

# Keysight EEsof EDA

## W2303 Verilog-A Element

Verilog-A custom non-linear models can be developed and used in all ADS circuit simulators

Verilog-A definition of SPICE Gummel-Poon

\$RCSfile: bjt.va,v\$ \$Revision: 1.9\$ \$Date: 2005/01/27 22:51:59\$

\*/

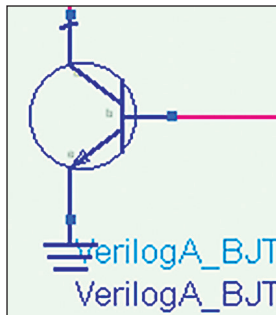
```
`include "constants.vams"
`include "disciplines.vams"
`include "compact.vams"
```

```
`define INCLUDE_LEAD_INDUCTANCE
`define INCLUDE_DELAY
`define THREE_TERMINALS
```

```
`define PI_SQ_24 14.5902504445
`define PI_SQ_144 2.43170840742
```

```
`define ZERO_TO_INF(paramValue, varName, infinity) \
  if (paramValue == 0.0) \
    varName = infinity;\
  else \
    varName = paramValue
```

```
`ifdef THREE_TERMINALS
module VerilogA_BJT(c,b,e);
`else
module VerilogA_BJT(c,b,e,s);
`endif
```



## Introduction

The W2303 Verilog-A element is an analog behavioral modeling and simulation environments for the Advanced Design System (ADS). ADS is the flagship product from Keysight Technologies' EEsof EDA, the technology and innovation leader in high-frequency mixed-signal electronic design automation (EDA).

ADS is the only design simulation platform that enables the co-design of IC, package, and board in high-frequency and high-speed applications. It seamlessly integrates system, circuit, and full 3D electromagnetic simulation with Keysight Technologies' test instrumentation, resulting in repeatable, first-pass electronic design success.

The W2303 Verilog-A Element enables analog behavioral modeling with the industry standard Verilog-A language within ADS. Used for applications ranging from transistors to MEMs, the Verilog-A models are compiled for speed and can be simulated and optimized with any of the time-, frequency- or envelope-domain system and circuit simulators in ADS.

Verilog-A supports so-called multi-discipline modeling, where the through and across variables need not be the familiar current and voltage variable supported by SPICE netlist syntax. In addition to that traditional electrical discipline, it supports magnetic, thermal, and kinematic natures and disciplines. The user can define additional discipline. Bilateral transducers between disciplines (such as an electric motor with back EMF and torque) can be modeled easily.

The user-defined models using standard Verilog-A equation constructs are intelligently compiled in ADS to use the fast and robust convergence algorithms already engineered for built-in ADS models, thus eliminating the special formulation of behavioral equations for specific simulators to converge. A comprehensive library of valuable Verilog-A source codes are supplied for new and built-in ADS models to allow fast new model development or to efficiently customize the underlying model equations. Customized Verilog-A models can contain parameters that can be extracted from measurements in Keysight's powerful IC-CAP (Integrated Circuit Characterization and Analysis Program) parameter extraction and device modeling software environment that also controls instrumentation and probe stations.

**Note on licensing:** In ADS 2009 Update 1 and prior releases, this Element was available as a separate line item. However, due consolidated pricing in ADS 2011 and beyond, it is no longer necessary to purchase the Verilog-A license and to obtain the associated codewords separately. In others words, if you are using ADS 2011 or later the functionality described here is included in the base product and simulators.



## The W2303 Verilog-A Elements includes:

- Support for industry-standard Verilog-A model development in ADS, with run-time speed and convergence comparable to built-in ADS models.
- Simulation and optimization in ADS time-, frequency- and envelope-domain system and circuit simulators, with full access to powerful internal convergence algorithms.
- At least 10x less lines of code compared with C-language-based models.
- Fully portable model development for use in all Verilog-A compatible simulators, distributable through design kits.
- Verilog-A model parameters extracted from measurements in the Keysight ICCAP device modeling environment.
- Verilog-A source codes for new models.
- Verilog-A Source codes for built-in devices.

### New models for which Verilog-A models are included

| Model name      | Description                                                                          |
|-----------------|--------------------------------------------------------------------------------------|
| aTFT            | Shur-RPI amorphous silicon thin film transistor MOSFET model                         |
| BSIMSOI         | Version 3.1 of the BSIMSOI model family                                              |
| EKV             | Version 2.6 of the EKV MOSFET model                                                  |
| HICUM_LO        | Level 0 version of the HICUM BJT model, a simplified version of the full HICUM model |
| HiSIM           | STARC/Hiroshima University surface potential based MOSFET model                      |
| Parker_Skellern | The Parker-Skellern MESFET model for medium power applications                       |
| pTFT            | Shur-RPI polysilicon thin film transistor MOSFET model                               |

### ADS built-in devices for which Verilog-A source codes are included

| Model name | Description                                             |
|------------|---------------------------------------------------------|
| Angelov    | Angelov GaAs FET model                                  |
| BJT        | SPICE Gummel-Poon BJT model                             |
| BSIM3      | UC Berkeley BSIM3 (version 3.22)                        |
| BSIM4      | UC Berkeley BSIM4 (version 4.3)                         |
| Curtice    | Curtice Quadratic GaAs FET model                        |
| Diode      | SPICE diode                                             |
| JFET       | SPICE silicon junction FET                              |
| JunCap     | Philips JunCap diode                                    |
| MESFET     | SPICE Metal Semiconductor FET model                     |
| MEXTRAM    | Philips Most Exquisite Transistor model for BJT devices |
| MOS9       | Philips MOS Model 9                                     |
| MOS11      | Philips MOS Model 11                                    |
| TOM1       | Triquint's Own Model 1                                  |
| TOM3       | Triquint's Own Model 3                                  |
| VBIC       | Vertical Bipolar InterCompany BJT model, as released    |

Unlike other behavioral modeling environments where intimate knowledge of the target simulator algorithms are required, the ADS Verilog-A behavioral modeling compilers intelligently enable the complete functionality and convergence capabilities developed originally for built-in models to be applied to user-defined models. Compared to C-language-based models, Verilog-A models require 10x less coding. Together with the rich set of Verilog-A device source codes to start from, you are guaranteed the most efficient language-based behavioral modeling capability possible.

Use this link for more information about Verilog-A.



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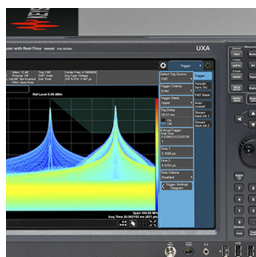
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