# Xyce™ Parallel Electronic Simulator Version 6.12 Release Notes

Sandia National Laboratories

October 18, 2019

The Xyce™ Parallel Electronic Simulator has been written to support the simulation needs of Sandia National Laboratories' electrical designers. Xyce™ is a SPICE-compatible simulator with the ability to solve extremely large circuit problems on large-scale parallel computing platforms, but also includes support for most popular parallel and serial computers.

For up-to-date information not available at the time these notes were produced, please visit the Xyce™ web page at http://xyce.sandia.gov.

## Contents




## New Features and Enhancements

### New Devices and Device Model Improvements

- The PSP103.4 model with self heating has been added as the level 1031 MOSFET.
- The Xyce/ADMS code generation back-end has been improved to
  - allow handling of analog functions with output variables other than their return value.
  - support the standard Verilog-A "hypot" function.
  - generate analytic derivatives without the use of Sacado. This refactor allows Xyce/ADMS to produce C++ code that evaluates model residuals and jacobians much more efficiently than before.

### Enhanced Solver Stability, Performance and Features

- Improved direct solver performance and reductions in general memory usage has been achieved through modifications to the topology layer.
- The time step recovery algorithm is now considered deprecated. It will be removed in a future version of Xyce.

### Interface Improvements

- Sweep loops for `.NOISE` analyses can now be specified using the HSpice-style `.DATA` command. This allows the user to specify parameter loops in which multiple parameters are changed simultaneously. Previously, this capability only applied to `.STEP`, `.DC` and `.AC` analyses.
- A new SPLOT print format that outputs data in standard columns, like a .prn file, but with improved compatibility for .STEP data with the splot command in gnuplot.
- RF parameter operators (e.g., S(1,1), SR(1,1), SI(1,1), SM(1,1), SP(1,1), SDB(1,1) and their corresponding Y- and Z-parameter versions) were added. Those operators work on both .PRINT AC and .MEASURE lines.
- The `.LIN` command, for S-parameter analysis, can now also output Y- or Z-parameter data into its Touchstone 1 or Touchstone 2 output files via a newly added `LINTYPE` argument.
- It is now possible to add a `STEPNUM` column as the first column in an output file, via `.OPTIONS OUTPUT ADD_STEPNUM_COL`. This new option improves the compatibility of Xyce output with gnuplot.

### Important Announcements

- The Xyce project is no longer providing binaries for RHEL6. This system is close to its end of life, and Sandia has been decommissioning its RHEL6 systems.
- The model interpolation technique described in the Xyce Reference Guide in section 2.1.18 has been marked as deprecated, and will be removed in a future release of Xyce.

- It has been determined that some distributions of Linux have broken builds of OpenMPI in their package repositories. Building Xyce from source code in parallel with these OpenMPI installs will result in a version of Xyce that may crash on some problems. This is not a bug in Xyce, but a packaging error of the OpenMPI package on those operating systems. Please see commentary in the "Known Defects" section of these release notes under bug number "967-SON".

- Xyce has deprecated the default conversion of quoted-string file names to a table of x,y pairs of data. The old convention of `PARAMETER="file.dat"` which worked in some model statements and in behavioral sources will now generate a warning in the Xyce output. The correct way to specify a file of data for a parameter is to use the new `tablefile` keyword as in `PARAMETER=tablefile("file.dat")`. While this release of Xyce will accept both the old and new syntax, the double quote technique will be removed in a future release, after which Xyce will only accept the syntax of `PARAMETER=tablefile("file.dat")`. Additionally, a new syntax of `PARAMETER=string("string value")` has been introduced to specify parameters that are pure strings. This will be deprecated in a future release and the simpler syntax of `PARAMETER="string value"` will be used to specify string valued parameters.

- The "Xygra" device, which was written as a special-purpose coupling mechanism to ALEGRA but which has occasionally been used for other coupling problems, has been marked as deprecated. The new, more flexible "General External" device was created to take its place, and has supplanted the use of Xygra in ALEGRA. The Xygra device and the API that enables it may be removed without notice in a future release of Xyce. If your code has been using the Xygra capability to couple to Xyce, you must replace your usage with the new capability. The "General External" coupling mechanism is documented thoroughly in an application note available on the Xyce web site.

- The minimum required version of Trilinos has changed. Please consult the "Building Guide" page on the Xyce website for more details.

## Defects Fixed in this Release

Table 1: Fixed Defects. Note that we have two different Bugzilla systems for Sandia users. SON, which is on the open network, and SRN, which is on the restricted network.

| Defect | Description |
|---|---|
| **1224-SON**: Improved error handling for .SAMPLING | In the previous release of Xyce, a `.SAMPLING` analysis would run even if the user-specified `STD_DEVIATIONS`, `ALPHA` and `BETA` values were invalid. For Gamma distributions, the user-specified `ALPHA` and `BETA` values must now be strictly positive. The `STD_DEVIATIONS` values specified for Gaussian distributions must now be non-negative. |
| **1223-SON**: ADMS and Xyce/ADMS do not correctly handle analog functions with output arguments | A long-standing bug in ADMS fails to propagate probe and variable dependence from analog function call input arguments into the output arguments. This leads to incorrect code generation by Xyce/ADMS when such functions are used. Xyce/ADMS now uses a modified version of ADMS's "implicit" templates that it invokes explicitly instead. Analog function output variables should now be processed just as correctly as if they had appeared on the left hand side of an assignment. The relevant fixes to ADMS's implicit templates have also been provided upstream to the ADMS maintainers. |
| **1219-SON**: Add PSP 103 model with self-heating | This model has been added as the level 1031 MOSFET. |
| **1210-SON**: Sign of negative values in parameter files ignored | When the `-prf` command line argument was used to pass Xyce a parameter file the leading negative signs of parameter values was ignored. This has been fixed. |
| **1204-SON**: Fix issue with extra blank lines in Touchstone 1 formatted output for .LIN analysis | There could be extra blank lines inserted in the Touchstone 1 formatted output, between the S-parameter values output for each frequency, if a `.LIN` analysis used any number of ports other than 2. The Touchstone 2 formatted output, which is the default output format for `.LIN` analyses, was not affected by this bug. |
| **1202-SON**: Fix segfaults caused by using .LIN SPARCALC=1 in a netlist without any port (P) devices | The use of a `.LIN` line with the parameter `SPARCALC` set to 1 in a netlist that requested a `.AC` analysis without any valid port (P) devices in the netlist would cause Xyce to segfault. |
| **1198-SON**: Binning doesn't work for BSIM6 and other models in the ADMS directory | Binning (the kind enabled by `.options parser model_binning=true`) did not work properly for several MOSFET models derived from Verilog-A, because the authors of those models had not included the dummy parameters **LMIN**, **LMAX**, **WMIN**, and **WMAX**. These dummy parameters are not used directly by any model, but must be present in order for the binning code to select the correct model card from a collection of cards based on the **L** and **W** parameter on the instance line. These models were BSIM6, PSP102, MVSG-HV, and the non-free EKV models. Dummy parameters have been added for all these models and they should now work with binning. |

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| **1197-SON**: Allow dependent parameters, other than C and Q, for the C-device that use expressions without solution variables in them | The C and Q instance parameters are allowed to be solution-dependent for the C-device. In Xyce 6.11, or earlier, an attempt to use an expression (that did not depend on solution variables such as nodal voltages) in the definition of other parameters, such as TEMP, for the C device would cause a parsing error. This is fixed now. |
| **1196-SON**: -hspice-ext math command line option fails on .FUNC statements the use Logical OR and Logical AND | The `-hspice-ext` command line option would fail on `.FUNC` statements that contained logical OR or logical AND operators. Examples were as follows, where `P1` and `P2` were previously defined on `.PARAM` lines:<br>`.FUNC ANDFUNC(p1,p2) {(P1&&P2) ? 1.0 : 2.0}`<br>`.FUNC ORFUNC(p1,p2) {(P1\|\|P2) ? 1.0 : 2.0}` |
| **1188-SON**: Various ill-formed .DATA, .DC and .STEP lines could cause Xyce to segfault | An attempt to use `.DATA`, `.DC` or `.STEP` lines with less than the required number of elements on those lines could cause Xyce to segfault. In addition, the error messages emitted for invalid uses of `DATA=<tableName>` on `.AC` `.DC` and `.STEP` lines, or for ill-formed `.DATA` statements, could be cryptic and unhelpful. |
| **989-SON**: I(*) will not print branch currents that are part of a Y device | Until this release of Xyce, the I(*) feature of the `.PRINT` would not output any branch currents (extra solution variables describing internal currents of a device) associated with Y devices. No Y devices in Xyce have such branch currents, but Y devices imported from Verilog-A plugins could. These branch currents are now output by I(*). |
| **1242-SON**: Allow S-parameter analysis to handle DC and negative frequencies | The non-positive frequencies were not allowed in the S-parameter analysis previously. The linear frequency sweep can now handle DC and negative frequencies. |

## Interface Changes in this Release

Table 2: Changes to netlist specification since the last release.

| Change | Detail |
|---|---|
| Single quotes can now be used as delimiters around file names on `.INC` and `.LIB` lines. | As examples, all three of these lines are now legal in Xyce.<br><br>`.INC models.lib`<br>`.INC 'models.lib'`<br>`.INC "models.lib"` |

## Known Defects and Workarounds

Table 3: Known Defects and Workarounds.

| Defect | Description |
|---|---|
| **1241-SON**: Expression library parsing bottleneck on large expressions | It has been determined that the expression library in Xyce can be the source of a severe parsing bottleneck when expressions are large and complex. Expressions of this sort show up most often when parsing large PDKs with complex use of the `.FUNC` feature, and when using the "tablefile" feature to import a large file of time/voltage pairs for use in a `B` source.<br>***Workaround***: There is currently no workaround for the issue of complex PDK function use, and the team is working on fixing this issue by redesigning the way Xyce handles expressions with user defined functions. For the "tablefile" issue, one should avoid using `B` sources with "tablefile" to read in large tables, and instead use the "PWL FILE" option of the `V` source, which does not have this parsing issue. |
| **1200-SON**: Model binning is not supported for the BSIM CMG model | Model binning is not supported for the `LMIN`, `LMAX`, `NFINMIN` and `NFINMAX` binning parameters needed by the BSIM CMG model.<br>***Workaround***: None |
| **1085-SON**: Expression library mishandles `.FUNC` definitions of functions that begin with "I" and are two characters long | Xyce's expression library assumes that all terms of the form "`Ix(<arguments>)`" are lead current expressions, where "x" is either a lead designator such as "D", "G" , or "S" for a MOSFET or "C", "B", "E" for a BJT, or a digit indicating the pin number of the device associated with the lead. This assumption makes it impossible for users to define a function with a two-character name starts with "I". Unfortunately, the parser does not warn of this problem should a user define such a function, and the first indication of something being wrong is an unhelpful error message about an "undefined parameter or function" where the problematic function is used.<br>***Workaround***: Do not use function names of two character length that begin with the letter "I". If you are making use of a vendor-supplied library that includes definitions of functions such as "I0", you will have to modify the library to change the function name and all the instances of its use. |
| **1037-SON**: The use of non-constant values in .PARAM statements may lead to unexpected results | This netlist line (`.PARAM PA = {TEMP}`) is forbidden in Xyce since the special variable `TEMP` is not constant. However, that netlist line will not produce a Xyce parsing error, and the value of `PA` in the simulation may then be set to zero in some contexts.<br>***Workaround***: Non-constant values should only be used in `.GLOBAL PARAM` statements in Xyce. This restriction may be different than in other Spice-like simulators. |

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| **1031-SON**: .OP output is incomplete in parallel | When Xyce is run in parallel, the `.OP` output may be incomplete.<br>***Workaround***: One workaround is to run the netlist in serial. Another one is to use these command line options: `-per-processor -l output`. In that case, the per-processor log files will have the `.OP` information for the devices that were instantiated on each processor. |
| **1009-SON**: Transient adjoint sensitivities don't work with `.STEP` | Transient adjoint sensitivities require backward integrations to be performed after the primary transient forward integration. Doing this properly requires information to be stored during the forward solve, and for certain bookkeeping to be performed. Currently, these extra operations to support transient adjoints are not properly set up for `.STEP` analysis.<br>***Workaround***: None |
| **1006-SON**: SDT (expression library time integration) derivatives are not supported, so SDT can't be used for sensitivity analysis objective functions | SDT is a function supported by the Xyce expression library to compute numerical time integration. When this function is used, the expression library does not produce correct derivatives. This impacts Jacobian matrix entries, when SDT is used with a Bsrc, and it also impacts sensitivity analysis, when SDT is used in an objective function. For the former case, this can result in a lack of robustness for circuits that contain SDT-Bsrc devices. For the latter case, the objective function will simply be incorrect.<br>***Workaround***: None |
| **1004-SON**: Ill-defined .STEP behavior for "default parameters" for transient sources (SIN, EXP, PWL, PULSE and SFFM) | If, for example, these netlist lines are used in a transient (`.TRAN`) simulation:<br>`V1 1 0 SIN(0 1 1)`<br>`.STEP V1 1 2 1`<br>then Xyce will run the simulation without warnings or errors, but no instance parameter of source `V1` will be stepped.<br>***Workaround***: Explicitly use the desired stepped parameter (e.g., `V0`) on the `.STEP` line. For example, `.STEP V1:V0 1 2 1` would work correctly. |
| **991-SON**: Non-physical BH Loops in non-linear mutual inductor | Nonlinear mutual inductors that have high coupling coefficients (i.e. model parameter `ALPHA` over 1.0e-4) and low loss characteristics (i.e. zero `GAP`) can produce B-H loops with nonphysical hysteresis.<br>***Workaround***: Lower `ALPHA` values or larger `GAP` values can ameliorate this issue, but the root cause is still under investigation. |
| **800-SON**: Use of global parameters in expressions on .MEASURE lines will yield incorrect results | The use of global parameters in expressions on .MEASURE lines is not allowed, as documented in the Xyce Reference Guide. However, instead of producing a parsing error the measure statement will be evaluated with the specified qualifier value (e.g., `FROM`) being left at its default value.<br>***Workaround***: None, other than not doing this. |

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| **971-SON**: Use of default device parameter syntax on a .PRINT line causes Xyce to print 0 for that parameter | This line (`.PRINT TRAN R1`) will cause Xyce to print 0 for the resistance value of R1.<br>***Workaround***: Use `.PRINT TRAN R1:R` instead. |
| **970-SON**: Some devices do not work in frequency-domain analysis | Devices that may be expected to work in AC or HB analysis do not at this time. For AC this includes, but is not limited to, the lossy transmission line (LTRA) and lossless transmission line (TRA). For HB, the transmission lines do work but the nonlinear dependent sources (B source and nonlinear E, F, G, or H source) do not.<br>***Workaround***: The LTRA and TRA models will need to be replaced with lumped transmission line models (YTRANSLINE) for AC analysis. There is not yet a workaround for the B source in harmonic balance. |

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| **967-SON**: Zoltan segmentation fault with OpenMPI 2.1.x and 3.0.0 on some systems | It has been observed that when Xyce and Trilinos are built with OpenMPI 2.1.x or 3.0.0 on certain unsupported operating systems, a small number of test cases in the regression suite crash with a segmentation fault inside the Zoltan library.<br>The Xyce team has determined that this is not a bug in either Xyce or Zoltan, but is instead due to some pre-packaged OpenMPI binaries on some operating systems having been built with an inappropriate option. This option, "–enable-heterogeneous" is explicitly documented in OpenMPI documentation as broken and unusable since 2013, but some package managers have OpenMPI binaries built with this option explicitly enabled. Turning on this option causes the resulting OpenMPI build to perform certain communication operations in a way that does not adhere to the MPI standard. There is nothing that can be done in Xyce or Zoltan to fix this issue — it is entirely a bug in the OpenMPI library as built on that system.<br>A new test case has been added to the Xyce test suite in order to detect this problem. The test is "MPI_Test/bug_967", and it will be run whenever the test suite is invoked with the "+parallel" tag as described in the documentation for the test suite at `https://xyce.sandia.gov/documentation/RunningTheTests.html`. If this test fails, your system has a broken OpenMPI build that cannot be used with Xyce.<br>At the time of this writing, this issue is present in Ubuntu Linux versions 17.10 and later, and there is an open bug report for it at `https://bugs.launchpad.net/ubuntu/+source/openmpi/+bug/1731938`.<br>The issue may be present in other distros of Linux that are derived from Debian (as is Ubuntu), but we cannot confirm this.<br>***Workaround***: The only workaround for this problem is to build OpenMPI from source yourself, and not to include "–enable-heterogeneous" in its configure options.<br>You should also post a bug report in your operating system's issue tracker requesting that they rebuild their OpenMPI binaries without the "–enable-heterogeneous" option. If you are using Ubuntu, you should register with that issue tracking system and add yourself to the list of people it affects in the existing bug report (doing so increases the "heat" of the bug, which may increase the likelihood of it being fixed). |
| **964-SON**: Compatibility of .PRINT TRANADJOINT with .STEP | The use of `.PRINT TRANADJOINT` is not compatible with `.STEP`. The resultant Xyce output will not be correct.<br>***Workaround***: There is none. |

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|---|---|
| **939-SON**: Invalid fields (XBEGIN, XEND and SUBTITLE) in Xyce-generated HOMOTOPY.csd files | The fields in the #H header block of the .HOMOTOPY.csd files are currently hard-coded to 0 and 1, respectively. The `SUBTITLE` field is incorrect for `.STEP` data. It is missing the values for the stepped parameters.<br>***Workaround***: There is no workaround for the `XBEGIN` and `XEND` issue. However, it should not affect the "viewability" of those files in the PSpice A/D viewer. The workaround for the `SUBTITLE` issue is to put the stepped parameters on the `.PRINT HOMOTOPY` line. |
| **932-SON**: Analysis lines do not support expressions for their operating parameters | The Xyce parser and analysis handlers do not yet support the use of expressions on netlist analysis lines such as `.TRAN`. The parameters of these analysis lines (such as stop time for `.TRAN` or fundamental frequency for `.HB`) may only be expressed as literal numbers.<br>***Workaround***: There is no workaround internal to Xyce. Use of an external netlist preprocessor would be required. |
| **928-SON**: The .hb_ic.prn file can be incorrect when .STEP is used with .HB | Xyce should only output the initial condition (IC) data for the accepted tolerance in the `<netlist-name>.hb_ic.prn` file. However, it currently outputs all of the intermediate IC data while harmonic balance tries to find a good tolerance if `.STEP` is used with `.HB`.<br>***Workaround***: There is no workaround. |
| **883-SON** .PREPROCESS REPLACEGROUND does not work on nodes referenced in expressions | The `.PREPROCESS REPLACEGROUND` feature does not replace ground synonyms if they appear in B source expressions.<br>***Workaround***: Do not use ground synonyms (`GND`, `GROUND`, etc.) in expressions. Use a literal "0" when referring to the ground node in expressions. |
| **812-SON**: Undocumented limitations on, and bugs with, parameter and global parameter names | Based on external customer input and pre-release testing, there are some bugs and undocumented limitations on parameter and global parameter names in Xyce. Parameters and global parameters should start with a letter, rather than with a number or "special" character like #. In addition, the use of a single character $V$ as a global parameter name can result in either netlist parsing failures or incorrect results from `.PRINT` lines. |
| **807-SON**: BSIM4 convergence problems with non-zero rgatemod value | There have been reports of convergence problems (e.g., the Xyce simulation fails part way through and says that the "time step is too small") when the `rgatemod` parameter is non-zero. |
| **794-SON**: Bug in TABLE Form of Xyce Controlled Sources | In some case, a Xyce netlist that contains a controlled source that uses the TABLE form will get the correct answer at first. However, it may then "stall" (e.g, keep taking really small time-steps) and never complete the simulation run.<br>***Workaround***: In some cases, the TABLE specification for the controlled source can be replaced with a Piecewise Linear (PWL) source that uses nested IF statements. |
| **783-SON**: Use of ddt in a B-Source definition may produce incorrect results | The `DDT()` function from the Xyce expression package, which implements a time derivative, may not function correctly in a B-Source definition.<br>***Workaround***: None. |

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|---|---|
| **727-SON**: Xyce parallel builds hang randomly on OS X | During Sandia's internal nightly testing of the OSX parallel builds, we see that Xyce "hangs on exit" with an estimated frequency of less than 1-in-5000 simulation runs. We have not seen this issue with parallel builds for either RHEL6 or BSD. The hang is on exit, whether on a successful exit or on an error exit. The hang occurs after all of the Xyce output has occurred though. So, the user will get their sim results, but might have trouble if the individual Xyce runs are part of a larger script. ***Workaround***: None. |
| **661-SON** Lead currents and power accessors (I(), P() and W()) do not work properly in .RESULT Statements | There are two issues. First, `.RESULT` statements will fail netlist parsing if the requested lead current is omitted from the `.PRINT TRAN` line. As an example, this statement (`.RESULT I(R1)`) requires either `I(R1)`, `P(R1)` or `W(R1)` to be on the `.PRINT TRAN` line. Second, the output value, in the `.res` file, for the lead current or power calculation will always be zero. |
| **652-SON**: HB output is buggy | While a straightforward use of `.print HB` works as described in the Xyce Users' Guide and Reference Guide, several of the documented features do not work as intended. More details are provided by other entries in this table. |
| **583-SON**: Switch with RON=0 leads to convergence failure. | The switch device does not prevent a user from specifying `RON=0` in its model, but then takes the inverse of this value to get the "on" conductance. The resulting invalid division will either lead to a division by zero error on platforms that throw such errors, or produce a conductance with "Not A Number" or "Infinity" as value. This will lead to a convergence failure. ***Workaround***: Do not specify an identically zero resistance for the switch's "on" value. A small value of resistance such as 1e-15 or smaller will generally work well as a substitute. |
| **469-SON**: Belos memory consumption on FreeBSD and excessive CPU on other platforms | Memory or thread bloat can result when using multithreaded dense linear algebra libraries, which are employed by Belos. If this situation is observed, either build Xyce with a serial dense linear algebra library or use environment variables to control the number of spawned threads in a multithreaded library. |
| **468-SON**: It should be legal to have two model cards with the same model name, but different model types. | SPICE3F5 and ngspice only require that model cards of the same type have unique model names. They accept model cards of different types with the same name. Xyce requires that all model card names be unique. |
| **250-SON**: NODESET in Xyce is not equivalent to NODESET in SPICE | As currently implemented, `.NODESET` applies the initial conditions given throughout a full nonlinear solve for the operating point, then uses the result as an initial guess for a second nonlinear solve with no constraints. This is not the same as SPICE, which merely applies the given initial conditions to a single nonlinear solve for the first two iterations, then lets the problem converge with no further constraints. This can lead to a Xyce `.NODESET` failing where the same netlist in SPICE might not, if the initial conditions are such that a full nonlinear solve cannot converge with those constraints in place. There is no workaround. |

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|---|---|
| **247-SON**: Expressions don't work on .options lines | Expressions enclosed in braces ({ }) are handled specially throughout Xyce, and may only be used in certain contexts such as in device model or instance parameters or on `.PRINT` lines. |
| **49-SON** Xyce BSIM models recognize the model TNOM, but not the instance TNOM | Some simulators allow the model parameter TNOM of BSIM devices to be specified on the instance line, overriding the model parameter TNOM. Xyce does not support this. |
| **27-SON**: Fix handling of .options parameters | When specifying .options for a particular package, what gets applied as the non-specified default options might change. |
| **2119-SRN**: Voltages from interface nodes for subcircuits do not work in expressions used in device instance parameters | This bug can be illustrated with this netlist fragment:<br><br>`X1 1 2 MySub`<br>`.SUBCKT MYSUB a c`<br>`R1  a b 0.5`<br>`R2  b c 0.5`<br>`.ENDS`<br>`B1 3 0 V={V(X1:a)}`<br><br>This fragment will produce the netlist parsing error `Directory node not found: X1:A`. The workaround is to use `V={V(1)}` in the B-source expression instead. This bug also affects the solution-dependent capacitor. |
| **1923-SRN**: LC lines run out of memory, even if equivalent (larger) RLC lines do not. | In some cases, circuits that run fine using an RLC approximation for a transmission line, exit with an out-of-memory error if the (supposedly smaller) LC approximation is used. |
| **1595-SRN**: Xyce won't allow access to inductors within subcircuits for mutual inductors external to subcircuits | It is not possible to have a mutual inductor outside of a subcircuit couple to inductors in a subcircuit.<br>***Workaround***: Put all inductors and mutual inductance lines that couple to them together at the same level of circuit hierarchy. |

## Supported Platforms

### Certified Support

The following platforms have been subject to certification testing for the Xyce version 6.12 release.

- Red Hat Enterprise Linux® 7, x86-64 (serial and parallel)
- Microsoft Windows 10®, x86-64 (serial)
- Apple® OS X Sierra, x86-64 (serial and parallel)

### Build Support

Though not certified platforms, Xyce has been known to run on the following systems.

- FreeBSD 11.x on Intel x86-64 and AMD64 architectures (serial and parallel)
- Distributions of Linux other than Red Hat Enterprise Linux 6
- Microsoft Windows under Cygwin and MinGW.

## Xyce Release 6.12 Documentation

The following Xyce documentation is available on the Xyce website in pdf form.

- Xyce Version 6.12 Release Notes (this document)
- Xyce Users' Guide, Version 6.12
- Xyce Reference Guide, Version 6.12
- Xyce Mathematical Formulation
- Power Grid Modeling with Xyce
- Application Note: Coupled Simulation with the Xyce General External Interface

Also included at the Xyce website as web pages are the following.

- Frequently Asked Questions
- Building Guide (instructions for building Xyce from the source code)
- Running the Xyce Regression Test Suite
- Xyce/ADMS Users' Guide
- Tutorial: Adding a new compact model to Xyce

## External User Resources

- Website: http://xyce.sandia.gov
- Google Groups discussion forum: https://groups.google.com/forum/#!forum/xyce-users
- Email support: xyce@sandia.gov
- Address:

  Electrical Models and Simulation Dept.
  Sandia National Laboratories
  P.O. Box 5800, M.S. 1177
  Albuquerque, NM 87185-1177

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