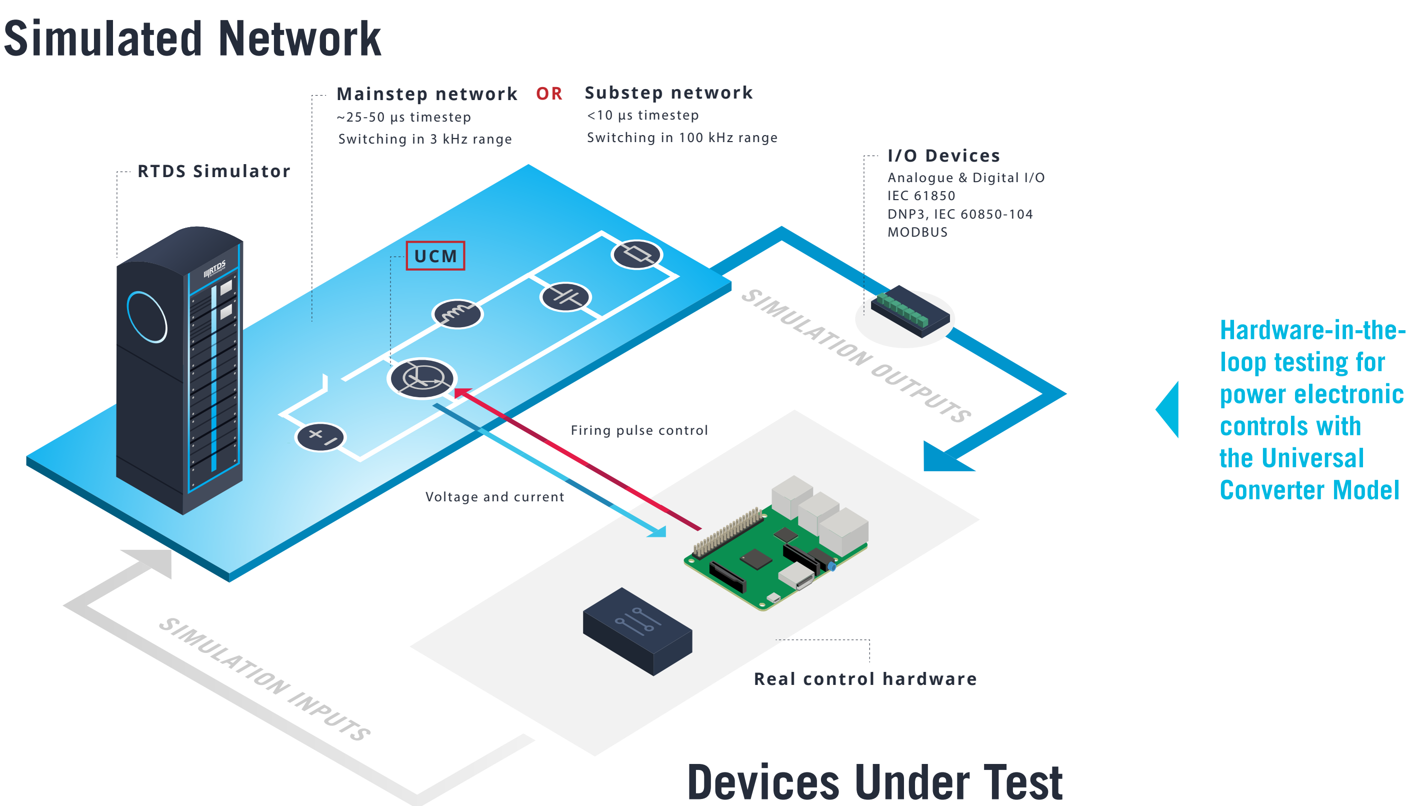
MODELLING

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

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.




## 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:

- Models switch ON/OFF statuses as switched resistances instead of L/C discrete circuits
- Utilizes our proprietary predictive switching algorithm to achieve embedded resistive switching
- Can be run in both the Mainstep and Substep simulation environments
- 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, AND FLYING CAPACITOR CONVERTER TOPOLOGIES.

## 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.

## SWITCHING FREQUENCIES OF OVER 100 kHz

With the Improved Firing input option in the Substep environment, the UCM can model switching at over 100 kHz. The UCM is unique in that it maintains this high switching frequency without sacrificing accuracy or numerical stability. The UCM uses a resistive switching algorithm rather than a L/C representation, which yields more accurate results with less noise.

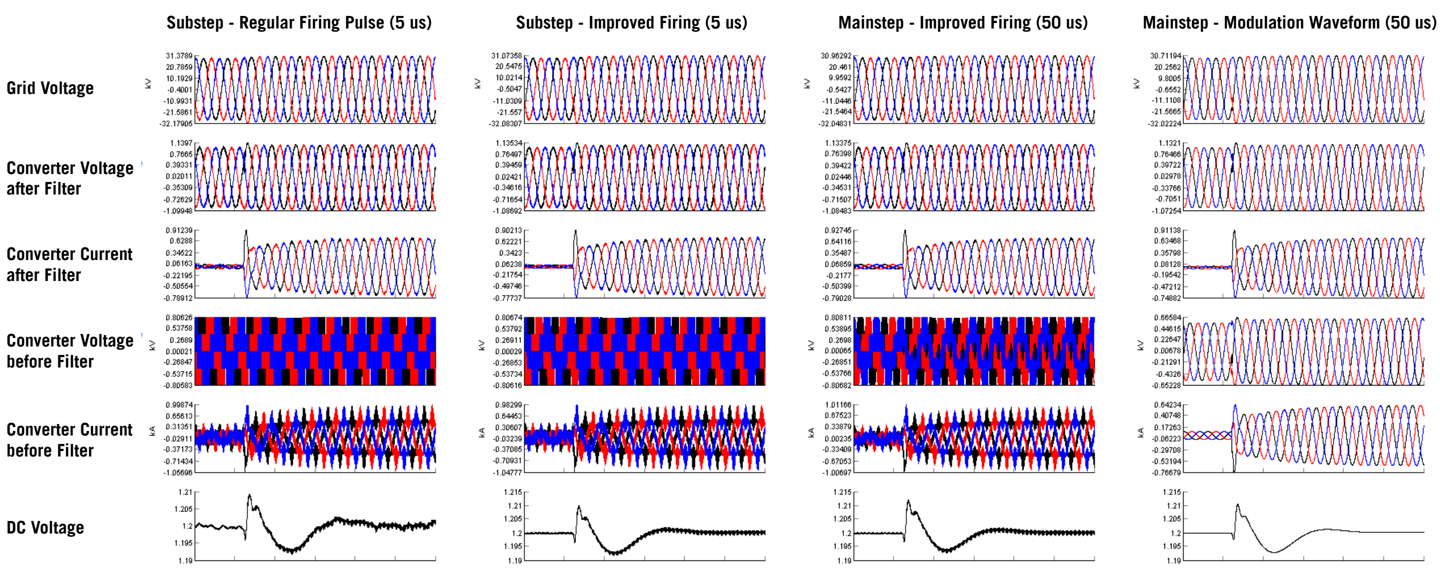
The UCM is not decoupled from the surrounding network at the DC bus. When converter models are decoupled, instability can occur if the simulation timestep is not reduced to the hundreds of nanoseconds range. Because the UCM is not decoupled, such constraints are not placed on the timestep size.

## DETAILED POWER ELECTRONICS REPRESENTATION AT 25-50 µS

When using Improved Firing input in the Mainstep environment, the UCM can be switched in the 10 kHz range. This is the first time that full switching converter models – rather than average value representations – can be run in the Mainstep environment, allowing low-level converter controls (such as PWM schemes) to be tested at 25-50 µs.

In this case, the UCM has a very low associated computational burden. Simulators with a single licensed core can now represent several two- and three-level converters in detail, including characteristic harmonic simulation, for the first time.

## 2-LEVEL UCM PERFORMANCE - STATCOM APPLICATION




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

150 Innovation Drive, Winnipeg, Canada R3T 2E1 • + 1 204-989-9700