Simscape™ Release Notes

How to Contact The MathWorks

www.mathworks.com	Web
comp.soft-sys.matlab	Newsgroup
www.mathworks.com/contact_TS.html	Technical Support

suggest@mathworks.com	Product enhancement suggestions
bugs@mathworks.com	Bug reports
doc@mathworks.com	Documentation error reports
service@mathworks.com	Order status, license renewals, passcodes
info@mathworks.com	Sales, pricing, and general information

508-647-7000 (Phone)

508-647-7001 (Fax)

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

For contact information about worldwide offices, see the MathWorks Web site.

Simscape™ Release Notes

Trademarks

MATLAB and Simulink are registered trademarks of The MathWorks, Inc. See www.mathworks.com/trademarks for a list of additional trademarks. Other product or brand names may be trademarks or registered trademarks of their respective holders.

Patents

The MathWorks products are protected by one or more U.S. patents. Please see www.mathworks.com/patents for more information.

Contents

Summary by Version

This table provides quick access to what's new in each version. For clarification, see "Using Release Notes" on page 1.

Version (Release)	New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Latest Version V3.1 (R2009a)	Yes Details	Yes Summary	Bug Reports	Printable Release Notes: PDF Current product documentation
V3.0 (R2008b)	Yes Details	Yes Summary	Bug Reports	No
V2.1 (R2008a)	Yes Details	No	Bug Reports	No
V2.0.1 (R2007b+)	No	No	Bug Reports	No
V2.0 (R2007b)	Yes Details	No	Bug Reports	No
V1.0 (R2007a)	Yes Details	Yes Summary	Bug Reports	No

Using Release Notes

Use release notes when upgrading to a newer version to learn about:

- New features

- Changes

- Potential impact on your existing files and practices

Review the release notes for other MathWorks™ products required for this product (for example, MATLAB® or Simulink®) for enhancements, bugs, and compatibility considerations that also might impact you.

If you are upgrading from a software version other than the most recent one, review the release notes for all interim versions, not just for the version you are installing. For example, when upgrading from V1.0 to V1.2, review the release notes for V1.1 and V1.2.

What's in the Release Notes

New Features and Changes

- New functionality
- Changes to existing functionality

Version Compatibility Considerations

When a new feature or change introduces a reported incompatibility between versions, the **Compatibility Considerations** subsection explains the impact.

Compatibility issues reported after the product is released appear under Bug Reports at The MathWorks™ Web site. Bug fixes can sometimes result in incompatibilities, so you should also review the fixed bugs in Bug Reports for any compatibility impact.

Fixed Bugs and Known Problems

The MathWorks offers a user-searchable Bug Reports database so you can view Bug Reports. The development team updates this database at release time and as more information becomes available. This includes provisions for any known workarounds or file replacements. Information is available for bugs existing in or fixed in Release 14SP2 or later. Information is not available for all bugs in earlier releases.

Access Bug Reports using your MathWorks Account.

Version 3.1 (R2009a) Simscape Software

This table summarizes what's new in Version 3.1 (R2009a):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	Yes—Details labeled as **Compatibility Considerations**, below. See also Summary.	Bug Reports	Printable Release Notes: PDF Current product documentation

New features and changes introduced in this version are

- "Simscape Language Source Protection" on page 3

- "Expanded MATLAB Support of Simscape Files" on page 4

- "Viewable and Customizable Source Files for Foundation Library Blocks" on page 4

- "Simscape Language Syntax Changes" on page 5

- "Increased Efficiency of Simscape Language Equations Processing" on page 5

- "New Physical Signal Blocks to Facilitate Rounding " on page 6

- "Model Reference Accelerator Mode Support " on page 6

- "Changes to Simscape Demos" on page 6

Simscape Language Source Protection

Simscape™ language files can be protected to enable model sharing without disclosing the component or domain source. You can then share the protected (executable) files without disclosing the file content (similar to P-code vs M-code). While Simscape source files have the extension `.ssc`, Simscape protected files have the extension `.sscp`.

Use the `ssc_protect` command to protect individual files and directories.

Use the `ssc_mirror` command to create a protected copy of a whole package, along with a custom block library built from it.

For more information, see "Using Source Protection for Simscape Files".

Expanded MATLAB Support of Simscape Files

MATLAB support of Simscape files has been expanded:

- If you issue the `open` command on a Simscape file, the file will open in the MATLAB Editor. The Simscape file must be on the MATLAB path, or in a package residing in a directory on the MATLAB path. For more information on packaging Simscape files, see "Organizing Your Simscape Files".

  If you issue the `open` command on a Simscape protected file (`*.sscp`), the corresponding Simscape source file (`*.ssc`) will open, provided it exists in the same directory as the Simscape protected file.

- Issuing the `help` command on a Simscape file displays the domain or component description, that is, all the comments immediately following the domain or component declaration, in the MATLAB Command Window.

- MATLAB Editor now supports syntax highlighting of Simscape files, similar to M-files. For more information, see "Appearance of an M-File — Making Files More Readable".

Viewable and Customizable Source Files for Foundation Library Blocks

You can now view the source files for many Foundation library blocks. When you open the block dialog box, it contains a link:

```
View source for BlockName
```

Click this link to open the Simscape source file for this block in the MATLAB Editor. To customize the block for your application, edit the source file and save it in a package directory. For more information, see "Using Simscape Files in Block Diagrams".

Compatibility Considerations

The block source has been optimized, with some previously defined but unused variables eliminated. Therefore, when you load an old model containing Foundation blocks, you might get warnings, for example:

```
Warning: In instantiating linked block 'model/R1' : Resistor block (mask) does not
have a parameter named 'current_Log'.
```

You can safely ignore these warnings. Once you save the model, the warnings will disappear.

Simscape Language Syntax Changes

The following changes have been implemented in Simscape language:

- The `throughs` keyword has been obsoleted. Use `variables(Balancing=true)` to declare Through variables in a domain.

- The `equation` keyword has been changed to `equations`.

- The name of a Simscape file must match the name of the component or domain it defines. If this is not the case, you will get an error when trying to build a library or use the block in a model.

For more information, see the Simscape Language Guide.

Compatibility Considerations

The changes are relatively minor, but may require modifying your existing Simscape files. The following table summarizes the old and new syntax.

Old Syntax	New Syntax
`throughs`	`variables(Balancing=true)`
`equation`	`equations`

Increased Efficiency of Simscape Language Equations Processing

Simscape language equations are now processed more efficiently, reducing the time required to process equations with multiple `if` statements.

New Physical Signal Blocks to Facilitate Rounding

Three new Physical Signal blocks have been added to the Nonlinear Operators library:

- PS Ceil block performs rounding of the signal toward positive infinity

- PS Floor block performs rounding of the signal toward negative infinity

- PS Fix block performs rounding of the signal toward zero

Model Reference Accelerator Mode Support

Simscape and its vertical products now support Model Reference Accelerator Mode for model simulation, but not for code generation. Model Reference Accelerator Mode for code generation is supported only by SimMechanics™ and SimDriveline™ software.

Changes to Simscape Demos

The following demo has been added in Version 3.1:

Demo Name	Description
Creating A New Circuit (ssc_new_elec)	Use this demo as a template for creating a new electrical model. Open the demo and use **File > Save As** to save it under the desired model name. Then delete the unwanted components and add new ones. This demo also opens an Electrical Starter Palette, which contains links to the most often used electrical components.

Version 3.0 (R2008b) Simscape Software

This table summarizes what's new in Version 3.0 (R2008b):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	Yes—Details labeled as **Compatibility Considerations**, below. See also Summary.	Bug Reports	No

New features and changes introduced in this version are

- "Simscape Language" on page 7

- "Explicit Solvers" on page 8

- "New Ways to Model Variable Chambers" on page 8

- "Model Reference Support " on page 9

- "More Solver Performance and Robustness Enhancements " on page 9

Simscape Language

New Simscape language extends the Simscape modeling environment by enabling you to create new components that do not exist in the Foundation library or in any of the vertical products. It is a dedicated textual physical systems modeling language with the following characteristics:

- Derives from MATLAB and familiar to those who use MATLAB

- Contains additional constructs specific to physical modeling and excludes constructs that have nothing to do with physical modeling

- Incorporated into the Simscape modeling interface

- Not focused on algorithm development

The Simscape language is intended to make modeling physical systems easy and intuitive. It lets you create new physical domains and components as

textual files and then use them in Simscape block diagrams to model the desired physical effects. For more information, see the Simscape Language Guide.

Explicit Solvers

It is now possible to choose any variable-step or fixed-step solver for models containing Simscape blocks. Note, however, that implicit solvers, such as ode14x, ode23t, and ode15s, are still a better choice for a typical model. In particular, for stiff systems, implicit solvers typically take many fewer timesteps than explicit solvers, such as ode45, ode113, and ode1.

By default, you will get a warning when using an explicit solver for a model containing Simscape blocks. For models that are not stiff, however, explicit solvers can be effective, often taking fewer timesteps than implicit solvers. Depending on the type of your model, you can configure your preferences to either turn off this warning (if your model is not stiff) or even change it into an error (to avoid inadvertent use of explicit solvers), by using the **Simscape** pane of the Configuration Parameters dialog box.

If you use an explicit solver, it requires time derivatives of the input signals. By default, needed input derivatives are provided by filtering the input through a low-pass filter. The derivative of the filtered input can then be computed by the Physical Networks simulation engine. The new **Derivatives** tab in the Simulink-PS Converter dialog box lets you turn off input filtering and instead provide the first derivative of input as an additional input signal to the Simulink-PS Converter block. For more information, see the Simulink-PS Converter block reference page.

Because input filtering can appreciably change the input signal and drastically affect simulation results if the time constant is too large, a warning is issued when input filtering is used. The warning indicates which Simulink-PS Converter blocks have their input signals filtered. This warning can also be turned off (or changed to an error) by changing the preferences on the **Simscape** pane of the Configuration Parameters dialog box.

New Ways to Model Variable Chambers

There are now two blocks that let you model fluid compressibility in variable chambers:

- Piston Chamber block lets you model fluid compressibility in a chamber created by the piston in a cylinder. It replaces the Variable Volume Chamber block, available in previous releases.

- Variable Chamber block lets you model fluid compressibility in variable volume chambers of any shape. The instantaneous value of the chamber volume is provided by using a physical signal port.

Compatibility Considerations

The Variable Volume Chamber block, available in previous releases, has been deprecated. It has been replaced by the Piston Chamber block in other (structural) blocks and in demos shipped with the product. If you have used the Variable Volume Chamber block in your models, it will continue to work. Going forward, however, use the Piston Chamber block to model fluid compressibility in cylinder chambers.

Model Reference Support

Simscape software now supports the Simulink model referencing functionality in Normal mode. Other Simulink models can now reference Simscape models in normal (non-code-generation) execution. Simscape models continue to be able to reference Simulink models (that do not contain Simscape blocks) in normal execution. See "Limitations" for more details.

More Solver Performance and Robustness Enhancements

Version 3.0 contains multiple further enhancements to simulation algorithms, resulting in improved robustness and reliability.

Version 2.1 (R2008a) Simscape Software

This table summarizes what's new in Version 2.1 (R2008a):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	No	Bug Reports	No

New features and changes introduced in this version are

- "Trimming Now Available for Simscape Models" on page 10

- "Thermal Unit Conversions Now Supported" on page 10

- "Enhancement to Specifying Units" on page 11

- "New Blocks" on page 12

- "Enhancements to Simulation Algorithms" on page 12

- ""What's This?" Context-Sensitive Help Available for Simulink Configuration Parameters Dialog" on page 12

- "New Simscape Demo" on page 13

Trimming Now Available for Simscape Models

Finding and managing operating points by trimming has been implemented for models that include Simscape and SimHydraulics® blocks. Simulink® Control Design™ product is required for using this functionality. For more information, see Trimming Simscape Models in the Simscape documentation.

Thermal Unit Conversions Now Supported

You can now specify temperature for your thermal models in a variety of units, including degrees Celsius, Fahrenheit, and Rankine. The unit manager automatically handles conversions between thermal units.

Thermal units sometimes require an affine conversion, that is, a conversion that performs both multiplication and addition. In situations when you deal with a relative, rather than absolute, temperature, you need to convert using just the linear term. Thermodynamic variables in block dialogs are automatically tagged as appropriate and handled by the unit manager. However, when an input or output signal is related to thermodynamic variables and contains units of temperature, you must decide whether affine conversion needs to be applied. The Simulink-PS Converter and PS-Simulink Converter block dialogs now contain the **Apply affine conversion** checkbox. If you select it, the unit manager uses the affine conversion, otherwise it applies the default linear conversion.

For more information, see "Thermal Unit Conversions" in the Simscape documentation, as well as the Simulink-PS Converter and PS-Simulink Converter block reference pages.

The `pm_addunit` command has also been modified to support affine conversions. Its second argument, `conversion`, may now be either a positive real scalar or a 1x2 array. If this argument has two elements, then it is specifying an affine conversion, with the first element (a positive real number) being the linear conversion coefficient, and the second being the offset.

Enhancement to Specifying Units

Simscape block dialogs have drop-down combo boxes for units next to a parameter value. You can either select a unit from the drop-down list, or type a commensurate unit name (or a mathematical expression with unit names) directly into the units combo box of the block dialog. For more information, see "Specifying Units in Block Dialogs" in the Simscape documentation.

Similarly, the Simulink-PS Converter and PS-Simulink Converter block dialogs now contain a drop-down list, which is prepopulated with some common input or output units. You can either select a unit from the list or type a unit name, or a mathematical expression with unit names. Note that you must still match the unit type:

- For a PS-Simulink Converter block, these units must be commensurate with the units of the input physical signal coming into the block.

- Signal units that you specify in a Simulink-PS Converter block must match the input type expected by the Simscape block connected to it.

New Blocks

Version 2.1 contains two new blocks:

- Gyrator block in the Electrical Elements library simulates an ideal gyrator, which can be used to implement an inductor with a capacitor.

- PS Abs block in the Physical Signals library returns absolute value of input signal.

Enhancements to Simulation Algorithms

Version 2.1 contains multiple enhancements to simulation algorithms, resulting in improved robustness and reliability.
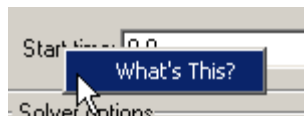
"What's This?" Context-Sensitive Help Available for Simulink Configuration Parameters Dialog

R2008a introduces "What's This?" context-sensitive help for parameters that appear in the Simulink Configuration Parameters dialog, including those on the **Simscape** pane. This feature provides quick access to a detailed description of the parameters, saving you the time it would take to find the information in the Help Browser.

To use the "What's This?" help, do the following:

1 Place your cursor over the label of a parameter.

2 Right-click. A **What's This?** context menu appears.

For example, the following figure shows the **What's This?** context menu appearing after a right-click on the **Start time** parameter in the **Solver** pane.

3 Click **What's This?**. A context-sensitive help window appears showing a description of the parameter.

New Simscape Demo

The following demo has been added in Version 2.1:

Demo Name	Description
House Heating System (ssc_house_heating_system)	The demo represents a simple house heating system consisting of a heater, thermostat, and a house structure with four thermally distinguishable parts: inside air, house walls, windows, and roof. You can investigate system behavior with the heating system turned on or off, and plot the heat cost and indoor versus outdoor temperatures.

Version 2.0 (R2007b) Simscape Software

This table summarizes what's new in Version 2.0 (R2007b):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	No	Bug Reports	Printable Release Notes: PDF Current product documentation

New features and changes introduced in this version are

- "Code Generation Now Available for Simscape Models" on page 14
- "New Thermal Block Libraries " on page 14
- "Additional Physical Signal Blocks" on page 15
- "Improved Simulation Performance " on page 15
- "New Simscape Demos" on page 16

Code Generation Now Available for Simscape Models

Code generation has been implemented for models that include Simscape and SimHydraulics blocks. For more information, see "Generating Code" in the Simscape documentation.

New Thermal Block Libraries

Version 2.0 contains new block libraries of fundamental thermal elements, sensors, and sources:

- Conductive Heat Transfer
- Convective Heat Transfer
- Radiative Heat Transfer
- Thermal Mass

- Thermal Reference

- Ideal Heat Flow Source

- Ideal Heat Flow Sensor

- Ideal Temperature Source

- Ideal Temperature Sensor

Additional Physical Signal Blocks

The new Physical Signal blocks introduced in Version 2.0 are listed below:

- PS Constant

- PS Math Function

- PS Max

- PS Min

- PS Sign

Improved Simulation Performance

In Version 2.0, various solver improvements have led to improved simulation performance:

- Enhanced handling of dependent dynamic states (higher-index DAEs)

  Simscape can now handle dependencies among the dynamic states as long as they are linear in the states and independent of time and inputs. This allows you, for example, to connect capacitors in parallel (even with their parasitic series resistances set to 0), inductors in series, and so on.

- Significant reduction of the number of equations, which substantially increased simulation speed

  The typical speedup of your models is between 5 and 10 times. There are some models that are below and above this range. Also, the number of states and equations changed between releases. This means that you will have to reset any calculations that relied on the states (such as initial state setting).

The changes to the simulation technology are significant. You may find that some of your models may require different or tighter tolerances to converge, while others will require no change. Refer to the troubleshooting section in the User's Guide for help in finding the cause of a problem if simulation failed.

New Simscape Demos

The following demos have been added in Version 2.0:

Demo Name	Description
DC Motor Thermal Circuit (ssc_dc_motor_thermal_circuit)	The demo illustrates how the thermal behavior of a motor can be simulated in lumped parameters.
Round Rod Heat Conduction (ssc_round_rod_heat_conduction)	The demo illustrates the usage of thermal blocks for developing a model of a long iron rod that is heated with a heat source through its left face. The right face and the outer cylindrical surface are open to atmosphere, with a force heat convection.

Version 1.0 (R2007a) Simscape Software

This table summarizes what's new in Version 1.0 (R2007a):

New Features and Changes	Version Compatibility Considerations	Fixed Bugs and Known Problems	Related Documentation at Web Site
Yes Details below	Yes—Details labeled as **Compatibility Considerations**, below. See also Summary.	Bug Reports	No

New features introduced in this version are described here.

Product Introduction

Simscape software extends the Simulink product line with tools for modeling and simulating multidomain physical systems. It enables you to describe multidomain physical systems containing mechanical, hydraulic, and electrical components as physical networks.

Simscape key features are:

- Single modeling environment for modeling and simulating physical systems, such as mechanical, electrical, and hydraulic systems

- Foundation library of physical modeling building blocks and fundamental mathematical elements

- Connection blocks to bridge modeling domains

- Full simulation and limited editing capabilities for models built with SimMechanics, SimDriveline, or SimHydraulics blocks (no license for these products required as long as the products are installed)

- Ability to specify units of parameters and variables, with all unit conversion handled automatically

Simscape software can be used for a variety of automotive, aerospace, defense, and industrial equipment applications. Together with

SimMechanics, SimDriveline, SimHydraulics, and SimPowerSystems™ (all available separately), Simscape lets you model complex interactions in electromechanical and hydromechanical systems.

Block Libraries Moved from SimHydraulics to Simscape

The Foundation and Utilities block libraries that used to be included in SimHydraulics (V1.0 and V1.1) are now part of Simscape product.

Compatibility Considerations

Several blocks that used to be in SimHydraulics V1.1 and are now part of Simscape software have undergone changes that have compatibility impact. These blocks are:

- Fluid Inertia
- Inertia
- Mass
- PS Integrator
- Rotational Spring
- Translational Spring

Each of these blocks has a parameter that specifies the initial condition for use in computing the block's initial state at the beginning of a simulation run. In this version, there is a difference in the way these initial conditions are computed, and as a result, the blocks work differently than they used to in the previous version. For details, see the block reference pages.

Compatibility Summary for Simscape Software

This table summarizes new features and changes that might cause incompatibilities when you upgrade from an earlier version, or when you use files on multiple versions. Details are provided in the description of the new feature or change.

Version (Release)	New Features and Changes with Version Compatibility Impact
Latest Version **V3.1 (R2009a)**	See the **Compatibility Considerations** subheading for these new features or changes: • "Viewable and Customizable Source Files for Foundation Library Blocks" on page 4 • "Simscape Language Syntax Changes" on page 5
V3.0 (R2008b)	See the **Compatibility Considerations** subheading for this new feature or change: • "New Ways to Model Variable Chambers" on page 8
V2.1 (R2008a)	None
V2.0.1 (R2007b+)	None
V2.0 (R2007b)	None
V1.0 (R2007a)	See the **Compatibility Considerations** subheading for this new feature or change: • "Block Libraries Moved from SimHydraulics to Simscape" on page 18