TESTING ELECTRIC RAILWAY SYSTEMS WITH THE RTDS® SIMULATOR

RTDS Technologies
AMETEK®

Real-time simulation and hardware-in-the-loop testing are applied for de-risking a wide variety of devices and schemes related to electrical energy – including electrified transportation systems. Electrified railways have unique network characteristics and challenges. The RTDS Simulator has various features and capabilities for modelling railway systems and testing the control, protection, and communications systems required to keep them running reliably and efficiently.

HIGH-ACCURACY RAILWAY AND TRACTION SYSTEM MODELLING

The RTDS Simulator runs an electromagnetic transient (EMT) simulation of the railway system and the surrounding grid. This provides a detailed representation of the dynamic and transient behaviour of the system, including transient phenomena.

High-speed or metro-style systems can be represented – system topology and parameters are easily adjusted using RSCAD® FX (our user-friendly simulation software).

RSCAD FX has a diverse component library for modelling single- and multi-phase AC circuits as well as DC systems.

- Model propulsion drive systems, including machines and power electronics, and their control (FOC, VVVF, etc.)
- Represent tractive and (regenerative) braking modes of operation
- Represent the movement of train sets, including train timetables
- Model lines, feeders, substations, section posts, autotransformers, and other typical components
- Model the interface between the railway and the transmission system, including Scott transformers and other topologies
- Diverse modelling library for single- and multi-phase circuits and DC systems

RSCAD FX includes a fully-documented sample case demonstrating electrified railway simulation, including both detailed and average models of train sets.
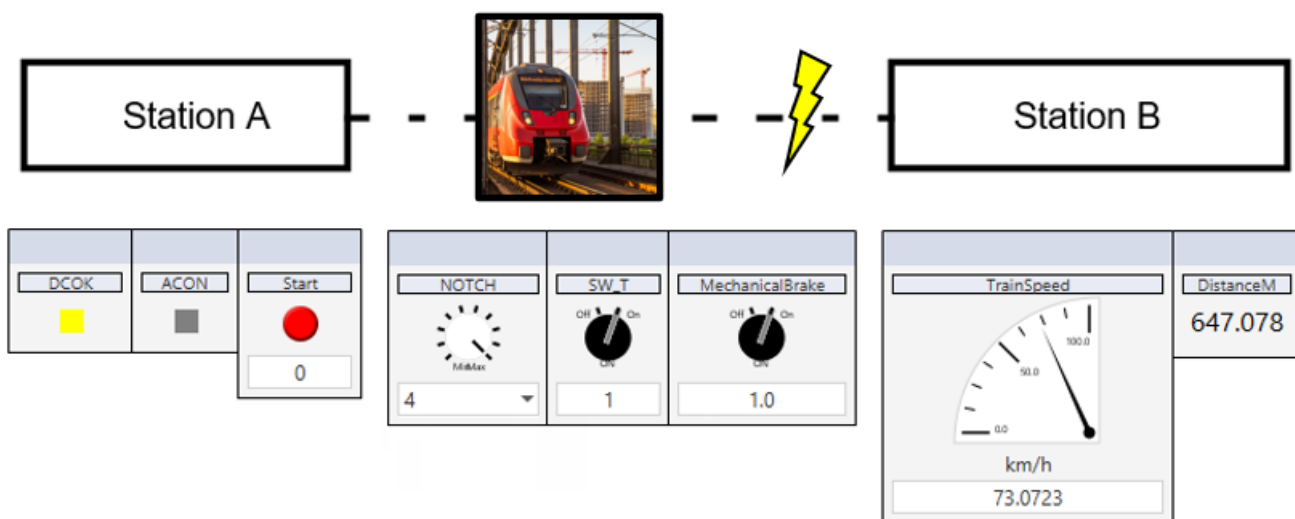
Running a real-time traction simulation in the RSCAD FX operator's console

YOUR WORLD IN REAL TIME.
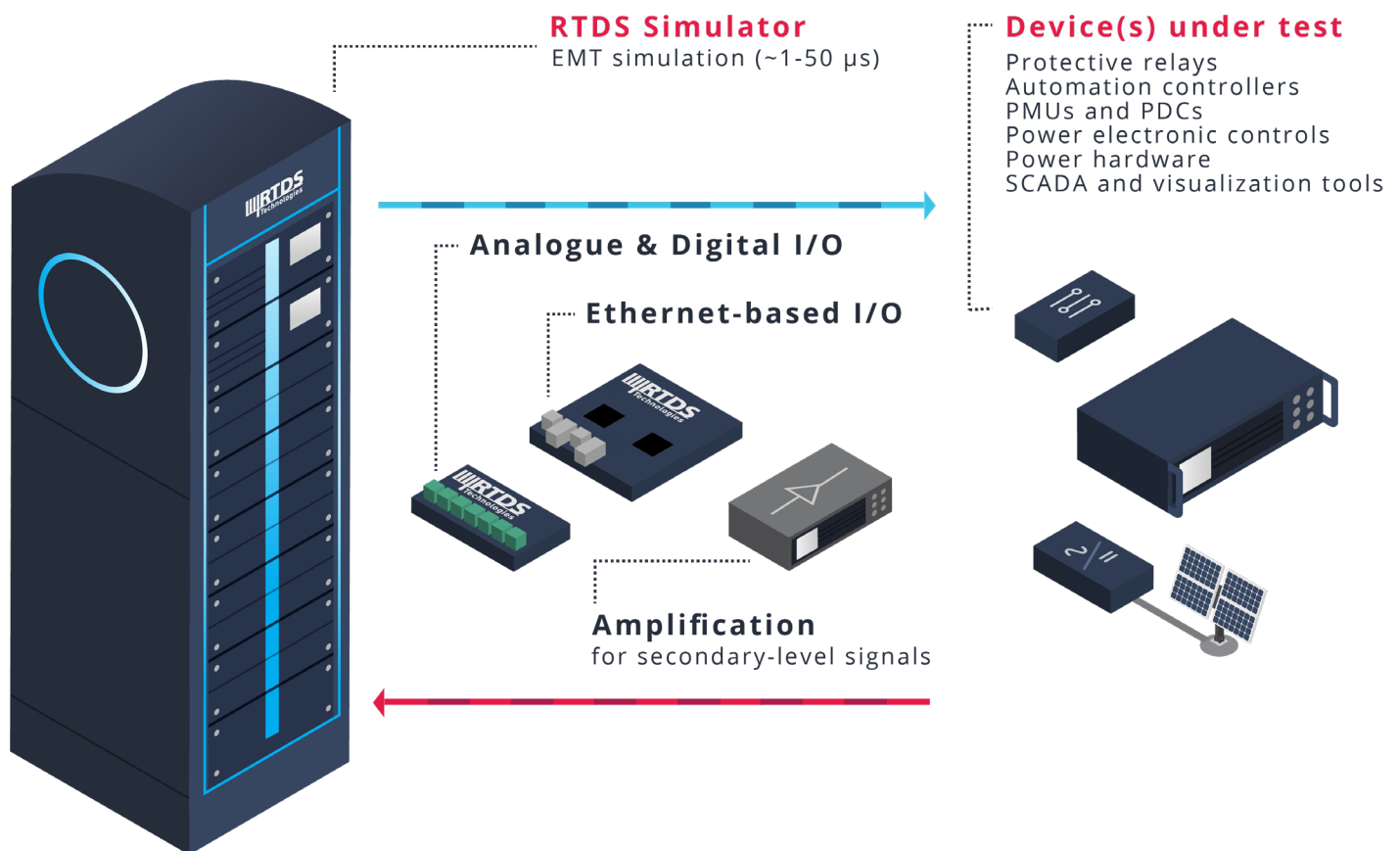RTDS.COM

INDUSTRY-LEADING POWER ELECTRONICS SIMULATION

The RTDS Simulator's Universal Converter Model (UCM) allows for efficient, stable, and accurate simulation of power electronic converters. The UCM is available in several topologies including two-level, three-level T-type and NPC, three-level flying capacitor, boost and buck, and dual-active-bridge.

- **Highly efficient:** Represent and test PWM schemes switching in the ~10 kHz range in the main timestep environment (25-50 μs). This eliminates the need for interfacing to a smaller-timestep environment and means several converters can be modelled in full detail on relatively limited simulation hardware.
- **Flexible and capable:** Running the UCM at a smaller timestep of <10 μs allows for testing schemes with switching frequencies as high as 200 kHz.

TESTING CONTROL AND PROTECTION SYSTEMS FOR RAILWAYS

Real-time simulation allows for hardware-in-the-loop (HIL) testing – connecting external control, protection, and/or power devices to the simulated network in a closed loop. The RTDS Simulator can include I/O cards for interfacing external traction control and protection systems, from scalar motor control to Scott transformer differential protection.

- **Analogue and digital I/O** including digital inputs sampling at 10 ns
- **Communication-based I/O** including MODBUS, generic TCP/UDP socket communication, DNP3/IEC 104, IEC 61850, and more

RTDS Simulator
EMT simulation (~1-50 μs)

Device(s) under test
Protective relays
Automation controllers
PMUs and PDCs
Power electronic controls
Power hardware
SCADA and visualization tools

Analogue & Digital I/O

Ethernet-based I/O

Amplification
for secondary-level signals

Hardware-in-the-loop testing with the RTDS® Simulator

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