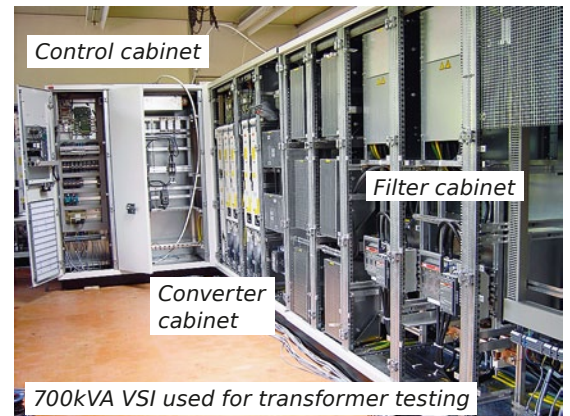


The VSI control has to be optimized to provide high quality waveforms to the device under test for:

- open-circuit test under nominal voltage,
- short-circuit test under nominal current, and
- partial discharge measurements with minimal interference from common mode currents.

Simultaneous optimization of the differential mode filter, common mode filter, the modulation algorithm and the closed-loop control is a challenging task.

When an OEM controller is connected to the **HIL⁴⁰⁰**, the simultaneous optimization of power electronics software and power electronics hardware is greatly simplified because the power hardware in the **HIL⁴⁰⁰** becomes as easy to handle as the control software.

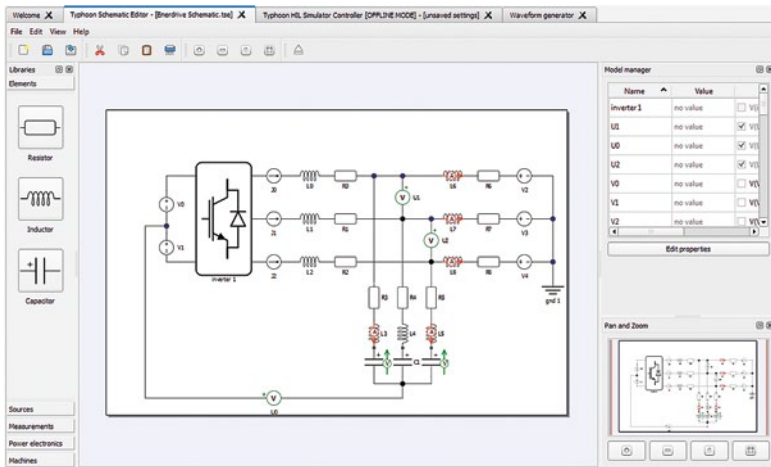


OEM controller of the 700kVA VSI converter

A setup comprising the **HIL⁴⁰⁰** and an OEM controller makes an ideal development environment which combines: real control signals, in real time, with "real hardware" which is as easy to operate as a software simulation package.

“**HIL**⁴⁰⁰ is a must have for every power electronics engineer”

Dr. Andreas Dittrich, CEO Enerdrive

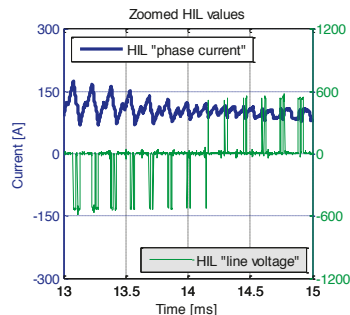
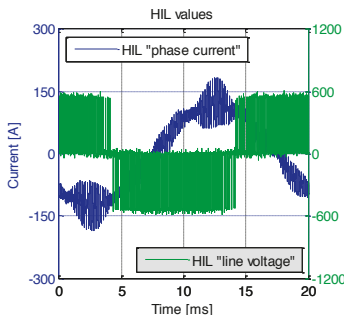
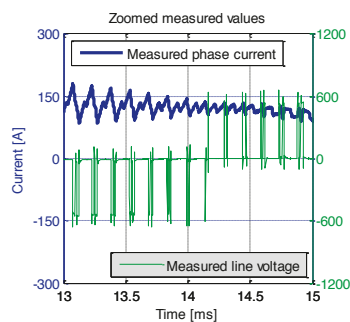
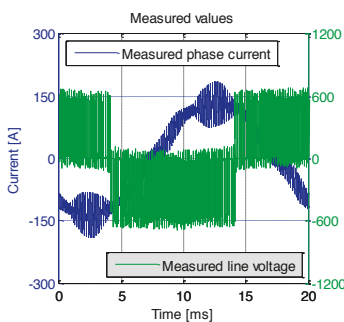
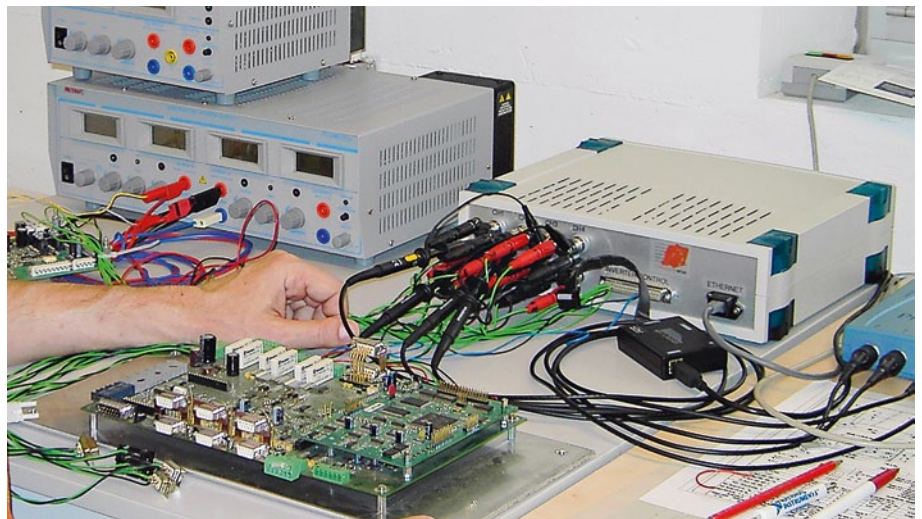


Typhoon **HIL** software tools provide an intuitive way to describe the power electronics hardware and to operate it inside the **HIL**⁴⁰⁰.

With **HIL**⁴⁰⁰ it is now possible to operate an OEM power electronics controller in the comfort of the office (figure below).

Furthermore, it is now possible to test the operating conditions that would be too time consuming, too expensive, or simply impractical to do in the laboratory.

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Measurements of inverter phase current and line voltage in the laboratory (top row graphs) match almost perfectly with the measurements from the setup with **HIL**⁴⁰⁰ in the office (bottom row graphs).

In both cases exactly the same OEM control software and hardware were used.

Thus, the **HIL**⁴⁰⁰ enables both physical and temporal decoupling of the power electronic software and hardware development.