StarSim FPGA Circuit RonRoff Solver

For running power electronics models based on RonRoff modeling
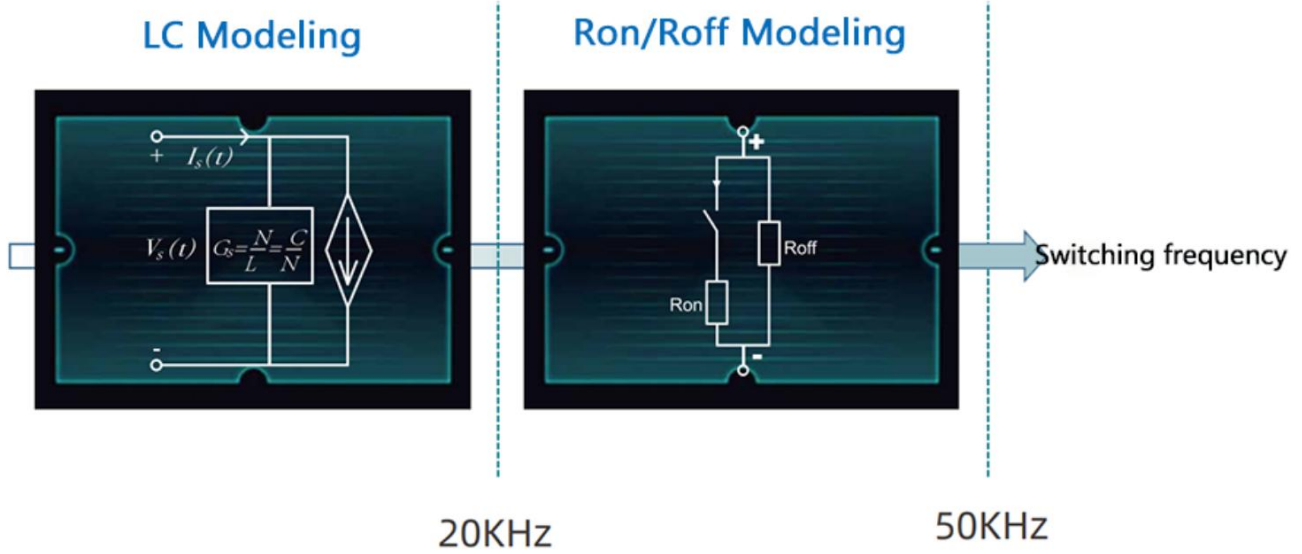
StarSim FPGA Circuit RonRoff Solver

StarSim FPGA Circuit RonRoff Solver is a license software independently developed by ModelingTech, which supports users to simulate power electronic switches in the form of RonRoff (large and small resistors), and it needs to be used in conjunction with StarSim FPGA Circuit Solver (LC Solver).

The necessity of RonRoff modeling for high switching frequency applications
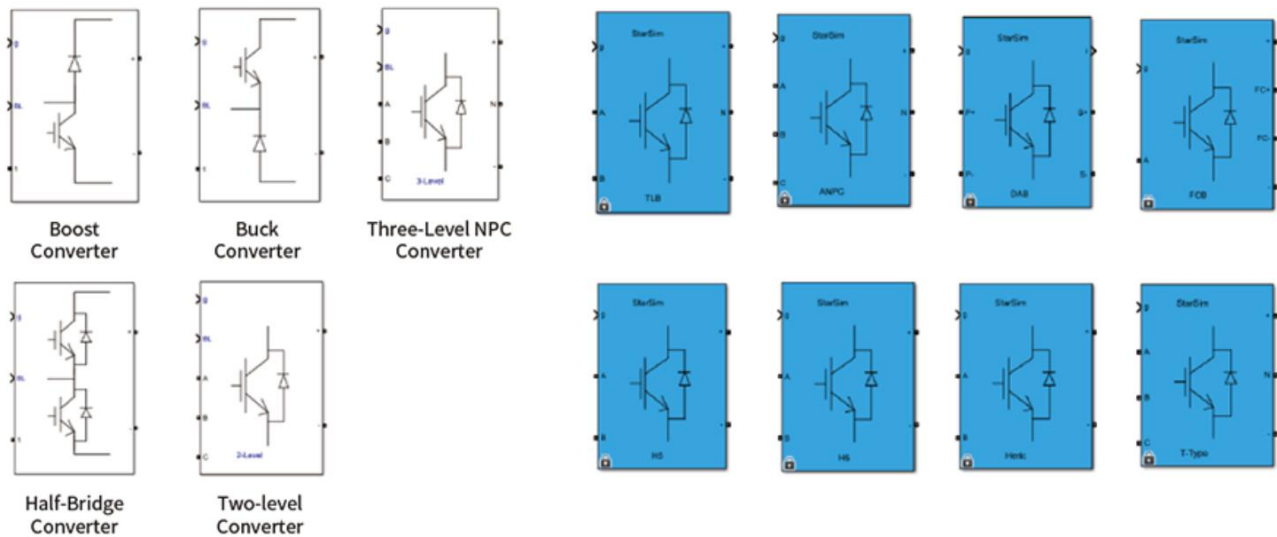
RonRoff modeling means that the closed switch is modeled as a small resistance, the open switch is modeled as a large resistor. It is a classic switch modeling method used in offline electromagnetic transient simulation software. With RonRoff modeling, the corresponding resistor values are switched when the switch state changes, so that when the switches in the power electronic converter bridge are frequently turned on and off, the admittance matrix of the system is constantly changing; this is very challenging for simulation based on FPGA.

The classical switching LC modeling approach has a very good advantage that no matter how the switch state changes, only the injection current calculation changes while the system admittance matrix remains unchanged. However, the limitation is that since the switch is modelled with an energy storage element (inductor or capacitor), the energy stored in the inductor or capacitor is easily lost when the switch state is changed, resulting in spurious power loss. When the switching frequency is less than 20 kHz, in general, the switching loss can be reduced with a proper setting of Gs and the switch-off initial voltage (Vs_off_init), and a better simulation result can be achieved. However, when PWM frequencies are higher than 20 kHz, it is often difficult to achieve good results with LC modeling.

For this reason, ModelingTech has introduced a hybrid simulation method of RonRoff and LC modeling. For low switching frequency topologies, users can use LC modeling, for high switching frequency topologies, users can choose the RonRoff modeling method to achieve better simulation results.

LC Modeling

$$G_s = \frac{N}{L} = \frac{C}{N}$$

$V_s(t)$, $I_s(t)$

Ron/Roff Modeling

Roff

Ron

Switching frequency

20KHz

50KHz

Support inverter topologies

Boost Converter

Buck Converter

Three-Level NPC Converter

Half-Bridge Converter

Two-level Converter

TLB

ANPC

DAB

FCB

H5

H6

Henk

T-Type

Application Scenarios

Renewable Energy

Wind Power Converter Testing

PV Inverter Testing

Multiple PCS Testing

Power System& Micro-grid

Microgrid Research

Green Hydrogen Microgrid Simulation

Renewable Energy Farm Simulation

Power Hardware in the Loop Testing

Multi-level System

Modular Multi-level Converter Simulation

High Voltage Converter(HVC) Simulation

Static Var Generation(SVG) Simulation

Electrified Transportation

Electric Motor Drive Controller Testing

Traction Motor Testing