RTDS Technologies

the world standard for real time digital power system simulation

Microgrid Simulation and Testing

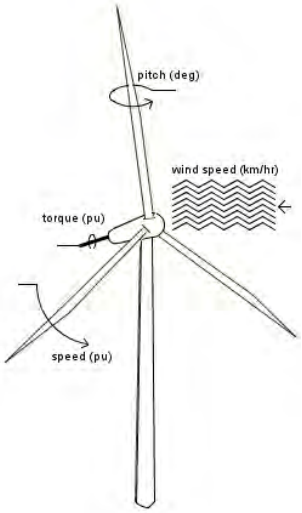
The increasing relevance of microgrids and the distributed energy resources that comprise them has generated a demand for detailed study tools and sophisticated hardware-in-the-loop test facilities to evaluate the operation of the associated control and power devices on the grid.

The RTDS® Simulator allows for detailed modeling of the power and control system components present in microgrids. The RTDS Simulator operates in real time, allowing the user to interface physical equipment with the simulated model in order to test and validate the operation of microgrid protection and control devices under realistic conditions.

Opportunities for microgrid studies using the RTDS Simulator include real time analysis of the impact of distributed energy resources on the grid voltage profile and stability, hardware-in-the-loop testing of microgrid control and protection devices, and power-hardware-in-the-loop testing of inverters, motors, generators, and transformers.

A wide variety of distributed energy resource (DER) models are available in the RSCAD model library

The development team at RTDS Technologies is always working on improving existing models and adding new models to RSCAD. Currently, the RSCAD model library includes the following:



Wind Turbines: RSCAD includes a vertical axis wind turbine model, which can be used in conjunction with other available components to model a full wind energy system. RSCAD also includes machine models, grid connection components, and reactive power compensation components, as well as control components for the modelling of pitch angle, reactive power, startup/shutdown, and other control schemes.

Machines: RSCAD includes wound rotor / doubly fed induction machine models, squirrel cage induction machines, and permanent magnet synchronous machine models.

Photovoltaics: RSCAD includes a solar PV panel model for which the user can define the module and array size. The control components library can be used to implement decoupled DQ-current control and other schemes, and includes a maximum power point tracking control model.

Fuel Cells: RSCAD includes a PEM type fuel cell model.

Storage: RSCAD includes a lithium ion battery model.

Pre-built and custom models for representing power electronic converters

RSCAD contains an entire component library dedicated to small timestep modeling—components which run at a smaller simulation timestep in order to represent high frequency switching and circuit dynamics. A key feature of these small timestep subnetworks is that the circuit and valve topology is user configurable.

RSCAD's small timestep VSC models can represent switching frequencies as high as ~40 kHz.

The RSCAD library also contains average models, which represent the steady state and transient behavior of converters without requiring a small timestep model. Average models are less computationally intensive and useful for cases in which a large number of converters must be simulated.

Simulate large distribution systems with Distribution Mode

RSCAD's Distribution Mode is capable of simulating distribution networks of over 1000 nodes in one tightly coupled area.

Distribution Mode was developed to accommodate the implementation of large feeder models made of up short lines and/or cables that are not long enough to allow the circuit to be separated into multiple subsystems. The component library available in Distribution Mode is a limited subset of the RSCAD modelling library, including sources, transformers, induction machines, pi-section transmission lines, renewable energy models, synchronous machines, and average models for power electronic converters. Distribution Mode has a full suite of input/output capabilities, allowing users to interface distribution-level protection and control devices in a closed loop with the simulation.

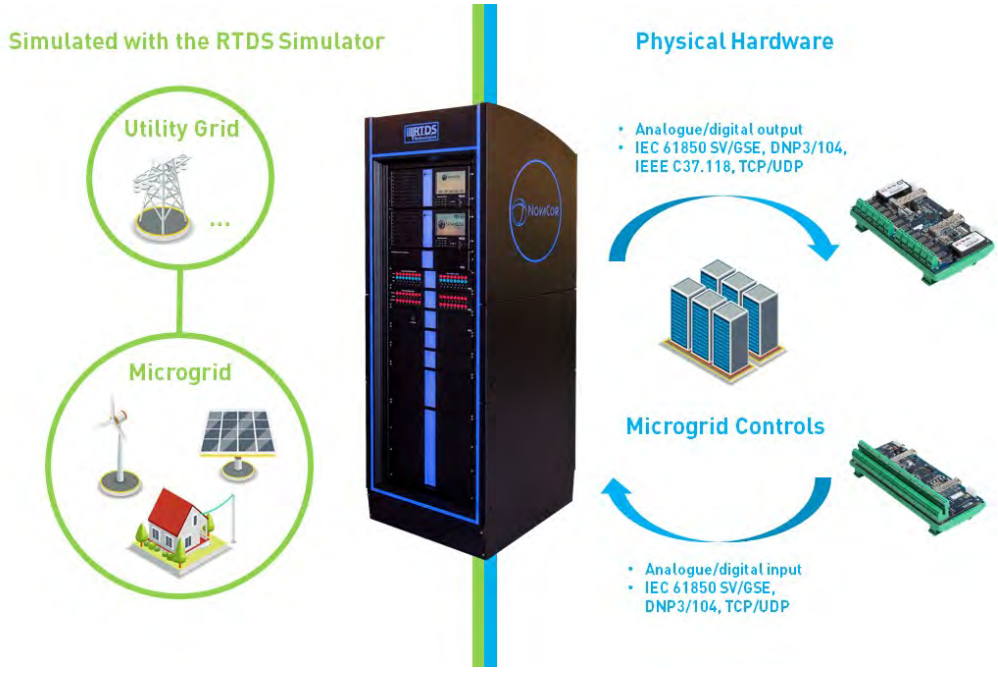
Closed-loop testing of microgrid control systems

The RTDS Simulator offers the most advanced and effective means available for the closed-loop testing of protection and control system equipment. Primary, secondary, and/or tertiary-level microgrid controllers can be interfaced with the real time simulation for hardware-in-the-loop testing.

Control systems developed in MATLAB/SIMULINK can also be imported into the real time simulation environment and interfaced with the simulation.

High level communication protocols: In addition to the conventional analogue and digital interface, the RTDS Simulator can be interfaced with external equipment via ethernet-based communication protocols. Available protocols include:

- DNP3 and IEC 60870-5-104 for SCADA applications
- MODBUS
- High-speed TCP/UDP
- IEC 61850 Sampled Values and GOOSE Messaging
- IEEE C37.118 for synchrophasor data



Power-hardware-in-the-loop testing for renewable energy hardware, batteries, and more

Power-hardware-in-the-loop (PHIL) simulation involves the real-time simulation environment exchanging power with real, physical power hardware, such as inverters, electric vehicles, batteries, motors, and loads.

When combined with a four-quadrant amplifier, the RTDS Simulator can be used in the PHIL context to test photovoltaic inverters, wind turbine generators, and batteries.

Learn more about PHIL simulation with the RTDS Simulator and watch our video at
www.rtds.com/applications/power-hardware-in-the-loop

100-150 Innovation Drive, Winnipeg, Canada R3T 2E1 • + 1 204 989 9700 • rtds@rtds.com