Simscape™ Electrical™ Release Notes

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The MathWorks, Inc.
3 Apple Hill Drive
Natick, MA 01760-2098

Simscape™ Electrical™ Release Notes

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R2018b

Version: 7.0

New Features

Bug Fixes

Compatibility Considerations

Simscape Electronics and Simscape Power Systems combined into Simscape Electrical

Simscape Electrical is a new product that includes the modeling, simulation, and analysis technologies previously contained in Simscape Electronics™ (formerly SimElectronics®) and Simscape Power Systems™ (formerly SimPowerSystems™).

Find the top-level Simscape Electrical block library, now named **Electrical**, under **Simscape** in the Simulink® Library Browser. It contains three sublibraries: **Electronics and Mechatronics**, **Power Systems**, and **Specialized Power Systems**. To open the top level-block library, at the MATLAB® command prompt, enter `simscapeelectrical`.

To access release notes for prior releases of Simscape Electronics and Simscape Power Systems, see:

- Simscape Electronics Release Notes
- Simscape Power Systems Release Notes

Electronics and Mechatronics

SPICE Conversion Assistant: Convert SPICE models to Simscape components

The new SPICE conversion assistant allows you to convert SPICE netlist files into equivalent Simscape component files. For more information, see “Converting a SPICE Netlist to Simscape Blocks”.

FEM-Parameterized PMSM Flux Parameterization: Specify flux linkage in polar or Cartesian coordinates

The FEM-Parameterized PMSM block now has additional parameterization options:

- You can use polar coordinates, rather than `id` and `iq`, to tabulate fluxes
- The block accepts flux tabulation options used by Motor-CAD, as well as tabulated iron losses

Servomotor Block Loss Parameterization: Tabulate losses and efficiency as a function of speed, torque, and DC supply voltage

The Servomotor block now has additional parameterization options that let you tabulate losses and efficiency as a function of speed, torque, and DC supply voltage. Previously, you could tabulate losses and efficiency only as a function of speed and torque. See the block reference page for details.

Battery Characteristics Visualization: Plot voltage-charge characteristics for battery model parameter values

A new quick plot feature lets you visualize the voltage-charge characteristics for the battery model parameter values. To plot the characteristics, right-click a Battery or Battery (Table-Based) block in your model and, from the context menu, select **Electrical > Basic characteristics**. The software automatically computes a set of bias conditions, based on the block parameter values, and opens a figure window containing a plot of no-load voltage versus the state-of-charge (SOC) for the block. For more information, see “Plot Basic Characteristics for Battery Blocks”.

Peltier Device Block: Model conversion between electrical and thermal energy

The Peltier Device is a new block in the Sources library that lets you convert electrical energy into thermal energy and vice-versa.

elec_getNodeDvDtSummary and elec_getNodeDvDtTimeSeries Functions: Calculate derivatives of terminal voltages with respect to time

Checking terminal voltage derivatives with respect to time (dv/dt) helps ensure that all devices operate within their safe operating areas. Two new functions let you calculate voltage derivatives, based on logged simulation data, for block ports (terminals) that belong to the electrical domain:

- The `elec_getNodeDvDtSummary` function returns a three-column MATLAB table. The first column lists the applicable logging nodes, the second column lists the corresponding electrical terminals, and the third column lists the maximum absolute value of dv/dt for each terminal, in V/s.
- The `elec_getNodeDvDtTimeSeries` function returns a four-column MATLAB table. The first column lists the applicable logging nodes and the second column lists the corresponding electrical terminals. The third and fourth columns list the time-series data of terminal voltages, in V, and corresponding dv/dt values, in V/s, for these electrical terminals.

To use these functions, you have to enable simulation data logging and run the simulation. For more information, see Data Logging.

Featured Examples

New examples in this release are:

- “Use of Peltier Device as Thermoelectric Cooler”
- “Conducted Emission of a Buck Converter”

Power Systems

Single-Phase Permanent Magnet Synchronous Motor Block: Model a single-phase PMSM with a squirrel-cage rotor

You can parameterize the Single-Phase Permanent Magnet Synchronous Motor (PMSM) block by specifying the flux linkage or the back electromotive force (BEMF) constant.

Multiphase Switched Reluctance Machines: Model low-current four- and five-phase SRMs

The Four-Phase Switched Reluctance Machine and Five-Phase Switched Reluctance Machine blocks represent electric motors that are driven by magnetic-reluctance torque. As is typical for reluctance machines, power is delivered to the stator rather than to the rotor.

You can parameterize either switched reluctance machine (SRM) block by specifying the saturated flux linkage, aligned inductance, and unaligned inductance or by specifying the current and angle vectors and the flux linkage matrix.

For examples that include these multiphase switched reluctance machines, see:

- “Four-Phase Switched Reluctance Machine Control”
- “Five-Phase Switched Reluctance Machine Control”

One-Quadrant Chopper Block: Convert from fixed to variable DC voltage bidirectionally

The One-Quadrant Chopper block is capable of bidirectional power flow between two connected electrical networks.

For an example that includes the One-Quadrant Chopper block, see “One-Quadrant Chopper Control”.

Average-Value Converters: Model DC-DC semiconductor converters that are suitable for real-time simulation

The Average-Value Chopper and Average-Value DC-DC Converter blocks allow you to convert DC voltages without switching. The relatively low computational cost of average-value converters makes them more suitable for real-time simulation than high-frequency semiconductor converter models.

For examples that include these average-value converter blocks, see:

- “Average-Value Chopper Control”
- “Average-Value DC-DC Converter Control”

Run-Time Parameter Support for All Machine Blocks: Speed up simulation tasks and modify component parameter values without regenerating C code

You can now modify certain block parameters for all electric machine blocks between simulation runs without regenerating C code or triggering the diagram update.

For more information, see Run-Time Parameters.

Single-Phase Asynchronous Machine Blocks: Model a single-phase ASM using fundamental or fundamental SI parameterization

Both the Single-Phase Asynchronous Machine (fundamental) and Single-Phase Asynchronous Machine (fundamental, SI) blocks represent a single-phase asynchronous machine with a squirrel cage rotor that you parameterize using fundamental per-unit or SI parameters, respectively. Choose between these four variants for either block:

- Split-phase
- Capacitor-start
- Capacitor-start-capacitor-run
- Main and auxiliary windings

For examples that include these single-phase ASM blocks, see:

- “Single-Phase Asynchronous Machine Direct Torque Control”
- “Single-Phase Asynchronous Machine Field-Oriented Control”

Asynchronous Machine Saturation: Include magnetic saturation in three-phase ASMs using open circuit lookup tables

Model magnetic saturation using lookup tables of per-unit no-load stator current saturation and the per-unit terminal voltage saturation data for these asynchronous machine (ASM) blocks:

- Asynchronous Machine Squirrel Cage (fundamental)
- Asynchronous Machine Squirrel Cage (fundamental, SI)
- Asynchronous Machine Wound Rotor (fundamental)
- Asynchronous Machine Wound Rotor (fundamental, SI)

To plot saturation data for an ASM block in a MATLAB figure window, right-click the block in your model, select the **Electrical** menu on the block context menu, and then choose one of these actions:

- **Plot Open-Circuit Saturation** — Plots terminal voltage versus no-load stator current. The plot contains three traces:
  - Unsaturated
  - Saturated
  - Derived
- **Plot Saturation Factor** — Plots saturation factor applied to magnetic inductance versus magnetic flux linkage.
- **Plot Saturated Inductance** — Plots magnetizing inductance versus per-unit magnetic flux linkage.

If you use the saturation mode, the **Magnetizing inductance, Lm (pu)** parameter (for fundamental blocks) or the **Magnetizing reactance, Xm** parameter (for fundamental, SI blocks) is hidden because the block computes the value based on the saturation curve.

Double-Squirrel Cage Asynchronous Machines: Specify a single or double cage for ASM squirrel cage blocks

You can now specify a single or double cage for these Asynchronous Machine (ASM) Squirrel Cage blocks.

- Asynchronous Machine Squirrel Cage (fundamental)
- Asynchronous Machine Squirrel Cage (fundamental, SI)

When you model a double cage, you can specify separate referred rotor resistance and leakage inductance for each cage.

Synchronous Machine Rotor Angle: Define the rotor axis alignment for synchronous machine blocks

You can now define the reference point for the rotor angle measurement in these synchronous machine blocks:

- Synchronous Machine Model 2.1 (fundamental)
- Synchronous Machine Model 2.1 (standard)
- Synchronous Machine Round Rotor (fundamental)
- Synchronous Machine Round Rotor (standard)
- Synchronous Machine Salient Pole (fundamental)
- Synchronous Machine Salient Pole (standard)

The default value for the **Rotor angle definition** is `Angle between the a-phase magnetic axis and the d-axis`. When you select this value, the rotor *d*-axis and stator *a*-phase magnetic axis are aligned when the rotor angle is zero. The other value you can choose for this parameter is `Angle between the a-phase magnetic axis and the q-axis`. When you select this value, the rotor *q*-axis and stator *a*-phase magnetic axis are aligned when the rotor angle is zero.

Synchronous Machine Block Accuracy Improvement: SM blocks that use standard parameters and the SM field circuit block return more accurate results

Due to improved mapping of mask parameters to model coefficients, in certain configurations, the simulation results from models that contain these synchronous machine blocks are more accurate in R2018b:

- Synchronous Machine Model 2.1 (standard)
- Synchronous Machine Round Rotor (standard)

- Synchronous Machine Salient Pole (standard)
- Synchronous Machine Field Circuit (pu)

Machine Plotting and Display Options: Perform plotting and display actions using the Electrical menu

In previous releases, you could perform plotting and display actions for machine blocks using the **Power Systems** menu on the block context menu. Now, use the **Electrical** menu on the block context menu to perform those same actions. For more information, see “Plotting and Display Options for Asynchronous and Synchronous Machines”.

Controlled Current Source (Three-Phase) Block: Control the current loop of a cascading control system

Use the Controlled Current Source (Three-Phase) block to control the output current of a current loop in a cascading control system or to represent a low-fidelity converter without modeling switches.

Expanded Control Library: Speed up modeling by using prebuilt and documented algorithm components

Save time deriving, implementing, testing, debugging, and documenting algorithm models by using blocks from the expanded Control library. The blocks are Simulink blocks that are modular and decoupled, customizable, and compatible with Embedded Coder®. Each block provides open access to the implementation source code.

To access the new blocks in the Simulink Library Browser, select, **Electrical > Power Systems > Control**, and then:

- **ASM Control** — For these single-phase ASM control blocks:
  - Single-Phase ASM Direct Torque Control — For an example that includes this block, see “Single-Phase Asynchronous Machine Direct Torque Control”.
  - Single-Phase ASM Field-Oriented Control — For an example that includes this block, see “Single-Phase Asynchronous Machine Field-Oriented Control”.
- **SM Control** — For the SM PSS1A block, which models a power system stabilizer with parameters that can account for the low-frequency effect of high-frequency torsional filters or shape the gain and phase characteristics of the stabilizer.

- **General Control** — For these control blocks:
  - Change Detector — Detect a change in the Boolean input.
  - Counter — Implement a fixed-time-period counter.
  - Fourier Analysis — Obtain the magnitude and angle of the input signal for a specified harmonic.
  - Monostable Flip-Flop — Generate a single pulse of a specified duration in response to an external trigger.
  - Moving Average — Calculate the average value of the input over a moving window.
  - On-Off Delay — Add a time delay in response to a detected transition in the input signal.
  - Second-Order Filter — Implement a low-pass, high-pass, band-pass, or band-stop second-order filter.
  - Second-Order Low-Pass Filter (Discrete or Continuous) — Implement an IEEE Std 421.5 second-order low-pass filter.
  - Serial-In Parallel-Out Shift Register — Obtain a vector of last *N* samples of the input signals.
  - Set-Reset Flip-Flop — Implement a bistable.
  - Signal Sample and Hold — Sample and hold the input signal.
  - Variable-Frequency Second-Order Filter — Implement a low-pass, high-pass, band-pass or band-stop second-order filter with variable frequency.

Battery Characteristics Visualization: Plot voltage-charge characteristics for battery model parameter values

A new quick-plot feature lets you visualize the voltage-charge characteristics for the battery model parameter values. To plot the characteristics, right-click a Battery or Battery (Table-Based) block in your model and, from the context menu, select **Electrical > Basic characteristics**. The software automatically computes a set of bias conditions based on the block parameter values, and opens a figure window containing a plot of no-load voltage versus the state-of-charge (SOC) for the block.

Block Name Changes: Blocks names disambiguated from identically named blocks in the Simscape Electrical Electronics and Mechatronics library

Blocks names that are identical to the names of blocks in the Simscape Electrical Electronics and Mechatronics libraries are changed in R2018b.

Block Name Changes

Library Path	Name Prior to R2018b	New Name
Simscape > Electrical > Power Systems > Passive Devices > Fundamental Components	Transmission Line	Transmission Line (Three-Phase)
Simscape > Electrical > Power Systems > Semiconductors > Fundamental Components	Diode	Diode (Piecewise Linear)
	Thyristor	Thyristor (Piecewise Linear)
Simscape > Electrical > Power Systems > Sources	Current Source	Current Source (Three-Phase)
	Voltage Source	Voltage Source (Three-Phase)

Compatibility Considerations

To prevent a script that contains the previous name of a block from producing an error, update the block names in your code.

HDL Code Generation from Simscape Electrical Power Systems Models: Convert models to HDL code for simulation on FPGA devices

If you have an HDL Coder™ license, you can use the Simscape HDL Advisor advisor to deploy a linear or switched linear plant model developed using Simscape Electrical blocks to a target FPGA. To generate code using the Simscape HDL Advisor:

1. Configure the Power Systems model for conversion.
2. Convert the Power Systems model to an HDL code-compatible implementation model.
3. Generate HDL code from the implementation model.

For more information, see “Real-Time Simulation”.

Featured Examples

New examples in this release are:

- “Average-Value Chopper Control”
- “Average-Value DC-DC Converter Control”
- “DC Motor Control (Lead-Lag)”
- “DC Motor Control (RST)”
- “DC Motor Control (Smith Predictor)”
- “DC Motor Control (State-Feedback and Observer)”
- “Five-Phase Switched Reluctance Machine Control”
- “Four-Phase Switched Reluctance Machine Control”
- “IPMSM Outer Loop Controller Evaluation”
- “One-Quadrant Chopper Control”
- “PMSM Parameterization from Datasheet”
- “PMSM Parameterization from Measurements”
- “Single-Phase Asynchronous Machine Direct Torque Control”
- “Single-Phase Asynchronous Machine Field-Oriented Control”
- “Vienna Rectifier”

Specialized Power Systems

SVPWM Generator (3-Level) Block: Generate pulses for three-phase three-level neutral-point-clamped converters

The SVPWM Generator (3-Level) block outputs 12 pulses that it generates using the space vector pulse width modulation (SVPWM) technique. A proportional regulator controls the neutral point voltage deviation of the NPC converter based on the DC voltage references and the DC current flowing in or out of the DC link.

Featured Example

The “Three-Level NPC Inverter Using Space-Vector PWM with Neutral-Point Voltage Control” example shows how to operate a 2-MVA, 3-Level NPC inverter using the Space Vector Pulse-Width-Modulation (SVPWM) technique with neutral point voltage control.