

Simulation and closed-loop testing with Distribution Systems

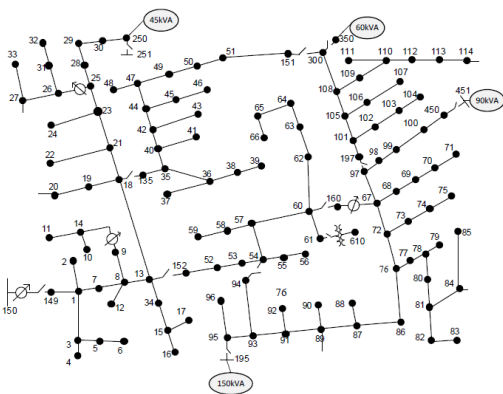
As the power industry shifts toward the grid of the future, distribution-level systems become both more relevant and more complex to control and operate. The RTDS® Simulator is used by electric utilities, protection and control equipment manufacturers, and learning/research institutions worldwide for distribution system studies and the closed-loop testing of distribution-level protection and control equipment. The controlled and flexible digital simulation environment remains a critical tool for the development, testing, and implementation of grid modernization principles and technologies.



Simulating distribution networks with the RTDS Simulator

The RTDS Simulator's Distribution Mode was developed to allow users to simulate large-scale distribution feeders in real time. Distribution Mode works in a substantially similar way to the normal simulation mode, but a few key differences allow

the user to model significantly more power system nodes in one tightly coupled area using Distribution Mode. Using this mode, feeders of over 1000 single-phase nodes can be simulated on one RTDS Simulator rack or chassis.



The IEEE 123 Node Test Feeder has been modeled on the RTDS Simulator with DERs

Distribution Mode relies on the feeder being radial in structure, which reduces the computational burden of solving the network in real time due to the highly sparse nature of the network's admittance matrix. Also, the simulation timestep for Distribution Mode is in the range of 150-200 microseconds to provide more time for calculating the network solution. These factors allow a vastly larger number of power system nodes to be modelled in one tightly coupled subsystem.

The component library available in Distribution Mode is a limited subset of the RTDS Simulator's modelling library. Among the components available are sources, transformers, induction machines, pi-section transmission lines, renewable energy models, and the synchronous machine model (e.g. diesel generator, gas turbine, etc.). Fully-switched models for power electronics are

not available for use in Distribution Mode—instead, average models are available to represent the steady state and transient behavior of converters in a computationally efficient manner.

Closed-loop testing of distribution system protection and control equipment

The introduction of Distribution Mode allows users to interface Volt-VAR controllers, load shedding and balancing schemes, multi-level microgrid control, SCADA systems, and other protection and control devices with a simulated large-scale distribution feeder in the real time simulation environment. The controlled and flexible environment of the digital simulation allows devices to be subjected to virtually all possible faults and operating conditions. The closed-loop interaction of the protection and control equipment with the network model provides insight on both the performance of the device(s) and its effect on the power system.



System requirements for using Distribution Mode

Distribution Mode is available in RSCAD Version 5 and above. It can be run on NovaCor chassis or RTDS Simulator racks containing PB5 Processor Cards (earlier generations of processing hardware cannot be used).