

Schematic pcell implementation in Virtuoso[®] platform

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Content



- What are parameterized cells ?
- Motivation
- Creating a schematic pcell
- Pcell architecture
- Examples from Virtuoso[®] analogLib
- Future work

What are parameterized cells ?



- Graphic, programmable, generic cell
- Allows customized instances
- Layout pcells are in use since many years
- Schematic pcell is a relatively new concept
- Required for changes in :
 - Pins
 - Size
 - Structure/Shape
- Independent of underlying database
- Open Simulation System (OSS) supports pcells

Advantages



- Faster library development
- Compact and efficient libraries
- Less maintenance
- Reduces chances of errors
- Eliminates hierarchy explosion for small changes

Creating a schematic pcell



- Steps to create a pcell
 - Create and edit skill code
 - Compile pcell
 - Define CDF parameter(s)
 - Test pcell
- Netlisting support
- Post processing support

Defining a pcell

skill code



| | | |
|-------------------------|---|---|
| Cell Identifier section | { | pcDefnePcell (list(ddGetObj("libName") "cellName" "viewName" "viewType")) |
| Formal Parameters | { | ((param1 "defaultValue" param2 10)) |
| Body of pcell | { | (;; Create symbol shape & connectivity)) |

- Compiled skill function < 64 K
- You can call your own functions within pcells
- pcCellView is an internal variable automatically created
- Should be compiled in PD workbenches (icfb, layoutPlus etc.)

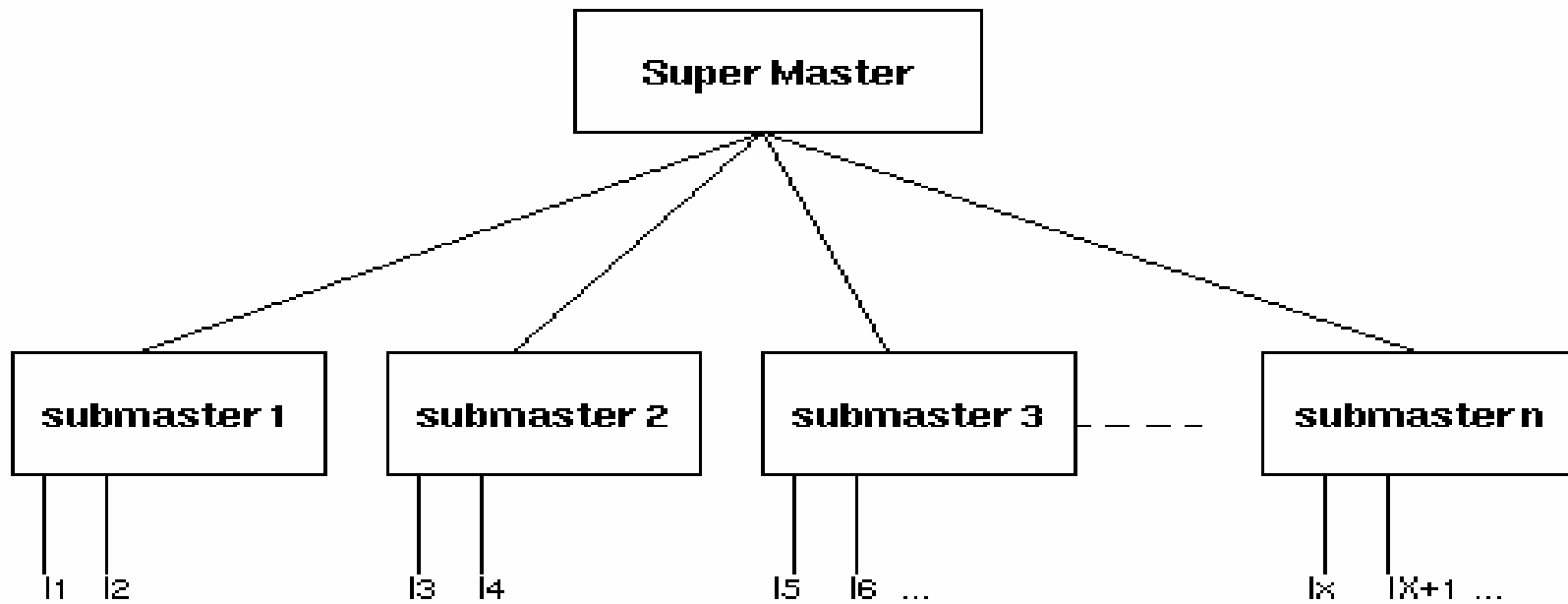
Specifying parameter values



The order in which system looks for value of parameters

1. On the instance
2. In the CDF for cell
3. In the CDF for library
4. In the pcDefinePcell function (default values)

Pcell architecture



- You cannot descend into submaster from an instance of pcell.
- Edits to master does not reflect on instances unless you compile.

Examples from Virtuoso[®] analogLib

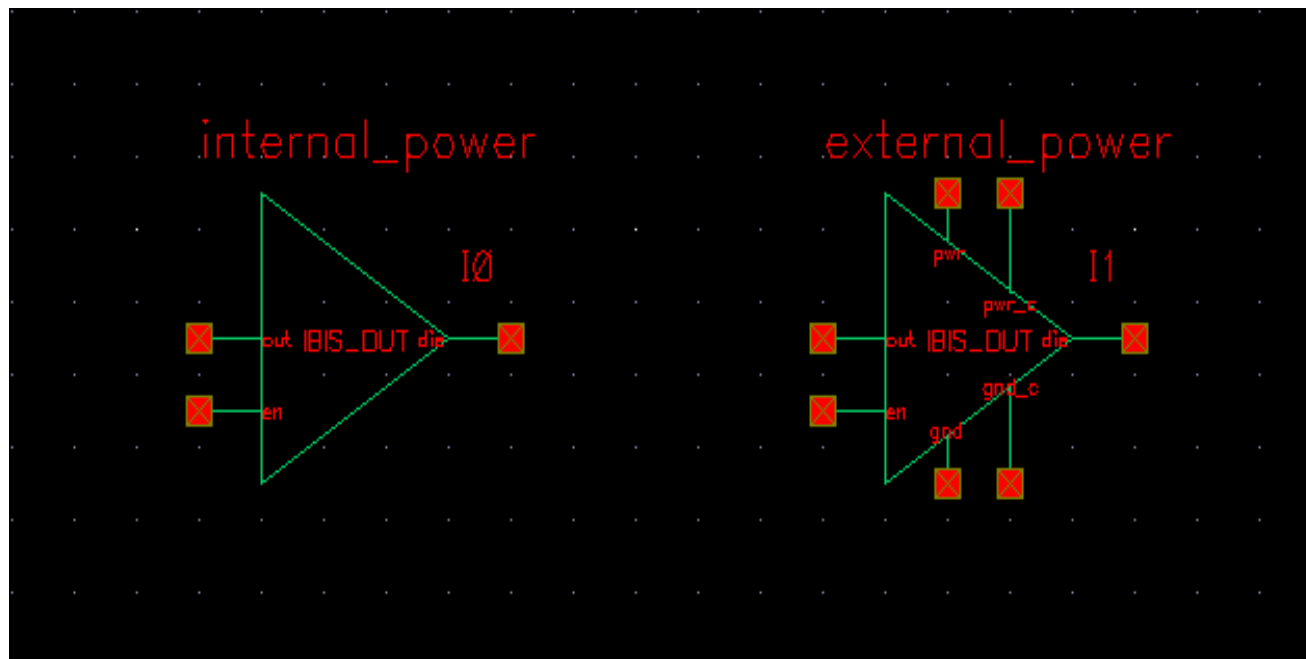


- `${CDS_INST_DIR}/tools/dfl/etc/cdslib/artist/analogLib`
- Some pcells in Virtuoso[®] analogLib:
 - `ibis_buffer`
 - `mtline`
 - `nport`
 - `scasubckt`
 - `vccsp`
 - `vcvsp`

Virtuoso[®] analogLib: ibis_buffer

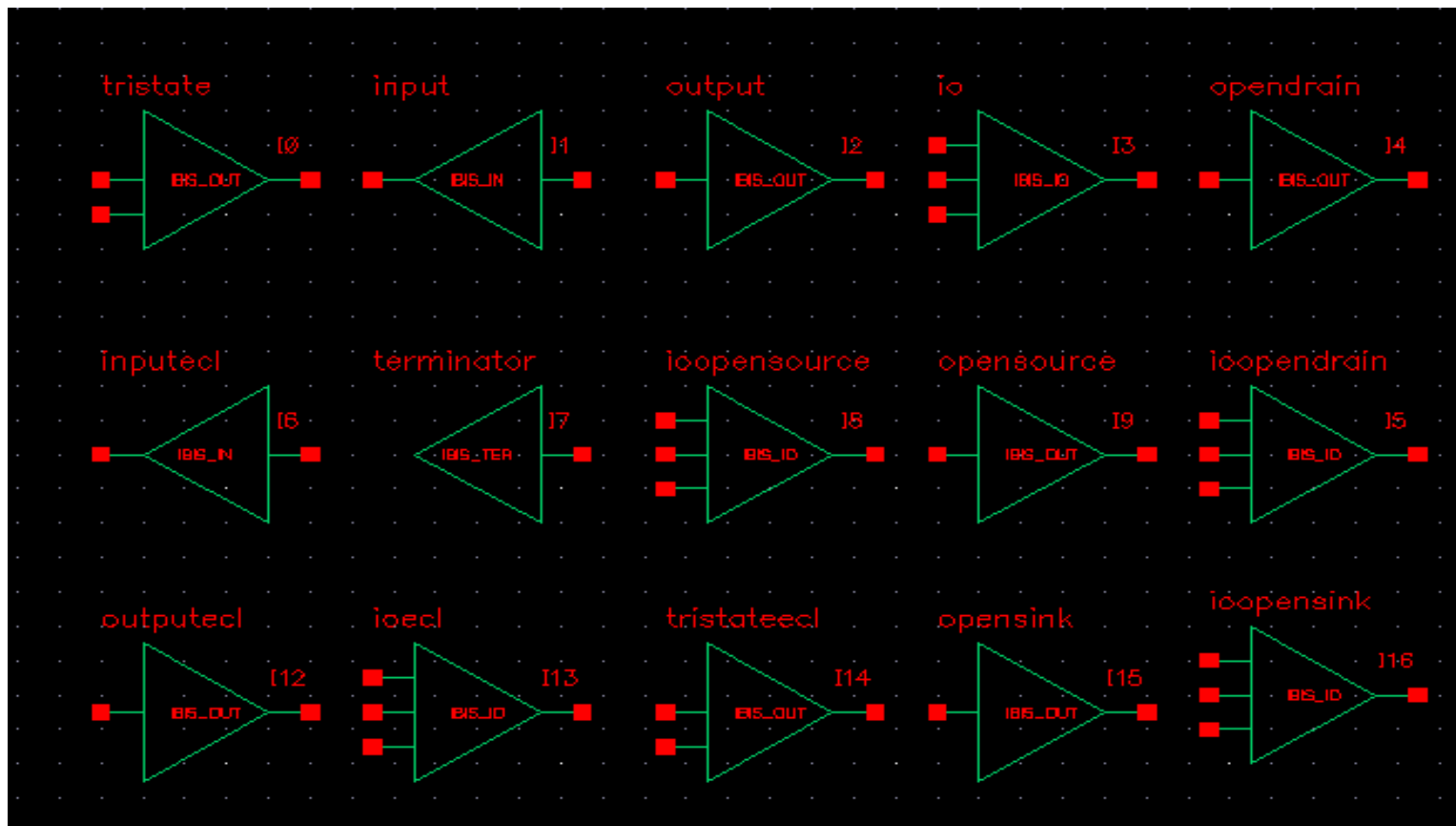


- Formal Parameters:
 - Buffer Variant (buffervariant)
 - Buffer Type (bufferType)



ibis_buffer cont...

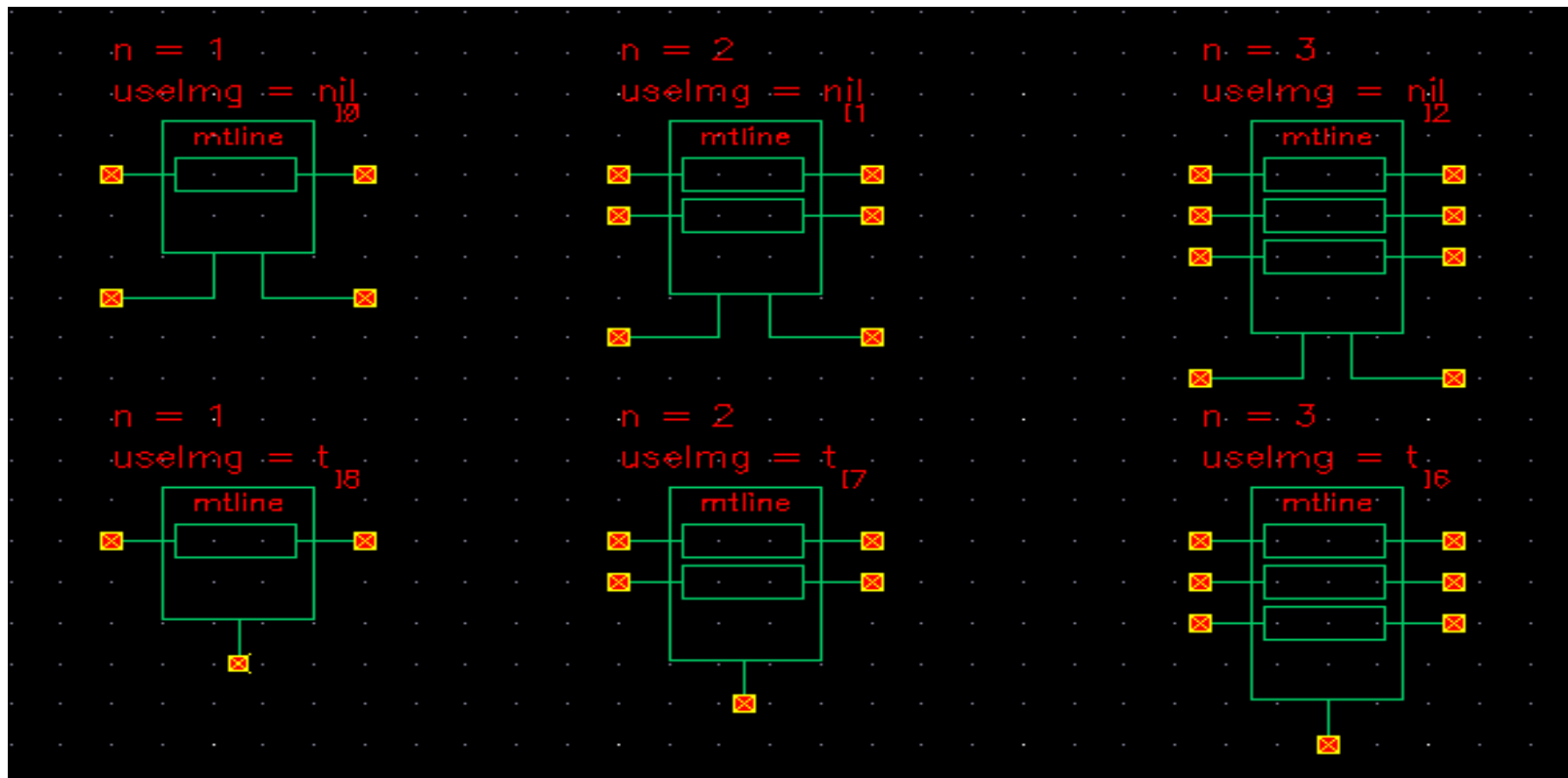
Buffer Type



Virtuoso[®] analogLib: mtline



- Formal Parameters:
 - Number of lines (n)
 - Use LMG subckt (uselmg)



Setting Instance Parameters



The screenshot shows the Virtuoso Schematic Editing interface. The main window title is "Virtuoso® Schematic Editing: myLib mtline_new schematic". The menu bar includes "Tools", "Design", "Window", "Edit", "Add", "Check", "Sheet", "Options", and "Help". The status bar shows "Cmd: Instance" and "Sel: 0".

The "Library Browser - Add Instance" dialog is open, displaying a list of libraries and cells. The "Library" column lists: analogLib, US_8ths, ahdLib, analogLib (highlighted), basic, cdsDefTechLib, functional, myLib, rfExamples, and rflib. The "Cell" column lists: mtline (highlighted), ibis_buffer, idc, ideal_balun, iexp, ind, iopamp, iprobe, ipulse, ipwl, ipwlf, isffm, isin, isource, ixfrm, mind, mline, mtline (highlighted), n1port, n2port, n3port, n4port, nbsim, nbsim4, njfet, nmes, nmes4, nmos, nmos4, nodeQuantity, noise, npn, and nport. The "View" column lists: symbol (highlighted), spectre, and symbol.

The "Add Instance" dialog is also open, showing the following fields and options:

- Library: analogLib
- Cell: mtline
- View: symbol
- Names: [empty]
- Array: Rows: 1, Columns: 1
- Rotate, Sideways, Upside Down (checkboxes)
- Num of lines (excluding ref.): 1
- RLCG data file: [empty]
- use lmg subckt: [checkbox]
- Invoke 'LMG' parameter extraction tool: [checkbox]
- Physical length: [empty]

Setting Instance Parameters ...



The screenshot shows the Virtuoso Schematic Editing interface. The main window title is "Virtuoso® Schematic Editing: myLib mtline_new schematic". The menu bar includes "Cmd: Instance", "Sel: 0", "Tools", "Design", "Window", "Edit", "Add", "Check", "Sheet", "Options", and "Help". A toolbar on the left contains various icons for editing and design. The main workspace shows a schematic diagram with a yellow box and lines. An "Add Instance" dialog box is open in the foreground, with the following fields and options:

- Library: analogLib
- Cell: mtline
- View: symbol
- Names: (empty)
- Array: Rows: 1, Columns: 1
- Buttons: Rotate, Sideways, Upside Down
- Num of lines (excluding ref.): 1
- RLCG data file: (empty)
- use lmg subckt:
- Invoke 'LMG' parameter extraction tool: (empty)
- Physical length: (empty)

At the bottom of the dialog box, there is a status bar with the text "mouse L: mouseAddPt()" and "Point at location for the inst".

Setting Instance Parameters ...



The screenshot shows the Virtuoso Schematic Editor interface. The title bar reads "Virtuoso® Schematic Editing: myLib mtline_new schematic". The menu bar includes "Cmd: Instance", "Sel: 0", "Tools", "Design", "Window", "Edit", "Add", "Check", "Sheet", "Options", and "Help". The main workspace displays two schematic symbols: a green one labeled "mtline" and a yellow one. An "Add Instance" dialog box is open in the foreground, with the following fields and options:

- Library: analogLib
- Cell: mtline
- View: symbol
- Names: (empty)
- Array: Rows: 1, Columns: 1
- Rotate: (button), Sideways: (button), Upside Down: (button)
- Num of lines (excluding ref.): 1
- RLCG data file: (empty)
- use lmg subckt:
- Invoke 'LMG' parameter extraction tool: (button)
- Physical length: (empty)

At the bottom of the dialog box, there are buttons for "Hide", "Cancel", "Defaults", and "Help". The background schematic shows a grid with two symbols: a green one labeled "mtline" and a yellow one. The status bar at the bottom of the editor shows "mouse L: mouseAddPt()" and "Point at location for the inst".

Setting Instance Parameters ...



Virtuoso® Schematic Editing: myLib mtline_new schematic

Cmd: Instance Sel: 0

Tools Design Window Edit Add Check Sheet Options Help

mouse L: mouseAddPt() M: mousePopUp() R:

Point at location for the instance.

Physical length

Setting Instance Parameters ...



Virtuoso® Schematic Editing: myLib mtlne_new schematic

Cmd: Sel: 1 4

Tools Design Window Edit Add Check Sheet Options Help

The schematic shows three instances of a component named 'mtlne' on a grid background. Instance I0 is on the left, I1 is in the middle, and I2 is on the right. Each instance consists of a green rectangular box with a smaller green box inside, connected to four red square terminals. Instance I1 is highlighted with a white border.

Property

mouse L: mouseSingleSelectPt M: mousePopUp() R: schHiCreateInst()

Setting Instance Parameters ...



Virtuoso® Schematic Editing: myLib mtline_new schematic

Cmd: Sel: 1

Tools Design Window Edit Add Check Sheet Options Help

Edit Object Properties

OK Cancel Apply Defaults Previous Next Help

Apply To: only current instance

Show: system user CDF

| Property | Value | Display |
|---------------|-----------|---------|
| Library Name | analogLib | off |
| Cell Name | mtline | off |
| View Name | symbol | off |
| Instance Name | I1 | off |

CDF Parameter

| Parameter | Value | Display |
|-------------------------------|--------------------------|---------|
| Num of lines (excluding ref.) | 1 | off |
| RLCG data file | | off |
| use lmg subckt | <input type="checkbox"/> | off |

R: schHiObjectProperty()

Setting Instance Parameters ...



Virtuoso® Schematic Editing: myLib mtline_new schematic

Cmd: Sel: 1

Tools Design Window Edit Add Check Sheet Options Help

Edit Object Properties

OK Cancel Apply Defaults Previous Next Help

Apply To: only current instance

Show: system user CDF

| Property | Value | Display |
|---------------|-----------|------------------------------|
| Library Name | analogLib | <input type="checkbox"/> off |
| Cell Name | mtline | <input type="checkbox"/> off |
| View Name | symbol | <input type="checkbox"/> off |
| Instance Name | I1 | <input type="checkbox"/> off |

Add Delete Modify

| CDF Parameter | Value | Display |
|-------------------------------|--------------------------|------------------------------|
| Num of lines (excluding ref.) | 2 | <input type="checkbox"/> off |
| RLCG data file | | <input type="checkbox"/> off |
| use lmg subckt | <input type="checkbox"/> | <input type="checkbox"/> off |

Invoke 'LMG' parameter extraction tool

R: schHiObjectProperty()

Setting Instance Parameters ...



Virtuoso® Schematic Editing: myLib mtline_new schematic

Cmd: Sel: 1

Tools Design Window Edit Add Check Sheet Options Help

Edit Object Properties

OK Cancel Apply Defaults Previous Next Help

Apply To: only current instance

Show: system user CDF

| Property | Value | Display |
|---------------|-----------|---------|
| Library Name | analogLib | off |
| Cell Name | mtline | off |
| View Name | symbol | off |
| Instance Name | I1 | off |

Add Delete Modify

| CDF Parameter | Value | Display |
|-------------------------------|--------------------------|---------|
| Num of lines (excluding ref.) | 2 | off |
| RLCG data file | | off |
| use lmg subckt | <input type="checkbox"/> | off |

Invoke 'LMG' parameter extraction tool

R: schHiObjectProperty()

Setting Instance Parameters ...



Virtuoso® Schematic Editing: myLib mtlire_new schematic

Cmd: Sel: 1 4

Tools Design Window Edit Add Check Sheet Options Help

The screenshot shows a schematic editing window with a dark background and a grid. Three instances of a component named "mtlire" are shown. Each instance is represented by a green rectangular box with four red square terminals. The middle instance is selected, indicated by a white rectangular border around it and the label "I1" in red text above it. The other two instances are labeled "I0" and "I2".

mouse L: mouseSingleSelectPt M: mousePopUp () R: schHiObjectProperty ()

Setting Instance Parameters ...



Virtuoso® Schematic Editing: myLib mtlne_new schematic

Cmd: Sel: 1 4

Tools Design Window Edit Add Check Sheet Options Help

Property

mouse L: mouseSingleSelectPt M: mousePopUp() R: schHiObjectProperty()

Setting Instance Parameters ...



Virtuoso® Schematic Editing: myLib mtline_new schematic

Cmd: Sel: 1

Tools Design Window Edit Add Check Sheet Options Help

Edit Object Properties

OK Cancel Apply Defaults Previous Next Help

Apply To: only current instance

Show: system user CDF

| Property | Value | Display |
|---------------|-----------|---------|
| Library Name | analogLib | off |
| Cell Name | mtline | off |
| View Name | symbol | off |
| Instance Name | I0 | off |

Add Delete Modify

| CDF Parameter | Value | Display |
|-------------------------------|--------------------------|---------|
| Num of lines (excluding ref.) | 1 | off |
| RLCG data file | | off |
| use lmg subckt | <input type="checkbox"/> | off |

Invoke 'LMG' parameter extraction tool

R: schHiObjectProperty()

Setting Instance Parameters ...



Virtuoso® Schematic Editing: myLib mtlire_new schematic

Cmd: Sel: 1

Tools Design Window Edit Add Check Sheet Options Help

Edit Object Properties

OK Cancel Apply Defaults Previous Next Help

Apply To: only current instance

Show: system user CDF

| Property | Value | Display |
|---------------|-----------|---------|
| Library Name | analogLib | off |
| Cell Name | mtlire | off |
| View Name | symbol | off |
| Instance Name | I0 | off |

Add Delete Modify

| CDF Parameter | Value | Display |
|-------------------------------|-------------------------------------|---------|
| Num of lines (excluding ref.) | 1 | off |
| LMG subcircuit file | | off |
| use lmg subckt | <input checked="" type="checkbox"/> | off |

Invoke 'LMG' parameter extraction tool

R: schHiObjectProperty()

Setting Instance Parameters ...



Virtuoso® Schematic Editing: myLib mtline_new schematic

Cmd: Sel: 1

Tools Design Window Edit Add Check Sheet Options Help

Edit Object Properties

OK Cancel Apply Defaults Previous Next Help

Apply To: only current instance

Show: system user CDF

| Property | Value | Display |
|---------------|-----------|------------------------------|
| Library Name | analogLib | <input type="checkbox"/> off |
| Cell Name | mtline | <input type="checkbox"/> off |
| View Name | symbol | <input type="checkbox"/> off |
| Instance Name | I0 | <input type="checkbox"/> off |

Add Delete Modify

| CDF Parameter | Value | Display |
|-------------------------------|-------------------------------------|------------------------------|
| Num of lines (excluding ref.) | 1 | <input type="checkbox"/> off |
| LMG subcircuit file | | <input type="checkbox"/> off |
| use lmg subckt | <input checked="" type="checkbox"/> | <input type="checkbox"/> off |

Invoke 'LMG' parameter extraction tool

R: schHiObjectProperty()

Setting Instance Parameters ...



Virtuoso® Schematic Editing: myLib mtlne_new schematic

Cmd: Sel: 1 4

Tools Design Window Edit Add Check Sheet Options Help

The schematic diagram shows three instances of a component named 'mtlne' on a grid background. The first instance on the left is labeled 'I0' and has four red connection points. The middle instance is labeled 'I1' and has four red connection points. The third instance on the right is labeled 'I2' and has two red connection points. Each instance is represented by a green rectangular box with internal lines and a smaller inner box.

mouse L: mouseSingleSelectPt M: mousePopUp() R: schHiObjectProperty()

Future work



- Virtuoso[®] AMS designer does not fully support pcells
- Dynamic simInfo (Netlister support)
- Dynamic termOrder, termMapping (Post-processing)
- New components in Virtuoso[®] analogLib (on need basis)