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Analog Library Reference

Product Version IC23.1
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Contents

1

Introduction to Analog Library

This topic contains information about all the components in the Analog Library (analogLib). The analogLib library is within the Virtuoso Analog Design Environment. You can access the library from the following path:

<your_install_dir>/tools/dfII/etc/cdslib/artist/analogLib

Make sure you specify this path in the search path of the Set Library Search Path form.

The analogLib library contains basic analog components, such as resistors, capacitors and transistors that are used in building complex analog blocks, such as amplifiers.

This topic contains information about all the components in the Analog Library. The information presented is intended for integrated circuit designers and assumes that you are familiar with analog design and the following:

- The applications used to design and develop integrated circuits in the Virtuoso Studio Design Environment, notably Virtuoso Schematic Editor and Virtuoso Analog Design Environment
- Component Description Format (CDF), which lets you create and describe your own components for use with Virtuoso Schematic Editor and Virtuoso Analog Design Environment

The analogLib library contains basic components, such as resistor, capacitance, and transistor. These basic analog parts are used in building complex analog blocks, such as amplifiers.

The components in analogLib are divided into 10 categories, such as Actives, Analysis, Parasitics and so on. For each component in analogLib multiple views, such as the symbol view and simulator specific views are available. For some components, the schematic view might also be available.

Each component may be supported by different simulators, such as spectre or auCdl. The simulators supported in the Cadence Analog Design Environment are:

- spectre

- ams
- auCdl
- auLvs
- hspiceD
- UltraSim

Tip

Although, multiple simulators may be supporting each component in `analogLib`, the descriptions, syntax, and examples used in this book are specific to `Spectre`. Components supported primarily by `hspiceD` are listed in Appendix B.

Licensing Requirements

For information on licensing in the Virtuoso Studio Design Environment, see Virtuoso Software Licensing and Configuration Guide.

Related Topics

Creating Analog Library Instances

Viewing Component Parameters Supported by Specific Simulators

Viewing and Editing Parameters for a Component

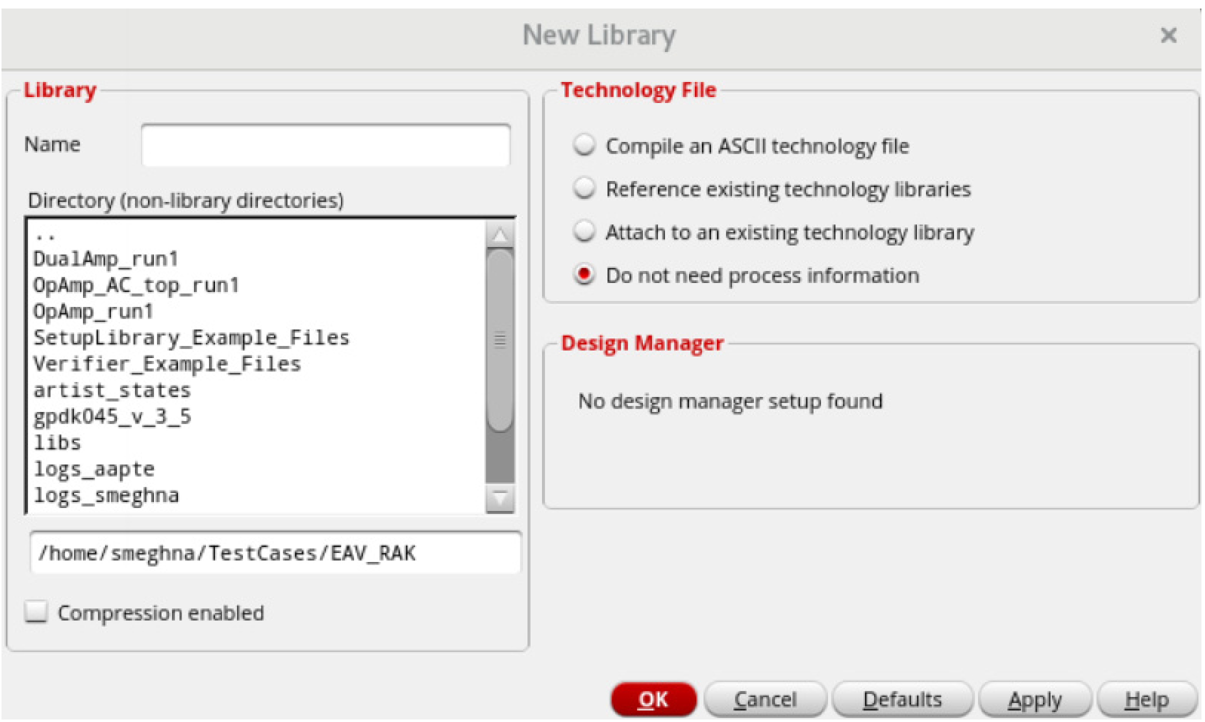
Creating Analog Library Instances

This topic lists all the basic parameters that you specify at the time of adding a component to a design. The Add Instance form may not show all the parameters at once. Depending on what values you specify for some parameters, more fields may appear in the Add Instance form. To display the parameters for a component using the Add Instance form, for these series of steps, create a library and cell.

1. Type `icms&` in the xterm window.

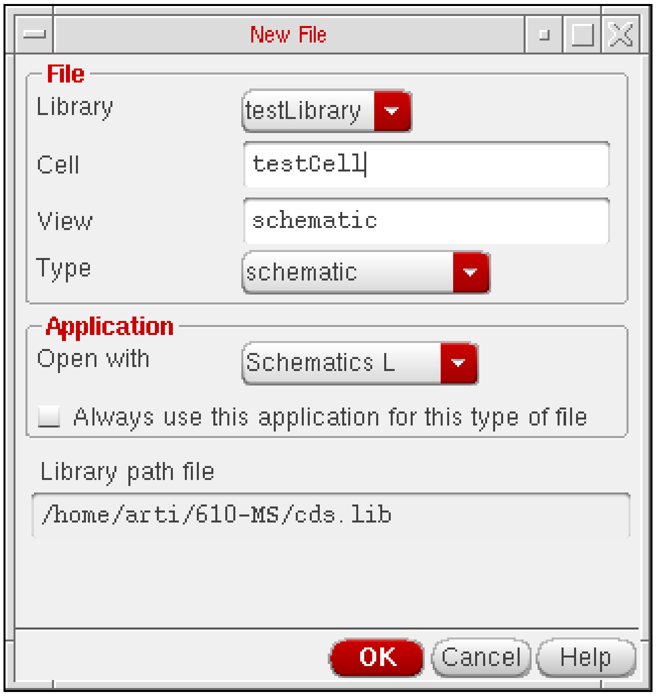
   The Cadence Information Window (CIW) appears.

2. Select *File – Close* to close all the *What's New* windows.
3. Select *File – New – Library* from CIW.
4. Type `testLibrary` in the Name field and select the *Do not need process information* radio button.



5. Click *OK*.
6. Select *File – New – Cellview* from CIW.

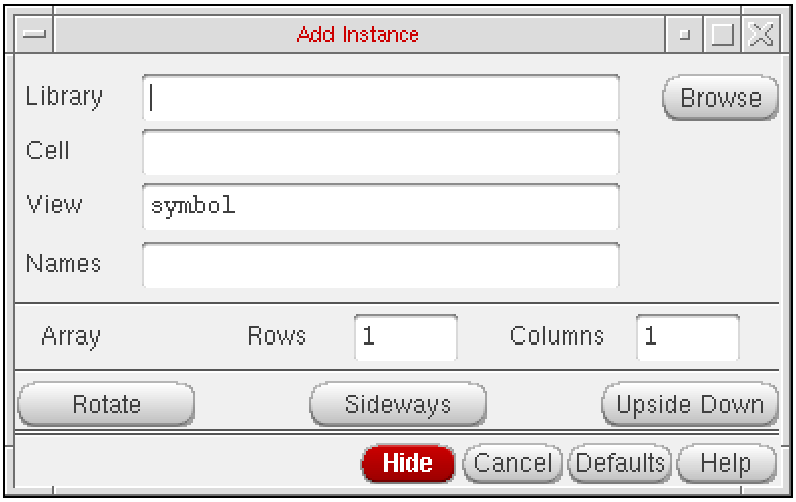
7. Select `testLibrary` in the *Library* field.



8. Type `testCell` in the *Cell* field and `schematic` in the *View* field.
9. Select `Schematic` from the Type list box.
10. Select the application from the *Open with* tool list box and click *OK*.

    The new cell is opened in Virtuoso Schematic Editor.
11. Select *Create – Instance* or click the *Create Instance* icon from the toolbar.

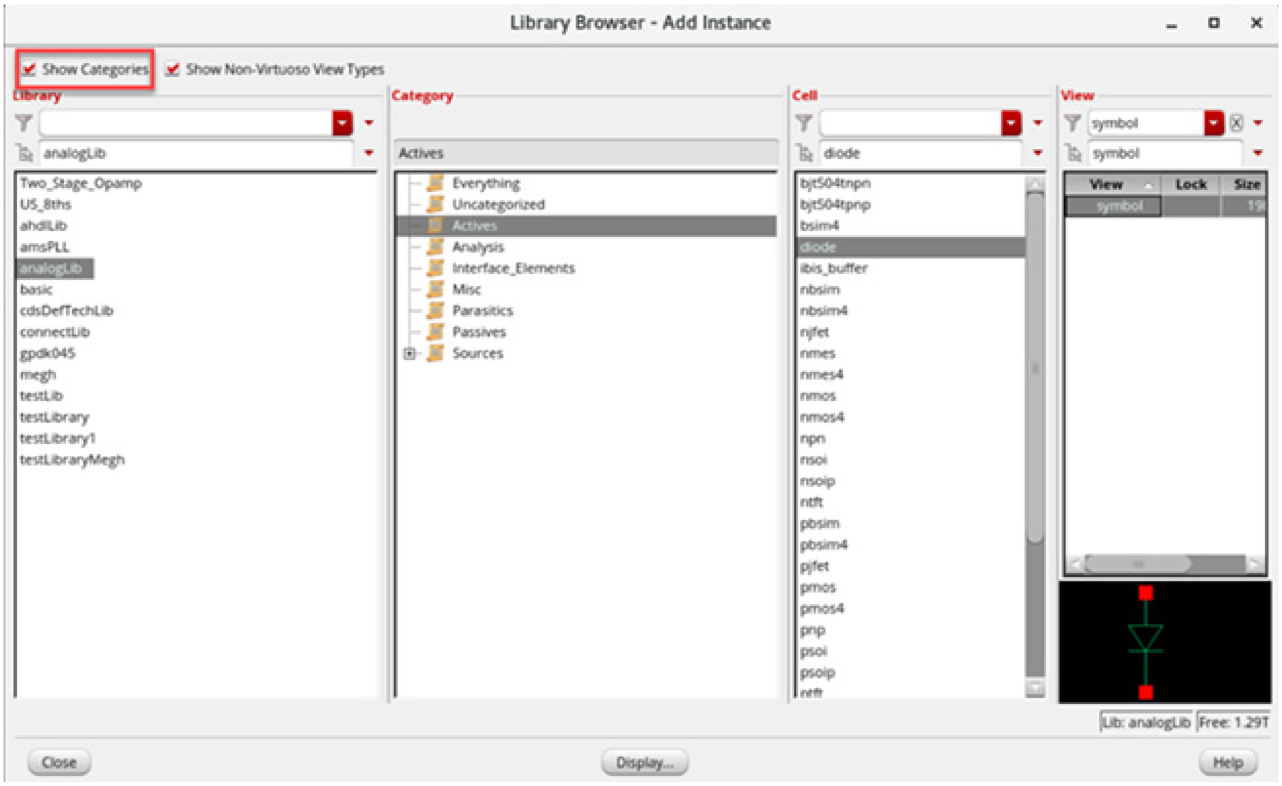
12. Click *Browse* from the Add Instance form.



13. Make sure that the *Show Categories* check box is selected in Library Browser.

14. Select `analogLib`, `Actives`, and `diode` from the Library, Category, and Cell list boxes respectively.

The View list box displays a list of the simulators that support the selected component. The `symbol` view applies to all components.

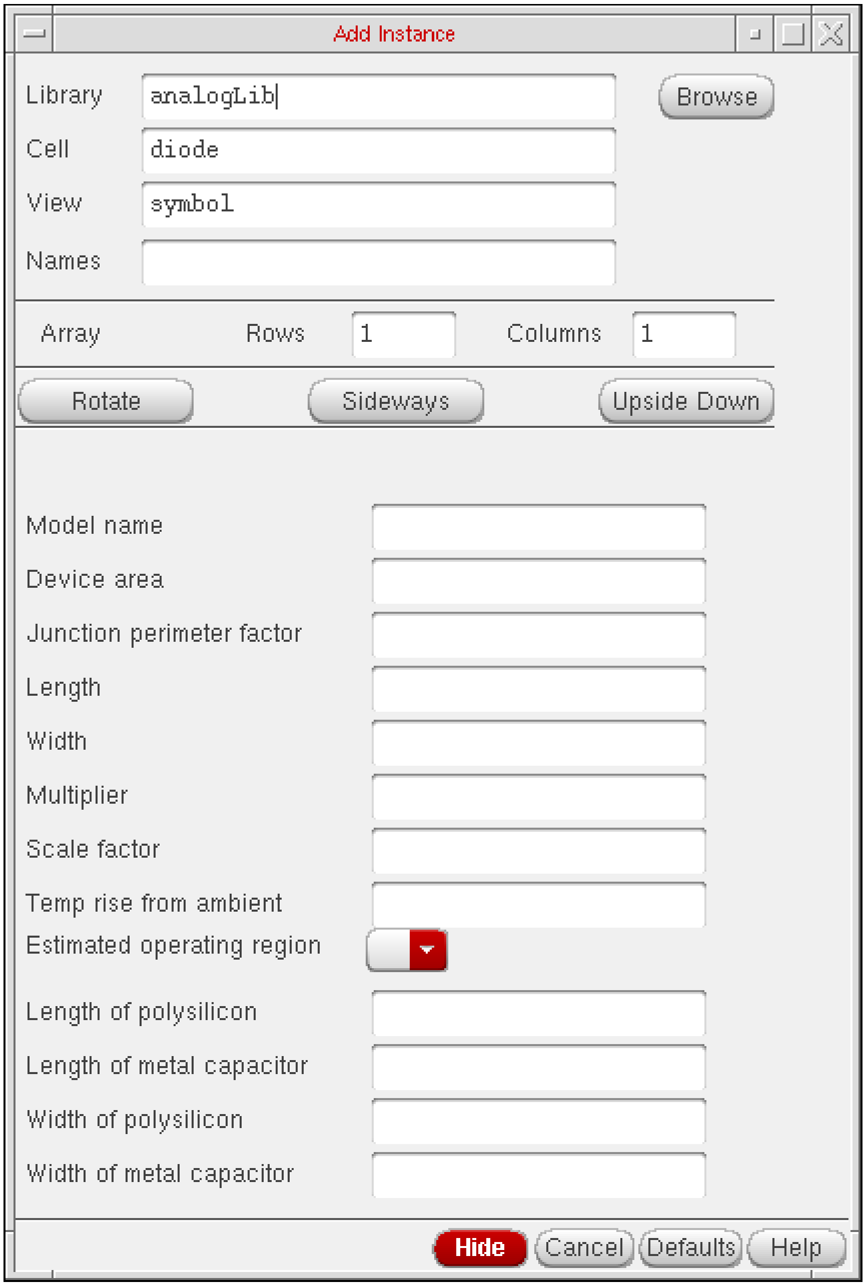


15. Select *symbol* from the View list box and click *Close*.

Notice the outline of the diode component when you move your cursor in the Virtuoso Schematic Editing window.

16. Click to place the component in the Virtuoso Schematic Editing window.

In the Add Instance form, notice that the library, cell, and view names appear in the *Library*, *Cell*, and *View* fields. The parameters for the selected component are also displayed.



These parameters are supported by the default simulators.

Related Topics

Viewing Component Parameters Supported by Specific Simulators

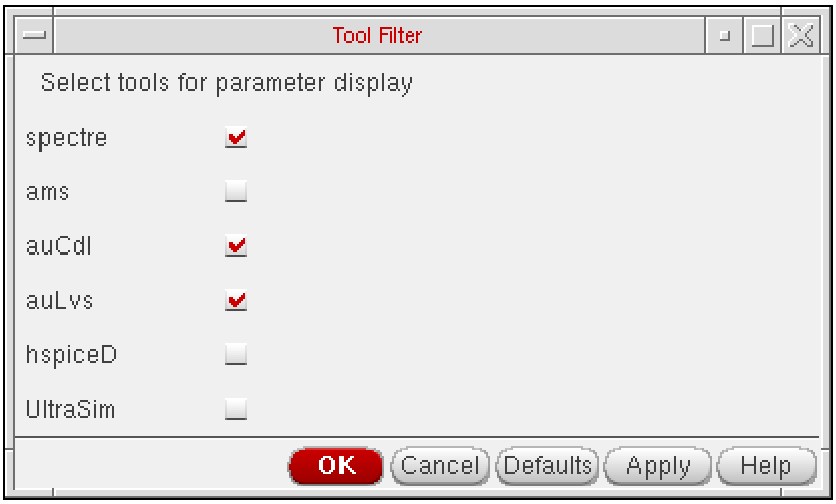
Viewing and Editing Parameters for a Component

Viewing Component Parameters Supported by Specific Simulators

To determine which simulators support which parameters, perform the following steps.

1. Select *Options – Tool Filter* from the Virtuoso Schematic Editing window.

   The Tool Filter form appears.



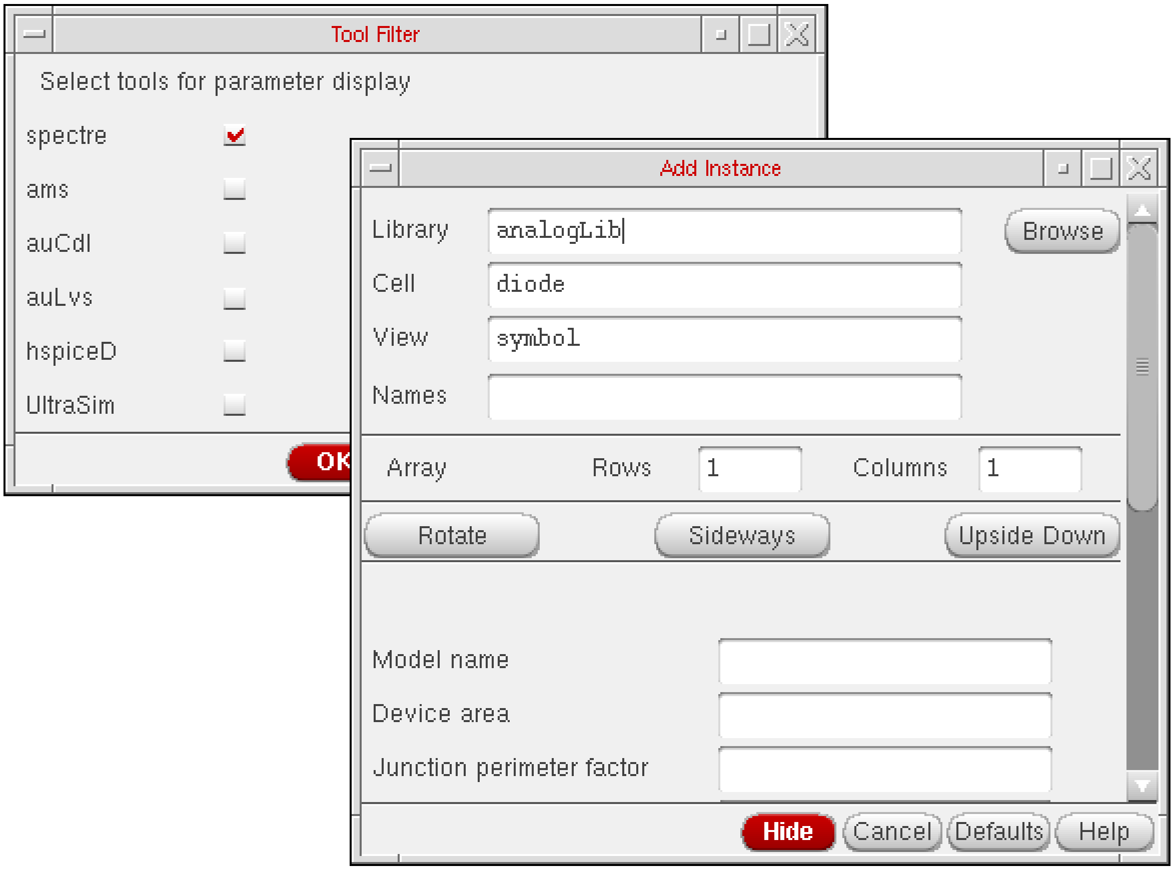
   By default, the `spectre`, `auCdl`, and `auLvs` simulators are selected.

2. Select the required simulator to view the supported parameters.

   For example, select only the `spectre` simulator in the Tool Filter form.

3. Click *Apply*.

Notice that the list of parameters in the Add Instance form changes to display only those parameters that are applicable for `Spectre` for the diode component.



In this way, you can identify those parameters of an `analogLib` component that are supported by specific simulators.

Related Topics

Creating Analog Library Instances

Viewing and Editing Parameters for a Component

Viewing and Editing Parameters for a Component

The properties of components are retrieved from their corresponding CDF parameters.

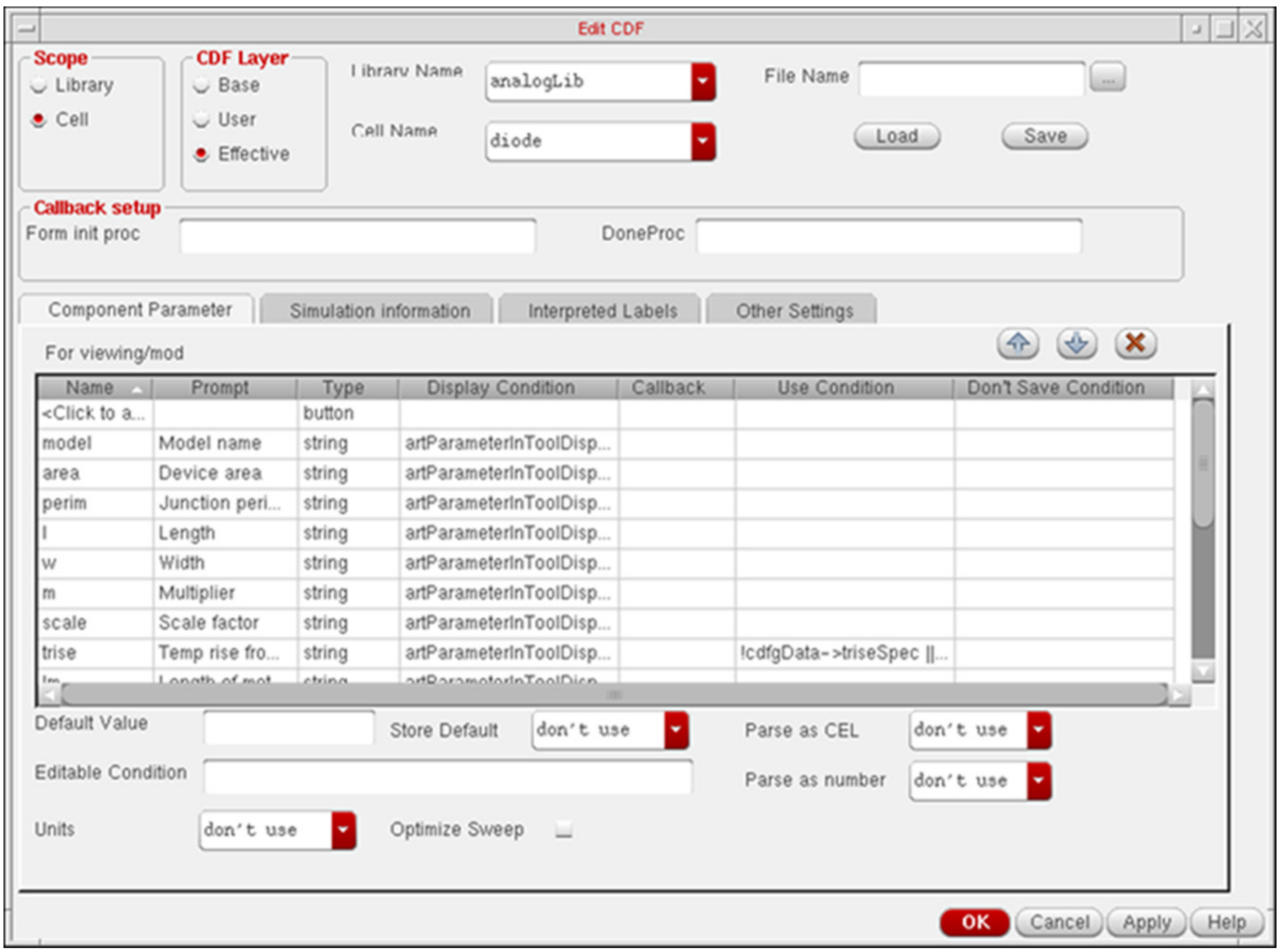
To view and edit the complete list of parameters for a component:

1. Select *Tools – CDF – Edit* from CIW.

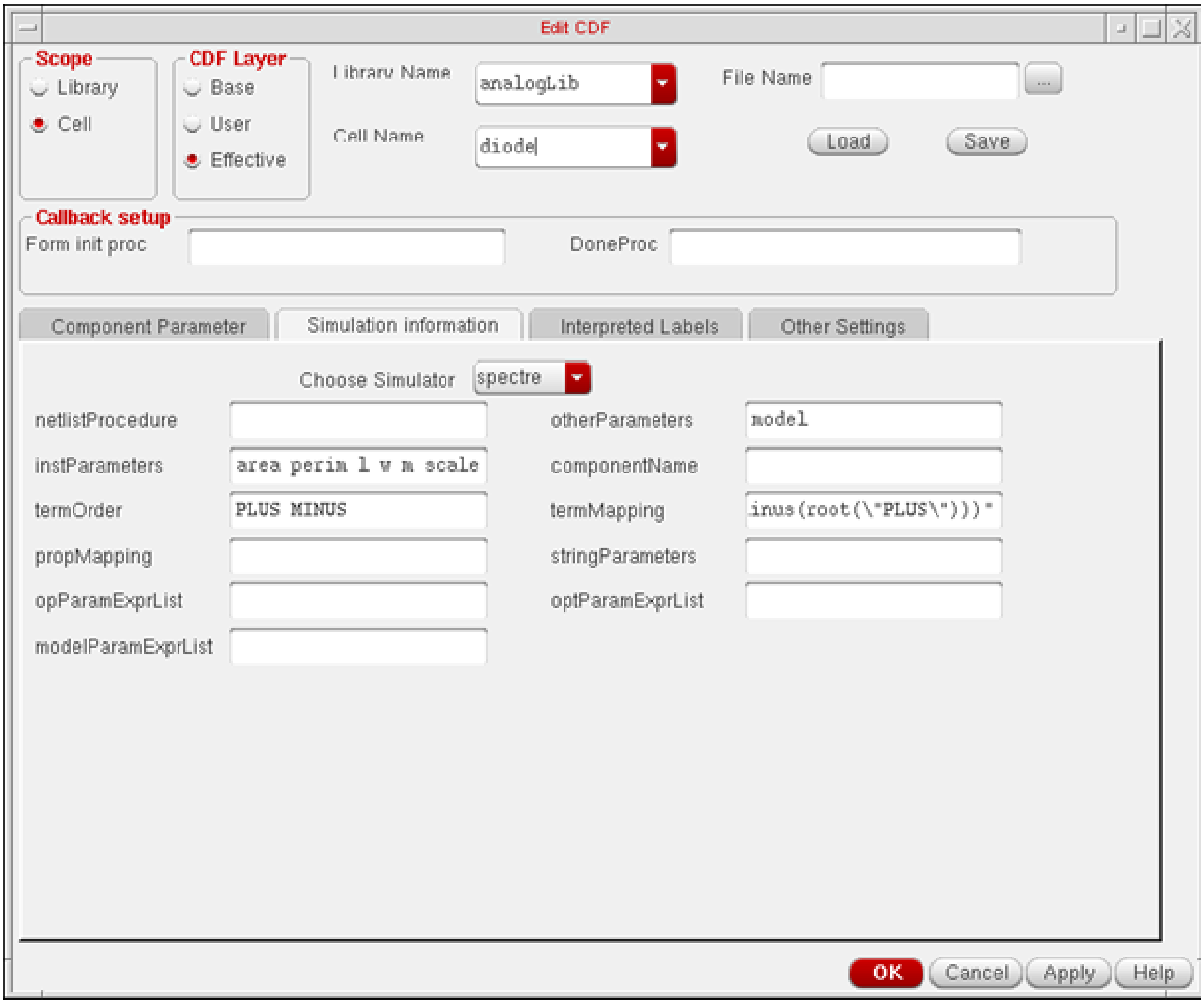
   The Edit CDF form appears.

2. Click *Browse* and select the library and cell names.

   The Edit CDF form displays the complete list of parameters for the selected component as shown below:



Click *Simulation Information* and select a simulator to view the list of parameters that the simulator supports. The fields appear blank for those simulators that do not support the selected component.



For more information on viewing and editing the CDF descriptions of a component, refer to the Component Description Format User Guide.

For modifying the simulation information refer to Modifying Simulation Information.

Caution

As far as possible, use the standard analogLib components shipped with an IC release. Do not mix or merge analogLib components with internal simInfo or CDF parameters from an older release with those from a newer release. For example, if you modify a local copy of the pcccs/spectre cell

> ***from the IC5032 release, create a sub-circuit, and later try to netlist the design using a newer release, such as IC5033, then the sub-circuit might not work correctly. This is because the base-level cell CDF information in the IC5032 release and the IC5033 release might not be the same.***

Related Topics

Creating Analog Library Instances

Viewing Component Parameters Supported by Specific Simulators

2

Active Components in Analog Library

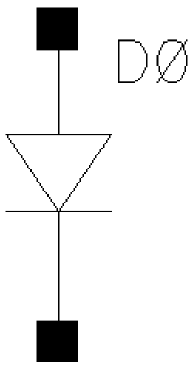
All components listed in the `Actives` category require a defined model card. Each element maps to a specific `Spectre` primitive with respect to its instance parameters.

The components in the `Actives` category are as follows:

- diode Symbol
- ibis_buffer Symbol
- nbsim Symbol
- nbsim4 Symbol
- njfet Symbol
- nmes Symbol
- nmos Symbol
- nmos4 Symbol
- npn Symbol
- nsoip Symbol
- ntft Symbol
- pbsim Symbol
- pbsim4 Symbol
- pjfet Symbol
- pmos Symbol
- pmos4 Symbol
- pnp Symbol
- psoi Symbol

- psoip Symbol
- ptft Symbol
- schottky Symbol
- usernpn Symbol
- userpnp Symbol
- vnpn Symbol
- vpnp Symbol
- zener Symbol

diode Symbol



Description

The junction diode model includes nonlinear junction capacitance and reverse breakdown. This device is supported within the altergroups.

Command-Line Help

```
spectre -h diode
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	–	–	x	–
Device area	`area`	x	–	–	x	–
Device initially off	`off`	–	–	–	x	–
Initial diode voltage	`Vd`	–	–	–	x	–
Junction perimeter factor	`perim`	x	–	–	–	–
Length	`l`	x	–	–	x	–
Width	`w`	x	–	–	x	–
Multiplier	`m`	x	–	–	x	–
Scale factor	`scale`	x	–	–	–	–
Temp rise from ambient	`trise`	x	–	–	–	–
Estimated operating region	`region`	x	–	–	–	–
Periphery of junction	`pj`	–	–	–	x	–
Width of polysilicon	`wp`	x	–	–	x	–
Length of polysilicon	`lp`	x	–	–	x	–
Width of metal capcitor	`wm`	x	–	–	x	–

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Length of metal capcitor	`lm`	x	-	-	x	-
Temperature difference	`dtemp`	-	-	-	x	-

Syntax/Synopsis

```
Name ( a c ) ModelName <parameter=value> ...
```

In the forward operation the voltage on the anode (‘a’) is more positive than the voltage on the cathode (‘c’).

Following is the model synopsis:

```
model ModelName diode <parameter=value> ...
```

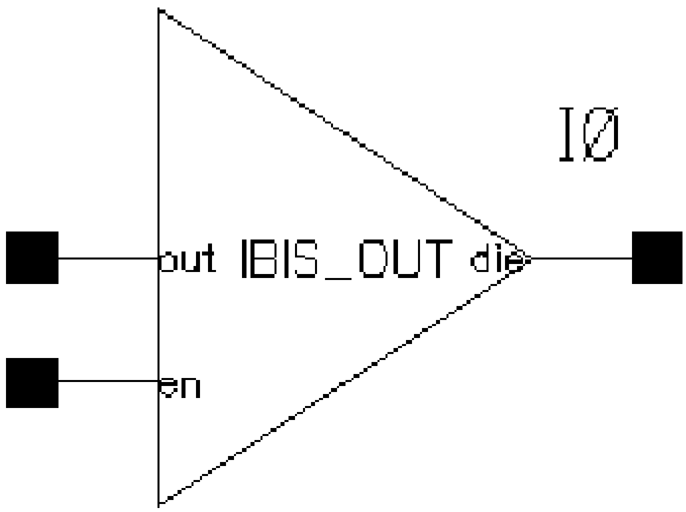
Examples

```
d0 (dp dn) pdiode l=3e-4 w=2.5e-4 area=1
```

Following is a sample model statement:

```
model pdiode diode is=1.8e-5 rs=1.43 n=1.22 nz=2.31 gleak=6.2e-5
rsw=10 isw=6.1e-10 ibv=0.95e-3 tgs=2 ik=1.2e7 fc=0.5 cj=1.43e-3
pb=0.967 mj=0.337 cjsw=2.76e-9 vjsw=0.94 jmax=1e20
```

ibis_buffer Symbol



Description

The IBIS buffer model is based on the I/O Buffer Information Specification standard, version `3.2`. The package and board models are not included in the buffer, they have to be added as separate subcircuits.

The `ibis_buffer` component is a `p-cell` that can have different pin combinations based on the selected buffer type. The supported buffer types are:

- `input`
- `output`
- `io`
- `tristate`
- `opendrain and opensink`
- `ioopendrain and ioopensink`
- `opensource`
- `ioopensource`

- `terminator`
- `inputecl`
- `outputecl`
- `ioecl`
- `tristateecl`

The following table lists the different pin combinations based on the buffer type. The presence of a pin is denoted by `Y`, absence of a pin is denoted by `N`, and optional pin is denoted by `O`.

Buffer Type	die/pad pin	input	output	enable	ground	power	ground clamp	power clamp	inverted die/pad pin
input	Y	Y	N	N	N	N	O	O	O
output	Y	N	Y	N	O	O	O	O	N
io	Y	Y	Y	Y	O	O	O	O	O
tristate	Y	N	Y	Y	O	O	O	O	N
opendrain opensink	Y	N	Y	N	O	N	O	N	N
ioopendrain ioopensink	Y	Y	Y	Y	O	N	O	N	O
opensource	Y	N	Y	N	N	O	N	O	N
ioopensource	Y	Y	Y	Y	N	O	N	O	O
terminator	Y	N	N	N	N	N	O	O	N
inputecl	Y	Y	N	N	N	N	O	O	O
outputecl	Y	N	Y	N	O	O	O	O	N
ioecl	Y	Y	Y	Y	O	O	O	O	O
tristateecl	Y	N	Y	Y	O	O	O	O	N

For each buffer type there can be four variants, `internal_power`, `external_power`, `differential _input`, and `diff_inp_and_ext_pwr`. Therefore, `ibis_buffer` can have `44` variants as shown in the following table.

	Buffer Type	Variant	die/pad	in	out	en	gnd	pwr	gnd_c	pwr_c	inv_die
1	input	1	Y	Y	N	N	N	N	N	N	N
2	input	2	Y	Y	N	N	N	N	Y	Y	N
3	input	3	Y	Y	N	N	N	N	N	N	Y
4	input	4	Y	Y	N	N	N	N	Y	Y	Y
5	output	1	Y	N	Y	N	N	N	N	N	N
6	output	2	Y	N	Y	N	Y	Y	Y	Y	N
7	io	1	Y	Y	Y	Y	N	N	N	N	N
8	io	2	Y	Y	Y	Y	Y	Y	Y	Y	N
9	io	3	Y	Y	Y	Y	N	N	N	N	Y
10	io	4	Y	Y	Y	Y	Y	Y	Y	Y	Y
11	tristate	1	Y	N	Y	Y	N	N	N	N	N
12	tristate	2	Y	N	Y	Y	Y	Y	Y	Y	N
13	opendrain	1	Y	N	Y	N	N	N	N	N	N
14	opendrain	2	Y	N	Y	N	Y	N	Y	N	N
15	ioopendrain	1	Y	Y	Y	Y	N	N	N	N	N
16	ioopendrain	2	Y	Y	Y	Y	Y	N	Y	N	N
17	ioopendrain	3	Y	Y	Y	Y	N	N	N	N	Y
18	ioopendrain	4	Y	Y	Y	Y	Y	N	Y	N	Y
19	opensource	1	Y	N	Y	N	N	N	N	N	N
20	opensource	2	Y	N	Y	N	N	Y	N	Y	N
21	ioopensource	1	Y	Y	Y	Y	N	N	N	N	N
22	ioopensource	2	Y	Y	Y	Y	N	Y	N	Y	N

	Buffer Type	Variant	die/pad	in	out	en	gnd	pwr	gnd_c	pwr_c	inv_die
23	`ioopensource`	3	Y	Y	Y	Y	N	N	N	N	Y
24	`ioopensource`	4	Y	Y	Y	Y	N	Y	N	Y	Y
25	`terminator`	1	Y	N	N	N	N	N	N	N	N
26	`terminator`	2	Y	N	N	N	N	N	Y	Y	N
27	`inputecl`	1	Y	Y	N	N	N	N	N	N	N
28	`inputecl`	2	Y	Y	N	N	N	N	Y	Y	N
29	`inputecl`	3	Y	Y	N	N	N	N	N	N	Y
30	`inputecl`	4	Y	Y	N	N	N	N	Y	Y	Y
31	`outputecl`	1	Y	N	Y	N	N	N	N	N	N
32	`outputecl`	2	Y	N	Y	N	Y	Y	Y	Y	N
33	`ioecl`	1	Y	Y	Y	Y	N	N	N	N	N
34	`ioecl`	2	Y	Y	Y	Y	Y	Y	Y	Y	N
35	`ioecl`	3	Y	Y	Y	Y	N	N	N	N	Y
36	`ioecl`	4	Y	Y	Y	Y	Y	Y	Y	Y	Y
37	`tristateecl`	1	Y	N	Y	Y	N	N	N	N	N
38	`tristateecl`	2	Y	N	Y	Y	Y	Y	Y	Y	N
39	`opensink`	1	Y	N	Y	N	N	N	N	N	N
40	`opensink`	2	Y	N	Y	N	Y	N	Y	N	N
41	`ioopensink`	1	Y	Y	Y	Y	N	N	N	N	N
42	`ioopensink`	2	Y	Y	Y	Y	Y	N	Y	N	N
43	`ioopensink`	3	Y	Y	Y	Y	N	N	N	N	Y
44	`ioopensink`	4	Y	Y	Y	Y	Y	N	Y	N	Y

Based on the model you have selected, you can create two types of `ibis_buffer`:

- with an external model card

  This is the default option. If you specify the model name the netlist is as follows:

```
b1 (1 2 3) "Model name" <other instance parameters>
```

For example, the netlist of an `ibis_buffer` with buffer type = `tristate`, buffer variant = `internal_power`, model name = `SN74_OUT_33_Typ_27degC`, polarity = `inv`, differential threshold = `1.2V`, delay time = `1ms`, delay schedule = `yes`, different element delays = `1p`, `2p`, `5p`, and `2p`, is as follows:

```
I65 (net013 net011 net012) SN74_OUT_33_Typ_27degC polarity=inv \
vdiff=1.2 delay=1m delay_schedule=[1p 2p 5p 2p]
```

- with an IBIS file

  If you specify an IBIS buffer file, then three additional parameters are displayed. In this case the netlist is as follows:

```
b1 (1 2 3) ibis_buffer file="IBIS file name" model="IBIS model name"
corner="IBIS model corner" <other instance parameters>
```

  For example, the netlist with the additional parameters IBIS filename = `~/main.scs`, IBIS modelname = `IBIS_Model`, corner = `typical` is as follows:

```
I65 (net013  net011 net012) ibis_buffer file="~/main.scs" \
model="IBIS_Model" corner=typical polarity=inv vdiff=1.2 delay=1m \
delay_schedule=[1p 2p 5p 2p]
```

Command-Line Help

```
spectre -h ibis_buffer
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Select IBIS Buffer Type	bufferType	x	-	-	x	-
param0	param0	x	-	-	x	-
Select IBIS Buffer Variant	bufferVariant2	x	-	-	x	-
Select IBIS Buffer Variant	bufferVariant4	x	-	-	x	-
IBIS Entry Method	ibisEntryMethod	x	-	-	x	-
Model name	model	x	-	-	x	-
IBIS file name	ibisFile	x	-	-	x	-
IBIS model name	ibisModelName	x	-	-	x	-
IBIS corner	ibisCorner	x	-	-	x	-
Polarity of the buffer	polarity	x	-	-	x	-
Differential threshold	vdiff	x	-	-	x	-
Delay Time	delay	x	-	-	x	-
Delay Schedule	ibisDelaySchedule	x	-	-	x	-
Rise on delay	rise_on_dly	x	-	-	x	-
Rise off delay	rise_off_dly	x	-	-	x	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Fall on delay	`fall_on_dly`	x	-	-	x	-
Fall off delay	`fall_off_dly`	x	-	-	x	-

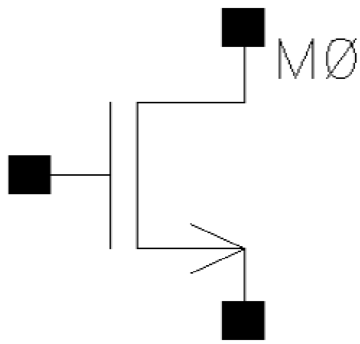
Syntax/Synopsis

```
Name ( die [inp] [out] [en] [gnd] [pwr] [gnd_c] [pwr_c] [inv_die] ) ModelName
        <parameter=value> ...
Name ( die [inp] [out] [en] [gnd] [pwr] [gnd_c] [pwr_c] [inv_die] )
        ibis_buffer <parameter=value> ...
```

Examples

```
I65 (net013 net011 net012) SN74_OUT_33_Typ_27degC polarity=inv \
vdiff=1.2 delay=1m delay_schedule=[1p 2p 5p 2p]
b1 (1 2 3) ibis_buffer file="IBIS file name" model="IBIS model name"
corner="IBIS model corner" <other instance parameters>
```

nbsim Symbol



Description

The component `nbsim` is an n-channel BSIM model. This device is supported within the altergroups. This device is supported within the altergroups.

Command-Line Help

For related information on MOS, use any of the following help commands:

```
spectre -h bsim1

spectre -h bsim2

spectre -h bsim3

spectre -h bsim3v3
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	x	-
Bulk node connection	`bn`	-	-	-	-	-
Multiplier	`m`	x	x	x	x	-
Width	`w`	x	x	x	x	-
Length	`l`	x	x	x	x	-
Drain diffusion area	`ad`	x	-	-	x	-
Source diffusion area	`as`	x	-	-	-	-
Drain diffusion periphery	`pd`	x	-	-	x	-
Source diffusion periphery	`ps`	x	-	-	x	-
Drain diffusion res squares	`nrd`	x	-	-	x	-
Source diffusion res squares	`nrs`	x	-	-	x	-
Drain diffusion length	`ld`	x	-	-	-	-
Source diffusion length	`ls`	x	-	-	-	-
NQS flag	`nqsmod`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Temp rise from ambient	`trise`	x	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-
Device initially off	`off`	-	-	-	x	-
Drain source initial voltage	`Vds`	-	-	-	x	-
Gate source initial voltage	`Vgs`	-	-	-	x	-
Bulk source initial voltage	`Vbs`	-	-	-	x	-
Additional drain resistance	`rdc`	x	-	-	x	-
Additional source resistance	`rsc`	x	-	-	x	-
Dist. OD & poly(one side)	`sa`	x	-	-	-	-
Dist. OD & poly(other side)	`sb`	x	-	-	-	-
Dist. betn neighbour fingers	`sd`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Temperature difference	`dtemp`	-	-	-	x	-
Source/ drain selector	`geo`	x	-	-	x	-

Syntax/Synopsis

```
Name ( d g s b ) ModelName <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName bsim1 <parameter=value> ...
```

Examples

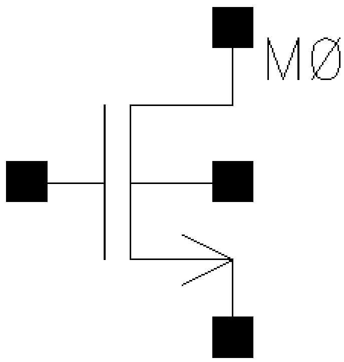
Following is a sample instance statement:

```
m1 (1 2 0 0) nchmod l=5u w=10u as=40u ad=40u pd=28u ps=28u m=1
```

Following is a sample model statement:

```
model nchmod bsim1 vfb0=-0.5 lvfb=0.5 wvfb=0.3 phi0=0.8 eta0=0.056 k1=0.5 muz=454
eg=0.99 gap1=5.5e-04 trs=1e-3 trd=1e-3 xpart=0.5 rs=10 rd=10
```

nbsim4 Symbol



Description

BSIM4 transistors require you to use a model statement. N-type BSIM Mos transistor has 4 terminals. `BSIM4` is the version-`4.21` of the `bsim` model. This device is supported within the altergroups.

Command-Line Help

For related information on MOS, use any of the following help commands:

```
spectre -h bsim4
```

```
spectre -h bsim1
```

```
spectre -h bsim2
```

```
spectre -h bsim3
```

```
spectre -h bsim3v3
```

Component Parameters

The CDF parameters for `nbsim4` are the same as the CDF parameters for `nbsim Symbol`.

Syntax/Synopsis

```
Name ( d g s b ) ModelName <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName bsim4 <parameter=value> ...
```

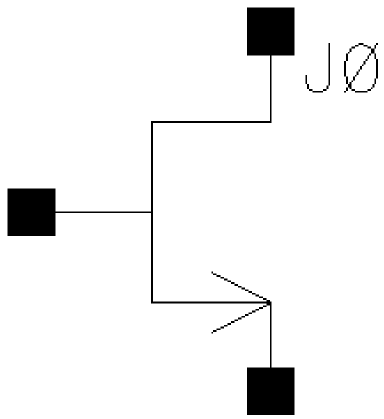
Examples

```
m4 (0 2 1 1) pchmod w=2u l=0.8u as=250p ad=250p pd=168p ps=168p m=1
```

Following is a sample model statement

```
model pchmod bsim4 type=p mobmod=0 capmod=2 version=4.21 toxe=3e-9
cdsc=2.58e-4 cdscb=0 cdscd=6.1e-8 cit=0 nfactor=1.1 xj=9e-8
vfb=0.76vsat=9.2e4 at=3.3e4 a0=1.1 ags=1.0e-20 a1=0 ngate=9e19
vth0=-0.42a1=0 a2=1 delta=0.014 pvag=1e-20 pclm=6.28e-4 pdits=0.2
pditsl=2.3e6pditsd=0.23 fprout=0.2 pdiblcb=3.4e-8 pdiblc1=0.81
drout=0.56pdiblc2=9.84e-6 pscbe1=8.14e8 pscbe2=9.58e-07 lint=5e-9
wint=5e-9dmcg=5e-6 dmci=5e-6 dmdg=5e-6 dmcgt=6e-7 dwj=4.5e-8
rsh=6cgso=7.43e-10 cgdo=7.43e-10 cgbo=2.56e-11 cgsl=1e-14
cgdl=1e-14ckappas=0.5 ckappad=0.5 noff=0.9 voffcv=0.02 acde=1 moin=15
xpart=0kt1l=0 kt2=2.2e-2 lpe0=5.75e-8 lpeb=2.3e-10 dvt0=2.89
dvt1=0.53dvt2=-3.2e-2 dvt0w=0 dvt1w=0 dvt2w=0 dvtp0=7.32e-7
dvtp1=0.12dsub=0.058 eta0=0.001 u0=4.19e-2 ua=8.7e-16 ub=3.06e-18
k1=0.33uc=4.6e-13 ute=-1.5 ua1=4.31e-9 ub1=7.61e-18 uc1=-5.6e-11
k2=-1.87e-2rdsw=369.4 rdw=184.7 rsw=184.7 prwg=3.22e-8 prwb=6.8e-11
wr=1rdswmin=0 rdwmin=0 rswmin=0 prt=0 b0=-1e-20 k3=80 k3b=0
w0=2.5e-6b1=0 keta=-0.047 alpha0=7.4e-2 alpha1=0.005 beta0=30
```

njfet Symbol



Description

The JFET model is derived from the FET model of Shichman and Hodges. JFETs require you to use a model statement. This device is supported within the altergroups. N-type Junction Field Effect Transistor is a n-channel JFET.

Command-Line Help

```
spectre -h jfet
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-
Bulk node connection	`bn`	-	-	-	-	-
Device area	`area`	x	-	-	x	-
Device initially off	`off`	-	-	-	x	-
Drain source initial voltage	`Vds`	-	-	-	x	-
Gate source initial voltage	`Vgs`	-	-	-	x	-
Gate to bulk and src voltage	`Vgbs`	-	-	-	x	-
Multiplier	`m`	x	-	-	x	-
Estimated operating region	`region`	x	-	-	-	-
Width	`w`	-	-	-	x	-
Length	`l`	-	-	-	x	-
Temperature difference	`dtemp`	-	-	-	x	-

Syntax/Synopsis

```
Name ( d g s [b] ) ModelName <parameter=value> ...
```

You do not have to specify the back gate terminal when you use the four-terminal model. If left unspecified, the substrate is connected to ground.

Following is the model Synopsis:

```
model ModelName jfet <parameter=value> ...
```

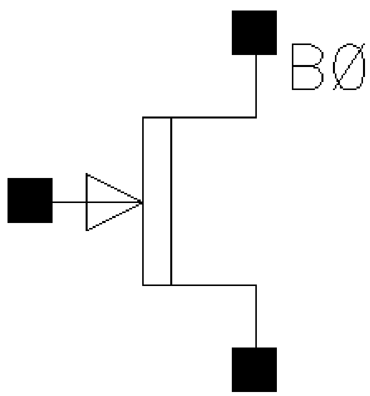
Examples

```
jf1 (net1 net2 0) jmod area=1
```

Following is a sample model statement:

```
model jmod jfet beta=9e-5 lambda=0 type=n vt0=-18.7 rd=10 rs=10 cgs=1.3e-13 pb=0.65
```

nmes Symbol



Description

The GaAs MESFET model is derived from the model by H. Statz and others at Raytheon. This model is completely symmetric and is modified slightly to make it charge conserving. GaAs MESFET instances require that you use a model statement. This device is supported within the altergroups.

Command-Line Help

```
spectre -h gaas
```

```
spectre -h tom2
```

```
spectre -h tom3
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-
Bulk node connection	`bn`		-	-	-	-
Device area	`area`	x	-	-	x	-
Device initially off	`off`	-	-	-	x	-
Drain source initial voltage	`Vds`	-	-	-	x	-
Gate source initial voltage	`Vgs`	-	-	-	x	-
Bulk source initial voltage	`Vbs`	-	-	-	x	-
Multiplier	`m`	x	-	-	x	-
Estimated operating region	`region`	x	-	-	-	-
Width	`w`	-	-	-	x	-
Length	`l`	-	-	-	x	-
Temperature difference	`dtemp`	-	-	-	x	-

Syntax/Synopsis

```
Name ( d g s ) ModelName <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName gaas <parameter=value> ...
```

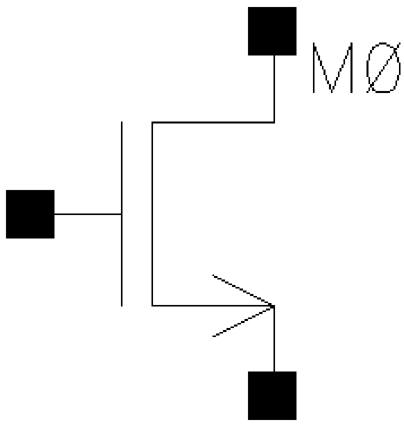
Examples

```
m1 (1 2 0) nmes area=1 m=2
```

Following is a sample model statement:

```
model nmes gaas type=n vto=-2 beta=0.06 lambda=0 b=0.25 rs=3.65 alpha=1.9 rd=1.98
is=1.1e-9 n=1.28 fc=0.5 cgs=0.365e-12
```

nmos Symbol



Description

N-type Generic MOS Transistor is an `Actives` component with 3 terminals.

Command-Line Help

For related information on MOS, use any of the following help commands:

```
spectre -h mos0
```

```
spectre -h mos1
```

```
spectre -h ekv
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	x	-
Bulk node connection	`bn`	-	-	-	-	-
Multiplier	`m`	x	x	x	x	-
Width	`w`	x	x	x	x	-
Length	`l`	x	x	x	x	-
Drain diffusion area	`ad`	x	-	-	x	-
Source diffusion area	`as`	x	-	-	x	-
Drain diffusion periphery	`pd`	x	-	-	x	-
Source diffusion periphery	`ps`	x	-	-	x	-
Drain diffusion res squares	`nrd`	x	-	-	x	-
Source diffusion res squares	`nrs`	x	-	-	x	-
Drain diffusion length	`ld`	x	-	-	-	-
Source diffusion length	`ls`	x	-	-	-	-

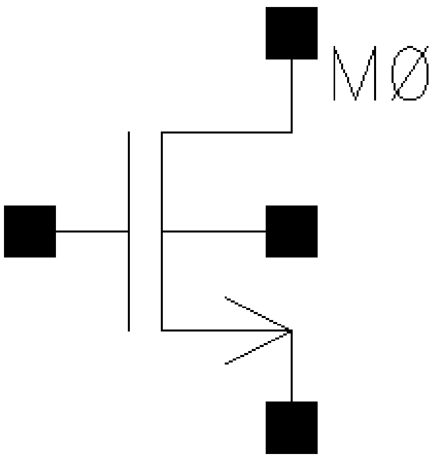
CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Device initially off	`off`	-	-	-	x	-
Drain source initial voltage	`Vds`	-	-	-	x	-
Gate source initial voltage	`Vgs`	-	-	-	x	-
Bulk source initial voltage	`Vbs`	-	-	-	x	-
Temp rise from ambient	`trise`	x	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-
Hot-electron degradation	`degradation`	x	-	-	-	-
Additional drain resistance	`rdc`	x	-	-	x	-
Additional source resistance	`rsc`	x	-	-	x	-
Dist. OD & poly(one side)	`sa`	x	-	-	-	-
Dist. OD & poly(other side)	`sb`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Dist. betn neighbour fingers	`sd`	x	-	-	-	-
Temperature difference	`dtemp`	-	-	-	x	-
Source/ drain selector	`geo`	x	-	-	x	-

Examples

```
M0 (net3 net1 net2) nmos
```

nmos4 Symbol



Description

N-type Generic MOS Transistor is an `Actives` component with 4 terminals.

Command-Line Help

For related information on MOS, use any of the following help commands:

```
spectre -h mos0
```

```
spectre -h mos1
```

```
spectre -h ekv
```

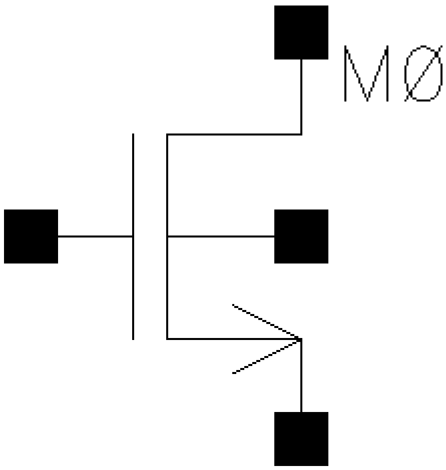
Component Parameters

The CDF parameters for `nmos4` are the same as the CDF parameters for nmos Symbol.

Examples

```
M0 (net1 net3 net4 net2) nmos4
```

npn Symbol



Description

Generic Bipolar Transistor (`npn`) is an ntype bjt. This device is supported within the altergroups.

Command-Line Help

```
spectre -h bjt

spectre -h bjt2

spectre -h bjt3

spectre -h bjt301

spectre -h vbic
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	x	-
Bulk node connection	`bn`	-	-	-	-	-
Device area	`area`	x	-	-	x	-
Base-emitter voltage	`Vbe`	-	-	-	x	-
Collector-emitter voltage	`Vce`	-	-	-	x	-
Device initially off	`off`	-	-	-	x	-
Multiplier	`m`	x	-	-	x	-
Temp rise from ambient	`trise`	x	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-
Temperature difference	`dtemp`	-	-	-	x	-
Base area	`areab`	-	-	-	x	-
Collector area	`areac`	-	-	-	x	-
Temp Rise Specifier	`triseSpec`	x	-	-	-	-
dtmp -Temp rise from ambient	`dtmp`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
dtemp - Temp rise from ambient	`dtempn`	-	-	-	-	-

Syntax/Synopsis

```
Name ( c b e [s] ) ModelName <parameter=value> ...
```

You do not have to specify the substrate terminal. If you do not specify it, the substrate is connected to ground.

Following is the model synopsis:

```
model ModelName bjt <parameter=value> ...
```

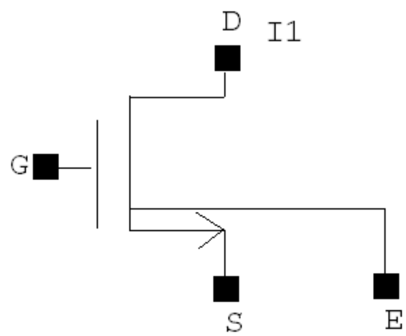
Examples

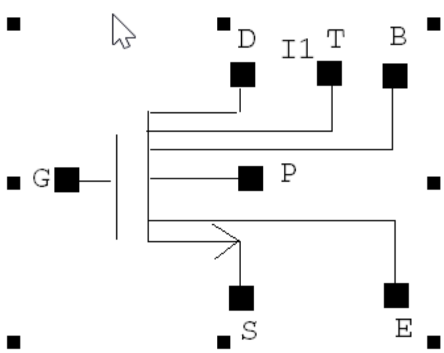
```
q1 (vcc net3 minus) npn_mod region=fwd area=1 m=1
```

Following is a sample model statement:

```
model npn_mod bjt type=npn is=10e-13 bf=200 va=58.8 ikf=5.63e-3 rb=700 rbm=86
re=3.2 cje=0.352e-12 pe=0.76 me=0.34 tf=249e-12 cjc=0.34e-12 pc=0.55
```

nsoip Symbol





Description

N-type BSIM SOI model (`nsoip`) is an n-type BSIM SOI model. In `nsoip`, there are four optional parameters in the CDF properties of the n-cell:

- Temperature Node present (`Tnode Out`)
- Thermal Node (`T`)
- External Body contact (`P`)
- Body Node (`B`)

There can be a number of permutations and combinations for these pins, however, only following seven permutations are supported:

- if `Tnodeout` = `0` or not given. The default is `0`.

  `4 nodes: D G S E`

`5 nodes: D G S E P`

`6 nodes: D G S E P B`

`7 nodes: D G S E P B T`

- if `Tnodeout` = `1`

`5 nodes: D G S E T`

`6 nodes: D G S E P T`

`7 nodes: D G S E P B T`

Command-Line Help

```
spectre -h bsimsoi
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-
Temperature Node Present	`TnodeOut` (earlier this was `bn`, therefore check)	x	-	-	-	-
Thermal Node(T)	`Tnode`	x	-	-	-	-
Ext. Body Contact (PinP)	`PinP`	x	-	-	-	-
Body Node	`BodyNodePin`	x	-	-	-	-
Width	`w`	x	-	-	-	-
Length	`l`	x	-	-	-	-
Source diffusion area	`as`	x	-	-	-	-
Drain diffusion area	`ad`	x	-	-	-	-
Source diffusion periphery	`ps`	x	-	-	-	-
Drain diffusion periphery	`pd`	x	-	-	-	-
Drain diffusion res squares	`nrd`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Source diffusion res squares	`nrs`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-

Syntax/Synopsis

```
Name ( d g s e [p] [b] [t] ) ModelName <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName bsimsoi <parameter=value> ...
```

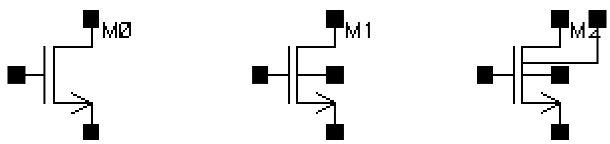
Examples

```
I6 (vdd! net9 0 0 ) bsimsoi w=1u 1=1u
```

Following is a sample model statement:

```
model nsoip_model bsimsoi type = n beta0 = 0 dvt = -0.032 delta = 0.01 k1 = 0.6
xbjt = 1 kt1 = -0.11 ndif = -1 noif = 1 vsdfb = 0 vevb = 0.075 dvt1 = 0.53
```

ntft Symbol



Description

N-Type Poly-Si TFT (`ntft`) is an n-type polysilicon tft. It can have a maximum of five terminals with drain, gate and source being mandatory terminals and substrate and thermal being optional. This device is supported within the altergroups.

The figures show the terminal with none, one or two optional nodes selected.

Command-Line Help

```
spectre -h psitft
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-	-	-	-
Optional Nodes	`Opins`	x	-	-	-	-	-	-	-
Optional Bulk Node _B	`bulknode`	x	-	-	-	-	-	-	-
Optional Thermal Node _T	`pinT`	x	-	-	-	-	-	-	-
Width	`w`	x	-	-	-	-	-	-	-
Length	`l`	x	-	-	-	-	-	-	-
Drain diffusion res squares	`nrd`	x	-	-	-	-	-	-	-
Source diffusion res squares	`nrs`	x	-	-	-	-	-	-	-
Multiplier	`m`	x	-	-	-	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-	-	-	-
Thermal resistance	`rth0`	x	-	-	-	-	-	-	-
Thermal capacitance	`cth0`	x	-	-	-	-	-	-	-
Num of segments	`nseg`	x	-	-	-	-	-	-	-

Syntax/Synopsis

```
Name ( d g s [b] [t] ) ModelName <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName psitft <parameter=value> ...
```

Examples

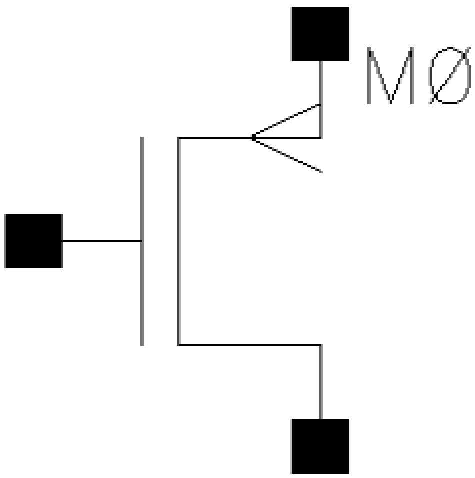
Following is a sample instance statement:

```
m4 (0 2 1 1 3) nch w=2u l=0.8u
```

Following is a sample model statement:

```
model nch psitft type=n
```

pbsim Symbol



Description

P-type BSIM MOS Transistor (`pbsim`) is a p-channel BSIM model with 3 terminals. This device is supported within the altergroups.

Command-Line Help

For related information on MOS, use any of the following help commands:

```
spectre -help bsim1

spectre -help bsim2

spectre -help bsim3

spectre -help bsim3v3
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	x	-
Bulk node connection	`bn`	-	-	-	-	-
Multiplier	`m`	x	x	x	x	-
Width	`w`	x	x	x	x	-
Length	`l`	x	x	x	x	-
Drain diffusion area	`ad`	x	-	-	x	-
Source diffusion area	`as`	x	-	-	x	-
Drain diffusion periphery	`pd`	x	-	-	x	-
Source diffusion periphery	`ps`	x	-	-	x	-
Drain diffusion res squares	`nrd`	x	-	-	x	-
Source diffusion res squares	`nrs`	x	-	-	x	-
Drain diffusion length	`ld`	x	-	-	-	-
Source diffusion length	`ls`	x	-	-	-	-
NQS flag	`nqsmod`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Device initially off	`off`	-	-	-	x	-
Drain source initial voltage	`Vds`	-	-	-	x	-
Gate source initial voltage	`Vgs`	-	-	-	x	-
Bulk source initial voltage	`Vbs`	-	-	-	x	-
Additional drain resistance	`rdc`	x	-	-	x	-
Additional source resistance	`rsc`	x	-	-	x	-
Temp rise from ambient	`trise`	x	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-
Dist. OD & poly(one side)	`sa`	x	-	-	-	-
Dist. OD & poly(other side)	`sb`	x	-	-	-	-
Dist. betn neighbour fingers	`sd`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Temperature difference	dtemp	-	-	-	x	-
Source/ drain selector	geo	x	-	-	x	-

Syntax/Synopsis

```
Name ( d g s b ) ModelName <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName bsim1 <parameter=value> ...
```

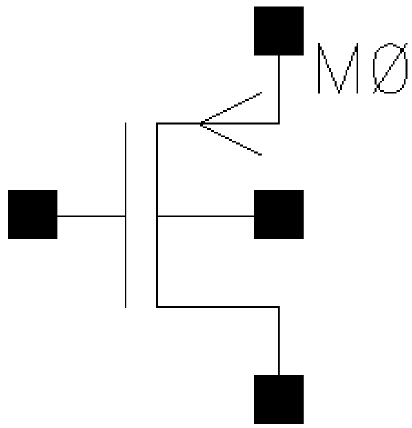
Examples

```
m1 (1 2 0 0) nchmod l=5u w=10u as=40u ad=40u pd=28u ps=28u m=1
```

Following is a sample model statement:

```
model nchmod bsim1 vfb0=-0.5 lvfb=0.5 wvfb=0.3 phi0=0.8 eta0=0.056 k1=0.5
muz=454 eg=0.99 gap1=5.5e-04 trs=1e-3 trd=1e-3 xpart=0.5 rs=10 rd=10
```

pbsim4 Symbol



Description

P-type BSIM MOS transistor (`pbsim`) is a p-channel BSIM model with 4 terminals. This device is supported within the altergroups.

Command-Line Help

For related information on MOS, use any of the following help commands:

```
spectre -help bsim1
```

```
spectre -help bsim2
```

```
spectre -help bsim3
```

```
spectre -help bsim3v3
```

Component Parameters

The CDF parameters for `pbsim4` are the same as the CDF parameters for pbsim Symbol.

Syntax/Synopsis

```
Name ( d g s b ) ModelName <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName bsim1 <parameter=value> ...
```

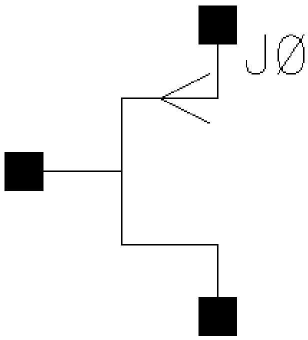
Examples

```
m1 (1 2 0 0) nchmod l=5u w=10u as=40u ad=40u pd=28u ps=28u m=1
```

Following is a sample model statement:

```
model nchmod bsim1 vfb0=-0.5 lvfb=0.5 wvfb=0.3 phi0=0.8 eta0=0.056 k1=0.5
muz=454 eg=0.99 gap1=5.5e-04 trs=1e-3 trd=1e-3 xpart=0.5 rs=10 rd=10
```

pjfet Symbol



Description

The JFET model is derived from the FET model of Shichman and Hodges. JFETs require you to use a model statement. This device is supported within the altergroups. P-type Junction Field Effect Transistor is a p-channel JFET.

Command-Line Help

```
spectre -h jfet
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-
Bulk node connection	`bn`	-	-	-	-	-
Device area	`area`	x	-	-	x	-
Device initially off	`off`	-	-	-	x	-
Drain source initial voltage	`Vds`	-	-	-	x	-
Gate source initial voltage	`Vgs`	-	-	-	x	-
Gate to bulk and src voltage	`Vgbs`	-	-	-	x	-
Multiplier	`m`	x	-	-	x	-
Width	`w`	-	-	-	x	-
Length	`l`	-	-	-	x	-
Temperature difference	`dtemp`	-	-	-	x	-
Estimated operating region	`region`	x	-	-	-	-

Syntax/Synopsis

```
Name ( d g s [b] ) ModelName <parameter=value> ...
```

You do not have to specify the back gate terminal when you use the four-terminal model. If left unspecified, the substrate is connected to ground.

Following is the model synopsis:

```
model ModelName jfet <parameter=value> ...
```

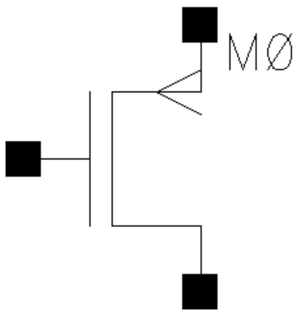
Examples

```
jf1 (net1 net2 0) jmod area=1
```

Following is a sample sodel statement:

```
model jmod jfet beta=9e-5 lambda=0 type=n vt0=-18.7 rd=10 rs=10 cgs=1.3e-13 pb=0.65
```

pmos Symbol



Description

P-Type Generic MOS Transistor (`pmos`) is a p-channel MOS transistor with 3 terminals.

Command-Line Help

For related information on MOS, use any of the following help commands:

```
spectre -h mos0
```

```
spectre -h mos1
```

```
spectre -h ekv
```

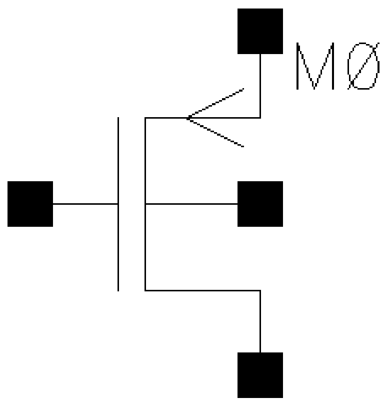
Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-
Bulk node connection	`bn`	-	-	-	-	-
Multiplier	`m`	x	x	x	x	-
Width	`w`	x	x	x	x	-
Length	`l`	x	x	x	x	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Drain diffusion area	`ad`	x	-	-	x	-
Source diffusion area	`as`	x	-	-	x	-
Drain diffusion periphery	`pd`	x	-	-	x	-
Source diffusion periphery	`ps`	x	-	-	x	-
Drain diffusion res squares	`nrd`	x	-	-	x	-
Source diffusion res squares	`nrs`	x	-	-	x	-
Drain diffusion length	`ld`	x	-	-	-	-
Source diffusion length	`ls`	x	-	-	-	-
Device initially off	`off`	-	-	-	x	-
Drain source initial voltage	`Vds`	-	-	-	x	-
Gate source initial voltage	`Vgs`	-	-	-	x	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Bulk source initial voltage	`Vbs`	-	-	-	x	-
Temp rise from ambient	`trise`	x	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-
Hot-electron degradation	`degradation`	x	-	-	-	-
Additional drain resistance	`rdc`	x	-	-	x	-
Additional source resistance	`rsc`	x	-	-	x	-
Dist. OD & poly(one side)	`sa`	x	-	-	-	-
Dist. OD & poly(other side)	`sb`	x	-	-	-	-
Dist. betn neighbour fingers	`sd`	x	-	-	-	-
Temperature difference	`dtemp`	-	-	-	x	-
Source/ drain selector	`geo`	x	-	-	x	-

pmos4 Symbol



Description

P-Type Generic MOS Transistor (`pmos4`) is a p-channel MOS transistor with 4 terminals.

Command-Line Help

For related information on MOS, use any of the following help commands:

```
spectre -h mos0
```

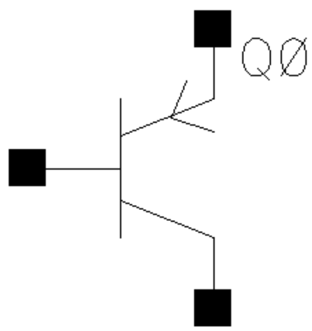
```
spectre -h mos1
```

```
spectre -h ekv
```

Component Parameters

The CDF parameters for `pmos4` are the same as the CDF parameters for pmos Symbol.

pnp Symbol



Description

Generic Bipolar Transistor (`pnp`) is a p-type bjt. This device is supported within the altergroups.

Command-Line Help

```
spectre -h bjt
```

```
spectre -h bjt2
```

```
spectre -h bjt3
```

```
spectre -h bjt301
```

```
spectre -h vbic
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	x	-
Bulk node connection	`bn`	-	-	-	-	-
Device area	`area`	x	-	-	x	-
Multiplier	`m`	x	-	-	x	-
Temp rise from ambient	`trise`	x	-	-	-	-
Temp Rise Specifier	`triseSpec`	x	-	-	-	-
dtmp -Temp rise from ambient	`dtmp`	x	-	-	-	-
dtemp - Temp rise from ambient	`dtempn`	-	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-
Base-emitter voltage	`Vbe`	-	-	-	x	-
Collector-emitter voltage	`Vce`	-	-	-	x	-
Device initially off	`off`	-	-	-	x	-
Temperature difference	`dtemp`	x	-	-	x	-
Base area	`areab`	-	-	-	x	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Collector area	`areac`	-	-	-	x	-

Syntax/Synopsis

```
Name ( c b e [s] ) ModelName <parameter=value> ...
```

You do not have to specify the substrate terminal. If you do not specify it, the substrate is connected to ground.

Following is the model synopsis:

```
model ModelName bjt <parameter=value> ...
```

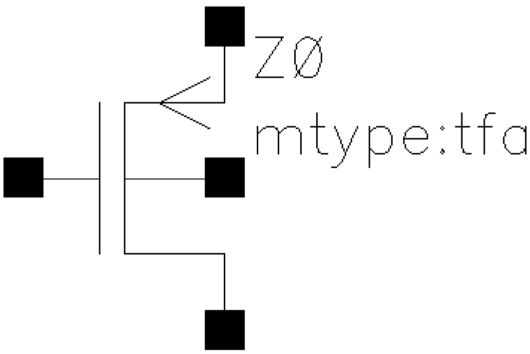
Examples

```
q1 (vcc net3 minus) npn_mod region=fwd area=1 m=1
```

Following is a sample model statement:

```
model npn_mod bjt type=npn is=10e-13 bf=200 va=58.8 ikf=5.63e-3 rb=700
rbm=86 re=3.2 cje=0.352e-12 pe=0.76 me=0.34 tf=249e-12 cjc=0.34e-12
pc=0.55
```

psoi Symbol



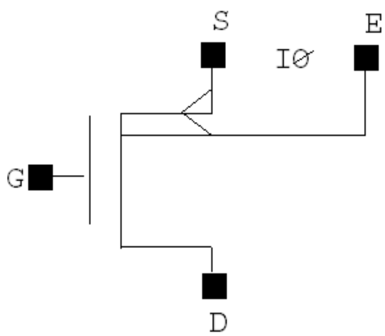
Description

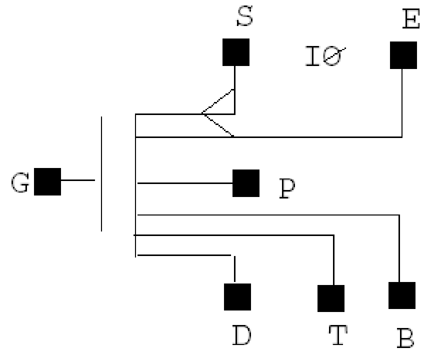
This component is an independent resistive source present in `Actives` category.

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Bulk node connection	`bn`	-	-	x	-	-
Multiplier	`m`	-	x	x	-	-
Width	`w`	-	x	x	-	-
Length	`l`	-	x	x	-	-

psoip Symbol





Description

This is a p-type BSIM SOI model. In `psoip`, there are four optional parameters in the CDF properties of the p-cell:

- Temperature Node present (`Tnode Out`)
- Thermal Node (`T`)
- External Body contact (`P`)
- Body Node (`B`)

There can be a number of permutations and combinations for these pins, however, only following seven permutations are supported:

- if `Tnodeout` is not selected:

  `4 nodes: D G S E`

  `5 nodes: D G S E P`

  `6 nodes: D G S E P B`

  `7 nodes: D G S E P B T`

- if `Tnodeout` is selected:

  `5 nodes: D G S E T`

  `6 nodes: D G S E P T`

  `7 nodes: D G S E P B T`

Command-Line Help

```
spectre -h bsimsoi
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-
Temperature Node Present	`TnodeOut(earlier this was bn,therefore check)`	x	-	-	-	-
Thermal Node(T)	Tnode	x	-	-	-	-
Ext. Body Contact (PinP)	PinP	x	-	-	-	-
Body Node	BodyNodePin	x	-	-	-	-
Width	`w`	x	-	-	-	-
Length	`l`	x	-	-	-	-
Source diffusion area	`as`	x	-	-	-	-
Drain diffusion area	`ad`	x	-	-	-	-
Source diffusion periphery	`ps`	x	-	-	-	-
Drain diffusion periphery	`pd`	x	-	-	-	-
Drain diffusion res squares	`nrd`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Source diffusion res squares	nrs	x	-	-	-	-
Multiplier	m	x	-	-	-	-

Syntax/Synopsis

```
Name ( d g s e [p] [b] [t] ) ModelName <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName bsimsoi <parameter=value> ...
```

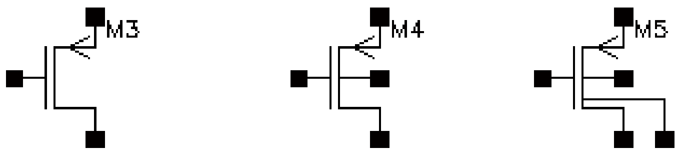
Examples

```
I7 (0 net9 vdd! vdd!) bsimsoi w=1u l=1u
```

Following is a sample model statement:

```
model psoip_model bsimsoi type = p beta0 = 0 dvt = -0.032 delta = 0.01 k1 = 0.6
xbjt = 1 kt1 = -0.11 ndif = -1 noif = 1 vsdfb = 0 vevb = 0.075 dvt1 = 0.53
```

ptft Symbol



Description

P-Type Poly-Si TFT (`ptft`) is a p-type polysilicon tft. It can have a maximum of five terminals with drain, gate and source being mandatory terminals and substrate and thermal being optional.

The diagrams show the terminal with none, one or two optional nodes selected. This device is supported within the altergroups.

Command-Line Help

```
spectre -h psitft
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-	-	-	-
Optional Nodes	`Opins`	x	-	-	-	-	-	-	-
Optional Bulk Node _B	`pinB`	x	-	-	-	-	-	-	-
Optional Thermal Node _T	`pinT`	x	-	-	-	-	-	-	-
Width	`w`	x	-	-	-	-	-	-	-
Length	`l`	x	-	-	-	-	-	-	-
Drain diffusion res squares	`nrd`	x	-	-	-	-	-	-	-
Source diffusion res squares	`nrs`	x	-	-	-	-	-	-	-
Multiplier	`m`	x	-	-	-	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-	-	-	-
Thermal resistance	`rth0`	x	-	-	-	-	-	-	-
Thermal capacitance	`cth0`	x	-	-	-	-	-	-	-
Num of segments	`nseg`	x	-	-	-	-	-	-	-

Syntax/Synopsis

```
Name ( d g s [b] [t] ) ModelName <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName psitft <parameter=value> ...
```

Examples

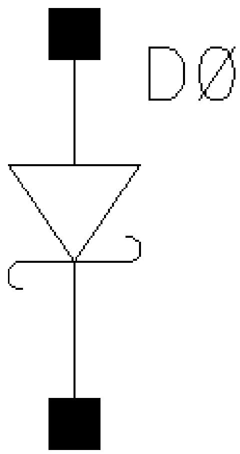
Following is a sample instance statement:

```
m4 (0 2 1 1 3) nch w=2u l=0.8u
```

Following is a sample model statement:

```
model nch psitft type=p
```

schottky Symbol



Description

Schottky is a special type of diode that has a low forward-voltage drop leading to greater system efficiency.

Command-Line Help

`spectre -h diode`

Component Parameters

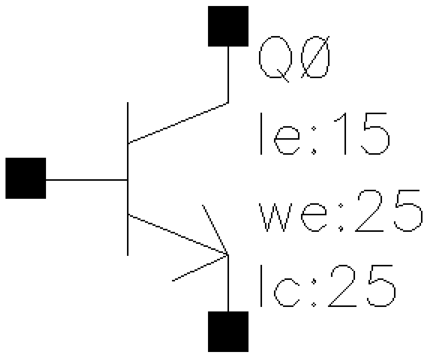
CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-
Device area	`area`	x	-	-	x	x
Device initially off	`off`	-	-	-	x	x
Initial diode voltage	`Vd`	-	-	-	x	x
Junction perimeter factor	`perim`	x	-	-	-	-
Length	`l`	x	-	-	x	x
Width	`w`	x	-	-	x	x
Multiplier	`m`	x	-	-	x	x
Scale factor	`scale`	x	-	-	-	-
Temp rise from ambient	`trise`	x	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-
Periphery of junction	`pj`	-	-	-	x	x
Width of polysilicon	`wp`	-	-	-	x	x
Length of polysilicon	`lp`	-	-	-	x	x
Width of metal capacitator	`wm`	-	-	-	x	x

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Length of metal capacitator	`lm`	-	-	-	x	x
Temperature difference	`dtemp`	-	-	-	x	x

Examples

```
D0 (net1 net2) schottky
```

usernpn Symbol



Description

User Specific NPN Bipolar Transistor (`usernpn`) is an n-type transistor which has 3 terminals. This device is supported within the altergroups.

Command-Line Help

```
spectre -h bjt
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	x	-
Bulk node connection	`bn`	-	-	-	-	-
Device area	`area`	x	-	-	x	-
Base-emitter voltage	`Vbe`	-	-	-	x	-
Collector-emitter voltage	`Vce`	-	-	-	x	-
Device initially off	`off`	-	-	-	x	-
Emitter length	`le`	x	-	-	-	-
Emitter width	`we`	x	-	-	-	-
Collector length	`lc`	x	-	-	-	-
Temp Rise Specifier	`triseSpec`	x	-	-	-	-
Temp rise from ambient	`trise`	x	-	-	-	-
dtmp -Temp rise from ambient	`dtmp`	x	-	-	-	-
dtemp - Temp rise from ambient	`dtemp`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Estimated operating region	`region`	x	-	-	-	-

Syntax/Synopsis

```
Name ( c b e [s] ) ModelName <parameter=value> ...
```

You do not have to specify the substrate terminal. If you do not specify it, the substrate is connected to ground.

Following is the model synopsis:

```
model ModelName bjt <parameter=value> ...
```

Examples

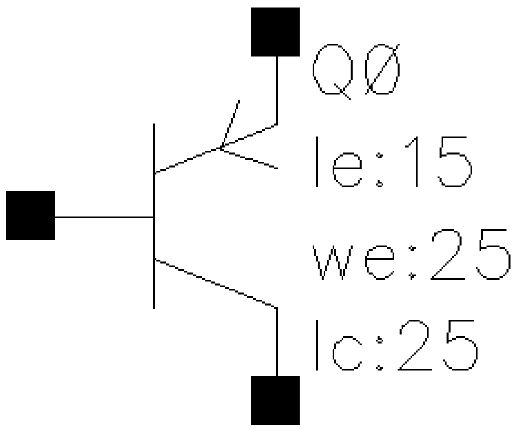
Following is a sample instance atatement:

```
q1 (vcc net3 minus) npn_mod region=fwd area=1 m=1
```

Following is a sample model statement:

```
model npn_mod bjt type=npn is=10e-13 bf=200 va=58.8 ikf=5.63e-3 rb=700 rbm=86
re=3.2 cje=0.352e-12 pe=0.76 me=0.34 tf=249e-12 cjc=0.34e-12 pc=0.55
```

userpnp Symbol



Description

User Specific PNP Bipolar Transistor (`userpnp`) is a p-type transistor which has 3 terminals.

Command-Line Help

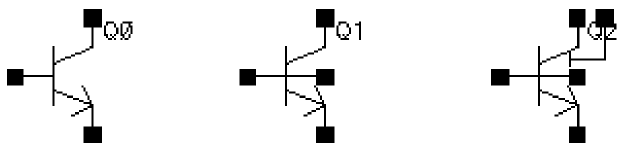
```
spectre -h bjt
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-
Bulk node connection	`bn`	-	-	-	-	-
Device area	`area`	x	-	-	x	x
Base-emitter voltage	`Vbe`	-	-	-	x	x

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Collector-emitter voltage	`Vce`	-	-	-	x	x
Device initially off	`off`	-	-	-	x	x
Emitter length	`le`	x	-	-	-	x
Emitter width	`we`	x	-	-	-	x
Collector length	`lc`	x	-	-	-	x
Temp Rise Specifier	`triseSpec`	x	-	-	-	-
Temp rise from ambient	`trise`	x	-	-	-	-
dtmp -Temp rise from ambient	`dtmp`	x	-	-	-	-
dtemp - Temp rise from ambient	`dtemp`	x	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-

vnpn Symbol



Description

Variable Bipolar Transistor (`vnpn`) is a variable terminal n-type bjt. It can have a maximum of five terminals with collector, emitter and base being mandatory terminals and substrate and thermal being optional.

The diagrams show the terminal with none, one or two optional nodes selected. This device is supported within the altergroups.

Command-Line Help

```
spectre -h bjt

spectre -h bjt2

spectre -h bjt3

spectre -h bjt301

spectre -h vbic
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-	-	-	-
Optional Nodes	`Opins`	x							
Optional Substrate Node _S	`pinS`	x	-	-	-	-	-	-	-
Optional Thermal Node _T	`pint`	x	-	-	-	-	-	-	-
Optional Thermal Node _dT	`pindt`	x	-	-	-	-	-	-	-
Temp Rise Specifier	`triseSpec`	x	-	-	-	-	-	-	-
Device area	`area`	x	-	-	-	-	-	-	-
Multiplier	`m`	x	-	-	-	-	-	-	-
Temp rise from ambient	`trise`	x	-	-	-	-	-	-	-
dtmp -Temp rise from ambient	`dtmp`	x	-	-	-	-	-	-	-
dtemp - Temp rise from ambient	`dtempn`	x	-	-	-	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-	-	-	-
Self Heating Switch	`self_heating`	x	-	-	-	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Length of Emitter Window	`le0`	x	-	-	-	-	-	-	-
Width of Emitter Window	`be0`	x	-	-	-	-	-	-	-
Number of emitter contacts	`ne`	x	-	-	-	-	-	-	-
Number of base contacts	`nb`	x	-	-	-	-	-	-	-
Location of collector contact	`location`	x	-	-	-	-	-	-	-
Number of collector contacts	`ncbjt`	x	-	-	-	-	-	-	-
Contact configuration	`order`	x	-	-	-	-	-	-	-
Number of structures in parallel	`npas`	x	-	-	-	-	-	-	-

Syntax/Synopsis

```
Name ( c b e [s] ) ModelName <parameter=value> ...
```

You do not have to specify the substrate terminal. If you do not specify it, the substrate is connected to ground.

Following is the model synopsis:

```
model ModelName bjt <parameter=value> ...
```

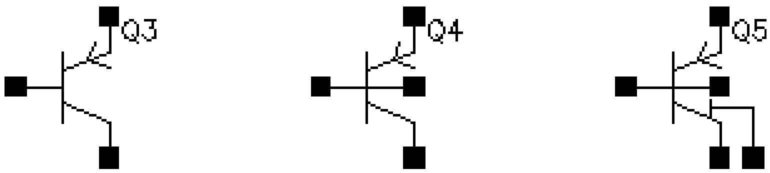
Examples

```
q1 (vcc net3 minus) npn_mod region=fwd area=1 m=1
```

Following is a sample model statement:

```
model npn_mod bjt type=npn is=10e-13 bf=200 va=58.8 ikf=5.63e-3 rb=700 rbm=86
re=3.2 cje=0.352e-12 pe=0.76 me=0.34 tf=249e-12 cjc=0.34e-12 pc=0.55
```

vpnp Symbol



Description

Variable Bipolar Transistor (`vpnp`) is a variable terminal p-type bjt. It can have a maximum of five terminals with collector, emitter and base being mandatory terminals and substrate and thermal being optional. This device is supported within the altergroups.

The diagrams show the terminal with none, one or two optional nodes selected.

Command-Line Help

```
spectre -h bjt

spectre -h bjt2

spectre -h bjt3

spectre -h bjt301

spectre -h vbic
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-	-	-	-
Optional Nodes	`Opins`	x							
Optional Substrate Node _S	`pinS`	x	-	-	-	-	-	-	-
Optional Thermal Node _T	`pint`	x	-	-	-	-	-	-	-
Optional Thermal Node _dT	`pindt`	x	-	-	-	-	-	-	-
Temp Rise Specifier	`triseSpec`	x	-	-	-	-	-	-	-
Device area	`area`	x	-	-	-	-	-	-	-
Multiplier	`m`	x	-	-	-	-	-	-	-
Temp rise from ambient	`trise`	x	-	-	-	-	-	-	-
dtmp -Temp rise from ambient	`dtmp`	x	-	-	-	-	-	-	-
dtemp - Temp rise from ambient	`dtempn`	x	-	-	-	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-	-	-	-
Self Heating Switch	`self_heating`	x	-	-	-	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Length of Emitter Window	`le0`	x	-	-	-	-	-	-	-
Width of Emitter Window	`be0`	x	-	-	-	-	-	-	-
Number of emitter contacts	`ne`	x	-	-	-	-	-	-	-
Number of base contacts	`nb`	x	-	-	-	-	-	-	-
Location of collector contact	`location`	x	-	-	-	-	-	-	-
Number of collector contacts	`ncbjt`	x	-	-	-	-	-	-	-
Contact configuration	`order`	x	-	-	-	-	-	-	-
Number of structures in parallel	`npas`	x	-	-	-	-	-	-	-

Syntax/Synopsis

```
Name ( c b e [s] ) ModelName <parameter=value> ...
```

You do not have to specify the substrate terminal. If you do not specify it, the substrate is connected to ground.

Following is the model synopsis:

```
model ModelName bjt <parameter=value> ...
```

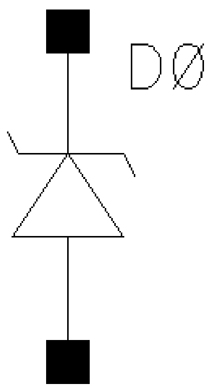
Examples

```
q1 (vcc net3 minus) npn_mod region=fwd area=1 m=1
```

Following is a sample model statement:

```
model npn_mod bjt type=npn is=10e-13 bf=200 va=58.8 ikf=5.63e-3 rb=700
rbm=86 re=3.2 cje=0.352e-12 pe=0.76 me=0.34 tf=249e-12 cjc=0.34e-12
pc=0.55
```

zener Symbol



Description

Zener Diode has p-n junction in reverse bias to use the zener effect to maintain a constant voltage.

Command-Line Help

```
spectre -h diode
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	x	x
Device area	`area`	x	-	-	x	x
Device initially off	`off`	-	-	-	x	x
Initial diode voltage	`Vd`	-	-	-	x	x
Junction perimeter factor	`perim`	x	-	-	-	-
Length	`l`	x	-	-	x	x
Width	`w`	x	-	-	x	x
Multiplier	`m`	x	-	-	x	x
Scale factor	`scale`	x	-	-	-	-
Temp rise from ambient	`trise`	x	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-
Periphery of junction	`pj`	-	-	-	x	x
Width of polysilicon	`wp`	-	-	-	x	x
Length of polysilicon	`lp`	-	-	-	x	x
Width of metal capacitator	`wm`	-	-	-	x	x

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Length of metal capacitator	`lm`	-	-	-	x	x
Temperature difference	`dtemp`	-	-	-	x	x

Related Topics

CDF Parameters Supported by Analog Library Components

auCdl and auLvs Components in Analog Library

Active Components

3

Analysis Specific Components in Analog Library

The components in the `Analysis Specific` category are as follows:

- cmdmprobe Symbol
- deepprobe Symbol
- diffsprobe Symbol
- diffstbprobe Symbol
- fourier Symbol
- fourier2ch Symbol
- iprobe Symbol
- nodeQuantity Symbol
- simulinkCoupler Symbol
- sprobe Symbol

Viewing the cmdmprobe Subcircuit

The subcircuit consists of two iprobes and two controlled sources that can be viewed by:

➡ Selecting *Design – Hierarchy – Descend Read* or *Descend Edit* from the Virtuoso Schematic Reading window.

Related Topics

Performing Stability Analysis in Spectre

cmdmprobe Symbol

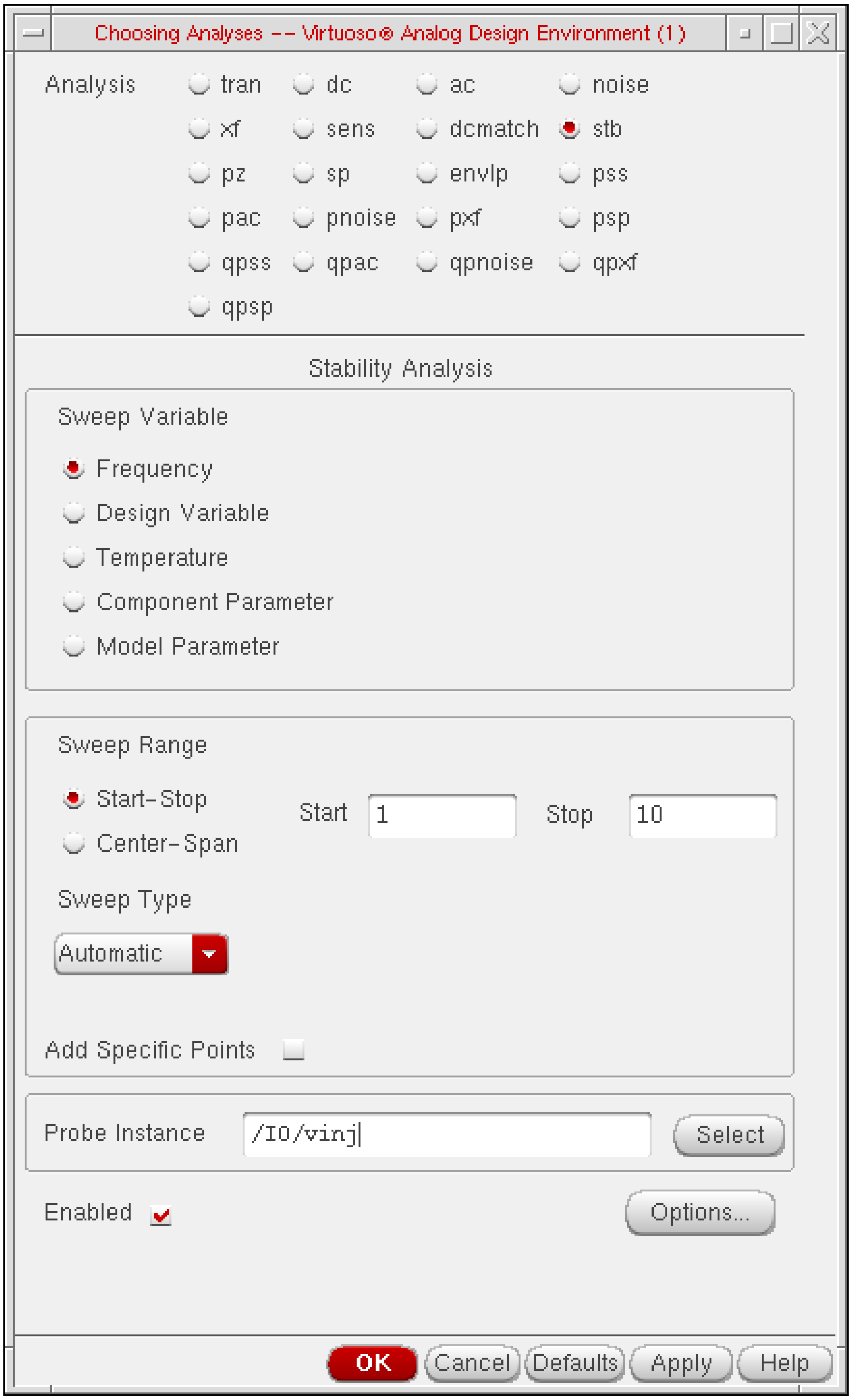
Performing Stability Analysis in Spectre

The subcircuit has two probes, `Vinj` and `Iinj`, designated for stability analysis. Their values are set to zero in a normal circuit simulation. To perform a stability analysis, specify the `vinj` probe in the Probe Instance field of the Choosing Analysis form. The process and the calculation is automated in Spectre's stability (stb) analysis. `Iinj` is internally placed to simplify the use model.

The steps to perform stability analysis in Spectre are as follows:

1. Add the cmdmprobe instance to the design.
2. Select the *Tools – Analog Environment* menu option.
3. Select *Analyses – Choose* to display the Choosing Analyses form.
4. Select the *stb* radio button.
5. Specify the *Start* Sweep Range and the *Stop* Sweep Range.
6. Click *Select* and then select the cmdmprobe instance from the design.

The <Inst_id>/vinj automatically appears in the Probe Instance field.



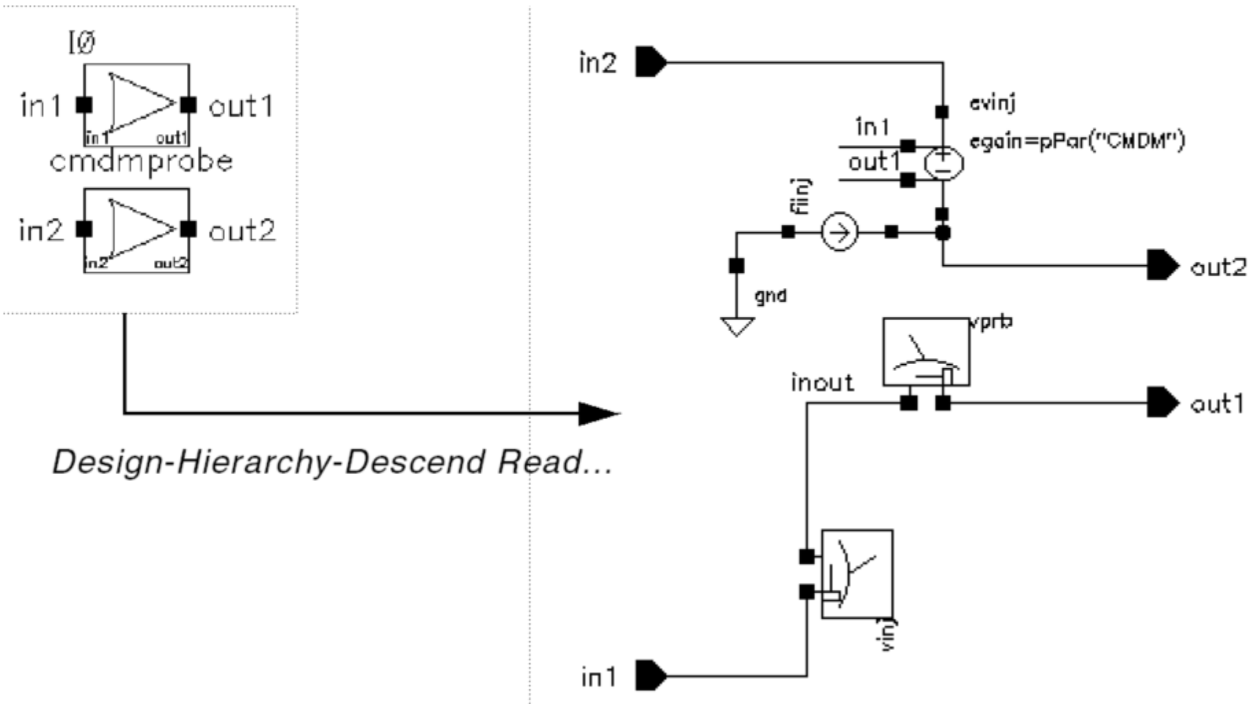
7. Click *OK*.

8. Select the *Simulation – Netlist and Run* menu option to generate the netlist in Spectre Direct.

Related Topics

Viewing the cmdmprobe Subcircuit

cmdmprobe Symbol



Description

Common Model Differential Model Probe is a Spectre subcircuit component used in Spectre stability analysis for measuring differential stability. It measures the common-mode stability when CMDM is set to `1` and differential-mode stability when CMDM is set to `-1`.

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
CMDM	`CMDM`	x	-	-	-	-

Examples

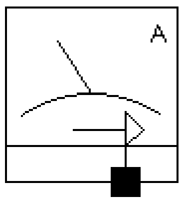
For the instance `I107` and Sweep Range between `1` and `10`, the netlist is as follows:

```
stb stb start=1 stop=10 probe=I107.vinj annotate=status
// Library name: analogLib
```

```
// Cell name: cmdmprobe
// View name: schematic
subckt cmdmprobe in1 in2 out1 out2
parameters CMDM=1
     evinj (in2 out2 in1 out1) vcvs gain=CMDM
     vprb (inout out1) iprobe
     vinj (inout in1) iprobe
     fiinj (0 out2) pcccs gain=CMDM probes=[ vprb vinj ] coeffs=[ 0 1 1 ]
ends cmdmprobe
// End of subcircuit definition.

// Library name: testLib
// Cell name: testCell
// View name: schematic
I107 (net048 net047 net046 net045) cmdmprobe CMDM=1
I111 (net080 net079 net078 net077) cmdmprobe CMDM=-1
```

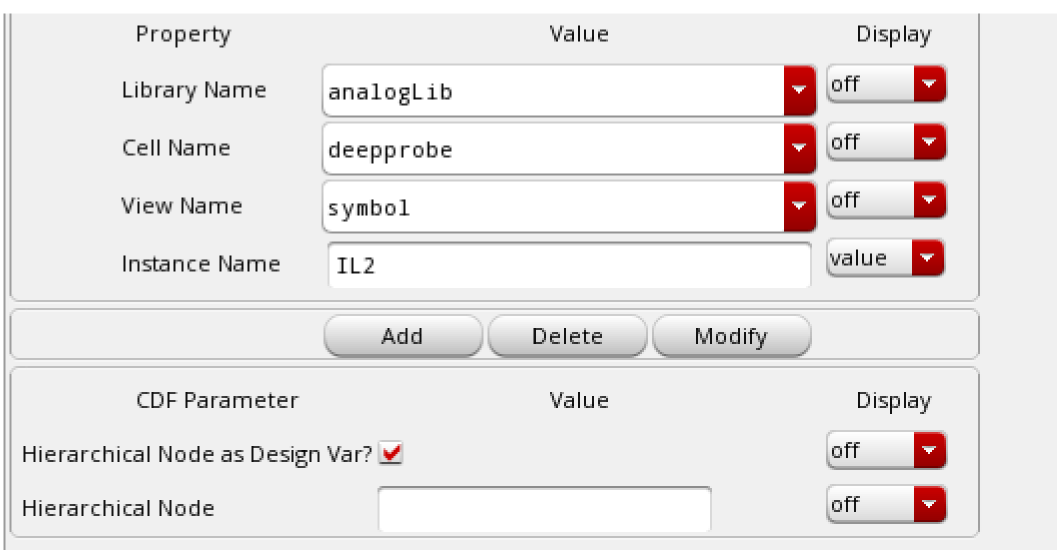
deepprobe Symbol



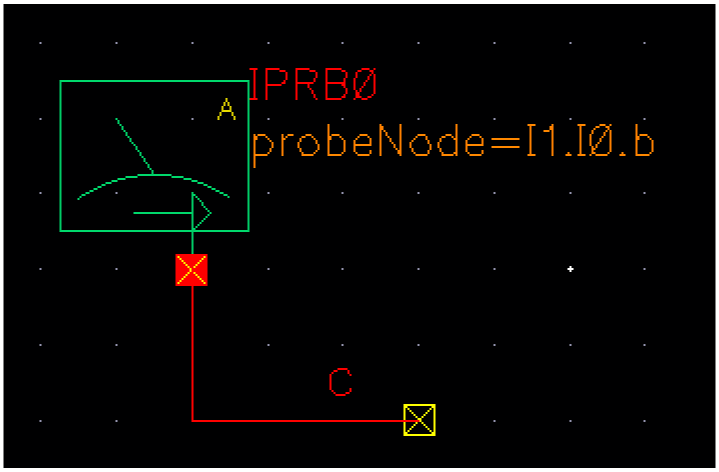
Description

It is a single pin device connected to an internal hierarchy net that lets you probe down through the design hierarchy. You can make a connection from the top-level testbench to an internal net within a sub-block inside the hierarchy by connecting a named wire to a deepprobe terminal. With this component, you can also short internal nets, connect two internal nets, or inject pulses on any internal net in the design.

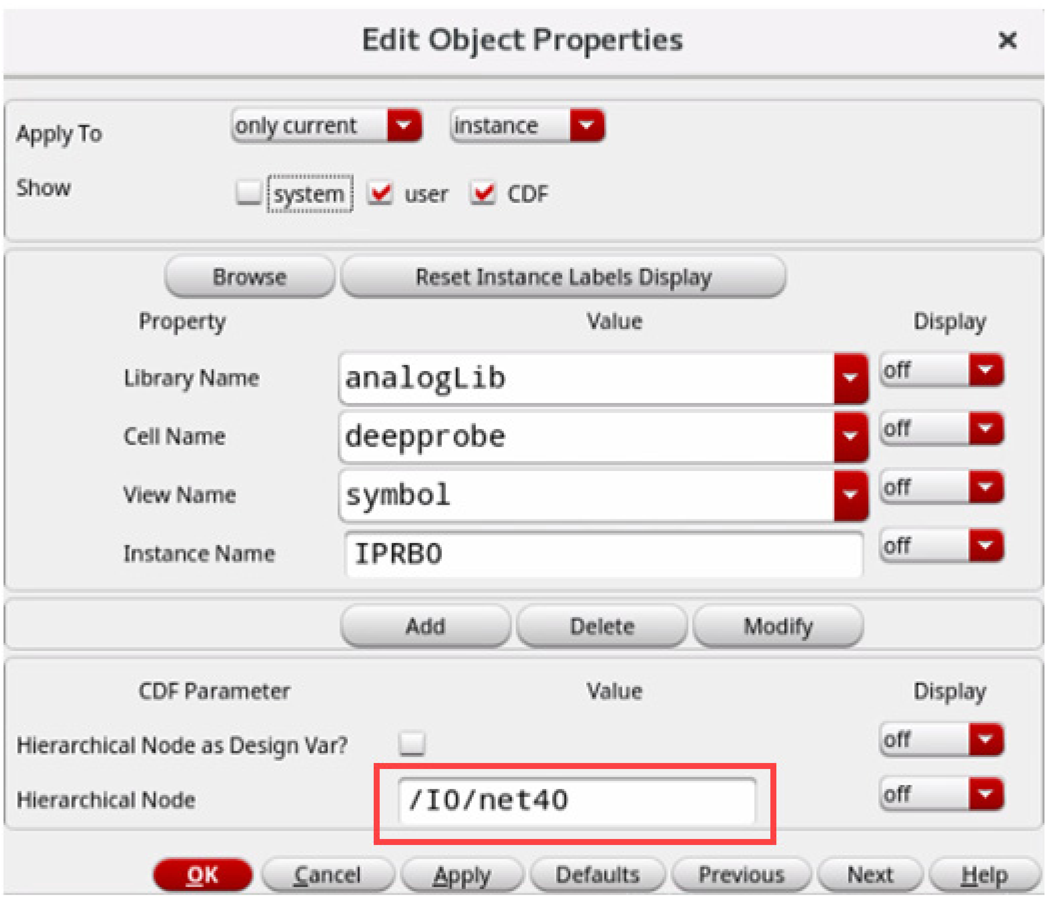
If you select the *Hierarchical Node as Design Var?* check box in the Edit Object Properties form, the value in the *Hierarchical Node* field is considered a variable and netlisted accordingly. Otherwise, the value for *Hierarchical Node* is considered a string value and netlisted directly.



Consider that you have the following deepprobe instance, named `IPRB0`, in your schematic:

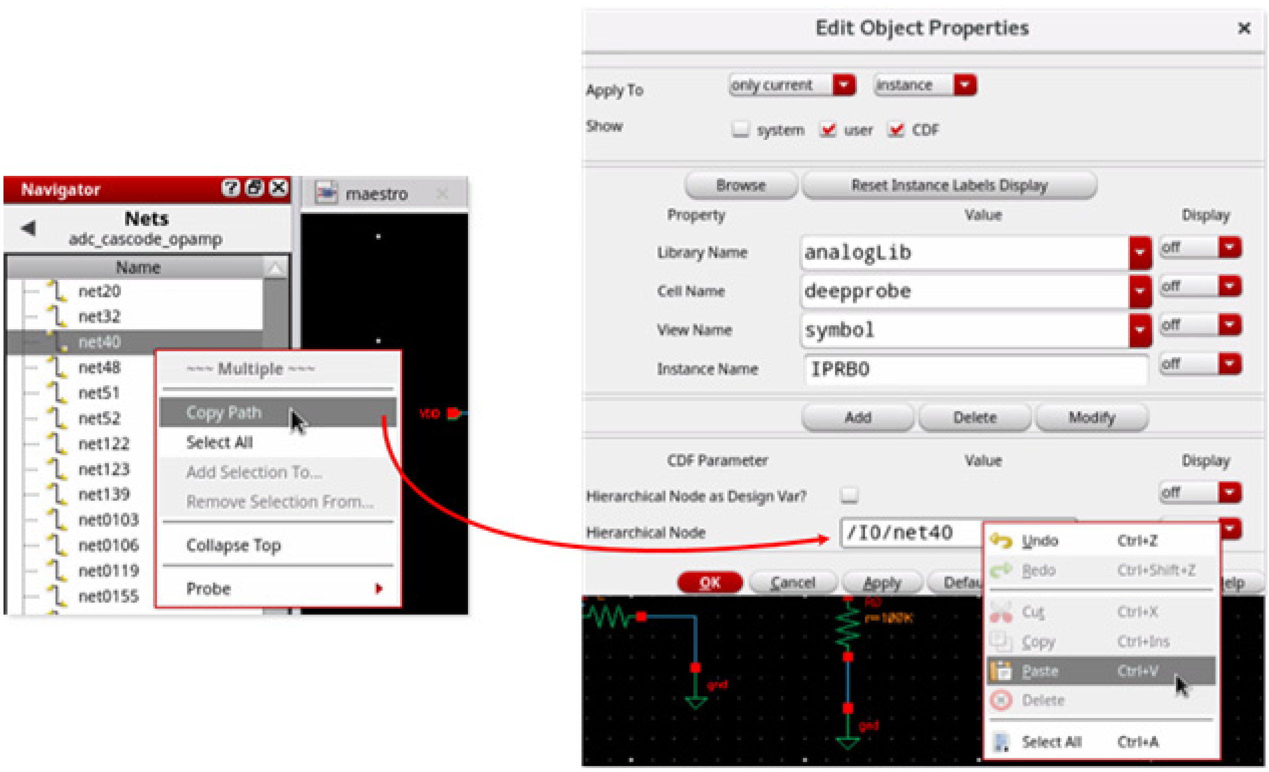


If you specify the value for the *Hierarchical Node* in schematic syntax, it is automatically translated into Spectre syntax during netlisting.



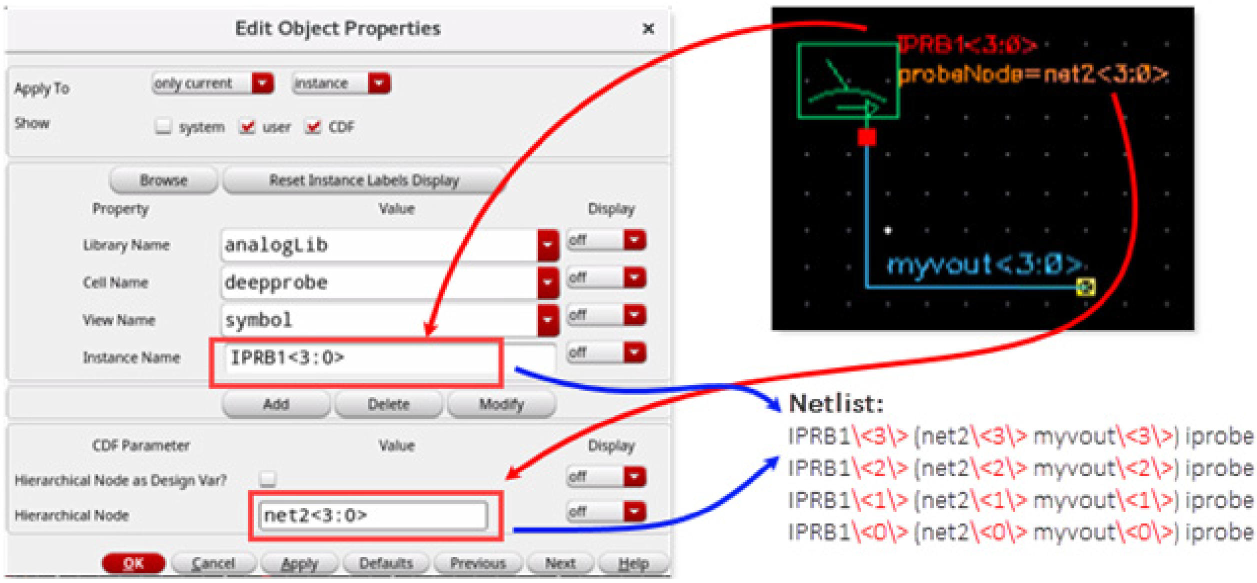
In this example, the *Hierarchical Node* `/I0/net40` is netlisted as `IPRB0 (I0.net40 net1) iprobe`.

To automatically derive the value of the hierarchical node, right-click the required net in the Navigator assistant in Virtuoso Schematic Editor, and select *Copy Path* from the shortcut menu. You can then paste this path in the Hierarchical Node field of the Edit Object Properties form.



Additionally, if you want to use the bus format to specify the instance name and its hierarchical node, ensure that the number of buses specified in the *Instance Name* and the *Hierarchical*

Node fields is the same. In such cases, the netlist prints separate statements for each bus in the deepprobe instance.



Command-Line Help

```
spectre -h iprobe
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Hierarchical Node	`probeNode`	x	-	-	x	-	-	-	-

Syntax/Synopsis

```
Name ( in out ) iprobe
```

Examples

The following example shows the netlist syntax of a `deepprobe` element.

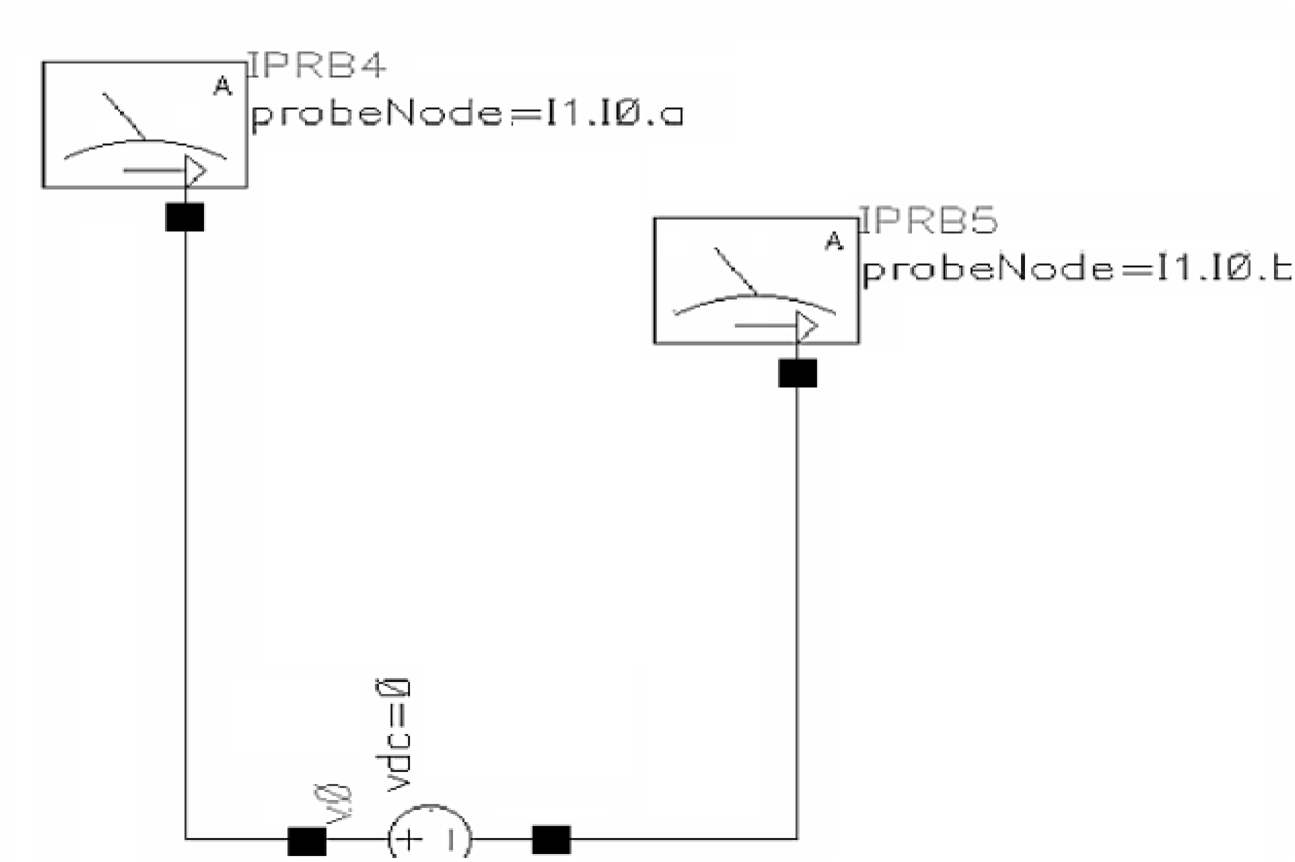
```
IPRB0 (I1.b c) iprobe
```

Here `I1.b` is the name of the hierarchical net and `c` is the name of the net connected to the deepprobe element.

The net name must be the same as it appears in the netlist. For example a member of a bussed net `(bus<5>)` may appear in the netlist as `bus\<5\>`. So if that is within the `I1` instance at the top level, you should enter `I1.bus\<5\>`.

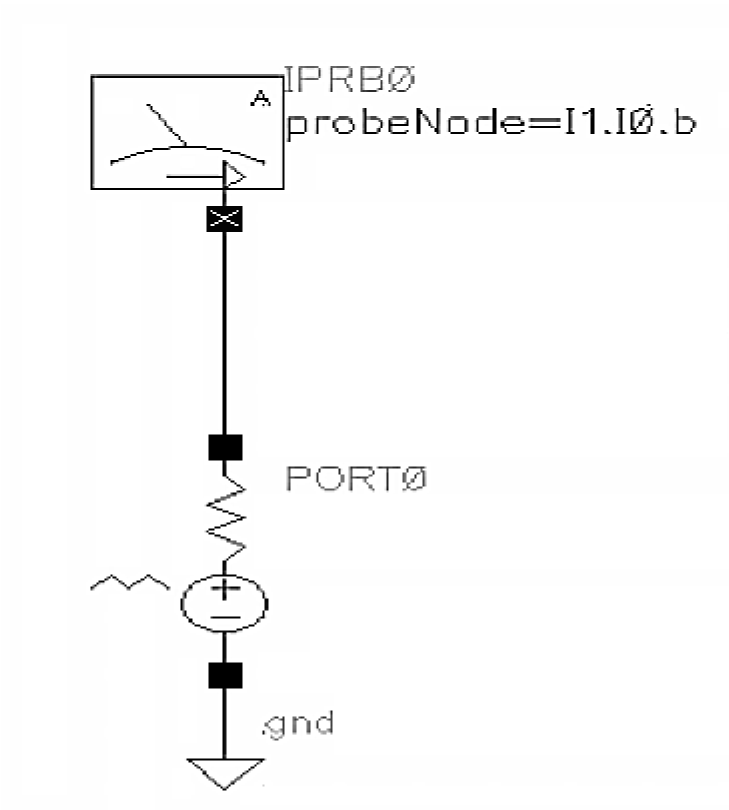
The following example shows two `deepprobe` elements being used to short two internal nets.

```
IPRB5 (I1.I0.b net7) iprobe
IPRB4 (I1.I0.a net6) iprobe
v0 (net6 net7) vsource dc=0 type=dc
```

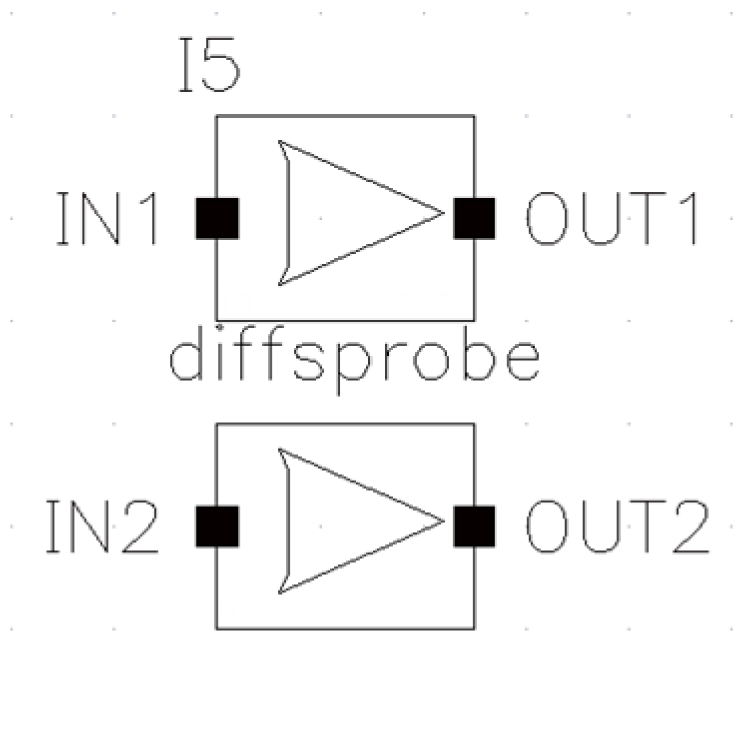


The following example shows a `deepprobe` element being used to inject pulses on an internal net.

```
IPRB0 (I1.I0.b net8) iprobe
PORT0 (net8 0) port r=50 type=pwl wave=[ 0 0 5n 0 ]
```



diffsprobe Symbol



Description

A special testbench that enables in-situ probing of bi-directional impedances, without breaking the circuit. This is a `Spectre` subcircuit component used for measuring differential impedance using `sprobe` devices in the S-parameter (`sp`) and Periodic S-Parameter (`psp`) analyses. To measure the differntial impedance, you must manually specify the `sprobe` names in the Choosing Analyses form for the `sp` and `psp` analyses.

For example, consider the following `sprobe` names specified in the given figure:

- `I15.SPRB_DM`
- `I15.SPRB_CM`

The following statements will be printed in the netlist:

```
I15 (net2 net3 net4 net5) diffsprobe
…
psp  psp  start=1G  stop=1.2G  lin=500  harmsvec=[0]
+    sprobes=[I15.SPRB_DM  I15.SPRB_CM]
annotate=status
…
```

```
sp sp sprobes=[I15.SPRB_DM I15.SPRB_CM] start=1G stop=1.2G lin=500 \
annotate=status
```

You can also specify output expressions containing sprobe names in the *Outputs Setup* tab of Virtuoso ADE Assembler and plot these expressions.

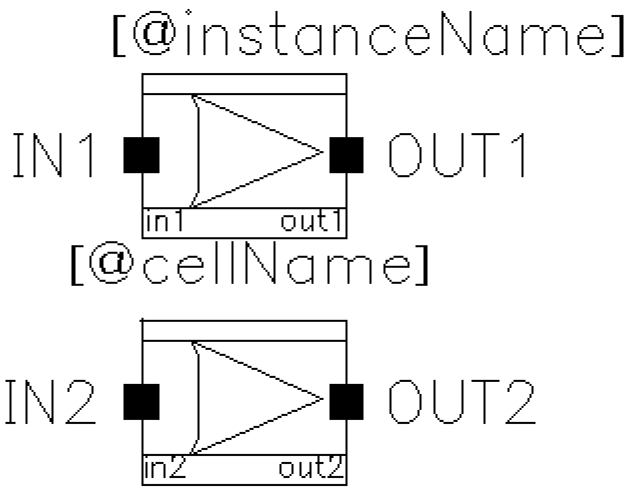
Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-

Syntax/Synopsis

```
Name ( in out ) diffsprobe
```

diffstbprobe Symbol



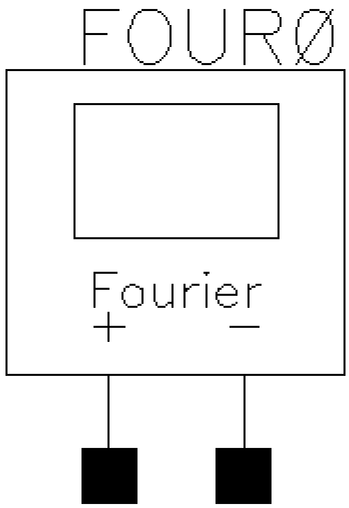
Description

Differential Stability Probe is a Spectre subcircuit component used in Spectre stability analysis for measuring differential stability for multi-loop circuits, such as differential feedback circuit.

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
CMDM	`CMDM`	x	-	-	-	-
lxRemoveDevice	`lxRemoveDevice`	-	x	-	-	-

fourier Symbol



Description

Ratiometric Fourier Analyzer measures the Fourier coefficients of two different signals at a specified fundamental frequency without loading the circuit. This device is not supported within the altergroups.

Command-Line Help

```
spectre -h fourier
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-
Fundamental frequency	`fund`	x	-	-	-	-
Minimum no. of time points	`points`	x	-	-	-	-
Active	`active`	x	-	-	-	-
Order of interpolation	`order`	x	-	-	-	-
Number of harmonics	`harms`	x	-	-	-	-
No. of reference Harmonics	`refharms`	x	-	-	-	-
Scale factor	`scale`	x	-	-	-	-
No. of desired harmonics	`harmsvec`	x	-	-	-	-
No. of reference harmonics	`refharmsvec`	x	-	-	-	-
First harmonics computed	`firstharm`	x	-	-	-	-
First of reference harmonics	`reffirstharm`	x	-	-	-	-
Nomalizing harmonic	`normharm`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Norm of reference harmonics	`refnormharm`	x	-	-	-	-
To print fourier results on	`where`	x	-	-	-	-

Syntax/Synopsis

```
Name ( [p] [n] [pr] [nr] ) ModelName <parameter=value> ...
```

```
Name ( [p] [n] [pr] [nr] ) fourier <parameter=value> ...
```

The signal between terminals ‘`p`’ and ‘`n`’ is the test or numerator signal. The signal between terminals ‘`pr`’ and ‘`nr`’ is the reference or denominator signal. Fourier analysis is performed on terminal currents by specifying the ‘`term`’ or ‘`refterm`’ parameters. If both ‘`term`’ and ‘`p`’ or ‘`n`’ are specified, then the terminal current becomes the numerator and the node voltages become the denominator. By mixing voltages and currents, it is possible to compute large signal immittances.

Following is the model synopsis:

```
model ModelName fourier <parameter=value> ...
```

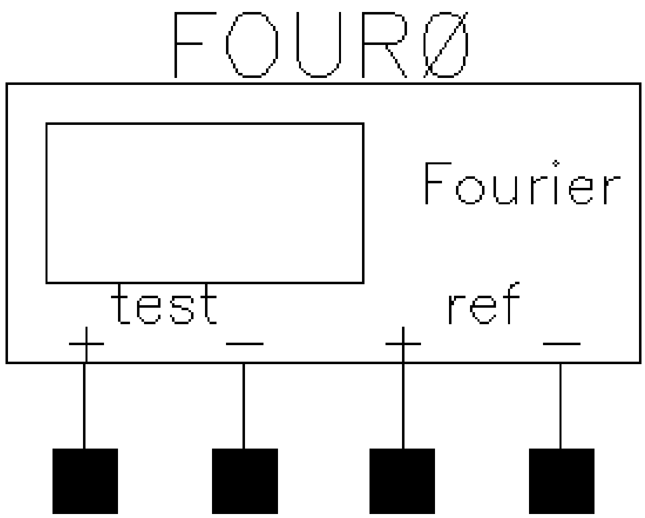
Examples

```
four1 (1 0) fourmod harms=50
```

Following is a sample model statement:

```
model fourmod fourier fund=900M points=2500 order=2
```

fourier2ch Symbol



Description

Ratiometric Fourier Analyzer With Reference Terminals is a component in `analysis specific` category of Analog Library.

Command-Line Help

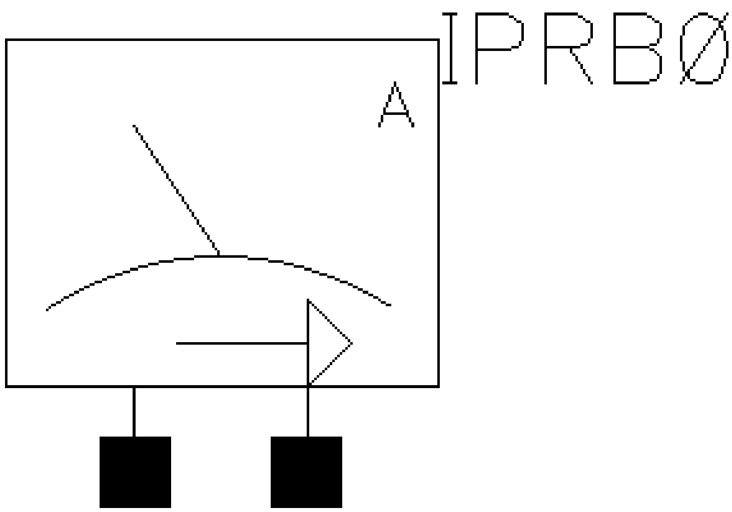
```
spectre -h fourier
```

CDF Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-
Fundamental frequency	`fund`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Minimum no. of time points	`points`	x	-	-	-	-
Active	`active`	x	-	-	-	-
Order of interpolation	`order`	x	-	-	-	-
Number of harmonics	`harms`	x	-	-	-	-
No. of reference Harmonics	`refharms`	x	-	-	-	-
Scale factor	`scale`	x	-	-	-	-
No. of desired harmonics	`harmsvec`	x	-	-	-	-
No. of reference harmonics	`refharmsvec`	x	-	-	-	-
First harmonics computed	`firstharm`	x	-	-	-	-
First of reference harmonics	`reffirstharm`	x	-	-	-	-
Nomalizing harmonic	`normharm`	x	-	-	-	-
Norm of reference harmonics	`refnormharm`	x	-	-	-	-
To print fourier results on	`where`	x	-	-	-	-

iprobe Symbol



Description

Current through the probe is computed and is defined as positive if it flows from the input node, through the probe, to the output node. Since the current variable gets the name of the '`iprobe`' instance, you cannot create an '`iprobe`' with the same name as a circuit node. This device is not supported within the altergroups.

Command-Line Help

```
spectre -h iprobe
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	x	-	-	-
Fundamental frequency	`fund`	x	x	-	-	-
Minimum no. of time points	`points`	x	x	-	-	-
Active	`active`	x	x	-	-	-
Order of interpolation	`order`	x	x	-	-	-
Number of harmonics	`harms`	x	x	-	-	-
No. of reference Harmonics	`refharms`	x	x	-	-	-
Scale factor	`scale`	x	x	-	-	-
Dummy DC voltage	`vdummy`	-	x	-	-	x
lxRemoveDevice	`lxRemoveDevice`	-	x	-	-	-

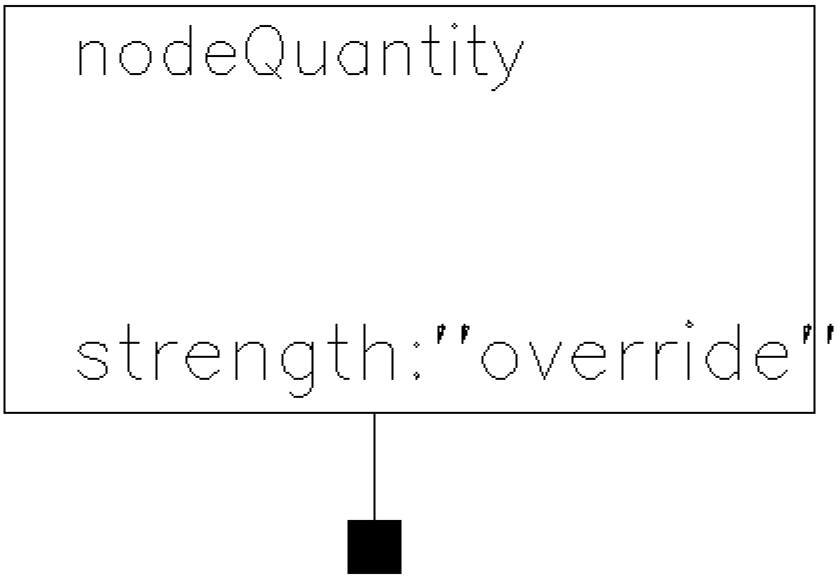
Syntax/Synopsis

```
Name ( in out ) iprobe
```

Examples

```
ip (1  0) iprobe
```

nodeQuantity Symbol



Description

Set Node Quantities contain information about specific types of signals, such as their units, absolute tolerances, and maximum allowed change per Newton iteration. Use the ‘quantity’ statement to create new quantities or to redefine properties of an existing quantity. Use this statement to set the quantities for a particular node. This device is not supported within the altergroups.

Command-Line Help

```
spectre -h node
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Flow	`flow`	x	-	-	-	x
Value	`value`	x	-	-	-	x
Strength	`strength`	x	-	-	-	x

Syntax/Synopsis

```
Name ( 1 [2] ... ) node <parameter=value> ...
```

Examples

For example, to indicate that the node `net1` is used for thermal signals, you could use the following node statement.

```
i17 (net1) node value=Temp flow=Pwr
```

`Temp` and `Pwr` are predefined quantities.

```
node1 (1 2 3) node value="T" flow="W" strength=override //Must define T and W with
quantity statement.
```

simulinkCoupler Symbol

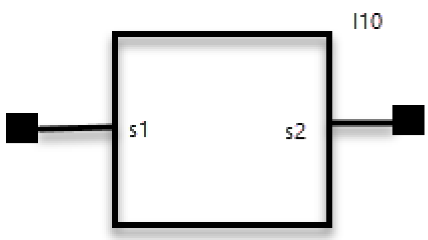
Description

The component `simulinkCoupler` is a `Pcell`. In order to cosimulate between AMS and simulink, two types of couplers are required. The `Pcell` is the coupler which is used on AMS side. On simulink side, `simulinkCoupler` is used. The couplers communicate to each other through a TCP/IP network socket connection.

Component Parameters

CDF Parameter Label	CDF Parameter
Coupler domain	`a_or_d`
Number of input pins	`n_inp`
Number of output pins	`n_outp`
Show advanced options	`advUser`
Initial coupler output voltage	`init_val`
Simulink(R) hostname	`hostname`
Socket port	`sockPort`
Sim response timeout	`sockTimeout`

sprobe Symbol



Description

This is a special testbench that enables in-situ probing of bi-directional impedances, without breaking the circuit.

Command-Line Help

```
spectre -h sprobe
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Reference Resistance	`r0`	x	x	-	-	-
Series Resistance	`rs`	x	x	-	-	-
Probe feed Resistance	`rfeed`	x	x	-	-	-

Syntax/Synopsis

```
Name ( in out ) sprobe
```

Examples

Following is a `sprobe` instance:

```
I1 (net7 net4) sprobe rs=0.01 rfeed=1e8 r0=50
```

Following is a `sprobe` analysis in one `sp` analysis:

```
sp sp sprobes=[I1 I0] …
```

Following are `sprobe` and normal `sp` analysis in one `sp` analysis:

```
sp sp ports=[PORT0] sprobes=[I1 I0]
```

Related Topics

CDF Parameters Supported by Analog Library Components

4

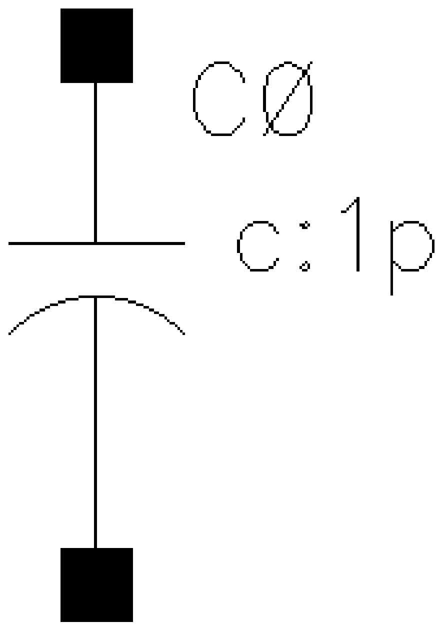
Parasitic Components in Analog Library

You can use the parasitic components of `anlogLib` to account for the effect of parasitics on analog circuits. By accounting for the effect of parasitics, you can improve the accuracy of your circuit simulations. These components are usually used during Diva extraction and are placed in an extracted view. Although these components are similar to the normal components, they appear only in extracted views.

The components in the `Parasitics` category are as follows:

- pcapacitor Symbol
- pdiode Symbol
- pinductor Symbol
- pmind Symbol
- presistor Symbol

pcapacitor Symbol



Description

Parasitic Capacitor is a component in `parasitics` category in Analog Library.

Command-Line Help

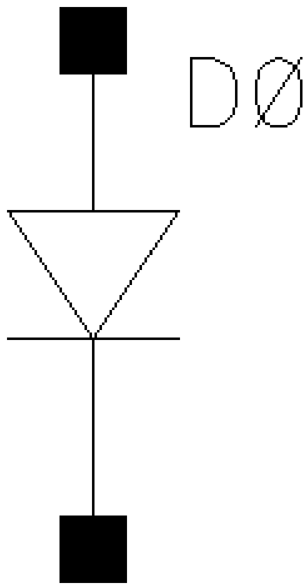
`spectre -h capacitor`

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Capacitance	`c`	x	x	x	x	x
Initial condition	`ic`	x	-	-	x	x
Model name	`model`	x	-	-	-	-
Width	`w`	x	-	-	x	x

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Length	`l`	x	-	-	x	x
Multiplier	`m`	x	-	-	x	x
Scale factor	`scale`	x	-	-	x	x
Temp rise from ambient	`trise`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	x	x
Temperature coefficient 2	`tc2`	x	-	-	x	x
Number of Polynomial Coeffs	`polyCoef`	-	-	-	x	x
Temperature difference	`dtemp`	-	-	-	x	x

pdiode Symbol



Description

Parasitic Diode is a component in `parasitics` category in Analog Library.

Command-Line Help

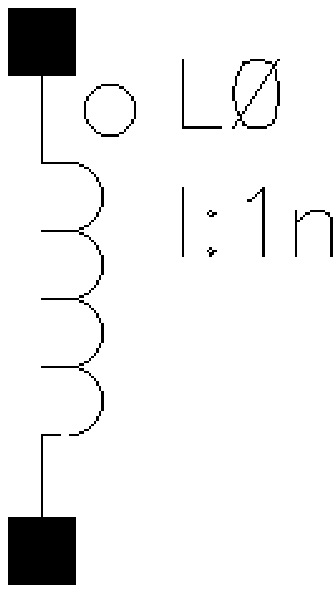
```
spectre -h diode
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-
Device area	`area`	x	-	-	x	x
Device initially off	`off`	-	-	-	x	x

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Initial diode voltage	`Vd`	-	-	-	x	x
Junction perimeter factor	`perim`	x	-	-	-	-
Length	`l`	x	-	-	x	x
Width	`w`	x	-	-	x	x
Multiplier	`m`	x	-	-	x	x
Scale factor	`scale`	x	-	-	-	-
Temp rise from ambient	`trise`	x	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-
Periphery of junction	`pj`	-	-	-	x	x
Width of polysilicon	`wp`	-	-	-	x	x
Length of polysilicon	`lp`	-	-	-	x	x
Width of metal capcitor	`wm`	-	-	-	x	x
Length of metal capcitor	`lm`	-	-	-	x	x
Temperature difference	`dtemp`	-	-	-	x	x

pinductor Symbol



Description

Parasitic Inductor is a component in `parasitics` category in Analog Library. This device is supported within the altergroups.

Command-Line Help

```
spectre -h inductor
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Inductance	`l`	x	x	x	x	x
Initial condition	`ic`	x	-	-	x	-
Model name	`model`	x	-	-	-	-
Resistance	`r`	x	-	-	x	x
Multiplier	`m`	x	-	-	x	x
Temp rise from ambient	`trise`	x	-	-	-	-
Scale factor	`scale`	-	-	-	x	x
Number of Polynomial Coeffs	`polyCoef`	-	-	-	x	-
Temperature coefficient 1	`tc1`	-	-	-	x	x
Temperature coefficient 2	`tc2`	-	-	-	x	x
Temperature difference	`dtemp`	-	-	-	x	x

Syntax/Synopsis

```
Name ( 1 2 ) ModelName <parameter=value> ...
```

```
Name ( 1 2 ) inductor <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName inductor <parameter=value> ...
```

Examples

Following is a sample instance statement without model:

```
l33 (0 net29) inductor l=10e-9 r=1 m=1
```

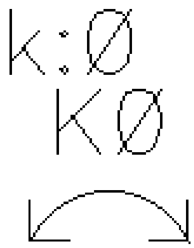
Following is a sample instance statement with model:

```
l33 (0 net29) ind l=10e-9 r=1 m=1
```

Following is a sample model statement:

```
model ind inductor l=6e-9 r=1 tc1=1e-12 tc2=1e-12 tnom=25
```

pmind Symbol



Description

Parasitic Mutual Inductor is a component in `parasitics` category in Analog Library. This device is not supported within the altergroups.

Command-Line Help

```
spectre -h mutual_inductor
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
First coupled inductor	`ind1`	x	-	-	-	-
Second coupled inductor	`ind2`	x	-	-	-	-
Coupling coefficient	`k`	x	-	-	x	x

Syntax/Synopsis

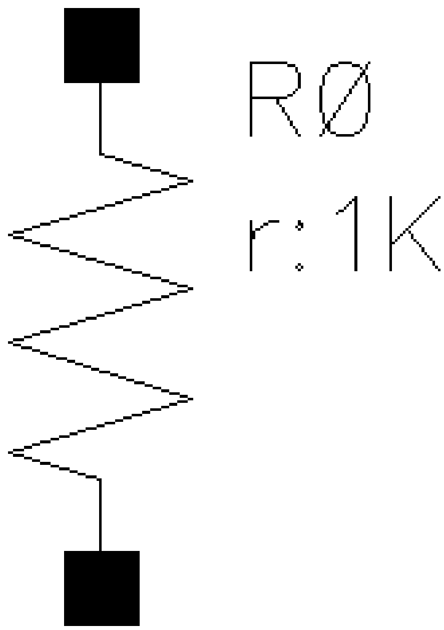
```
Name mutual_inductor <parameter=value> ...
```

Examples

Sample instance statement with two inductors:

```
l1 (1 0) inductor
l2 (2 0) inductor
ml1 mutual_inductor coupling=1 ind1=l1 ind2=l2
```

presistor Symbol



Description

Parasitic Resistor is a component in `parasitics` category in Analog Library. This device is supported within the altergroups.

Command-Line Help

```
spectre -h resistor
```

CDF Parameters

CDF Parameter	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Resistance	`r`	x	x	x	x	x
Temperature coefficient 1	`tc1`	x	-	-	x	x
Temperature coefficient 2	`tc2`	x	-	-	x	x
Model name	`model`	x	-	-	-	-
Length	`l`	x	-	-	x	x
Width	`w`	x	-	-	x	x
Resistance Form	`resform`	x	-	-	-	-
Multiplier	`m`	x	-	-	x	x
Scale factor	`scale`	x	-	-	x	x
Temp rise from ambient	`trise`	x	-	-	-	-
Generate noise?	`isnoisy`	x	-	-	-	-
Capacitance connected	`hrc`	-	-	-	x	x
Temperature difference	`dtemp`	-	-	-	x	x
AC resistance	`ac`	-	-	-	x	-
Capacitance	`c`	-	-	x	-	-

Syntax/Synopsis

```
Name ( 1 2 ) ModelName <parameter=value> ...
```

```
Name ( 1 2 ) resistor <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName resistor <parameter=value> ...
```

Examples

Following is a sample statement without model:

```
r1 (1 2) resistor r=1.2K m=2
```

Following is a sample statement with model:

```
r1 (1 2) resmod l=8u w=1u
```

Following is a sample model statement:

```
model resmod resistor rsh=150 l=2u w=2u etch=0.05u tc1=0.1 tnom=27 kf=1
```

Related Topics

CDF Parameters Supported by Analog Library Components

5

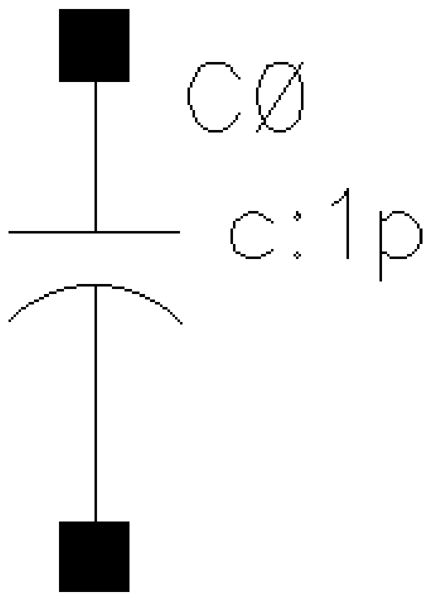
Passive Components in Analog Library

The components in the `Passive` category are:

- cap Symbol
- capq Symbol
- core Symbol
- corefragment Symbol
- delay Symbol
- delayline Symbol
- fracpole Symbol
- ideal_balun Symbol
- ind Symbol
- indq Symbol
- mind Symbol
- msline Symbol
- mtline Symbol
- nport Symbol
- phyres Symbol
- rcwireload Symbol
- res Symbol
- spxtswitch Symbol
- switch Symbol
- tline Symbol

- winding Symbol
- xfmr Symbol

cap Symbol



Description

The component `cap` is a two terminal capacitor. You can assign the capacitance or let Spectre compute it from the physical length and width of the capacitor. In either case, the capacitance can be a function of temperature or applied voltage. This device is supported within the altergroups.

Command-Line Help

```
spectre -h capacitor
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Capacitance	`c`	x	x	x	x	x
Initial condition	`ic`	x	-	-	x	x
Model name	`model`	x	-	-	-	-
Width	`w`	x	-	-	x	x
Length	`l`	x	-	-	x	x
Multiplier	`m`	x	-	-	x	x
Scale factor	`scale`	x	-	-	x	x
Temp rise from ambient	`trise`	x	-	-	-	-
Number of Polynomial Coeffs	`polyCoef`	x	-	-	x	x
PolyCoeff 1	`c1`	x	-	-	x	x
Temperature coefficient 1	`tc1`	x	-	-	x	x
Temperature coefficient 2	`tc2`	x	-	-	x	x
Temperature difference	`dtemp`	-	-	-	x	x
Capacitor Area	`area1`	x	x	x	x	x

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Capacitor Perimeter	`perim1`	-	x	x	x	x

Syntax/Synopsis

```
Name ( 1 2 ) ModelName <parameter=value> ...
Name ( 1 2 ) capacitor <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName capacitor <parameter=value> ...
```

Examples

Following is a sample without model:

```
c2 (1 0) capacitor c=2.5u tc1=1e-8
```

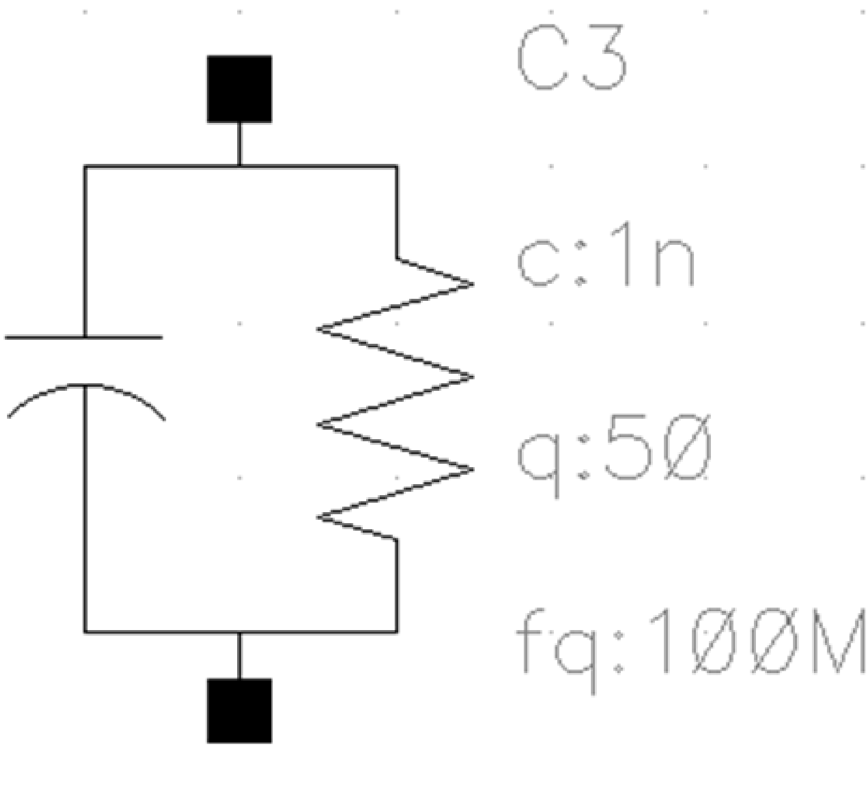
Following is a sample with model:

```
c2 (1 0) proc_cap c=2.5u tc1=1e-8
```

Following is a sample model statement:

```
model proc_cap capacitor c=2u tc1=1.2e-8 tnom=25
```

capq Symbol



Two Terminal Capacitor Resistor

The `capq` instance is a capacitor with the Q factor `q`' specified at a particular frequency `fq`.

The parameter mode specifies the exact form of the frequency dependence of the real part of the admittance `Re(Y)`. The equations are written in terms of admittance Y, where by default,

- `w=2*Pi*freq`
- `wq=2*Pi*fq`
- `fq=1.0e8 Hz`. This is the frequency at which `q` is measured.
- `mode=1`. This is the integer parameter that selects the frequency dependence.
- `c=1e9F`. This is the default capacitance.
- `q=50.0`. This is the quality factor measured at `fq`.
- `alph=0`. This is the scaling factor for `Q`.

- `qf=q*(freq/fq)^alph`
- `Y=2*pi*freq*c*(1/qf+j)`

If the `capq` symbol does not work in `mode 4`, the `alph` property is ignored.

The following table describes the various modes and the corresponding equations:

Mode	Description
1	Constant real part of the admittance Re(Y)=const. Equation: `Re(Y)=wq*c/q=const; Im(Y)=w*C`.
2	Re(Y) increases proportional to sqrt(freq). Equation: `Re(Y)=c*sqrt(wq*w)/q; Im(Y)=w*C`.
3	Re(Y) increases linearly with frequency. Equation: `Re(Y)=w*c/q; Im(Y)=w*C`.
4	Re(Y) decreases proportional to (freq/fq)^alph. Equation: `Re(Y)=w*c/Qf; Im(Y)=w*c; Qf=q*(freq/fq)^alph`.

Command-Line Help

```
spectre -h capq
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre
Alpha parameter	`alph`	x
Capacitance	`c`	x
Frequency for C and Q	`fq`	x
Generate noise?	`isnoisy`	x
Mode	`mode`	x
Model name	`model`	x
Multiplier	`m`	x
Quality factor	`q`	x
Temp rise from ambient	`trise`	x

Examples

```
C0 (net1 net2) capq c=1n q=50 fq=100M mode=4 alph=0.35
```

core Symbol

Description

This component models the magnetic hysteresis, with air gap, frequency, and temperature effects. The model is based on the AWB model for magnetic cores and windings. The user has to specify the core's material and geometric parameters to model the hysteresis.

The material parameters to specify are the '`Br`', '`Bm`', and '`Hc`' of the core. The geometric parameters are the area, magnetic path length, and the air gap of the core.

You can specify the magnetic path length in one of the following ways:

- Give the length directly in cm.
- Or give the outer and inner diameter of the core.

Cores without terminals represent complete magnetic loops. Cores with terminals are fragments that you can use as building blocks to build models of complicated core structures.

This device is not supported within the altergroups.

Command-Line Help

```
spectre -h core
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-
Device area	`area`	x	-	-	-	-
Physical length	`len`	x	-	-	-	-
Inner diam of toroidal core	`idiam`	x	-	-	-	-
Outer diam of toroidal core	`od`	x	-	-	-	-
Gap length	`gap`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Total Num of windings	`numOfL`	-	-	-	x	-
Name of winding 1	`l1 - l20`	-	-	-	x	-
Initial magnetization of core	`mag`	-	-	-	x	-

Syntax/Synopsis

```
Name ... ModelName <parameter=value> ...
```

Following is the Model Synopsis:

```
model ModelName core <parameter=value> ...
```

Examples

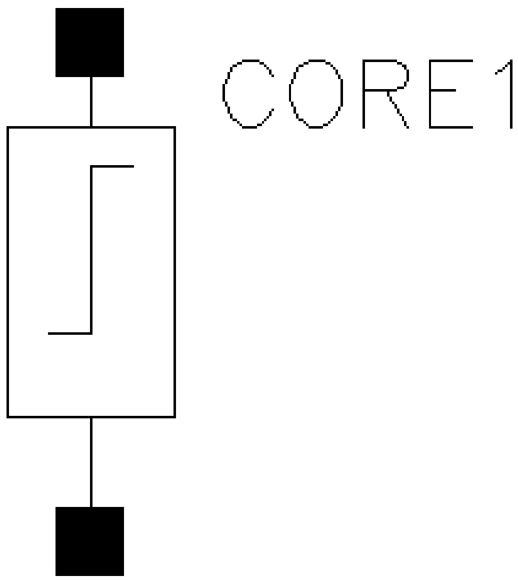
Following is a sample instance statement:

```
c1 (1 0) core_mod area=1.2 len=8.1 id=0.55 gap=0.25
```

Following is a sample model statement:

```
model core_mod core len=7.7 area=0.85 br=1e3 bm=5e3 hc_t1=0.2 p1_f1=2.08
f1=10e3 p2_f2=50 f2=100K bflux=1e3 density=4.75
```

corefragment Symbol



Description

The component `corefragement` is a magnetic core with hysteresis. Cores without terminals represent complete magnetic loops. Cores with terminals are fragments that you can use as building blocks to build models of complicated core structures.

Command-Line Help

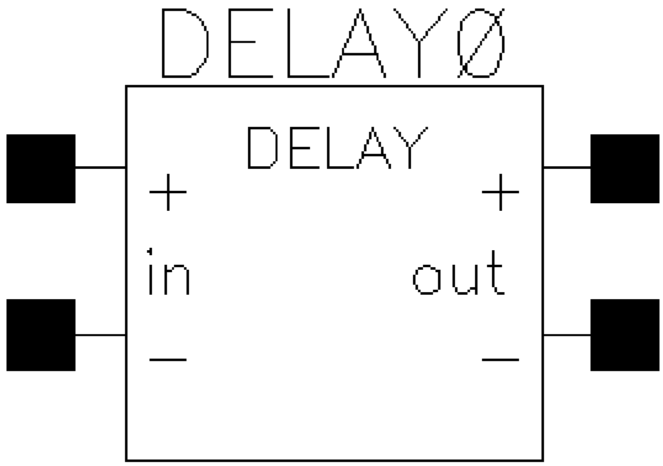
```
spectre -h core
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Device area	`area`	x	-	-	-	-
Physical length	`len`	x	-	-	-	-
Inner diam of toroidal core	`idiam`	x	-	-	-	-
Outer diam of toroidal core	`od`	x	-	-	-	-
Gap length	`gap`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-

delay Symbol



Description

The delay line model is a four terminal device with zero output impedance and infinite input impedance. The output between nodes ‘`p`’ and ‘`n`’ is the input voltage between nodes ‘`ps`’ and ‘`ns`’ delayed by the time delay ‘`td`’ and scaled by ‘`gain`’. This device is not supported within the altergroups.

Command-Line Help

```
spectre -h delay
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Delay time	`td`	x	-	-	-	-
Gain	`gain`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-

Syntax/Synopsis

```
Name ( p n ps ns ) delay <parameter=value> ...
```

Examples

```
dl1(outp outn cntrlp cntrln) delay td=10n gain=1.5
```

delayline Symbol

Description

The `delayline` component is a lossless transmission line section with a specified delay time T_d and characteristic impedance Z_0. The `ABCD` matrix of a lossless transmission line section is given by:

$$ABCD = \begin{bmatrix} \cos(\omega T_d) & jZ_d \sin(\omega T_d) \\ \dfrac{j\sin(\omega T_d)}{Z_0} & \cos(\omega T_d) \end{bmatrix}$$

Command-Line Help

```
spectre -h mtline
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Characteristic impedance	`zo`	x	-	-	x	x
Delay time	`td`	x	-	-	x	x

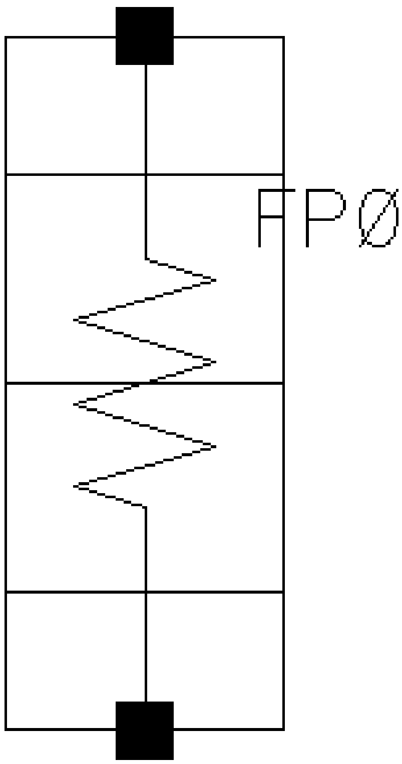
Syntax/Synopsis

```
Name ( in out ) mtline <parameter=value> ...
```

Examples

```
DL0 ( net1 net2 ) mtline z0=50 td=1n
```

fracpole Symbol



Description

The component `fracpole` is a fractional impedance/admittance pole. The circuit is a one-port that exhibits poles and zeros that are real and spaced evenly in a logarithmic sense over the frequency range. The impedance exhibited by one port approximates a fractional pole slope between `-1` and `0` in the frequency range.

In other words, if the impedance is plotted on a log-log scale, it has a negative slope equal to the fraction specified. If the user requested half a pole, the slope will be `-1/2`, and so on. Since it is a lumped approximation, the slope is not exact but slowly oscillates about the specified value.

This device is supported within the altergroups.

Command-Line Help

```
spectre -h fracpole
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Low freq. limit for approx.	`f0`	x	-	-	-	-
Freq 1 to Freq50High freq. limit for approx.	`f1`	x	-	-	-	-
Unity intercept point	`coef`	x	-	-	-	-
Slope of imp on log/log scale	`slope`	x	-	-	-	-
Num of lumps in approx.	`lumps`	x	-	-	-	-
Num of lumps/dec in approx.	`dec`	x	-	-	-	-
Profile	`profile`	x	-	-	-	-
Multiplicity factor	`m`	x	-	-	-	-
Initial condition	`ic`	x	-	-	-	-
Res. for initial conds.	`rforce`	x	-	-	-	-

Syntax/Synopsis

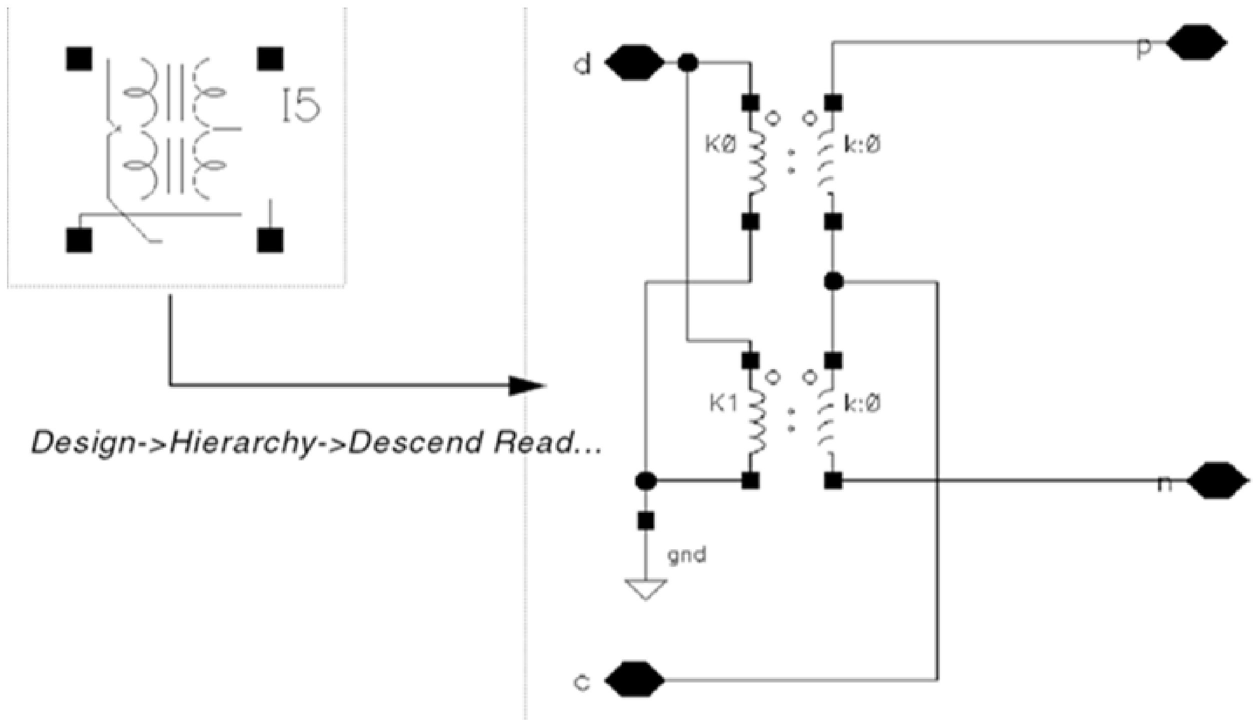
```
Name ( 1 2 ) ModelName <parameter=value> ...
```

```
Name ( 1 2 ) fracpole <parameter=value> ...
```

Following is the model synopsis

```
model ModelName fracpole <parameter=value> ...
```

ideal_balun Symbol



Description

The `balun` is a bidirectional balanced-unbalanced convertor that can be used in circuits that require single or differential signal transformation. Although a passive network (including the transformer) is used to achieve balun, this implementation employs a three-port network. It requires three ports (or nodes) because the reference nodes are always at the global ground, `single`, `blip`, and `bal_n`.

The `balun` is used for converting ground-referred differential-mode (`d`) and common-mode (`c`) signals to balanced positive (`p`) and negative (`n`) signals.The `balun` is accurate at all frequencies including DC, because it uses ideal transformers.

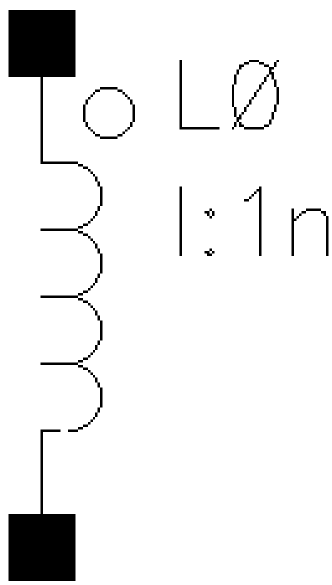
```
subckt balun (d c p n)
    T1 (d 0 p c) transformer n1=2
    T2 (d 0 c n) transformer n1=2
ends balun
```

Notice that the `balun` is bidirectional, you can use, as inputs or outputs, either the unbalanced signals (`d` for differential mode and `c` for common-mode) or the balanced signals (`p` for positive and `n` for negative).

Component Parameters

`ideal_balun` has no component parameters.

ind Symbol



Description

The component `ind` is a two terminal inductor. The inductance of this component can be a function of temperature or branch current. If you do not specify the inductance in the instance statement, it is taken from the model.

Command-Line Help

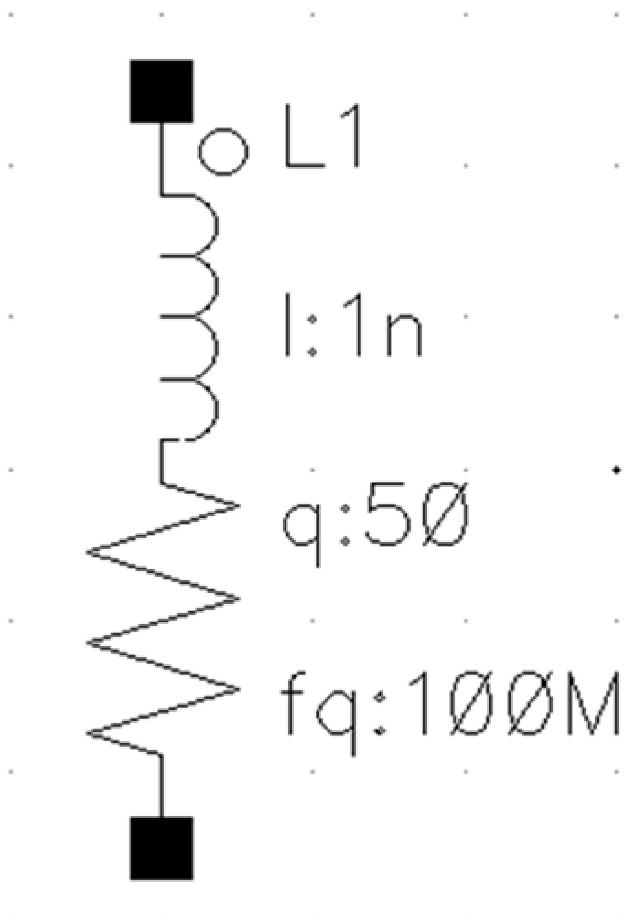
```
spectre -h inductor
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Use S-parameters	`useSParamsCheckBox`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Browse s-parameter file	`nportFileB`	x	-	-	-	-
S-parameter data file	`dataFile`	x	-	-	-	-
Model name	`model`	x	-	-	-	-
Inductance	`l`	x	x	x	x	x
Resistance	`r`	x	-	-	x	x
Multiplier	`m`	x	-	-	x	x
Temp rise from ambient	`trise`	x	-	-	-	-
Initial condition	`ic`	x	-	-	x	-
Temperature coefficient 1	`tc1`	-	-	-	x	x
Temperature coefficient 2	`tc2`	-	-	-	x	x
Generate noise?	`isnoisy`	x	-	-	-	-
Scale factor	`scale`	-	-	-	x	x
Number of Polynomial Coeffs	`polyCoef`	-	-	-	x	-
Poly Coeff 1	`c1 - c20`	-	-	-	x	-
Temperature difference	`dtemp`	-	-	-	x	x

indq Symbol



Two Terminal Series Inductor Resistor

The inductance of this component can be a function of temperature or branch current. If you do not specify the inductance in the instance statement, it is taken from the model statement.

The `indq` component also has the frequency-dependent Q-factor with four modes of frequency dependence. This component has the following optional parameters:

- `wq=2*Pi*fq`
- `q=50.0`. This is the quality factor measured at `fq`.
- `fq=1e8 Hz`. This is the frequency at which `l` and `q` are measured.
- `mode=0`. This is the integer parameter that selects the frequency dependence.
- `alph=0`. This is the scaling factor for `Q`.

If the `indq` symbol does not work in `mode 4`, the `alph` property is ignored.

- `rdc=0.0`. This is the DC resistance used in `mode=2` and `mode=3`.
    - `qf=q*(freq/fq)^alph, Z=2*pi*freq*L*(1/qf+j).`

The following table describes the various modes and the corresponding equations:

Mode	**Description**
1	RL series branch with `R=wq*L/Q=const`, `L=const`.
2	RL series branch with `R=Rdc+R2*sqrt(freq)` and `LsLext+L2/sqrt(f req).`
3	RL series branch with `R=sqrt(Rdc^+Rac^)`, `L=const`.
4	RL series branch with `R=2*PI*f*L/Qf`, `Qf=q*(f/fq)''alph` and `L=const`. This mode is ignored in transient.

This device is supported within the altergroups. During `auCdl` netlisting, the `Multiplier`, `Quality Factor`, and `Frequency for L and Q` CDF parameters are not netlisted. The indq component is netlisted similar to the `ind` component.

For more information, see indq.

Command-Line Help

```
spectre -h inductor
```

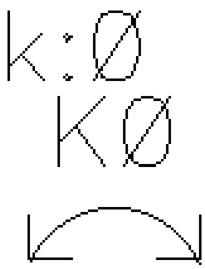
Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl
Use S-parameters	useSParamsCheck Box	x	x
Browse s-parameter file	nportFileB	x	x
S-parameter data file	dataFile	x	x
Alpha parameter	alph	x	x
Mode	mode	x	x
Model name	model	x	x
Inductance	l	x	x
Multiplier	m	x	-
Temp rise from ambient	trise	x	x
Generate noise?	isnoisy	x	x
Quality factor	q	x	-
Rdc in mode 2 and 3	rdc	x	x
Frequency for L and Q	fq	x	-

Examples

```
L1 (net1 net2) inductor l=1n q=50 fq=100M mode=4 alph=0.55
LL0 vout net7 1n $[LP]
```

mind Symbol



Description

The `mind` component is a mutual inductor. It couples two previously specified inductors. There is no limit to the number of inductors that you can couple or to the number of couplings to a particular inductor, but you must specify separate mutual inductor statements for each coupling. Using the ‘dot’ convention, place a ‘dot’ on the first terminal of each inductor.

The mutual inductor modifies the constitutive equations of two isolated inductors to:

```
v1 = L11*di1/dt + M*di2/dt
v2 = M*di1/dt + L22*di2/dt
```

where the mutual inductance, `M`, is computed from the coupling coefficient, `k`, using,

```
k = |M|/sqrt(L11*L22).
```

This device is not supported within the altergroups.

Command-Line Help

```
spectre -h mutual_inductor
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
First coupled inductor	`ind1`	x	-	-	-	-
Second coupled inductor	`ind2`	x	-	-	-	-
Coupling coefficient	`k`	x	-	-	x	x

Syntax/Synopsis

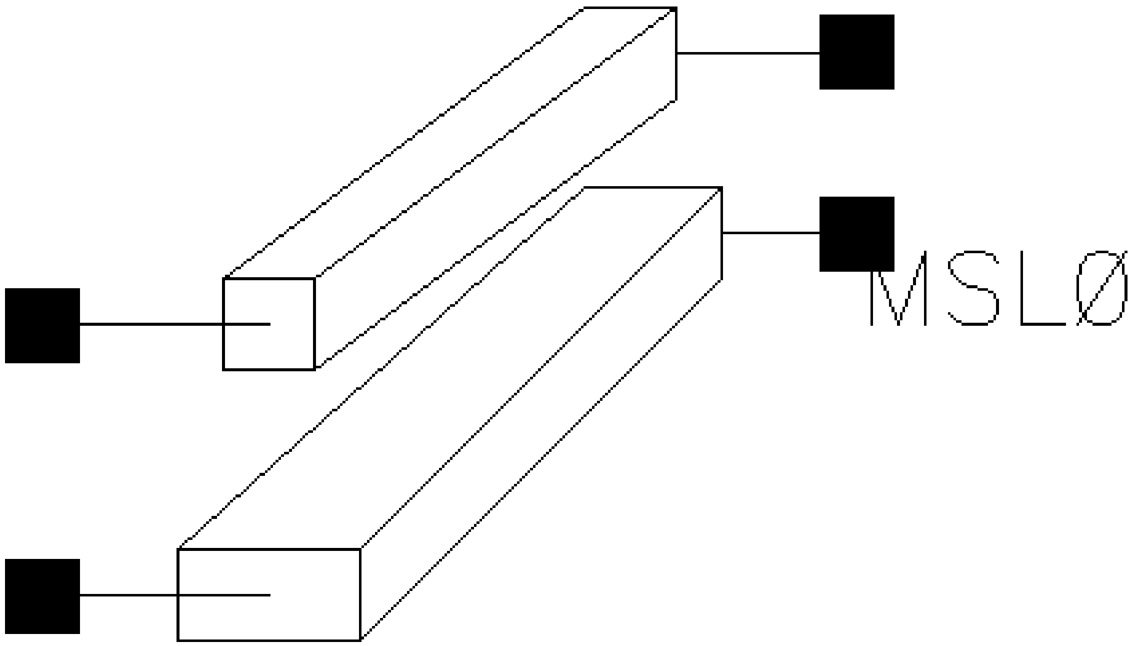
```
Name mutual_inductor <parameter=value> ...
```

Examples

Following is a sample instance statement with two inductors:

```
l1 (1 0) inductor
l2 (2 0) inductor
ml1 mutual_inductor coupling=1 ind1=l1 ind2=l2
```

msline Symbol



Description

This component is a microstrip line based on the equations of Hammerstad and Jensen. The model contains a thickness correction to the width and frequency dependent permittivity and characteristic impedance. The dispersion equations are those of Kirschning and Jansen.

This device is supported within the altergroups.

Command-Line Help

```
spectre -h msline
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Length	`l`	x	-	-	-	-
Width	`w`	x	-	-	-	-
Substrate height	`h`	x	-	-	-	-
Conductor thickness	`t`	x	-	-	-	-
Relative permittivity	`eps`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Max signal frequency	`fmax`	x	-	-	-	-

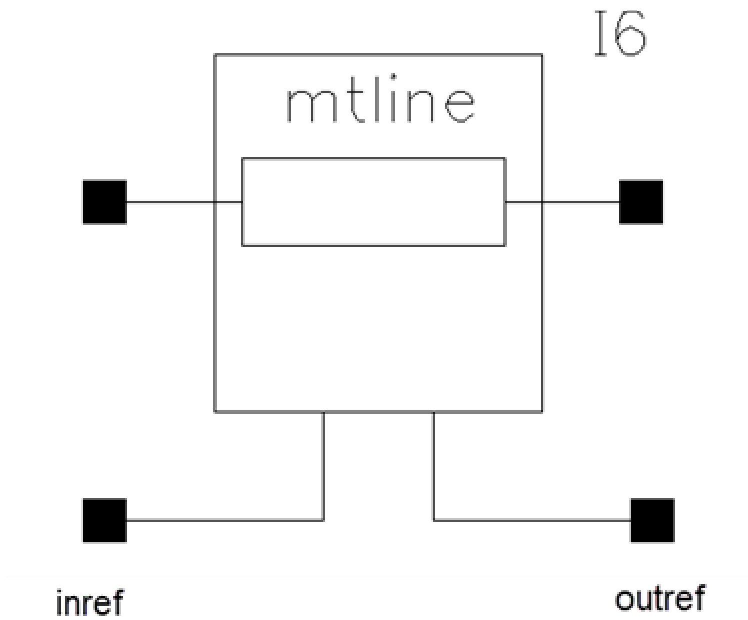
Syntax/Synopsis

```
Name ( t1 b1 t2 b2 ) msline <parameter=value> ...
```

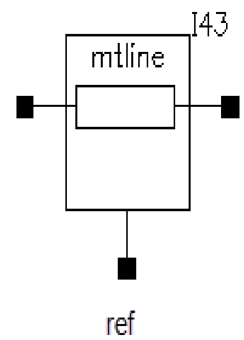
Examples

```
tl1 (in 0 out 0) msline l=0.15 w=0.01 h=0.01
```

mtline Symbol



mtline without subcircuit
(even number of pins)



mtline with sub-circuit
(odd number of pins)

Description

The component `mtline` is a multi-conductor transmission line. It is characterized by constant RLCG matrices or frequency dependent RLCG data. An `mtline` can have as many conductors as defined in the *Num of lines (excluding ref.)* field. However, there must be at least two conductors, with one conductor used as a reference, to define terminal voltages. The reference conductor can be ground. The order of the conductors is the same as the order of data in the input.

All of the conductors are assumed to have the same length. The input to `mtline` are conductor length, per-unit-length resistance (`R`), inductance (`L`), capacitance (`C`), and conductance (`G`) matrices. As these matrices are symmetric, either a full matrix description or a lower half matrix description can be used.

You can use mtline in four different modes:

- *RLGC* - Lets you specify the per-unit-length constant RLGC matrices and frequency dependent RLGC data file
- *FieldSolver* - Lets you specify the 2-D field solver geometry and material property information

- *S-parameter* - Lets you specify the S-Parameter data
- *Tline* - Lets you specify the old single-conductor tline parameters (to ease migration)

This device is not supported within the altergroups. The *Edit Object Properties* or *CDF Parameters* of the component `mtline` in analogLib are dynamic and subject to change based on the usage of IC Spectre or MMSIM Spectre installation.

Parameters for the mtline Component

This section describes the following Component Parameters for the `mtline` component:

Num of lines (excluding ref.), lets you specify the number of lines excluding the reference lines. The reference conductor is used as a return path. There is no upper limit on number of conductors that mtline can have in Spectre. However, there must be at least two conductors with one conductor used as reference to define terminal voltages.The reference conductor can be ground. The order of the conductors is the same as the order of the data in the input.

Model name lets you specify the name of the model to be associated with the `mtline` component.

Physical length lets you specify the physical length of the line, required in order to perform the transmission line simulation. All the conductors in an mtline instance are assumed to have the same length, and to be uniform along the length. Default = `0.01m`.

When using S-~~p~~Parameter data, the physical length of the line must be specified.

In the Tline use model, physical length is used with Propagation velocity normalized to specify the electrical length of the line.

Multiplicity factor lets you specify the multiplicity factor of the `mtline` component. The valuemust be a nonzero real number. This number lets you specify a number of mtline components in parallel. Default=`1`.

Max signal frequency lets you specify the maximum signal frequency used to determine the relevant range of rational fitting used in the 2D field solver. Default = `25e09 Hz`.

Spectre uses the rational fitting algorithm to build a stable model that approximates the desired transmission line characteristics. The *Max signal frequency* is used to determine the relevant range of rational fitting. The accuracy of the mtline model depends on how well the rational approximation is over frequency range from fmax to fmin. When constant RLGC matrices are provided, fmin is set to 1Hz and fmax defaults to 25GHz. A good estimate of the Max signal frequency is three times the inverse of rise time in the input signal. When a RLGC data file is provided, the lowest frequency point in the data file is used as fmin' and the largest frequency point in the data file is used as fmax. You must provide sufficient data points to cover both low frequencies and high-frequencies to obtain an accurate, stable model.

Type of Input lets you select a type of input, and displays additional fields required for the specified type of input in the form. Possible values are: *RLGC*, *FieldSolver*, *Tline*, and *S-Parameter*.

If you select `RLGC` or `S-Parameter` as the type of input, you can select the *RLGC data file as Design Var?* check box or the *S-Parameter file as Design Var?* check box.These check boxes let you use a design variable to specify the RLGC data file or the S-Parameter file.

RLGC data file as Design var?, when selected, lets you use a design variable to specify the RLGC data file. This check box is shown only when you select the *RLGC* option for *Type of Input*.

RLGC data file lets you specify the RLGC data file that contains the frequency dependent RLGC data. This field is shown only when the *RLGC* option for *Type of Input* is selected and the *use lmg subckt* check box is not selected on the Edit Properties form.

The RLGC data file parameter can be used to store the 2-D field solver output for use in subsequent simulations. If the file parameter is given, mtline checks the existence of the file. If the file does not exist, the RLGC model is generated by the field solver and the output is stored in a file. If the file exists, mtline checks if the RLGC data stored in the file matches the mtline 2-D field solver input. If it does not match, a new set of RLGC data is generated and the file is overwritten. Otherwise, the data is reused. If the RLCG data file parameter is not given, the RLGC data is stored in the `input.rlgc` file in the `simulation/circuitName/spectre/schematic/netlist` directory.

use lmg subckt, when selected, shows the *LMG subcircuit file* field and hides all RLCG-specific fields. This field is shown only when you select the *RLGC* option for *Type of Input*.

LMG subcircuit file lets you specify the name of the LMG subcircuit file. This field is shown only when you select the *use lmg subckt* check box.

Enter RLCG etc. matrices, when selected, displays the following additional fields. This check box is shown only when you select the *RLGC* option for *Type of Input*. The following fields are vectors. For example, if you want to multiply your R matrix per unit length by a design variable `myScale`, you need to surround the expression with parentheses. For example, enter it as `(myScale*50)`. If you do not add the parentheses, Spectre fails during simulation. The following fields are displayed only when you select the *Enter RLCG etc. matrices* check box.

- ***R matrix per unit length*** lets you specify the resistance matrix per unit length. Units: `Ohm/m`.
- ***L matrix per unit length*** lets you specify the inductance matrix per unit length. Units: `H/m`.
- ***G matrix per unit length*** lets you specify the conductor matrix per unit length. Units: `S/m`.
- ***C matrix per unit length*** lets you specify the capacitance matrix per unit length. Units: `F/m`.
- ***Skin effect res matrix per unit length*** lets you specify the skin effect resistance matrix per unit length. Units: `Ohm/m*sqrt(Hz)`
- ***Dielectric loss cond matrix per unit length*** lets you specify the dielectric loss conductance matrix per unit length. Units: `S/m*Hz`

  `mtline` supports LC, RC, RGC, RLG, RLC, and RLGC transmission line systems. For example,

  - When only L and C matrices are provided, a lossless transmission line system is modeled.
  - When only R and C matrices are provided, an RC transmission line system is modeled.

  Since the per-unit-length RLGC matrices are generally symmetric, either a full matrix description or a lower half matrix description is accepted. You enter the matrix as a series of numbers, e. g. `50 10 1 10 50 10 1 10 50` (full matrix) or `50 10 50 1 10 50` (half matrix). Spectre determines whether the matrix is full or half matrix depending on the number of entries. For example, for a `3x3` matrix, if you enter six entries, Spectre knows that it is a half matrix. If you enter nine entries, Spectre knows that it is a full matrix. Spectre complains if the number of entries does not make either a full or a half matrix.
- ***Dielectric loss cutoff frequency*** lets you specify the cutoff frequency for dielectric loss. Units: `Hz`
- ***Dielectric loss onset frequency*** lets you specify the onset frequency for dielectric loss. Units: `Hz`

S-parameter file as Design Var?, when selected, lets you use a design variable to specify the S-Parameter file. This check box is shown only when you select the *S-parameter* option for *Type of Input*.

S-parameter File lets you specify the data file that contains the frequency dependent RLGC data or S-Parameter data file. This field is shown only when you select the *S-parameter* option for *Type of Input*.

You can also specify Y- or Z-parameters. Spectre parses the data file and determines whether the data is in S-, Y-, or Z-parameter format.

The supported S-Parameter data file formats include `Touchstone`, `Spectre` and `CITIfile`.

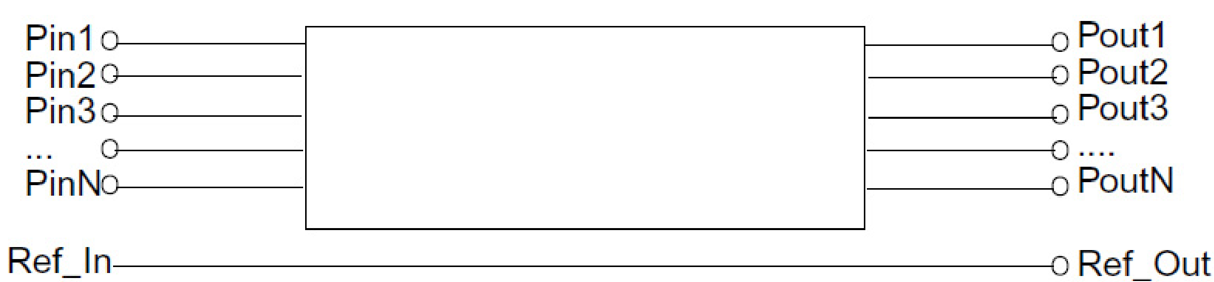
Spectre reads the comment line in the S-Parameter data file to determine whether the frequency data is in `Hz`, `MHz`, `GHz`, etc. It also determines the characteristic impedance and format of the data (`real,imag`), (`mag,deg`), (`mag,rad`), (`db,deg`), or (`db,rad)`.

Spectre imports the S-Parameter data describing a transmission line system. mtline converts the frequency dependent S-Parameter to frequency dependent RLGC data and stores the results in the `input.rlgc` file,located in `simulation/CircuitName/spectre/schematic/netlist` directory, for reuse in subsequent simulations.

When the file parameter corresponds to S-Parameter data, `mtline` first checks the existence of the `input.rlgc` file to determine if the S-to-RLGC extraction has been performed in a previous simulation.

The ordering of the S-Parameter input file should be in the format of input ports followed by the output ports of the transmission line system, or `Pin1, Pin2, Pin3, ..., Pout1, Pout2, Pout3,...`

The S-Parameter data file for use with mtline should have the S-Parameter data interpreted in the following order.



Frequency scale factor lets you specify the frequency scale factor for frequency-dependent RLGC data and S-Parameter data. This field is shown only when you select the *RLGC* or *S-parameter* option for *Type of Input*. The default value is `1`.

Generate noise? lets you control whether the `mtline` component must generate noise. Possible values are *yes* and *no*.

Transmission line type, lets you choose the transmission line type. Possible values are microstrip line (*microstrip*), stripline (*stripline*), coplanar waveguide (*coplanar*), and substrate lossy line(*sublossline*). Default = *sublossline*. If you need to include dielectric loss in your microstrip or stripline model, use the sublossline transmission line type.

Model type, lets you specify the model type. For each line configuration, you can choose one of three model types: *lossless*, *narrowband*, or *wideband*. Default = *wideband*.

In the lossless model, the internal inductance of the conductor is disregarded by setting the frequency value high; 30GHz for cases without substrate loss and 15 GHz for cases with substrate loss, and ignoring the value of Max signal frequency (fmax).

For the narrowband model, the RLGC data is calculated at the Max signal frequency (fmax, default is 25GHz) and assumed to be constant over the frequency of interest. The narrowband model is valid near fmax.

With the wideband model, true frequency dependent RLGC data is calculated over the frequency of interest (DC to fmax). For most applications, choose the wideband model as it provides the best model accuracy.

Number of dielectric layers lets you specify the number of dielectric layers. Dielectric layers are stacked above the ground plane (when `numgnd=1`), or between the ground planes (when `numgnd=2`). There can be up to `12` dielectric layers.This field is shown only when you select the *FieldSolver* option for *Type of Input* and *coplanar* or *sublossline* for *Transmission line type*.

Number of Ground Planes lets you specify the number of ground planes, This field is shown only when you select the *FieldSolver* option for *Type of Input* and *coplanar* or *sublossline* for *Transmission line type*.

Rel dielectric const of layers(er) lets you specify the relative dielectric constant of the dielectric layer. It is a vector type that handles different layer geometries and layer properties. When the number of elements in the vector is less than the number of layers, the value of the last element in the vector is applied to all of the remaining layers.This field is shown only when you select the *FieldSolver* option for *Type of Input*.

Dielectric layer thickness (d) lets you specify the dielectric layer thickness. It is a vector type to handle different layer geometries and layer properties. When the number of elements in the vector is less than the number of layers, the value of the last element in the vector is applied to all of the remaining layers. Units = `meters`.This field is shown only when you select the *FieldSolver* option for *Type of Input*.

Dielectric loss type lets you specify the dielectric loss type. The loss value is specified using the *Dielectric layer loss* parameter. Possible values are *sigma* and *tangent*. A particular dielectric layer can be lossy, and either the loss tangent parameter (`tan = sigma/`

`(w*ep0)`) or the loss sigma parameter (`sigma = tan*w*ep0`) can be used. Default value: `tangent`.This field is shown only when you select the *FieldSolver* option for *Type of Input* and *coplanar* or *sublossline* for *Transmission line type*.

Dielectric layer loss lets you specify the dielectric layer loss. The loss can be in terms of dielectric conductivity or tangent loss, determined by the *Dielectric loss type* parameter.This field is shown only when you select the *FieldSolver* option for *Type of Input* and *coplanar* or *sublossline* for *Transmission line type*.

Signal line width lets you specify the signal line width, This field is shown only when you select the *FieldSolver* option for *Type of Input*. When the number of elements in the vector is less than the number of layers, the value of the last element in the vector is applied to all of the remaining layers. Units: `meters`.

Signal line thickness lets you specify the signal line thickess. This field is shown only when you select the *FieldSolver* option for *Type of Input*. When the number of elements in the vector is less than the number of layers, the value of the last element in the vector is applied to all of the remaining layers. Units: meters.

Signal line height (h) lets you specify the signal line height. This field is shown only when you select the *FieldSolver* option for *Type of Input*. The distance between the signal line and ground plane at the bottom of the 2-D interconnect cross section. When the number of elements in the vector is less than the number of layers, the value of the last element in the vector is applied to all of the remaining layers. Units: `meters`.

Signal line spacing lets you specify the signal line spacing(the distance between the signal lines). This field is shown only when you select the *FieldSolver* option for *Type of Input*. It can be negative in order to describe overlapping signal lines. When the number of elements in the vector is less than the number of layers, the value of the last element in the vector is applied to all the remaining layers. Units: `meters`.

Gnd Plane thickness lets you specify the ground plane thickness. This field is shown only when you select the *FieldSolver* option for *Type of Input*. When the number of elements in the vector is less than the number of layers, the value of the last element in the vector is applied to all of the remaining layers. Units: `meters`.

Ground plane conductivity lets you specify the ground plane conductivity. This field is shown only when you select the *FieldSolver* option for *Type of Input*. Units: `S/m`.

Signal line conductivity lets you specify the signal line conductivity. This field is shown only when you select the *FieldSolver* option for *Type of Input*. Units: `S/m`.

Charecteristic impedance lets you specify the characteristic impedance of lossless line. This field is shown only when you select the *Tline* option for *Type of Input*. Default: `50`. Units: `Ohms`.

Delay Time lets you specify the time delay of a lossless line in seconds; a measure of the electrical length. This field is shown only when you select the *Tline* option for *Type of Input*. Units: `seconds`.

Frequency lets you specify the reference frequency, which is used in conjunction to the normalized length to specify electrical length of line.This field is shown only when you select the *Tline* option for *Type of Input*. Units: `Hz`.

Normalized length, lets you specify the normalized electrical length in wavelengths at the specified reference frequency of a lossless line.This field is shown only when you select the *Tline* option for *Type of Input*. Default: `0.25`.

Propagation velocity normalized lets you specify the propagation velocity of the line given as a multiple of c, the speed of light in free space (`vel <= 1`). This field is shown only when you select the *Tline* option for *Type of Input*. `vel=c/sqrt(år)`.

Corner frequency, lets you specify the corner frequency for skin effect. This is the frequency where skin depth equals the wall thickness of the conductor.This field is shown only when you select the *Tline* option for *Type of Input*. Default: `0`. Units: `Hz`.

DC series res/Length lets you specify the DC series resistance per unit length.This field is shown only when you select the *Tline* option for *Type of Input*. Default: `0`. Units: `Ohm/m`.

Loss resistance per unit length lets you specify the conductor (series) resistance per unit length at conductor loss frequency.This field is shown only when you select the *Tline* option for *Type of Input*. Default: `0`. Units: `Ohm/m`.

- `seriesr` = `2*z0*alphac` (when `alphac` is given)
- `seriesr` = `2*z0*fc/(2*qc*c*vel)` { when `qc` is given }

  where `seriesr` is the *Loss resistance per unit length*, `c` is the speed of light. `z0` is *Characteristic Impedance*, `fc` is *Conductor loss frequency*, `alphac` is *Conductor loss at fc* , and `qc` is *Conductor loss quality factor*.

Conductor loss at fc lets you specify the conductor loss at the conductor loss frequency (low loss approximation). This field is shown only when you select the *Tline* option for *Type of Input*. Default: `0`. Units: `dB/m`.

Conductor loss quality factor lets you control the conductor loss quality factor at conductor loss frequency (low loss approximation). This field is shown only when you select the *Tline* option for *Type of Input*. Default: `infinity`.

Dielectric loss frequency lets you specify the dielectric loss measurement frequency. It is used in conjunction with *Dielectric loss quality factor*. This field is shown only when you select the *Tline* option for *Type of Input*. Units: `Hz`.

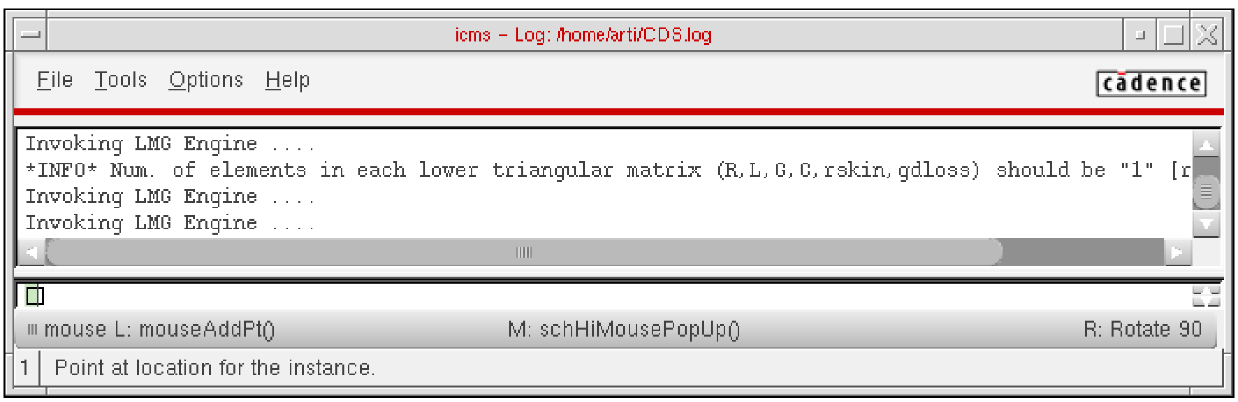
Loss conductance per unit length, lets you specify the dielectric (shunt) conductance per unit length at conductor loss measurement frequency. This field is shown only when you select the *Tline* option for *Type of Input*.

Dielectric loss lets you specify the dielectric loss (low loss approximation). This field is shown only when you select the *Tline* option for *Type of Input*.

Dielectric loss quality factor lets you specify the dielectric loss quality factor at dielectric loss measurement frequency (low loss approximation). This field is shown only when you select the *Tline* option for *Type of Input*.

Conductor loss frequency lets you specify the conductor loss frequency. It is used in conjunction with *Loss resistance per unit length*, *Conductor loss at fc*, and *Conductor loss quality factor*. This field is shown only when you select the *Tline* option for *Type of Input*.

The number of elements that you need to specify for the R/L/G is determined by the number of lines that you specify. For example, if the number of lines (n) is 3, then you need to specify (n*2) 6 elements each for R, L, and G. This information is displayed in CIW as follows.



Command-Line help

```
spectre -h mtline
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Num of lines (excluding ref.)	`n`	x	-	-	-	-
Model name	`model`	x	-	-	-	-
Physical length	`len`	x	-	-	-	-
Multiplicity factor	`mf`	x	-	-	-	-
Max signal frequency	`fmax`	x	-	-	-	-
Type of Input	`modelType`	x	-	-	-	-
RLCG data file as Design var?	`rlgc_file_as_var`	x	-	-	-	-
RLCG data file	`file`	x	-	-	-	-
use lmg subckt	`uselmg`	x	-	-	-	-
LMG subcircuit file	`subcktfile`	x	-	-	-	-
Enter RLCG etc. matrices	`entermatrices`	x	-	-	-	-
R matrix per unit length	`R`	x	-	-	-	-
L matrix per unit length	`L`	x	-	-	-	-
G matrix per unit length	`G`	x	-	-	-	-
C matrix per unit length	`C`	x	-	-	-	-
Skin effect res matrix per unit length	`rskin`	x	-	-	-	-

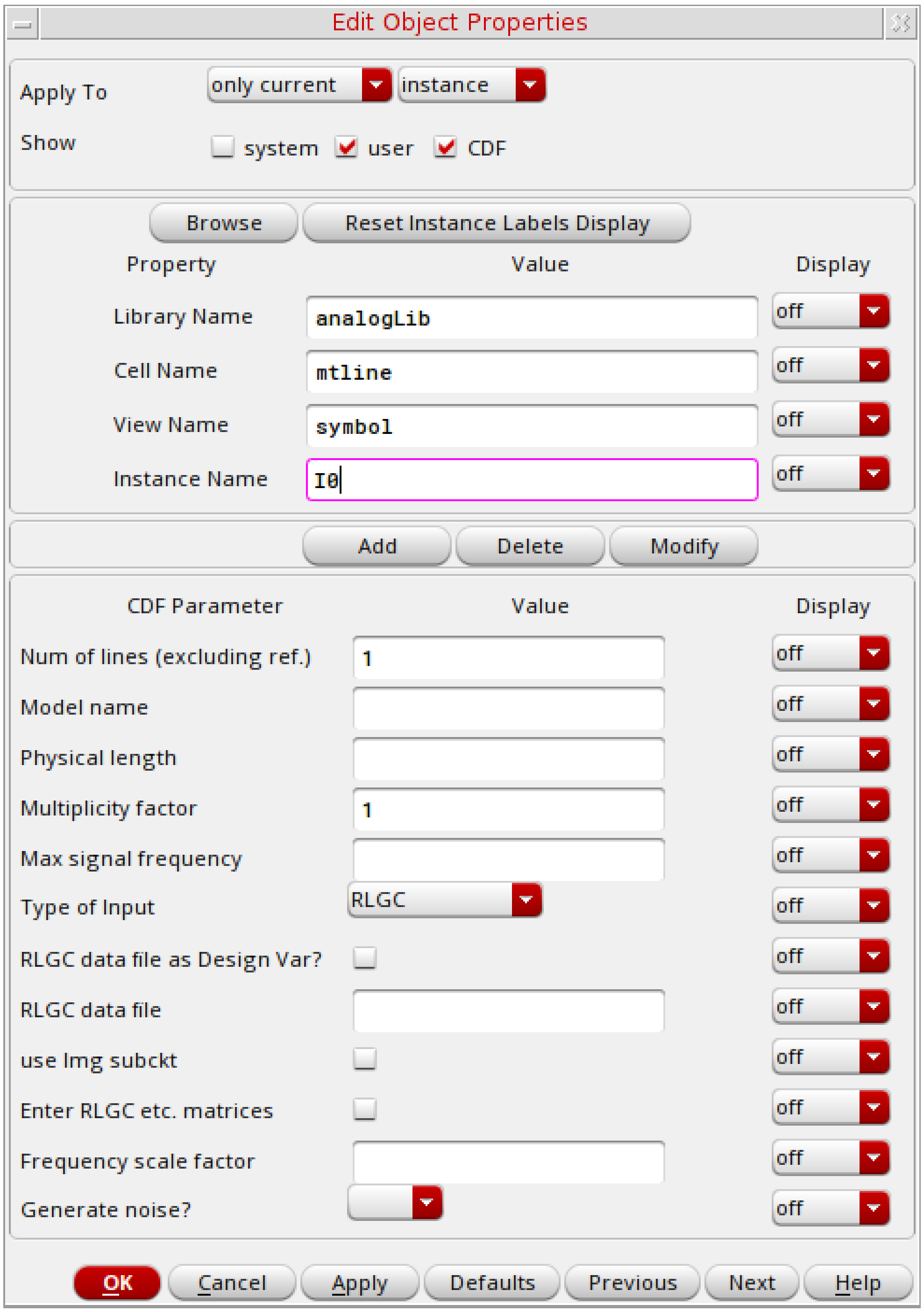
CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Dielectric loss cond matrix per unit length	`gdloss`	x	-	-	-	-
S-parameter file as Design var?	`sparam_file_as_var`	x	-	-	-	-
S-parameter File	`file1`	x	-	-	-	-
Frequency scale factor	`freqscale`	x	-	-	-	-
Generate noise?	`isnoisy`	x	-	-	-	-
Transmission line type	`linetype`	x	-	-	-	-
Model type	`modeltype`	x	-	-	-	-
Number of dielectric layers	`numlayer`	x	-	-	-	-
Number of Ground Planes	`numgnd`	x	-	-	-	-
Rel dielectric const of layers(er)	`er`	x	-	-	-	-
Dielectric layer thickness (d)	`layerthickness`	x	-	-	-	-
Dielectric loss type	`dlosstype`	x	-	-	-	-
Dielectric layer loss	`dloss`	x	-	-	-	-
Signal line width	`linewidth`	x	-	-	-	-
Signal line thickness	`linethickness`	x	-	-	-	-
Signal line height (h)	`lineheight`	x	-	-	-	-
Signal line spacing	`linespace`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Gnd Plane thickness	gndthickness	x	-	-	-	-
Ground plane conductivity	gndsigma	x	-	-	-	-
Signal line conductivity	linesigma	x	-	-	-	-
Charecteristic impedance	z0	x	-	-	-	-
Delay Time	tdmt	x	-	-	-	-
Frequency	fmt	x	-	-	-	-
Normalized length	nlmt	x	-	-	-	-
Propagation velocity normalized	velmt	x	-	-	-	-
Corner frequency	corner	x	-	-	-	-
DC series res/Length	dcr	x	-	-	-	-
Loss resistance per unit length	seriesr	x	-	-	-	-
Conductor loss at fc	alphac	x	-	-	-	-
Conductor loss quality factor	qc	x	-	-	-	-
Dielectric loss frequency	fd	x	-	-	-	-
Loss conductance per unit length	shuntg	x	-	-	-	-
Dielectric loss	alphad	x	-	-	-	-
Dielectric loss quality factor	qd	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Conductor loss frequency	`fcmt`	x	-	-	-	-
Dielectric loss cutoff frequency	`fgdloss`	x	-	-	-	-
Dielectric loss onset frequency	`fgdloss1`	x	-	-	-	-

Examples

For adding a `mtline` with a sub-circuit, specify the following parameters:



The netlist for an example of mtline with a sub-circuit:

```
I0 (net15 net16 net039 net040 net14) tline2
include "./w_subckt/tline2.scs"
```

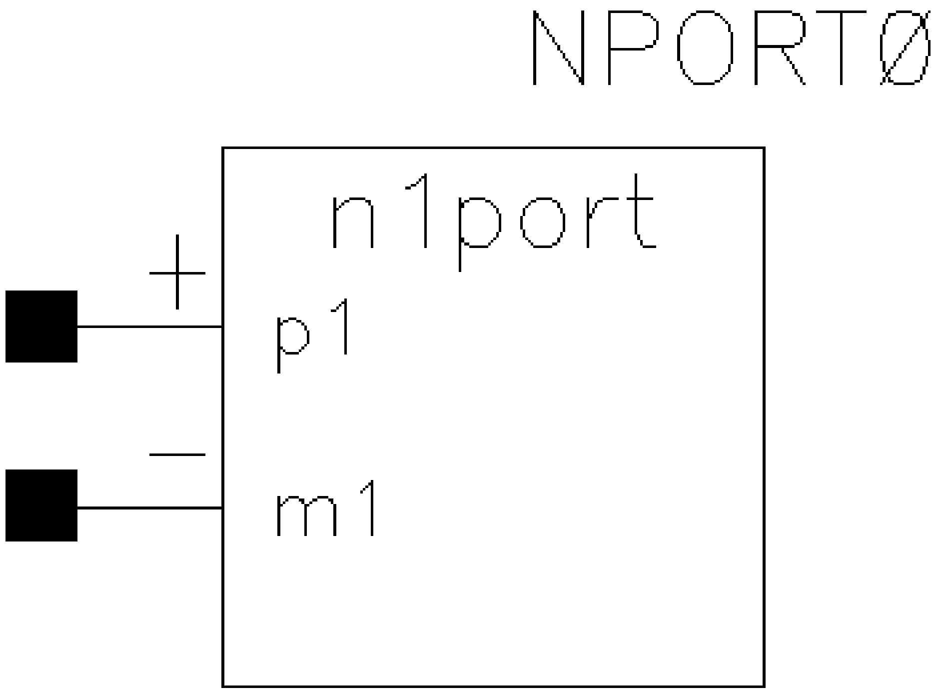
The netlist for an example of mtline without a sub-circuit, with n=`10`, and entermatrices=`nil`:

```
I1 (net11 net12 net031 net032 net033 net034 net9 net10) mtline len=1.000m \
m=1 file="./wo_subckt/w_line.dat" freqscale=2 fmax=100
```

The netlist for the example of mtline without a sub-circuit, n=`3`, and entermatrices=`t`.

```
I2 (net7 net8 net023 net024 net025 net026 net5 net6) mtline len=5.000m m=1 \
r=[1K 1K 0 1K 0 1K] l=[418e-9 125e-9 418e-9 125e-9 125e-9 418e-9] \
g=[23e-6 34e-6 4e-6 3e-6 6e-6 1e-6] c=[94e-12 -22e-12 94e-12 \
-22e-12 -22e-12 94e-12] rskin=[3 4 1 1 1 1] gdloss=[1 2 3 1 1 1] \
file="./w_subckt/w_line.dat" freqscale=4 fmax=200
```

nport Symbol

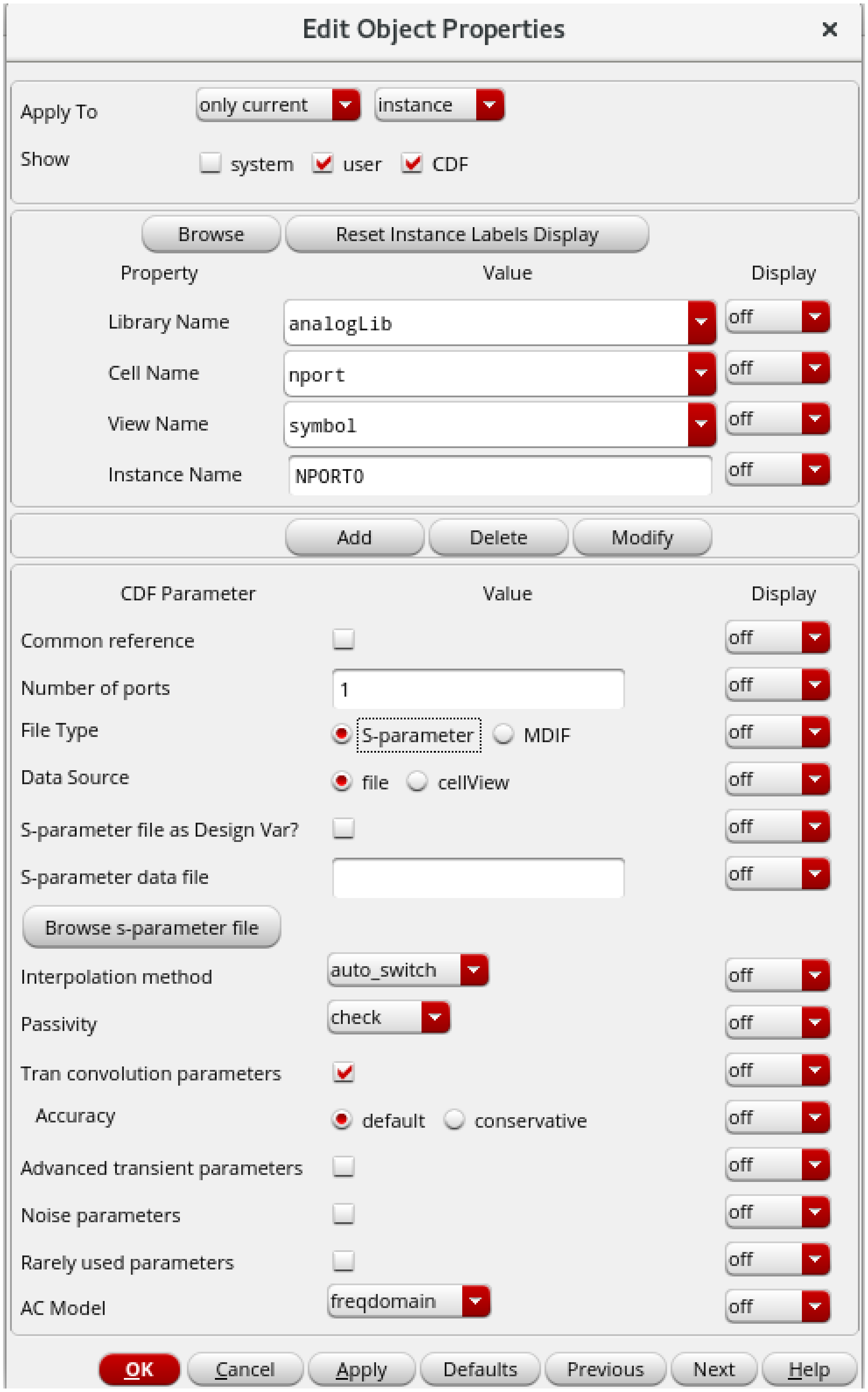


Description

The component `nport` is a linear N port. An `N-port` takes its characteristics from an S-Parameter data file. An N-port can have as many ports as there are in the `N-port` described in the S-Parameter data file. Each pair of terminals in the `nport` instance statement represents one port. Because there is no limit to the number of ports, there is no limit to the number of terminals. However, the terminals must be given in pairs and there must be at least one pair. The order of the pairs is the same as the order of the ports in the data file. This device is not supported within the altergroups.

Important

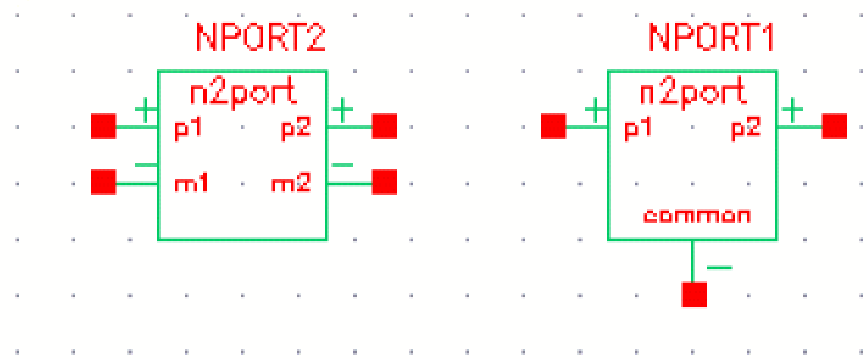
When using Spectre, we strongly recommended that you use `nport` instead of the deprecated `n1port`, `n2port`, `n3port`, and `n4port`, as these devices are retained strictly for legacy purposes and for supporting third-party simulators, such as Hspice.


Edit Object Properties
Apply To
only current
instance
Show
system
user
CDF
Browse
Reset Instance Labels Display
Property
Value
Display
Library Name
analogLib
off
Cell Name
nport
off
View Name
symbol
off
Instance Name
NPORT0
off
Add
Delete
Modify
CDF Parameter
Value
Display
Common reference
off
Number of ports
1
off
File Type
S-parameter
MDIF
off
Data Source
file
cellView
off
S-parameter file as Design Var?
off
S-parameter data file
off
Browse s-parameter file
Interpolation method
auto_switch
off
Passivity
check
off
Tran convolution parameters
off
Accuracy
default
conservative
off
Advanced transient parameters
off
Noise parameters
off
Rarely used parameters
off
AC Model
freqdomain
off
OK
Cancel
Apply
Defaults
Previous
Next
Help

Parameters for the nport component

This topic describes the following CDF parameters for the `nport` component:

- *Common reference*: Specifies the plus and minus pins for all the individual ports when the check box is deselected. If you select the check box, the symbol redraws with a single common ground reference pin at the bottom of the symbol. This eliminates the need to add ground connections to each port of the symbol.



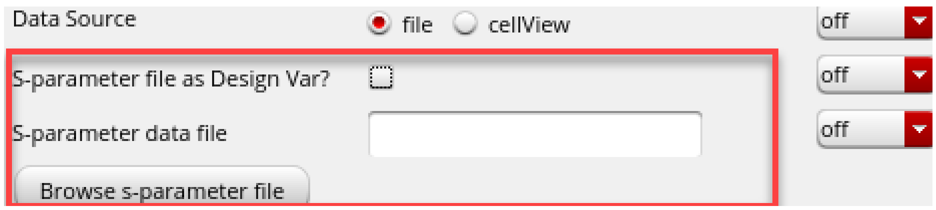
When Common reference is not selected   When Common reference is selected

- *Number of ports:* Specifies the number of ports in the S-Parameter data file. This field controls the number of ports shown on the `nport` symbol.
- *File Type:* Lets you select the type of the file. Possible options are *S-parameter* and *MDIF*.
  - *S-parameter*: Contains information about how a device or a circuit responds to signals at different frequencies.
  - *MDIF*: Contains the collection of multiple S-Parameter files.

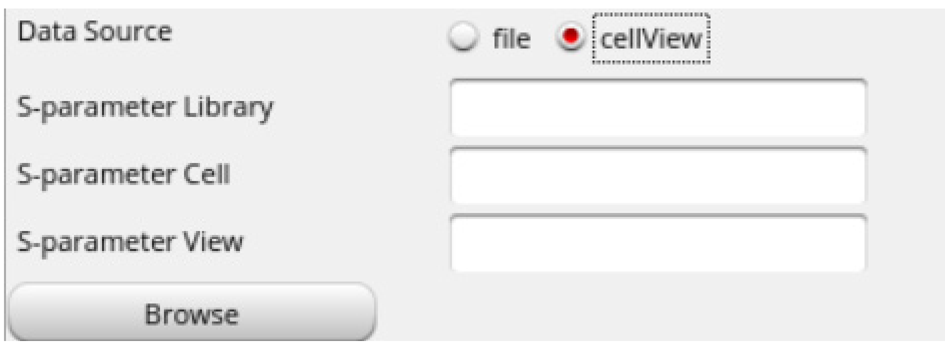
The following options are displayed when you select *S-parameter* in *File Type*.

- *Data Source*: Lets you select the source of the S-Parameter data file for the `nport` symbol. Possible options are *file* and *cellView*.

- *file*: Selecting this option displays the *S-parameter file as Design Var?* check box, *S-parameter data file*, and *Browse s-parameter file* fields.



- *cellView*: Selecting this option displays the *S-parameter Library*, *S-parameter Cell*, and *S-parameter View* fields and the *Browse* button. You can enter details in the fields or click *Browse* to select the S-Parameter cellview using the Choose s-parameter cellView form.



The `nport` instance is printed in the netlist with the S-Parameter text cellview path. For example:

```
NPORT0 ( net1 net1) nport
file="/scratch/ade_data/<user>/EAV_RAK/libs/Two_Stage_Opamp/
OpAmp_AC_top/text/text.txt"
```

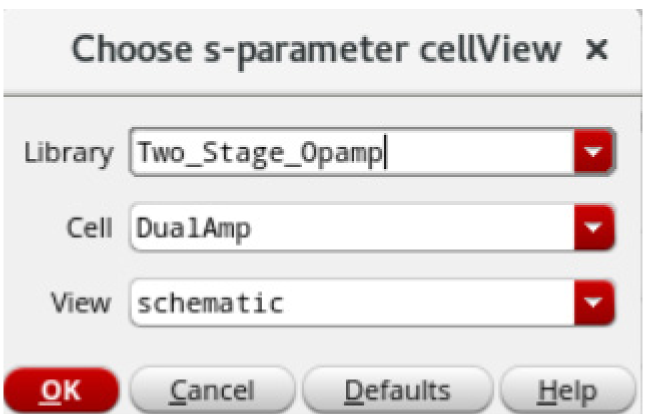
- *S-parameter file as Design Var?*: Checks if the S-Parameter file can be used as a design variable.

  You must add this S-Parameter file as a design variable in an ADE Explorer cellview, which uses the same schematic as the `nport`. After running a simulation with the new design variable, you can view the netlist file, and further change the *S-parameter data file* for different corners. For more information, see Edit Object Properties – Instance and Block.

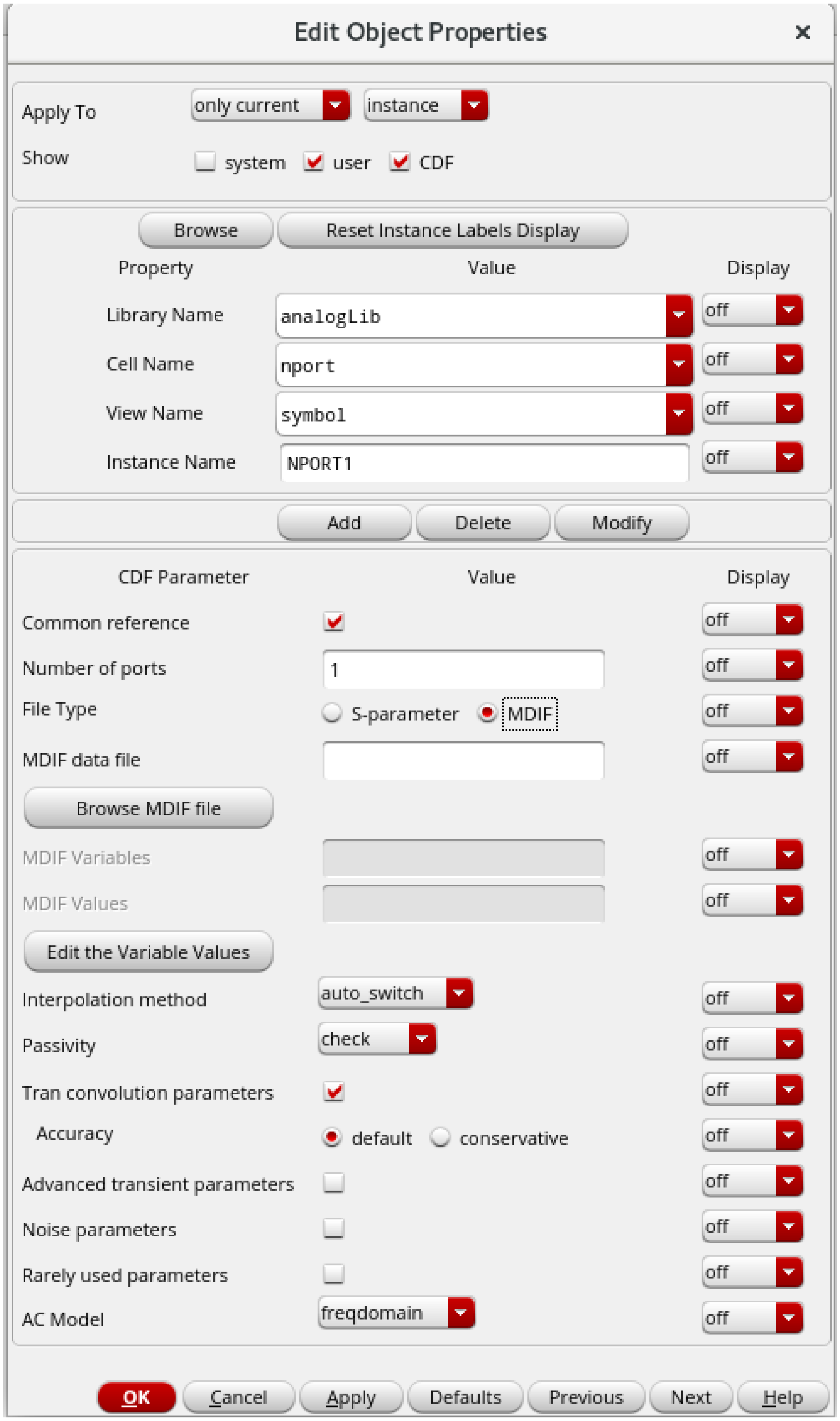
- *Browse s-parameter file*: Lets you select the S-Parameter data file. This button is shown only when you select the *file* option for *Data Source* and when you do not select the *S-parameter file as Design Var?* check box.

- *S-parameter data file*: Displays the path of the S-Parameter data file that you select using the *Browse s-parameter file* button or name of the S-parameter file that you select using the *S-parameter file as Design Var?* check box. This file contains parameters, frequencies, or model information that can be analyzed by the Spectre simulator. This field is shown only when you select the *file* option for *Data Source*.

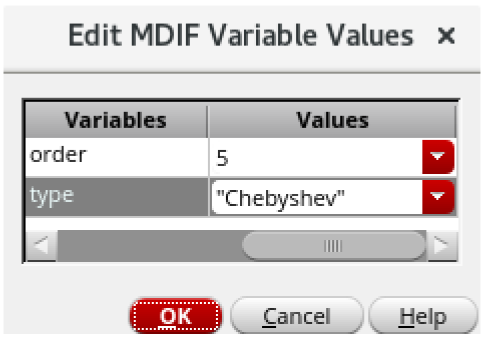
- *S-parameter Library*: Specifies the name of the library that contains the S-Parameter cellview. This field is shown only when you select the *cellview* option for *Data Source*.
- *S-parameter Cell*: Specifies the name of cell that contains the S-Parameter view. This field is shown only when you select the *cellView* option for *Data Source*.
- *S-parameter View:* Specifies the name of the S-Parameter view. This field is shown only when you select the *cellview* option for *Data Source*.
- *Browse* displays the Choose S-Parameter cellView form. This form lets you browse to a location and specify the S-Parameter cellview. The *Browse* button is shown only when you select the *cellview* option for *Data Source*.



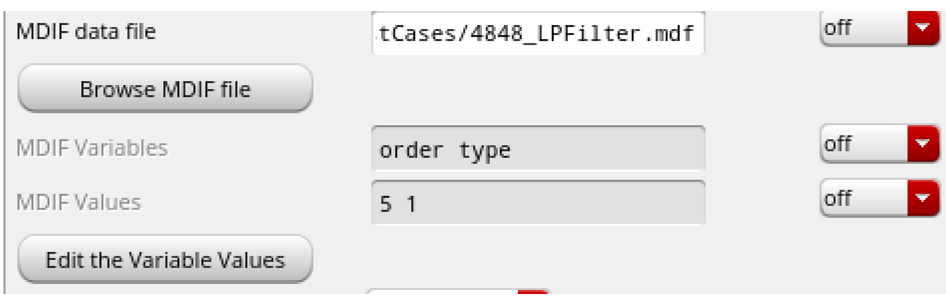
The following options are displayed when you select *MDIF* in *File Type*.



- *MDIF data file:* Displays the path of the MDIF data file that you select using the *Browse MDIF file* button. This file contains parameters, or model information that can be analyzed by Spectre.
- *Browse MDIF file:* Lets you select the MDIF data file.
- *Edit the Variables Values:* Lets you open the Edit MDIF Variable Values form where you can edit the values of the variables defined in the selected MDIF data file.



- *MDIF Variables*: Displays the variables defined in the selected MDIF data file. For example, `order` and `type` are the variables defined in the selected MDIF data file.
- *MDIF Values*: Displays the values of the variables defined in the selected MDIF data file. You can edit them by clicking the *Edit the Variables Values* button.



- *Interpolation method*: Controls the interpolation method for the S-Parameter and MDIF data files. It is valid only for `datafmt` = `spectre/touchstone/citi/bnp`. The supported methods are `auto_switch`, `linear`, `spline`, and `bbspice`. In general, the recommended method is `default`.

  `linear` and `spline` control the sampling of the S-Parameter data for the convolution-based method. In both the methods, the S-Parameter data is sampled using a linear frequency spacing from zero to three times the highest frequency in the S-Parameter data file in order to calculate the impulse response of the transfer function.

  - `auto_switch`: Spectre uses the default for `interp` according to the global option `nport_default_interp=auto_switch`.

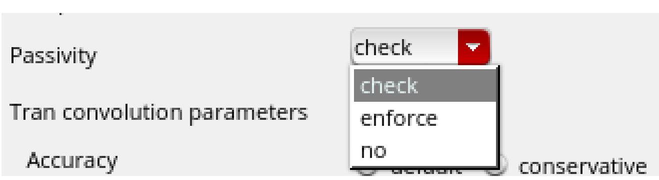
If `nport_default_interp` is set to `auto_switch`, `nport` automatically switches the interpolation method based on the analysis. It chooses *bbspice* for pss shooting Newton analysis, and *linear* for analyses, such as `ac`, `dc`, and `sp`. See `spectre -h nport` for information on how `nport_default_interp` works for your particular version of Spectre.

All `nport` elements in the netlist that do not have `interp` set will have `interp` set to the value specified in the global option `nport_default_interp`. If an `nport` instance has the `interp` option explicitly specified, the instance option takes priority over the global option. Possible values for `nport_default_interp` are `spline`, `linear`, `bbspice`, and `auto_switch`. For more information, see Interpolation Method.

- `linear`: Specifies a data point needed in the sample that is not directly in the S-Parameter file.
- `spline`: It uses a cubic spline algorithm. Cubic spline can occasionally introduce errors when there are rapid changes in the transfer functions defined in the S-Parameter file near the sample point.
- `bbspice`: It is used to do the rational fit. Bbspice uses a rational model to represent the S-Parameter data.

■ *Passivity*: Specifies and enforces the passivity of S-Parameters. Spectre always checks to determine if the S-Parameter data is passive. Due to poor measurement accuracy, the S-Parameter data may be non-passive. Non-passive S-Parameter data may lead to non-converging or even unstable time domain simulations. The *Passivity* option controls detection and enforcement of S-Parameter simulation model passivity.

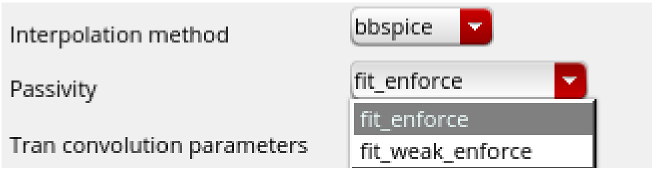
For the *Interpolation method* options of `linear` and `spline`, *Passivity* may be set to *no*, *check* or *enforce*.



- `check`: Specifies that the simulation only checks the S-Parameter data at each frequency point and report non-passive data. This is default.
- `enforce:` Specifies that the simulator corrects the data to ensure passivity if the original data is non-passive.
- `no`: Does not add a passivity check.

Passivity options of *no*, *check*, and *enforce* are interpreted as `passivity=fit_enforce` for `interp=bbspice`.

For `interp=bbspice`, *Passivity* may be set to `fit_weak_enforce` or `fit_enforce`. The default value is `fit_enforce`.



- `fit_enforce`: Specifies that the simulator always attempts to create a passive simulation model and favors passivity over accuracy.
- `fit_weak_enforce`: Specifies that the simulator does not create a passive model if the passivity enforcement phase results in significant accuracy loss.

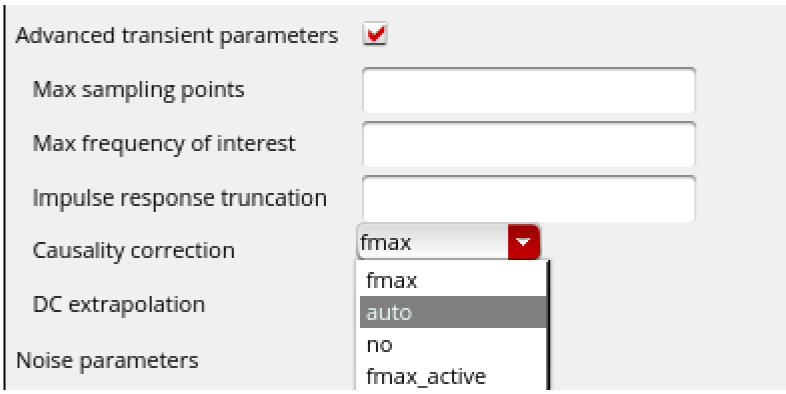
■ *Tran convolution parameters:* Controls the accuracy parameter for transient convolution. When you select this check box, the *Accuracy* option is displayed.

- *Accuracy*: Sets the accuracy to `default` or `conservative`.
    - `conservative`: Specifies the exceptional accuracy. This causes more frequency-domain sample points, and produces a more accurate impulse response at the cost of runtime.
    - `default`: Accuracy is set tight enough that *conservative* should only be needed in rare instances.

■ *Advanced transient parameters:* Controls the maximum sampling points, frequency and the impulse response truncation. Selecting the check box displays the corresponding options:

- *Max sampling points***:** Specifies the maximum number of frequency points to be sampled in the adaptive algorithm. The default is `131072`. In every case, encountered so far, the actual number of samples taken by the adaptive algorithm is much smaller than the default. In extremely unusual cases, it can be raised to `262144`.
- *Max frequency of interest*: Specifies the highest frequency for the frequency domain sampling of the S-Parameter file. The default is three times the highest frequency in the S-Parameter file. This property should not be changed.
- *Impulse response truncation*: Specifies to deliberately cut off the tail of the impulse response which might theoretically continue to infinite time. Leave this property at the default of `1e-4`, which corresponds to a gain of -`80 dB`.

- *Causality correction*: Specifies the reasonable results from an `nport` in either the DC or transient-based analyses. It is performed by setting the transfer function between the highest frequency in the S-Parameter file and three times this frequency so that the data becomes causal. The data within the frequencies specified in the S-Parameter file is unchanged. Setting *Causality correction* to `fmax` or `auto` overrides the setting of *High freq extrapolation* contains four choices: `no`, `fmax`, `auto`, or `fmax_active`. *fmax* is the default and is highly recommended.



  - `no`: Does not add a causality check.

    Setting the *Causality correction* check to *no* is incredibly risky unless you are absolutely sure that the S-Parameter file is causal as described.

  - `fmax`: Retains the data in the frequency range of the S-Parameter file, and then adds a transfer function above the frequency range in the S-Parameter file to force the system to be causal. This transfer function extends to the setting of Max frequency of interest, which defaults to three times the highest frequency in the S-Parameter file. If you suspect that the maximum frequency of interest needs to be changed, use causality *Auto* instead, if you are not an expert.

  - `auto`: Applies the causality correction in a similar manner to choosing fmax. *auto* can also vary the maximum frequency of interest if it needs to get a causal time-domain model.

  - `fmax_active`: Enhances causality correction for active devices to improve the simulation accuracy. This option is only available for `linear` interpolation `.bbspice` should never be used when the S-Parameter file represents an active device because *bbspice* enforces *passivity*.

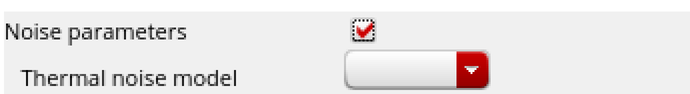
These properties are provided for S-Parameter simulation experts only and apply to linear or spline interpolation. It is strongly recommended that you do not change the default values of these properties.

- *DC extrapolation* can be set to constant or unwrap. The default is *constant*.

  - `constant`: Projects the first point down to zero frequency at exactly the same level.
  - `unwrap`: Specifies an estimation based on the first few frequency points in the S-Parameter file.

- *Noise parameters:* Controls the `nport` noise parameters. Selecting the check box displays the corresponding options.
  - *Thermal noise*: Specifies if `nport` should generate noise. Possible values are `no` and `yes`. Thermal noise defaults to *yes*. Set the value to `no` if you want to disable noise production.

  - *Thermal noise model*: Specifies the noise parameters in the S-Parameter file if it is available, and if not, it uses an internal noise model. Internal forces the *internal* noise model. Thermal noise model defaults to external.

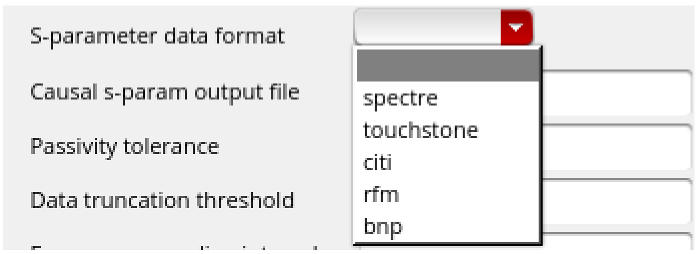


  - *Noise correlation*: When set to *real* forces the `nport` noise correlation matrix to be real-valued. The parameter is used for backward compatibility only. Its value is determined automatically and its use is not recommended because it can lead to an incorrect answer. The simulator will generate a warning if the noise correlation matrix is complex while the value of `noisecorr` is set to *real*. Possible values are *real* and *complex*.

- *Rarely used parameters*: Controls if you want to use the related parameters for `nport`. Selecting the check box displays the corresponding options.

Only two parameters are commonly used: *Causal s-param output file* and *Additional parameter list*.

- *S-parameter data format*: Specifies the format of the S-Parameter data file. If this parameter is not specified, Spectre detects the format by itself. Possible values are *spectre*, *touchstone*, *citi*, *rfm* and *bnp*.



- *Causal s-param output file:* Specifies a filename in this field causes the S-Parameter data after causality correction to be placed in the specified file. It contains a filename beginning with a slash (`/`).This file will be created the first time the causal impulse response is calculated. This file can then be plotted directly in the waveform display tool. Most of the time, the causal impulse response calculated matches the original data provided in the S-Parameter file up to the maximum frequency provided in the S-Parameter file. To make the time-domain model causal, data is added based on the *fmax* option to make the model causal.

- *Passivity tolerance* is only used when the *Passivity* property is set to check or enforce. *Passivity tolerance* does not need to be set. The default is `1e-6`. This defines how close to unity gain should be modified by the passivity check and enforcement. *Passivity* will be enforced and/or reported when the gain is (`1 - Passivity tolerance`) or greater.

- *Data truncation threshold* defaults to `1e-3`, which corresponds to `-60dB` gain. When the cross coupling terms become smaller than the *Data truncation threshold*, they are ignored. Cross coupling is the coupling from one port to another port.

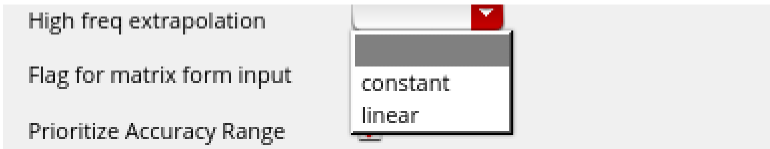
- *Frequency sampling interval* sets the delta frequency for the sampling from zero to the maximum frequency of interest. Leave this property at the default value. With adaptive sampling, this should never be necessary. If used, this delta should be a power of two divisor of the maximum frequency of interest.

- *Multiplier* specifies how many `nport` devices to put in parallel. This is rarely used.

- *Scale factor* scales the frequency of the S-Parameter file. For example, many S-Parameter files have the frequency in GHz. In this case, set the *Scale factor* to `1e9`.

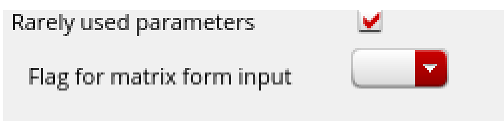
- *High freq extrapolation* is ignored when causality correction is applied. The *High freq extrapolation* field can be set to constant or linear.

This property should not be used.



- *constant* maintains the same amplitude and phase as the last point in the S-Parameter file to infinite frequency, if the causality check is not run.
- *linear* keeps the amplitude constant at the last frequency point, but the phase increases linearly with frequency.

- *Flag for matrix form input* should not be set. In the past, each time the simulation ran, the impulse response was calculated for every port of every instance of the `nport` every time the simulation was started. In some cases, especially with a large number of ports, this could take considerable time. This flag was provided so the step of calculating the impulse response could be skipped. Since the impulse response is cached and available for re-use at any time, this property should never be needed. This is a deprecated parameter that should not be set.



- *Prioritize Accuracy Range* Specifies a frequency band of interest to prioritize the accuracy of *bbspice* fitting at this band. The parameter takes a vector where the first element is the start frequency point and the second element is the end frequency point.

The frequency band is printed in the netlist as `bbsfreqband=[...]`. For example:

```
NPORT1 (net3 net4) nport bbsfreqband=[2G 3G]
```

Here, the start frequency is `2G` and the end freqency is `3G`.

- *Start Frequency*: Specifies the start frequency point for the frequency band.
- *End Frequency*: Specifies the stop frequency point for the frequency band.

- *Additional parameter list:* Used to unlock new features. When this feature is used, a warning message is issued. This warning can be ignored.

Caution

It is strongly recommended that you only set the following properties on the Edit Object Properties or Add instance form for `nport`***:***

- The Number of ports in the S-Parameter file
- The S-Parameter data file name.
- The Common reference terminal.
- Interpolation methods - *default*, *linear*, *spline* or *bbspice*. The *default* interpolation method is typically recommended.

Caution

It is strongly recommended that you leave the following parameters set to their default values for nearly all applications:

- Tran convolution parameters
- Advanced transient parameters
- Noise parameters
- Rarely used parameters

Command-Line help

```
spectre -h nport
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Common Reference	`nmode`	x	-	-	x	-
Number of Ports	`p`	x	-	-	x	-
File Type	`fileType`	x	-	-	-	-
Data Source	`dataSource`					
S-parameter file as Design Var?	`sparam_file_as_var`	x	-	-	-	-
S-parameter data file	`sparam_data`	x	-	-	x	-
Browse S-parameter file	`nportFileB`	x	-	-	-	-
Browse MDIF file	`browse_mdif`	x	-	-	-	-
MDIF data file	`mdif_dataFile`	x	-	-	-	-
MDIF Variables	`var_mdif`	x	-	-	-	-
MDIF Values	`val_mdif`	x	-	-	-	-
Edit the Variable Values	`edit_mdif`	x	-	-	-	-
Interpolation Method	`interp`	x	-	-	-	-
Passivity	`passivity`	x	-	-	-	-
Tran convolution parameters	`tranParaLabel`	x	-	-	-	-
Accuracy	`accuracyMode`	x	-	-	-	-
Causality correction	`causality`	x	-	-	-	-
Flag for matrix form input	`matrixform`	x	-	-	-	-
Matrix entry data file	`matrixfile`	x	-	-	-	-
Type of Port 1 to Type of Port20	`porttype1 to porttype20`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Quantity of Port1 to Quantity of Port20	`portquantity1 to portquantity20`	x	-	-	-	-
Multiplier	`m`	x	-	-	x	-
Scale Factor	`scale`	x	-	-	-	-
Max frequency of interest	`fmax`	x	-	-	x	-
Frequency sampling interval	`fdelta`	x	-	-	-	-
Max order impulse response	`maxn`	x	-	-	-	-
Impulse response truncation	`imptrunc`	x	-	-	-	-
Noise parameters	`noiseParaLabel`	x	-	-	x	-
Rarely used parameters	`otherParaLabel`	x	-	-	x	-
Data truncation threshold	`datatrunc`	x	-	-	-	-
Thermal Noise	`thermalnoise`	x	-	-	-	-
Use Smooth Data Windowing	`usewindow`	x	-	-	-	-
S-parameter data format	`datafmt`	x	-	-	-	-
Thermal noise model	`noisemodel`	x	-	-	-	-
S-parameter Data File	`dataFile`	x	-	-	x	-
Noise correlation matrix	`noisecorr`	x	-	-	-	-
DC extrapolation	`dcextrap`	x	-	-	-	-
High Frequency Extrapolation	`hfextrap`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Passivity	`passivity_bbspipce`	x	-	-	-	-
Passivity Tolerance	`pabstol`	x	-	-	-	-
Advanced transient parameters	`tranAdvanParaLabel`	x	-	-	x	-
Causal s-param output file	`outFile`	x	-	-	-	-
Additional Parameter List	`additionalParam`	x	-	-	-	-
Prioritize Accuracy Range	`prioritizeAccuracy Range`	x	-	-	-	-
Start Frequencyt	`startFrequency`	x	-	-	-	-
End Frequencyt	`endFrequency`	x	-	-	-	-
Model name	`hmname`	-	-	-	x	-
Enable mixed mode	`mixedmode`	-	-	-	x	-
The order of indices	`datatype`	-	-	-	x	-
Characteristic impedance	`zo`	-	-	-	x	-
Hspice S-parameter data format	`datafmtHspice`	-	-	-	x	-
Hspice Interpolation method	`interpolation`	-	-	-	x	-
Enable passive checker	`passive`	-	-	-	x	-
Delay frequency	`delayfreq`	-	-	-	x	-
Extracts a system delay	`delayhandle`	-	-	-	x	-
Temperature difference	`dtemp`	-	-	-	x	-
High freq extrapolate method	`highpass`	-	-	-	x	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Linear interpolation data type	`intdattyp`	-	-	-	x	-
Low freq extrapolate method	`lowpass`	-	-	-	x	-
Enable noise passive checker	`noipassivechk`	-	-	-	x	-
Precondition factor keyword	`precfac`	-	-	-	x	-
Enable rational function	`rational_func`	-	-	-	x	-
Reuse rational function data	`rational_func_reuse`	-	-	-	x	-
Method of smooth	`smooth`	-	-	-	x	-
Width of the smoothing window	`smoothpts`	-	-	-	x	-
Stamping method	`stamp`	-	-	-	x	-

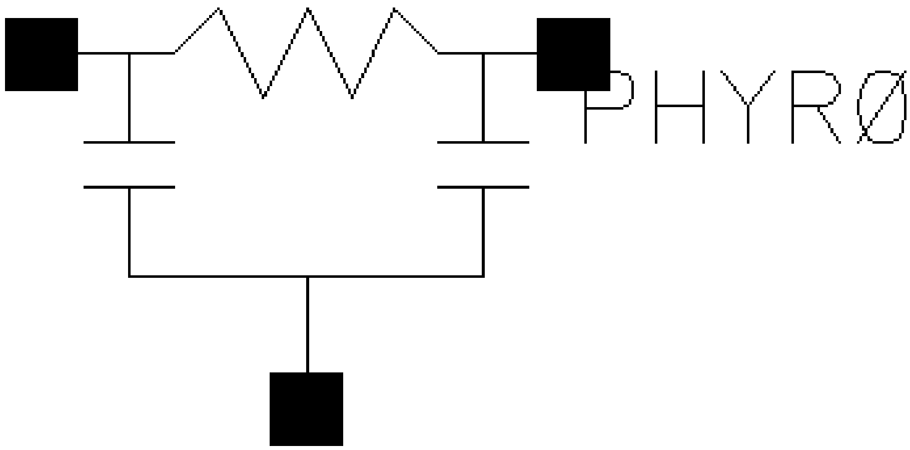
Syntax/Synopsis

```
model ndata nport file="sparam.data" scale=1
```

Examples

```
x1 (a1 0 b1 0 b3 0) ndata file="sparam 2.data"
```

phyres Symbol



Description

The component `phyres` is a physical resistor. It consists of a two terminal resistor (tied between ‘`t1`’ and ‘`t2`’) and two diodes (tied between ‘`t1`’-‘`t0`’ and ‘`t2`’-‘`t0`’). The diodes are junction diodes. Under normal operation, the two diodes are reverse biased, but the parameter ‘subtype’ can reverse the direction of the diodes. If you do not specify ‘`t0`’, ground is assumed. The instance parameters always override model parameters. If you do not specify the instance resistance value, it is calculated from the model parameters. This device is supported within the altergroups.

Command-Line Help

```
spectre -h phy_res
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-
Resistance	`r`	x	-	-	-	-
Capacitance	`c`	x	-	-	-	-
Length	`l`	x	-	-	-	-
Width	`w`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-
Lin temp co of lin cap	`tc1c`	x	-	-	-	-
Quad temp co of lin cap	`tc2c`	x	-	-	-	-
Temp rise from ambient	`trise`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-

Syntax/Synopsis

```
Name ( 1 2 [0] ) ModelName <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName phy_res <parameter=value> ...
```

Examples

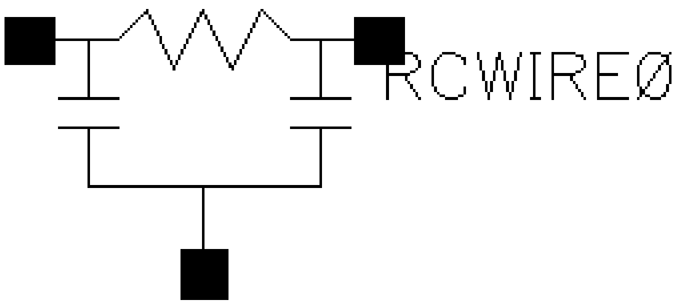
Following is the sample instance statement:

```
res1 (net9 vcc) resphy l=1e-3 w=2e-6
```

Following is the sample model statement:

```
model resphy phy_res rsh=85 tc1=1.53e-3 tc2=4.67e-7 etch=0 cj=1.33e-3
cjsw=3.15e-10 tc1c=9.26e-4
```

rcwireload Symbol



Description

The component `rcwireload` is a wire model of a two terminal resistor with an optional third terminal at the instance level. If the third terminal is not specified then the two-terminal resistance model is used with the third terminal as ground.

In RC wire load model, R represents the interconnect metal or poly resistance and C represents substrate capacitance from node to ground.

You can specify the capacitance explicitly or allow it to be computed from the physical length and width of the resistor. The model parameter `cratio` can be used to allocate the parasitic capacitance of the wire element between the model's input capacitor and the output capacitor. The value of each capacitor, as a function of temperature, is represented as linear temperature coefficient of capacitor (`tc1c`) and quadratic temperature coefficient of capacitor (`tc2c`).

For details refer to `spectre help`.

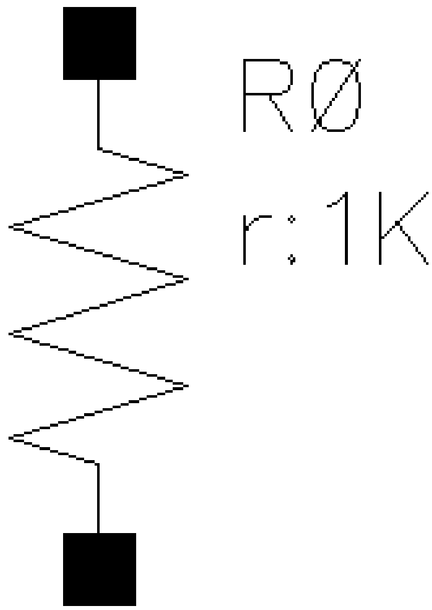
Command-Line Help

```
spectre -h resistor
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	x	x	x	x	-
Resistance	`r`	x	x	x	x	-
Length	`l`	x	-	-	-	-
Width	`w`	x	-	-	-	-
Resistance Form	`resform`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Scale factor	`scale`	x	-	-	-	-
Temp rise from ambient	`trise`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-
Generate noise?	`isnoisy`	x	-	-	-	-
Capacitance	`c`	x	-	-	-	-
Lin temp co of lin cap	`tc1c`	x	-	-	-	-
Quad temp co of lin cap	`tc2c`	x	-	-	-	-

res Symbol



Description

The component res is a two terminal resistor. You can give the resistance explicitly or allow it to be computed from the physical length and width of the resistor. In either case, the resistance can be a function of temperature or applied voltage.

- If `R(inst)` is not given,

  `R(inst) = R(model)`

- If `R(model)` is given,

  `R(inst) = Rsh * (L - 2 * etchl) / (W - 2 * etch).`

If the polynomial coefficients vector (‘`coeffs=[c1 c2 ...]`’) is specified, the resistor is nonlinear. When ‘nonlinform’ is set to ‘`g`’, the resistance is:

```
R(V) = dV / dI
     = R(inst) / (1 + c1 * V + c2 * V^2 + ...).
```

This device is supported within the altergroups.

Command-Line Help

```
spectre -h resistor
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Resistance	`r`	x	x	x	x	x
Temperature coefficient 1	`tc1`	x	-	-	x	x
Temperature coefficient 2	`tc2`	x	-	-	x	x
Model name	`model`	x	-	-	-	-
Length	`l`	x	-	-	x	x
Width	`w`	x	-	-	x	x
Resistance Form	`resform`	x	-	-	-	-
Multiplier	`m`	x	-	-	x	x
Scale factor	`scale`	x	-	-	x	x
Temp rise from ambient	`trise`	x	-	-	-	-
Generate noise?	`isnoisy`	x	-	-	-	-
Capacitance connected	`hrc`	-	-	-	x	x
Temperature difference	`dtemp`	-	-	-	x	x
AC resistance	`ac`	-	-	-	x	-

Syntax/Synopsis

```
Name ( 1 2 ) ModelName <parameter=value> ...
Name ( 1 2 ) resistor <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName resistor <parameter=value> ...
```

Examples

Following is a sample instance statement without model:

```
r1 (1 2) resistor r=1.2K m=2
```

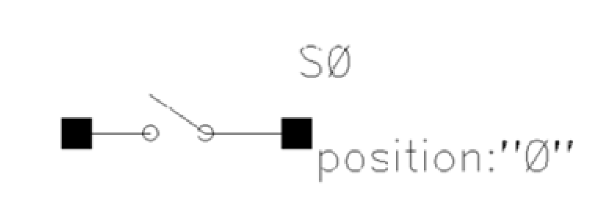
Following is a sample instance statement with model:

```
r1 (1 2) resmod l=8u w=1u
```

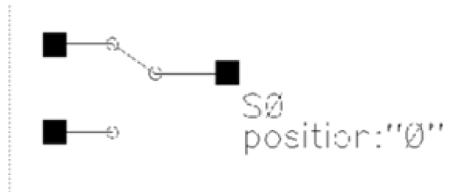
Following is a sample model statement:

```
model resmod resistor rsh=150 l=2u w=2u etch=0.05u tc1=0.1 tnom=27 kf=1
```

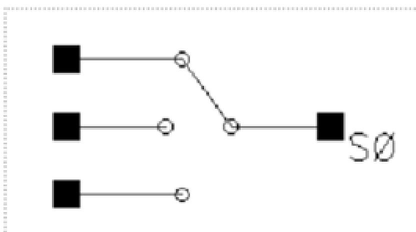
spxtswitch Symbol



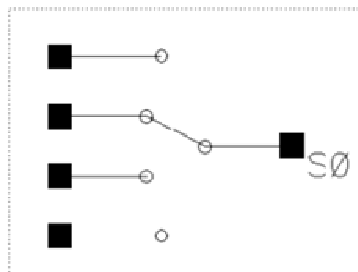
sp1tswitch



sp2tswitch



sp3tswitch



sp4tswitch

Description

- `sp1tswitch` - Ideal Switch With `1` Position
- `sp2tswitch` - Ideal Switch With `2` Positions
- `sp3tswitch` - Ideal Switch With `3` Positions
- `sp4tswitch` - Ideal Switch With `4` Positions

Ideal switch is a single-pole multiple-throw switch with infinite ‘`off`’ resistance and zero ‘`on`’ resistance. The switch is provided to allow you to reconfigure your circuit between analyses. You can only change the switch state between analyses (using the alter statement), not during an analysis.

This device is not supported within the altergroups.

Command-Line Help

```
spectre -h switch
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Switch position	position	x	-	-	-	-
DC position	dcPosition	x	-	-	-	-
AC position	acPosition	x	-	-	-	-
Tran position	tranPosition	x	-	-	-	-
IC position	icPosition	x	-	-	-	-
Offset voltage	offset	x	-	-	-	-
Multiplier	m	x	-	-	-	-
Parameter Type	paramTyp	x	-	-	-	-

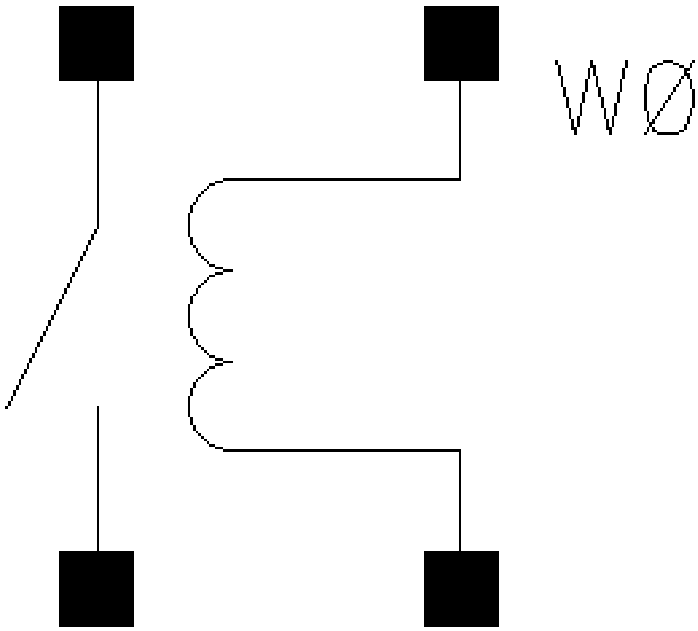
Syntax/Synopsis

```
Name ( t0 t1 ... ) switch <parameter=value> ...
```

Examples

```
sw1 (t1 t2 t3) switch dc_position=0 ac_position=1 tran_position=2
```

switch Symbol



Description

The four-terminal relay is a voltage controlled relay tied between terminals ‘`t1`’ and ‘`t2`’. The voltage between terminals ‘`ps`’ and ‘`ns`’ controls the relay resistance. The relay resistance varies nonlinearly between ‘`ropen`’ and ‘`rclosed`’, the open relay resistance and closed relay resistance, respectively. These resistance values correspond to control voltages of ‘`vt1`’ and ‘`vt2`’ respectively. The four parameters, ‘`vt1`’, ‘`vt2`’, ‘`ropen`’, and ‘`rclosed`’, can be instance or model parameters.

This device is not supported within the altergroups.

Command-Line Help

```
spectre -h relay
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Open/ close voltage	vsw	-	-	-	-	-
Delay time	td	-	-	-	-	-
Time interval for switching	ts	-	-	-	-	-
Open switch resistance	ro	x	-	-	-	-
Close switch resistance	rc	x	-	-	-	-
Open voltage	vt1	x	-	-	-	-
Closed voltage	vt2	x	-	-	-	-
Multiplier	m	x	-	-	-	-
Estimated operating region	region	x	-	-	-	-
Resistance	r	-	-	-	-	-

Syntax/Synopsis

```
Name ( 1 2 ps ns ) ModelName <parameter=value> ...
Name ( 1 2 ps ns ) relay <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName relay <parameter=value> ...
```

Examples

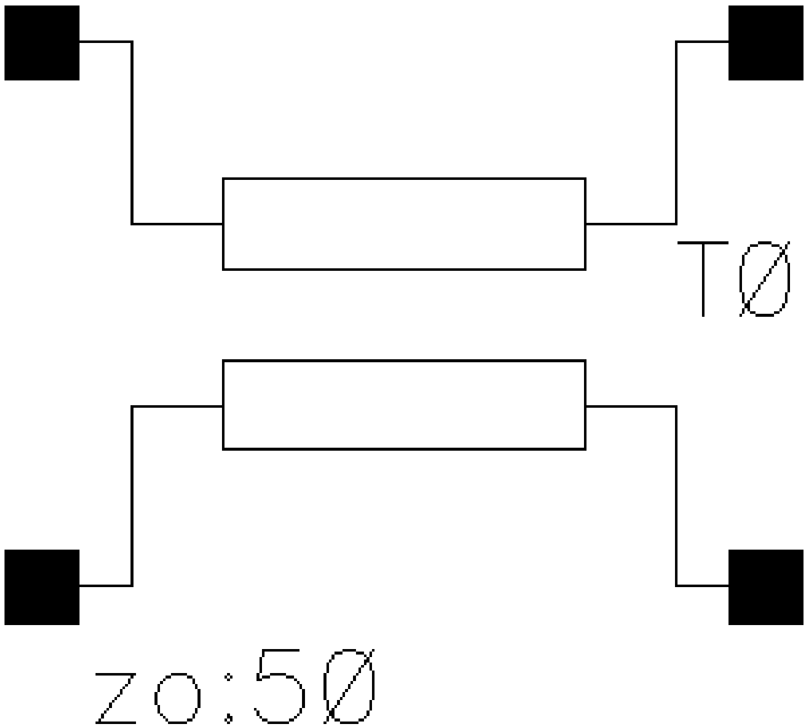
Following is a sample instance statement:

```
rel1 (1 2 ps ns) my_relay ropen=1G rclosed=2
```

Following is a sample model statement:

```
model my_relay relay vt1=2.5 vt2=5 ropen=100M rclosed=0.1
```

tline Symbol



Description

The component `tline` is transmission line model which is either lossy or lossless includes dielectric and conductor loss effects. The conductor loss includes skin effect assuming finite or infinite conductor thickness.

Only the odd mode is modeled, so only the voltage difference across each port is important. The absolute voltage of each terminal is not significant. Also, the current into one node of a port equals the current leaving the other node of the port.

This device is supported within the altergroups.

Command-Line Help

```
spectre -h tline
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Characteristic impedance	`zo`	x	-	-	x	x
Delay time	`td`	x	-	-	x	x
Frequency	`freq`	x	-	-	x	x
Normalized length	`nl`	x	-	-	x	x
Voltage 1	`v1`	-	-	-	x	x
Current 1	`i1`	-	-	-	x	x
Voltage 2	`v2`	-	-	-	x	x
Current 2	`i2`	-	-	-	x	x
Model name	`model`	x	-	-	-	-
Propogation velocity normalized	`vel`	x	-	-	-	x
Physical length	`len`	x	-	-	x	x
Multiplier	`m`	x	-	-	-	-
Loss resistance per unit length	`rs`	x	-	-	-	-
Loss conductance per unit length	`g`	x	-	-	-	-

Syntax/Synopsis

```
Name ( t1 b1 t2 b2 ) ModelName <parameter=value> ...
Name ( t1 b1 t2 b2 ) tline <parameter=value> ...
```

Following is the model synopsis:

```
model ModelName tline <parameter=value> ...
```

Examples

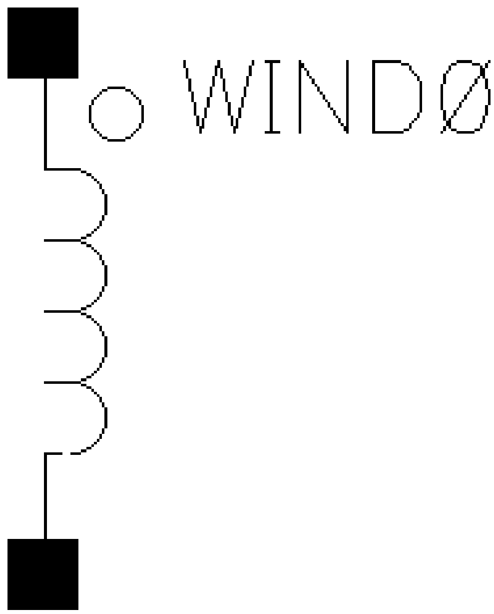
Following is a sample instance statement:

```
t1 (1 0 2 0) lmodel z0=100
```

Following is a sample model statement:

```
model lmodel tline f=10M z0=50 alphac=8501 fc=10M dcr=88
```

winding Symbol



Description

The `winding` component for winding for magnetic core is used in conjunction with magnetic cores to model coils and transformers with hysteresis. Each winding must be associated with a single core, though a core may have any number of windings.

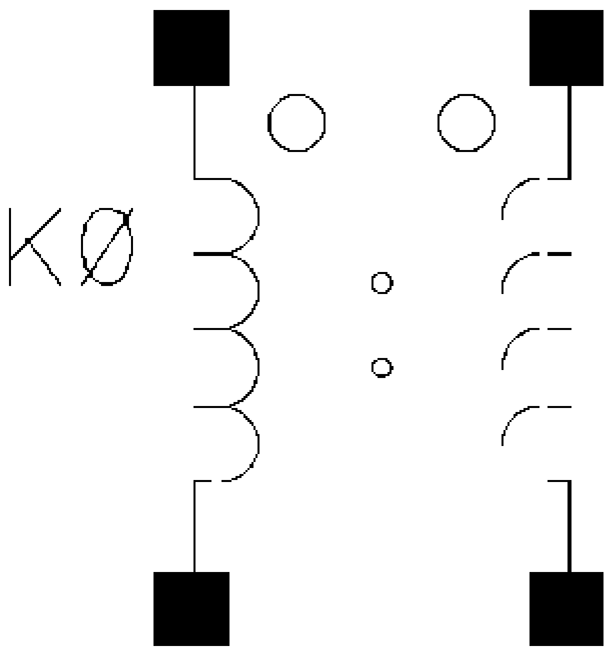
Command-Line Help

```
spectre -h winding
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Name of core	`core`	x	-	-	-	-
Num of turns on winding	`turn`	x	-	-	x	-
Res of the winding	`resis`	x	-	-	x	-
Multiplier	`m`	x	-	-	-	-
Initial condition	`ic`	x	-	-	x	-
Resistance	`r`	-	-	-	-	-

xfmr Symbol



Description

The component `xmfr` is a linear two winding ideal transformer. Winding `1` connects terminals ‘`t1`’ and ‘`b1`’, and winding `2` connects ‘`t2`’ and ‘`b2`’. The number of turns on windings `1` and `2` are given by ‘`n1`’ and ‘`n2`’ respectively, where ‘`n2`’ must not be zero. The absolute number of turns of each winding is not important, only the ratio of ‘`n1`’ to ‘`n2`’. Current through winding `1` is computed.

An ideal transformer is modeled, so it acts as a transformer at DC. In particular, it implements

```
v1/v2 = n1/n2
i1/i2 = -n2/n1
```

This device is not supported within the altergroups.

Command-Line Help

```
spectre -h transformer
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Coupling coefficient	`k`	-	-	-	x	x
Primary inductor	`pi`	-	-	-	x	x
Secondary inductor	`si`	-	-	-	x	x
Number of turns on primary	`n1`	x	-	-	-	-
Number of turns on secondary	`n2`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-

Syntax/Synopsis

```
Name ( t1 b1 t2 b2 ) transformer <parameter=value> ...
```

Examples

```
tr1 (1 0 2 0) transformer n1=3 n2=3 m=2
```

Related Topics

CDF Parameters Supported by Analog Library Components

Passive Components

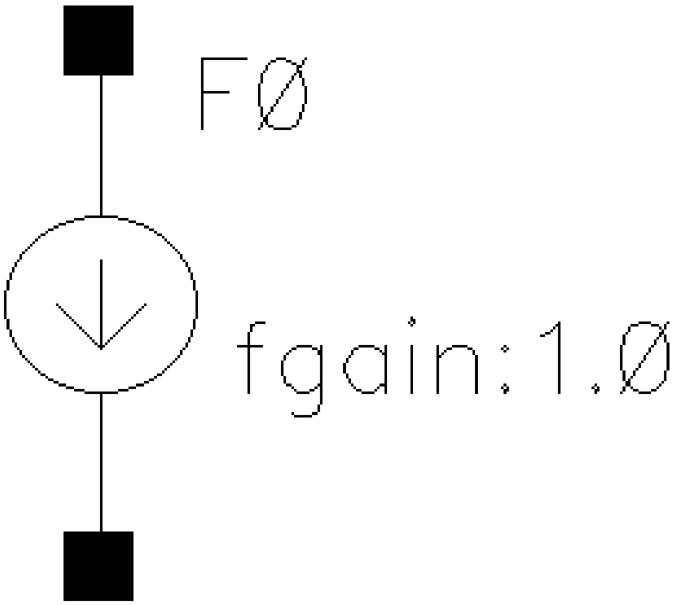
6

Sources - Dependent Components in Analog Library

The components in the `Source-Dependent` category are as follows:

- cccs Symbol
- ccvs Symbol
- pcccs Symbol
- pccvs Symbol
- pvccs, pvccs2, pvccs3 Symbol
- pvccsp Symbol
- pvcvs, pvcvs2, pvcvs3 Symbol
- pvcvsp Symbol
- vccs Symbol
- Voltage-Controlled Current Sources (G-Elements)
- vccsp Symbol
- vcvs Symbol
- vcvsp Symbol

cccs Symbol



Description

Linear Current Controlled Current Source is a current-controlled source detects the current with a probe device. A valid probe is a component instance in the circuit that naturally computes current. For example, probes can be voltage sources (independent or controlled), inductors, transmission lines, microstrip lines, N-ports, and transformers. If the probe device computes more than one current (such as transmission lines, microstrip lines, and N-ports), the index of the probe port through which the controlling current flows needs to be specified. Positive current exits the source node and enters the sink node of the controlled source.

The component `cccs` uses the same values of parameters `fgain`, `maxm`, `minm`, `m` for both `Spectre` and `hspiceD` simulators. This device is supported within the altergroups. This device can also model ideal digital gates.

Command-Line Help

```
spectre -h cccs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Name of voltage source	vref	x	-	-	x	x
Current gain	fgain	x	-	-	x	x
Initial condition	ic	-	-	-	-	x
Port	port	x	-	-	-	-
Type of transfer char	trfType	x	-	-	-	-
Multiplier	m	x	-	-	x	x
Type of Source	typesrc	x	-	-	-	-
Maximum Output Current	maxm	x	-	-	x	-
Minimum Output Current	minm	x	-	-	x	-
Absolute Output Current	absol	x	-	-	-	-
Smoothing Factor	smoothing	x	-	-	-	-
Type	csType	-	-	-	x	x
Current gain (Obsolete)	hfgain	-	-	-	x	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Maximum output current (Obsolete)	`maxi`	-	-	-	x	x
Minimum output current (Obsolete)	`mini`	-	-	-	x	x
Scale factor	`scale`	-	-	-	x	x
Multiplier (Obsolete)	`hm`	-	-	-	x	
Temperature coefficient 1	`tc1`	-	-	-	x	x
Temperature coefficient 2	`tc2`	-	-	-	x	x
Absolute value	`habs`	-	-	-	x	-
Initial condition	`hic`	-	-	-	x	-
Delta	`delta`	x	-	-	x	x
Number of controlling pairs	`xypairs`	-	-	-	x	x
Delay Time	`htd`	-	-	-	x	-
Absolute value	`abs`	x	-	-	-	x
Delay Time	`td`	-	-	-	-	x

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Controlling Volt 1	`x1 - x20`	-	-	-	x	x

Syntax/Synopsis

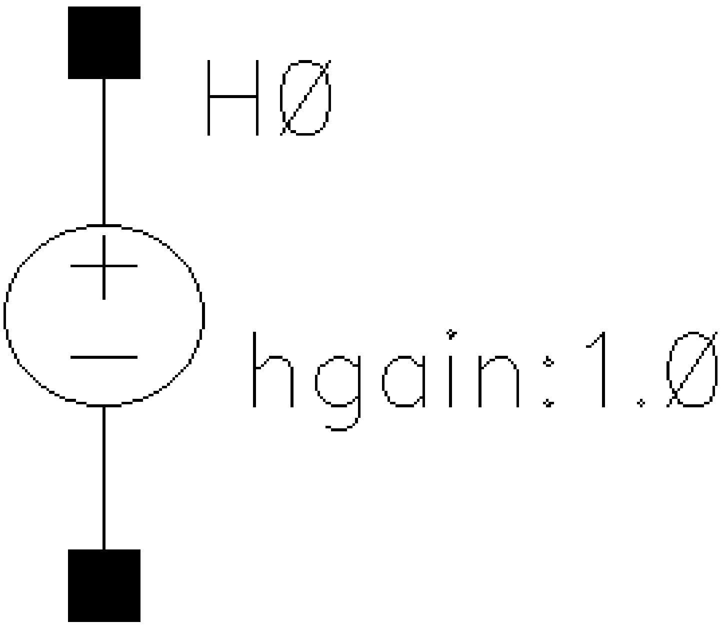
```
Name ( sink src ) cccs <parameter=value> ...
```

Examples

```
vcs (pos gnd) cccs gain=2.5 probe=v1 m=1
```

where, `v1` is an instance of a voltage source.

ccvs Symbol



Description

Linear Current-Controlled Voltage Source senses the current with a probe device. A valid probe is a component instance in the circuit that naturally computes current. For example, probes can be voltage sources (independent or controlled), inductors, transmission lines, microstrip lines, N-ports, and transformers.

If the probe device computes more than one current (such as transmission lines, microstrip lines, and N-ports), the index of the probe port through which the controlling current flows needs to be specified. Current through the controlled voltage source is calculated and is defined to be positive if it flows from the positive terminal, through the source, to the negative terminal.

Component ccvs uses the same values of parameters `hgain`, `maxm`, and `minm` for both `Spectre` and `hspiceD` simulators. This device is supported within the altergroups. This device can also model ideal digital gates.

Command-Line Help

```
spectre -h ccvs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Name of voltage source	`vref`	x	-	-	x	x
Transresistance	`hgain`	x	-	-	x	x
Initial condition	`ic`	-	-	-	-	x
Port	`port`	x	-	-	-	-
Type of transfer char	`trfType`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Type of Source	`typesrc`	x	-	-	-	-
Minimum Output Voltage	`minm`	x	-	-	x	-
Maximum Output Voltage	`maxm`	x	-	-	x	-
Absolute Output Voltage	`absol`	x	-	-	-	-
Smoothing Factor	`smoothing`	x	-	-	-	-
Type	`csType`	-	-	-	x	x
Transresistance (Obsolete)	`hhgain`	-	-	-	x	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Maximum output voltage (Obsolete)	`maxv`	-	-	-	x	x
Minimum output voltage (Obsolete)	`minv`	-	-	-	x	x
Scale factor	`scale`	-	-	-	x	x
Temperature coefficient 1	`tc1`	x	-	-	x	x
Temperature coefficient 2	`tc2`	x	-	-	x	x
Absolute value	`habs`	-	-	-	x	-
Initial condition	`hic`	-	-	-	x	-
Delta	`delta`	x	-	-	x	x
Number of controlling pairs	`xypairs`	-	-	-	x	x
Delay Time	`htd`	-	-	-	x	-
Absolute value	`abs`	x	-	-	-	x
Delay Time	`td`	-	-	-	-	x
Controlling Volt 1	`x1 - x20`	-	-	-	x	x

Syntax/Synopsis

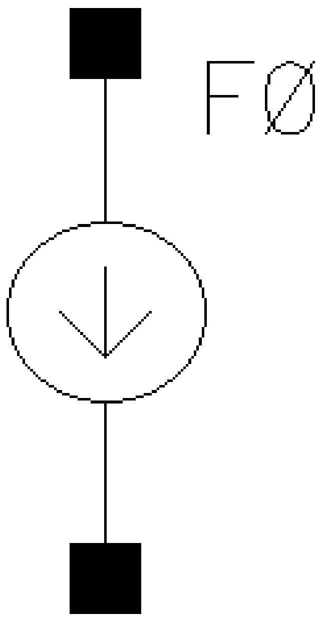
```
Name ( p n ) ccvs <parameter=value> ...
```

Examples

```
vvs (pos gnd) ccvs rm=1 probe=v1 m=1
```

`v1` is an instance of a voltage source.

pcccs Symbol



Description

The component pcccs stands for Polynomial Current Controlled Current Source. A vector of coefficients specifies the polynomial function that defines the relationship between the output current and the controlling currents. You must specify at least one coefficient. The component pcccs stands for Polynomial Controlled Current Source.

For a polynomial in N variables a1, a2, ... an, the polynomial function F(a0,a1,...,an) is given by:

```
F = c0 + c1 * a1 + c2 * a2 + ...
+ c(m+1) * a1^2 + c(m+2) * a1 * a2 +...
+ c(2m+1) * a2^2 + c(2m+2) * a2 * a3 +...
```

where the c0, c1 and c2 are coefficients of the polynomial terms, and m is the multiplier.

This device is supported within the altergroups.

Command-Line Help

```
spectre -h pcccs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Max Coefficient Number	`polyCoef`	x	-	-	-	-
Poly Coeff 0	`c0`	x	-	-	-	-
Poly Coeff 1	`c1`	x	-	-	-	-
Poly Coeff 2	`c2`	x	-	-	-	-
Poly Coeff 3	`c3`	x	-	-	-	-
Poly Coeff 4	`c4`	x	-	-	-	-
Number of Probes	`probeCnt`	x	-	-	-	-
Probe 1	`p1`	x	-	-	-	-
Port 1	`port1`	x	-	-	-	-
Probe 2	`p2`	x	-	-	-	-
Port 2	`port2`	x	-	-	-	-
Probe 3	`p3`	x	-	-	-	-
Port 3	`port3`	x	-	-	-	-
Probe 4	`p4`	x	-	-	-	-
Port 4	`port4`	x	-	-	-	-
Gain	`gain`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Maximum Output Current	`maxm`	x	-	-	-	-
Minimum Output Current	`minm`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Absolute Output Current	absol	x	-	-	-	-
Smoothing Factor	smoothing	x	-	-	-	-
Temperature coefficient 1	tc1	x	-	-	-	-
Temperature coefficient 2	tc2	x	-	-	-	-

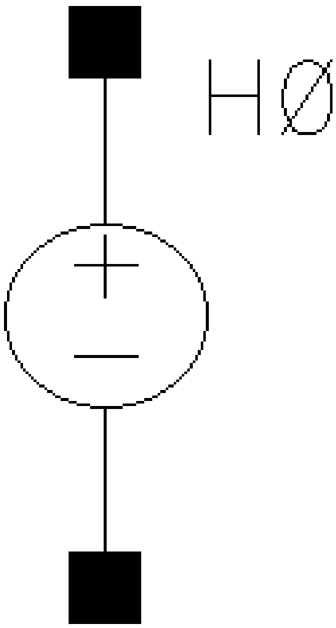
Syntax/Synopsis

```
Name ( sink src ) pcccs <parameter=value> ...
```

Examples

```
vpc (net1 0) pcccs probes=[vb vc ve vlp vpn] coeffs=[0 8.8e6 -8.8e6 9e6 8e6 -9e6]
```

pccvs Symbol



Description

The component pccvs stands for Polynomial Current Controlled Voltage Source. The polynomial function defining the relationship between the output voltage and the controlling currents is specified by a vector of coefficients. At least one coefficient must always be specified. Current through the voltage source is calculated and is defined as positive if it flows from the positive terminal, through the source, to the negative terminal.

For a polynomial in N variables a1, a2,... an, the polynomial function F(a0,a1,...,an) is given by:

```
F = c0 + c1 * a1 + c2 * a2 + ...
+ c(m+1) * a1^2 + c(m+2) * a1 * a2 +...
+ c(2m+1) * a2^2 + c(2m+2) * a2 * a3 +...
```

where the c0, c1 and c2 are coefficients of the polynomial terms, and m is the multiplier.

This device is supported within the altergroups.

Command-Line help

```
spectre -h pccvs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Max Coefficient Number	polyCoef	x	-	-	-	-
Poly Coeff 0	c0	x	-	-	-	-
Poly Coeff 1	c1	x	-	-	-	-
Poly Coeff 2	c2	x	-	-	-	-
Poly Coeff 3	c3	x	-	-	-	-
Poly Coeff 4	c4	x	-	-	-	-
Number of Probes	probeCnt	x	-	-	-	-
Probe 1	p1	x	-	-	-	-
Port 1	port1	x	-	-	-	-
Probe 2	p2	x	-	-	-	-
Port 2	port2	x	-	-	-	-
Probe 3	p3	x	-	-	-	-
Port 3	port3	x	-	-	-	-
Probe 4	p4	x	-	-	-	-
Port 4	port4	x	-	-	-	-
Gain	gain	x	-	-	-	-
Multiplier	m	x	-	-	-	-
Maximum Output Voltage	maxm	x	-	-	-	-
Minimum Output Voltage	minm	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Absolute Output Voltage	absol	x	-	-	-	-
Smoothing Factor	smoothing	x	-	-	-	-
Temperature coefficient 1	tc1	x	-	-	-	-
Temperature coefficient 2	tc2	x	-	-	-	-

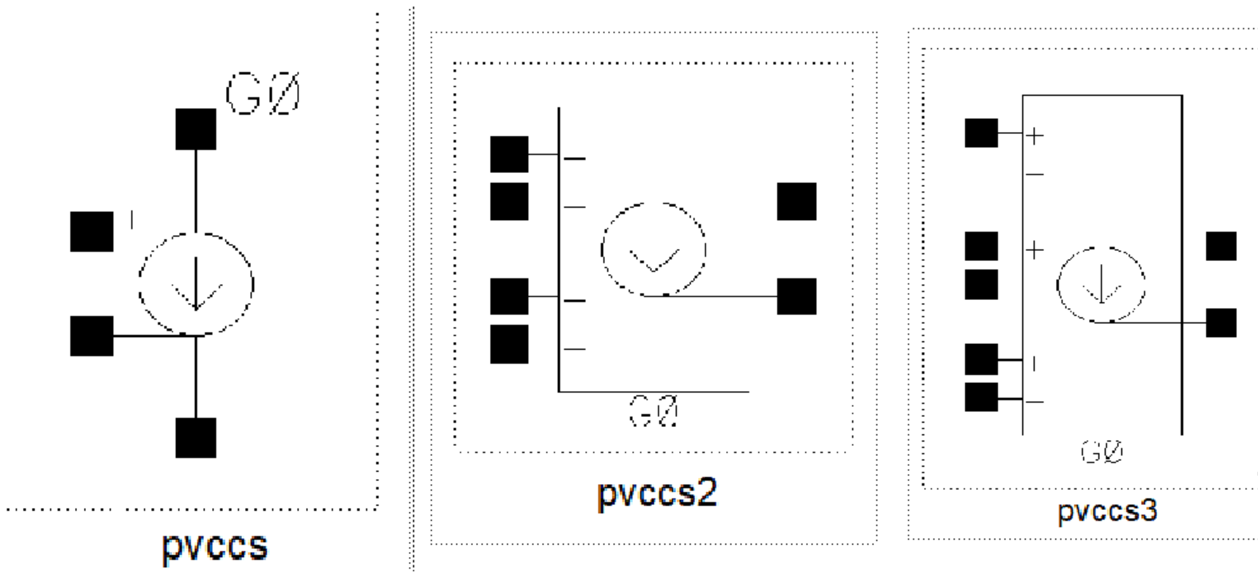
Syntax/Synopsis

```
Name ( p n ) pccvs <parameter=value> ...
```

Examples

```
ixy (net1 0) pccvs coeffs=[0 1 0 1] probes=[vin1 vin2] gain=2
```

pvccs, pvccs2, pvccs3 Symbol



Description

A polynomial voltage controlled current source in which the symbol varies with the number of controlling voltages. A vector of coefficients specifies the polynomial function that defines the relationship between the output current and the controlling voltages. You must specify at least one coefficient. Current exits the source node and enters the sink node.

For a polynomial in `M` variables `a1, a2, ... am`, the polynomial function `F(a0,a1,...,an)` is given by:

```
F = c0 + c1 * a1 + c2 * a2 + ...
+ c(m+1) * a1^2 + c(m+2) * a1 * a2 +...
+ c(2m+1) * a2^2 + c(2m+2) * a2 * a3 +...
```

where the `c0`, `c1` and `c2` are coefficients of the polynomial terms, and `m` is the multiplier.

The coefficients should be given in the order of the polynomial terms. The order of the polynomial terms is:

1. Lower degree term goes before higher degree term. For example, `a1` is before `a1^2`.
2. For the same degree terms, the term whose first variable has higher degree goes first. If the first variable has the same degree, then check the second variable, and so on. For example, for terms in 3 variables and of 4 degrees, a `1^4` goes before `a1^3*a2`. And `a1^3*a2` goes before `a1^3*a3`.

If you have high degree terms, using `coeff` parameter may not be convenient. You can use a file to specify the nonzero coefficients. You use one line in your file to specify one coefficient. The format is to put the degree of the variables first, then the coefficient. For example, if you have term `1.5*a1*a2^2*a3`, the degrees of `a1`, `a2` and `a3` are `1 2 1`, the coefficient is `1.5`.

So the line in your file is:

```
1 2 1 1.5
```

This device is supported within altergroups.

Command-Line Help

```
spectre -h pvccs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Max Coefficient Number	`polyCoef`	x	-	-	x	-
Poly Coeff 0	`c0 - c20`	x	-	-	x	-
Initial condition	`ic`	-	-	-	x	-
Scale factor	`scale`	-	-	-	x	-
Absolute value	`abs`	x	-	-	x	-
Gain	`gain`	x	-	-	-	-
Multiplier	`m`	x	-	-	x	-
Maximum Output Current	`maxm`	x	-	-	x	-
Minimum Output Current	`minm`	x	-	-	x	-
Absolute Output Current	`absol`	x	-	-	-	-
Smoothing Factor	`smoothing`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	x	-
Temperature coefficient 2	`tc2`	x	-	-	x	-
File containing Poly Coeffs	`filecoef`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Coeffs to be specified in	`coefSpec`	x	-	-	-	-

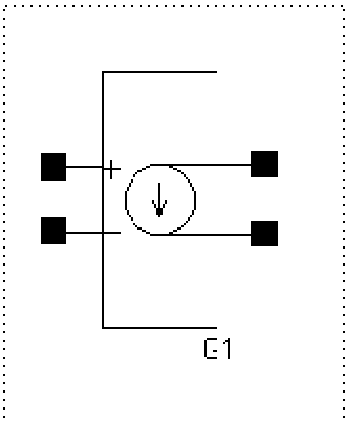
Syntax/Synopsis

```
Name ( sink src ps1 ns1 ... ) pvccs <parameter=value> ...
```

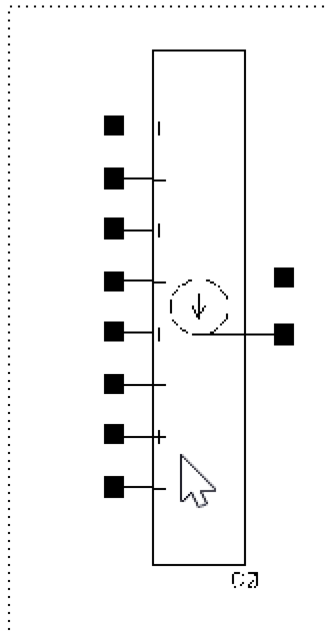
Examples

```
v2 (net1 0 net2 0) pvccs coeffs=[0 -2e-3 - 10e-3] gain=2 m=1
```

pvccsp Symbol



pvccsp



pvccsp with 4
controlling voltages

Description

Parameterized Cell Based Polynomial Nonlinear Voltage Controlled Current Source is a Pcell-based polynomial voltage controlled current source in which the symbol varies with the number of controlling voltages. pvccsp is similar to pvccs except that it has one additional parameter (`nc`) that specifies the number of controlling voltage sources.

The maximum number of controlling voltages is `20`. Therefore, if you specify a number greater than `20`, the value of this parameter will default to `20`.

Command-Line Help

```
spectre -h pvccs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Num of controlling voltage(s)	`nc`	x	-	-	-	-
Max Coefficient Number	`polyCoef`	x	-	-	-	-
Poly Coeff 0	`c0`	x	-	-	-	-
Poly Coeff 1	`c1`	x	-	-	-	-
Poly Coeff 2	`c2`	x	-	-	-	-
Poly Coeff 3	`c3`	x	-	-	-	-
Poly Coeff 4	`c4`	x	-	-	-	-
Gain	`gain`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Maximum Output Current	`maxm`	x	-	-	-	-
Minimum Output Current	`minm`	x	-	-	-	-
Absolute Output Current	`absol`	x	-	-	-	-
Smoothing Factor	`smoothing`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-

Examples

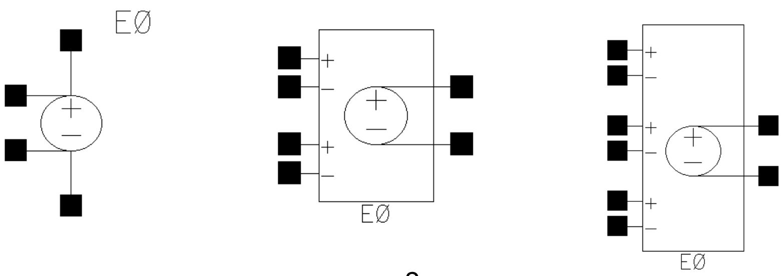
Following is the netlist when the pvccs coefficient is specified as an instance parameter and not specified in a file:

```
G0 (net21 net23 net22 net24 ) pvccs gain=1.0  m=1 coeffs=[ 1 1 1 1 ]  min=1.0
max=3.1 abs=off tc1=0 tc2=0
```

Following is the netlist when the pvccs coefficient is specified in a file:

```
G0 (net21 net23 net22 net24 ) pvccs gain=1.0  m=1 file=”abc.coeff”  min=1.0
max=3.1 abs=off tc1=0 tc2=0
```

pvcvs, pvcvs2, pvcvs3 Symbol



pvcvs pvcvs2 pvcvs3

Description

It is a polynomial voltage controlled voltage source in which the symbol varies with the number of controlling voltages. A vector of coefficients specifies the polynomial function that defines the relationship between the output voltage and the controlling voltages. You must specify at least one coefficient. Current through the voltage source is calculated and is defined to be positive if it flows from the positive terminal, through the source, to the negative terminal.

For a polynomial in `N` variables `a1, a2, ... an`, the polynomial function `F(a0,a1,...,an)` is given by:

```
F = c0 + c1 * a1 + c2 * a2 + ...
+ c(m+1) * a1^2 + c(m+2) * a1 * a2 +...
+ c(2m+1) * a2^2 + c(2m+2) * a2 * a3 +...
```

where the `c0`, `c1` and `c2` are coefficients of the polynomial terms, and `m` is the multiplier.

This device is supported within the altergroups.

Command-Line Help

```
spectre -h pvcvs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Max Coefficient Number	`polyCoef`	x	-	-	-	-
Poly Coeff 0	`c0 - c20`	x	-	-	-	-
Initial condition	`ic`	-	-	-	x	-
Scale factor	`scale`	-	-	-	x	-
Absolute value	`abs`	x	-	-	x	-
Gain	`gain`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Minimum Output Voltage	`minm`	x	-	-	x	-
Maximum Output Voltage	`maxm`	x	-	-	x	-
Absolute Output Voltage	`absol`	x	-	-	-	-
Smoothing Factor	`smoothing`	x	-	-	-	-
Temperature coefficient 1	`tc1`	-	-	-	x	-
Temperature coefficient 2	`tc2`	x	-	-	x	-

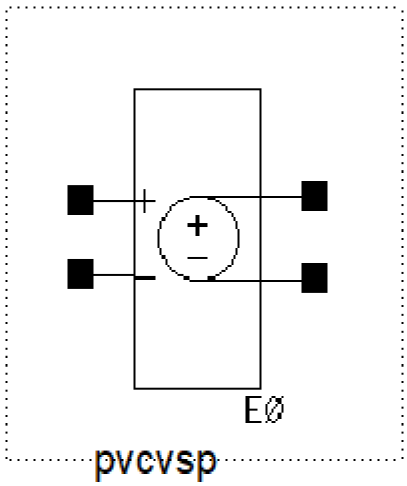
Syntax/Synopsis

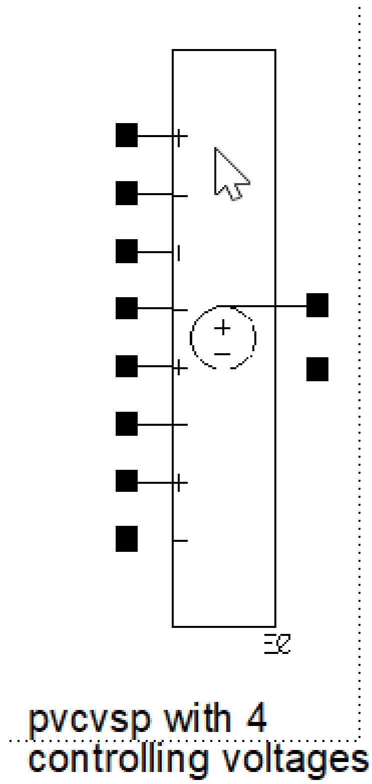
```
Name ( p n ps1 ns1 ... ) pvcvs <parameter=value> ...
```

Examples

```
v1 (p 0 c1 0) pvcvs coeffs=[0 0 0 0.1 1 1] gain=1
```

pvcvsp Symbol





Description

Parameterized Cell Based Polynomial Nonlinear Voltage Controlled Voltage Source is a Pcell-based polynomial voltage controlled voltage source in which the symbol varies with the number of controlling voltages. This component is similar to `pvcvs` except that it has one additional parameter (`nc`) that specifies the number of the controlling voltage sources.

The maximum number of controlling voltages is `20`. Therefore, if you specify a number greater than `20`, the value of this parameter will default to `20`.

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Num of controlling voltage(s)	`nc`	x	-	-	-	-
Max Coefficient Number	`polyCoef`	x	-	-	-	-
Poly Coeff 0	`c0`	x	-	-	-	-
Poly Coeff 1	`c1`	x	-	-	-	-
Poly Coeff 2	`c2`	x	-	-	-	-
Poly Coeff 3	`c3`	x	-	-	-	-
Poly Coeff 4	`c4`	x	-	-	-	-
Gain	`gain`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Minimum Output Voltage	`min`	x	-	-	-	-
Maximum Output Voltage	`max`	x	-	-	-	-
Absolute Output Voltage	`abs`	x	-	-	-	-
Smoothing Factor	`delta`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-

Examples

Following is the netlist when the pvcvs coefficient is passed as an instance parameter and not specified in a file:

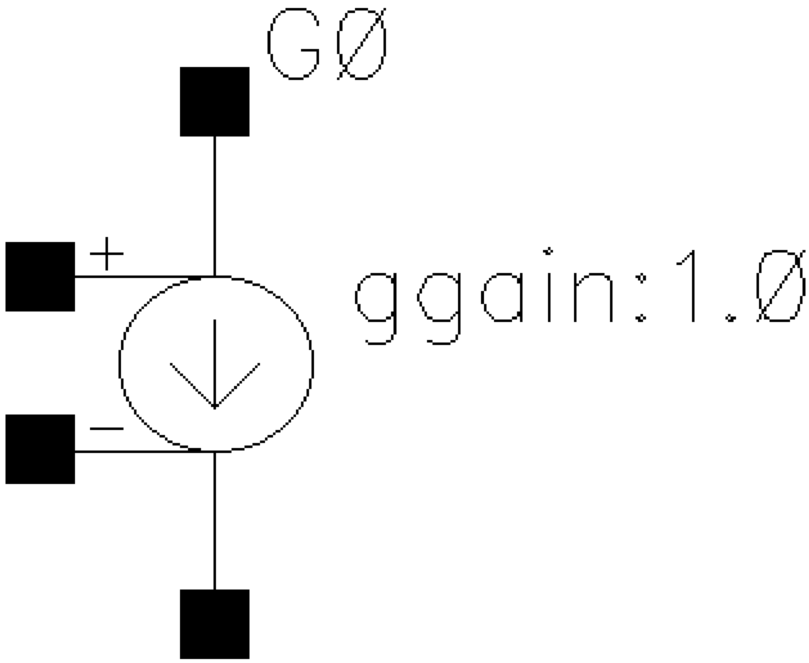
```
E0 (net21 net23 net22 net24 ) pvcvs gain=1.0  m=1 coeffs=[ 1 1 1 1 ]  min=1.0
max=3.1 abs=off tc1=0 tc2=0
```

Following is the netlist when the PVCVS coefficient is specified in a file:

```
E0 (net21 net23 net22 net24 ) pvcvs gain=1.0  m=1 file=”abc.coeff”  min=1.0
max=3.1 abs=off tc1=0 tc2=0
```

The parameters, `polyCoef` and `coefSpec`, are not netlisted.

vccs Symbol



Description

The component `vccs` stands for Linear Voltage Controlled Current Source. Positive current exits the source node and enters the sink node.

The component `vccs` uses the same values of parameters `ggain`, `maxm`, `minm`, and `m` for both `Spectre` and `hspiceD` simulators. This device is supported within the altergroups.

Command-Line Help

```
spectre -h vccs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Transconductance	`ggain`	x	-	-	x	x
Initial condition	`ic`	-	-	-	-	x
Multiplier	`m`	x	-	-	x	x
Type	`csType`	-	-	-	x	x
Transconductance (Obsolete)	`hggain`	-	-	-	x	-
Maximum output current (Obsolete)	`maxi`	-	-	-	x	x
Minimum output current (Obsolete)	`mini`	-	-	-	x	x
Maximum output current	`maxm`	x	-	-	x	-
Minimum output current	`minm`	x	-	-	x	-
Scale factor	`scale`	-	-	-	x	x
Multiplier (Obsolete)	`hm`	-	-	-	x	-
Temperature coefficient 1	`tc1`	-	-	-	x	x

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Temperature coefficient 2	`tc2`	-	-	-	x	x
Absolute value	`habs`	-	-	-	x	-
Initial condition	`hic`	-	-	-	x	-
Pwl type	`pwlType`	-	-	-	x	x
Delta	`delta`	x	-	-	x	x
Number of controlling pairs	`xypairs`	-	-	-	x	x
Delay Time	`htd`	-	-	-	x	-
Absolute value	`abs`	x	-	-	-	x
Delay Time	`td`	-	-	-	-	x
Type of input of source	`inputtype`	x	-	-	-	-

Syntax/Synopsis

```
Name ( sink src ps ns ) vccs <parameter=value> ...
```

Examples

```
v1 (1 0 2 3) gm=-1 m=2
```

Voltage-Controlled Current Sources (G-Elements)

The components in Voltage-Controlled Current Sources (G-Elements) are as follows:

- Voltage-Controlled Capacitor
- Voltage-Controlled Current Source
- Voltage-Controlled Resistor

Voltage-Controlled Capacitor

```
Gxx n+ n- vccap pwl(1) in+ in- [delta = val] [scale = val]
     + [m = val] [tc1 = val] [tc2 = val] x1, y1, x2, y2 ... [ic = val]
```

Voltage-Controlled Current Source

Behavioral

```
Gxx n+ n- [vccs] cur = 'equation' [max = val] [min = val] [scale = val]
```

Linear

```
Gxx n+ n- [vccs] in+ in- transconductance [max = val] [min = val]
     + [m = val] [scale = val] [tc1 = val] [tc2 = val] [abs = 1] [ic = val]
```

Piece-Wise Linear

```
Gxx n+ n- [vccs] pwl(1) in+ in- [delta = val] [scale = val]
     + [m = val] [tc1 = val] [tc2 = val] x1, y1, x2, y2 ... [ic = val]
```

Polynomial

```
Gxx n+ n- [vccs] poly(ndim) in+ in- ... inndim+ inndim-
     + [tc1 = val] [tc2 = val] [scale = val] [max = val]
     + [min = val] [abs = 1] p0 [p1 ...] [ic = vals]
```

Delay Element

```
Gxx n+ n- [vccs] delay in+ in- td = val
     + [tc1 = val] [tc2 = val] [scale = val] [npdelay = val]
```

Voltage-Controlled Resistor

Linear

```
Gxx n+ n- vcr in+ in- transfactor [max = val] [min = val]
     + [m = val] [scale = val] [tc1 = val] [tc2 = val] [ic = val]
```

Piece-Wise Linear

```
Gxx n+ n- vcr pwl(1) in+ in- [delta = val] [scale = val]
     + [m = val] [tc1 = val] [tc2 = val] x1, y1, x2, y2 ... [ic = val]

Gxx n+ n- vcr npwl(1) in+ in- [delta = val] [scale = val]
     + [m = val] [tc1 = val] [tc2 = val] x1, y1, x2, y2 ... [ic = val]

Gxx n+ n- vcr ppwl(1) in+ in- [delta = val] [scale = val]
     + [m = val] [tc1 = val] [tc2 = val] x1, y1, x2, y2 ... [ic = val]
```

Polynomial

```
Gxx n+ n- vcr poly(ndim) in+ in- ... inndim+ inndim-
     + [tc1 = val] [tc2 = val] [scale = val] [max = val]
     + [min = val] [abs = 1] p0 [p1 ...] [ic = vals]
```

Description

Defines voltage-controlled current sources (VCCSs), voltage-controlled resistors (VCRs), and voltage-controlled capacitors (VCCAPs) in behavioral, linear, piece-wise linear, poly, and delay forms. In the behavioral function, the equation can contain terms of node voltages. In linear form, the output value is estimated with ‘[v(in+)-v(in-)]’ multiplied by `transfactor` or `transconductance`, followed by the `scale` and temperature adjustment, before confined with the `abs`, `min`, and `max` parameters. In the piece-wise linear function, at least two pairs of voltage-current (or voltage-resistance, voltage-capacitance) points are required.

Arguments

Arguments	Description
n+, n-	Terminals of controlled element.
in+, in-	Positive and negative controlling nodes.
vcr, vccap, vccs	Keywords for the voltage-controlled resistor, capacitor, and current source elements. **Note:** vcr, vccap, and vccs are reserved words that cannot be used as node names.
cur = *'equation'*	Current of the controlled element flowing from n+ to n-. It can be ■ An expression with parameters and functions of node voltages ■ Branch currents of other elements ■ Time, frequency, or temperature
max = *val*	Maximum value of the controlled current or resistance.
min = *val*	Minimum value of the controlled current or resistance.
transconductance	Voltage to current conversion factor.
transfactor	Voltage to resistance conversion factor.
scale = *val*	Scaling factor; scales current by its value (default = 1.0).
m = *val*	Multiplier (default = 1).
tc1 = *val*	First-order temperature coefficient for the element.
tc2 = *val*	Second-order temperature coefficient for the element.
abs	Output current takes its absolute value if abs = 1.
ic = *val*	Initial value of the current source (default = 0.0).
delta = *val*	A value used to smooth corners of the piece-wise linear function. The default is 1/4 of the smallest distance between break points, and is not to exceed 1/2 of this value.
x1...	Voltage drops between the controlling nodes in+ and in-. They must be in ascending order.
y1...	Element output value corresponding to x1...
npdelay	The number of data points used in delay simulations.

`npwl`	The `npwl` and `ppwl` functions are used to interchange the `n+` and `n-` nodes, but use the same transfer function. ■ For the `in-` node connected to `n+`, if v(n+,n-) < 0, then the controlling voltage is v(in+,in-). Otherwise, the controlling voltage is v(in+,n-). ■ For the `in-` node connected to `n-`, if v(n+,n-) > 0, then the controlling voltage is v(in+,in-). Otherwise, the controlling voltage is v(in+,n+).
`ppwl`	■ For the `in-` node, connected to `n+`, if v(n+,n-) > 0, then the controlling voltage is v(in+,in-). Otherwise, the controlling voltage is v(in+,n-). ■ For the `in-` node, connected to `n-`, if v(n+,n-) < 0, then the controlling voltage is v(in+,in-). Otherwise, the controlling voltage is v(in+,n+). If the `in-` node does not connect to either `n+` or `n-`, the Virtuoso UltraSim simulator changes `npwl` and `ppwl` to `pwl`.

Examples

The following example defines a `VCCS` connected to nodes `1` and `2`, with its current dependent on the voltage of nodes `6` and `7` in the given form.

```
G1 1 2 cur = ’3.0*sin(v(7)/2)+v(6)^2’
```

The following example defines a `VCCS` connected to nodes `1` and `2`. Its current is initialized as 0, and is half of the voltage at node `5`. The current is also confined within 0 and 5 amps. The output current is multiplied by 2.

```
G2 1 2 vccs 5 0 0.5 max = 5 min = 0 m = 2 ic = 0
```

The following example defines a `VCCS` connected to nodes `1` and `2`, its current controlled by the voltage at node `5`. The current is calculated in a piece-wise linear function with a smoothing parameter of 0.2, and is scaled by 1.e-3 upon output.

```
G3 1 2 vccs pwl(1) 5 0 delta = 0.2 0, 0 0.5,1 1.5,1.5 scale = 1.e-3
```

The example defines a `VCR` connected to nodes `1` and `2`, with its resistance dependent on the voltage difference between nodes `5` and `4` in a piece-wise linear form. The initial resistance is 1k. The output resistance is decreased by 2/3.

```
Gres 1 2 vcr pwl(1) 5 4 m = 3 0,0 1,1k 2,1.5k 3,1.8k 4,2.0k 5,2.0k ic = 1k
```

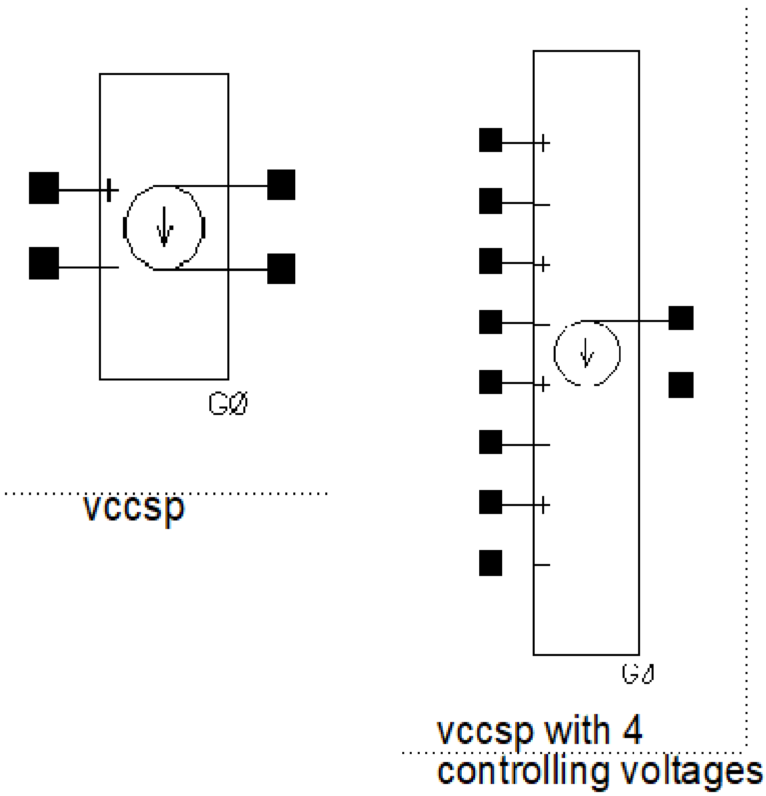
The following example defines a `VCCAP` connected to nodes `1` and `2`, with its capacitance dependent on the voltage difference between nodes `5` and `4` in a piece-wise linear form. The initial capacitance is set to 10 p after being scaled with 1e-12. The output capacitance is increased by a factor of 3.

```
Gcap 1 2 vccap pwl(1) 5 4 m = 3 scale = 1.e-12 0,0 1,10 2,15 3,18 4,20 5,20 ic = 10
```

The following example tells the Virtuoso UltraSim simulator to model the source-drain resistor of the n-channel MOSFET which is used as a switch. Based on the `npwl` function, the resistor value (`Gnmos`) does not change when changing the position of the `d` and `s` nodes.

```
Gnmos d s vcr npwl(1) g s m =3 0,5g 1,5meg 2,5k 3,1k 5,50
```

vccsp Symbol



Description

Parameterized Cell Based Voltage Controlled Current Source (`vccsp`) is a Pcell-based voltage controlled current source in which the symbol varies with the number of controlling voltages. vccsp is similar to vccs except that it has one additional parameter (nc) that specifies the number of controlling voltage sources.

The maximum number of controlling voltages is `20`. Therefore, if you specify a number greater than `20`, the value of this parameter will default to `20`.

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Num of controlling voltage(s)	`nc`	x	-	-	-	-
Transconductance	`ggain`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Type of Source	`typesrc`	x	-	-	-	-
Minimum Output Voltage	`min`	x	-	-	-	-
Maximum Output Voltage	`max`	x	-	-	-	-
Absolute Output Voltage	`abs`	x	-	-	-	-
Smoothing Factor	`delta`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-

Examples

Following is the netlist for the linear transfer characteristic:

```
G0  (net011 net012 net09 net010) vcvs type=vcvs  m=1  gain =1.0 min=1 max=4
abs=off tc1= 0 tc2=0
```

Following is the netlist for the PWL transfer characteristic when the voltage or voltage pair is not specified in a file:

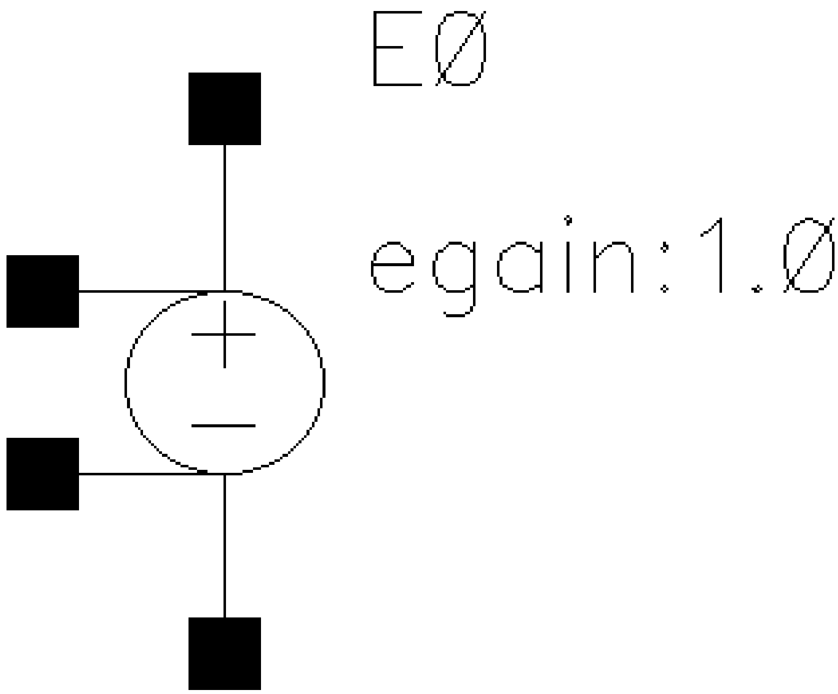
```
G0  (net011 net012 net09 net010) vcvs type=vcvs  m=1 pwl=[1 1 2 4] scale=1
delta=0 tc1=0 tc2=0
```

Following is the netlist for the PWL transfer characteristic when the voltage or voltage pair is specified in a file:

```
G0  (net011 net012 net09 net010) vcvs type=vcvs  m=1 file=”abc” scale=1 delta=0
tc1=0 tc2=0
```

The parameters, `trfType` and `iVectSpec` are not netlisted.

vcvs Symbol



Description

The component `vcvs` stands for Linear Voltage Controlled Voltage Source. Current through the voltage source is calculated and is defined to be positive if it flows from the positive terminal, through the source, to the negative terminal.

Component vcvs uses the same values of parameters `egain`, `maxm`, and `minm` for both `Spectre` and `hspiceD` simulators. This device is supported within the altergroups. This device can also model ideal digital gates.

Command-Line help

```
spectre -h vcvs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Voltage gain	`egain`	x	-	-	x	x
Initial condition	`ic`	-	-	-	-	x
Multiplier	`m`	x	-	-	-	-
Type	`csType`	-	-	-	x	x
Voltage gain (obsolete)	`hegain`	-	-	-	x	-
Maximum output voltage (obsolete)	`maxv`	-	-	-	x	x
Minimum output voltage (obsolete)	`minv`	-	-	-	x	x
Maximum output current	`maxm`	x	-	-	x	-
Minimum output current	`minm`	x	-	-	x	-
Scale factor	`scale`	-	-	-	x	x
Temperature coefficient 1	`tc1`	-	-	-	x	x

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Temperature coefficient 2	`tc2`	-	-	-	x	x
Absolute value	`habs`	-	-	-	x	-
Initial condition	`hic`	-	-	-	x	-
Delta	`delta`	x	-	-	x	x
Number of controlling pairs	`xypairs`	-	-	-	x	x
Delay Time	`htd`	-	-	-	x	-
Absolute value	`abs`	x	-	-	-	x
Delay Time	`td`	-	-	-	-	x

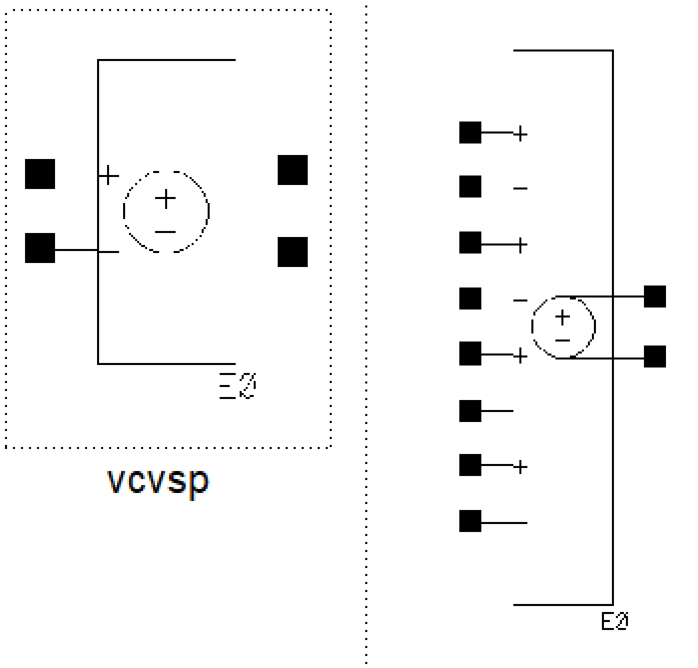
Syntax/Synopsis

```
Name ( p n ps ns ) vcvs <parameter=value> ...
```

Examples

```
e1 (out1 0 pos neg) vcvs gain=10
```

vcvsp Symbol



vcvsp

vcvsp with 4 controlling voltages

Description

The component `vcvsp` stands for Parameterized Cell Based Voltage Controlled Voltage Source. It is a Pcell-based voltage controlled voltage source in which the symbol varies with the number of controlling voltages.

The maximum number of controlling voltages is `20`. If it set to a number greater than `20`, the default value, `20`, is used.

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Num of controlling voltage(s)	`nc`	x	-	-	-	-
Type of transfer char	`trfType`	x	-	-	-	-
Voltage gain	`egain`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Type of source	`typesrc`	x	-	-	-	-
Minimum Output Voltage	`min`	x	-	-	-	-
Maximum Output Voltage	`max`	x	-	-	-	-
Absolute Output Voltage	`abs`	x	-	-	-	-
Smoothing Factor	`delta`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-

Examples

Following is the netlist for linear transfer characteristic:

```
G0  (net011 net012 net09 net010) vcvs type=vcvs  m=1  gain =1.0 min=1 max=4
abs=off tc1= 0 tc2=0
```

Following is the netlist for PWL transfer characteristic when the voltage or voltage pair is not specified in a file but passed as an instance parameter:

```
G0  (net011 net012 net09 net010) vcvs type=vcvs  m=1 pwl=[1 1 2 4]   scale=1
delta=0 tc1=0 tc2=0
```

Following is the netlist for PWL transfer characteristic when the voltage or voltage pair is not specified in a file:

```
G0  (net011 net012 net09 net010) vcvs type=vcvs  m=1 file=”abc”   scale=1
delta=0 tc1=0 tc2=0
```

The parameters, `trfType` and `iVectSpec`, are not netlisted.

Related Topics

CDF Parameters Supported by Analog Library Components

Sources - Dependent Components

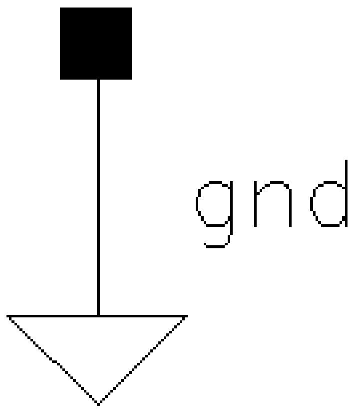
7

Sources - Global Components in Analog Library

This topic contains a list of all those components of the Analog Library that netlist as a global net. The components are as follows:

- gnd Symbol
- gnda Symbol
- gndd Symbol
- vcc Symbol
- vcca Symbol
- vccd Symbol
- vdd Symbol
- vdda Symbol
- vddd Symbol
- vee Symbol
- veea Symbol
- veed Symbol
- vrefgnd Symbol
- vss Symbol
- vssa Symbol
- vssd Symbol

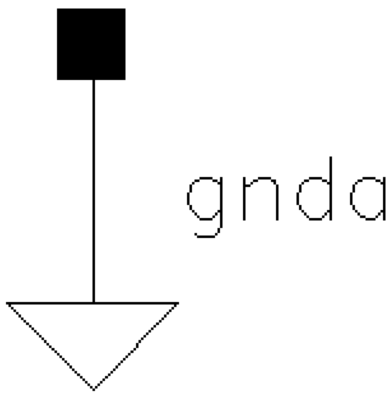
gnd Symbol



Component Parameters

This component has no parameters.

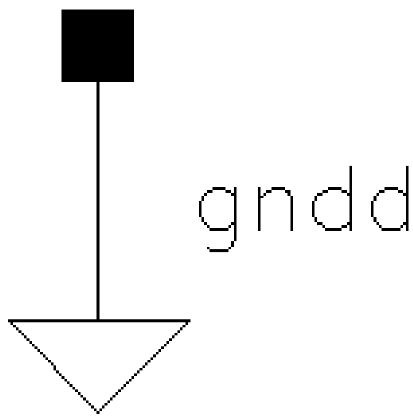
gnda Symbol



Component Parameters

This component has no parameters.

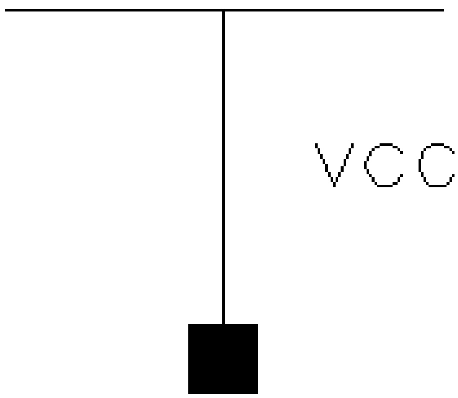
gndd Symbol



Component Parameters

This component has no parameters.

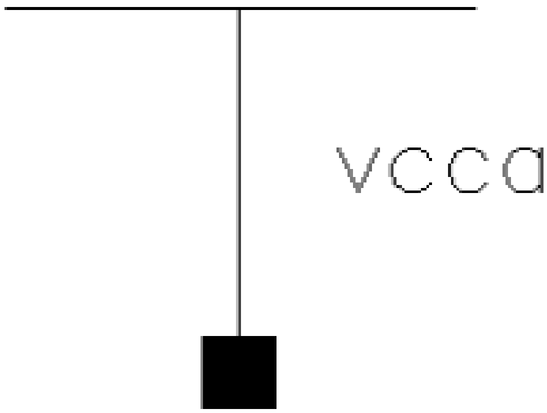
vcc Symbol



Component Parameters

This component has no parameters.

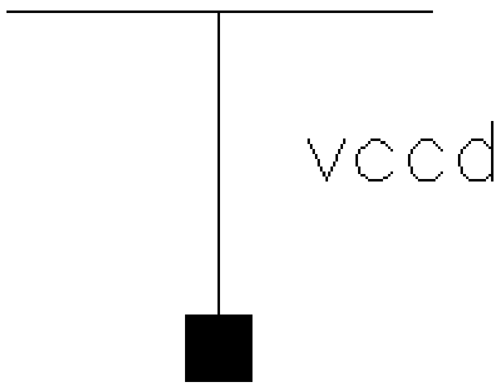
vcca Symbol



Component Parameters

This component has no parameters.

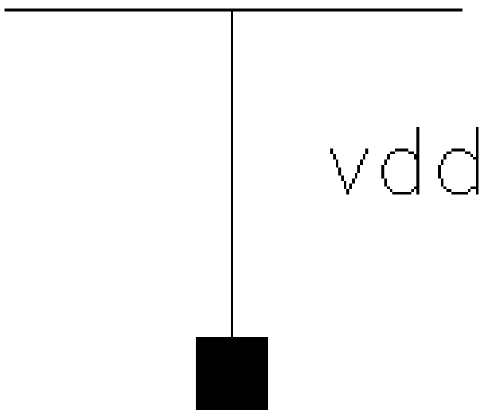
vccd Symbol



Component Parameters

This component has no parameters.

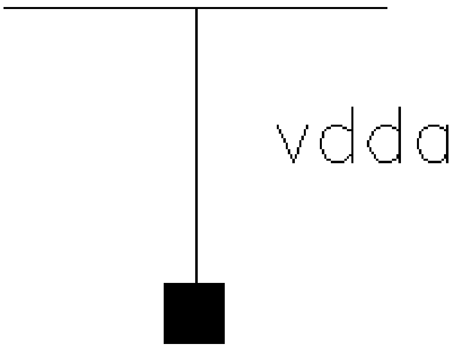
vdd Symbol



Component Parameters

This component has no parameters.

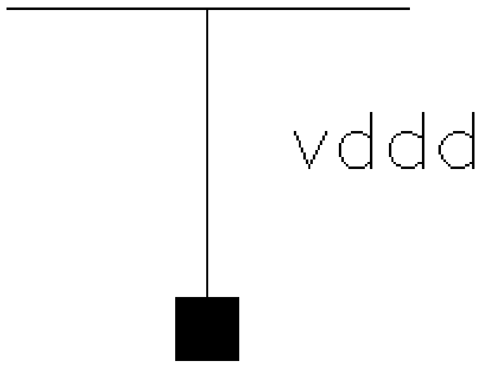
vdda Symbol



Component Parameters

This component has no parameters.

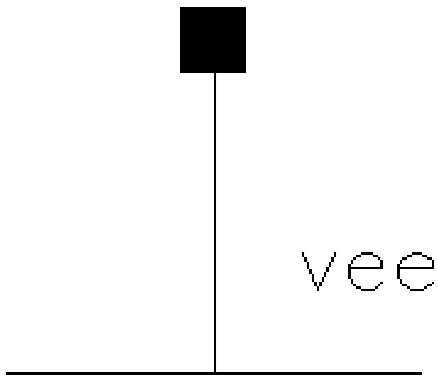
vddd Symbol



Component Parameters

This component has no parameters.

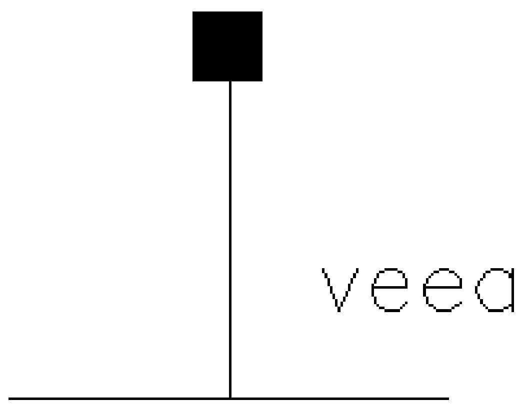
vee Symbol



Component Parameters

This component has no parameters.

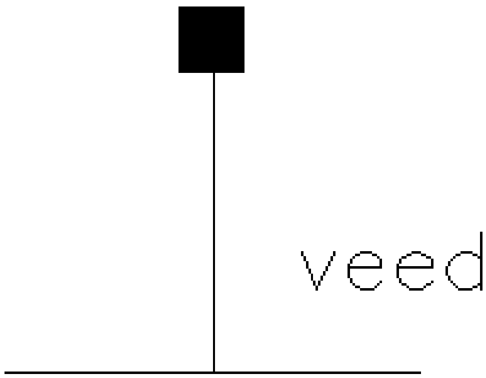
veea Symbol



Component Parameters

This component has no parameters.

veed Symbol



Component Parameters

This component has no parameters.

vrefgnd Symbol

Description

This component can be used at either the global level or the `subckt` level as a local option.

Component Parameters

This component has no parameters.

Examples

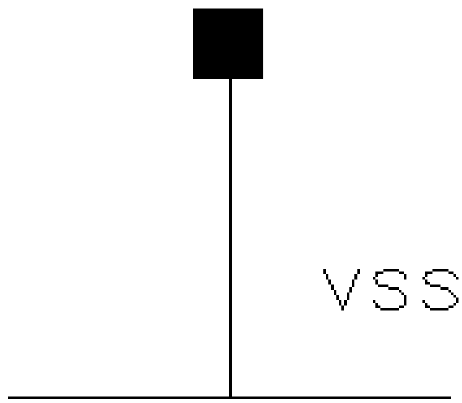
If it is in the netlist, option `vrefgnd1` is applied at the subckt level and `vrefgnd2` is applied on the top node, as follows:

```
vrefgnd1 options node_name=n1 subckt=x1
vrefgnd2 options node_name=top_n1
```

Here,

- `vrefgnd1` is applied to `subcktx1` and node `x1.n1` is used as reference gnd.
- `vrefgnd2` is applied to the top level and node `n1` is used as reference gnd.

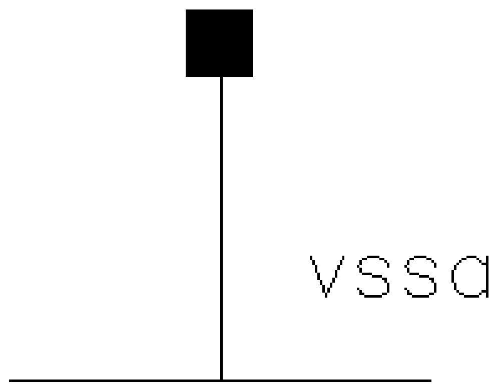
vss Symbol



Component Parameters

This component has no parameters.

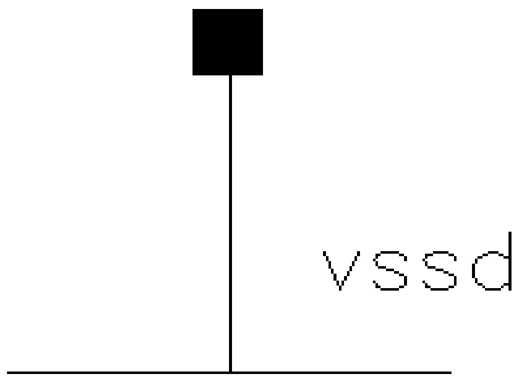
vssa Symbol



Component Parameters

This component has no parameters.

vssd Symbol



Component Parameters

This component has no parameters.

Related Topics

CDF Parameters Supported by Analog Library Components

8

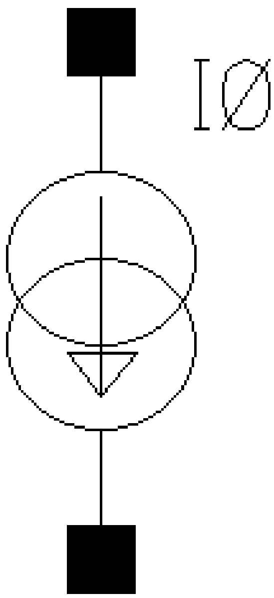
Sources - Independent Components in Analog Library

The components in the `Source-Independent` category are as follows:

- idc Symbol
- iexp Symbol
- ipulse Symbol
- ipwl Symbol
- ipwlf Symbol
- isin Symbol
- isource Symbol
- iprbs Symbol
- multibit Symbol
- pdc Symbol
- pexp Symbol
- port Symbol
- ppulse Symbol
- pprbs Symbol
- ppwl Symbol
- ppwlf Symbol
- psin Symbol
- vbit Symbol
- vdc Symbol

- vexp Symbol
- vpulse Symbol
- vpwl Symbol
- vpwlf Symbol
- vpwlfm Symbol
- vsin Symbol
- vprbs Symbol
- vsource Symbol

idc Symbol



Description

The component `idc` stands for Independent DC Current Source in Source-Independent category. It is a constant isource. This device is supported within the altergroups.

Command-Line Help

```
spectre -h isource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	`acm`	x	-	-	x	x
AC phase	`acp`	x	-	-	x	x
DC current	`idc`	x	-	-	x	x
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Multiplier	`m`	x	-	-	x	x
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-
PAC magnitude	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-
Source type	`srcType`	x	-	-	-	-
AC Phase	`acPhase`	x	-	-	-	-

Syntax/Synopsis

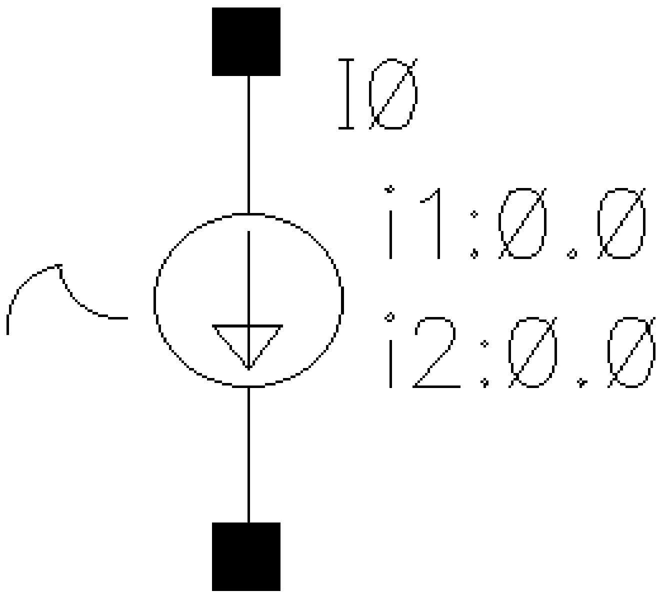
```
Name ( sink src ) isource <parameter=value> ...
```

Positive current exits the source node and enters the sink node.

Examples

```
i1 (in 0) isource dc=0 type=pulse delay=10n val0=0 val1=500u period=500n
rise=1n fall=1n width=250n
```

iexp Symbol



Description

The component `iexp` stands for Independent Exponential Current Source in Source-Independent category. This device is supported within the altergroups.

Command-Line Help

```
spectre -h isource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	`acm`	x	-	-	x	x
AC phase	`acp`	x	-	-	x	x
DC current	`idc`	x	-	-	x	x
Current 1	`i1`	x	-	-	x	x
Current 2	`i2`	x	-	-	x	x
Delay time 1	`td1`	x	-	-	x	x
Damping factor 1	`tau1`	x	-	-	x	x
Delay time 2	`td2`	x	-	-	x	x
Damping factor 2	`tau2`	x	-	-	x	x
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/ freq pairs	`FNpairs`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-
PAC magnitude	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-
Multiplier	`m`	x	-	-	x	x
Delay time	`td`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-
DC source	`dc`	-	-	-	x	x
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Delay Time	`delay`	x	-	-	-	-

Syntax/Synopsis

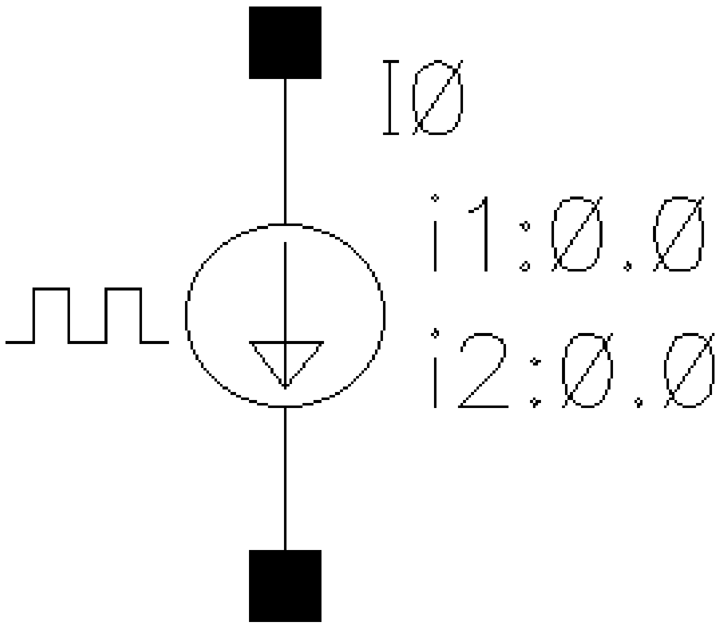
```
Name ( sink src ) isource <parameter=value> ...
```

Positive current exits the source node and enters the sink node.

Examples

```
i1 (in 0) isource dc=0 type=pulse delay=10n val0=0 val1=500u period=500n
rise=1n fall=1n width=250n
```

ipulse Symbol



Description

The component `ipulse` stands for Independent Pulse Current Source in Source-Independent category. It is a square wave varying isource. This device is supported within the altergroups.

Command-Line Help

```
spectre -h isource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	acm	x	-	-	x	x
AC phase	acp	x	-	-	x	x
DC current	idc	x	-	-		
Current 1	i1	x	-	-	x	x
Current 2	i2	x	-	-	x	x
Delay time	td	x	-	-	x	x
Rise time	tr	x	-	-	x	x
Fall time	tf	x	-	-	x	x
Pulse width	pw	x	-	-	x	x
Period	per	x	-	-	x	x
Frequency name for 1/ period	fundname	x	-	-	-	-
Noise file name	noisefile	x	-	-	-	-
Number of noise/freq pairs	FNpairs	x	-	-	-	-
XF magnitude	xfm	x	-	-	-	-
PAC magnitude	pacm	x	-	-	-	-
PAC phase	pacp	x	-	-	-	-
Multiplier	m	x	-	-	x	x
Temperature coefficient 1	tc1	x	-	-	-	-
Temperature coefficient 2	tc2	x	-	-	-	-
Nominal temperature	tnom	x	-	-	-	-
DC source	dc	-	-	-	x	x
Freq 1 to Freq 50	F1 - F50	x	-	-	-	-
Noise 1 to Noise 50	N1 - N50	x	-	-	-	-
Source type	srcType	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Type of rising & falling edge	`risefalledge`	x	-	-	-	-
Delay Time	`delay`	x	-	-	-	-

Syntax/Synopsis

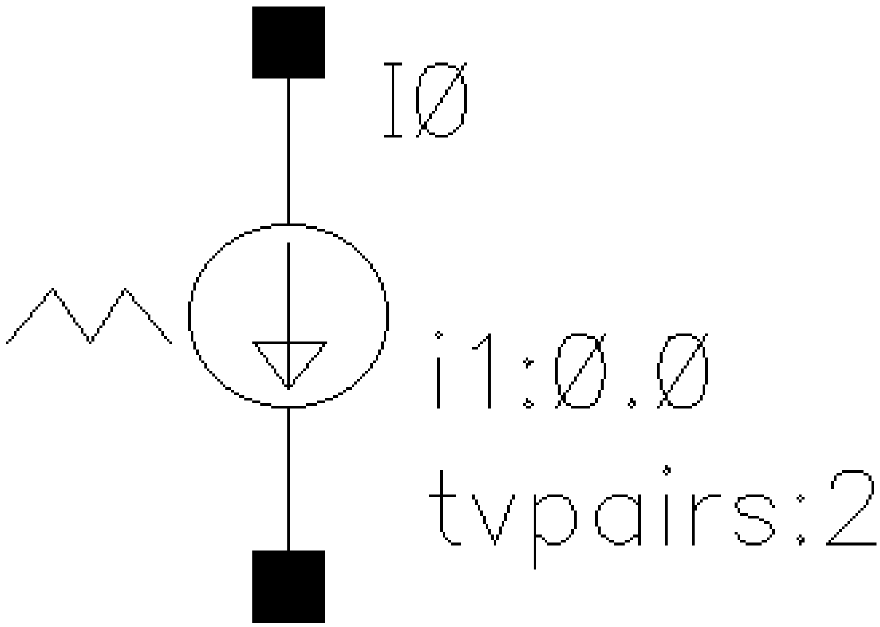
```
Name ( sink src ) isource <parameter=value> ...
```

Positive current exits the source node and enters the sink node.

Examples

```
i1 (in 0) isource dc=0 type=pulse delay=10n val0=0 val1=500u period=500n
rise=1n fall=1n width=250n
```

ipwl Symbol



Description

The component `ipwl` stands for Independent Piece-Wise Linear Current Source in Source-Independent category. This device is supported within the altergroups.

Command-Line Help

```
spectre -h isource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Number of pairs of points	`tvpairs`	x	-	-	x	x
AC magnitude	`acm`	x	-	-	x	x

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC phase	`acp`	x	-	-	x	x
DC current	`idc`	x	-	-		
Time 1	`t1 - t50`	x	-	-	x	x
Current 1	`i1 - i50`	x	-	-	x	x
Frequency name for 1/period	`fundname`	x	-	-	-	-
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-
PAC magnitude	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-
Multiplier	`m`	x	-	-	x	x
Delay time	`td`	x	-	-	x	x
Offset current	`io`	x	-	-	-	-
Scale factor	`scale`	x	-	-	-	-
Time scale factor	`stretch`	x	-	-	-	-
Period of the PWL	`pwlperiod`	x	-	-	-	-
Transition width	`twidth`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-
DC source	`dc`	-	-	-	x	x
Repeated function	`rpt`	-	-	-	x	x
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Source type	`srcType`	x	-	-	-	-
Type of rising & falling edge	`risefalledge`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Delay Time	`delay`	x	-	-	-	-
Transition width	`twidth`	x	-	-	-	-

Syntax/Synopsis

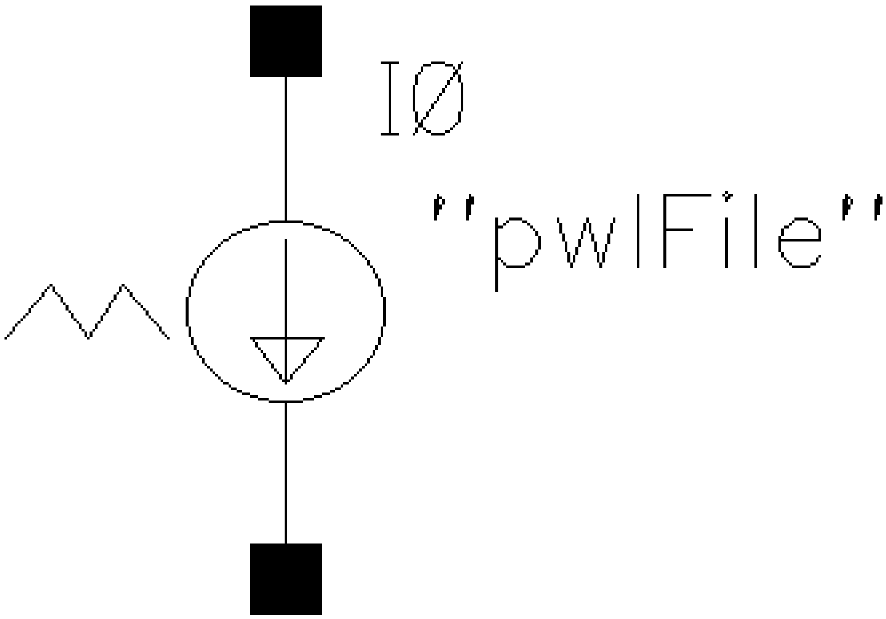
```
Name ( sink src ) isource <parameter=value> ...
```

Positive current exits the source node and enters the sink node.

Examples

```
i1 (in 0) isource dc=0 type=pulse delay=10n val0=0 val1=500u period=500n
rise=1n fall=1n width=250n
```

ipwlf Symbol

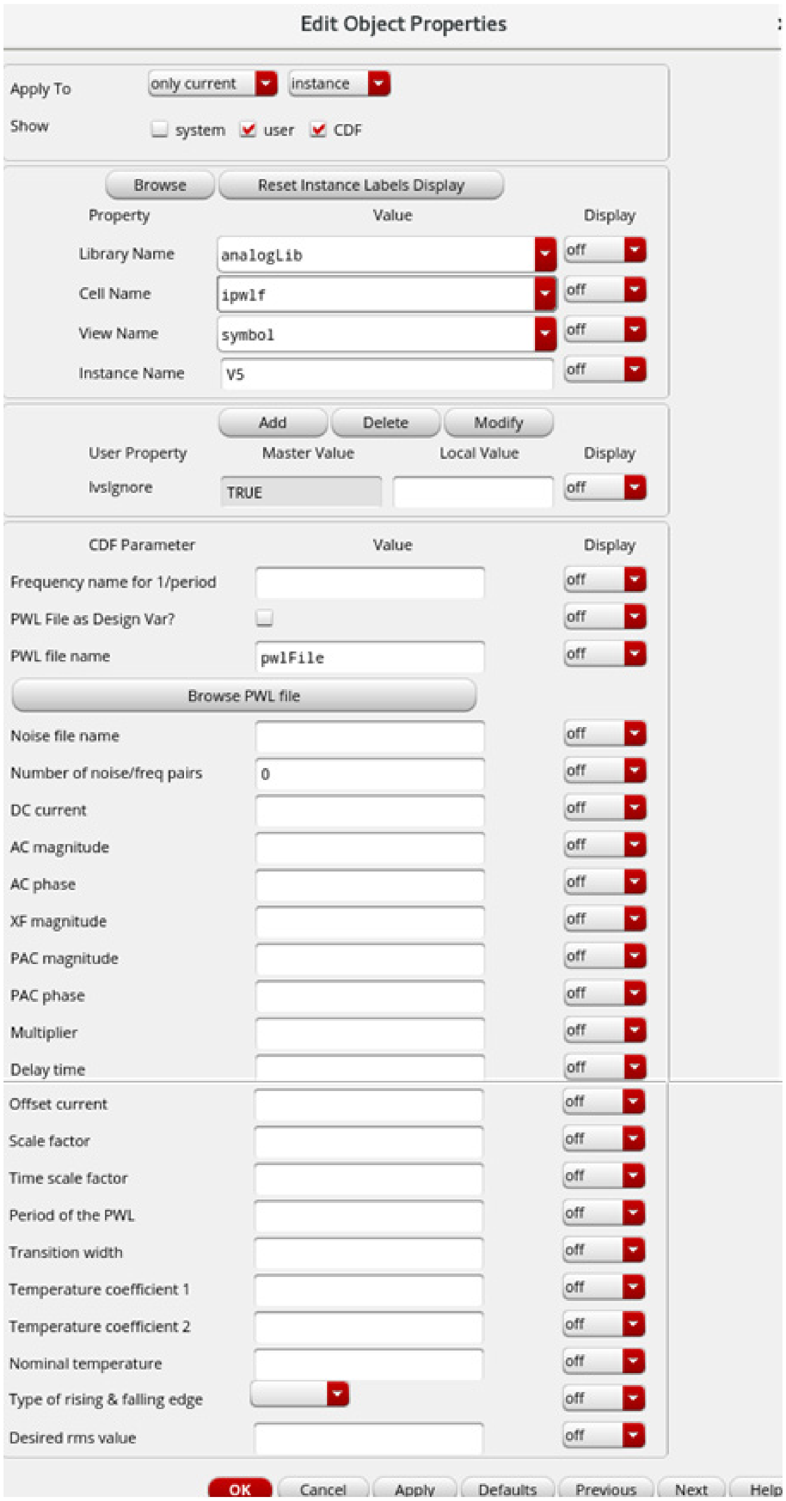


Description

The component `ipwlf` stands for Independent Piece-Wise Current Source in Source-Independent category. This device is supported within the altergroups.

To select the PWL file:

1. Select `analogLib` from the *Library Name* field, `ipwlf` from the *Cell Name* field, and `symbol` from the *View Name* field in the Edit Object Properties form.
2. Click the *Browse PWL file* button to select the PWL file or specify the path to the PWL file in the *PWL file name* field.
3. [Optional] Select the *PWL file as Design Var?* check box to specify the name of the design variable in the *PWL file name* field.


Edit Object Properties
Apply To
only current
instance
Show
system
user
CDF
Browse
Reset Instance Labels Display
Property
Value
Display
Library Name
analogLib
off
Cell Name
ipwlf
off
View Name
symbol
off
Instance Name
V5
off
Add
Delete
Modify
User Property
Master Value
Local Value
Display
lvsIgnore
TRUE
off
CDF Parameter
Value
Display
Frequency name for 1/period
off
PWL File as Design Var?
off
PWL file name
pwlFile
off
Browse PWL file
Noise file name
off
Number of noise/freq pairs
0
off
DC current
off
AC magnitude
off
AC phase
off
XF magnitude
off
PAC magnitude
off
PAC phase
off
Multiplier
off
Delay time
off
Offset current
off
Scale factor
off
Time scale factor
off
Period of the PWL
off
Transition width
off
Temperature coefficient 1
off
Temperature coefficient 2
off
Nominal temperature
off
Type of rising & falling edge
off
Desired rms value
off
OK
Cancel
Apply
Defaults
Previous
Next
Help

Command-Line Help

```
spectre -h isource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	`acm`	x	-	-	x	-
AC phase	`acp`	x	-	-	x	-
DC current	`idc`	x	-	-	x	-
PWL file name	`fileName`	x	-	-	x	-
Frequency name for 1/period	`fundname`	x	-	-	-	-
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-
PAC magnitude	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Delay time	`td`	x	-	-	-	-
Offset current	`io`	x	-	-	-	-
Scale factor	`scale`	x	-	-	-	-
Time scale factor	`stretch`	x	-	-	-	-
Period of the PWL	`pwlperiod`	x	-	-	-	-
Transition width	`twidth`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Source type	`srcType`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Type of rising & falling edge	`risefalledge`	x	-	-	-	-
Delay Time	`delay`	x	-	-	-	-
PWL File as Design Var?	`pwl_file_as_var`	x	-	-	-	-
Desired rms value	`rmsValue`	x	-	-	-	-

Syntax/Synopsis

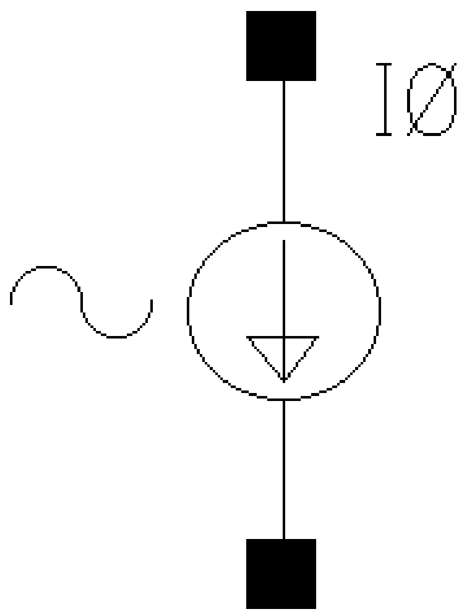
```
Name ( sink src ) isource <parameter=value> ...
```

Positive current exits the source node and enters the sink node.

Examples

```
i1 (in 0) isource dc=0 type=pulse delay=10n val0=0 val1=500u period=500n
rise=1n fall=1n width=250n
```

isin Symbol



Description

The component `isin` stands for Independent Sinusoidal Current Source in Source-Independent category. It is a sin wave isource. This device is supported within the altergroups.

Command-Line Help

```
spectre -h isource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	`acm`	x	-	-	x	x
AC phase	`acp`	x	-	-	x	x
DC current	`idc`	x	-	-		
Offset current	`io`	x	-	-	x	x
Amplitude	`ia`	x	-	-	x	x
Frequency	`freq`	x	-	-	x	x
Delay time	`td`	x	-	-	x	x
Damping factor	`theta`	x	-	-	x	x
First frequency name	`fundname`	x	-	-	-	-
Second frequency name	`fundname2`	x	-	-	-	-
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
Number of FM files	`filenums`	x	-	-	-	-
Name of FM File1	`fmmodfile1`	x	-	-	-	-
Name of FM File2	`fmmodfile2`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-
PAC magnitude	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-
Multiplier	`m`	x	-	-	x	x
Initial phase for Sinusoid	`sinephase`	x	-	-	-	-
Amplitude 2	`ia2`	x	-	-	-	-
Initial phase for Sinusoid 2	`sinephase2`	x	-	-	-	-
Frequency 2	`freq2`	x	-	-	-	-
FM modulation index	`fmmodindex`	x	-	-	-	-
FM modulation frequency	`fmmodfreq`	x	-	-	-	-
AM modulation index	`ammodindex`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AM modulation frequency	`ammodfreq`	x	-	-	-	-
AM modulation phase	`ammodphase`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-
DC source	`dc`	-	-	-	x	x
Phase delay	`phi`	-	-	-	x	x
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Delay Time	`delay`	x	-	-	-	-
Sine DC level	`sinedc`	x	-	-	-	-

Syntax/Synopsis

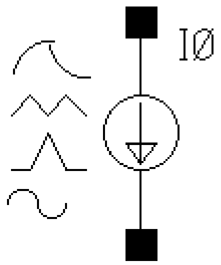
```
Name ( sink src ) isource <parameter=value> ...
```

Positive current exits the source node and enters the sink node.

Examples

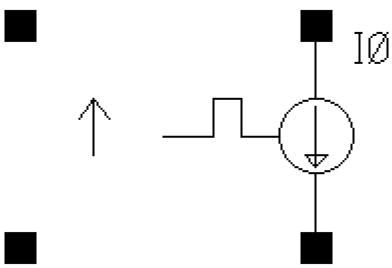
```
i1 (in 0) isource dc=0 type=pulse delay=10n val0=0 val1=500u period=500n
rise=1n fall=1n width=250n
```

isource Symbol



Description

If *Source type* = `prbs`, and *Trigger* = `External rising edge`, `External falling edge`, or `External both edges`, two extra ports are added to the isource symbol as shown below:



You can specify the wave shape for isource by selecting one of the following options from the *Source type* drop-down list box in the Edit Object Properties form:

- *dc* – Generates a dc level from isource. When the Source type is set to dc, the dc and temperature effect parameters are active. The dc setting sets the DC level for all analyses.
- *sine* – Generates sinusoidal waveforms.

  Up to two sinusoids can be generated simultaneously. They are denoted as 1 and 2. You can set the amplitude, frequency, and phase for both individually. The amplitude can be set to either a current or a power level. When you set a power level, the assumption is that the isource is perfectly matched. The source that is internal to isource gets double the amplitude specified by the power in `dBm`. You can also specify sinusoidal AM or FM modulation of sinusoid 1. Sinusoid 2 cannot be modulated.
- *pulse* – Generates a step, a single pulse, or a periodic pulse waveform.

When you specify the current, you are specifying the current when isource is properly terminated, and not the current on the internal current source. Therefore, the current on the internal source is set to twice the value specified on the component.

- *exp* – Generates an exponential waveform. The exponential waveform can generate one exponential pulse, and cannot generate a periodic signal.

  When you specify the current, you are specifying the current when isource is properly terminated, and not the current on the internal current source. Thus, the current on the internal source is set to twice the value specified on isource.

- *pwl* – Generates piecewise linear waveforms that allow an arbitrary input waveform to be generated.

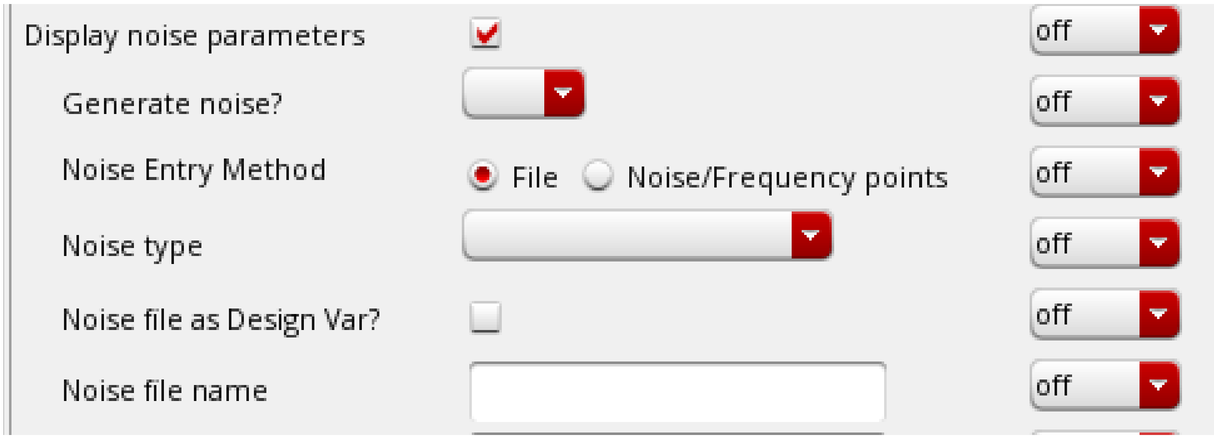
  The input can either be a file that contains time and current pairs, or you can enter the time-current pairs directly in the PWL source properties form. Remember that the current you enter in the piecewise linear file assumes that the isource is properly terminated. The internal current source gets set to double the value specified in the piecewise linear current specifications.

- *bit* – Generates bit sequence or string from isource. The bit source has four states: 1, 0, m, and z, which represent the high, low, middle current, and high-impedance state respectively. It allows patterns defining a sequence of bits.

- *prbs* – PRBS is an acronym for Pseudo-Random Binary Sequence. This source has three modes. It can be used to generate a maximum-length pseudo-random sequence. You can specify the beginning state and tap gains for a Fibonacci PRBS generator. A third mode allows reading an ASCII file that describes the sequence of one and zero events to generate.

Note: The symbol `ibit` is the same as `isource type=bit`.

If you select the *Display noise parameters* check box in the Edit Object Properties form, the *Noise file as Design Var?* check box is displayed. You can select this check box to specify the noise file as a design variable in the *Noise file name* field.



For more information on the available source types, see the section *Source type* in AnalogLib Components Used in RF Simulation.

This device is supported within the altergroups.

Independent Current Source

The value of the DC current as a function of the temperature is given by:

```
I(T) = I(tnom) * [1 + tc1 * (T - tnom) + tc2 * (T - tnom)^2].
```

Command-Line Help

```
spectre -h isource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
DC current	`idc`	x	-	-	x	x
Source type	`srcType`	x	-	-	x	-
Frequency name 1	`fundname`	x	-	-	-	-
Frequency 1	`freq`	x	-	-	x	x
Amplitude 1 (Ipk)	`ia`	x	-	-	x	x
Amplitude 2(Ipk)	`ia2`	x	-	-	x	x
Phase for Sinusoid 1	`sinephase`	x	-	-	-	-
Sine DC level	`sinedc`	x	-	-	x	-
Sinusoid Ampl 1 (Ipk) to Sinusoid Ampl 9 (Ipk)	`vav1 - vav9`	x	-	-	-	-
File name	`fileName`	x	-	-	x	-
Browse and select file	`selectFile`	x	-	-	x	-
Number of PWL/Time pair	`tvpairs`	x	-	-	x	-
Time 1	`t1 - t50`	x	-	-	x	-
Current 1	`i1 - i50`	x	-	-	x	-
Delay time	`td`	x	-	-	-	x
Type of rising & falling edge	`risefalledge`	x	-	-	x	-
Rise time start	`td1`	x	-	-	x	-
Rise time constant	`tau1`	x	-	-	x	-
Fall time start	`td2`	x	-	-	x	-
Fall time constant	`tau2`	x	-	-	x	-
DC offset	`offset`	x	-	-	-	-
Amplitude scale factor	`scale`	x	-	-	-	-
Time scale factor	`stretch`	x	-	-	-	-
Breakpoints	`allbrkpts`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Period	`pwlperiod`	x	-	-	x	-
Period start time	`pwlperiodstart`	x	-	-	x	-
Transition width	`twidth`	x	-	-	-	-
Period of waveform	`per`	x	-	-	x	-
Display second sinusoid	`numofsines`	x	-	-	-	-
FM modulation index 1	`fmmodindex`	x	-	-	x	-
FM modulation freq 1	`fmmodfreq`	x	-	-	x	-
AM modulation index 1	`ammodindex`	x	-	-	x	-
AM modulation freq 1	`ammodfreq`	x	-	-	x	-
AM modulation phase 1	`ammodphase`	x	-	-	-	-
Damping factor 1	`theta`	x	-	-	x	-
Display small signal params	`smallSig`	x	-	-	x	-
PAC Magnitude (Ipk)	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-
AC Magnitude (Ipk)	`acm`	x	-	-	x	-
AC phase	`acp`	x	-	-	x	-
XF Magnitude (Ipk)	`xfm`	x	-	-	-	-
Display noise parameters	`noiseParam`	x	-	-	-	-
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Display modulation params	`modulation`	x	-	-	x	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Display temperature params	`tempParam`	x	-	-	-	-
Linear temp. coefficient	`tc1`	x	-	-	-	-
Quadratic temp. coeff.	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-
Transition reference	`transitionreference`	x	-	-	-	-
Multiplier	`m`	x	-	-	x	x
DC source	`dc`	-	-	-	x	x
Phase delay	`phi`	-	-	-	x	x
Number of FM files	`filenums`	x	-	-	-	-
Name of FM File1	`fmmodfile1`	x	-	-	-	-
Name of FM File2	`fmmodfile2`	x	-	-	-	-
Reference Value	`ref`	x	-	-	-	-
Remove Device	`lxRemoveDevice`	-	x	-	-	-
RJ(seed)	`rjseed`	x	-	-	-	-
RJ(rms)	`rjrms`	x	-	-	-	-
PJ(amplitude)	`pjamp`	x	-	-	-	-
PJ(frequency)	`pjfreq`	x	-	-	-	-
PJ(type)	`pjtype`	x	-	-	-	-
PAM modulation	`pam4_modulation`	x	-	-	-	-
PAM4 mapping	`pam4_mapping`	x	-	-	-	-
Threshold	`triggerthreshold`	x	-	-	-	-
High-Z impedance	`highz`	x	-	-	-	-
Min high-Z trans. width	`min_z_transition_width`	x	-	-	-	-
Z state 1 to Z state 50	`Z1 - Z50`	x	-	-	-	-

For HspiceD, parameter `pwlperiod` is supported under the following conditions:

- In case `pwlperiod` is specified and `pwlperiodstart` is not specified, then another current-time pair must be added, where time = `pwlperiod` and current is the same as the current in the last current-time pair.
- But, if the value specified for `pwlperiod` is the same as the time specified in the last current-time pair, then no additional current-time pair is required.
- In case both `pwlperiod` and `pwlperiodstart` are specified, then another current-time pair must be added, where time = (`pwlperiod + pwlperiodstart`) and current is the same as the current in the last current-time pair.

Syntax/Synopsis

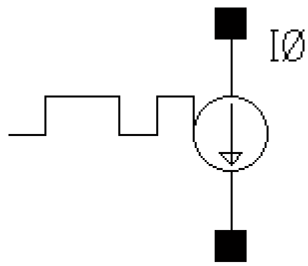
```
Name ( sink src [ctl] ) isource <parameter=value> ...
```

Positive current exits the source node and enters the sink node. The third node(ctl) is used as a switch only for prbs.

Examples

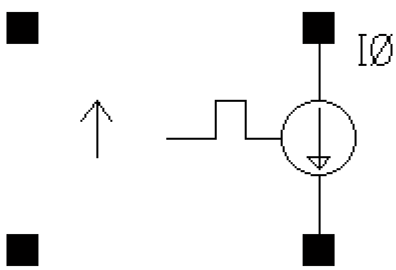
```
i1 (in 0) isource dc=0 type=pulse delay=10n val0=0 val1=500u period=500n
rise=1n fall=1n width=250n
```

iprbs Symbol



Description

If *Trigger* = `External rising edge`, `External falling edge`, or `External both edges`, two extra ports are added to the iprbs symbol as shown below:



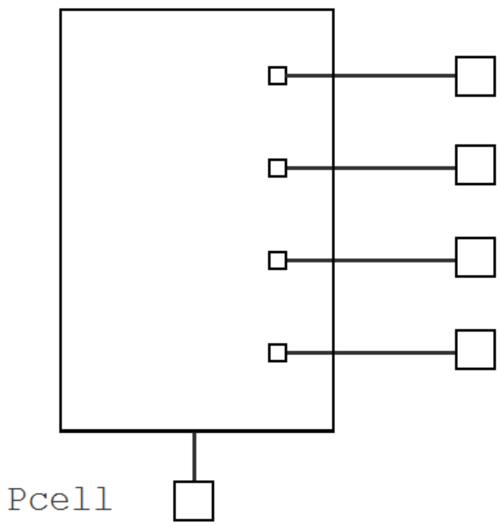
Command-Line Help

```
spectre -h isource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Bit string	`data`	x	-	-	-	-	-	-	-
Final value for logical 1	`val1`	x	-	-	-	-	-	-	-
Final value for logical 0	`val0`	x	-	-	-	-	-	-	-
Delay time	`delay`	x	-	-	-	-	-	-	-
Rise time	`rise`	x	-	-	-	-	-	-	-
Fall time	`fall`	x	-	-	-	-	-	-	-
Period of waveform	`period`	x	-	-	-	-	-	-	-
Reference Value	`ref`	x	-	-	-	-	-	-	-
Waveform Random Delay Time	`jitter`	x	-	-	-	-	-	-	-
Generates Random Count	`seed`	x	-	-	-	-	-	-	-
Bit	`taps`	x	-	-	-	-	-	-	-

multibit Symbol



Description

The component, `multibit` is a `Pcell`, which allows you to provide a DC stimulus for a bus having multiple bits. The number of bits, the bit pattern, logic high, and logic low voltages can be selected as parameters. The `Pcell` also supports scalar (single bit) as well as bus outputs. The multibit device does not support more than `32` bits.

Examples

For instance `I0`, the netlist as follows:

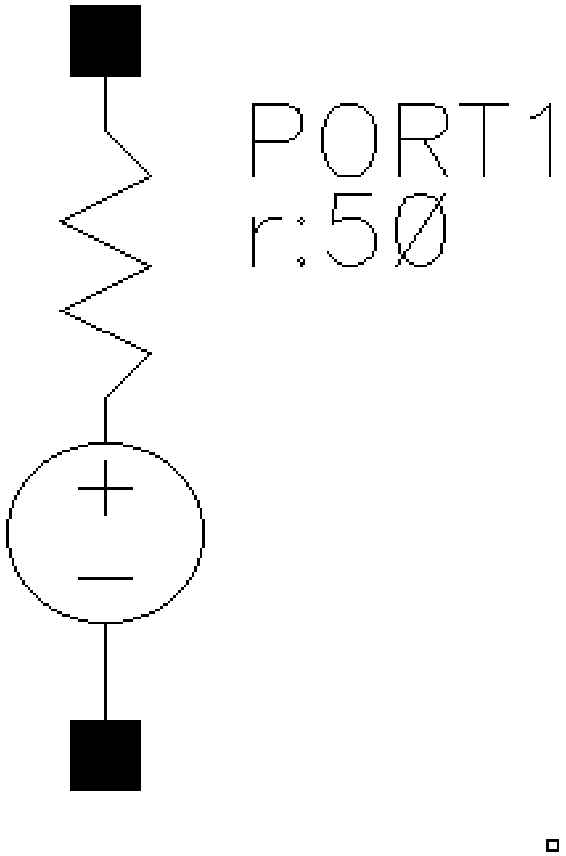
```
// Library name: analogLib
// Cell name: multibit
// View name: schematic
subckt multibit_pcell_0 a0 a1 a2 a3 ref
parameters a3=fmod(int((0)/8),2) vbit1=1 vbit0=0 a2=fmod(int((0)/4),2) \
        a1=fmod(int((0)/2),2) a0=fmod(int((0)/1),2)
    V3 (a3 ref) vsource dc=a3 > 0 ? vbit1 : vbit0 type=dc
    V2 (a2 ref) vsource dc=a2 > 0 ? vbit1 : vbit0 type=dc
    V1 (a1 ref) vsource dc=a1 > 0 ? vbit1 : vbit0 type=dc
    V0 (a0 ref) vsource dc=a0 > 0 ? vbit1 : vbit0 type=dc
ends multibit_pcell_0
// End of subcircuit definition.
```

```
// Library name: InhConn
// Cell name: test
// View name: schematic
I0 (net5 net4 net3 net2 net1) multibit_pcell_0 a3=fmod(int((0)/8),2) \
        vbit1=1 vbit0=0 a2=fmod(int((0)/4),2) a1=fmod(int((0)/2),2) \
        a0=fmod(int((0)/1),2)
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Input Mode	mode1	x	-	-	-	x
Number of Bits	numbits	x	-	-	-	x
Expand Bus	expand	x	-	-	-	x
Bit Pattern(MSB...LSB)	pattern	x	-	-	-	x
Decimal Value	dec	x	-	-	-	x
Bit 1 voltage level	vbit1	x	-	-	-	x
Bit 0 voltage level	vbit0	x	-	-	-	x

pdc Symbol



Description

The component, `pdc` is an independent DC Resistive Source. When Source Type = `dc`, the dc and temperature effect parameters are active and set the DC level for all analyses. The DC voltage sets the DC level of the source for DC analysis. The value must be a real number. If you do not specify the DC value, it is assumed to be the time = `0` value of the waveform.

The DC voltage parameter specifies the DC voltage across the port when it is terminated in its reference resistance. In other words, the DC voltage of the internal voltage source is double the user specified DC value, dc. The same is true for the values for the transient, AC, and PAC signals of the port.

This device is not supported within the altergroups.

For more information on this component refer to The PORT Element.

Command-Line Help

```
spectre -h port
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Resistance	`r`	x	-	-	-	-
Port number	`num`	x	-	-	-	-
DC voltage	`vdc`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-
AC magnitude	`acm`	x	-	-	-	-
AC phase	`acp`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-
PAC magnitude	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Source type	`srcType`	x	-	-	-	-

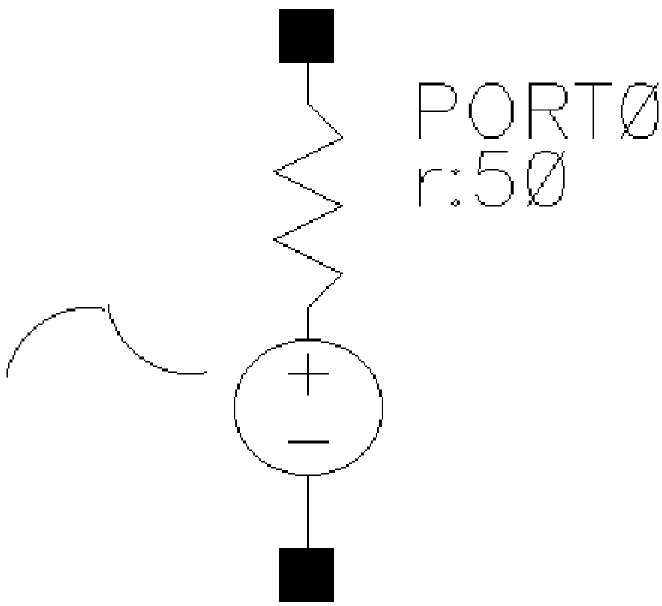
Syntax/Synopsis

```
Name ( p n ) port <parameter=value> ...
```

Examples

```
p20 (2 0) port num=2 r=50 type=pulse period=1e-9 rise=1e-10 fall=1e-10 val1=1
width=0.5n mag=1
```

pexp Symbol



Description

The component, `pexp` is an Independent Exponential Resistive Source. For more information on this component refer to The PORT Element. This device is not supported within the altergroups.

Command-Line help

```
spectre -h port
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Resistance	`r`	x	-	-	-	-
Port number	`num`	x	-	-	-	-
DC voltage	`vdc`	x	-	-	-	-
Delay time	`td`	x	-	-	-	-
Delay time 1	`td1`	x	-	-	-	-
Damping factor 1	`tau1`	x	-	-	-	-
Delay time 2	`td2`	x	-	-	-	-
Damping factor 2	`tau2`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	acm	x	-	-	-	-
AC phase	acp	x	-	-	-	-
XF magnitude	xfm	x	-	-	-	-
PAC magnitude	pacm	x	-	-	-	-
PAC phase	pacp	x	-	-	-	-
Source type	srcType	x	-	-	-	-

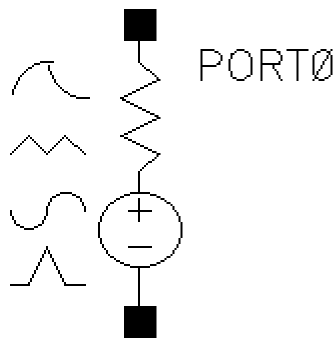
Syntax/Synopsis

```
Name ( p n ) port <parameter=value> ...
```

Examples

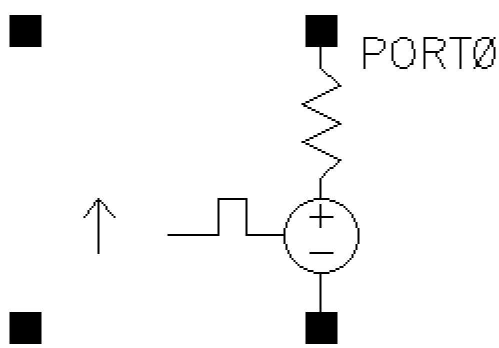
```
p20 (2 0) port num=2 r=50 type=pulse period=1e-9 rise=1e-10 fall=1e-10 val1=1
width=0.5n mag=1
```

port Symbol



Description

If *Source type* = `prbs`, and *Trigger* = `External rising edge`, `External falling edge`, or `External both edges`, two extra ports are added to the port symbol as shown below:



You can specify the wave shape for the port by selecting one of the following options from the *Source type* drop-down list box in the Edit Object Properties form:

- *dc*—Generates a dc level from the port. When the Source type is set to dc, the dc and temperature effect parameters are active. The dc setting sets the DC level for all analyses.
- *sine*—Generates sinusoidal waveforms.

  Up to two sinusoids can be generated simultaneously. They are denoted as 1 and 2. You can set the amplitude, frequency, and phase for both individually. The amplitude can be set to either a voltage or a power level. When you set a power level, the assumption is that the port is perfectly matched. The source that is internal to the port gets double the amplitude specified by the power in `dBm`. You can also specify sinusoidal AM or FM modulation of sinusoid 1. Sinusoid 2 cannot be modulated.

- *pulse*—Generates a step, a single pulse, or a periodic pulse waveform.

  When you specify the voltage, you are specifying the voltage when the port is properly terminated, and not the voltage on the internal voltage source. Therefore, the voltage on the internal source is set to twice the value specified on the component.

- *exp*—Generates an exponential waveform. The exponential waveform can generate one exponential pulse, and cannot generate a periodic signal.

  When you specify the voltage, you are specifying the voltage when the port is properly terminated, and not the voltage on the internal voltage source. Thus, the voltage on the internal source is set to twice the value specified on the port.

- *pwl*—Generates piecewise linear waveforms that allow an arbitrary input waveform to be generated.

  The input can either be a file that contains time and voltage pairs, or you can enter the time-voltage pairs directly in the PWL source properties form. Remember that the voltages you enter in the piecewise linear file assumes that the port is properly terminated. The internal voltage source gets set to double the value specified in the piecewise linear voltage specifications.

- *pwlz*—Generates piecewise linear waveforms that allow an arbitrary input waveform to be generated. This source type resembles the pwl source type, except that some voltage values can be replaced by the high-impedance state. In addition to voltage-time pairs supported by pwl, pwlz also supports z-state in the waveform. When z-state is active, the voltage source is disconnected from the node and it is put in high-impedance state.

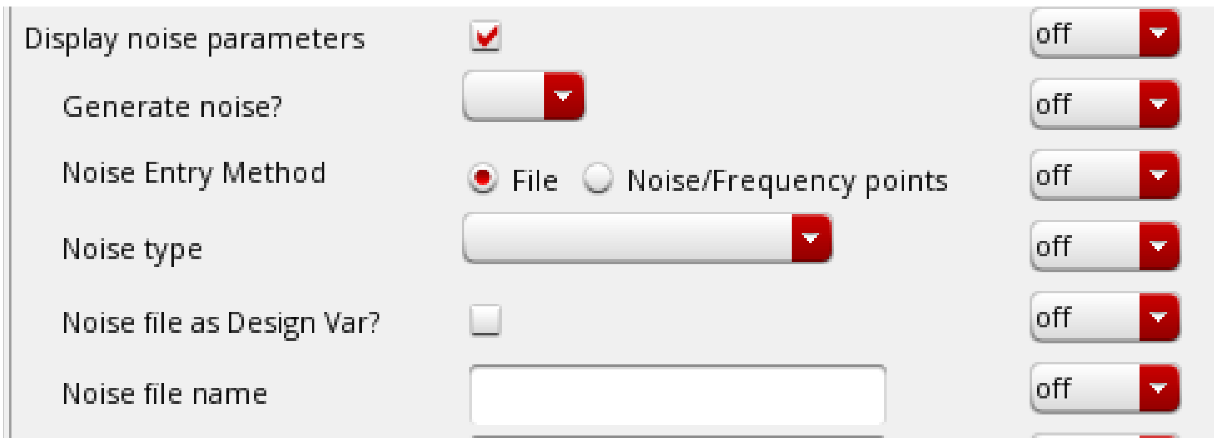
- *bit*—Generates bit sequence or string from the port. The bit source has four states: 1, 0, m, and z, which represent the high, low, middle voltage, and high impedance state respectively. It allows patterns defining a sequence of bits. When the m state is specified, the output voltage is set halfway between `0` state and `1` state voltages.

- *prbs*—PRBS is an acronym for Pseudo-Random Binary Sequence. This source has three modes. It can be used to generate a maximum-length pseudo-random sequence. You can specify the beginning state and tap gains for a Fibonacci PRBS generator. A third mode allows reading an ASCII file that describes the sequence of one and zero events to generate.

If you select the *Display noise parameters* check box in the Edit Object Properties form, the *Noise file as Design Var?* check box is displayed. You can select this check box to specify the noise file as a design variable in the *Noise file name* field.

Power of PWL waveform (`pwldbm`) is an alternative to *Amplitude scale factor* (`scale`). Use `pwldbm` to specify the rms power for the waveform and spectre automatically calculates the correct scale factor.

If `pwldbm` is specified, it overwrites the `scale` parameter.



For more information on the available source types, see the section *Source type* in the chapter AnalogLib Components Used in RF Simulation.

For more information on this component refer to The Port Element.

Command-Line Help

```
spectre -h port
```

Component Parameters

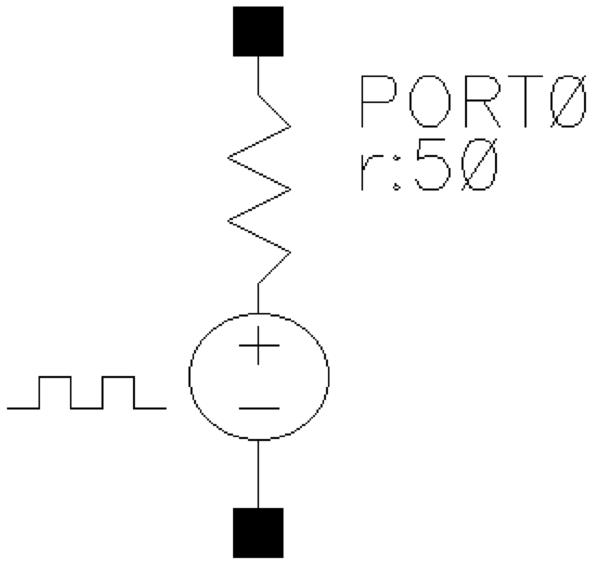
CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Resistance	`r`	x	-	-	-	-
Reactance	`x`	x	-	-	-	-
Port number	`num`	x	-	-	-	-
DC voltage	`vdc`	x	-	-	-	-
Source type	`srcType`	x	-	-	-	-
Frequency name 1	`fundname`	x	-	-	-	-
Frequency 1	`freq`	x	-	-	-	-
Amplitude 1 (Vpk)	`va`	x	-	-	-	-
PAC Magnitude (Vpk)	`pacm`	x	-	-	x	-
Amplitude 1 (dBm)	`vaDBm`	x	-	-	-	-
Phase for Sinusoid 1	`sinephase`	x	-	-	-	-
Sine DC level	`sinedc`	x	-	-	-	-
PJ(amplitude)	`pjamp`	x	-	-	-	-
PJ(frequency)	`pjfreq`	x	-	-	-	-
PJ(type)	`pjtype`	x	-	-	-	-
RJ(rms)	`rjrms`	x	-	-	-	-
RJ(seed)	`rjseed`	x	-	-	-	-
Number of PWL/Time pair	`tvpairs`	x	-	-	-	-
Time 1	`t1 - t50`	x	-	-	-	-
Voltage 1	`v1 - v50`	x	-	-	-	-
FM modulation index	`fmmodindex`	x	-	-	-	-
FM modulation frequency	`fmmodfreq`	x	-	-	-	-
AC Magnitude (Vpk)	`acm`	x	-	-	-	-
AM modulation index	`ammodindex`	x	-	-	-	-
AM modulation frequency	`ammodfreq`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AM modulation phase	`ammodphase`	x	-	-	-	-
Delay time	`td`	x	-	-	-	-
Amplitude scale factor	`scale`	x	-	-	-	-
Power of PWL waveform	`pwldbm`	x	-	-	-	-
Display second sinusoid	`numofsines`	x	-	-	-	-
Display modulation params	`modulation`	x	-	-	-	-
Display small signal params	`smallSig`	x	-	-	-	-
Display temperature params	`tempParam`	x	-	-	-	-
Display noise parameters	`noiseParam`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Number of FM files	`filenums`	x	-	-	-	-
Name of FM File1	`fmmodfile1`	x	-	-	-	-
Name of FM File2	`fmmodfile2`	x	-	-	-	-
High-Z impedance	`highz`	x	-	-	-	-
Min high-Z trans. width	`min_z_transition_width`	x	-	-	-	-
PAM modulation	`pam4_modulation`	x	-	-	-	-
PAM4 mapping	`pam4_mapping`	x	-	-	-	-
Sinusoid Ampl 1 (Vpk) to Sinusoid Ampl 9 (Vpk)	`vav1 - vav9`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
XF Magnitude (Vpk)	`xfm`	x	-	-	-	-
Z state 1 to Z state 50	`Z1 - Z50`	x	-	-	-	-

For more information on the jitter parameters: `pjamp`, `pjfreq`, `pjtype`, `rjrms`, and `rjseed` refer to Independent Current Source (isource) section in Spectre® Circuit Simulator Components and Device Models Reference

ppulse Symbol



Description

The component, ppulse is an independent resistive pulse source. For more information on this component refer to Appendix H of the The PORT Element.

Command-Line Help

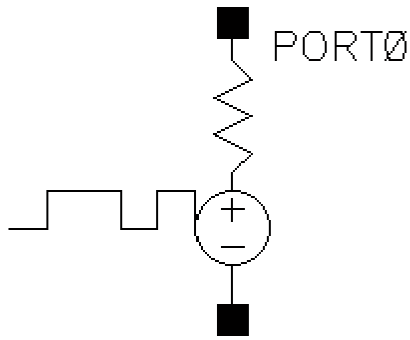
```
spectre -h port
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Frequency name for 1/period	`fundname`	x	-	-	-	-
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/ freq pairs	`FNpairs`	x	-	-	-	-

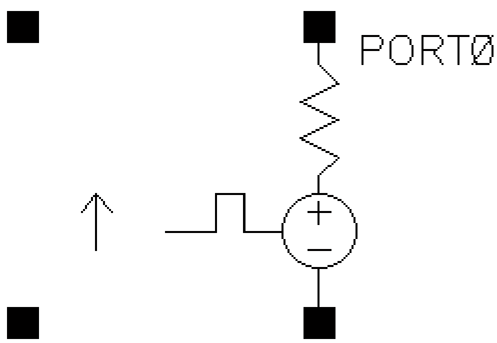
CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Delay Time	`delay`	x	-	-	-	-
Resistance	`r`	x	-	-	-	-
Port number	`num`	x	-	-	-	-
DC voltage	`vdc`	x	-	-	-	-
Delay time	`td`	x	-	-	-	-
Voltage 1	`v1`	x	-	-	-	-
Voltage 2	`v2`	x	-	-	-	-
Period	`per`	x	-	-	-	-
Rise time	`tr`	x	-	-	-	-
Fall time	`tf`	x	-	-	-	-
Pulse width	`pw`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-
AC magnitude	`acm`	x	-	-	-	-
AC phase	`acp`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-
PAC magnitude	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-

pprbs Symbol



Description

If *Trigger* = `External rising edge`, `External falling edge`, or `External both edges`, two extra ports are added to the pprbs symbol as shown below:



The component pprbs is an Independent Resistive Pulse Source. For more information on this component refer to Appendix H of the *Spectre Circuit Simulator and Accelerated Parallel Simulator RF Analysis User Guide*.

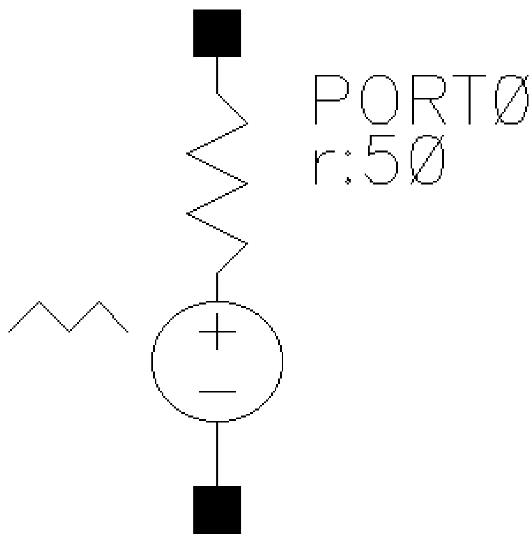
Command-Line Help

```
spectre -h port
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Bit string	data	x	-	-	-	-	-	-	-
Final value for logical 1	val1	x	-	-	-	-	-	-	-
Final value for logical 0	val0	x	-	-	-	-	-	-	-
Delay time	delay	x	-	-	-	-	-	-	-
Rise time	rise	x	-	-	-	-	-	-	-
Fall time	fall	x	-	-	-	-	-	-	-
Period of waveform	period	x	-	-	-	-	-	-	-
Resistance	r	x	-	-	-	-	-	-	-
Reference Value	ref	x	-	-	-	-	-	-	-
Waveform Random Delay Time	jitter	x	-	-	-	-	-	-	-
Generates Random Count	seed	x	-	-	-	-	-	-	-
Bit	taps	x	-	-	-	-	-	-	-
Multiplier	m	x	-	-	-	-	-	-	-
Port number	num	x	-	-	-	-	-	-	-

ppwl Symbol



Description

The component ppwl is an independent piece-wise linear resistive source. For more information on this component refer to Appendix H of the The PORT Element

Command-Line Help

```
spectre -h port
```

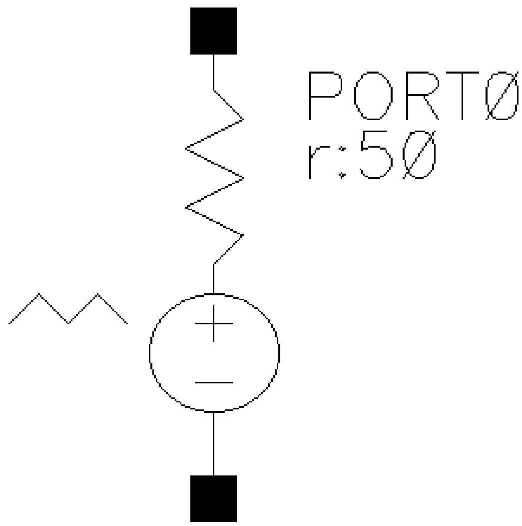
Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Frequency name for 1/period	`fundname`	x	-	-	-	-
Noise file name	`noisefile`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Number of pairs of points	`tvpairs`	x	-	-	-	-
Time 1	`t1 - t50`	x	-	-	-	-
Voltage 1	`v1 - v50`	x	-	-	-	-
Resistance	`r`	x	-	-	-	-
Port number	`num`	x	-	-	-	-
DC voltage	`vdc`	x	-	-	-	-
Delay time	`td`	x	-	-	-	-
Offset Voltage	`vo`	x	-	-	-	-
Scale factor	`scale`	x	-	-	-	-
Time scale factor	`stretch`	x	-	-	-	-
All are breakpoints	`allbrkpts`	x	-	-	-	-
Period of the PWL	`pwlperiod`	x	-	-	-	-
Transition width	`twidth`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Nominal temperature	`tnom`	x	-	-	-	-
AC magnitude	`acm`	x	-	-	-	-
AC phase	`acp`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-
PAC magnitude	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-
Source type	`srcType`	x	-	-	-	-

ppwlf Symbol



Description

The component `ppwlf` is a p-type source independent component which stands for Piece-Wise Linear Resistive source based on File.

For more information on this component refer to Appendix H of the The PORT Element.

Command-Line Help

```
spectre -h port
```

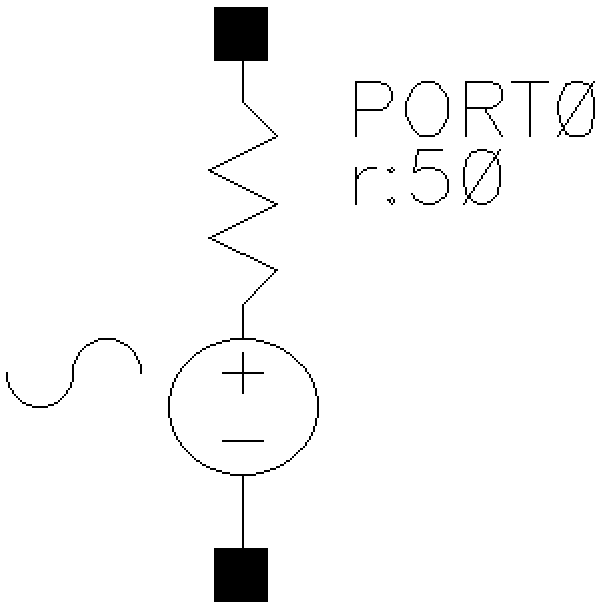
Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Frequency name for 1/period	`fundname`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Resistance	`r`	x	-	-	-	-
Port number	`num`	x	-	-	-	-
DC voltage	`vdc`	x	-	-	-	-
Delay time	`td`	x	-	-	-	-
Offset voltage	`vo`	x	-	-	-	-
Scale factor	`scale`	x	-	-	-	-
Time scale factor	`stretch`	x	-	-	-	-
All are breakpoints	`allbrkpts`	x	-	-	-	-
Period of the PWL	`pwlperiod`	x	-	-	-	-
Transition width	`twidth`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	`acm`	x	-	-	-	-
AC phase	`acp`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-
PAC magnitude	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-
Source type	`srcType`	x	-	-	-	-

psin Symbol



Description

The Independent Sinusoidal Resistive Source (`psin`) is used in all RF circuits for `SpectreRF` and `Spectre S-parameter` simulations. When you netlist `psin` in the analog design environment using the Spectre simulator, you can see that `psin` is the port component in the Spectre simulation. A port is a resistive source that is tied between positive and negative terminals. It is equivalent to a voltage source in series with a resistor, and the reference resistance of the port is the value of the resistor.

For more information on this component refer to The PORT Element.

Command-Line help

```
spectre -h port
```

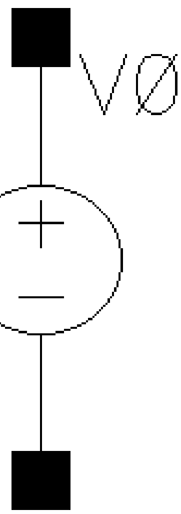
Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Frequency name	`fundname`	x	-	-	-	-
Second frequency name	`fundname2`	x	-	-	-	-
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
Number of FM files	`filenums`	x	-	-	-	-
Name of FM File1	`fmmodfile1`	x	-	-	-	-
Name of FM File2	`fmmodfile2`	x	-	-	-	-
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Resistance	`r`	x	-	-	-	-
Port number	`num`	x	-	-	-	-
DC voltage	`vdc`	x	-	-	-	-
Source type	`srcType`	x	-	-	-	-
Delay time	`td`	x	-	-	-	-
Sine DC level	`sinedc`	x	-	-	-	-
Amplitude	`va`	x	-	-	-	-
Amplitude (dBm)	`vaDBm`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Initial phase for Sinusoid	`sinephase`	x	-	-	-	-
Frequency	`freq`	x	-	-	-	-
Amplitude 2 (Vpk)	`va2`	x	-	-	-	-
Amplitude 2 (dBm)	`vaDBm2`	x	-	-	-	-
Initial phase for Sinusoid 2	`sinephase2`	x	-	-	-	-
Frequency 2	`freq2`	x	-	-	-	-
FM modulation index	`fmmodindex`	x	-	-	-	-
FM modulation frequency	`fmmodfreq`	x	-	-	-	-
AM modulation index	`ammodindex`	x	-	-	-	-
AM modulation frequency	`ammodfreq`	x	-	-	-	-
AM modulation phase	`ammodphase`	x	-	-	-	-
Damping factor	`theta`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Nominal temperature	`tnom`	x	-	-	-	-
Noise temperature	`noisetemp`	x	-	-	-	-
AC magnitude	`acm`	x	-	-	-	-
AC phase	`acp`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-
PAC magnitude	`pacm`	x	-	-	-	-
PAC magnitude (dBm)	`pacmDBm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-

vdc Symbol



Description

The component Independent Voltage Source (`vdc`) is a constant vsource. This device is supported within the altergroups.

Command-Line Help

```
spectre -h vsource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	`acm`	x	-	-	x	x
AC phase	`acp`	x	-	-	x	x
DC voltage	`vdc`	x	-	-	x	x
Noise file name	`noiseFile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-
PAC magnitude	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-
Source type	`srcType`	x	-	-	-	-
AC Phase	`acPhase`	x	-	-	-	-

Syntax/Synopsis

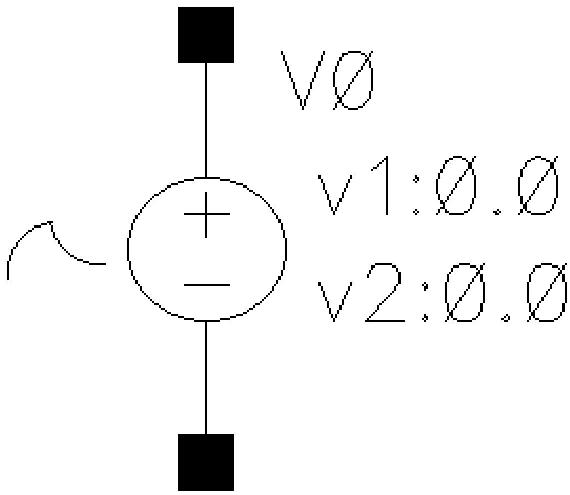
```
Name ( p n ) vsource <parameter=value> ...
```

Examples

```
vpulse1 (1 0) vsource type=pulse val0=0 val1=5 period=100n rise=10n fall=10n
width=40n
```

```
vpwl1 (1 0) vsource type=pwl wave=[1n 0 1.1n 2 1.5n 0.5 2n 3 5n 5] pwlperiod=5n
```

vexp Symbol



Description

The component, Independent Exponential Voltage Source (`vexp`) is an exponential vsource. This device is supported within the altergroups.

Command-Line help

```
spectre -h vsource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	`acm`	x	-	-	x	x
AC phase	`acp`	x	-	-	x	x
DC voltage	`vdc`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Voltage 1	v1	x	-	-	x	x
Voltage 2	v2	x	-	-	x	x
Delay time 1	td1	x	-	-	x	x
Damping factor 1	tau1	x	-	-	x	x
Delay time 2	td2	x	-	-	x	x
Damping factor 2	tau2	x	-	-	x	x
Noise file name	noisefile	x	-	-	-	-
Number of noise/freq pairs	FNpairs	x	-	-	-	-
XF magnitude	xfm	x	-	-	-	-
PAC magnitude	pacm	x	-	-	-	-
PAC phase	pacp	x	-	-	-	-
Delay time	td	x	-	-	-	-
Temperature coefficient 1	tc1	x	-	-	-	-
Temperature coefficient 2	tc2	x	-	-	-	-
Nominal temperature	tnom	x	-	-	-	-
DC source	dc	-	-	-	x	x
Freq 1 to Freq 50	F1 - F50	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Delay Time	`delay`	x	-	-	-	-
Source type	`srcType`	x	-	-	-	-

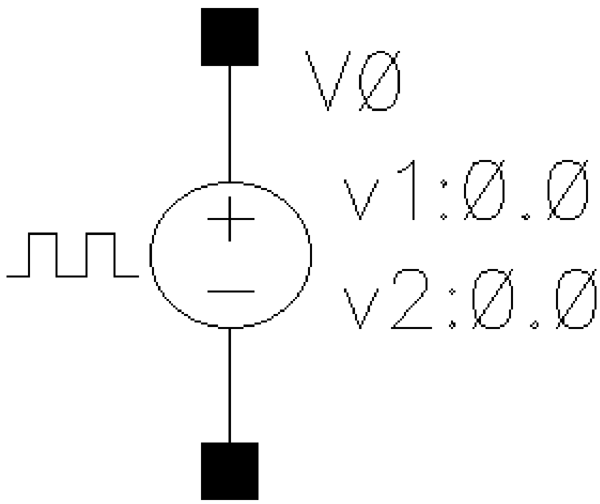
Syntax/Synopsis

```
Name ( p n ) vsource <parameter=value> ...
```

Examples

```
vpulse1 (1 0) vsource type=pulse val0=0 val1=5 period=100n rise=10n fall=10n
width=40n
vpwl1 (1 0) vsource type=pwl wave=[1n 0 1.1n 2 1.5n 0.5 2n 3 5n 5] pwlperiod=5n
```

vpulse Symbol



Description

The component Independent Pulse Voltage Source (`vpulse`) is a square wave varying vsource. This device is supported within the altergroups.

Command-Line Help

```
spectre -h vsource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	acm	x	-	-	x	x
AC phase	acp	x	-	-	x	x
DC voltage	vdc	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Voltage 1	v1	x	-	-	x	x
Voltage 2	v2	x	-	-	x	x
Delay time	td	x	-	-	x	x
Type of rising & falling edge	risefalledge	x	-	-	-	-
Rise time	tr	x	-	-	x	x
Fall time	tf	x	-	-	x	x
Pulse width	pw	x	-	-	x	x
Period	per	x	-	-	x	x
Frequency name for 1/period	fundname	x	-	-	-	-
Noise file name	noisefile	x	-	-	-	-
Number of noise/freq pairs	FNpairs	x	-	-	-	-
Freq 1 to Freq 50	F1 - F50	x	-	-	-	-
Noise 1 to Noise 50	N1 - N50	x	-	-	-	-
XF magnitude	xfm	x	-	-	-	-
PAC magnitude	pacm	x	-	-	-	-
PAC phase	pacp	x	-	-	-	-
Temperature coefficient 1	tc1	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Temperature coefficient 2	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-
DC source	`dc`	-	-	-	x	x
Source type	`srcType`	x	-	-	-	-
Delay Time	`delay`	x	-	-	-	-

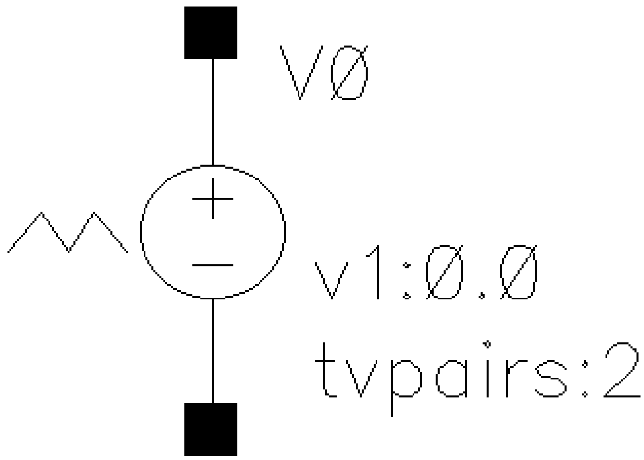
Syntax/Synopsis

```
Name ( p n ) vsource <parameter=value> ...
```

Examples

```
vpulse1 (1 0) vsource type=pulse val0=0 val1=5 period=100n rise=10n fall=10n
width=40n
vpwl1 (1 0) vsource type=pwl wave=[1n 0 1.1n 2 1.5n 0.5 2n 3 5n 5] pwlperiod=5n
```

vpwl Symbol



Description

The component Independent Piece-Wise Linear Voltage Source (`vpwl`) is a piece-wise linear vsource.

Command-Line Help

```
spectre -h vsource
```

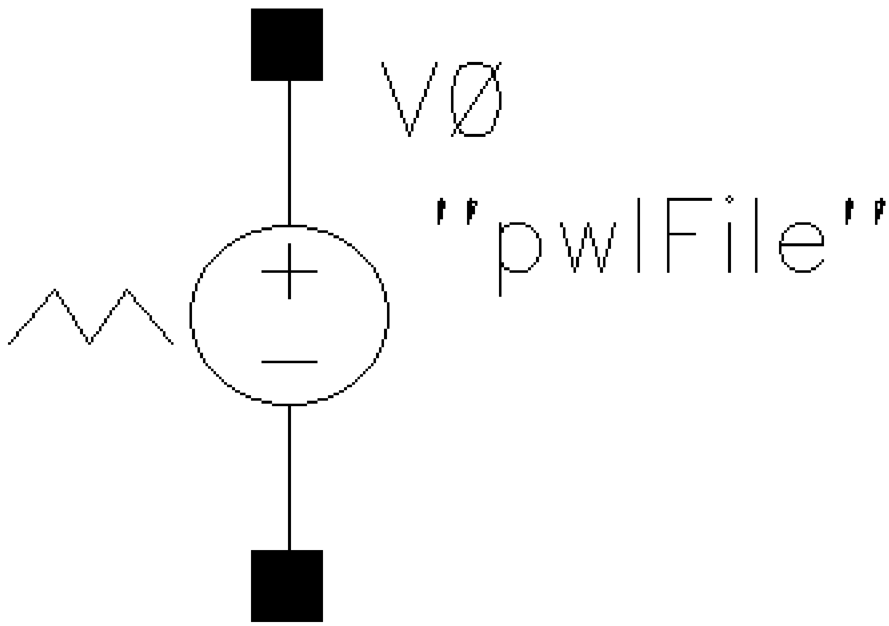
Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Number of pairs of points	`tvpairs`	x	-	-	x	x
AC magnitude	`acm`	x	-	-	x	x
AC phase	`acp`	x	-	-	x	x

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
DC voltage	`vdc`	x	-	-	-	-
Time 1	`t1 - t50`	x	-	-	x	x
Voltage 1	`v1 - v50`	x	-	-	x	x
Frequency name for 1/period	`fundname`	x	-	-	-	-
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-
PAC magnitude	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-
Delay time	`td`	x	-	-	x	x
Type of rising & falling edge	`edgetype`	x	-	-	-	-
Offset voltage	`vo`	x	-	-	-	-
Scale factor	`scale`	x	-	-	-	-
Time scale factor	`stretch`	x	-	-	-	-
Period of the PWL	`pwlperiod`	x	-	-	-	-
Transition width	`twidth`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Temperature coefficient 2	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-
DC source	`dc`	-	-	-	x	x
Repeated function	`rpt`	-	-	-	x	x
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Delay Time	`delay`	x	-	-	-	-
Source type	`srcType`	x	-	-	-	-
Abstime	`abstime`	x	-	-	-	-

vpwlf Symbol



Description

The component (`vpwlf`) stands for Independent Piece-Wise Linear Voltage Source Based on File.

To select the PWL file:

1. Select `analogLib` from the *Library Name* field, `vpwlf` from the *Cell Name* field, and `symbol` from the *View Name* field in the Edit Object Properties form.
2. Click the *Browse PWL file* button to select the PWL file or specify the path to the PWL file in the *PWL file name* field.

3. [Optional] Select the *PWL file as Design Var?* check box to specify the name of the design variable in the *PWL file name* field.

Command-Line help

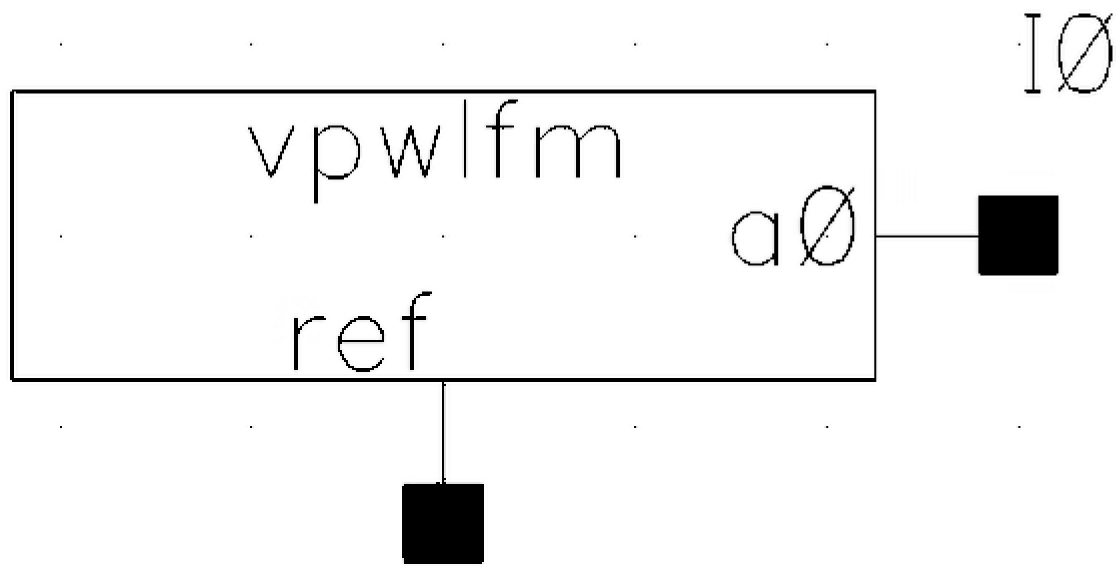
```
spectre -h vsource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	`acm`	x	-	-	x	-
AC phase	`acp`	x	-	-	x	-
DC voltage	`vdc`	x	-	-	x	-
PWL file name	`fileName`	x	-	-	x	-
Frequency name for 1/period	`fundname`	x	-	-	-	-
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-
PAC magnitude	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-
Delay time	`td`	x	-	-	-	-
Type of rising & falling edge	`edgetype`	x	-	-	-	-
Offset voltage	`vo`	x	-	-	-	-
Scale factor	`scale`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Time scale factor	stretch	x	-	-	-	-
Period of the PWL	pwlperiod	x	-	-	-	-
Transition width	twidth	x	-	-	-	-
Temperature coefficient 1	tc1	x	-	-	-	-
Temperature coefficient 2	tc2	x	-	-	-	-
Nominal temperature	tnom	x	-	-	-	-
Freq 1 to Freq 50	F1 - F50	x	-	-	-	-
Noise 1 to Noise 50	N1 - N50	x	-	-	-	-
Delay Time	delay	x	-	-	-	-
Source type	srcType	x	-	-	-	-
PWL File as Design Var?	pwl_file_as_var	x	-	-	-	-
Desired rms value	rmsValue	x	-	-	-	-
Cosine Filter	cosineFilter	x	-	-	-	-
Abstime	abstime	x	-	-	-	-
vcsv Signal Name	vcsv	x	-	-	-	-

vpwlfm Symbol



Description

The component (`vpwlfm`) stands for Independent Piece-Wise Linear Voltage Source Based on File for multiple signals.

To load the signals:

- Select `vpwlfm` from the *Cell* field in the Add Instance form.
- Click *Browse PWL file* to select the PWL file or specify the path to the PWL file in the *PWL file name* field.
- Click *Select Signals From PWL File* to load the signals from the PWL file or specify the name of the signals in the *Signal names* field.

You can use semicolon (`;`) to specify multiple signals in the *Signal names* field. For example: `signal1;signal2;signal3`.

Note: The `vpwlfm` symbol supports only the VCSV file extension. The VCSV file contains multiple PWL signals and the numbers of pins are changed dynamically with respect to number of signals.

Command-Line Help

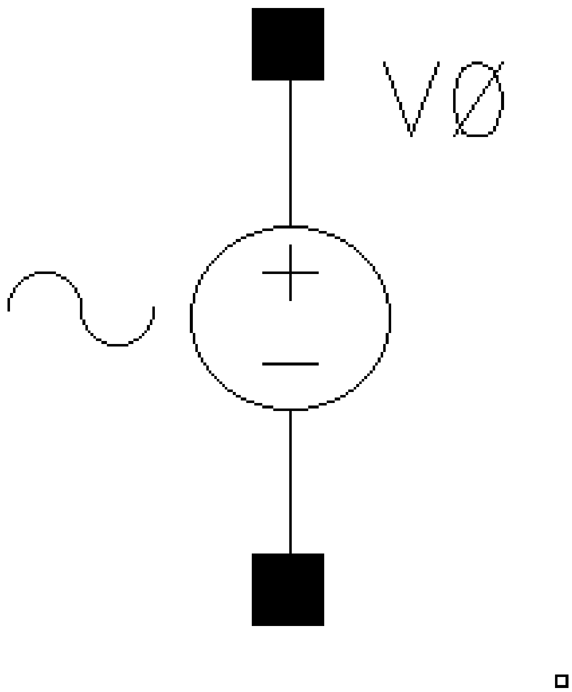
```
spectre -h vsource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Frequency	`freq`	x	-	-	-	-
PWL file name	`fileName`	x	-	-	-	-
Signal names	`signalNames`	x	-	-	-	-
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
DC voltage	`vdc`	x	-	-	-	-
AC magnitude	`acm`	x	-	-	-	-
AC phase	`acp`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-
PAC magnitude	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-
Delay time	`td`	x	-	-	-	-
Offset voltage	`vo`	x	-	-	-	-
Scale factor	`scale`	x	-	-	-	-
Time scale factor	`stretch`	x	-	-	-	-
Period of the PWL	`pwlperiod`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Transition width	`twidth`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-
Type of rising & falling edge	`edgetype`	x	-	-	-	-
Desired rms value	`rmsValue`	x	-	-	-	-
Cosine Filter	`cosineFilter`	x	-	-	-	-
Abstime	`abstime`	x	-	-	-	-

vsin Symbol



Description

The component Independent Sinusoidal Voltage Source (`vsin`) is a sin wave vsource. This device is supported within the altergroups.

Command-Line Help

```
spectre -h vsource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	`acm`	x	-	-	x	x
AC phase	`acp`	x	-	-	x	x
DC voltage	`vdc`	x	-	-	-	-
Offset voltage	`vo`	x	-	-	x	x
Amplitude	`va`	x	-	-	x	x
Frequency	`freq`	x	-	-	x	x
Delay time	`td`	x	-	-	x	x
Damping factor	`theta`	x	-	-	x	x
First frequency name	`fundname`	x	-	-	-	-
Second frequency name	`fundname2`	x	-	-	-	-
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
Number of FM files	`filenums`	x	-	-	-	-
Name of FM File1	`fmmodfile1`	x	-	-	-	-
Name of FM File2	`fmmodfile2`	x	-	-	-	-
XF magnitude	`xfm`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
PAC magnitude	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-
Initial phase for Sinusoid	`sinephase`	x	-	-	-	-
Amplitude 2 (Vpk)	`va2`	x	-	-	-	-
Initial phase for Sinusoid 2	`sinephase2`	x	-	-	-	-
Frequency 2	`freq2`	x	-	-	-	-
FM modulation index	`fmmodindex`	x	-	-	-	-
FM modulation frequency	`fmmodfreq`	x	-	-	-	-
AM modulation index	`ammodindex`	x	-	-	-	-
AM modulation frequency	`ammodfreq`	x	-	-	-	-
AM modulation phase	`ammodphase`	x	-	-	-	-
Temperature coefficient 1	`tc1`	x	-	-	-	-
Temperature coefficient 2	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-
DC source	`dc`	-	-	-	x	x

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Phase delay	`phi`	-	-	-	x	x
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Delay Time	`delay`	x	-	-	-	-
Source type	`srcType`	x	-	-	-	-
Sine DC level	`sinedc`	x	-	-	-	-

Syntax/Synopsis

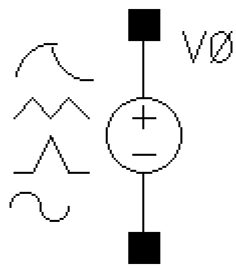
```
Name ( p n ) vsource <parameter=value> ...
```

Examples

```
vpulse1 (1 0) vsource type=pulse val0=0 val1=5 period=100n rise=10n fall=10n
width=40n
```

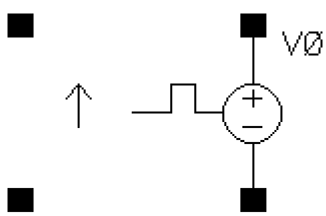
```
vpwl1 (1 0) vsource type=pwl wave=[1n 0 1.1n 2 1.5n 0.5 2n 3 5n 5] pwlperiod=5n
```

vsource Symbol



Description

If *Source type* = `prbs`, and *Trigger* = `External rising edge`, `External falling edge`, or `External both edges`, two extra ports are added to the vsource symbol as shown below:



You can specify the wave shape for vsource by selecting one of the following options from the *Source type* drop-down list box in the Edit Object Properties form:

- *dc*—Generates a dc level from vsource. When the Source type is set to dc, the dc and temperature effect parameters are active. The dc setting sets the DC level for all analyses.
- *sine*—Generates sinusoidal waveforms.

  Up to two sinusoids can be generated simultaneously. They are denoted as 1 and 2. You can set the amplitude, frequency, and phase for both individually. The amplitude can be set to either a voltage or a power level. When you set a power level, the assumption is that the vsource is perfectly matched. The source that is internal to vsource gets double the amplitude specified by the power in `dBm`. You can also specify sinusoidal AM or FM modulation of sinusoid 1. Sinusoid 2 cannot be modulated.
- *pulse*—Generates a step, a single pulse, or a periodic pulse waveform.

When you specify the voltage, you are specifying the voltage when vsource is properly terminated, and not the voltage on the internal voltage source. Therefore, the voltage on the internal source is set to twice the value specified on the component.

- *exp*—Generates an exponential waveform. The exponential waveform can generate one exponential pulse, and cannot generate a periodic signal.

  When you specify the voltage, you are specifying the voltage when vsource is properly terminated, and not the voltage on the internal voltage source. Thus, the voltage on the internal source is set to twice the value specified on vsource.

- *pwl*—Generates piecewise linear waveforms that allow an arbitrary input waveform to be generated.

  The input can either be a file that contains time and voltage pairs, or you can enter the time-voltage pairs directly in the PWL source properties form. Remember that the voltages you enter in the piecewise linear file assumes that the vsource is properly terminated. The internal voltage source gets set to double the value specified in the piecewise linear voltage specifications.

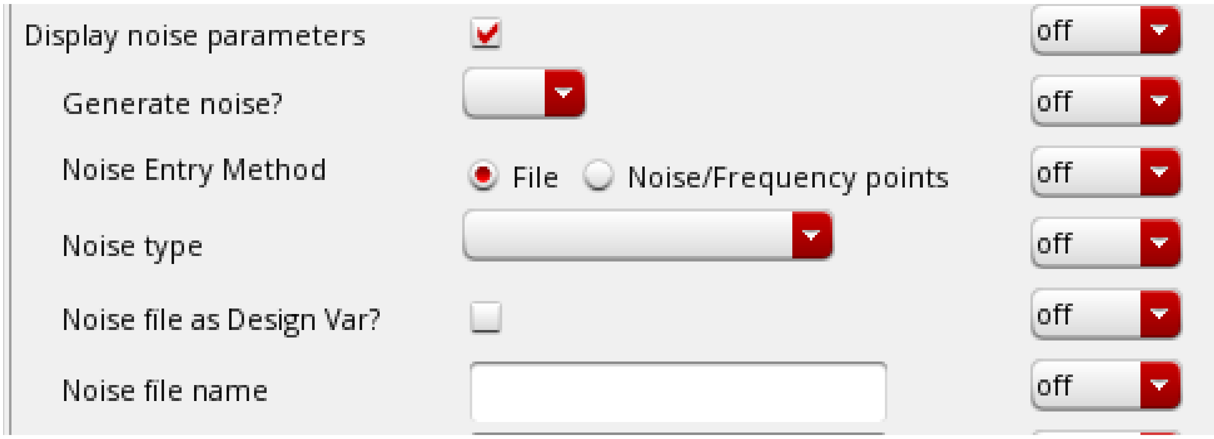
- *pwlz*—Generates piecewise linear waveforms that allow an arbitrary input waveform to be generated. This source type resembles the pwl source type, except that some voltage values can be replaced by the high-impedance state. In addition to voltage-time pairs supported by pwl, pwlz also supports z-state in the waveform. When z-state is active, the voltage source is disconnected from the node and it is put in high-impedance state.

- *bit*—Generates bit sequence or string from vsource. The bit source has four states: `1`, `0`, `m`, and `z`, which represent the high, low, middle voltage, and high impedance state respectively. When the `m` state is specified, the output voltage is set halfway between `0` state and `1` state voltages. This source type lets you create simple or nested patterns defining a sequence of bits.

  Note: Nested patterns are supported only for Spectre.

- *prbs*—PRBS is an acronym for Pseudo-Random Binary Sequence. This source has three modes. It can be used to generate a maximum-length pseudo-random sequence. You can specify the beginning state and tap gains for a Fibonacci PRBS generator. A third mode allows reading an ASCII file that describes the sequence of one and zero events to generate.

If you select the *Display noise parameters* check box in the Edit Object Properties form, the *Noise file as Design Var?* check box is displayed. You can select this check box to specify the noise file as a design variable in the *Noise file name* field.



For more information on the available source types, see the section *Source type* in the chapter <u>AnalogLib Components Used in RF Simulation</u>.

Independent Voltage Source

Current through the source is computed and is defined to be positive if it flows from the positive node, through the source, to the negative node.

The value of the DC voltage as a function of the temperature is given by:

```
V(T) = V(tnom) * [1 + tc1 * (T - tnom) + tc2 * (T - tnom)^2].
```

Command-Line Help

```
spectre -h vsource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
<u>DC voltage</u>	`vdc`	x	-	-	x	-
<u>Source type</u>	`srcType`	x	-	-	x	-
<u>Frequency name 1</u>	`fundname`	x	-	-	-	-
<u>Frequency 1</u>	`freq`	x	-	-	x	x

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Amplitude 1 (Vpk)	`va`	x	-	-	x	x
Phase for Sinusoid 1	`sinephase`	x	-	-	-	-
Sine DC level	`sinedc`	x	-	-	x	-
Browse and select file	`selectFile`	x	-	-	x	-
File name	`fileName`	x	-	-	x	-
Number of PWL/Time pair	`tvpairs`	x	-	-	x	-
Sinusoid Ampl 1 (Vpk) to Sinusoid Ampl 9 (Vpk)	`vav1 - vav9`	x	-	-	-	-
Time 1	`t1 - t50`	x	-	-	x	-
Voltage 1	`v1 - v50`	x	-	-	x	-
Delay time	`td`	x	-	-	x	x
Type of rising & falling edge	`edgetype`	x	-	-	x	-
Pattern Parameter Data	`data`	x	-	-	x	-
Rise time start	`td1`	x	-	-	x	-
Rise time constant	`tau1`	x	-	-	x	-
Fall time start	`td2`	x	-	-	x	-
Fall time constant	`tau2`	x	-	-	x	-
DC offset	`offset`	x	-	-	-	-
Amplitude scale factor	`scale`	x	-	-	-	-
Time scale factor	`stretch`	x	-	-	-	-
Breakpoints	`allbrkpts`	x	-	-	-	-
Period of waveform	`per`	x	-	-	x	-
FM modulation index 1	`fmmodindex`	x	-	-	x	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
FM modulation frequency 1	`fmmodfreq`	x	-	-	x	-
AM modulation index 1	`ammodindex`	x	-	-	x	-
AM modulation frequency 1	`ammodfreq`	x	-	-	x	-
AM modulation phase 1	`ammodphase`	x	-	-	-	-
Display second sinusoid	`numofsines`	x	-	-	-	-
Damping factor 1	`theta`	x	-	-	x	-
Display small signal params	`smallSig`	x	-	-	x	-
PAC Magnitude (Vpk)	`pacm`	x	-	-	-	-
PAC phase	`pacp`	x	-	-	-	-
AC Magnitude (Vpk)	`acm`	x	-	-	x	-
AC phase	`acp`	x	-	-	x	-
XF Magnitude (Vpk)	`xfm`	x	-	-	-	-
Display noise parameters	`noiseParam`	x	-	-	-	-
Noise file name	`noisefile`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Noise 1 to Noise 50	`N1 - N50`	x	-	-	-	-
Display modulation params	`modulation`	x	-	-	x	-
Display temperature params	`tempParam`	x	-	-	-	-

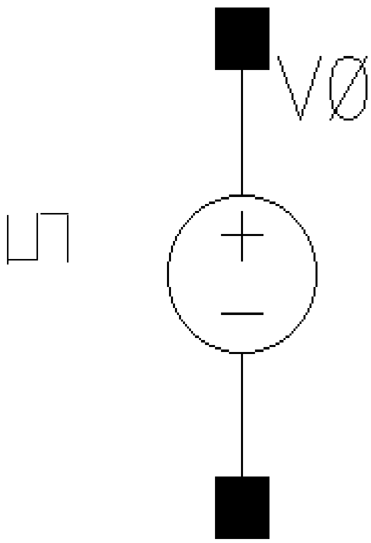
CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Linear temp. coefficient	`tc1`	x	-	-	-	-
Quadratic temp. coeff.	`tc2`	x	-	-	-	-
Nominal temperature	`tnom`	x	-	-	-	-
DC source	`dc`	-	-	-	x	x
Offset voltage	`vo`	-	-	-	x	x
Phase delay	`phi`	-	-	-	x	x
Repeated function	`rpt`	-	-	-	-	x
Period	`pwlperiod`	x	-	-	x	-
PAM modulation	`pam4_modulation`	x	-	-	-	-
PAM4 mapping	`pam4_mapping`	x	-	-	-	-
Period start time	`pwlperiodstart`	x	-	-	x	-
Transition width	`twidth`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-
Delay Time	`delay`	x	-	-	-	-
Number of FM files	`filenums`	x	-	-	-	-
Name of FM File1	`fmmodfile1`	x	-	-	-	-
Name of FM File2	`fmmodfile2`	x	-	-	-	-
Reference Value	`ref`	x	-	-	-	-
Remove Device	`lxRemoveDevice`	-	x	-	-	-
RJ(seed)	`rjseed`	x	-	-	-	-
RJ(rms)	`rjrms`	x	-	-	-	-
PJ(amplitude)	`pjamp`	x	-	-	-	-
PJ(frequency)	`pjfreq`	x	-	-	-	-
PJ(type)	`pjtype`	x	-	-	-	-
Taps	`lfsrtaps`	x	-	-	x	-
Seed	`lfsrseed`	x	-	-	x	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Seed	`seed`	x	-	-	x	-
Transition reference	`transitionreference`	x	-	-	-	-
LFSR Mode	`lfsrmode`	x	-	-	x	-
Threshold	`triggerthreshold`	x	-	-	-	-
Rise Delay	`td01`	x	-	-	x	-
Fall Delay	`td10`	x	-	-	x	-
High-Z impedance	`highz`	x	-	-	-	-
Min high-Z trans. width	`min_z_transition_width`	x	-	-	-	-
Z state 1 to Z state 50	`Z1 - Z50`	x	-	-	-	-

For `HspiceD`, the parameter `pwlperiod` is supported under the following conditions:

- In case `pwlperiod` is specified and `pwlperiodstart` is not specified, then another voltage-time pair must be added, where time = `pwlperiod` and voltage is the same as the voltage in the last voltage-time pair.
- But, if the value specified for `pwlperiod` is the same as the time specified in the last voltage-time pair, then no additional voltage-time pair is required.
- In case both `pwlperiod` and `pwlperiodstart` are specified, then another voltage-time pair must be added, where time = (`pwlperiod + pwlperiodstart`) and voltage is the same as the voltage in the last voltage-time pair.

vbit Symbol



Description

The component `vbit` is an Independent Voltage Source.

Command-Line Help

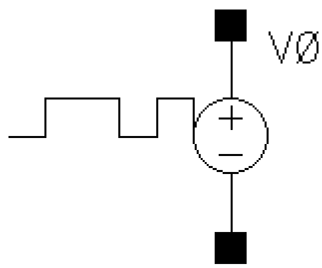
```
spectre -h vsource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Bit string	`data`	x	-	-	-	-	-	-	-
Starting bit when repeating	`rptstart`	x	-	-	-	-	-	-	-
Repeat times	`rpttimes`	x	-	-	-	-	-	-	-

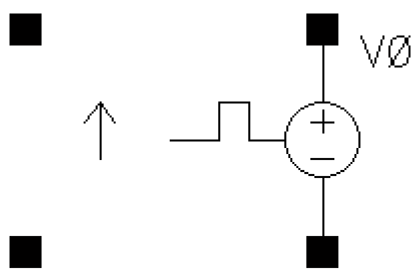
CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Final value for logical 1	`val1`	x	-	-	-	-	-	-	-
Final value for logical 0	`val0`	x	-	-	-	-	-	-	-
Delay time	`delay`	x	-	-	-	-	-	-	x
Rise time	`rise`	x	-	-	-	-	-	-	-
Fall time	`fall`	x	-	-	-	-	-	-	-
Period of waveform	`period`	x	-	-	-	-	-	-	-
Source type	`type`	x	-	-	-	-	-	-	-

vprbs Symbol



Description

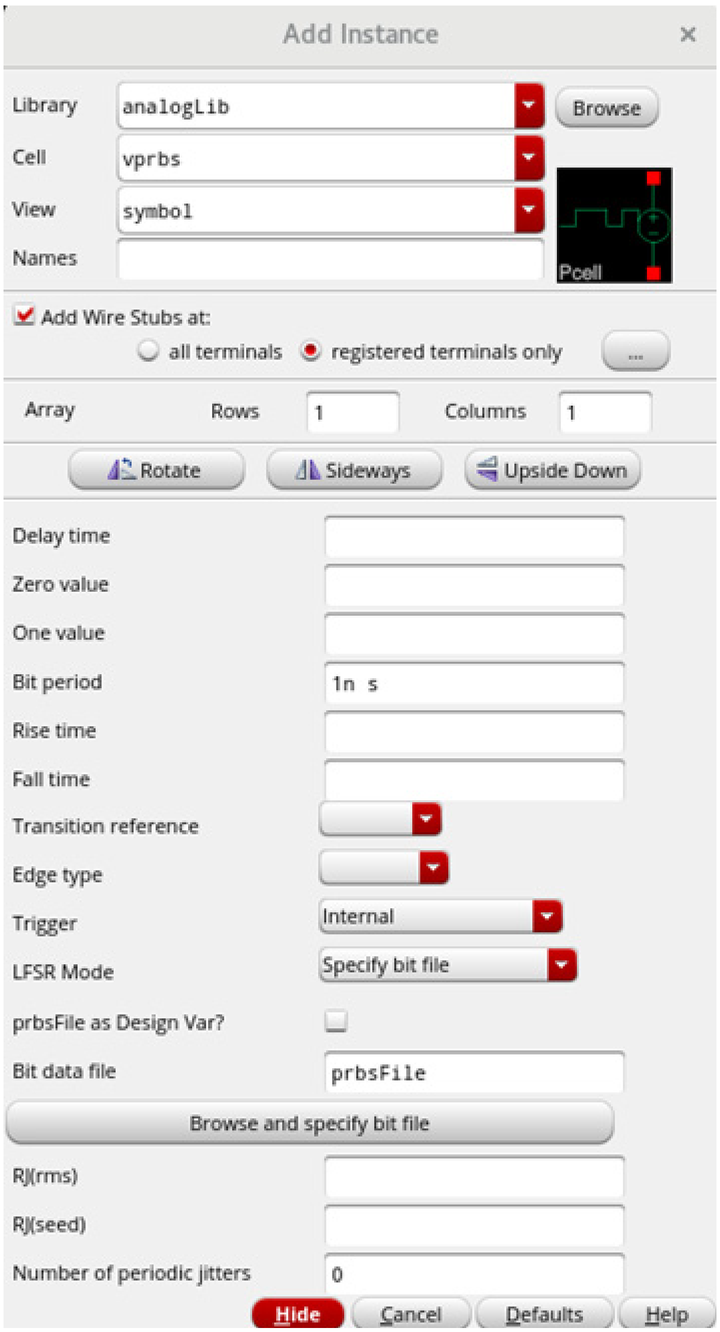
The component, `vprbs` is an independent voltage source. If *Trigger* = `External rising edge`, `External falling edge`, or `External both edges`, two extra ports are added to the vprbs symbol as shown below:



To select the bit file:

1. Select `analogLib` from the *Library* field, `vprbs` from the *Cell* field, and `symbol` from the *View* field in the Add Instances form.
2. Select the `Specify bit file` option from the *LFSR Mode* list.

3. Click the *Browse and specify bit file* button to select the bit file or specify the path to the bit file in the *Bit data file* field.



4. [Optional] Select the *prbsFile as Design var?* check box to specify the name of the design variable in the *Bit data file* field.

Command-Line help

```
spectre -h vsource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Delay time	tdPrbs	x	-	-	-	-	-	-	-
Final value for logical 0	val0	x	-	-	-	-	-	-	-
Final value for logical 1	val1	x	-	-	-	-	-	-	-
Bit Period	perPrbs								
Rise time	rise	x	-	-	-	-	-	-	-
Fall time	fall	x	-	-	-	-	-	-	-
Transition reference	transitionreference	x	-	-	-	-	-	-	-
Edge Type	edgetype								
Trigger	trigger								
LFSR Mode	lfsrmode	x	-	-	x				
RJ(rms)	rjrms	x	-	-	-	-	-	-	
RJ(seed)	rjseed	x	-	-	-	-	-	-	x
Period of waveform	period	x	-	-	-	-	-	-	-
Threshold	triggerthreshold	x	-	-	-	-	-	-	-
prbsFile as Design Var?	prbsFile_as_var	x	-	-	-	-	-	-	-
Bit data file	prbsFile	x	-	-	-	-	-	-	-
Taps	lfsrtaps	x	-	-	-	-	-	-	-

Related Topics

CDF Parameters Supported by Analog Library Components

Ports in Analog Library

Sources - Independent Components

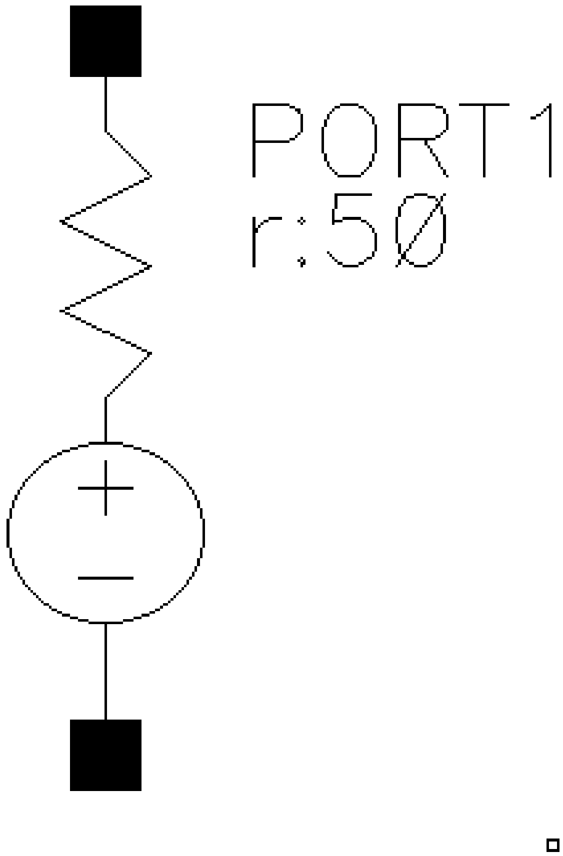
9

Ports in Analog Library

The components in the `Ports` category are as follows:

- pdc Symbol
- pexp Symbol
- port Symbol
- port3t Symbol
- ppulse Symbol
- ppwl Symbol
- ppwlf Symbol
- psin Symbol

pdc Symbol

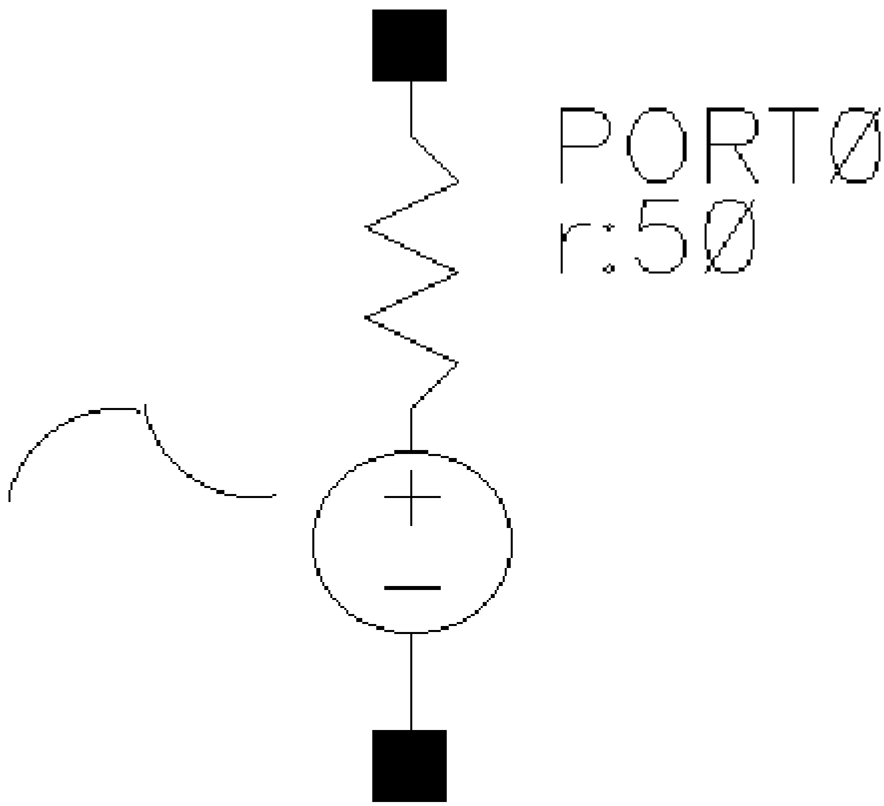


Description

The component pdc is and Independent DC Resistive Source and the same as pdc described in the pdc Symbol.

For more information on ports refer to The PORT Element.

pexp Symbol

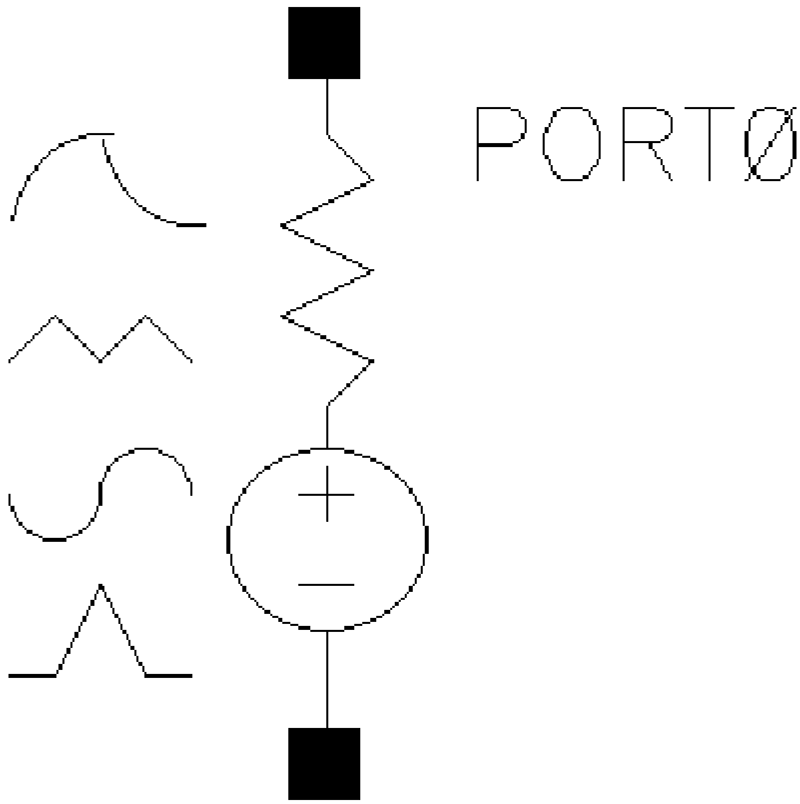


Description

The component pexp is an Independent Exponential Resistive Source and the same as pexp described in the pexp Symbol.

For more information on ports refer to The PORT Element.

port Symbol

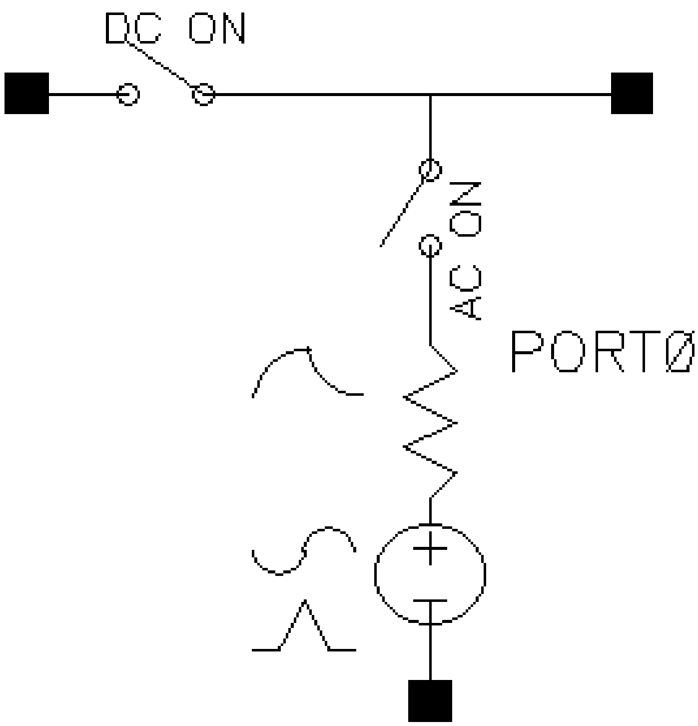


Description

The component port is and Independent Resistive Source and the same as port described in the port Symbol.

For more information on ports refer to The PORT Element.

port3t Symbol



Description

The component port3t is an independent resistive source. You can define a three-terminal independent resistive source with an ideal choke inductor and an ideal blocking capacitor. They work like switches to terminate or connect appropriate branch depending on the type of analysis. This device is not supported within altergroup.

For more information on ports refer to The PORT Element.

Command-Line Help

```
spectre -h port
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Frequency name 1	`fundname`	x	-	-	-	-
Frequency name 2	`fundname2`	x	-	-	-	-
Noise file name	`noisefile`	x	-	-	-	-
File name	`fileName`	x	-	-	-	-
Display second sinusoid	`numofsines`	x	-	-	-	-
Display modulation params	`modulation`	x	-	-	-	-
Display small signal params	`smallSig`	x	-	-	-	-
Display temperature params	`tempParam`	x	-	-	-	-
Display noise parameters	`noiseParam`	x	-	-	-	-
Number of noise/freq pairs	`FNpairs`	x	-	-	-	-
Freq 1 to Freq 50	`F1 - F50`	x	-	-	-	-
Number of PWL/Time pair	`tvpairs`	x	-	-	-	-
Time 1	`t1 - t50`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Voltage 1	`v1 - v50`	x	-	-	-	-
Number of FM files	`filenums`	x	-	-	-	-
Name of FM File1	`fmmodfile1`	x	-	-	-	-
Name of FM File2	`fmmodfile2`	x	-	-	-	-
Resistance	`r`	x	-	-	-	-
Reactance	`x`	x	-	-	-	-
Choke ind for net analyser	`lchock`	x	-	-	-	-
Blocking cap for net analyser	`cblock`	x	-	-	-	-
Port number	`num`	x	-	-	-	-
DC voltage	`vdc`	x	-	-	-	-
Source type	`srcType`	x	-	-	-	-
Delay time	`td`	x	-	-	-	-
Frequency 1	`freq`	x	-	-	-	-
Amplitude 1 (Vpk)	`va`	x	-	-	-	-
Amplitude 1 (dBm)	`vaDBm`	x	-	-	-	-
Phase for Sinusoid 1	`sinephase`	x	-	-	-	-
Sine DC level	`sinedc`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
FM modulation index	fmmodindex	x	-	-	-	-
FM modulation frequency	fmmodfreq	x	-	-	-	-
AM modulation index	ammodindex	x	-	-	-	-
AM modulation frequency	ammodfreq	x	-	-	-	-
AM modulation phase	ammodphase	x	-	-	-	-
PAC magnitude	pacm	x	-	-	-	-
PAC phase	pacp	x	-	-	-	-
Power of PWL waveform	pwldbm	x	-	-	-	-

Syntax/Synopsis

```
Name ( p n [choke]... ) port <parameter=value> ...
```

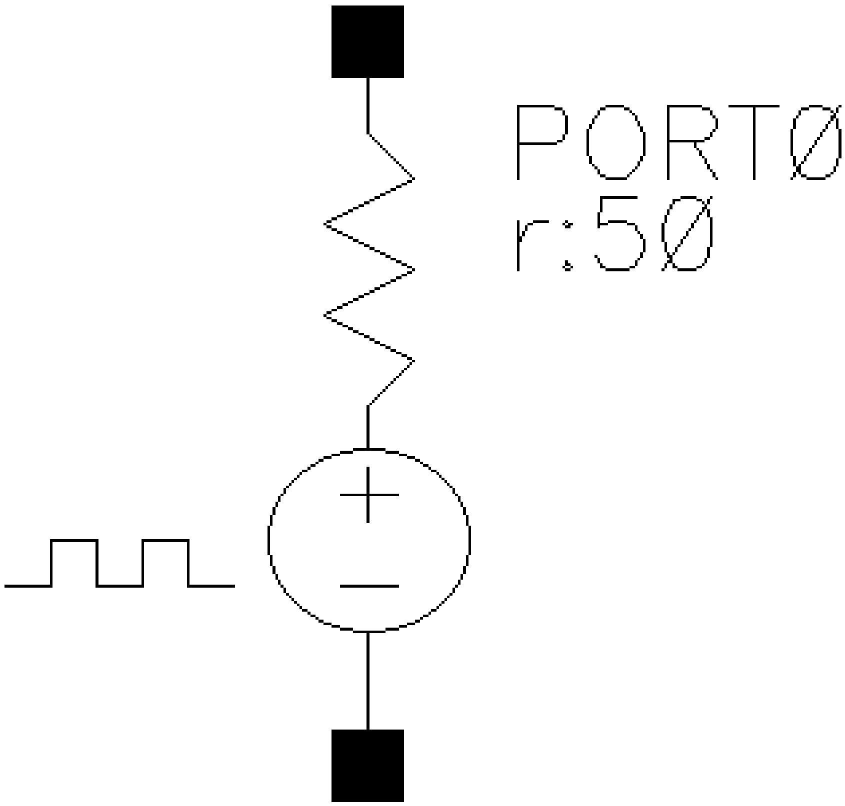
Examples

Following is a Sample Instance Statement:

```
p20 (2 0) port num=2 r=50 type=pulse period=1e-9 rise=1e-10 fall=1e-10 val1=1
width=0.5n mag=1
```

```
p30 (2 0 choke) port num=1 r=50 lchoke=0.1 cblock=0.00001 type=pulse period=1e-8
rise=1e-8 fall=1e-10
```

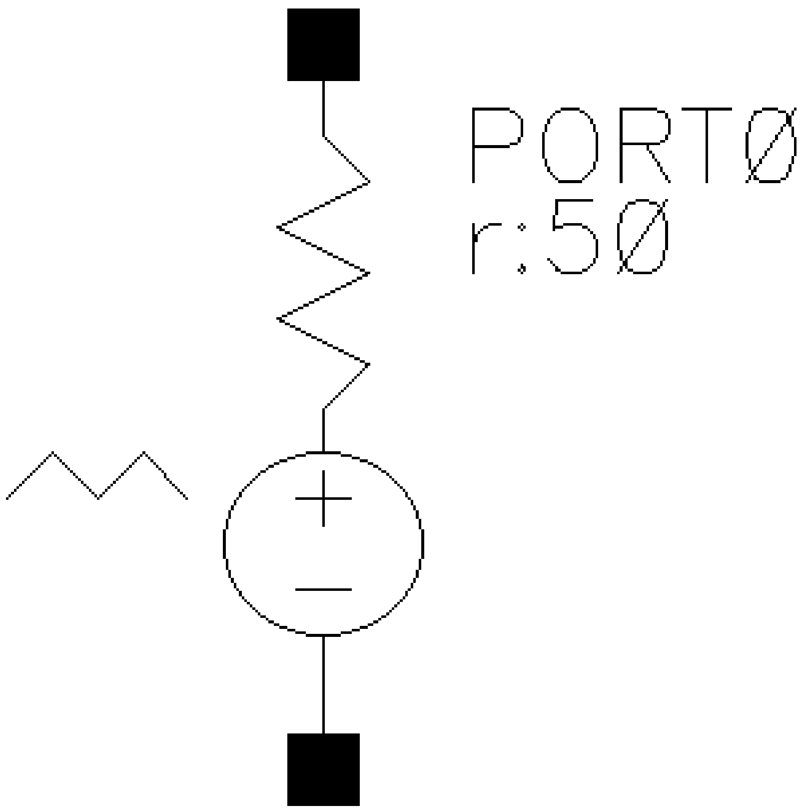
ppulse Symbol



Description

The component ppulse is an independent resistive pulse source. This component is the same as ppulse described in the ppulse Symbol.

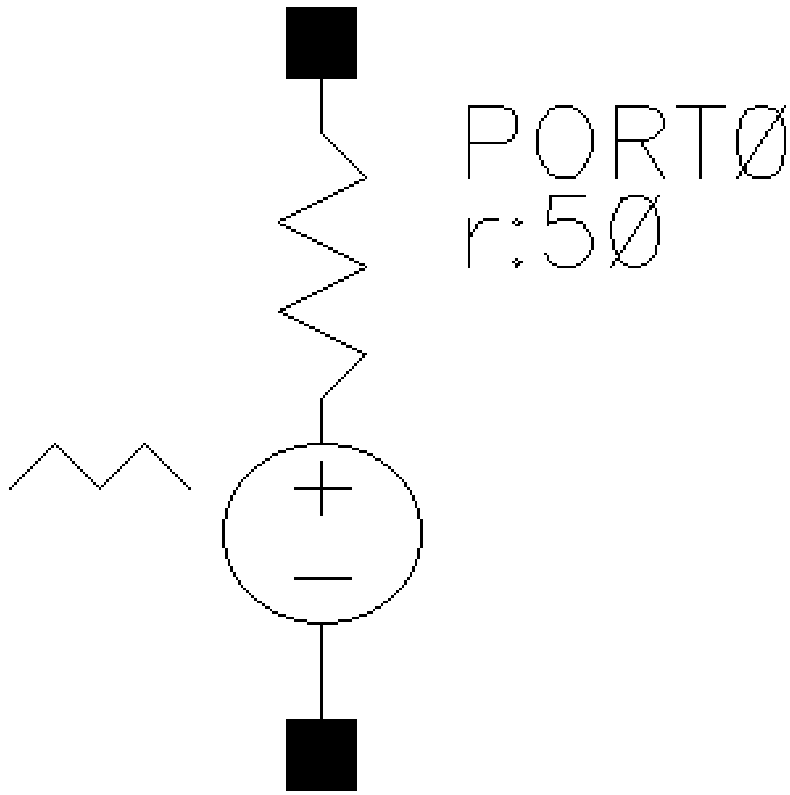
ppwl Symbol



Description

The component ppulse is an independent piece-wise linear resistive source. This component is the same as ppulse described in the ppwl Symbol.

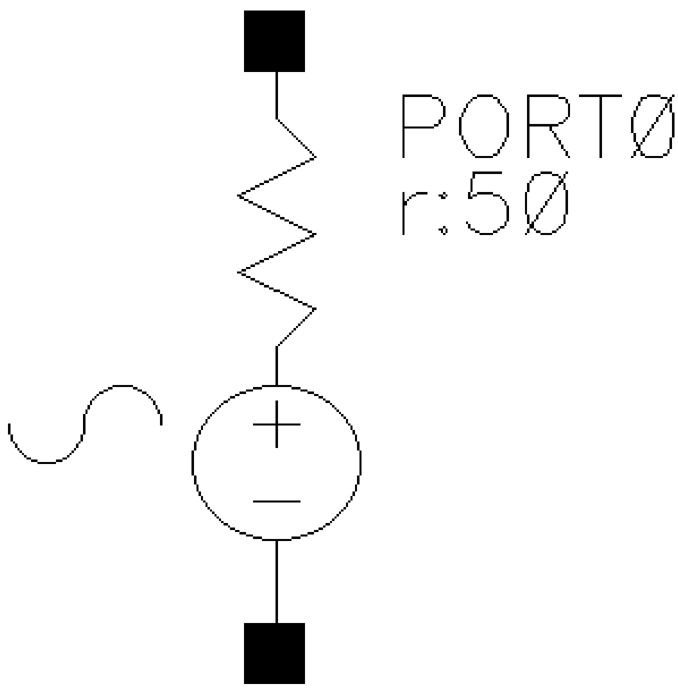
ppwlf Symbol



Description

The component `ppwlf` is an independent piece-wise linear resistive source based on file. This component is the same as ppwlf described in the ppwlf Symbol.

psin Symbol



Description

The component `psin` is an independent sinusoidal resistive source. This component is the same as ppwlf described in the psin Symbol.

Related Topics

CDF Parameters Supported by Analog Library Components

Sources - Independent Components in Analog Library

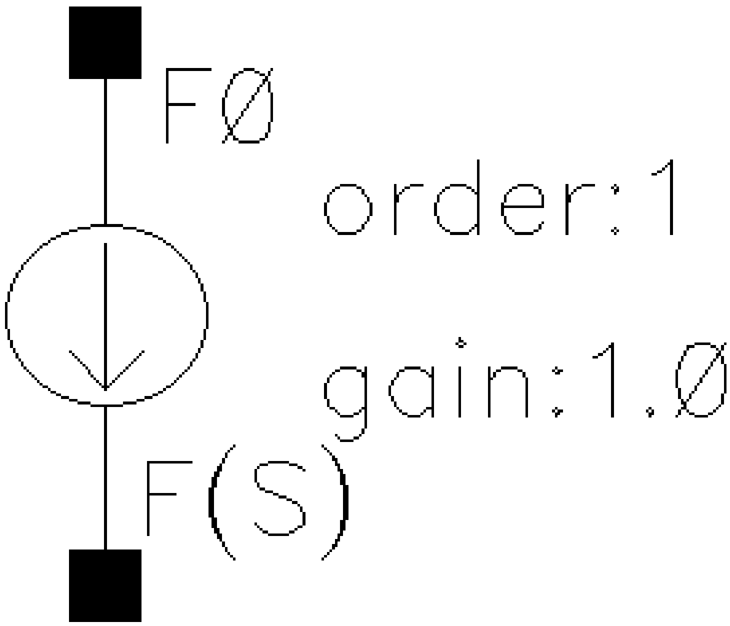
10

Sources - Z_S_Domain Components in Analog Library

The components in the `Z_S Domain` category are as follows:

- scccs Symbol
- sccvs Symbol
- svccs Symbol
- svcvs Symbol
- zcccs Symbol
- zccvs Symbol
- zvccs Symbol
- zvcvs Symbol

scccs Symbol



Description

The output of S-Domain Linear Current Controlled Current Source is defined through a transfer function given as a ratio of two polynomials in the complex variable `s`. Polynomials can be specified in terms of either coefficients or roots. The roots of the numerator are the `zeros` of the transfer function and the roots of the denominator are the `poles`. This device is not supported within the altergroups.

Command-Line Help

```
spectre -h scccs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Specification type	spec	x	-	-	-	-
Order of transfer function	order	x	-	-	-	-
Probe Device Name	probe	x	-	-	-	-
Coef. of num. const. term	a0	x	-	-	-	-
Coef. of num. 1st term	a1	x	-	-	-	-
Coef. of den. const. term	b0	x	-	-	-	-
Coef. of den. 1st term	b1	x	-	-	-	-
Port	port	x	-	-	-	-
Gain	gain	x	-	-	-	-
Multiplier	m	x	-	-	-	-

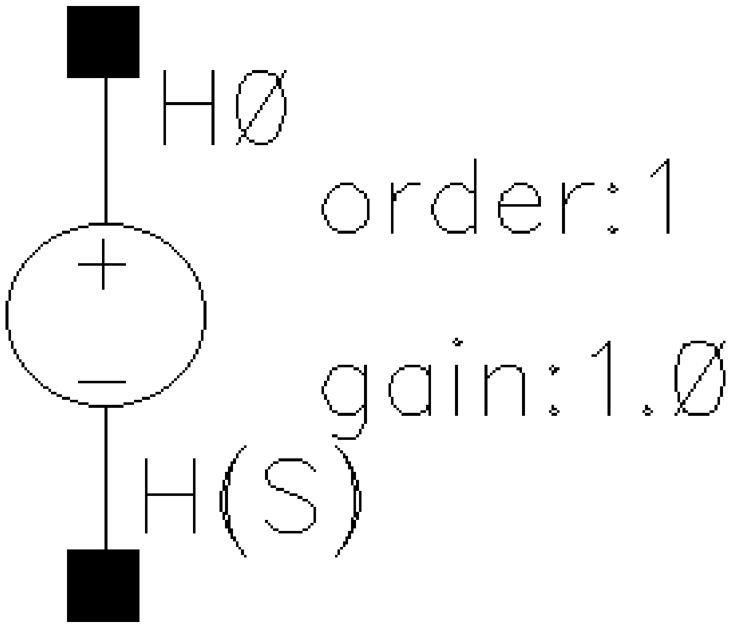
Syntax/Synopsis

```
Name ( sink src ) scccs <parameter=value> ...
```

Examples

```
l1 (2 1) inductor l=15
sc1 (1 0) scccs probe=l1 zeros=[0 6 0 -6 2 -8 2 8] poles=[-1 0 0 64 0 -64 -2 8 -2 -8]
```

sccvs Symbol



Description

The output of S-Domain Linear Current Controlled Voltage Source is defined through a transfer function given as a ratio of two polynomials in the complex variable `s`. Polynomials can be specified in terms of either coefficients or roots. The roots of the numerator are the `zeros` of the transfer function and the roots of the denominator are the `poles`. This device is not supported within the altergroups.

Command-Line Help

```
spectre -h sccvs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Specification type	spec	x	-	-	-	-
Order of transfer function	order	x	-	-	-	-
Probe Device Name	probe	x	-	-	-	-
Coef. of num. const. term	a0	x	-	-	-	-
Coef. of num. 1st term	a1	x	-	-	-	-
Coef. of den. const. term	b0	x	-	-	-	-
Coef. of den. 1st term	b1	x	-	-	-	-
Port	port	x	-	-	-	-
Gain	gain	x	-	-	-	-
Multiplier	m	x	-	-	-	-

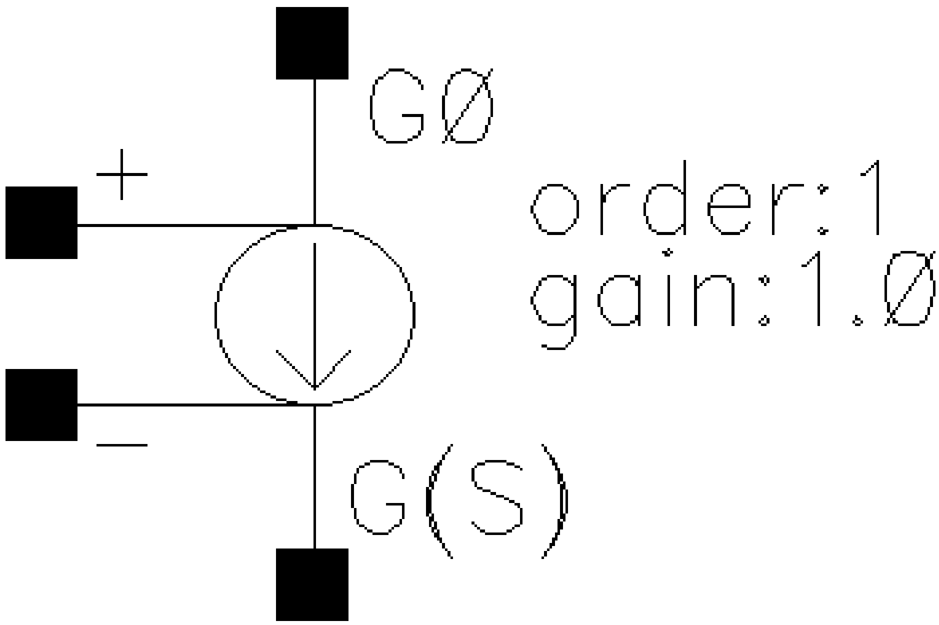
Syntax/Synopsis

```
Name ( p n ) sccvs <parameter=value> ...
```

Examples

```
myv (1 0) vsource type=sine freq=10K
scc1 (2 0) sccvs probe=myv gain=0.5 numer=[2] denom=[5]
```

svccs Symbol



Description

The output of S-Domain Linear Voltage Controlled Current Source is defined through a transfer function given as a ratio of two polynomials in the complex variable `s`. Polynomials can be specified in terms of either coefficients or roots. The roots of the numerator are the `zeros` of the transfer function and the roots of the denominator are the `poles`. This device is not supported within the altergroups.

Command-Line Help

```
spectre -h svccs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Specification type	spec	x	-	-	-	-
Order of transfer function	order	x	-	-	-	-
Coef. of num. const. term	a0	x	-	-	-	-
Coef. of num. 1st term	a1	x	-	-	-	-
Coef. of den. const. term	b0	x	-	-	-	-
Coef. of den. 1st term	b1	x	-	-	-	-
Gain	gain	x	-	-	-	-
Multiplier	m	-	-	-	-	-

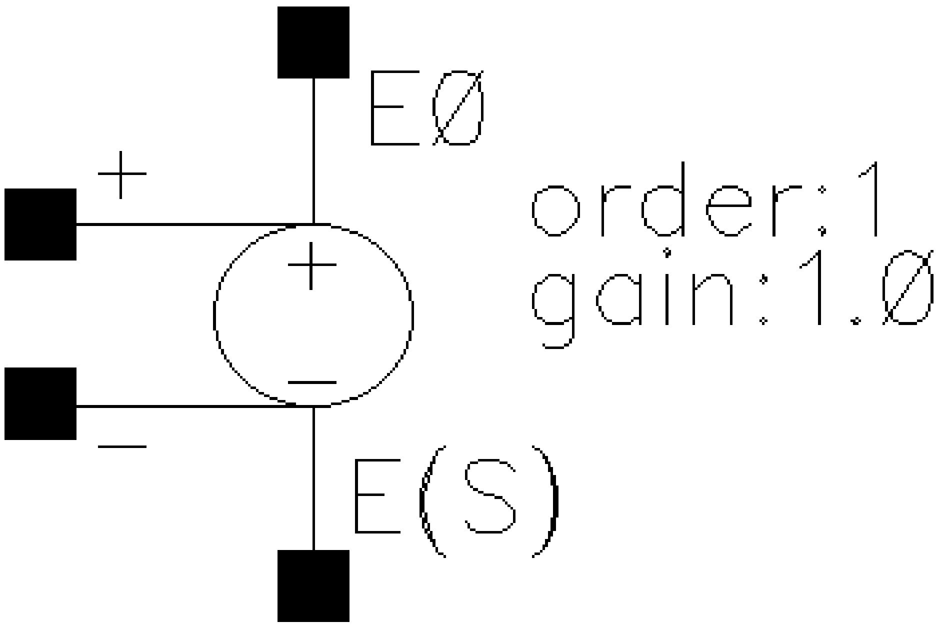
Syntax/Synopsis

```
Name ( sink src ps ns ) svccs <parameter=value> ...
```

Examples

```
s2 (1 0 control 0) svccs gain=0.4 numer=[2 3] denom=[4 5 1]
```

svcvs Symbol



Description

The output of S-Domain Linear Voltage Controlled Volatge Source is defined through a transfer function given as a ratio of two polynomials in the complex variable `s`. Polynomials can be specified in terms of either coefficients or roots. The roots of the numerator are the `zeros` of the transfer function and the roots of the denominator are the `poles`. This device is not supported within the altergroups.

Command-Line Help

```
spectre -h svcvs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Specification type	spec	x	-	-	-	-
Order of transfer function	order	x	-	-	-	-
Coef. of num. const. term	a0	x	-	-	-	-
Coef. of num. 1st term	a1	x	-	-	-	-
Coef. of den. const. term	b0	x	-	-	-	-
Coef. of den. 1st term	b1	x	-	-	-	-
Gain	gain	x	-	-	-	-
Multiplier	m	x	-	-	-	-

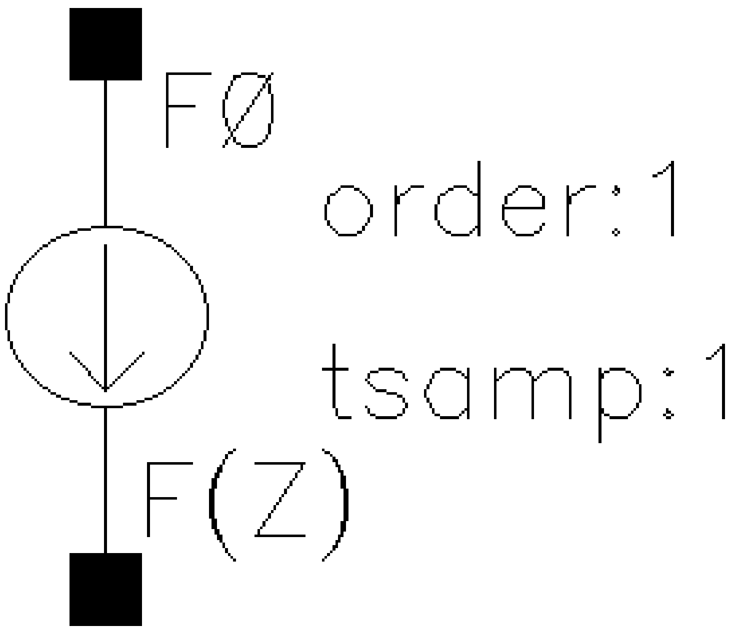
Syntax/Synopsis

```
Name ( p n ps ns ) svcvs <parameter=value> ...
```

Examples

```
e1 (1 0 control 0) svccs gain=5 poles=[-1 0 1 0] zero=[0 0 1 0]
```

zcccs Symbol



Description

The output of Z-Domain Linear Current Controlled Current Source is defined with a transfer function given as the ratio of two polynomials in the complex variable `z`. Each polynomial can be specified using either its coefficients or its roots. The roots of the numerator are the `zeros` of the transfer function and the roots of the denominator are the `poles`. This device is not supported within the altergroups.

Command-Line Help

```
spectre -h zcccs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Specification type	`spec`	x	-	-	-	-
Order of transfer function	`order`	x	-	-	-	-
Probe Device Name	`probe`	x	-	-	-	-
Coef. of num. const. term	`a0`	x	-	-	-	-
Coef. of num. 1st term	`a1`	x	-	-	-	-
Coef. of den. const. term	`b0`	x	-	-	-	-
Coef. of den. 1st term	`b1`	x	-	-	-	-
Port	`port`	x	-	-	-	-
Sampling period	`tsamp`	x	-	-	-	-
Delay time	`td`	x	-	-	-	-
Transaction time	`tt`	x	-	-	-	-
Gain	`gain`	x	-	-	-	-
Polynomial argument	`polyarg`	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
S to Z Transformation	sxz	x	-	-	-	-
Multiplier	m	x	-	-	-	-

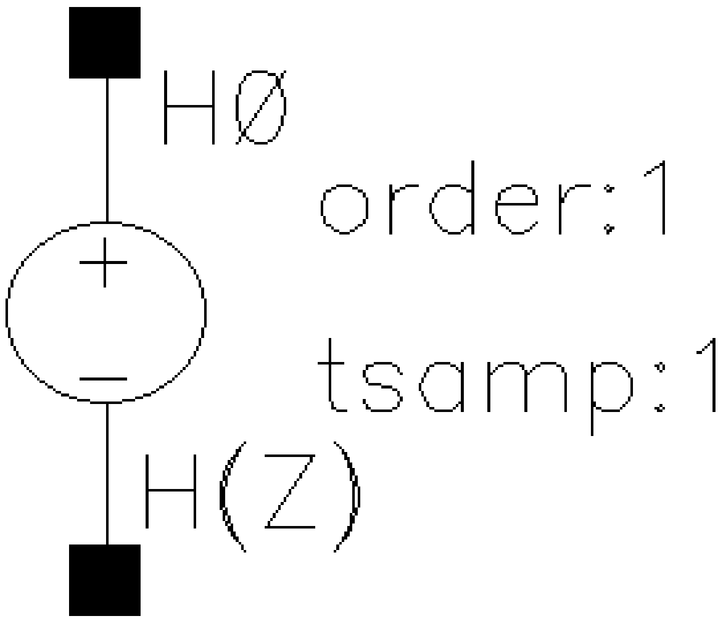
Syntax/Synopsis

```
Name ( sink src ) zcccs <parameter=value> ...
```

Examples

```
va (1 0) vsource type=sine freq=10K
z2 (2 0) zcccs probe=va gain=1 ts=4.9e-5 tt=1e-5 polyarg=inservez
numer=[1 -1] denom=[1 0]
```

zccvs Symbol



Description

The output of Z-Domain Linear Current Controlled Voltage Source is defined with a transfer function given as the ratio of two polynomials in the complex variable `z`. Each polynomial can be specified using either its coefficients or its roots. The roots of the numerator are the `zeros` of the transfer function and the roots of the denominator are the `poles`. This device is not supported within the altergroups.

Command-Line Help

```
spectre -h zccvs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Specification type	spec	x	-	-	-	-
Order of transfer function	order	x	-	-	-	-
Probe Device Name	probe	x	-	-	-	-
Coef. of num. const. term	a0	x	-	-	-	-
Coef. of num. 1st term	a1	x	-	-	-	-
Coef. of den. const. term	b0	x	-	-	-	-
Coef. of den. 1st term	b1	x	-	-	-	-
Port	port	x	-	-	-	-
Sampling period	tsamp	x	-	-	-	-
Delay time	td	x	-	-	-	-
Transaction time	tt	x	-	-	-	-
Gain	gain	x	-	-	-	-
Polynomial argument	polyarg	x	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
S to Z Transformation	sxz	x	-	-	-	-
Multiplier	m	x	-	-	-	-

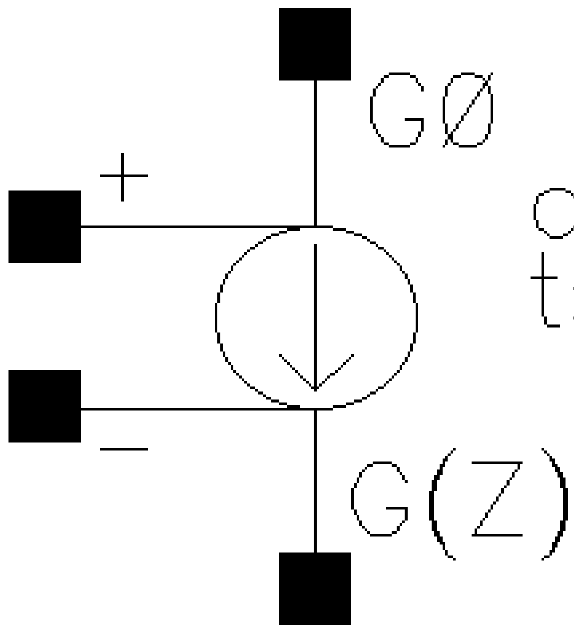
Syntax/Synopsis

```
Name ( p n ) zccvs <parameter=value> ...
```

Examples

```
va (1 0) vsource type=sine freq=10K
z2 2 0 zccvs probe=va gain=-2 ts=5e-5 tt=1.1e-5 numer=[1 -1]
```

zvccs Symbol



Description

The output of Z-Domain Linear Voltage Controlled Current Source is defined with a transfer function given as the ratio of two polynomials in the complex variable `z`. Each polynomial can be specified using either its coefficients or its roots. The roots of the numerator are the `zeros` of the transfer function and the roots of the denominator are the `poles`. This device is not supported within the altergroups.

Command-Line Help

```
spectre -h zvccs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Polynomial argument	`polyarg`	x	-	-	-	-
S to Z Transformation	`sxz`	x	-	-	-	-
Specification type	`spec`	x	-	-	-	-
Order of transfer function	`order`	x	-	-	-	-
Coef. of num. const. term	`a0`	x	-	-	-	-
Coef. of num. 1st term	`a1`	x	-	-	-	-
Coef. of den. const. term	`b0`	x	-	-	-	-
Coef. of den. 1st term	`b1`	x	-	-	-	-
Sampling period	`tsamp`	x	-	-	-	-
Delay time	`td`	x	-	-	-	-
Transaction time	`tt`	x	-	-	-	-
Gain	`gain`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-

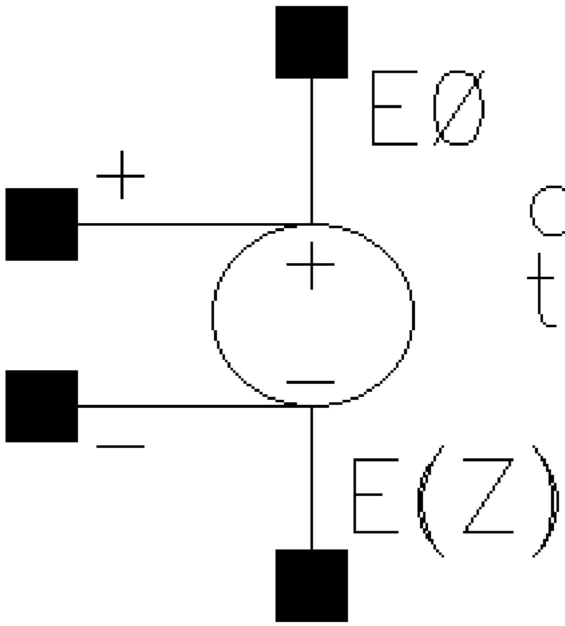
Syntax/Synopsis

```
Name ( sink src ps ns ) zvccs <parameter=value> ...
```

Examples

```
va (1 0) vsource type=sine freq=10K
z1 (2 0 1 0) zvccs gain=2 ts=4.5e-5 tt=1e-5 zeros=[-1 0] poles=[0 0]
```

zvcvs Symbol



Description

The output of Z-Domain Voltage Controlled Voltage Source is defined with a transfer function given as the ratio of two polynomials in the complex variable `z`. Each polynomial can be specified using either its coefficients or its roots. The roots of the numerator are the zeros of the transfer function and the roots of the denominator are the poles.

To use the '`s`' to '`z`' transformation, set the optional '`sxz`' parameter to one of the transformation methods - forward differences, backward differences, or bilinear. When the '`sxz`' parameter is specified, the transfer function specification is assumed to be given in the complex variable s and it will be transformed to the complex variable `z` using the indicated method. This device is not supported within the altergroups.

Command-Line Help

```
spectre -h zvcvs
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Polynomial argument	`polyarg`	x	-	-	-	-
S to Z Transformation	`sxz`	x	-	-	-	-
Specification type	`spec`	x	-	-	-	-
Order of transfer function	`order`	x	-	-	-	-
Coef. of num. const. term	`a0`	x	-	-	-	-
Coef. of num. 1st term	`a1`	x	-	-	-	-
Coef. of den. const. term	`b0`	x	-	-	-	-
Coef. of den. 1st term	`b1`	x	-	-	-	-
Sampling period	`tsamp`	x	-	-	-	-
Delay time	`td`	x	-	-	-	-
Transaction time	`tt`	x	-	-	-	-
Gain	`gain`	x	-	-	-	-
Multiplier	`m`	x	-	-	-	-

Syntax/Synopsis

```
Name ( p n ps ns ) zvcvs <parameter=value> ...
```

Examples

```
va (1 0) vsource type=sine freq=10K
z3 (3 0 1 0) zvcvs gain=-1 ts=4e-5 tt=1e-5 numer=[-1 -1]
```

Related Topics

CDF Parameters Supported by Analog Library Components

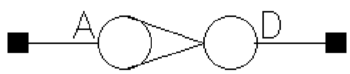
11

Interface Elements in Analog Library

The components in the `Interface elements` category are as follows:

- MOS_a2d Symbol
- MOS_d2a Symbol
- TTL_a2d Symbol
- TTL_d2a Symbol

MOS_a2d Symbol



Description

Interface Element for MOS - Metal Oxide Semiconductor Analog to Digital Convertor is a general Interface Element (IE) for mixed signal. To match your design, you need to change the Base CDF. The default is for `5V` logic. Do not manually place this component in your schematic as the IE placement is done automatically by the mixed signal netlister. This device is not supported within the altergroups.

Node	Name
`Input`	`A`
`Output`	`D`

Command-Line Help

```
spectre -h a2d
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Macro Name	`macro`	-	-	-	-	-
Level 0 threshold	`a2d_v0`	x	-	-	-	-
Level 1 threshold	`a2d_v1`	x	-	-	-	-
Time to x state	`a2d_tx`	x	-	-	-	-

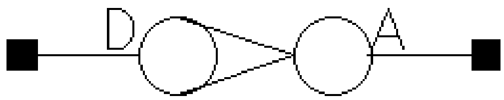
Syntax/Synopsis

```
Name ( p n ) a2d <parameter=value>
```

Examples

```
I0 a2d timex=1m v1=1.5 vh=3.5
```

MOS_d2a Symbol



Description

Interface Element for MOS - Metal Oxide Semiconductor Digital to Analog Convertor is a general Interface Element (IE) for mixed signal. To match your design, you need to change the Base CDF. The default is for `5V` logic. Do not manually place this component in your schematic as the IE placement is done automatically by the mixed signal netlister. This device is not supported within the altergroups.

Node	Name
`Input`	`D`
`Output`	`A`

Command-Line Help

```
spectre -h d2a
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Macro name	`macro`	-	-	-	-	-
Level 0 voltage	`d2a_vl`	x	-	-	-	-
Level 1 voltage	`d2a_vh`	x	-	-	-	-
Rise time	`d2a_tr`	x	-	-	-	-
Fall time	`d2a_tf`	x	-	-	-	-
Level X voltage	`d2a_vx`	x	-	-	-	-
Level Z voltage	`d2a_vz`	x	-	-	-	-

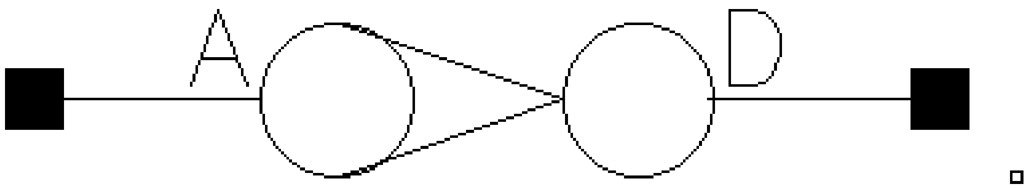
Syntax/Synopsis

```
Name ( p n ) d2a <parameter=value> ...
```

Examples

```
I1 d2a fall=2n rise=3n val1=5 val0=0 valx=1.25
```

TTL_a2d Symbol



Description

Interface Element for TTL - Transistor to Transistor Logic Analog to Digital Convertor is an Interface Element (IE) for `TTL` that is used as an analog-to-digital interface for mixed-signal simulations. The analog-to-logic converter transfers analog waveforms to a logic simulator.

Command-Line Help

```
spectre -h a2d
```

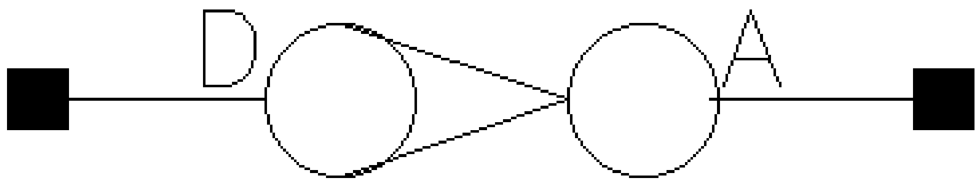
Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Macro Name	`macro`	x	-	-	-	-
Level 0 threshold	`a2d_v0`	x	-	-	-	-
Level 1 threshold	`a2d_v1`	x	-	-	-	-
Time to x state	`a2d_tx`	x	-	-	-	-

Examples

```
I3 interfaceElement timex=1m vl=1.5 vh=3.5
```

TTL_d2a Symbol



Description

Interface Element for TTL - Transistor to Transistor Digital to Logic Analog Convertor is an Interface Element (IE) for TTL that is used as a digital-to-analog interface for mixed-signal simulations.

Command-Line Help

```
spectre -h d2a
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Macro Name	`macro`	x	-	-	-	-
Level 0 voltage	`d2a_vl`	x	-	-	-	-
Level 1 voltage	`d2a_vh`	x	-	-	-	-
Rise time	`d2a_tr`	x	-	-	-	-
Fall time	`d2a_tf`	x	-	-	-	-
Level X voltage	`d2a_vx`	x	-	-	-	-
Level Z voltage	`d2a_vz`	x	-	-	-	-

Examples

```
I3 interfaceElement fall=2n rise=3n val1=5 val0=0
```

Related Topics

CDF Parameters Supported by Analog Library Components

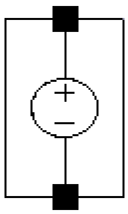
12

Behavioral Model in Analog Library

Using `bsource`, you can express the value of a resistance, capacitance, voltage or current as a combination of node voltages, branch currents, time expression, and built-in expressions.

The component in the `Behavioral Model` category is bsource Symbol.

bsource Symbol



Description

Behavioral Source component can be used to model a resistor, inductor, capacitor, voltage or current source as a behavioral component.

Command-Line Help

```
spectre -h bsource
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Model type	behav_param	x	-	-	-	-	-	-	-
Expression	expr	x	-	-	-	-	-	-	-
Multiplier	m	x	-	-	-	-	-	-	-
Temp rise from ambient	trise	x	-	-	-	-	-	-	-
Nominal temperature	tnom	x	-	-	-	-	-	-	-
Temperature coefficient 1	tc1	x	-	-	-	-	-	-	-
Temperature coefficient 2	tc2	x	-	-	-	-	-	-	-
Max value of bsource expr	max_val	x	-	-	-	-	-	-	-
Min value of bsource expr	min_val	x	-	-	-	-	-	-	-
Flicker noise coefficient	kf	x	-	-	-	-	-	-	-
Flicker noise exponent	af	x	-	-	-	-	-	-	-
Generate noise?	isnoisy	x	-	-	-	-	-	-	-

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Lin temp co of lin cap	`tc1c`	x	-	-	-	-	-	-	-
Quad temp co of lin cap	`tc2c`	x	-	-	-	-	-	-	-
DC-Mismatch parameter	`mr`	x	-	-	-	-	-	-	-
Initial condition	`ic`	x	-	-	-	-	-	-	-
Implementation Type	`ctype`	x	-	-	-	-	-	-	-
White noise expression	`white_noise`	x	-	-	-	-	-	-	-
Flicker noise expression	`flicker_noise`	x	-	-	-	-	-	-	-
Model name	`model`	x	-	-	-	-	-	-	-

Syntax/Synopsis

```
name (node1 node2) bsource behav_param param_list
```

Related Topics

CDF Parameters Supported by Analog Library Components

A

CDF Parameters Supported by Analog Library Components

The following table describes the CDF Parameters supported by Analog Library components

CDF Parameter Label	CDF Parameter	Description	Default
# of lumps in element	`lumps`		
Absolute Output Current	`absol`		0
Abstime	`abstime`	Specifies whether the time specified by the waveform or the PWL file is considered as an absolute value or a relative value. Valid values are `0` and `1`. The default value is `1`, which indicates that `t1`, `t2`, `t3`, ... are absolute values. The value `0` indicates that `t1`, `t2`, `t3`, ... are relative values. In case of relative values, the mapped absolute time is `t1`, `(t1+t2)`, `(t1+t2+t3)`… .	
Absolute Value	`abs`		
Absolute value	`habs`		
AC magnitude	`acm`	Specifies the amplitude of small-signal voltage for AC analysis in `volt`.	

CDF Parameter Label	CDF Parameter	Description	Default
AC Model	`acModel`	Alters nport behavior in small signal analyses: sp, ac and xf. Possible values are freqdomain and timedomain.	freqdomain
AC phase	`acp`	Specifies the phase of a small AC signal in `degrees`. Typically, only one source in the circuit has AC magnitude set to a value other than zero, and many times it has an *AC magnitude* = `1` and *AC phase* = `0`. However, there are situations where more than one source has a non-zero AC magnitude. For example, you can apply a differential small-signal input with two sources with the AC magnitudes set to `0.5` and the AC phases set to `0` and `180`.	
AC Phase	`acPhase`		
AC position	`acPosition`	Position to which switch is set at the start of AC analysis.	-
AC resistance	`ac`		-
Active	`active`	Whether Fourier analysis should be performed or skipped. Possible values are no or yes.	-
Accuracy	`accuracyMode`	Whether accuracy should be default or conservative.	default
Additional drain resistance	`rdc`		-
Additional parameter list	`additionalParam`		-

CDF Parameter Label	CDF Parameter	Description	Default
Additional source resistance	`rsc`		-
Advanced transient parameters	`tranAdvanParaLabel`		-
All are breakpoints *Breakpoints*	`allbrkpts`		-
Alias of mult	`area`		-
Alpha parameter	`alph`	Scaling factor for `Q`.	-
AM modulation frequency	`ammodfreq`		-
AM modulation index	`ammodindex`		-
AM modulation phase	`ammodphase`		-
Amplitude 1 (Ipk)	`ia`		-
Amplitude 1 (dBm)	`vaDBm`		-
Amplitude 1 (Vpk)	`va`		-
Amplitude 2 (Ipk)	`ia2`		-
Amplitude 2 (Vpk)	`va2`		-
Amplitude 2 (dBm)	`vaDBm2`		-
Anode gate voltage	`Vag`		-
Base area	`areab`		-
Base-emitter voltage	`Vbe`		-
Bit data file	`prbsFile`	Specifies the name or path to the bit data file.	
Bit 1 voltage level	`vbit1`	Specifies the voltage level at Bit `1`.	1
Bit 0 voltage level	`vbit0`	Specifies the voltage level at Bit `0`.	0
Bit Pattern(MSB...LSB)	`pattern`	Specifies the pattern of the bit.	0000
Bit Period	`perPrbs`	Specifies the period of the waveform.	

CDF Parameter Label	CDF Parameter	Description	Default
Browse and select file	`selectFile`	Can be used to open the file browser for selecting a waveform file. The path of the selected file is stored in the `fileName` parameter.	`nil`
Browse and select s-data file	`nportFileB`	Opens the file browser for selecting an s-data file. This check box is shown only when you do not select the *S-parameter file as Design Var?* check box.	`nil`
Browse MDIF file	`browse_mdif`	Lets you select the MDIF data file for the `nport` symbol.	
Blocking cap for net analyser	`cblock`	Blocking capacitance for network analyser.	0.0001 F
Body contact area	`ab`		-
Body diffusion resistor square	`nrb`		-
Body-source initial voltage	`Vbys`		-
Browse S-parameter file	`nportFileB`	Lets you browse to a location and specify the S-Parameter data file.	-
Bulk node connection	`bn`		-
Bulk source initial voltage	`Vbs`		-
Capacitance	`c`	Capacitance	1p F
Capacitor Area	`area`	Area of capacitor	1
Capacitor Perimeter	`perim`	Perimeter for capacitor	0
Capacitance connected	`hrc`		-
Carrier frequency	`fc`		-
Cathode gate voltage	`Vcg`		

CDF Parameter Label	CDF Parameter	Description	Default
Causality Correction	`causality`	Possible values are fmax, auto, no, fmax_active.	fmax
Characteristic impedance	`zo`	Characteristic impedance of lossless line.	50
checkFlag	`checkFlag`	Checks the state of the flag.	1
check box status	`checkBoxValue`	Checks the status of the check box.	1
Check Passivity	`passivity`	Check and enforce passivity of s parameters.	no
Chock ind for net analyser	`lchock`	Chock inductor for network analyser.	0.1 H
Close switch resistance	`rc`	Resistance of a fully closed relay.	-
Closed voltage	`vt2`	Relay resistance is ‘rclosed’ at this voltage.	-
CMDM	`CMDM`		1
Coef. of den. 1st term	`b1`		-
Coef. of den. const. term	`b0`		-
Coef. of num. 1st term	`a1`		-
Coef. of num. const. term	`a0`		-
Collector area	`areac`		-
Collector length	`lc`		-
Collector-emitter voltage	`Vce`		-
Common Reference	`nmode`	When selected, redraws the symbol with a single common reference pin at the bottom and eliminates the need to add reference connections to each port of the symbol	-

CDF Parameter Label	CDF Parameter	Description	Default
Conductor thickness	`t`		-
Contact configuration	`order`		-
Controlling Volt 1	`x1`		-
Controlling Volt 2	`x2`		-
Corresp Element 1	`y1`		-
Corresp Element 2	`y2`		-
Cosine Filter	`cosineFilter`	Specifies digital modulation for the PWL source. Valid values are `none` and `nrc`. `nrc` specifies a raised cosine filter that is to be used on the output waveform of the PWL source. This can be used to decrease the numerical noise floor of the modulation specified in the `I` and `Q` modulating file. When `nrc` is selected, the PWL file must have evenly spaced points with timepoints at `1/(2*Bandwidth of the filter)`.	`none`
Coupler domain	`a_or_d`	Specifies the domain to which the coupler belongs: analog or digital	analog
Coupling coefficient	`k`	Coupling coefficient	0
Current 1 - Current 50	`i1 - i50`		-
Current 2	`i2`		-
Current eqn	`cur`		-
Current gain	`fgain`		-

CDF Parameter Label	CDF Parameter	Description	Default
Current gain (Obsolete)	`hfgain`	**Note:** Parameter hfgain is obsolete. Parameter fgain is used for both Spectre and HspiceD instead.	-
Damping factor	`theta`		-
Damping factor 1 *Rise time constant*	`tau1`	Rise time constant for exponential wave.	
Damping factor 2 *Fall time constant*	`tau2`	Fall time constant for exponential wave.	
Data truncation threshold	`datatrunc`		
DC current	`idc`	Specifies the DC current.	
DC extrapolation	`dcextrap`	Long delay DC extrapolation method: constant or unwrap	constant
DC position	`dcPosition`	Position to which switch is set at the start of DC analysis.	0
DC source	`dc`		
DC voltage	`vdc`		
Decimal Value	`dec`	Value of Bit Pattern in Decimal.	0
Delay Schedule	`ibisDelaySchedule`		NO
Delay Time	`delay`		
Delay time	`tdPrbs`	Specifies the time delay from the beginning of the transient interval to the beginning of the first bit. It is mandatory to specify the *Bit period* parameter.	0
Delay Time	`htd`	Time delay	
Delay time 1 *Rise time start*	`td1`	Rise start time for exponential wave	

CDF Parameter Label	CDF Parameter	Description	Default
Delay time 2 *Fall time start*	`td2`	Fall start time for exponential wave.	
Delta	`delta`		
Desired rms value	`rmsValue`	Specifies the value of RMS voltage for the PWL waveform.	
Device area	`area`	Transistor area factor.	
Device initially off	`off`		
Dielectric loss cond matrix per unit length	`gdloss`	Dielectric loss conductance matrix per unit length.	
Dielectric loss cutoff frequency	`fgdloss`	Cutoff frequency for Dielectric loss.	
Dielectric loss onset frequency	`fgdloss1`	Onset frequency for Dielectric loss.	
Differential threshold	`vdiff`		
Display modulation params	`modulation`		
Display noise parameters	`noiseParam`		
Display second sinusoid	`numofsines`		
Display small signal params	`smallSig`		
Distance to a single well edge	sc		
Edit the Variable Values	`edit_mdif`	Lets you edit the values of the variables defined in the selected MDIF data file.	
shift in 0-bias threshold vth0	`delvo`		
File Type	`fileType`	Specifies the type of file for the `nport` symbol.	

CDF Parameter Label	CDF Parameter	Description	Default
Frequency for Q/ Frequency for L and Q	`fq`	Frequency at which quality factor and inductance are measured.	
Gate contact-channel edge	`xgw`		
Expand Bus	`expand`	Expand bus. Possible values are yes and no.	Yes
Input Mode	`mode1`	Input mode for Bit pattern. Possible values are binary, hexadecimal and octal.	Binary
MDIF data file	`mdif_dataFile`		
MDIF Variables	`var_mdif`	Displays the variables defined in the selected MDIF data file.	
MDIF Values	`val_mdif`	Displays the values of the variables defined in the selected MDIF data file.	
Number of Bits	`numbits`	Number of Bits.	4
Number of gate contacts	`ngcon`		
Number of input pins	`n_inp`	Number of input ports. Min:0 and Max:100	1
Number of output pins	`n_outp`	Number of output ports. Min:0 and Max:100	1
Mode	`mode`	Integer parameter that selects the frequency dependence.	
Rdc	`rdc`	DC resistance	0.0
Show advanced options	`advUser`	When selected, the parameters under it will be shown. By default the parameetrs are not shown	1

CDF Parameter Label	CDF Parameter	Description	Default
Initial coupler output voltage	`init_val`	Initial value of for interpolation. Sets the analog output value for simulation time to 0	0
Simulink(R) hostname	`hostname`	Hostname of the master simulator.	local host
Socket port	`sockPort`	TCP port number for socket connection. This parameter must be set to the same value for coupler of both simulators. It should be greater than 1024	5023
Sim response timeout	`sockTimeout`	Seconds to wait for an answer from the master simulator during simulation. Increase this value if the master simulator needs long calculation time per sample/frame. It should be greater than 30.	120
DC-Mismatch parameter	`mr`	DC-Mismatch parameter. Valid only for r.	-
Delay frequency	`delayfreq`		-
Display temperature params	`tempParam`		
Dist. betn & poly(one side)	`sa`		
Dist. betn OD & poly(otherside)	`sb`		
Dist. betn neighbour fingers	`sd`		
Drain diffusion area	`ad`		
Drain diffusion length	`ld`		
Drain diffusion periphery	`pd`		
Drain diffusion res squares	`nrd`		

CDF Parameter Label	CDF Parameter	Description	Default
Drain source initial voltage	`Vds`		
Dummy DC voltage	`vdummy`		0
Edge Type	`edgetype`	Specifies the type of rising and falling edges. Possible values are `linear` and `halfsine`.	`Linear`
Emitter length	`le`		
Emitter width	`we`		
Enable mixed mode	`mixedmode`		-
Enable noise passive checker	`noipassivechk`		-
Enable passive checker	`passive`		-
Enable rational function	`rational_func`	Enables the rational function when using hspiceD.	t
End Frequency	`endFrequency`	Specifes the end frequency point in `bbsfreqband`.	
Enter RLCG etc. matrices	`entermatrices`		
Estimated operating region	`region`	Estimated operating region. Possible values are off, on or breakdown.	-

CDF Parameter Label	CDF Parameter	Description	Default
Expression	`expr`	Behavioral expression. Depending on the value of `behave_param`, this can be either `simple_expr` or `generic_expr`. `simple_expr` – Spectre expression which contains the following: ■ Netlist parameters ■ Current simulation time, `$time` ■ Current frequency, `$freq` ■ Node voltage, `v(a,b)`, where `a` and `b` are nodes in the Spectre netlist, or `v(a)`, which is the voltage between node a and ground ■ Branch currents, `i("inst_id:index")`, where `inst_id` is an instance name given in the netlist and `index` is the port index that starts from `1`. Default value of `index` is `1`. ■ Note: If the value of the port index is set to `0`, `simple_expr` treats it as the default value `1`. `generic_expr` – `simple_expr` or `ddt()` of `simple_expr` or `idt()` of `simple_expr`.	0

CDF Parameter Label	CDF Parameter	Description	Default
Extracts a system delay	`delayhandle`		-
Fall Delay	`td10`	Time delay for 1 to 0 transition.	-
Fall on delay	`fall_on_dly`		
Fall off delay	`fall_off_dly`		
Fall time	`d2a_tf`		2n s
Fall time	`fall`	Time for transition to fall from Level 1 voltage to Level 0 voltage.	
Fall time	`tf`	Specifies the time for transition to fall from Level 1 voltage to Level 0 voltage. If the fall time is not specified, the fall time is same as the rise time. If rise time is also not specified, the fall time is `1/100` of the period of waveform or simulation interval. The simulation interval is the minimum value of `width` and `stop-start-width`. If the type is `prbs`, the fall time is `1/10` of the bit duration.	
Final Value for logical 0	`val0`	Specifies the value when voltage = `0 V` in pulse and exponential waveforms.	
Final Value for logical 1	`val1`	Specifies the value when voltage = `1 V` in pulse and exponential waveforms.	
First coupled inductor	`ind1`	Inductor to be coupled	
First harmonics computed	`firstharm`	First harmonic computed for the test (numerator) channel.	“ “

CDF Parameter Label	CDF Parameter	Description	Default
First of reference harmonics	`reffirstharm`	First harmonic computed for the reference (denominator) channel.	" "
Flag for matrix form input	`matrixform`	Flag for matrix form input. Possible values are `no` or `yes`.	
Flicker noise expression	`flicker_noise`	Generates pink noise with given power at 1 Hz that varies in proportion to `1/f^exp`. Noise contributions with the same tag are combined for a module.	-
*Flicker noise coefficien*t	`kf`	Flicker noise co-efficient. Valid for r and g elements.	`0`
Flicker noise exponent	`af`	Flicker noise exponent. Valid for r and g elements.	`2`
Flow	`flow`	Flow quantity	
FM modulation frequency	`fmmodfreq`		
FM modulation index	`fmmodindex`		
Freq 1 to Freq 50	`F1-F50`	Specifies the frequency in frequency/noise pair.	
Frequency	`freq`	Specifies the reference frequency used in conjunction to the normalized length to specify electrical length of line.	
Frequency 1	`freq`		
Frequency 2	`freq2`		
Frequency name 1	`fundname`		
Frequency name for 1/ period	`fundname`	Specifies the period of the periodic PWL waveform in frequency domain.	
Frequency sampling interval	`fdelta`		

CDF Parameter Label	CDF Parameter	Description	Default
Frequency scale factor	`freqscale`	Specifies the frequency scale factor for frequency-dependent RLGC data and S-Parameter data.	
Front gate-source voltage	`Vgfs`		
Fundamental frequency	`fund`		-
Gain	`gain`	Specifies the gain Parameter.	1.0
Gap length	`gap`	Specifies the gap length.	
Gate source initial voltage	`Vgs`		
Gate to bulk and src voltage	`Vgbs`		
Generate noise?	`isnoisy`	Specifies whether the resistor should generate noise. Possible values are no or yes.	-
Hierarchical Node	`probeNode`	Hierarchical net name in Spectre syntax. The net name should be as it appears in the netlist.	-
High Frequency Extrapolation	`hfextrap`	Long delay high-frequency extrapolation method. Possible values are constant and linear.	constant
High freq extrapolate method	`highpass`	Possible values are 0,1,2,3,4.	3
High freq. limit for approx.	`f1`	High frequency limit for the approximation.	f1=1.0e6 Hz
High-Z impedance	`highz`	Impedance of high z state.	-
Hot-electron degradation	`degradation`		
Hspice Interpolation method	`interpolation`	Possible values are: linear, spline, step, hybrid.	linear

CDF Parameter Label	CDF Parameter	Description	Default
Hspice S-parameter data format	`datafmtHspice`	Possible values are fqmodel, touchstne, citi, rfm, bnp.	touchstone
IBIS Entry Method	`ibisEntryMethod`		
IBIS file name	`ibisFile`		
IBIS model name	`ibisModelNameo`		
IBIS corner	`ibisCorner`	Specify the corner of an IBIS buffer. Possible corner parameters are typical, maximal, minimal, fast, and slow.	typical
IC position	`icPosition`	Position to which switch is set at the start of IC analysis (precedes transient analysis).	0
Implementation Type	`ctype`	Different implementations of a capacitor. When the value is `1`, bsource current is `ddt(cap*V(node1, node2))`, where `cap` is the bsource capacitor value with temp effect, mfactor effect, scale effect and so on. `V(node1, node2)` is the voltage between the bsource terminals. When the value is `2`, the current is `ddt(cap)`. When the value is 0 or any other value, the current value is `cap*ddt(V(node1, node2))`.	0
Impulse response truncation	`imptrunc`		
Inductance	`l`		1n

CDF Parameter Label	CDF Parameter	Description	Default
Initial condition	`ic`	Initial condition	-
Initial condition	`hic`		
Initial diode voltage	`Vd`		-
Initial magnetization of core	`mag`		
Initial phase for Sinusoid	`sinephase`		
Initial phase for Sinusoid 2	`sinephase2`		
Inner diam of toroidal core	`idiam`	Inner diameter of toroidal core	
Integral-1st distribution func	`sca`		
Integral-2nd distribution func	`scb`		
Integral-3rd distribution func	`scc`		
Internal junction voltage	`Vbcc`		
Interpolation Method	`interp`	Method to interpolate S-Parameter data. Possible values are `default`, `spline`, `linear`, `bbspice`, and `auto_switch`.	`default`
Invoke 'LMG' parameter extraction tool	`firelmg`		
Junction perimeter factor	`perim`		-
Length	`l`	Length of the resistor	-
Length of Emitter Window	`le0`		

CDF Parameter Label	CDF Parameter	Description	Default
Length of metal capacitor	`lm`	Length of metal capacitor	-
Length of polysilicon	`lp`	Length of polysilicon capacitor	-
Level 0 threshold	`a2d_v0`		1.5 V
Level 0 voltage	`d2a_vl`	Final value for logical 0.	0 V
Level 1 threshold	`a2d_v1`		3.5 V
Level 1 voltage	`d2a_vh`		5 V
Level X voltage	`d2a_vx`		
Level Z voltage	`d2a_vz`		
LFSR Mode	`lfsrmode`	Specifies the custom values of seeds and taps. Alternatively, you can specify a maximum length sequence by setting the length of LFSR.	PN32
Lin temp co of lin cap	`tc1c`	Linear temperature coefficient of capacitor.	
Linear interpolation data type	`intdattyp`	Data type of linear interpolation. Values: RI, DBSA, MA.	MA
LMG subcircuit file	`subcktfile`		
Location of collector contact	`location`		
Loss conductance per unit length	`g`	Dielectric (shunt) conductance per unit length	
Loss resistance per unit length	`rs`		
Low freq extrapolate method	`lowpass`	Values: 0,1,2,3,	1
Low freq. limit for approx.	`f0`	Low frequency limit for the approximation.	1.0 Hz

CDF Parameter Label	CDF Parameter	Description	Default
lxRemoveDevice.	`lxRemoveDevice`	Removes a device during netlisting.	(short(PLUS MINUS))
Macro name	`macro`		
Matrix entry data file	`matrixfile`	Matrix entry data file name.	
Max	`max`		-
Max Coefficient Number	`polyCoef`		0
Max order impulse response	`maxn`		
Max signal frequency	`fmax`	Maximum signal frequency	
Maximum output current (Obsolete)	`maxi`		
Maximum output current	`maxm`	Sets the Voltage gain for both Spectre and HspiceD.	
Maximum output resistance	`maxr`		
Maximum output voltage (Obsolete)	`maxv`	**Note:** Parameter `maxv` is obsolete. Parameter `maxm` is used to set the Voltage gain for both Spectre and HspiceD instead.	
Max value of bsource expr	`max_val`	Maximum value of bsource expression. Valid for all behavioral elements, but used with i and v elements to clip the current or voltage between the specified values.	-
Method of smooth	`smooth`	Possible values are 0,1,2,3,4.	0
Min	`min`		-
Min high-Z trans. width	`min_z_transition_width`	Minimum width of transition from z-state to a non z-state. The width of transition is set as 1e-3*(z-state duration).	-

CDF Parameter Label	CDF Parameter	Description	Default
Minimum no. of time points	`points`		-
Minimum output current (Obsolete)	`mini`		
Minimum output current	`minm`		
Minimum output resistance	`minr`		
Minimum output voltage (Obsolete)	`minv`		
Min value of bsource expr	`min_val`	Minimum value of bsource expression. Valid for all behavioral elements, but used with i and v elements to clip the current or voltage between the specified values.	-
Model name	`model`	Specifies the name of the model to be associated with the component.	-
Model name	`hmname`	Specifies the name of the model to be associated with the component.	MDN

CDF Parameter Label	CDF Parameter	Description	Default
Model type	`behav_param`	Type of behavioral source. It can be one of the following: `c=simple_expr` – Capacitance between the nodes `g=simple_expr` – Conductance between the nodes `i=generic_expr` – Current through bsource `l=simple_expr` – Inductance between the nodes `phi=simple_expr` – Flux in the bsource device `q=simple_expr` – Charge in bsource device `r=simple_expr` – Resistance between the nodes `v=generic_expr` – Voltage across the nodes	v
Model type	`modeltype`	Model type. Possible values are *lossless*, *narrowband*, and *wideband*.	
Modulation frequency	`fm`		
Modulation index	`mdi`		
Multiplicity factor	`mf`	Multiplicity factor.	1
Multiplier (Obsolete)	`hm`	**Note:** Parameter `hm` is obsolete. Parameter `m` is used for both Spectre and HspiceD instead.	
Name of core	`core`	Name of core around which winding is wrapped.	-

CDF Parameter Label	CDF Parameter	Description	Default
Name of FM File1 *Name of FM File2*	`fmmodfile1` `fmmodfile2`	Name of files that contain data for Frequency Modulated waveform for a sinesoid source.	-
Name of the model	`modelName`		
Name of voltage source	`vref`		
Name of winding 1	`l1`		
No. of reference Harmonics	`refharms`	Number of harmonics for reference (denominator) channel, if an array is not given. The harmonics start from ‘reffirstharm’ and go up to ‘reffirstharm’ + ‘harms’ - 1.	-
No. of Harmonics for PSS	`pssharms`		
Noise correlation matrix	`noisecorr`	Type of noise correlation matrix: real or complex	
Noise 1 to Noise 50	`N1 - N50`	Specifies the noise in frequency/noise pair.	
Noise file name	`noisefile`	Specifies the name of file containing excess spot noise data in the form of frequency-noise pairs.	
Noise parameters	`noiseParaLabel`	.	
Noise temperature	`noisetemp`		
Nominal temperature	`tnom`	Specifies the value of the temperature used in nominal run.	
Normalized length	`nl`	Normalized electrical length in wavelengths at ‘f’ of a lossless line.	
Nomalizing harmonic	`normharm`	Normalizing harmonic for the test (numerator) channel.	“ “

CDF Parameter Label	CDF Parameter	Description	Default
Nomalizing reference harmonic	`refnormharm`	Normalizing harmonic for the reference (denominator) channel.	“ “
NQS flag	`nqsmod`		
Num of controlling voltage(s)	`nc`		
Num of lines (excluding ref.)	`n`	Number of lines.	1
Number of turns on secondary	`n2`	Number of turns on winding 2.	
Num of turns on winding	`turn`	Number of turns on winding.	-
Number of base contacts	`nb`		
Number of collector contacts	`ncbjt`		
Number of emitter contacts	`ne`		
Number of controlling pairs	`xypairs`		
Number of desired harmonics	`harmsvec`	Array of desired harmonics for test (numerator) channel.	`0`
Number of devices in parallel	`mult`		
Number of FM files	`filenums`	Number of files that contain data for Frequency Modulated waveform for a sinesoid source. You can specify a max of 2 files.	none
Number of harmonics	`harms`	Number of harmonics for test (numerator) channel, if an array is not given. The harmonics start from ‘firstharm’ and go up to ‘firstharm’ + ‘harms’ - 1.	-

CDF Parameter Label	CDF Parameter	Description	Default
Num of lumps in approx.	`lumps`	Number of lumps used in the approximation.	
Num of lumps/dec in approx.	`dec`	Number of lumps per decade used in the approximation.	1.0
Number of noise/freq pairs	`FNpairs`	Specifies the number of noise/ frequency pairs.	
Number of PWL/Time pairs	`tvpairs`		
Number of pairs of points	`tvpairs`		
Number of Polynomial Coeffs *Max Coefficient Number*	`polyCoef`		0
Number of ports	`padNum`		1
Number of Ports	`p`		1
Number of reference harmonics	`refharmsvec`	Array of desired harmonics for reference (denominator) channel.	0
Number of Probes	`probeCnt`		
Num of segments	`nseg`		
Number of structures in parallel	`npas`		
Number of turns on primary	`n1`	Number of turns on winding 1.	
Offset constant	`oc`		
Offset current	`io`	Specifies the offset current in series with common terminal.	
Offset voltage *DC offset*	`offset`	Specifies the offset voltage in series with common terminal.	-
Offset voltage	`vo`	Specifies the offset voltage in series with common terminal.	-

CDF Parameter Label	CDF Parameter	Description	Default
Open switch resistance	`ro`	Resistance of a fully open relay.	
Open voltage	`vt1`	Relay resistance is ‘ropen’ at this voltage	
Open/close voltage	`vsw`		
Optional Nodes	`Opins`		
Optional Node Configuration	`soipOpNodes`	The options PinP, pinP_pinB, and pinP_pinB_Tnode correspond to each pin in the component. To know about the pins that these options correspond to, type spectre -h.	
Optional Node Configuration	`vbicOpNodes`	Substrate Node and Substrate & Temp. Node configurations.	
Optional Bulk Node_B	`pinB`		
Optional Substrate Node_S	`pinS`		
Optional Thermal Node_T	`pinT`		
Optional Thermal Node_dT	`pindT`		
Order of interpolation	`order`	Order of interpolation	-
Outer diam of toroidal core	`od`	Outer diameter of toroidal core	
Causal s-param output file	`outFile`	File used for storing the equivalent S-Parameter data based on corresponding time-domain model. The file format is touchstone. The instance name is added as a suffix and the file extension is added automatically.	-
PAC magnitude	`pacm`	Specifies the magnitude of the periodic AC analysis.	
PAC magnitude (dBm)	`pacmDBm`		

CDF Parameter Label	CDF Parameter	Description	Default
PAC phase	`pacp`	Specifies the phase of the periodic AC analysis.	
PAM4 mapping	`pam4_mapping`	Specifies a mapping from a pair of bit to 4-level voltages. Possible values are `0123`, `0132`, `0213`, `0231`, `0312`, `0321`, `1023`, `1032`, `1203`, `1230`, `1302`, `1320`, `2013`, `2031`, `2103`, `2130`, `2301`, `2310`, `3012`, `3021`, `3102`, `3120`, `3201`, and `3210`. PAM-4 signals have four distinct levels represented by 00, 01, 11 and 10 respectively. The transition between these levels depends on the value specified for this parameter. For example, 1203 represents the transition as 01 10 00 11. *PAM4 mapping* is only visible when you select `bit` *Source type* with *pam4* modulation.	`0132`
PAM modulation	`pam4_modulation`	Specifies the type of amplitude modulation; effective for *bit* and *prbs* sources. Possible values are: ■ `none`- Default behavior of the source. ■ `pam3`- Enables PAM3 modulation in the source. ■ `pam4`- Enables PAM4 modulation in the source.	`none`
param0	`param0`		

CDF Parameter Label	CDF Parameter	Description	Default
Parameter Type	`paramTyp`	Input type for other paramters. Possible values are cyclic and string.	cyclic
Passivity	`passivity`	Possible values are check, enforce, and no.	check
Passivity	`passivity_bbspice`	Possible values are fit_enforce and fit_weak_enforce.	check
Passivity Tolerance	`pabstol`	Absolute tolerance of passivity criteria.	1e-6

<table>
<tr><th>CDF Parameter Label</th><th>CDF Parameter</th><th>Description</th><th>Default</th></tr>
<tr><td>Pattern Parameter Data</td><td><code>data</code></td><td>Specifies the sequence in which the bits are to be arranged. It can be used to create both simple and nested bit patterns.

Note: Nested patterns are supported only for Spectre.

In case of nested patterns, ensure that the specified value conforms to the following rules:

■ An opening bracket for a pattern to be multiplied is preceded only by a pattern multiplier.

■ A pattern multiplier is preceded only by a space character or an opening bracket.

■ Every opening/closing bracket has a corresponding closing/opening bracket.

■ A closing bracket for a pattern to be multiplied is followed only by a space character or a closing bracket.

For example, if <code>data</code> = <code>4(01) 2(11001) 10</code>, then the final bit sequence is: <code>01 01 01 01 11001 11001 10</code>.</td><td>-</td></tr>
<tr><td>Period

Period of waveform</td><td><code>per</code></td><td>Specifies the bit duration.</td><td></td></tr>
</table>

CDF Parameter Label	CDF Parameter	Description	Default
Period of the PWL Period	`pwlperiod`	Specifies the period of the periodic PWL waveform in time domain.	
Period start time	`pwlperiodstart`	Period start time of the periodic PWL waveform	
Periphery of junction	`pj`		-
Phase delay	`phi`		
Phase for Sinusoid 1	`sinephase`		
Physical length	`len`	Effective physical length of magnetic path (used with ‘vel’ to specify electrical length of line).	
PJ(amplitude)	`pjamp`	When set for PRBS source or Bit source, the source has a periodic jitter for which the amplitude is `pjamp` and the frequency is `pjfreq`.	
PJ(frequency)	`pjfreq`	When set for PRBS source or Bit source, the source has a periodic jitter whose amplitude is pjamp and whose frequency is pjfreq.	
PJ(type)	`pjtype`	For PRBS source or Bit source, pjtype defines the type of periodic jitter. Possible valudes are sine, sawtooth, and square.	sine
Polarity of the buffer	`polarity`	Possible values: inv, noninv, or blank	inv
Poly Coeff 0	`c0`	Polynomial coefficients. At least one must be given.	
Poly Coeff 1	`c1`	Polynomial coefficients. At least one must be given.	
Poly Coeff 2	`c2`		
Poly Coeff 3	`c3`		

CDF Parameter Label	CDF Parameter	Description	Default
Poly Coeff 4	`c4`		
Polynomial argument	`polyarg`		
Port	`port`		
Port 1	`port1`		
Port 2	`port2`		
Port 3	`port3`		
Port 4	`port4`		
Port number	`num`		
Power of PWL waveform	`pwldbm`	Power of PWL waveform in dBm.	
Primary inductor	`pi`		
prbsFile as Design Var?	`prbsFile_as_var`	Checks if the bit data file can be used as a design variable.	
Precondition factor keyword	`precfac`		0.75
Prioritize Accuracy Range	`prioritizeAccuracyRange`	Specifes a frequency band of interest to prioritize the accuracy of *bbspice* fitting at this band.	t
Probe 1	`p1`	Devices through which the controlling currents flow.	
Probe 2	`p2`	Index of the probe ports through which the controlling currents flow.	
Probe 3	`p3`		
Probe 4	`p4`		
Probe Device Name	`probe`		

CDF Parameter Label	CDF Parameter	Description	Default
Profile	`profile`	Specifies what happens outside the range of approximation. Possible values are ff, df, fd, or dd. It is dd if abs(slope) >= 0.5 and ff otherwise.	-
Propogation velocity normalized	`vel`	Propagation velocity of the line given as a multiple of ‘c’, the speed of light in free space. (vel <= 1).	
Pulse width	`pw`		
PWL file name	`fileName`	Specifies the name of the PWL file.	
PWL File as Design Var?		Checks if the PWL file can be used as a design variable.	
Pwl type	`pwlType`		
Quad temp co of lin cap	`tc2c`	Quadratic temperature coefficient of capacitor.	
Quantity of Port1 to Quantity of Port20	`portquantity1` to `portquantity20`	Quantities of ports. Use 0 for voltage and 1 for current.	
Rarely used parameters	`otherParaLabel`	Rarely used parameters.	-
Reactance	`x`	Reactance, that can have real number values. It can either be positive or negative.	-

CDF Parameter Label	CDF Parameter	Description	Default
Reference Value	`ref`	Specifies the crossing reference for the control node. This parameter applies only when the Prbs source operates as a 3 or 4 terminal device. When the voltage across terminals 3 and 4 drops below ref, the output of the source is set to 0. If terminal 4 is not specified, it is assumed to be connected to ground.	-
Relative permittivity	`eps`	Substrate permittivity relative to a vacuum.	
Remove Device	`lxRemoveDevice`	Added to the auCDL view of a device to indicate that the device is shorted.	
Repeated function	`rpt`		
Res. for initial conds.	`rforce`	Resistance used when forcing initial conditions.	1.0 Ohm
Res of the winding	`resis`	Resistance of the winding.	-
Resistance	`r`	Resistance	1K Ohms
Resistance Form	`resform`	Default is 'yes' if 'r < thresh'. Possible values are no or yes.	-
Reuse rational function data	`rational_func_reuse`	Possible values are 0,1, 2.	1
Rise Delay	`td01`	Time delay for 0 to 1 transition.	-
Rise on delay	`rise_on_dly`		
Rise off delay	`rise_off_dly`		
Rise time	`d2a_tr`		3n s
Rise time	`rise`	Time for transition to rise from Level 0 voltage to Level 1 voltage.	3n s

CDF Parameter Label	CDF Parameter	Description	Default
Rise time	`tr`	Specifies the time for transition to rise from Level 0 voltage to Level 1 voltage.	3n s
RJ(seed)	`rjseed`	Specifies a random number generator that is used in generating random jitter for the `prbs` sources.	1
RJ(rms)	`rjrms`	Specifies the source for `prbs` that has a normally distributed random jitter, for which the mean is `zero` and whose standard deviation is `rjrms`.	
RLCG data file	`file`	Specifies the name of the RLGC data file.	
RLCG data file as Design var?	`rlgc_file_as_var`	Checks if the RLGC data file is used as a design variable.	
S to Z Transformation	`sxz`		
S-parameter Data File	`dataFile`	S-Parameter data file name.This file contains parameters, frequencies, or model information that can be analyzed by the Spectre simulator.	
S-parameter File	`file1`	S-parameter file name.	
S-parameter file as Design Var?	`sparam_file_as_var`	Checks if the S-parameter file is used as a design variable.	-
S-parameter data format	`datafmt`	Possible values are spectre, touchstone,citi, rfm, bnp.	
Sampling period	`tsamp`		
Scale factor	`scale`	Specifies the scale factor for amplitude.	-
Second coupled inductor	`ind2`	Inductor to be coupled	

CDF Parameter Label	CDF Parameter	Description	Default
Second frequency name	`fundname2`		
Secondary inductor	`si`		
Seed	`seed`	Set registerlength=[2 ... 32] to choose a Maximum Length Sequence or define a custom PRBS by use of the parameters, lfsrtaps and lfsrseed.	-
Seed	`lfsrseed`	For PRBS source, lfsrseed is an integer array which sets the initial state of the LFSR. Array elements sets the locations of non-zero bits. Locations are 1-based and ordered from MSB to LSB of the LFSR. For example, assume lfsrtaps=[6] and lfsrseed=[1 3 5]. The width of the register is then 6 bits and the initial state is `101010`.	-
Signal amplitude	`sa`		
Signal frequency	`fs`		
Signal names	`signalNames`	Specifies the name of the PWL signals.	
Select IBIS Buffer Type	`bufferType`		
Select IBIS Buffer Variant	`bufferVariant2`		
Select IBIS Buffer Variant	`bufferVariant4`		
Self Heating Switch	`sel_heating`		
Sine DC level	`sinedc`		
Sinusoid Ampl 1 to Sinusoid Ampl 9	`vav1 - vav9`		

CDF Parameter Label	CDF Parameter	Description	Default
Skin effect res matrix per unit length	`rskin`		
Slope of imp on log/log scale	`slope`	Slope of the impedance when plotted on a log-log scale.	0.5
Smoothing Factor	`smoothing`		
Source diffusion area	`as`		
Source diffusion length	`ls`		
Source diffusion periphery	`ps`		
Source diffusion res squares	`nrs`		
Source type	`srcType`	Specifies the type of source.	
Source/drain selector	`geo`		
Specification type	`spec`		
Stamping method	`stamp`	Possible values are Y, S, YSTS, SSTS, DEFMBED.	Y
Start Frequency	`startFrequency`	Specifes the start frequency point in `bbsfreqband`.	t
Strength	`strength`	Quantity strength. Possible values are indifferent, suggest, insist, or override.	override
Subckt file	`modelFile`		
Substrate height	`h`		
Switch position	`position`	Switch position (0, 1, 2, ...).	0
Taps	`lfsrtaps`	For PRBS source, lfsrtaps is an integer array which sets the location of LFSR taps. Locations are 1-based and ordered form MSB to LSB of the LFSR. The largest element of the taps array is equal to the width of the LFSR.	-

CDF Parameter Label	CDF Parameter	Description	Default
Temp Rise Specifier	`triseSpec`		
dtmp -Temp rise from ambient	`dtmp`		
dtemp -Temp rise from ambient	`dtempn`		
Temp rise from ambient	`trise`	Temperature rise from ambient	-
Temperature coefficient 1 *Linear temp. coefficient*	`tc1`	Specifies the linear temperature or first order temperature coefficient.	-
Temperature coefficient 2 *Quadratic temp. coeff.*	`tc2`	Specifies the quadratic temperature or second order temperature coefficient.	-
Temperature difference	`dtemp`		-
The order of indices	`datatype`		-
Thermal Node(T)	`Tnode`		-
Thermal Noise	`thermalnoise`	Thermal noise. Possible values are no or yes.	yes
Thermal noise model	`noisemodel`	Possible values are internal and external.	
Thermal resistance	`rth0`		
Thermal capacitance	`cth0`		

CDF Parameter Label	CDF Parameter	Description	Default
Threshold	`triggerthreshold`	For PRBS, when triggerthreshold is set and the source is instantiated with optional control terminals (terminals 3 and optionally 4; if terminal 4 is unspecified it is assumed to be connected to ground), triggerthreshold defines the crossing threshold for the trigger event. The event causes the emission of the next PRBS pulse.	
Time 1	`t1`		
Time 2	`t2`		
Time interval for switching	`ts`		
Time scale factor	`stretch`	Specifies a multiplier for the times given for PWL waveform. Setting the time scale factor greater than 1 increases the times in the file, and reduces the frequency.	1
Time to x state	`a2d_tx`		1m s
Total Num of windings	`numOfL`		
Tran position	`tranPosition`	Position to which switch is set at the start of transient analysis.	0
Tran convolution parameters	`tranParaLabel`	Accuracy parameters for transient convolution.	0
Transaction time	`tt`		
Transconductance	`ggain`		
Transconductance (Obsolete)	`hggain`	**Note:** Parameter `hggain` is obsolete. Parameter `ggain` is used for both Spectre and HspiceD instead.	

CDF Parameter Label	CDF Parameter	Description	Default
Transition reference	`transitionreference`	Defines the voltage swing for the duration of rise and fall time, as a percentage of `val1` - `val0`. For example, *Transition reference*= `100` means that the output voltage transitions from `val0` to `val1` in rise seconds. `90` means that it transitions from `0.1*(val1-val0)` to `0.9*(val1-val0)` in rise seconds, 80 means from `0.2*(val1-val0)` to `0.8*(val1-val0)....` Possible values are `100`, `90`, `80`, `70`, and `60`.	100
Transition width	`twidth`	Transition width is used when making PWL waveforms periodic and the ending value of the PWL file does not equal the beginning value. Before repeating, the waveform changes linearly in an interval of transition width from its value at period – transition width to its value at the beginning of the waveform. Thus, the transition width must always be much less than the period.	`PWL period/1000`.
Transmission line type	`linetype`	Transmission line type. Possible values are `microstrip`, `stripline`, `coplanar`, and `sublossline`.	
Transresistance	`hgain`		

CDF Parameter Label	CDF Parameter	Description	Default
Transresistance (Obsolete)	`hhgain`	**Note:** Parameter `hhgain` is obsolete. Parameter `hgain` is used for both Spectre and HspiceD instead.	
Trigger	`trigger`	Specifies the triggering mode. For `prbs`, it specifies the direction of control signal at the crossing event. Possible values are `rise`, `fall`, and `both`.	
Type	`csType`		
Type of input of source	`inputtype`	Type of input of the source. Possible values are `single`, `and`, `nand`, `or`, `nor`, `npwl`, or `ppwl`.	`nil`
Type of input	`modelType`	Type of input selected for the component. Possible values are `RLGC`, `FieldSolver`, `Tline, and S-parameter`.	`nil`
Type of Port 1 to Type of Port20	`porttype1 - porttype20`	Types of ports. Use 0 for input port, 1 for output port, and 2 if the port is both input and output.	
Use S-parameters	`useSParamsCheckBox`	Controls whether S-parameters are specified or not.	
White noise expression	`white_noise`	Generates white noise with given power. Noise contributions with the same tag are combined for a module.	-
Width	`w`		
Width of Polysilicon	`wp`		
Width of metal capacitor	`wm`		
Width of the smoothing window	`smoothpts`		

CDF Parameter Label	CDF Parameter	Description	Default
Ext. Body Contact(PinP)	`PinP`		
Body Node	`BodyNodePin`		
Width of Emitter Window	`wemw`		
Value	`value`		
vcsv Signal Name	`vcsv`	Specifies the name of the VCSV signal.	
Volt/res conversion factor	`transfactor`		
Voltage eqn	`vol`		
Voltage gain	`egain`	Sets the Voltage gain for both Spectre and HspiceD.	
Voltage gain (obsolete)	`hegain`	**Note:** Parameter `hegain` is obsolete. Parameter `egain` is used to set the Voltage gain for both Spectre and HspiceD instead.	
Type of transfer char	`trfType`		
Type of Source	`typesrc`		
XF magnitude	`xfm`	Specifies the magnitude of the transfer function analysis.	
Type of rising & falling edge	`risefalledge`	Specifies the type of edge. Possible values are `rising` or `falling`.	
Voltage 1	`v1`		
Voltage 2	`v2`		
Unity intercept point	`coef`		
use Img subckt	`uselmg`		
Use smooth data windowing	`usewindow`	Possible values are yes and no.	

CDF Parameter Label	CDF Parameter	Description	Default
To print fourier results on	`where`	Where Fourier results should be printed. Possible values are screen, logfile, and both.	logfile
Z state 1 to Z state 50	`Z1 - Z50`	Disable voltage N and netlist z as the value.	No
Dielectric loss cond matrix per unit length	`gdloss`	Dielectric loss conductance matrix per unit length.	
Frequency scale factor	`freqscale`	The frequency scale factor for frequency-dependent RLGC data and S-parameter data.	
Multiplicity factor	`mf`	Specifies the number of ports in parallel. The value must be a non-zero real number.	1
Model name	`model`	Specifies the name of the model to be associated with the component.	-
Number of dielectric layers	`numlayer`	Number of dielectric layers.	1
Number of Ground Planes	`numgnd`	Number of ground planes,	1
Num of lines (excluding ref.)	`n`	Number of lines.	1
Conductor loss frequency	`fcmt`	Conductor loss frequency. Used in conjunction with `seriesr`, `qc`, or `alphac`.	
Frequency	`fmt`	Reference frequency, used in conjunction with `nl` to specify electrical length of line.	
Normalized length	`nlmt`	Normalized electrical length in wavelengths at the specified reference frequency of a lossless line.	

CDF Parameter Label	CDF Parameter	Description	Default
Propagation velocity normalized	`velmt`	Propagation velocity of the line given as a multiple of c, the speed of light in free space (vel <= 1).	
Corner frequency	`corner`	Corner frequency for skin effect.	
DC series res/Length	`dcr`	DC series resistance per unit length.	
Loss resistance per unit length	`seriesr`	Conductor (series) resistance per unit length at `fc`.	
Conductor loss at fc	`alphac`	Conductor loss measurement frequency(low loss approximation).	
Conductor loss quality factor	`qc`	Conductor loss quality factor at conductor loss measurement frequency (low loss approximation).	
Dielectric loss frequency	`fd`	Dielectric loss measurement frequency.	
Loss conductance per unit length	`shuntg`	Dielectric (shunt) conductance per unit length at conductor loss measurement frequency.	
Dielectric loss	`alphad`	Dielectric loss (low loss approximation).	
Dielectric loss quality factor	`qd`	Dielectric loss quality factor at dielectric loss measurement frequency (low loss approximation).	
Rel dielectric const of layers(er)	`er`	Relative dielectric constant.	
Dielectric layer thickness (d)	`layerthickness`	Dielectric layer thickness.	

CDF Parameter Label	CDF Parameter	Description	Default
Dielectric loss type	`dlosstype`	Dielectric loss type. The loss value is specified using the `dloss` parameter. Possible values are *sigma* and *tangent*.	
Dielectric layer loss	`dloss`	Dielectric layer loss. The loss can be in terms of dielectric conductivity or tangent loss, determined by the dlosstype parameter.	
Quality Factor/Q	`q`	Quality factor specified for capq and indq.	
Signal line width	`linewidth`	Signal line width,	
Signal line thickness	`linethickness`	Signal line thickess.	
Signal line height (h)	`lineheight`	Signal line height.	
Signal line spacing	`linespace`	Signal line spacing.	
Gnd Plane thickness	`gndthickness`	Ground plane thickness.	
Ground plane conductivity	`gndsigma`	Ground plane conductivity.	
Signal line conductivity	`linesigma`	Signal line conductivity.	
Charecteristic impedance	`z0`	Characteristic impedance of lossless line.	50 Ohms
Delay Time	`tdmt`	Specifies the time delay of a lossless line in `second`.	
Physical length	`len`	Effective physical length of magnetic path (used with ‘vel’ to specify electrical length of line).	
RLCG data file	`file`	Specifies the name of the RLGC data file.	
RLCG data file as Design var?	`rlgc_file_as_var`	Checks if the RLGC data file is used as a design variable.	

CDF Parameter Label	CDF Parameter	Description	Default
S-parameter File	`file1`	S-parameter file path. Uses the S-parameter file name only when *S-parameter file as Design Var?* is enabled.	
S-parameter file as Design Var?	`sparam_file_as_var`	Checks if the S-parameter file is used as a design variable.	-
Transmission line type	`linetype`	Transmission line type. Possible values are `microstrip`, `stripline`, `coplanar`, and `sublossline`.	
Type of input	`modelType`	Type of input selected for the component. Possible values are `RLGC`, `FieldSolver`, `Tline`, `and S-parameter`.	`nil`

Related Topics

Active Components in Analog Library

Analysis Specific Components in Analog Library

Parasitic Components in Analog Library

Passive Components in Analog Library

Sources - Dependent Components in Analog Library

Sources - Global Components in Analog Library

Sources - Independent Components in Analog Library

Sources - Z_S_Domain Components in Analog Library

B

Analog Library Support for hspiceD Components

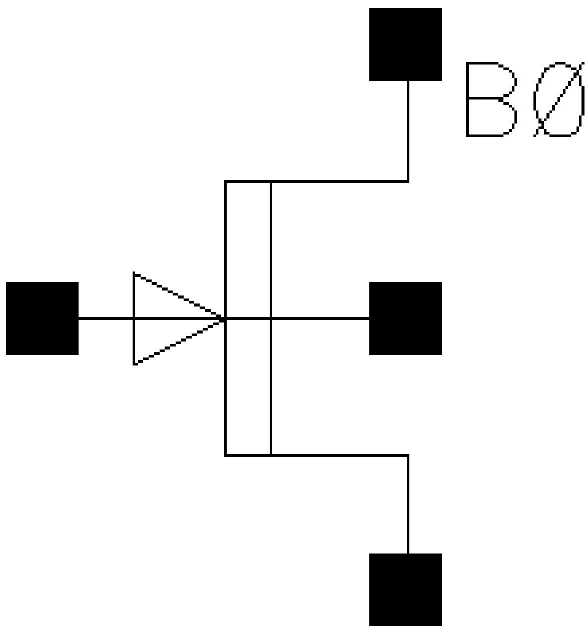
This topic lists all the Analog Library components that are primarily supported by `hspiceD`.

- Active Components
- Passive Components
- Sources - Dependent Components
- Sources - Independent Components

Active Components

The component in the `Active` category in `hspiceD` is N-type MES FET Transistor (`nmes4`).

nmes4 Symbol



Description

N-type MES FET Transistor is a component in `hspiceD` category with 4 Terminals.

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Device area	`area`	-	-	-	x	-
Device initially off	`off`	-	-	-	x	-
Drain source initial voltage	`Vds`	-	-	-	x	-
Gate source initial voltage	`Vgs`	-	-	-	x	-
Bulk source initial voltage	`Vbs`	-	-	-	x	-
Width	`w`	-	-	-	x	-
Length	`l`	-	-	-	x	-
Model name	`model`	-	-	-	x	-
Multiplier	`m`	-	-	-	x	-
Temperature difference	`dtemp`	-	-	-	x	-

Related Topics

Passive Components

Sources - Dependent Components

Sources - Independent Components

Active Components in Analog Library

auCdl and auLvs Components in Analog Library

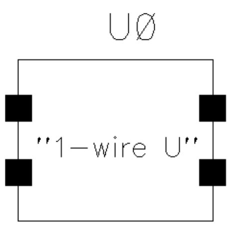
CDF Parameters Supported by Analog Library Components

Passive Components

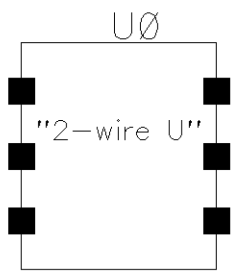
The component in the `Passive` category in `hspiceD` are as follows:

- uxwire Symbol
- vccap Symbol
- vcres Symbol

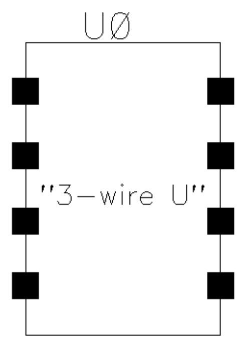
uxwire Symbol



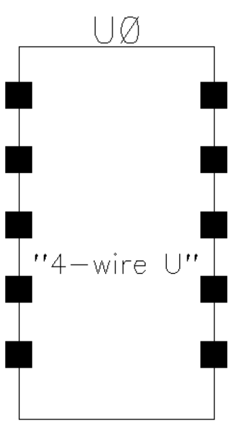
u1wire



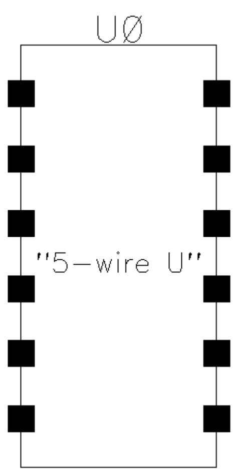
u2wire



u3wire



u4wire

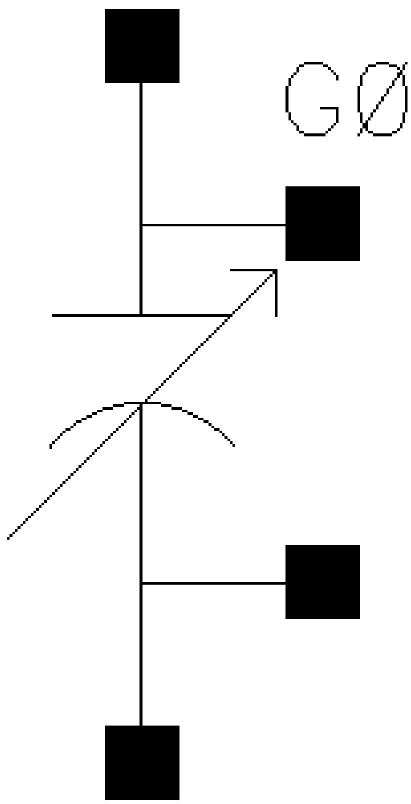


u5wire

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Model name	`model`	-	-	-	x	-
Length	`l`	-	-	-	x	-
# of lumps in element	`lumps`	-	-	-	x	-

vccap Symbol

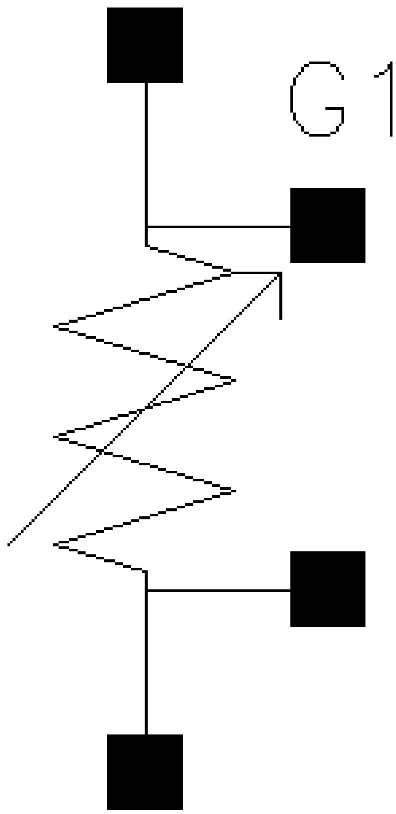


Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Scale factor	`scale`	x	-	-	x	-
Multiplier	`hm`	x	-	-	x	-
Temperature coefficient 1	`tc1`	x	-	-	x	-
Temperature coefficient 2	`tc2`	x	-	-	x	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Initial condition	`hic`	x	-	-	x	-
Delta	`delta`	x	-	-	x	-
Type	`csType`	x	-	-	x	-
Number of controlling pairs	`xypairs`	x	-	-	x	-
Controlling Volt 1	`x1 - x20`	x	-	-	x	-
Corresp Element 1	`y1 -y20`	x	-	-	x	-

vcres Symbol



Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Type	csType	x	-	-	x	x
Volt/res conversion factor	transfactor	x	-	-	x	x
Maximum output resistance	maxr	x	-	-	x	-
Minimum output resistance	minr	x	-	-	x	-
Scale factor	scale	x	-	-	x	x
Multiplier	hm	x	-	-	x	-
Temperature coefficient 1	tc1	x	-	-	x	x
Temperature coefficient 2	tc2	x	-	-	x	x
Initial condition	hic	x	-	-	x	-

Related Topics

Active Components

Sources - Dependent Components

Sources - Independent Components

Passive Components in Analog Library

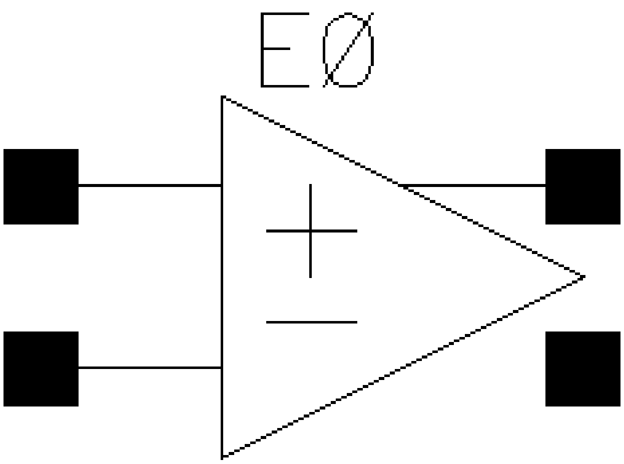
CDF Parameters Supported by Analog Library Components

Sources - Dependent Components

The component in the `Sources-Dependent` category in `hspiceD` are as follows:

- iopamp Symbol
- ixfmr Symbol

iopamp Symbol

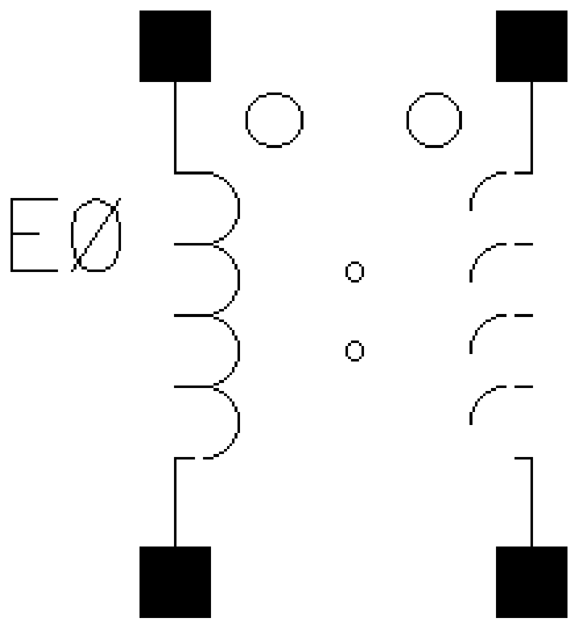


Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Scale factor	`scale`	-	-	-	x	-
Multiplier	`hm`	-	-	-	x	-
Temperature coefficient 1	`tc1`	-	-	-	x	-
Temperature coefficient 2	`tc2`	-	-	-	x	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Initial condition	`hic`	-	-	-	x	-
Delta	`delta`	-	-	-	x	-
Type	`csType`	-	-	-	x	-
Number of controlling pairs	`xypairs`	-	-	-	x	-
Controlling Volt 1	`x1 - x20`	-	-	-	x	-
Corresp Element 1	`y1 -y20`	-	-	-	x	-

ixfmr Symbol



Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Coupling coefficient	`k`	-	-	-	x	-

Related Topics

Active Components

Passive Components

Sources - Independent Components

Sources - Dependent Components

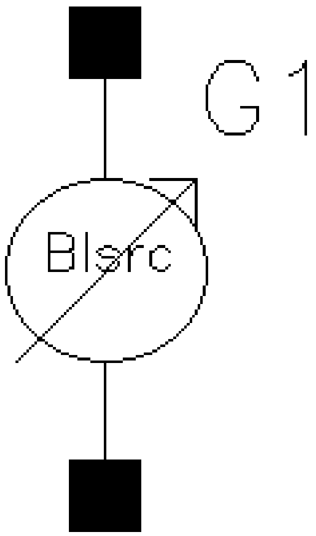
CDF Parameters Supported by Analog Library Components

Sources - Independent Components

The component in the `Sources-Independent` category in `hspiceD` are as follows:

- bcs Symbol
- bvs Symbol
- iam Symbol
- isffm Symbol
- vam Symbol
- vsffm Symbol

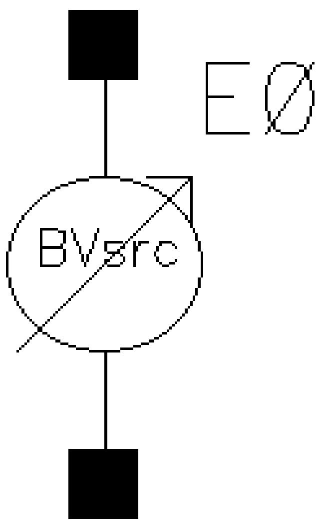
bcs Symbol



Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Current eqn	`cur`	-	-	-	x	-
Min	`min`	-	-	-	x	-
Max	`max`	-	-	-	x	-
Scale factor	`scale`	-	-	-	x	-
Multiplier	`hm`	-	-	-	x	-

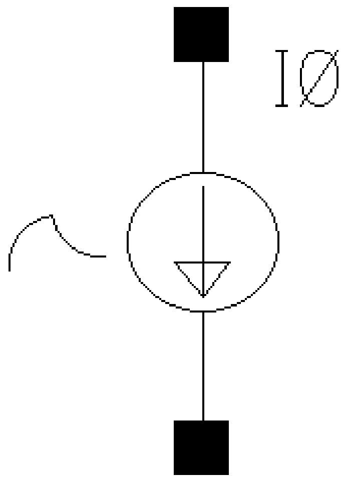
bvs Symbol



Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Voltage eqn	`vol`	-	-	-	x	-
Min	`min`	-	-	-	x	-
Max	`max`	-	-	-	x	-

iam Symbol

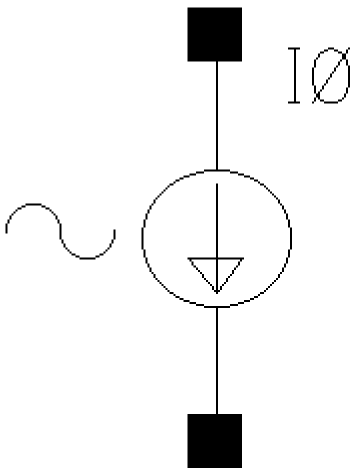


Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Signal amplitude	sa	-	-	-	x	-
Carrier frequency	fc	-	-	-	x	-
Modulation frequency	fm	-	-	-	x	-
Offset constant	oc	-	-	-	x	-
Delay time	td	-	-	-	x	-
DC source	dc	-	-	-	x	-
Multiplier	m	-	-	-	x	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	`acm`	-	-	-	x	-
AC phase	`acp`	-	-	-	x	-

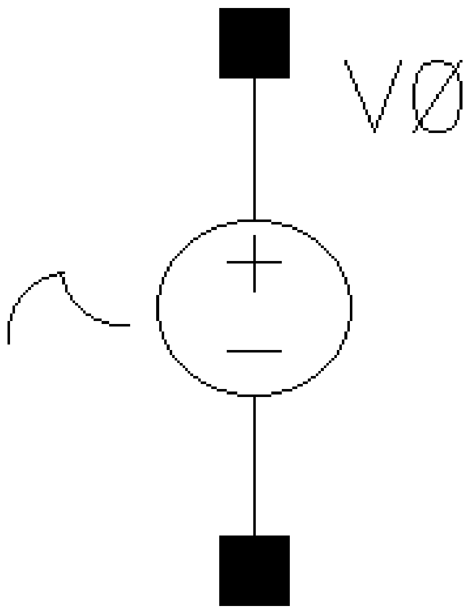
isffm Symbol



Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	acm	-	-	-	x	-
AC phase	acp	-	-	-	x	-
DC current	idc	-	-	-	-	-
Offset current	io	-	-	-	x	-
Amplitude	ia	-	-	-	x	-
Frequency	freq	-	-	-	x	-
Modulation index	mdi	-	-	-	x	-
Signal frequency	fs	-	-	-	x	-
Multiplier	m	-	-	-	x	-

vam Symbol

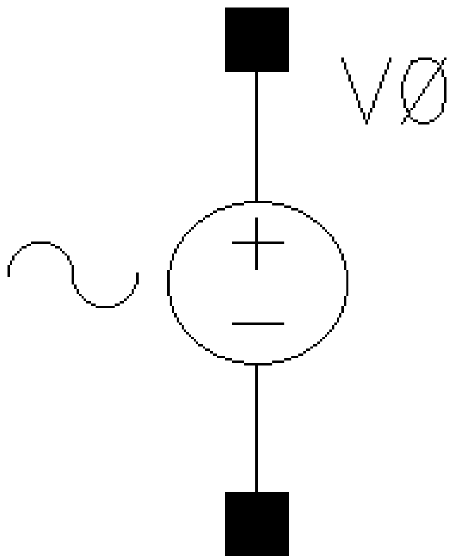


Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Signal amplitude	sa	-	-	-	x	-
Carrier frequency	fc	-	-	-	x	-
Modulation frequency	fm	-	-	-	x	-
Offset constant	oc	-	-	-	x	-
Delay time	td	-	-	-	x	-
DC source	dc	-	-	-	x	-

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
AC magnitude	`acm`	-	-	-	x	-
AC phase	`acp`	-	-	-	x	-

vsffm Symbol



Related Topics

Active Components

Passive Components

Sources - Dependent Components

Sources - Independent Components in Analog Library

CDF Parameters Supported by Analog Library Components

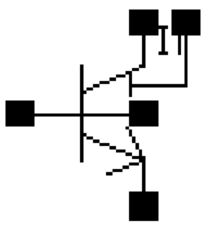
C

auCdl and auLvs Components in Analog Library

The following components are supported only by `auCdl` or `auLvs`:

- bjt504tnpn Symbol
- bjt504tpnp Symbol
- bsim4 Symbol
- nsoi Symbol
- scr Symbol
- vbic Symbol

bjt504tnpn Symbol



Description

The Compact Bipolar-Transistor Model provides a detailed description of a vertical integrated NPN transistor.

Command-Line Help

```
spectre -h bjt502
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-	-	-	-
Number of devices in parallel	`mult`	x	-	-	-	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-	-	-	-
Multiplicity factor	`m`	x	-	-	-	-	-	-	-
Alias of mult	`area`	x	-	-	-	-	-	-	-

Syntax/Synopsis

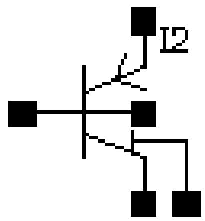
```
Name ( c b e s ) ModelName <parameter=value> ...
```

Related Topics

Active Components in Analog Library

CDF Parameters Supported by Analog Library Components

bjt504tpnp Symbol



Description

The Compact Bipolar-Transistor Model provides a detailed description of a vertical integrated PNP transistor.

Command-Line Help

```
spectre -h bjt502
```

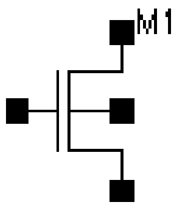
Component Parameters

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-	-	-	-
Number of devices in parallel	`mult`	x	-	-	-	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-	-	-	-
Multiplicity factor	`m`	x	-	-	-	-	-	-	-
Alias of mult	`area`	x	-	-	-	-	-	-	-

Syntax/Synopsis

```
Name ( c b e s ) ModelName <parameter=value> ...
```

bsim4 Symbol



Description

This component is a simple BSIM MOS transistor.

Command-Line Help

```
spectre -h bsim4
```

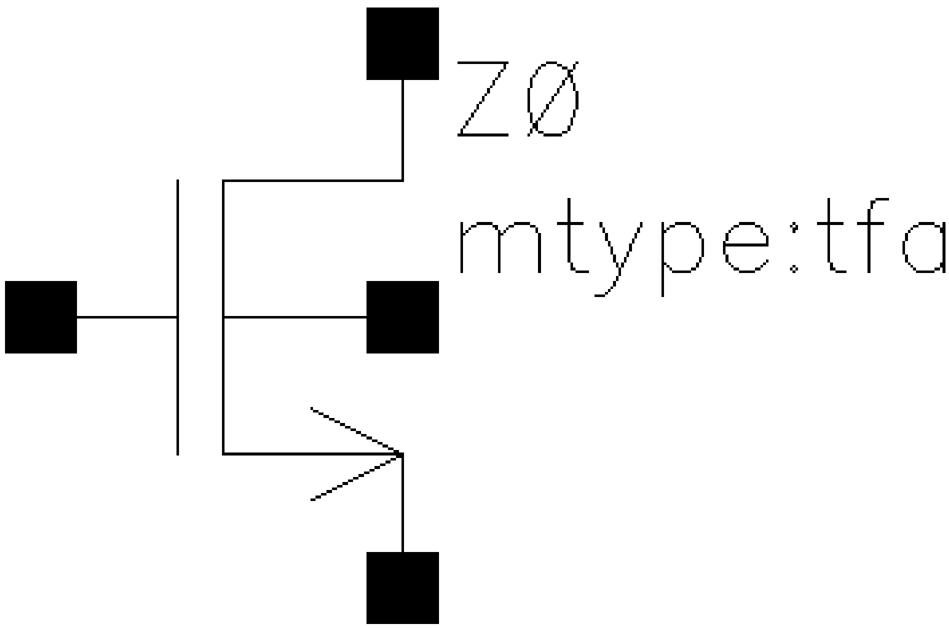
Component Parameters

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-	-	-	-
Integral-1st distribution func	`sca`	x	-	-	-	-	-	-	-
Integral-2nd distribution func	`scb`	x	-	-	-	-	-	-	-
Integral-3rd distribution func	`scc`	x	-	-	-	-	-	-	-
Distance to a single well edge	`sc`	x	-	-	-	-	-	-	-
shift in 0-bias threshold vth0	`delvo`	x	-	-	-	-	-	-	-
Gate contact-channel edge	`xgw`	x	-	-	-	-	-	-	-
Number of gate contacts	`ngcon`	x	-	-	-	-	-	-	-

Syntax/Synopsis

```
Name ( d g s b ) ModelName <parameter=value> ...
```

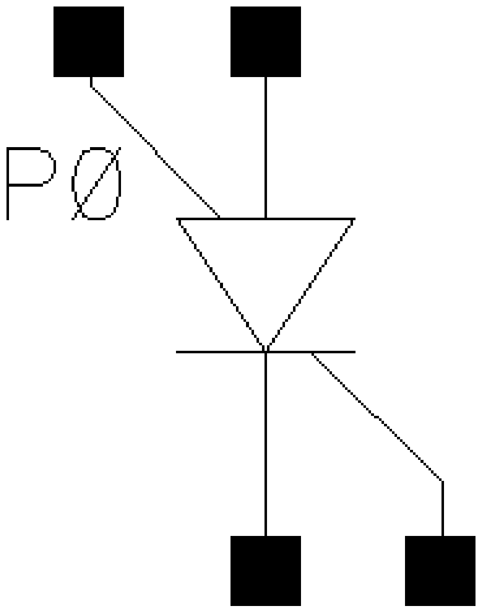
nsoi Symbol



Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Bulk node connection	`bn`	-	-	x	-	-
Multiplier	`m`	-	x	x	-	-
Width	`w`	-	x	x	-	-
Length	`l`	-	x	x	-	-

scr Symbol



Description

Silicon Controlled Rectifier is a conventional rectifier controlled by a gate signal. Although the main circuit is a rectifier, the application of a forward voltage is not enough for conduction. Therefore, a gate signal controls the rectifier conduction.

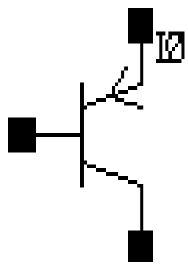
Component Parameters

CDF Parameter Label	CDF Parameter	spectre	auCdl	auLvs	hspiceD	UltraSim
Bulk node connection	bn	-	-	x	-	-

Examples

```
P231   32   5   21   8   7   PSCR
PN01   25   14   18   2   PMOD   IC=-.8 .8 -15
```

vbic Symbol



Description

This component is a bipolar transistor.

Command-Line Help

```
spectre -h vbic
```

Component Parameters

CDF Parameter Label	CDF Parameter	spectre	spectreS	cdsSpice	auCdl	auLvs	hspiceS	hspiceD	UltraSim
Model name	`model`	x	-	-	-	-	-	-	-
Optional Node configuration	`vbicOpNodes`	x	-	-	-	-	-	-	-
Device area	`area`	x	-	-	-	-	-	-	-
Multiplier	`m`	x	-	-	-	-	-	-	-
Estimated operating region	`region`	x	-	-	-	-	-	-	-
Temp rise from ambient	`trise`	x	-	-	-	-	-	-	-
Temperature difference	`dtemp`	x	-	-	-	-	-	-	-

Syntax/Synopsis

```
Name ( c b e [s] [dt] [tl] ) ModelName <parameter=value> ...
```

Related Topics

Active Components in Analog Library