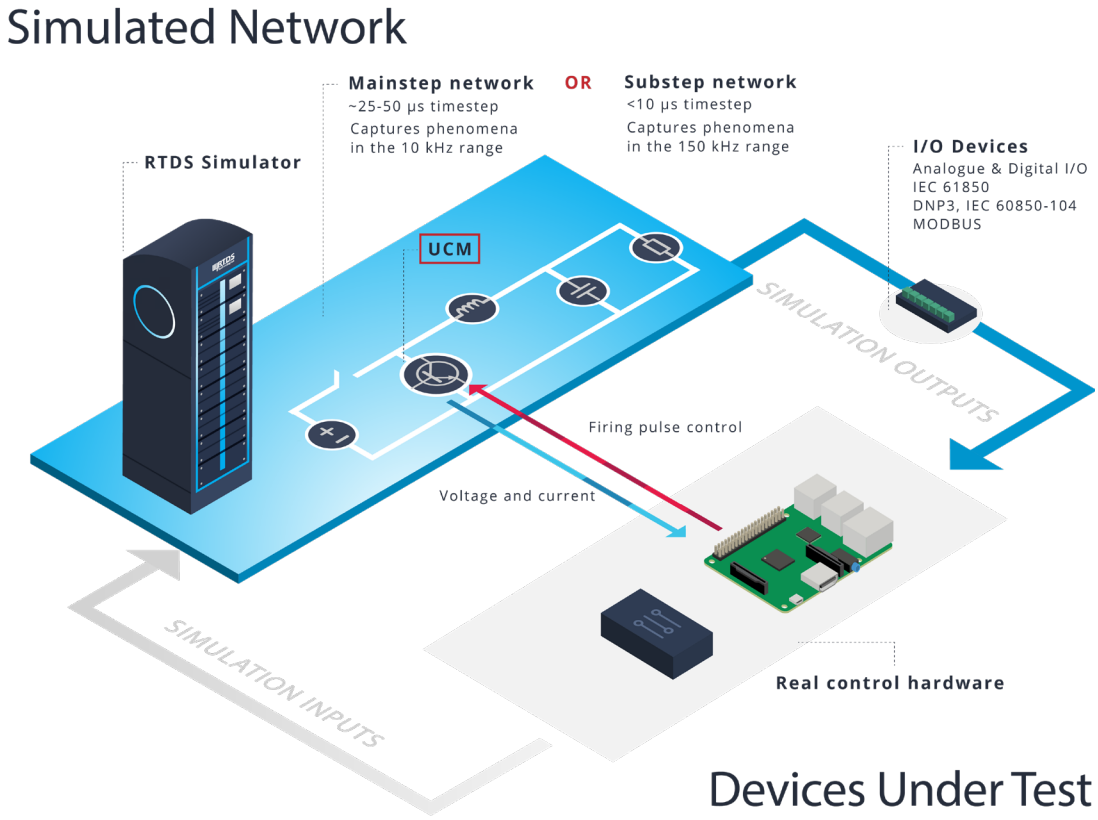
MODELLING

UNIVERSAL CONVERTER MODEL: INDUSTRY LEADING REAL-TIME POWER ELECTRONICS SIMULATION

RTDS Technologies
AMETEK

Small simulation timesteps are normally required to represent power electronics-based schemes in detail. For the first time ever, the RTDS® Simulator's Universal Converter Model (UCM) enables the simulation of high frequency switching and circuit dynamics of converters in the Main Timestep environment. Furthermore, in the Substep environment, the UCM achieves unprecedented VSC switching frequencies while maintaining accuracy, fidelity, and flexibility. The UCM runs directly on the RTDS Simulator's central processing hardware, without the need for an auxiliary FPGA.



Hardware-in-the-loop testing for converter controls with the Universal Converter Model

WHAT IS THE UNIVERSAL CONVERTER MODEL?

The UCM was developed to overcome many of the challenges associated with real-time power electronics modelling. The UCM:

- Performs identically to interpolation-triggered models
- Can be run in either the Mainstep and Substep simulation environments depending on desired switching frequency
- Is tightly coupled with the surrounding network
- Has three different input options which govern the level of granularity in the model's output

THE UCM IS CURRENTLY AVAILABLE FOR TWO-LEVEL, NPC, T-TYPE, BOOST, BUCK, DUAL ACTIVE BRIDGE, AND FLYING CAPACITOR TOPOLOGIES.

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THREE INPUT OPTIONS FOR FLEXIBILITY IN DETAIL AND COMPUTATIONAL BURDEN

Modulation Waveform

Mainstep and Substep (~1-50 µs)
The converter model receives a sine wave for modulation. The result is similar to our existing average value models, with some performance improvements, including improved representation of blocked-deblocked transitions.

Regular Firing Pulse

Substep only (≤10 µs)
The converter model reads firing pulses once per timestep. Performance is similar to our existing resistively-switched Substep converter models with some improvements.

Improved Firing

Mainstep and Substep (~1-50 µs)
The converter model captures firing pulses at a high resolution (10 ns) and enables multiple on/off transitions within each timestep. Offers significantly improved performance, including improved representation of characteristic harmonics and reduced non-characteristic harmonics.

CAPTURE PHENOMENA IN THE ~150 KHZ RANGE

With the Improved Firing input option in the Substep environment, the UCM supports a cutoff frequency of ~150 kHz. The UCM is unique in that it can represent high-frequency waveform content without sacrificing accuracy or numerical stability.

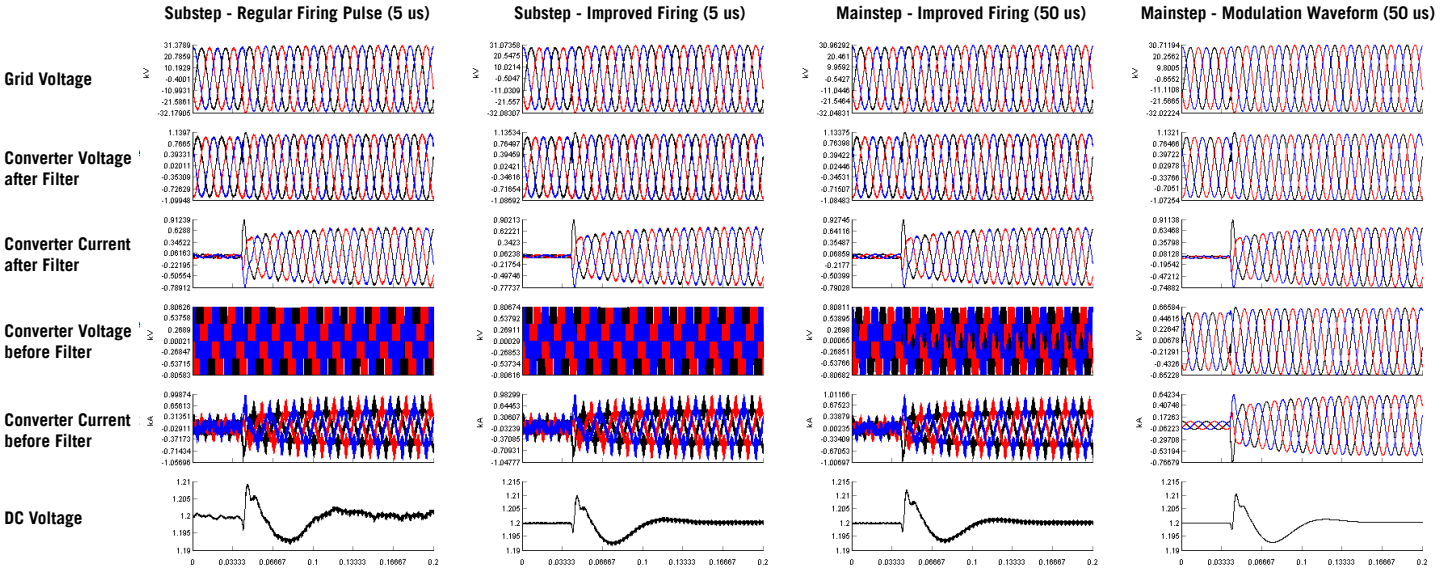
The UCM is not decoupled from the surrounding network at the DC bus. When converter models are decoupled, instability can occur if the simulation timestep is not reduced to the hundreds of nanoseconds range. Because the UCM is not decoupled, such constraints are not placed on the timestep size.

DETAILED POWER ELECTRONICS REPRESENTATION AT 25-50 µS FOR THE FIRST TIME

When using Improved Firing input in the Mainstep environment, the UCM supports a cutoff frequency of ~10 kHz. Large-scale renewable applications with 2-3 kHz switching frequencies can be represented with full switching detail, including main characteristic harmonics, in the Mainstep environment. The UCM enables hardware-in-the-loop testing of low-level converter controls (such as PWM schemes) at 25-50 µs timesteps.

2-LEVEL UCM PERFORMANCE - STATCOM APPLICATION

These graphs from RSCAD FX show the advantage of the UCM's Improved Firing input in the Mainstep environment.



LEARN MORE ABOUT THE UNIVERSAL CONVERTER MODEL AND POWER ELECTRONICS SIMULATION AT RTDS.COM/UCM

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