Advanced Design System 2002
RFIC Dynamic Link

February 2002
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Chapter 1: Introduction

Agilent Technologies and Cadence Design Systems both offer powerful EDA design tools. Many of today’s design engineers prefer to use a combination of these tools to take advantage of the strengths of both design environments. Because of this desire to use multiple tools, Agilent Technologies has developed the RFIC Dynamic Link for Cadence. The Dynamic Link enables both tops-down and bottoms-up design and simulation in Advanced Design System (ADS) using IC designs from the Cadence database.

Advanced Design System

Advanced Design System has been developed specifically to simulate the entire communications signal path. This unique solution integrates the widest variety of proven RF, DSP, and electromagnetic design tools into a single, flexible environment. Building on years of expertise developing new technologies for our EDA tools, such as Series IV and MDS, Advanced Design System provides a broad range of high-performance capability. This makes it easy to explore design ideas, then model the electrical and physical design of the best candidates.

Virtuoso Schematic Composer

The Virtuoso Schematic Composer from Cadence Design Systems is a hierarchical design entry tool used by RFIC circuit designers. Useful for both analog and digital designs, the database created is accessible by the Cadence simulation and physical layout tools. The tool supports multi-sheet schematics, including cross-referencing, symbol creation, automatic HDL cell template generation, global nets and hierarchical property definition for most database objects. The tool also provides hierarchical checking of connectivity, consistency of different cell representations and label attachments.
RFIC Dynamic Link

RFIC Dynamic Link is an EDA framework integration software product based on Inter-Process Communication (IPC), rather than data file translation, maximizing data integrity and ease of use. This manual describes how to install and configure the RFIC Dynamic Link product and assists you in designing and analyzing analog mixed-signal and RF circuits via Dynamic Link. Chapter 3, Getting Started Tutorial is provided to help you quickly get started with using the RFIC Dynamic Link. For information on Library Customization, refer to the RFIC Dynamic Link Library Guide.

RFIC Dynamic Link Use Model

The RFIC Dynamic Link use-model coincides with that of both Cadence and ADS, with only a few exceptions. Essentially, the Affirma Analog Circuit Design Environment (Analog Artist in 4.4.3) user interface is replaced with the Advanced Design System and all of its functionality. The Affirma features that are not directly replaced by ADS are provided on the ArtistUtilities pull-down menu in the Cadence Virtuoso Schematic window.

Note  If the ArtistUtilities pull-down menu does not appear in the Cadence Virtuoso Schematic window, choose Tools > ADS in the Cadence schematic window.

Usage assumes basic familiarity with the Cadence IC Design Framework II (DFII), including Virtuoso schematic capture and Affirma Analog Circuit Design Environment, as well as basic familiarity with design and simulation in the Advanced Design System.

Additional Information

- Wherever a shell variable is set, this manual uses the K-shell syntax.
- Unless otherwise mentioned, assume case sensitivity.
- Terminology used for Agilent Technologies and Cadence EDA Tools is frequently different. For example, a project in ADS is similar to a library in Cadence and design in ADS is similar to a cellview in Cadence.
What’s in this Manual

The goal of this manual is to help you get started, providing relevant examples that teach you how to use the software, and show you where you can get more information as you need it. This manual contains:

- **Chapter 2, Administrative Tasks** describes the system requirements and how to install and configure the software.
- **Chapter 3, Getting Started Tutorial** steps you through the process of simulating a circuit using components from the Dynamic Link analogLib library. Other examples are also included to help you become more familiar with the product.
- **Chapter 4, Starting, Viewing Designs and Exiting** provides information on launching ADS from a Cadence Schematic window, performing some basic operations and closing the Dynamic Link between ADS and Cadence.
- **Chapter 5, Netlisting, Simulating, and Displaying Data** describes the procedures for netlisting and simulating a design as well as viewing the netlist from either ADS or a Cadence schematic window. Information on net, instance and expression name mapping is also provided.
- **Chapter 6, Using Design Variables** describes how to edit a design variable in ADS and also update your Cadence design variables.
- **Chapter 7, Tuning and Optimizing Designs** provides information on tuning and optimizing designs using the ADS tuning and optimization capabilities.
- **Chapter 8, Annotating a DC Solution** describes the steps necessary for annotating ADS DC and Operating Point simulation results to the Cadence schematic design.
- **Chapter 9, Using Additional Features of RFIC Dynamic Link** includes a collection of Dynamic Link features such as using the Netlist File Include component and “Freezing” selective subcircuits. Compatibility features covering support for Duplicate Pin Names, Bus-ports, Buses and Bundles, Unnamed Nets and pPar and iPar are also discussed.
- **Chapter 10, Using Switch Views, Stop Views and the Hierarchy Editor** provides information on using switch views, stop views and the Hierarchy Editor in Dynamic Link.
- **Appendix A, Command Reference and Troubleshooting** describes the function of each of the menu selections provided in Advanced Design System (Cadence Menu), Cadence Schematic window (ArtistUtilities Menu), and the Cadence
Introduction

CIW (ADS Menu) while using the RFIC Dynamic Link. Troubleshooting information that can help you resolve common problems is also provided in this appendix.
Chapter 2: Administrative Tasks

This chapter describes system requirements and how to install and configure the software. You may require help from a UNIX or EDA Administrator to complete these tasks.

System Requirements

This section describes the minimum hardware, operating system, EDA Framework and License requirements necessary for using the RFIC Dynamic Link.

Hardware Requirements

The information in Table 2-1 describes the minimum hardware requirements for the RFIC Dynamic Link.

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAM</td>
<td>256MB</td>
</tr>
<tr>
<td>Swap Space</td>
<td>500MB</td>
</tr>
<tr>
<td>Hard Disk Space</td>
<td>20MB of disk space for installation</td>
</tr>
</tbody>
</table>

Software Requirements

RFIC Dynamic Link version 2002 requires ADS 2002. Dynamic Link is supported by Cadence DFII versions 4.4.3QSR1, 4.4.5 and 4.4.6 and on all UNIX operating system versions from Hewlett Packard, Sun and IBM which run this Cadence software. Refer to Table 2-2 for a summary of supported platforms. For additional information, please contact Cadence Design Systems Inc.
License Requirements
In addition to your standard Advanced Design System licenses, the following additional product licenses are required.

**RFIC Dynamic Link License**
- trans_idf (for ADS 2002)
- Idf_c_interface (previous ADS Dynamic Link Versions)

**Cadence Licenses**
- OASIS_Simulation_Interface
- 34510 - Affirma(TM) analog design environment
- 300 - Virtuoso(R) layout editor (if using layout)

**Note** You must purchase all required Cadence licenses from Cadence Design Systems.
Installing RFIC Dynamic Link

The RFIC Dynamic Link installation procedure continues to be improved to make it easier for you to install and configure.

To install RFIC Dynamic Link:

1. Follow instructions in the ADS “Installation on UNIX Systems” manual to run the SETUP utility and load the install program.

2. After the Agilent EEsof Installation Manager starts, you are prompted to select one of the following installation options:

   • **Typical** - If you choose a Typical installation, the RFIC Dynamic Link will not be installed.
   
   • **Complete** - If you choose a Complete installation, the RFIC Dynamic Link will be automatically installed.
   
   • **Custom** - If you choose a Custom installation, you must select both Simulators and Design Entry and The RFIC Dynamic Link components from the scroll-down list in the Agilent EEsof Software Installation dialog box.

---

**Note**  The Simulators and Design Entry component is the basic ADS software, including the Design Environment, Data Display, and Analog/RF Systems and Signal Processing simulators. This is a minimum requirement for RFIC Dynamic Link.
3. After the installation is complete, you will need to run the `idfConfigCadence` script to configure Cadence for use with RFIC Dynamic Link. This script is located under:

```
$HPEESOF_DIR/bin/idfConfigCadence
```
Configuring the Cadence Install Directory

After the installation procedure (see “Installing RFIC Dynamic Link” on page 2-3), you will need to run the idfConfigCadence script. This script configures the Cadence install directory for use with ADS by adding or modifying five files.

Note You must have write access to your Cadence install directory.

The following four files are created:

<Cadence Installation Dir>/tools/dfII/etc/tools/ads/.cdsenv
<Cadence Installation Dir>/share/cdssetup/hierEditor/ads
<Cadence Installation Dir>/tools/dfII/etc/skill/hnl/ads.ile
<Cadence Installation Dir>/tools/dfII/etc/skill/si/caplib/ads.ile

Note For Cadence versions 4.4.5 & 4.4.6, the second line above is replaced by:
<Cadence Installation Dir>/share/cdssetup/hierEditor/templates/ads

The fifth file, <Cadence Installation Dir>/tools/dfII/etc/tools/auCore/.cdsenv, is edited to add ads to the Tool Filter list of simulators.
Administrative Tasks

Note  The files described in this section are created or modified based on detailed instructions provided in the Cadence OASIS Integrator’s Guide. The information in the Cadence manual describes how to integrate a simulator into Cadence Analog Artist using the Cadence direct toolkit.

Important  While deviating from the information described in the Cadence OASIS Integrator’s Guide may work for RFIC Dynamic Link, the files have been specifically set up to follow the Cadence documentation. Agilent Technologies does not support deviations from this information. For more information, refer to:
Cadence OASIS Integrator’s Guide
Version 4.4.5, December, 1999
Pages 4-12, 4-13, 6-2 and 6-6.

Running the idfConfigCadence Script

Before running the idfConfigCadence script, set HPEESOF_DIR to your ADS installation directory and set your PATH to include Cadence software.

The idfConfigCadence command uses the following general syntax:

```
idfConfigCadence { -h | -ls | -rm }
```

Simply entering idfConfigCadence at the command line with no options runs the script to configure Cadence for RFIC Dynamic Link. Table 2-3 displays a list of the options and definitions used by the idfConfigCadence command.

<table>
<thead>
<tr>
<th>Option</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>-h</td>
<td>This option can be used to display the idfConfigCadence help file.</td>
</tr>
<tr>
<td>-ls</td>
<td>This option can be used to list the Cadence configuration files for ADS/RFIC Dynamic Link and indicate whether Cadence is ready for ADS RFIC Dynamic Link or not.</td>
</tr>
<tr>
<td>-rm</td>
<td>This option removes the Cadence configuration for ads/RFIC Dynamic Link by deleting the files previously installed with the idfConfigCadence script and removing ads from the Cadence toolFilter. For more information on the Cadence Tool Filter, refer to your Cadence documentation.</td>
</tr>
</tbody>
</table>
Understanding the idfConfigCadence Script

When the idfConfigCadence script is executed without any options, the script performs the following operations:

- Copies
  
  \$HPEESOF_DIR/idf/skill/4.4.X/adsCdsenvFile
  
  to
  
  <Cadence Installation Dir>/tools/dfII/etc/tools/ads/.cdsenv

- Copies
  
  \$HPEESOF_DIR/idf/config/ads.hierEd
  
  to
  
  <Cadence Installation Dir>/share/cdssetup/hierEditor/ads

- Creates two new empty files called ads.ile in the following locations:
  
  \<Cadence Installation Dir>/tools/dfII/etc/skill/hnl/ads.ile
  
  \<Cadence Installation Dir>/tools/dfII/etc/skill/si/caplib/ads.ile

Configuring for a New Cadence Release

The idfConfigCadence script configures the Cadence installation directory for use with Dynamic Link. However, if a new version of the Cadence software is subsequently installed in a new directory, it will not have the Dynamic Link configuration. In this case, you would have to run the idfConfigCadence script as described in “Configuring the Cadence Install Directory” on page 2-5.

Configuring the Software

This section describes the various aspects of configuring and/or modifying the software to provide additional flexibility.
Administrative Tasks

Configuring the UNIX Environment

There are several UNIX environment variables relevant to Dynamic Link. These are described in the table below:

<table>
<thead>
<tr>
<th>Environment Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDF_CONFIG_FILE</td>
<td>The name of the configuration file (only the file name, not the entire path). Default value is idf.cfg.</td>
</tr>
<tr>
<td>IDF_ADS_PROJ_DIR</td>
<td>If this environment variable is defined, ADS will attach to the specified project when RFIC Dynamic Link launches ADS.</td>
</tr>
<tr>
<td>IDF_DEBUG_MODE</td>
<td>If set to TRUE debugging will be turned on and additional log messages will be written to the CIW; the log files mps.log and emx.log are also created. Default value is FALSE.</td>
</tr>
<tr>
<td>IDF_LOG_FILE</td>
<td>Name of the file (only the file name, not the entire path) to which ADS messages, normally written to stderr are redirected. Default value is idf.log.</td>
</tr>
<tr>
<td>PATH</td>
<td>The UNIX path variable.</td>
</tr>
</tbody>
</table>

Configuring the ADS Install Directory

The installation procedure configures the ADS install directory by automatically adding, modifying or replacing some files and/or directories.

The following files and/or directories are created, modified or replaced:

- $HPEESOF_DIR/bin/idfmp
- $HPEESOF_DIR/bin/idf
- $HPEESOF_DIR/bin/idfConfigCadence
- $HPEESOF_DIR/idf
- $HPEESOF_DIR/idf/ael
- $HPEESOF_DIR/idf/cdslib
- $HPEESOF_DIR/idf/components
- $HPEESOF_DIR/idf/config
- $HPEESOF_DIR/idf/examples
- $HPEESOF_DIR/idf/skill
- $HPEESOF_DIR/idf/symbols
- $HPEESOF_DIR/circuit/symbols/idfSymbol.dsn
- $HPEESOF_DIR/circuit/config/ADSlibconfig
- $HPEESOF_DIR/tools/lib/dpkg/info/idf*
Modifying the RFIC Dynamic Link-Cadence Initialization File

The RFIC Dynamic Link-Cadence initialization file (.cdsinit) is located in the directory $HPEESOF_DIR/idf/config/.cdsinit. Append it to or load it from the first available .cdsinit file from the list below:

- <Cadence Installation Dir>/tools/dfl/local/.cdsinit
- ./.cdsinit
- $HOME/.cdsinit

Modifying the Configuration File

Dynamic Link comes with the default configuration file $HPEESOF_DIR/idf/config/idf.cfg. This file is used to set various site-specific or user-specific options. It is searched for and read sequentially from the following locations in the order given, so that settings in files read later override those of earlier files:

$HPEESOF_DIR/idf/config/
$HOME/hpeesof/config/
./

The name of the configuration file can be set via the UNIX environment variable IDF_CONFIG_FILE. By default the configuration file is named idf.cfg.

The configuration file consists of lines in the form <parameter> = <value>. The various parameters that can be set in the configuration file are listed below, with brief descriptions and an example for each. If no configuration file is found or some parameters are not set, internal default values are used. Note that wherever a file name is required for a configuration parameter value, it may be specified with a path prefix that is a UNIX environment variable value or using standard UNIX conventions such as ~/. A complete example configuration file can be found at the end of this section.

- **Model Path:** This is a space-separated list of directories that is searched in sequence until a model file for each implemented component is found. The default is ~/.models. Example:
  
  ```
  IDF_MODEL_PATH = "~/.models /usr/local/eda/cmos/models"
  ```

**Note** This applies to Cadence IC 4.4.3 only.
Administrative Tasks

- **Switch View List**: If an instance has none of the views listed in the switch view list, the netlister reports an error. The default is ads sch.model schematic. Example:
  
  ```
  IDF_SWITCH_VIEW_LIST = "ads sch.model schematic"
  ```

- **Stop View List**: The netlister identifies primitives with a stop list. When it reaches a view that is listed in both the switch view and stop view lists, the instance is netlisted and no expansion occurs below this level. There is normally no reason to change the Stop View list to anything other than ads. Example:
  
  ```
  IDF_STOP_VIEW_LIST = "ads"
  ```

- **Project Path**: This indicates the path to the ADS project to attach to upon starting ADS via RFIC Dynamic Link. Example:
  
  ```
  IDF_ADS_PROJ_DIR = /tmp/ads_prj
  ```

- **Netlist Filter**: When you have site customization that is not performed by the supplied netlister, this option enables you to specify the name of the program or script used to post-process the netlist generated by Analog Artist. The position of the netlist file name in your command string is indicated by %s. Example:
  
  ```
  IDF_NETLIST_FILTER = "$HPEESOF_DIR/bin/myfilter %s"
  ```

- **Netlist Suffix**: This is the suffix for the Advanced Design System netlist file generated by Analog Artist for each sub-circuit. The default is .net. Example:
  
  ```
  IDF_NETLIST_SUFFIX = "\".net"
  ```

- **Model Suffix**: This is the suffix for each Advanced Design System model file in the specified model search path directories. The default is .ads. Example:
  
  ```
  IDF_MODEL SUFFIX = "\".ads"
  ```

---

**Note**

This applies to Cadence IC 4.4.3 only.

---

- **Debug Mode**: This option enables you to turn debugging messages on or off. These messages appear in order to help you determine the cause and/or location of problems.

  By default, debugging is turned off. To enable debugging, set this option to TRUE. Example:

  ```
  IDF_DEBUG_MODE = TRUE
  ```
• **Symbol Generation:** This option enables you to specify whether to generate a missing symbol using the Cadence symbol generator or the Advanced Design System symbol generator. The Cadence symbol generator is used as the default. Example:

   IDF_CADENCE_SYMBOL = FALSE

• **User AEL Files:** Users can define their own AEL functions and load them into the ADS environment via a list of comma separated file names. These files get loaded just after the Dynamic Link environment is initialized. Example:

   IDF_USER_AEL_FILES = “file1.ael, $HOME/file2.atf”

• **Expression Mapping:** This causes sub-strings in Cadence expressions to be mapped to corresponding sub-strings in ADS expressions in the netlist file and/or in the design variable values used. Example:

   IDF_EXPR_MAP = “foo bar”

• **Freezing Subcircuit Netlists:** When this variable is set to yes (or TRUE), all Cadence subcircuits for which a netlist already exists are not re-netlisted. The default is FALSE. Example:

   IDF_FREEZE_NETLISTS = TRUE

**Note**  The Freeze parameter can be set to yes (TRUE) or no (FALSE).

To freeze selected subcircuits, see “Freezing Selected Subcircuits” on page 9-10.

• **Message Timeout:** This specifies the timeout period in seconds for message actions initiated in ADS to complete in DFII. The default is 45. Example:

   IDF_MSG_TIMEOUT = 120

• **Other Options:** The following special options should not be altered.

   IDF_AEL_FILES = “globals.atf, utils.atf, commands.atf, callbacks.atf, symbol.atf, include.atf”
   IDF_PDE_EXEC = hpeesofde
   IDF_PDE_ARGS = “-env de_sim”
   IDF_PRODUCT_NAME = idf
   IDF_SCALE_FACTOR = 2.0
Administrative Tasks

Example Configuration File

```
IDF_MODEL_PATH = "~/models $HOME/myModels"
IDF_SWITCH_VIEW_LIST = "ads sch.model schematic"
IDF_ADS_PROJ_DIR = "./examples_prj"
IDF_NETLIST_FILTER = "~/bin/mynetlistfilter"
IDF_NETLIST_SUFFIX = "inet"
IDF_MODEL_SUFFIX = "ads"
```

Modifying the BindKey Settings

When using Composer, the Dynamic Link bindkey settings are inherited from the Cadence Schematics application, just as happens for the analogArtist-Schematic application. This is the default or preferred behavior however, if custom bindkeys are required:

1. Modify the `IdfSetBindKeys()` function accordingly. This function is provided in the file:
   `$HPEESOF_DIR/idf/skill/bindKeys.il`
   
   For example, if you would like to modify your key mappings to match the ADS key mappings because you are more familiar with ADS, modify the bindkeys as described above.

2. Edit the `ads.ini` file replacing the call to the function, `hiInheritBindKey("IdfSchematic" "Schematics")` with a call to `IdfSetBindKeys()`. The `ads.ini` file is located in:
   `$HPEESOF_DIR/idf/skill/4.4.x/ads.ini`

Managing Projects and Designs

Your Cadence designs will remain in their original locations. They are not copied, translated, or otherwise modified. When ADS starts up in Dynamic Link mode, it puts you in a project directory defined by the `IDF_ADS_PROJ_DIR` environment variable. If this variable is not defined, only the ADS Main window will open and no project will be attached.

To change this behavior, you can do one of the following:

- Specify your own startup project directory by defining `IDF_ADS_PROJ_DIR` in your UNIX environment or via the configuration file `idf.cfg`.  

2-12 Managing Projects and Designs
• After the Advanced Design System has come up, go to the Main window and open a new or existing project (File > New or File > Open).

For more information on projects and design files, refer to “Managing Projects and Designs” in the ADS User's Guide.
Chapter 3: Getting Started Tutorial

This tutorial steps you through the process of simulating a circuit using components from the Dynamic Link analogLib library. Other examples are also included to help you become familiar with the product.

Both the drop-down menus and icons are described to help familiarize you with the Advanced Design System environment.

Setting up the Examples Directory

From any directory of your choice, enter:

```
cp -r $HPEESOF_DIR/idf/examples .
cd examples
```

**Note**  This must be done before attempting the Getting Started Tutorial. The cds.lib file under the examples directory defines libraries provided by Dynamic Link. The .cdsinit file under this directory loads the Dynamic Link .cdsinit file which then loads the context files required to run Dynamic Link.

Starting the Cadence Design Framework

Ensure that you are in the examples directory then open Cadence by typing the appropriate command (typically icms or msfb). The Cadence Command Interpreter Window (CIW) appears.
3-2 Starting the Cadence Design Framework

Getting Started Tutorial

Opening a Cadence Composer Schematic

To open a schematic in Cadence Composer:

1. Choose File > Open from the Cadence CIW. The Open File dialog box appears.
2. Select examples from the Library Name drop-down list.

3. Click PowerAmp in the Cell Names list. This sets the Cell Name field to PowerAmp.

4. Select schematic from the View Name drop-down list if not already selected.

5. Select the edit Mode if not already selected.

6. Click OK. The Cadence examples, PowerAmp schematic appears.
Linking with Advanced Design System

To link the Cadence design environment to Advanced Design System:

1. Choose **Tools > ADS** from the menu bar in the Cadence Schematic window. In a few moments, the Advanced Design System Main window appears in the upper-left hand corner of your display. This is followed by an empty ADS Schematic window to the right of the Main window.
Figure 3-3. Advanced Design System Main Window

Note  Depending on your system, it may take a few moments for the ADS windows to appear. View the Cadence CIW window for the link status.

The ADS Schematic window should display a Cadence menu item and is automatically titled untitled1 (see Figure 3-4).
Opening a Test Schematic Design

To open a test schematic design:

1. Choose **File > Open Design** in the ADS Schematic window to display the Open Design dialog box. Use this dialog box to select the design you wish to simulate.
2. The examples_prj selection in the Project drop-down list is set by default in the Open Design dialog box.

3. Select PowerAmp_test.dsn from the Designs list. The PowerAmp_test.dsn schematic contains simulation components that can be selectively activated or deactivated.

4. Click OK to include the PowerAmp_test.dsn schematic in the ADS Schematic window.

**Adding a Symbol of the Cadence Cellview**

To add a symbol of the Cadence cellview in the Advanced Design System Schematic window:

1. Choose Cadence > Instance > Add Instance of Cellview in the ADS Schematic window.
Getting Started Tutorial

Figure 3-5. Adding a Cellview

A Select Design dialog box appears, enabling you to select the Cadence Cellview to simulate.
2. In the Cell Name field of this dialog, verify the entry or type the name of the Cellview you want to simulate (in this case PowerAmp). Alternatively, you can use the Browse button and library manager to select the name.

3. Click OK. A symbol of your Cadence Cellview is automatically generated.

4. An instance of the symbol is attached to the cursor for you to place. In the Advanced Design System Schematic window, click the left mouse button to place the symbol as desired.

5. You may continue placing more instances of the same cellview, or, in this case, choose the Cancel Command And Return To Select Mode icon to proceed with the next step. Similarly, you may place instances of other Cadence designs.

Adding Design Variables

To add the design variables from the Cadence Cellview to the ADS schematic window choose Cadence > Design Variables > Get Design Variables.

This places a corresponding VarEqn component on the ADS schematic containing the design variables from Cadence (i.e. Rcc, Rout, Remitin and Remitout).

Adding Model Files

To add a model file

1. Choose Cadence > Add Netlist File Include

2. Place the Netlist File Include component in an open area on the schematic.

3. Double click the include component icon. The Netlist File Include dialog box appears.
4. In the Netlist File Include dialog box, click **modelLibraryFiles** in the Select Parameter list box. The Model Library File field appears in the dialog box.

5. Click **Browse** just below the Model Library File field to locate the first model library file. The Select File dialog box appears.
6. In the Select File dialog box, use the Directories field to locate the models directory.

   `<your_current_working_dir>/examples/models`

   This sets the path for the location of the model library files.

7. In the Select File dialog box, use the Files field to locate and click the `nppw1.ads` model file, then click OK. An information message appears stating that a new path has been added to the include path list.

   Click OK in the Information Message dialog box. You are returned to the Netlist File Include dialog box.
8. In the Netlist File Include dialog box, notice that the Model Library File field now contains the npnpwa1.ads model file. Click **Apply** to add the npnpwa1.ads model file.

9. Click **Browse** again to locate the second model library file. The Select File dialog box appears.

10. In the Select File dialog box, use the **Files** field to locate and click the npnpwa2.ads model file, then click **OK**. You are returned to the Netlist File Include dialog box.

11. In the Netlist File Include dialog box, notice that the Model Library File field now contains the npnpwa2.ads model file. Click **Add** to add the npnpwa2.ads model file.

12. The Select Parameter field should now contain the information below.

   ```
   modelLibraryFiles[1]=npnpwa1.ads
   ```

13. Click **OK** in the Netlist File Include dialog box.

For more information on the Netlist File Include Component, refer to “Using the Netlist File Include Component” on page 9-1.
Performing a DC Simulation

To run a DC simulation on an ADS schematic and then annotate the results to the Cadence Composer Window:

1. Choose **Edit > Component > Activate** then click on the DC component in the ADS Schematic window or choose the Activate Components icon to activate the DC component.

![Figure 3-6. Activating Components in an ADS Schematic Window](image-url)
2. Choose **Simulate > Simulate** or choose the Simulate icon to run a simulation. A simulation dialog box appears in your display.

3. After the simulation is complete, a Data Display window titled PowerAmp_test automatically appears. Close this window using the **File > Close Window** menu option.

4. Click the PowerAmp schematic symbol in the ADS Schematic window.

5. Choose **Cadence > Annotate > Annotate DC Solution to Selected Cellview**. This displays the DC node voltages on the Cadence schematic.
Annotating DC Operating Points to a Selected Cellview

Any simulation that includes a DC analysis produces DC operating point information for most active and some passive devices in the circuit. This data includes currents, power, voltages, and linearized device parameters of the selected device.

To run a DC Operating Point Simulation on an ADS schematic and then annotate the results to the Cadence Composer Window:

1. Double-click the DC Simulation component in the ADS schematic window. The DC Operating Point Simulation dialog box appears.
Getting Started Tutorial

2. Click the **Parameters** tab in the DC Operating Point Simulation dialog box.

3. Click **Detailed** in the **Device operating point level** section of the DC Operating Point Simulation dialog box.

**Note**  For a subset of the detailed DC Operating Point Simulation information that covers most common parameters, click **Brief** in the **Device operating point level** section of the DC Operating Point Simulation dialog box.
4. Choose Simulate > Simulate or choose the Simulate icon to run a simulation. A simulation dialog box appears in your display.

5. After the simulation is complete, a Data Display window titled PowerAmp_test automatically appears. Close this window using the File > Close Window menu option.

6. Click the PowerAmp schematic symbol in the ADS Schematic window.

7. Choose Cadence > Annotate > Annotate Operating Points to Selected Cellview. This displays the DC operating point values for each component on the Cadence schematic.

**Node Probing with RFIC Dynamic Link**

With the RFIC Dynamic Link Node-Probing feature, you can select nodes of interest in a Cadence subcircuit and display their voltages in an ADS Data Display window. ADS saves voltage data for all the named nodes. Any node with a node name prefix different from _net is considered a named node. For detailed information on the ADS Node-Probing feature, refer to the ADS “Circuit Simulation” manual.

The following is an example session of using the Dynamic Link Node-Probing feature with the PowerAmp example.

1. In the Cadence schematic window, choose Options > Editors. The Cadence Editor Options form appears.
2. Change Net Name Prefix field from net to _net then click OK. This prevents ADS from saving data for all the nodes in the PowerAmp cellview.

3. Click Design > Check and Save in the Cadence schematic window to ensure a new ADS netlist for the PowerAmp cellview is generated the next time a simulation is performed for the ADS PowerAmp_test design.

4. Double click the DC Simulation controller component in the ADS schematic window to open the DC Operating Point Simulation dialog box.
5. Click the **Output** tab in the DC Operating Point Simulation dialog box.

6. Click **Add/Remove** in the Output section of the DC Operating Point Simulation dialog box to open the Edit OutputPlan dialog box.
7. Click the + sign to the left of the X1 component in the Available Outputs field to start Dynamic Link Node Probing setup. This raises the Cadence schematic window containing the PowerAmp cellview. The prompt in the Cadence schematic window is changed to **ADS Node Probing Setup: Click a wire**.

8. Click the wire connecting to the collector of the Q0 transistor in the upper-left region of the schematic window. A node1 label is added to that wire in the Cadence schematic window. Meanwhile, node1 also appears in the Current Selection field on the right side of the ADS Edit OutputPlan dialog box.

9. Click the wire connecting to the emitter of Q0 to add another node, node2, to the ADS Edit OutputPlan dialog box for DC Simulation. The Q0 transistor in the upper-left region of the Cadence schematic window should now appear similar to Figure 3-8.
10. Click **OK** in the ADS Edit OutputPlan dialog box to close the dialog box. The DC Operating Point Simulation dialog box should now appear similar to **Figure 3-9**.
11. Click **OK** in the DC Operating Point Simulation dialog box to instruct ADS to save voltage values for \texttt{X1.node1} and \texttt{X2.node2} after DC simulation.

12. Click the Simulate icon or select **Simulate > Simulate** menu item in the ADS schematic window to run a DC Simulation. The ADS Data Display window appears automatically once the ADS DC Simulation is complete.

13. Click the List icon on the left of the Data Display window then click a desired location in the ADS Data Display window to bring up the Plot Traces & Attributes dialog box.
14. In the Plot Traces & Attributes dialog box, click node1 on the left, then click >>Add>> in the middle to add node1 to the Traces field on the right. Click node2 and then click >>Add>> to add node2.

15. Click OK to close the Plot Traces & Attributes dialog box. The voltages of node1 and node2 are immediately listed in the ADS Data Display window.
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Additional Notes:

• When the Add/Remove button in the DC Operating Point Simulation dialog box is clicked to bring up the Edit OutputPlan dialog box, as described in step 6 above, all of the named nodes and subcircuit components at current circuit level appear in the Available Outputs field on the left. You can select a named node from the Available Outputs field and then click Add >> to add it to the Current Selection field on the right. You can also remove a named node from the Current Selection field by clicking << Remove after selecting it.

• Clicking the + sign to the left of a subcircuit component in the Available Outputs field displays all the named nodes and subcircuit components within that subcircuit. In step 7 above, nothing was displayed initially because there was no named node or subcircuit in the PowerAmp cellview.

• After a Cadence schematic window is raised as a result of clicking the + sign mentioned above, any named or unnamed node in the Cadence subcircuit hierarchy can be selected by clicking the left mouse button at any point on the wire. To select a node in Cadence subcircuit, choose Design > Hierarchy > Descend Edit menu item in the Cadence schematic window, click OK in the form popped up, and then click a wire of interest. Valid selections are limited to the current window and the current circuit hierarchy.

• Expanding a Cadence circuit component in the Edit OutputPlan dialog box for Scattering-Parameter Simulation will also raise a Cadence schematic window. Any unnamed wire selected will also have a label attached, but this node will not be added to the Current Selections field in the Edit OutputPlan dialog box because no DC voltage data will be available for S-Parameter simulation.

• During the Node Probing operation, the left mouse button in the Cadence Virtuoso schematic window is mapped to a Dynamic Link SKILL procedure. Do not bind any function to the left mouse button during this period. Any bindkey function previously mapped to the left mouse button will not work until the tune mode ends.

Performing an S-parameter Simulation

To perform an S-parameter Simulation on an ADS schematic:

1. Choose Edit > Component > Deactivate then place the cross hair over the DC component and click or choose the Deactivate Components icon.
2. Choose **Edit > Component > Activate** then place the cross hair over the S-parameter component and click or choose the Activate Components icon. The ADS schematic is now ready to simulate an S-parameter.

3. Choose **Simulate > Simulate** or choose the Simulate icon to run the S-parameter simulation.

After the simulation is complete, a Data Display window titled **PowerAmp_test** automatically appears.

**Note**  The amplifier used in this tutorial is not a traditional microwave amplifier for use by itself. It is meant to be used as part of an RFIC, where it takes a small voltage signal and converts it into a current for driving a larger-signal amplifier, off chip. It has not been designed to have S11 and S22 less than 1. More simulations are run on the amplifier in the ADS example file, IQ_Mod_from_MDS_prj.zap, which you can download from the Agilent EEsof EDA external website. The example described in this document is only illustrating the RFIC Dynamic Link for Cadence.

**Displaying Your Results**

To view the results of your simulation in a plotted Data Display:
1. Select PowerAmp_test from the Default Dataset drop-down list if not already selected.

2. From the Data Display window, choose Insert > Plot, move the frame to an appropriate location within the window and click. This anchors a frame for your plot. Similarly, you can choose the Rectangular Plot icon to drag and drop the plot frame.

3. The Plot Traces & Attributes dialog box appears. Select S(2,1) and then click Add. Select dB from the dialog box then click OK.

4. Click OK again to view the Data Display.
Note  Figure 3-11 shows the forward gain, S(2,1), at 1.9 GHz to be approximately 12.57 dB. By varying the value of Remitout in this case, you can modify the circuit to achieve the desired results. After you have completed the tutorial, take some time to experiment with different values of Remitout.

Performing a Parameter Optimization

To optimize the parameters of Var1 in the ADS schematic:
1. Choose the Activate Components icon then place the cross hair over the Nominal Optimization component. Repeat this step for the Goal component. The ADS schematic is now ready to optimize the S-parameter.

![Figure 3-12. Activating Components in an ADS Schematic Window](image)

2. Choose Edit > Component > Edit Component Parameters and then click the VarEqn component. The Variables and equations dialog box appears.

3. In the Variables and equations dialog box, select the parameter Remitout in the Select Parameter field.


5. Click the Optimization tab and set the Optimization status to Enabled.

6. Set the Minimum Value to 120 and the Maximum Value to 200.
7. Click **OK** twice, once in the Setup dialog box and once in the Variables and equations dialog box. Note that the Remitout parameter on the ADS schematic now displays:

   \[ \text{Remitout} = 163 \; \text{opt} \{120 \text{ to } 200\} \]

8. Choose **Simulate > Simulate** or choose the Simulate icon. This netlists each Cadence subcircuit in the Affirma Analog Circuit Design Environment (Analog Artist in 4.4.3), as well as the top-level ADS schematic, and starts the Advanced Design System simulator.

   **Note** A simulation status window appears, reporting the status of the simulation; depending on your system, this may take some time. Check this status window to see if any errors occurred during netlisting or simulation.
After the simulation is complete, a Data Display window titled PowerAmp_test automatically appears. For information on configuring the Data Display, refer to “Displaying Your Results” on page 3-25.

Note Figure 3-13 shows the optimized forward gain, S(2,1), at 1.9 GHz to be approximately 13.08dB as set by the Goal component in the ADS Schematic window.

Figure 3-13. Data Display with Optimized Simulation Results

9. Choose Simulate > Update Optimized Values to update the optimized values. This changes the value of Remitout in the VarEqn component to the optimized value.
10. Choose **Cadence > Design Variables > Update Design Variables to Cellviews** to update the optimized value to the Cadence cellview. A **Confirmation Message** dialog box appears.

![Confirmation Message](image)

Design variables for <examples Poweramp schematic> updated to cellview database
Select <Copy from> on the Design Variables form to update the Artist session

11. Click the **Close** button.

12. From the Cadence menu bar, choose **ArtistUtilities > Design Variables**. A **Design Variables** form appears.

- **Note** If the ArtistUtilities pull-down menu does not appear in the Cadence Virtuoso Schematic window, choose **Tools > ADS** in the Cadence schematic window.

13. Click **Copy From** in the **Cellview Variables** section. This enables you to update the design variables to the Artist session.

![Design Variables Form](image)

Performing a Parameter Optimization 3-31
Verifying Your Results

You may now verify the results of your optimization by using the optimized value of Remitout in an S-parameter simulation. Set the value of Remitout = 120 (approximate optimum value) and repeat the steps in “Performing an S-parameter Simulation” on page 3-24 with the new value of Remitout.

Note  Figure 3-14 again shows the optimized forward gain, $S(2,1)$, at 1.9 GHz to be approximately 13.08 dB as set by the Goal component in the ADS Schematic window. By using the optimized value of Remitout, you have verified the optimum desired results of the circuit.

Figure 3-14. Data Display with Optimized Simulation Results
Ending the Session

Use the following steps to exit the Dynamic Link environment and close both ADS and Cadence.

1. Choose the Advanced Design System Schematic menu option \texttt{Cadence > Close Cadence Connection}. This closes ADS and terminates the link between Cadence and the Advanced Design System.

2. Exit from the Cadence CIW.

3. Congratulations… you have now successfully completed the Tutorial.
Chapter 4: Starting, Viewing Designs and Exiting

This chapter describes the procedures for:

- Launching Advanced Design System from a Cadence Schematic window via the RFIC Dynamic Link
- Adding an instance of a Cadence design to an ADS schematic
- Pushing into a design hierarchy
- Exiting Dynamic Link, ADS and the Cadence Schematic window

Starting Advanced Design System

To run Advanced Design System from the Cadence Schematic window using RFIC Dynamic Link:

1. In the Cadence Schematic window, open the desired cell view.
2. Choose Tools > ADS from the Cadence Schematic window banner menu. The Advanced Design System Main window appears in the upper left corner of your screen followed, to the right, by an empty ADS Schematic window (this may take some time).

The Cadence schematic window displays an ArtistUtilities pull-down menu. This menu provides some familiar, useful Affirma Analog Circuit Design Environment (4.4.5 & 4.4.6) interface functionality. For further information about these options, consult your Cadence documentation.
Note The terminal output (stderr) of ADS gets redirected to the file idf.log in the directory in which the Cadence framework is started. Once the link is started, subsequently opening a Cadence design will not involve the overhead of re-starting ADS, but you will need to select Tools > ADS just to see the ArtistUtilities pull-down menu.

Adding an Instance of a Cadence Design

To add an instance of a Cadence design to an ADS test schematic, choose Cadence > Instance > Add Instance of Cellview.

A dialog box appears, allowing the selection of a Cadence design.

If a symbol already exists for the design in Cadence, the symbol geometry is duplicated in ADS; otherwise the Cadence symbol generator is automatically invoked to generate a Cadence symbol, which is then automatically duplicated in ADS.

If Cancel is selected, or if the configuration file has the entry,

    IDFCADENCE_SYMBOL = FALSE

the ADS symbol generation is automatically invoked (as opposed to the Cadence symbol generation). This generates the symbol in ADS.
Note  The generated symbol can be edited and modified if needed. If aesthetics are a concern, it is recommended that the symbol be manually created in Cadence and then automatically replicated in ADS as described above. The symbol of the Cadence design is given the following nomenclature <library>_<cell>_<view>. For example, examples_PowerAmp_schematic. There is a skeleton schematic of the Cadence design that also gets created in ADS. This is used as a placeholder to link with the actual Cadence design; you do not need to edit this.

Pushing into the Design Hierarchy

To view a design deeper in the Advanced Design System schematic hierarchy:

1. Select the component you want to push into in the ADS Schematic window.
2. Choose the Push Into Hierarchy icon. This downward arrow icon is located below the Cadence menu item in the tool bar.
3. If the selected component is a Cadence cellview instance, the corresponding Cadence cellview is opened in the Cadence design editor. If this view is already open, it is simply raised to the top of the window stack.

Exiting

To exit RFIC Dynamic Link and related tools:

1. Choose Cadence > Close Connection. This terminates the link between Cadence and ADS and exits ADS.
2. From the Cadence CIW select File > Exit. This closes all Cadence tools, after possibly prompting you to save your changes.
Starting, Viewing Designs and Exiting
Chapter 5: Netlisting, Simulating, and Displaying Data

This chapter describes the procedures for netlisting and simulating a design as well as viewing the netlist from either Advanced Design System or a Cadence Schematic window. Information on net, instance and expression name mapping is also provided.

Netlisting and Simulating a Design

Netlisting automatically occurs when you simulate your schematic in Advanced Design System. The complete netlist is sent to the simulator, stored in memory, and written to a netlist.log file in the project directory of ADS. You can view the netlist in the netlist.log file as needed.

To netlist and simulate a schematic in Advanced Design System:

1. In the ADS Schematic window, choose the Simulate icon or choose the menu item Simulate > Simulate.
   A Simulation window appears, indicating the netlisting status and listing any errors encountered. If the netlisting is successful, the design is then simulated; otherwise, act on the errors displayed in the Simulation window and repeat step one above.

2. For information on configuring and viewing the simulation results in the Data Display window, refer to the “Data Display Basics” in the ADS Data Display manual.

Viewing Netlists

This section describes how to view the top-level netlist from Advanced Design System as well as how to view an ADS subnetwork netlist for a Cadence design from a Cadence Schematic window.

Viewing Netlists from Advanced Design System

To generate and display the entire top-level ADS netlist, select Cadence > Top-level Design Netlist.
Netlisting, Simulating, and Displaying Data

Viewing Netlists from the Cadence Schematic Window

To generate and display the ADS subnetwork netlist for the Cadence design displayed in a particular Cadence Schematic window:

1. From the menu bar, select ArtistUtilities > Subcircuit Netlist. Netlisting progress is displayed in the Cadence CIW.

Note  If you do not see the ArtistUtilities pull down menu in the Cadence toolbar, and you only want to generate a Cadence Subcircuit Netlist, select Tools > ADS > Turn On ArtistUtilities from the Cadence Command Interpreter Window (CIW).
2. A log window pops up, displaying the netlist results. Once you have viewed the results, you can select **File > Close Window** to exit this window.

**Net and Instance Name Mapping**

Since Advanced Design System nomenclature rules differ from those of Cadence, nets, instances, etc. must be properly mapped. This mapping is done automatically as part of the netlisting function. The mapping rules are as follows.
• Advanced Design System keywords used as net or instance names are mapped by appending an underscore (_) to the name.

Table 5-1. Net and Instance Name Mapping

<table>
<thead>
<tr>
<th>Name</th>
<th>Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>then</td>
<td>then_</td>
</tr>
<tr>
<td>else</td>
<td>else_</td>
</tr>
<tr>
<td>elseif</td>
<td>elseif_</td>
</tr>
<tr>
<td>endif</td>
<td>endif_</td>
</tr>
<tr>
<td>equals</td>
<td>equals_</td>
</tr>
<tr>
<td>notequals</td>
<td>notequals_</td>
</tr>
<tr>
<td>and</td>
<td>and_</td>
</tr>
<tr>
<td>not</td>
<td>not_</td>
</tr>
<tr>
<td>or</td>
<td>or_</td>
</tr>
<tr>
<td>global</td>
<td>global_</td>
</tr>
<tr>
<td>model</td>
<td>model_</td>
</tr>
<tr>
<td>define</td>
<td>define_</td>
</tr>
<tr>
<td>end</td>
<td>end_</td>
</tr>
<tr>
<td>parameters</td>
<td>parameters_</td>
</tr>
</tbody>
</table>

• Any non-alphabetical character (e.g. not a-z) in a net or instance name is mapped to an under bar (_).

• Advanced Design System uses a single name space for all names, regardless of object type (net, instance, etc.). This may necessitate name mapping in addition to the above.

Expression Name Mapping

Most Cadence Analog Expression Language (AEL) expressions contain constants, functions and suffixes with equivalents in ADS. In most cases the names of these equivalents are identical, requiring no mapping. As far as possible, Cadence expressions are pre-evaluated in the Cadence environment, prior to netlisting and prior to getting design variables from Cadence. This leaves only a few built-in function names to map (i.e. names that are not identical in the two environments).
Some built-in operator and function names in the Cadence Affirma Analog Circuit Design Environment (4.4.5 and 4.4.6) as yet do not map to anything in the ADS environment. For these non-mapping functions, custom equivalents in ADS need to be written and mapped until they are available as built-ins in ADS. Custom mapping is enabled via the configuration file option IDF_EXPR_MAP. For more information, refer to Expression Mapping in “Modifying the Configuration File” on page 2-9.

Table 5-2. Function Name Mapping

<table>
<thead>
<tr>
<th>Cadence</th>
<th>ADS</th>
</tr>
</thead>
<tbody>
<tr>
<td>complex</td>
<td>cmplx</td>
</tr>
<tr>
<td>fabs</td>
<td>abs</td>
</tr>
<tr>
<td>log</td>
<td>ln</td>
</tr>
<tr>
<td>log10</td>
<td>log</td>
</tr>
</tbody>
</table>

Table 5-3. Non-Mapping Operators

<table>
<thead>
<tr>
<th>Cadence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>unary minus</td>
</tr>
<tr>
<td>~</td>
<td>unary one’s complement</td>
</tr>
<tr>
<td>%</td>
<td>modulo</td>
</tr>
<tr>
<td>&lt;&lt;</td>
<td>left shift</td>
</tr>
<tr>
<td>&gt;&gt;</td>
<td>right shift</td>
</tr>
<tr>
<td>&amp;</td>
<td>bitwise AND</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>^</td>
<td>bitwise XOR</td>
</tr>
<tr>
<td>?:</td>
<td>conditional expression</td>
</tr>
</tbody>
</table>

Table 5-4. Non-Mapping Functions

<table>
<thead>
<tr>
<th>Cadence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>acosh</td>
<td>inverse hyperbolic cosine</td>
</tr>
<tr>
<td>asinh</td>
<td>inverse hyperbolic sine</td>
</tr>
<tr>
<td>atanh</td>
<td>inverse hyperbolic tangent</td>
</tr>
</tbody>
</table>
Using Global Nodes

Cadence designs typically use implicit global nodes (names ending in !) for substrate power and ground connections. This notation is now supported by Advanced Design System. If the exclamation point suffix is used, a globalnode does not need to be placed in the ADS schematic.

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>aelCheckRange</td>
<td>determines if a number falls within a range</td>
</tr>
<tr>
<td>conjgate</td>
<td>complex conjugate</td>
</tr>
<tr>
<td>floor</td>
<td>floor of a real number</td>
</tr>
<tr>
<td>ceil</td>
<td>ceiling of real number</td>
</tr>
<tr>
<td>mag</td>
<td>magnitude</td>
</tr>
<tr>
<td>db10</td>
<td>10 times log10</td>
</tr>
<tr>
<td>db20</td>
<td>20 times log10</td>
</tr>
</tbody>
</table>
Chapter 6: Using Design Variables

This chapter describes how to add or edit a design variable in Advanced Design System and also update your Cadence design variables.

Cadence Affirma Analog Circuit Design Environment (Analog Artist in 4.4.3) design variables are intended to be global in the context of a particular Artist session or Cellview. When you select Cadence > Design Variables > Get Design Variables, these variables are automatically mapped to corresponding variables in a VarEqn component in the Advanced Design System schematic. This mapping ensures that these variables can be used for optimization or statistical analysis in ADS.

All the design variables for each Cadence design are put into a single VarEqn component. Each time the menu item Cadence > Design Variables > Get Design Variables is selected, this component is updated with the most recent values from Cadence.

Adding and Editing Design Variables

To add or edit a design variable for the ADS schematic:

1. From the Cadence schematic menu bar, choose ArtistUtilities > Design Variables.
2. In the ADS Schematic window, choose Cadence > Design Variables > Get Design Variables. This places a corresponding VarEqn component on the ADS schematic containing the design variables from Cadence. If the VarEqn component already exists it is updated only with variables and values that are not already there.

![Figure 6-1. VarEqn Block corresponding to Design Variables](image-url)
Using Design Variables

**Note** There is no way to distinguish a design variable of the same name coming from different Cadence cellviews. If a variable has different values in different cellviews, the value sent to ADS is chosen arbitrarily. Non-alphanumeric characters, like parentheses, in variable expressions must be preceded by a backslash (\').

---

**Updating Cadence Design Variables**

To update your Cadence design variables:

1. In the Advanced Design System Schematic window, select **Cadence > Design Variables > Update Design Variables**.

**Note** Design variables can be used for optimizations and sweeps in ADS. Variables used for this purpose should not be assigned a value or expression in Cadence; the Value (Expr) text entry box should be left blank.

---

6-2  Updating Cadence Design Variables
Chapter 7: Tuning and Optimizing Designs

This chapter provides information on tuning and optimizing designs using the Advanced Design System tuning and optimization capabilities.

Tuning Cadence Instance Parameters and Design Variables

The ADS tuning capability enables you to change one or more design parameter values and see its effect on the output without simulating the entire design again from the beginning. Dynamic Link extends the ADS tuning function to instance parameters and design variables in Cadence subcircuits. For more information on using the ADS tuning feature, refer to “Tuning” in the ADS Tuning, Optimization, and Statistical Design manual.

This section uses the PowerAmp example used in Chapter 3, Getting Started Tutorial for demonstrating tuning of Cadence instance parameters and design variables.

A Dynamic Link For Cadence Tuning Example

1. Follow the steps listed in “Performing an S-parameter Simulation” on page 3-24 in the Chapter 3, Getting Started Tutorial. Plot S(2,1) in the ADS Data Display window after ADS S-parameter simulation is completed. The S(2,1) plot should resemble Figure 7-1.
2. In the ADS Schematic window, choose Simulate > Tuning or click the Tune Parameters icon (tuning fork) in the toolbar.

3. Wait for the initial analysis to complete. The TuneControl dialog box appears as shown in Figure 7-2.

Figure 7-1. Data Display with S(2,1) of the PowerAmp_test Design.
Figure 7-2. The Initial ADS Tune Control Dialog Box.

Note that the prompt at the bottom of the Cadence schematic window says:

**ADS Tune Mode: Click an instance**

4. Move your cursor over resistor R7 in the Cadence schematic window and click the left mouse button (left click). A slider control for R7.R immediately appears in the ADS Tune Control dialog box. Note that only integer and floating point parameters are tunable. R7 contains only one tunable parameter R (r in Cadence spectre), the resistance.

5. Left click resistor R0 in the Cadence schematic window. A menu pops up beneath R0 as illustrated in Figure 7-3. The popup menu is displayed because there is more than one tunable parameter in R0, R and Tnom. Cadence instance parameters are sent to ADS one at a time.
Step 6. Select examples_PowerAmp_schematic.R0.R(10) in the pop-up menu. This creates a slider control for R0.R in the ADS Tune Control dialog box.
7. In the ADS Schematic window, click the design variable Remitout in the VAR1 block. Figure 7-4 shows the ADS Tune Control dialog box with R7.R, R0.R, and VAR1.Remitout being selected. Recall that VAR1.Remitout is a design variable originated from the Cadence subcircuit.

8. In the ADS Tune Control dialog box, select a tune analysis mode from the Simulate drop-down list. This tells ADS when you want tuning to occur. For this example, choose After each change if not already selected.

After you finish with all of the steps in this example, try each tuning analysis method (after each change, after pressing the Tune button, while the slider is moving) to see which one works best for you.

9. Drag the slider for examples_PowerAmp_schematic.R7.R to 300 (Ohms). You also can change the tunable parameters by doing the following:
Tuning and Optimizing Designs

- Click the left or right arrows.
- Type the value in the box.

10. Drag the slider for examples_PowerAmp_schematic.R0.R to 5 (Ohms).
11. Finally, drag the slider for PowerAmp_test.VAR1.Remitout to 120 (Ohms).

Observe the results in Data Display window each time you release the mouse button after dragging the slider in the Tune Control dialog box to a desired location. Figure 7-6 shows four S(2,1) curves displayed in the same Data Display window as results of changing R7.R, R0.R and VAR1.Remitout in the Tune Control dialog box.

![Figure 7-5. ADS Tune Control Dialog Box (With R7.R, R0.R and VAR1.Remitout values Changed).](image)

12. You can click the Reset button to restore all the sliders to their original values. The Update button in the Tune Control dialog box enables you to write the instance parameter values currently displayed in the dialog box into the Cadence Schematic window. For Cadence design variables, such as VAR1.remitout, you still need to select Cadence > Update Design Variables to
Cellviews in ADS schematic window and then follow the instruction in the Confirmation Message form to complete the update.

There is no undo function for the Update operation, therefore, do not click the Update button if you do not want to change values in the Cadence subcircuit.

13. Click the Cancel button in the Tune Control Dialog box to end tuning. The prompt at the bottom of the Cadence Virtuoso schematic window returns to its default greater than sign, "->."

This example demonstrated three types of tuning operations in Dynamic Link:

- Clicking a Cadence instance with a single tunable parameter causes that parameter to be sent to ADS for tuning.
Clicking a Cadence instance with multiple tunable parameters results in a pop-up menu being displayed. Selecting an item from the pop-up menu causes the parameter associated with that menu item to be sent to ADS for tuning.

After obtaining Cadence design variables by selecting Cadence > Get Design Variables in the ADS schematic window, clicking a Cadence design variable in the ADS VAR1 block sends that variable for tuning.

All the above three types of operation act like a toggle switch. Selecting an item already on the Tune Control dialog box removes it from the dialog box.

You can descend down a Cadence design hierarchy to find an instance parameter for tuning. You can then return to higher level Cadence design hierarchy to select another instance parameter.

Note: During the node probing operation, the left mouse button in the Cadence Virtuoso schematic window is mapped to a Dynamic Link SKILL procedure. Do not bind any function to the left mouse button during this period. Any bindkey function previously mapped to the left mouse button will not work until the tune mode ends.

If you have a problem while tuning and need to discontinue the operation, enter IdfMpsTuneEnd in the Cadence CIW input area. This will end the Dynamic Link Tune Mode operation.

Optimizing Designs

Performance optimization enables you to specify a range of device or component values. The software can then automatically compute the nominal values that best meet your performance goals or specifications. A family of optimizers come with ADS, each with a different mathematical effect or use. For more information on performance optimization, refer to “Performing Nominal Optimization” in the ADS Tuning, Optimization, and Statistical Design manual.

To optimize a design in the Advanced Design System:

1. In the Schematic window containing the design you want to optimize, choose Optim/Stat/Yield/DOE from the component palette. The Optim/Stat/Yield/DOE palette is displayed.
2. Set the options (Goal, Nominal Optimization, etc.) as desired. When a Nominal Optimization component is first added, you need to enable the output to the dataset. Click the Nominal Optimization component and choose **Edit > Component > Edit Component Parameters**. This brings up a Nominal Optimization dialog box. Select the Parameters tab and ensure that the Analysis outputs and Optimization variables are checked. Click **OK**.
3. Proceed with the Advanced Design System optimization.
Updating the Cadence Cellview

Once the optimum value of a variable is computed by an ADS simulation, you can update the value to the Cadence cellview. To update the Cadence cellview:

1. In the Schematic window, choose Cadence > Design Variables > Update Design Variables to Cellviews.

**Note** Only the nominal values of variables get updated to Cadence; any range values are ignored. Variables to be optimized should not be assigned a value in Cadence; they may be assigned a nominal value and a range in ADS.
Chapter 8: Annotating a DC Solution

This chapter describes how to annotate your simulation results in Advanced Design System to a Cadence cellview.

Annotating DC Voltages to a Cadence Cellview

To annotate a DC voltage solution in Advanced Design System to the Cadence cellview:

1. In Advanced Design System, set up and simulate your schematic. This schematic must contain a DC Simulation Component as shown in Figure 8-1.

![Figure 8-1. Example setup for DC Simulation](image)

2. Select the schematic symbol in the ADS schematic that represents the Cadence circuit you want to back annotate. For example, the amplifier block in Figure 8-1.

3. From the ADS Schematic window, choose Cadence > Annotate > Annotate DC Solution to Selected Cellview.

4. The voltages are then displayed on the Cadence schematic as shown in Figure 8-2.
Annotating DC Currents to a Cadence Cellview

To annotate a DC current solution in Advanced Design System to the Cadence cellview:

1. First annotate the DC voltages as described in “Annotating DC Voltages to a Cadence Cellview” on page 8-1.

2. From the Cadence schematic window, choose Edit > Component Display. The Edit Component Display Options form appears.

3. Click an instance in the Cadence Schematic window. For this example, Q0 was selected. Note that the title of the Edit Component Display Options form
changes to include the component selected. In this case, the title Edit Component ‘Q0’ Display appears.

4. Click the terminal checkbox from the Select Label options. Notice that the form now displays a Terminal Labels section. This section shows that DC and voltage is currently selected as seen in Figure 8-3.

![Edit Component ‘Q0’ Display form showing DC Voltage]

5. Click the currents checkbox in the Terminal Labels section of the Edit Component Display form to display currents instead of voltage. Figure 8-4 shows the design with the DC currents annotated.

6. Click OK to clear the Edit Component ‘Q0’ Display form.
Annotating a DC Solution

Figure 8-4. DC Current Annotation on the Cadence Schematic

Note: If you do not select an instance, the library that your changes will apply to will be the library that contains the schematic (i.e. examples_lib for the PowerAmp example). Since the primitives (i.e. the res and npn cells) are not in the schematic's library, you will not see any changes to the annotation if you do not first select an instance from the proper library. The Edit Component Display form enables you to control how labels are displayed for each library, cell and instance in the design.
Displaying Voltages or Currents from a Previous Simulation

To display voltages or currents from a previous simulation:

1. Before displaying voltages or currents you must have annotated a DC solution to the schematic in a prior Cadence session. Follow the instructions for annotating a DC solution (see Chapter 8, Annotating a DC Solution) to a schematic if you have not already done so.

2. From the Cadence Schematic window, choose Edit > Component Display. The Edit Component Display Options form appears.

4. Enter the full path to the Data Directory. This is everything up to the psf directory. The psf (storage format) directory contains Cadence formatted data. The structure for the path name is,

\(<\text{simulation\_directory}\>/\langle\text{cell\_name}\rangle/\langle\text{simulator}\rangle/\langle\text{view}\rangle\)

The path for the Data Directory used in the example for Figure 8-2 was,

~\(/\text{simulation/PowerAmp/ads/schematic}\)

The annotation code looks in the psf directory.

5. Click OK in the Set Label Display Simulation Data Directory form.

6. Click OK in the Edit Component Display Options form.

Creating Symbols for Hierarchical Subcircuits with cdsTerm

To create symbols for hierarchical subcircuits using cdsTerm:

1. From the Cadence Schematic window, choose Design > Create Cellview > From Cellview. The Cellview From Cellview form appears.
2. In the Cellview From Cellview form, ensure the following settings are correct:
   • From View Name - schematic
   • To View Name - symbol
   • Tool / Data Type - Composer-Symbol

   Click OK. The Symbol Generation Options form appears, assuming a symbol does not already exist.

3. In the Symbol Generation Options form, click the Edit Labels checkbox. Your form will display the Label options.

4. In the Symbol Generation Options form, select analog pin annotate from the Label Choice pull-down menu. The Name field should now display cdsTerm("(pinname)").

5. Select all pins from the Apply To drop-down menu and click Add. This generates a new label rule that creates a cdsTerm for each pin. You may alter the location if you choose. The form with all appropriate option settings is shown in Figure 8-5.
Figure 8-5. Symbol Generation Options to create a symbol with cdsTerms on each pin
For more information on the Symbol Generation Option form, refer to your Cadence documentation.
Chapter 9: Using Additional Features of RFIC Dynamic Link

This chapter describes some of the additional features provided by the RFIC Dynamic Link. Some of the issues related to compatibility between Advanced Design System and the Cadence tools are also discussed in this chapter.

Using the Netlist File Include Component

This section describes how to use the Netlist File Include Component in RFIC Dynamic Link. The Netlist File Include component is provided as a means of duplicating the Definition, Stimulus, and Model Library File include used in Cadence/Affirma. This include component can be used with any 4.4.* version of the Cadence DFII.

The Netlist File Include Component is intended to be placed at the top-level ADS schematic. If the component exists in a design below the top level, it will not be netlisted.

Adding a Netlist File Include Component

To place an instance of the Netlist File Include Component:

1. From the top-level ADS schematic window, choose Cadence > Add Netlist File Include. An instance of the Netlist File Include Component is attached to your cursor.

2. Move the cursor to where you want to place the component, then single click. A Netlist File Include component symbol is placed on the schematic as shown in Figure 9-1.

Figure 9-1. The Netlist File Include Component Symbol
Note: Only one Netlist File Include Component may be placed in a design. This is to ensure that files are not multiply included (this causes redefinition errors within the ADS simulator). Because the Netlist File Include component must be unique, you cannot place multiple instances and then disable the ones you do not want.

Accessing the Netlist File Include Dialog

To access and edit information in the Netlist File Include Component, double click the Netlist File Include Component icon. The Netlist File Include dialog box appears.

Alternatively, you can choose Edit > Component > Edit Component Parameters and select the Netlist File Include Component icon or use the Edit Component Parameters icon.
Select Parameter
The Select Parameter list box displays a list of four parameters that enable you to create your include definition. Refer to each of the sections listed for detailed information on defining these parameters.

- “includePath” on page 9-4
- “definitionFiles” on page 9-5
- “stimulusFiles” on page 9-5
- “modelLibraryFiles” on page 9-6
- “UsePreprocessor” on page 9-8

Display parameter on schematic
The Display parameter on schematic check box in the Netlist File Include dialog box is used to list the individual parameters and their associated values on the schematic. If you want to display the parameters, activate the check box.

Component Options
The Component Options dialog box enables you to change the visibility of the component parameters on a schematic and/or reference items in hierarchical designs. To access the Component Options, click the Component Options button on the Netlist File Include dialog box. A Component Options dialog box appears.

![Component Options dialog box](image)

Changing the Visibility of Component Parameters on a Schematic
You can change the visibility status of all parameters of the Netlist File Include component through the Component Options dialog box.
Using Additional Features of RFIC Dynamic Link

- **Set All**—Displays all parameters for this component on the schematic. Use this option to display all, or almost all, parameters for this component. To display most—but not all—parameters, select Set All and then go back and turn off the display of individual parameters as desired.

- **Clear All**—Clears the display of all parameters for this component from the schematic. Use this option to turn off the display of all, or almost all, parameters for this component. To display a small subset of parameters, select Clear All and then go back and turn on the display of individual parameters as desired.

**Referencing VAR Data Items and Model Items in Hierarchical Designs**

The Scope option applies to the VAR (Variables and Equations) data item and most model items (such as R_Model, BJ T_Model, BSIM3_Model). Exception: it does not apply to multi-layer models. Scope indicates the levels, from a hierarchical standpoint, that recognize the expressions defined in the VAR data item or model item.

- **Nested**—VAR or model item expressions are recognized within the design containing the VAR or model item, as well as within any subnetworks (designs at lower levels) referenced by the design containing the VAR or model item.

- **Global**—VAR or model item expressions are recognized throughout the entire design, no matter what level in the design hierarchy the VAR or model item is placed.

**includePath**

The includePath parameter is a space delimited search path that is used to locate definition, stimulus, and model files. The include path needs to be set up for the simulation machine in order to work properly. However, there is an issue with this. The netlister searches through the include path to find files, and then outputs the values as expanded full paths (the simulator requires this). If the expanded full path on the netlisting machine is different from the expanded full path of the simulation machine, the simulator will not find the file to be included. If you want to do remote simulations, ensure that the expanded full path of your included file is the same on the netlisting machine and the simulation machine. Note that, in directory names, path prefixes such as '.', '..', '~', and '$' all have the usual UNIX interpretation.

To enter a group of include paths:

1. Click the includePath= parameter in the Select Parameter list box.
2. Enter the name of the search path in the Search Path for included files (space delimited) field separating each search path by a space.

**definitionFiles**

The definitionFiles parameter is a space delimited list of definition files. In Affirma parlance, a definition file is a file that contains process definition information. Note that there is no way to specify a particular segment of a definition file — this means that the entire file will be used. Do not set up corner case analysis and then use the definition file list to include a library, use the modelLibraryFiles parameter instead.

To enter a list of definition files:

1. Click the definitionFiles= parameter in the Select Parameter list box.
2. Enter the name of each definition file in the Definition Files List (space delimited) field separating each file by a space.

**stimulusFiles**

The stimulusFiles parameter is a space delimited list of stimulus files. In Affirma parlance, a stimulus file is a file that contains voltage source and current source definitions. Thus, if you create a global node VCC, you can make a stimulus file that contains something like:

```
V_Source:V1 VCC 0 Vdc=5V
```

This would then set VCC to be a 5 Volt global DC node, without requiring you to put the voltage supply into the schematic. No preprocessing is done on any of the stimulus file — everything must be set up properly on your own. This is primarily useful if you are simulating different levels of hierarchy and have used global power rails — the stimulus file can be shared between all of the levels, so that you do not need to disable voltage supplies at different levels of hierarchy to do different simulations.

To enter a list of Stimulus files:

1. Click the stimulusFiles= selection in the Select Parameter list box.
2. Enter the name of the file in the Stimulus Files List (space delimited) field. If you want to add additional stimulus files, simply separate each file by a space.
Using the Netlist File Include Component

**modelLibraryFiles**

This parameter enables you to build a list of model files that you want to include. To specify the path and filename of a model file to include:

1. Click the `modelLibraryFiles[n]` in the Select Parameter list box. This activates the Model Library File selection field.

2. Click the **Browse** button. The Select File dialog appears.
3. Double-click as needed to locate the directory containing your model file or enter the full path and file name in the Selection field. Click OK to return to the Netlist File Include dialog.

4. Once selected, the filename of the model file is displayed in the Library Model File field. Note that the path is appended to the includePath parameter and the file name is added to the modelLibraryFile parameter definition.

Example:

```
includePath=Path1 Path2 ... ModelFilePath
modelLibraryFiles[n]=filename
```

5. To add additional model files, click Add. This creates additional model file parameter definitions in the Select Parameter list box. Repeat steps 1 through 4 to define the path and file name. You can continue adding model file parameters as needed. You can also use the Cut and Paste buttons to move or delete any model file parameters.
Using Additional Features of RFIC Dynamic Link

Section (optional)

You may only have a single file for each model LibraryFiles[n] parameter — unlike the prior parameters — this is not a space delimited list. Each model file can have a Section designator. This enables you to include only a portion of a model file for corner analysis, provided your model file has been set up properly. The section designator is optional; if it is left empty, the entire file will be included (provided it has no dependencies on needing a particular section set up).

To properly set up a model file to utilize the section directive, you must bracket the sections using `#ifdef <section> /#endif` C-Pre-Processor(CPP) directives. The netlister automatically defines and undefines a variable with the name section before and after the `#include` statement. As an example, if you wanted to have a file with corner cases, and had a Nominal section, you would make the file as follows:

```c
#ifdef Nominal
; Nominal section
R:R1 in out R=50
#endif
```

If the same library file is named, with a different section, a single `#include` is generated, with multiple `#define` statements around it.

UsePreprocessor

The UsePreprocessor parameter defaults to “yes”. Setting this parameter to yes causes a preprocessor directive (`#include`) to be used which results in faster behavior by not copying the full text of the file. This parameter can also be set to no to provide a slower, but more compatible, full-text inclusion behavior.

To set the UsePreprocessor parameter,

1. Click the UsePreprocessor=yes parameter in the Select Parameter field of the Netlist File Include dialog box. The Parameter Entry Mode pull-down menu appears.

2. Click the Parameter Entry Mode pull-down menu in the Netlist File Include dialog box and select the appropriate option.
The UsePreprocessor parameter was developed for delivering increased speed to old ADS designs that use the geminiInclude, spiceInclude or csvInclude component and for delivering increased flexibility to old ADS designs using the idfInclude component.

**Summarizing the Netlist File Include Component**

For all of the Netlist File Include component parameters, a single include statement is netlisted for each file. The netlister checks to see if a file has already been output, to avoid having multiple definitions of files. The precedence is that model files are output first, so that the segment directives can be placed around the `#include`.

If you are using the Netlist File Include component, it is not putting out `#ifdef <file>` statements to further ensure that files are not multiply included. If you use a Netlist File Include component, you should not additionally use other file include components to avoid multiple inclusions which will cause a simulator redefinition error.
Using Additional Features of RFIC Dynamic Link

Example:

Parameter settings

```
includePath="./models"
definitionFiles="functions.def"
stimulusFiles="vccdef.stim"
modelLibraryFiles[1]="resistor.lib Nominal"
```

Netlist File Output (Note that ./ is /users/default/default_prj in this example):

```
#define Nominal
#include "/users/default/default_prj/models/resistor.lib"
#undef Nominal
#include "/users/default/default_prj/models/functions.def"
#include "/users/default/default_prj/models/vccdef.stim"
```

It is worth noting that, once the Netlist File Include component is netlisted, the simulator makes no differentiation between definition, stimulus, or model files. Each file will generate the `#include` statements.

You may want to use the `modelLibraryFiles` parameter for all of your files so that you can put corner case statements into all of your model files.

Freezing Selected Subcircuits

The RFIC Dynamic Link Freeze mode enables you to keep Cadence from generating a new netlist each time you simulate in Advanced Design System. This helps to avoid unnecessary time-outs caused by re-netlisting a large Cadence subcircuit.

Setting the Freeze Parameter

If you want to keep a Cadence Cellview from being netlisted and a netlist already exists, edit the ADS dummy design for that Cellview which would have a name of the form `<lib> <cel> <view>.dsn` and set the Freeze parameter to “yes” or “TRUE”. Refer to the example schematic in Figure 9-2 for the location of the Freeze parameter setting. To turn the Freeze parameter off, set the parameter to “no” or “FALSE”. The default value for the Freeze parameter is “FALSE.”

9-10 Freezing Selected Subcircuits
Generating a Cadence Subcircuit Netlist

In order to run Dynamic Link in Freeze mode, the Cadence subcircuit netlist must exist. If a Cadence subcircuit netlist does not exist, you can generate a new Cadence subcircuit netlist before running your ADS Simulation. Choose **ArtistUtilities > Subcircuit Netlist** from your Cadence Schematic window.

**Note**  If you do not see the ArtistUtilities pull down menu in the Cadence tool bar, select **Tools > ADS > Turn On ArtistUtilities** from the Cadence CIW.
Using Additional Features of RFIC Dynamic Link

This generates the Cadence subcircuit netlist. You can now run your ADS Simulation in Freeze mode.

**Note** If you set the Freeze parameter to TRUE but the Cadence subcircuit has never been netlisted, the Cadence subcircuit will automatically be netlisted the first time an ADS Simulation is attempted.

### Setting the netlistFile Parameter

The netlistFile parameter is used to specify the location of the ADS netlist of a frozen Cadence Cellview. On the dummy (placeholder) design, set the netlistFile parameter to point to the appropriate netlist file. For example:

```
netlistFile="examples_PowerAmp_schematic.net"
```

The default location for storing the ADS netlist of a frozen Cadence Cellview is:

```
<current_ADS_project_directory>/networks/
```

If you want to copy the netlist file elsewhere, set the netlistFile parameter to point to the full path and file name of the new location. For example:

```
netlistFile="/tmp/my_design.net"
```

Refer to the example schematic in Figure 9-2 for the location of the netlistFile parameter setting.

### Using “Freeze” Mode to Simulate a Design in ADS Standalone

You can run Advanced Design System standalone (without Cadence DFII or RFIC Dynamic Link) using a frozen netlist from an earlier RFIC Dynamic Link session (see “Freezing Selected Subcircuits” on page 9-10). The parameter Freeze=TRUE must be set on all dummy designs in ADS that represent Cadence cellviews.

While RFIC Dynamic Link is not designed to operate on a PC, you can take an ADS netlist (created using Dynamic Link on your UNIX workstation) of your Cadence cellview and copy it to your PC for an ADS simulation. This type of operation is typically done for board design. Once you have done some minor configuration, you can then add simulation and control components externally to your design and resimulate on the PC.
To setup and simulate your Cadence cellview in Advanced Design System on a standalone Windows NT machine:

1. Install RFIC Dynamic Link on your PC.

2. For each Cadence CellView, copy the netlist, AEL and design files into your working project directory's networks subdirectory. For instance, copy the following example PowerAmp schematic files into your project directory:

   examples_PowerAmp_Schematic.net
   examples_PowerAmp_Schematic.ael
   examples_PowerAmp_Schematic.dsn

3. If the Cadence CellView contains design variables, you will need to manually enter them into a VAR block in the top level ADS schematic. To do this:
   - Choose Data Items from the Component Pallet.
   - Click the Var Eqn block to add the component and use the cursor to place an instance on the schematic. You may continue placing more instances of the Var Eqn block, or choose the Cancel Command And Return To Select Mode icon to proceed with the next step.
   - Enter the appropriate values into Var Eqn block.

It is important to note that any changes made to the design on your standalone machine will not be reflected in your original Cadence cellview. While you may add simulation and control elements externally, the fundamental design should not be changed if you want it to match your original Cadence design.

Compatibility between Advanced Design System and Cadence Tools

Some of the features provided by the RFIC Dynamic Link include support for compatibility issues related to differences between Advanced Design System and the various Cadence tools. This section addresses several of these compatibility issues.

Support for Duplicate Pin Names

It is typical for the top (chip) level schematic to have multiple pins for the same signal, usually power and ground connections. The netlister lists duplicate I/O ports only once in the subnetwork definition and likewise for the nets connected to an instance of the subnetwork. However, the netlister in ADS (which does the top-level
Using Additional Features of RFIC Dynamic Link

netlisting), writes out the multiple connections to ports with the same name, causing a conflict to be reported by the ADS simulator while parsing the final netlist. To eliminate this conflict, when the symbol generator encounters duplicate pin names, it draws only one pin with a given name and issues a warning message. However, duplicate pins at lower levels in the Cadence schematic hierarchy are allowed, because no ADS symbol is involved.

**Using Buses**

For an example on using buses in RFIC Dynamic Link, refer to Chapter 3, Getting Started Tutorial and use the PowerAmp2 Cadence cellview in place of the PowerAmp cellview. Then use the PowerAmp2_test ADS design in place of the PowerAmp_test design. The PowerAmp2 example is the same as the PowerAmp example except that it uses bus wires.

For details on creating buses in ADS, refer to Chapter 3 of the ADS User's Guide. For details on using buses within Cadence Design Framework II, refer to your Cadence documentation.

**Setting up Unnamed Nets**

In ADS, unnamed nets begin with an _net prefix followed by an integer. All other net value are written out to the output dataset during simulation. By default, Cadence tools use the prefix net followed by an integer. By default, the dataset can get very large. To avoid this, set the Net Name Prefix in the Cadence schematic to _net instead of net.

To set the default Net Name Prefix in the Cadence schematic:

- Choose Options > Editor (Cadence 4.4.6) or Design > Options > Editor (Cadence 4.4.3)
- In the Editor Options dialog box, enter _net in the Net Name Prefix field
- Click OK.
- Choose Design > Check and Save to save each related Cadence schematic.

**Support for pPar and iPar**

This section describes the general use of parent parameters (pPar) and instance parameters (iPar).
**pPar()**

*Figure 9-3* shows an example of an inverter design that contains two CMOS transistors (M0 & M1).

This Composer circuit contains instances whose parameters are defined in terms of parent parameter values using `pPar()`. The parameters in this case are defined as:

\[
\begin{align*}
l &= \text{pPar("ln")} \\
w &= \text{pPar("wn")}
\end{align*}
\]

for M0, and
Using Additional Features of RFIC Dynamic Link

\[
l = pPar("lp")
\]
\[
w = pPar("wp")
\]

for M1.

This inverter circuit also has an associated symbol view in Cadence Composer. The symbol view shown in Figure 9-4 is equivalent to a black box that displays the input, output and instance properties for the circuit in Figure 9-3.

The default values of \(wn\), \(ln\), \(wp\) and \(lp\) are displayed in the symbol view along with the associated symbol for the device.

![Figure 9-4. Composer Symbol View showing default values for pPar()](image)

9-16 Compatibility between Advanced Design System and Cadence Tools
The Composer symbol is instantiated in ADS via the Dynamic Link where the instance properties also appear in ADS Schematic (see Figure 9-5).

![Figure 9-5. Inherited Symbol in ADS](image)

The parameter values are reflected in the netlist that is sent to the simulator. These values can be viewed and edited using the Cadence Edit Component CDF form (see Figure 9-6).

If the Cadence menu option Design > Create Cellview > From Cellview is used, the CDF for the schematic will be set up automatically. The Cadence software will traverse the hierarchy looking for pPar statements and automatically generate parameters. It will also set up netlisting data for known simulators.

If you are modifying an existing schematic and you have already generated a symbol for your schematic, it may be necessary to manually add the netlisting data for ADS. If this is the case, do the following:

1. Go to the Simulation Information section of the Edit Component CDF form (see Figure 9-6) and click Edit.
Using Additional Features of RFIC Dynamic Link

2. When the Edit Simulation Information dialog (see Figure 9-7) appears, change the Choose Simulator setting to “ads”.

Figure 9-6. Edit Component CDF Form
3. In the netlistProcedure field enter “IdfSubcktCall”.

4. In the instParameters field enter the parameters you wish to have netlisted for ADS. For the inv circuit, this means entering “wn ln wp lp”. The parameter order does not matter.

5. If you are using Cadence 4.4.3, you also need to set the macroArguments field. Change the entry set so that it is identical to the instParameters field. For the inv circuit, enter “wn ln wp lp”. Note that, in Cadence versions after 4.4.3, the macroArguments field is no longer used and is not displayed in the dialog box.

6. Change the componentName field entry to “subcircuit” or leave it blank.

7. Set the termOrder field to the order you wish to netlist the terminals in for ADS. You should have one entry for each terminal on your design. For the inv circuit, this is set to “in out”. You can also quote the names, but it is not necessary.

8. If you wish to back annotate currents, make the appropriate entry in the termMapping field. This is done by specifying the name of a terminal, followed
Using Additional Features of RFIC Dynamic Link

by the ADS pin number it will be. For the inv example, termMapping entry
would be “nil in “:P1” out “:P2””.
For more information on editing simulator information, refer to “Modifying the
Component Description Format” in Chapter 3 of the “RFIC Dynamic Link Library
Guide”.

iPar()
Similarly, the Dynamic Link supports the use of iPar. For any given instance, you can
define an instance parameter as a function of another parameter of the same
instance. For example, if the parameter w in Figure 9-3 were defined as
w=2*iPar(“l”), then if l=10, then w=20.

Using Inherited Connections
You can use inherited connections in Dynamic Link. It is recommended that you only
use inherited connections with Cadence 4.4.5 and up however; they have been
validated to work with Cadence 4.4.3 as well. In Cadence 4.4.3, programmable nodes
may also be used, and are recommended in preference to inherited connections.

Inherited connections used in Dynamic Link must all be resolved within the Cadence
hierarchy. For example, if you create a schematic in Cadence called test, that contains
instances that have inherited connections with them, such as nmos in analogLib, the
default connectivity is used in test if no netset properties have been placed on
instances in the hierarchy of the top level circuit. If you have hierarchy above the top
level Cadence schematic placed in the ADS design environment, you cannot place
netset properties on those instances.
Using S-parameter File Devices from analogLib

Cadence provides four S-parameter file components in the analogLib library:

- n1port
- n2port
- n3port
- n4port

These devices are supported in ADS with the rficdl.library file. In order to use the devices:

1. Make sure that the rficdl.library file is included as the IDF library in the file ADSlibconfig. This file is found in $HPEESOF_DIR/circuit/config. Ensure that the following line appears in the file:

   ```
   IDF $HPEESOF_DIR/idf/components/rficdl.library
   ```

   The installation procedure should add the proper line in automatically.

2. Cadence's spectre and ADS do not use the same format for S-parameter files. However, there is a single parameter that is used to designate the S-parameter file name for both simulators. While you can use a full path name in the file parameter, it is recommended that you input the file name, and then set up paths that will point to different directories where the files with the proper format can be found. In Cadence Affirma, the search path for the S-parameter files is the same as the search path for the model files. Within ADS, the search path is based on the data file search path. By default, the data file search path in ADS is ./data. If you have a process kit that contains the S-Parameter files, it will not be convenient to copy the files into your working project. To avoid this, you can add the configuration variable DATA_FILES= to your de_sim.cfg file (this can be in $HPEESOF_DIR/config, $HPEESOF_DIR/custom/config, or $HOME/hpeesof/config). Each path should be delimited with a semicolon character. It is recommended that you keep ./data within the path for compatibility.

Cadence provides a utility program that can translate Cadence spectre S-parameter files to ADS touchstone S-parameter files. The program is called sptr (S-parameter translation). With no options specified, it will convert a spectre format file to an ADS file (e.g. sptr spar.s2p sparads.s2p). The program can also convert ADS format files to Cadence format. The program is in the same directory as the spectre executable, and should install with the spectre package.
Using Additional Features of RFIC Dynamic Link
Chapter 10: Using Switch Views, Stop Views and the Hierarchy Editor

This chapter provides information on using switch views, stop views and the Hierarchy Editor. A switch view is a list that describes the views to use and their priority. A stop view is a list that designates when to stop moving down in hierarchy. In other words, if a view is in the switch view list, and also in the stop view list, it won't traverse any lower in hierarchy.

RFIC Dynamic Link supports the concept of using switch views and stop views. Dynamic Link also supports Cadence's Hierarchy Editor tool, which enables more detailed specification of switch views and stop views than the standard Artist forms. Switch views and stop views are utilized by the netlister to expand hierarchy. The Hierarchy Editor enables you to override the switch view list and stop view list for each instance in a schematic's hierarchy.

Note  The information provided in this chapter refers to using the Cadence Hierarchy Editor tool with the RFIC Dynamic Link and Advanced Design System. For more detailed information on using the Cadence Hierarchy Editor tool exclusively, refer to your Affirma Analog Circuit Design Environment User Guide. For more detailed information on expanding hierarchy in the Cadence environment, refer to the section on “How the Netlister Expands Hierarchy” in your Cadence documentation.

Expanding Hierarchy with the Dynamic Link Netlister

The flowchart shown in Figure 10-1 describes the general process used by the RFIC Dynamic Link netlister to move through and expand the hierarchy in Dynamic Link.
Using Switch Views, Stop Views and the Hierarchy Editor

10-2 Expanding Hierarchy with the Dynamic Link Netlister
In the Cadence schematic window, choose the **ArtistUtilities > Setup Options** menu item to access the Setup Options form. The Setup Options form enables you to designate a switch view list, and a stop view list.

![Setup Options Form](image)

**Figure 10-2. Setting a Switch View List and a Stop View List.**

Each instance in a hierarchy has a master cell, that contains a number of views for that cell. Typically views are schematic, symbol, layout, extracted, etc. The switch view list is used to enable you to designate the priority of each view for hierarchical netlisting. The stop view is used to designate whether a view in the switch view list should be traversed for hierarchy. A stop view is implied to have no hierarchy. For an example of this, refer to the design hierarchy_bottom in the library examples_lib that is provided with the Dynamic Link installation.
Using Switch Views, Stop Views and the Hierarchy Editor

In this example, the cell `hierarchy_bottom` has two alternate schematic views, `schematic_ideal` and `schematic_parasitics` (see Figure 10-3 and Figure 10-4 respectively).

Figure 10-3. Alternate schematic view `schematic_ideal` for the example cell `hierarchy_bottom`.

Figure 10-4. Alternate schematic view `schematic_parasitics` for the example cell `hierarchy_bottom`.

10-4 Expanding Hierarchy with the Dynamic Link Netlister
Two instances of the cell hierarchy_bottom have been placed in the schematic hierarchy_top (see Figure 10-5) in the examples_lib.

![Figure 10-5. The schematic view for the example cell hierarchy_top](image)

This cell is in turn placed in the ADS example project design hierarchyTest, with the schematic view chosen as the Cadence view (see Figure 10-6). Because there are two alternate schematics, it becomes necessary to tell the netlister which one to use when you netlist the design hierarchy_top. The switch view list is used to tell the netlister which one you want to use.
Using Switch Views, Stop Views and the Hierarchy Editor

Figure 10-6. The cadence cell hierarchy_top placed in ADS

Figure 10-7 shows how the setup options have been changed to designate that schematic_ideal takes priority.

Referring to the Hierarchy Expansion flowchart in Figure 10-1, when an instance of hierarchy_bottom is encountered, the following occurs:

1. There is no ads view, so the next switch view is looked at.
2. There is no schematic view, so the code continues to the next switch view.
3. There is a schematic ideal view. Since schematic ideal is not in the stop view list, it is opened, so that a subcircuit can be netlisted for it.

4. With hierarchy_bottom as the top cell, now the first instance, and only instance encountered, is the analogLib res component. The switch view list is consulted.
   - Is there an ads view? Yes, there is.
   - Is the ads view a stop view? Yes, it is.

This means that the res component will not be opened as a schematic with hierarchy. Instead, it is meant to be a simulator primitive. Either a built in simulator component exists, which will be used, or a subcircuit definition has been included into the simulator that defines what the component is. A single component line is output for it, and the netlister continues on.

**Figure 10-8** shows the resulting netlist from netlisting hierarchy_top with schematic ideal having higher priority than schematic parasitics. Note that the instances and subcircuit definition have been highlighted.

![Netlist Example](image)

**Figure 10-8.** Netlist of the example cell hierarchy_top with schematic ideal taking priority
Using Switch Views, Stop Views and the Hierarchy Editor

If you prefer to use the schematic_parasitics schematic, the hierarchy_top schematic does not need to be changed. Instead, in the setup options form, you change the switch view list so that schematic_parasitics comes before schematicIdeal as shown in Figure 10-9.

![Setup Options Table](image)

Figure 10-9. Switch View List with schematic_parasitics taking priority over schematicIdeal

Referring to the flowchart in Figure 10-1 again, when an instance of hierarchy_bottom is encountered, the switch view list is checked. There is no ads view or schematic view. There is a schematic_parasitics view, which is not a part of the stop view list. This results in the netlister opening the schematic_parasitics view, which is netlisted as a subcircuit. The netlister then goes on to the next instance, without ever checking for a schematicIdeal view (in point of fact, it is not necessary to put schematicIdeal in the switch view list, since it will not be used). Figure 10-10 shows the resulting netlist with the setup options from Figure 10-9.
In all of the above examples, the stop view list was set to ads. This is the recommended stop view list to use for the RFIC Dynamic Link netlister. If you consult the netlist flowchart in Figure 10-1, you will notice that it is not necessary for the stop view to be ads, any view can be used to designate that a part is a primitive. In the future, the RFIC Dynamic Link netlister will be expanded, so that alternate simulation definitions can be used based on which stop view is encountered (e.g. ads vs. ads_ptolemy). At present, the netlister always uses the simulation definition defined for ads in the cell’s CDF, no matter which stop view is encountered.
Using the Hierarchy Editor with RFIC Dynamic Link

The Hierarchy Editor is a stand alone Cadence tool that enables switch views and stop views to be designated for each instance in a schematic hierarchy. For information regarding the hierarchy editor in general, consult your Cadence "Hierarchy Editor User Guide".

When the Hierarchy Editor is used, a cell view specific to that tool is generated. The view itself is actually a text file, and cannot be opened directly in anything other than the Hierarchy Editor. The default view name for the Hierarchy Editor is config. A config view has a top cell view that it points to. All other information regarding switch views and stop views is then created based on the top cell view that is being pointed to. It is not necessary for the Hierarchy Editor view to be a part of the cell that it is pointing to, although in most cases this will be the simplest way to organize things.

Figure 10-11 displays the Create New File form used to create a Hierarchy Editor view. In this case, a Hierarchy Editor view is being made for the example cell hierarchy_top (see Figure 10-5). The goal is to set up this config view so that, during netlisting, it is possible to specify that one instance of hierarchy_bottom should use the schematic_ideal view, while the other instance uses the schematic_parasitics view.

![Create New File form](figure.png)

Figure 10-11. Creating a Hierarchy-Editor view

After the new view is created, the Hierarchy Editor tool is started. For a new view, the New Configuration form appears as shown in Figure 10-12.
Notice that all fields are left blank initially, except the Library and Cell fields which were specified in the Create New File form shown in Figure 10-11. At this point, it is necessary to designate the top cell view, as well as the switch view list and stop view list. The Library List can normally be left blank. For more information on the Library List field, refer to your Cadence “Hierarchy Editor User’s Guide”.

It is necessary to fill in the Top Cell view. The top cell view should be a standard CDB view. From the standpoint of RFIC Dynamic Link, this means either a view that is edited with Virtuoso-schematic, or Virtuoso-layout. If you use a layout view, it should be an extracted view of some sort (i.e. the layout will contain connectivity and instances that can be traced back to schematic equivalents). Typically, you will put in either schematic or extracted as the view name.

The Library List, View List, and Stop List can be filled in by using a template. Templates contain default settings for particular simulators. To select a template, click the Use Template button in the New Configuration form. The Use Template form appears.
Using Switch Views, Stop Views and the Hierarchy Editor

In Figure 10-13, the ads template was selected, which has filled the View List in as ads schematic extracted, and the stop list as ads. These names represent the default view names for the tools that the Dynamic Link netlister supports. During netlisting, the view list and stop list will override the switch view list and stop view list that is specified using the Dynamic Link setup options dialog. Also, the Hierarchy Editor view will not consult the Dynamic Link options dialog to fill in the switch view list or stop view list, it is a completely separate tool, and must be set up independently.

Figure 10-13. New Hierarchy Editor Configuration, using ADS template

When the new configuration is accepted, the main Hierarchy Editor window will be filled out. The main window shows the current Top Cell setting, as well as the global Library List, View List, and Stop List. In addition, the Hierarchy Editor will expand the hierarchy of the top cell, and show which views will be used for each instance within the top cell's hierarchy. When nothing has been overridden, the expansion will
follow the flow chart shown in Figure 10-1. Figure 10-14 shows how the example hierarchy_top schematic view was expanded using the global bindings. The Cell Bindings shows the two cells that were found, hierarchy_top and hierarchy_bottom. You may need to select View > Update to see the hierarchy_bottom Cell in the Cell Bindings list. The view found for hierarchy_top was schematic, this is a special case. Because it is the top cell, the library, cell, and view found will always be the same as what is specified for the top cell, regardless of the view list and stop list. The cell hierarchy_bottom says that the view found was **NONE**. Because hierarchy_bottom has the views schematic_ideal, schematic_parasitics, and symbol, this is accurate. None of hierarchy_bottom’s views are in the global view list. If netlisting were attempted at this point, an error would result. The cell bindings give a visual indication of this.
Using Switch Views, Stop Views and the Hierarchy Editor

In Figure 10-15, the global view list has been changed, so that it now includes schematic_ideal and schematic_parasitics. The cell bindings are now updated to reflect the new hierarchy expansion. Because schematic_ideal precedes schematic_parasitics in the global view list, the expansion now says that, for hierarchy_bottom, schematic_ideal is the view found. Also, the analogLib res cell has been found, because hierarchy_bottom was expanded. This expansion happens because schematic_ideal is not listed in the global stop view list. Since res has an ads view, the expander decides that ads will be the view used for the res cell.
So far, all of this demonstrates is that the Hierarchy Editor can be used to see how expansion would occur for a specified view list and stop list. That’s nice, but it doesn’t add any functionality over what was provided by the Setup Options form. What is needed is a way of overriding the view list. As it happens, the Hierarchy Editor is capable of doing just that.
In Figure 10-16, the switch view list has been changed, so that schematic_parasitics is now first in the switch view list.

Notice that the instance bindings table is now displayed. When hierarchy_top is selected, the instance table shows all of the instances in the schematic. As it happens, hierarchy_top contains two instances of hierarchy_bottom, I2 and I3 (see Figure 10-5). If the global switch view list is used, both instances will expand to use schematic_parasitics. In this case, we have chosen to change the default behavior. In the view to use field, schematic_ideal has been specified. The view found field now specifies schematic_ideal instead of schematic_parasitics. Now, when the cell hierarchy_top is netlisted with this configuration, it will be necessary to expand the hierarchy for both schematic_parasitics and schematic_ideal. The netlister keeps track of the proper component name for the netlist.
Figure 10-17 shows the resultant netlist that is created using this configuration.

Figure 10-17. Netlist using configuration detailed in figure 10-15.

An alternate way of viewing the overridden expansion is to look at the tree view, as opposed to the cell and instance binding tables. This is shown in Figure 10-18.
Using the Hierarchy Editor with RFIC Dynamic Link

Figure 10-18. Tree view of hierarchy_top configuration with I2 set to use schematic_ideal.

The Hierarchy Editor makes it possible to override the hierarchy expansion on any instance. It is also possible to override the global switch view list on any instance. This allows you to change the expansion options for one tree of a hierarchy, while leaving all other trees intact.

**Placing the config view in ADS**

In order for a Hierarchy Editor configuration to be used during netlisting, it is necessary to place the Hierarchy Editor view in the ADS schematic. This is done by selecting the Cadence menu option. When the Select Design dialog appears, set the view name to the Hierarchy Editor view. In the hierarchy_top example, this is done by selecting the view name config (see Figure 10-19).
A new symbol is generated for the config view, and you are then able to place it. In the hierarchy_top example, the symbol graphics are inherited from the hierarchy_top cell. This results in a symbol that looks identical to the hierarchy_top schematic symbol for ADS. However, this symbol is now linked to the Hierarchy Editor view, as opposed to being linked to the schematic view.
Figure 10-20 shows the new test bench where the config view is used instead of the schematic view. If the Cadence instance is selected, and you descend into its hierarchy, the top cell view for the configuration will be opened. The configuration being used will be indicated in the title of the schematic/layout window that is opened. Figure 10-21 shows the hierarchy_top schematic that will be opened. Note that the title indicates that the Config in use is examples_lib hierarchy_top config. This is important, as it means that hierarchy expansion will obey that particular configuration.

Note also that the top cell view does not need to remain constant. Thus, if you wish to do a simulation where the top cell schematic is used, and then do another simulation wherein an extracted view is used, you do not need to make multiple ADS symbols and then swap them. You can make a single Hierarchy Editor configuration, and swap the top cell view name. Once the test bench is set up, you do not need to modify anything in ADS to change your simulation. For the hierarchy_top example, a simulation would result in the netlist shown in Figure 10-17, based on the configuration shown in Figure 10-16.
Figure 10-21. Schematic window attached to a Hierarchy Editor configuration
Using Switch Views, Stop Views and the Hierarchy Editor
Appendix A: Command Reference and Troubleshooting

This appendix describes the function of each menu selection provided in Advanced Design System (Cadence Menu), the Cadence Schematic window (ArtistUtilities Menu) and the Cadence CIW (ADS Menu) while using the RFIC Dynamic Link. Troubleshooting information that can help you resolve common problems is also provided in this appendix.

Cadence Menu

ADS Schematic window

Instance > Add Instance of Cellview...

Add a symbol of a Cadence design to the current Advanced Design System Schematic window. For example, see “Adding a Symbol of the Cadence Cellview” on page 3-7 in Chapter 3 of the RFIC Dynamic Link User’s Guide.

Instance > Update Instance of Cellview

Discards <ads_prj>/networks/<lib>_<cell>_<view>.dsn and <ads_prj>/networks/<lib>_<cell>_<view>.ael, regenerates an ADS symbol from the Cadence symbol, and deletes the $HOME/simulation/<cell> directory. Deleting the $HOME/simulation/<cell> directory forces ADS to recreate a new netlist the next time ADS requires a netlist for a Cadence subcircuit.

Design Variables > Get Design Variables

Add design variables from a Cadence Cellview to an Advanced Design System Schematic window. For example, see “Adding Design Variables” on page 3-9 in Chapter 3 of the RFIC Dynamic Link User’s Guide.

Design Variables > Update Design Variables to Cellview

Update the value of the Advanced Design System schematic design variables to the Cadence Cellview. For example, see “Updating Cadence Design Variables” on page 6-2 in Chapter 6 of the RFIC Dynamic Link User’s Guide.
Add Netlist File Include
Enables duplication of the Definition, Stimulus, and Model Library File include used in Cadence/Affirma. For more information, refer to “Using the Netlist File Include Component” on page 9-1.

Top-level Design Netlist
Generate and display the Advanced Design System subnetwork netlist for the Cadence design displayed in a particular Composer window. For example, see “Viewing Netlists from Advanced Design System” on page 5-1 in Chapter 5 of the RFIC Dynamic Link User’s Guide.

Annotate > Annotate DC Solution to Selected Cellview
Display the DC node voltages, generated by the ADS simulator, on the Cadence Schematic Window. For example, see “Performing a DC Simulation” on page 3-13 in Chapter 3 of the RFIC Dynamic Link User’s Guide.

Annotate > Annotate Operating Points to Selected Cellview
Display the DC operating points, generated by the ADS simulator, on the Cadence Schematic Window. For example, see “Annotating DC Operating Points to a Selected Cellview” on page 3-15 in Chapter 3 of the RFIC Dynamic Link User’s Guide.

Close Connection
Closes ADS and terminates the link between Cadence and ADS. For example, see “Ending the Session” on page 3-33 in Chapter 3 of the RFIC Dynamic Link User’s Guide.
ArtistUtilities Menu
Cadence Schematic Window

Setup Options ...
Set parameters such as Model Search Path (Cadence versions 4.4.2 and 4.4.3 only), Switch View List and Stop View List. The default values for this dialog are obtained from the configuration file. For more information, consult your Cadence documentation.

New Design ...
Select a new design to include in the Cadence Cellview. Set parameters such as Library Name, Cell Name and View Name. The dialog also offers a browse feature to search for existing designs. For more information, consult your Cadence documentation.

Design Variables ...
Modify the Component Description Format (CDF) information for a component so that it works with ADS. For example, see “Adding and Editing Design Variables” on page 6-1 in Chapter 6 of the RFIC Dynamic Link User's Guide. For more information, consult your Cadence documentation.

Save State ...
Save a state of a simulation. The simulation name, variables, model path, outputs and environment options are all available selections. For more information, consult your Cadence documentation.

Load State ...
Load an Analog Artist state. For more information, consult your Cadence documentation.

Subcircuit Netlist
Generate and display the Advanced Design System subnetwork netlist for the Cadence design displayed in a particular Cadence Schematic window. For example, see “Viewing Netlists from the Cadence Schematic Window” on page 5-2 in Chapter 5 of the RFIC Dynamic Link User's Guide. For more information, consult your Cadence documentation.

_____________________________________________________________
Note  If the ArtistUtilities pull-down menu does not appear in the Cadence Virtuoso Schematic window, choose Tools > ADS in the Cadence schematic window.

### ADS Menu

Cadence Command Interpreter Window (CIW)

There are two additional ADS menu items accessible from the Cadence CIW.

**Start ADS**

Launch Advanced Design System without opening a Cadence cellview.

**Turn On ArtistUtilities**

Adds the ArtistUtilities menu item to the Cadence schematic window with only the Subcircuit Netlist menu item enabled. This option enables you to create a Cadence subcircuit netlist without launching Advanced Design System.

### Troubleshooting

All errors, warnings, and other messages are directed to the Cadence CIW. When a new message is written to the CIW, the window is raised to the top of your window stack so that new messages are always visible. Error messages may also be logged in a file, idf.log.

Some known problems and solutions are listed in the following section. You may find this information helpful in determining how to resolve a particular problem however, if you’re unable to resolve a problem with the RFIC Dynamic Link using the information provided, contact Agilent EEsof-EDA customer support.

### Known Problems and Solutions

**Problem:** By default, ADS does not create its own private color map, which may lead to unpredictable color behavior and/or menu buttons in place of icons.

**Solution:** Try one or more of the following:
• Set `HPEESOF_COLORMAP = private` in the ADS configuration file
  `$HOME/hpeesof/config/hpeesof.cfg` or
  `$HPEESOF_DIR/config/hpeesof.cfg`.
• Set `CDS_NUM_USER_COLORS = 16` in your `.profile` or `.cshrc` file.
• Restart Dynamic Link after exiting all other color-intensive applications.

**Problem:** When you remake a symbol, even when the old symbol is deleted, ADS does not allow you to create another symbol with the same name.

**Solution:** Click the instance in the ADS schematic window, then choose Cadence > Instance > Update Instance of Cellview.

**Problem:** There is no distinction between a design variable X from Design A and a design variable X from a different Design B.

**Solution:** Use unique design variable names for different designs, unless you really intend them to be the same variable, in which case there's no problem.

**Problem:** Symbol generation via Cadence symbol duplication does not reproduce arcs.

**Solution:** Use line segments instead of arcs.

**Problem:** Could not spawn master program. This message appears in your parent terminal window upon attempting to use the ADS link.

**Solution:** Ensure that `$HPEESOF_DIR/bin` is in your PATH and that `$HPEESOF_DIR/bin/idfmp` is a valid executable. If this does not work, ask your UNIX System Administrator to reboot your system or otherwise determine if a socket address is in use.

**Problem:** *Error* Could not find 'nlpglobals/ads' in library 'basic'. The nlpglobals’ cell view is required. Netlisting aborted. This error occurs either while netlisting in Analog Artist or after clicking Simulate in the ADS.

**Solution:** Copy the spectre view in the nlpglobals cell to create an ads view.

**Problem:** The UNIX environment does not set up properly when an in-house script for DFII is used.

**Solution:** Starting DFII using an in-house script may not set up the UNIX environment properly for RFIC Dynamic link. Work with your System Administrator to ensure that you understand what environment variables need to be set in the in-house script and modify your script accordingly.
Installation and Use Checklist

This section provides a checklist that can be used to help you resolve problems with RFIC Dynamic Link. You can use the questions below to help determine what the cause of a particular problem might be.

- Is RFIC Dynamic Link installed? If yes, the following files/directories should exist:

  $HPEESOF_DIR/bin/idf
  $HPEESOF_DIR/bin/idfmp
  $HPEESOF_DIR/circuit/symbols/idfSymbol.dsn
  $HPEESOF_DIR/idf/ael/
  $HPEESOF_DIR/idf/skill/4.4.6/ads.ini
  $HPEESOF_DIR/idf/skill/4.4.6/ads.al
  $HPEESOF_DIR/idf/skill/4.4.6/ads.cxt
  $HPEESOF_DIR/idf/skill/4.4.5/ads.ini
  $HPEESOF_DIR/idf/skill/4.4.5/ads.al
  $HPEESOF_DIR/idf/skill/4.4.5/ads.cxt
  $HPEESOF_DIR/idf/skill/4.4.3/ads.ini
  $HPEESOF_DIR/idf/skill/4.4.3/ads.al
  $HPEESOF_DIR/idf/skill/4.4.3/ads.cxt
  $HPEESOF_DIR/idf/config/
  $HPEESOF_DIR/idf/cdslib/4.4.6/analogLib/
  $HPEESOF_DIR/idf/cdslib/4.4.5/analogLib/
  $HPEESOF_DIR/idf/cdslib/4.4.3/analogLib/
  $HPEESOF_DIR/idf/cdslib/4.4.6/basic/
  $HPEESOF_DIR/idf/cdslib/4.4.5/basic/
  $HPEESOF_DIR/idf/cdslib/4.4.3/basic/
  $HPEESOF_DIR/idf/examples/

- Is Cadence configured for RFIC Dynamic Link? Run idfConfigCadence -h (RFIC Dynamic Link 2002) or $HPEESOF_DIR/idf/config/configCadence -h (RFIC Dynamic Link 2001).
• Is HPEESOF_DIR set? Run idfenv (RFIC Dynamic Link 2002).
• Is $HPEESOF_DIR/bin in your $PATH?
• Is icms in your $PATH?
• Are cds_root and cdso both in your $PATH?
• Is PATH and LM_LICENSE_FILE set in ~/.cshrc, ~/.profile, ~/.kshrc, or other scripts sourced by these scripts? Execute echo $SHELL or finger to display your login shell.
• Is your ADS license.dat file in the default $HPEESOF_DIR/licenses/ directory or is it set in $LM_LICENSE_FILE?
• Is there a trans_idf (RFIC Dynamic Link 2002) or Idf_c_interface (previous versions of RFIC Dynamic Link) feature in the ADS license.dat file? Has this feature expired?
• Which item in the following list defines the Cadence license file?

$CDS_LIC_FILE
<Cadence_install_dir>/share/license/clients
$LM_LICENSE_FILE
<Cadence_install_dir>/share/license/license.dat

• Does the Cadence license contain the valid features listed below:

OASIS_Simulation_Interface
34510
300 (only if using layout)

• Are all seats of the above ADS and Cadence licenses taken?
• Does $HPEESOF_DIR/idf/config/cdsinit exist?
• Is $HPEESOF_DIR/idf/config/cdsinit loaded in
  <Cadence_installation_directory>/tools/dfII/local/.cdsinit?
• If the above file does not exist, is $HPEESOF_DIR/idf/config/cdsinit loaded in/.cdsinit?
• If the above files do not exist, is $HPEESOF_DIR/idf/config/cdsinit loaded in $HOME/.cdsinit?

• If none of the .cdsinit files exists, cp $HPEESOF_DIR/idf/examples/.cdsinit ./

• Does the .cdsinit file that loads RFIC Dynamic Link’s .cdsinit file change PATH, CDS_INST_DIR, LM_LICENSE_FILE?

• Does the icms, icfb, or msfb script change your PATH or LM_LICENSE_FILE? Run idfenv at the UNIX prompt, start Cadence, enter system("idfenv") in the Cadence CIW, and then compare the output of idfenv before and after the Cadence script is executed.

• What is in the ./cds.lib? Do all of the libraries appear in blue in Cadence Library Path Editor form? If you are using the Agilent Technologies version of analogLib and analogLib appears in red, check to see if IDF_CDS_VERSION is used in cds.lib and it is not defined in the effective .cdsinit file.

• Does an ads view exist for the components in use? Use the Cadence Library Manager to check to see if the analogLib/ cap cell contains an ads view.

• Does the ads simlinfo section exist in the Cadence Component Description Format (CDF) for the components in use? Is all of the information in the ads simlinfo correct? Use the Edit Component CDF form (Tools > CDF > Edit) or cdfDump("<lib>" "/<tmp/<cell>.cdf" ?cellName "<cell>" ?edit t) function to see if the ads simlinfo section exists in a cellview (leave out the ?cellName "<cell>" for dumping the library CDF instead of the cell CDF).

• Does the ads view exist for the global cellview nlpglobals under the basic library? If not, open the Cadence Library Manager, select symbol or spectre view, press middle mouse button, choose Copy from the popup list, and copy the symbol or spectre view to the ads view.

• If RFIC Dynamic Link failed to create an ADS netlist, can the Cadence netlister create a spectre netlist? Select Tools > Analog Environment from Cadence schematic window, select Setup >Simulator/Directory/Host from the Affirma DE window and ensure that spectre is selected as the Simulator, then select Simulation > Netlist > Create to generate a spectre netlist.

• Has the Cadence symbol changed since the instance was placed in ADS? Select the instance in the ADS 2002 schematic window, then choose Cadence > Instance > Update Instance to Cellview to recreate ADS symbol and remove the ~/simulation/<cell>/directory to force Dynamic Link to regenerate the netlist. With RFIC Dynamic Link 2001, remove <lib>_<cell>_<view>* under
<ads_prj>/networks/, delete ~/simulation/<cell>, then delete the instance in the ADS schematic and replace the instance.

• Is the de_sim.cfg file under the ADS project directory corrupted?

• Is there any local ADS customization in $HOME/hpeesof/config/de_sim.cfg? Search for AEL.

• Is there site-wide ADS customization in $HPEESOF_DIR/config/de_sim.cfg or custom/config? For example, the line that reads "+dynamic_link" in the de_sim.cfg file includes the file dynamic_link.cfg.

• If some components require models, are the associated ADS model files included with the modelLibraryFiles parameter in the idfInclude component?

• For debugging purposes, if the ./idf.log file appears to be shorter than expected for debugging, is IDF_DEBUG_MODE set to TRUE in the UNIX environment?

• If the current GMT in ./idf.log and ~/CDS.log do not match, is there a lock on ~/CDS.log? Is it ~/CDS.log.1 or ~/CDS.log.2 that is the Cadence log file for this session?

• Are there any suspicious options set in any of the following four Cadence .cdsenv files?
  • <cds>/tools/dfII/etc/tools/<application>/.cdsenv
  • <cds>/tools/dfII/local/.cdsenv
  • $HOME/.cdsenv
  • ~/.cdsenv

The above files contain user preference options.
Glossary

**ADS (Advanced Design System)**
Advanced Design System is an EDA System for high-frequency circuit and system design.

**AEL (Cadence Analog Expression Language)**
In the Cadence context, AEL is the syntax and API (available in Skill or C) to support full or partial expression evaluation for repetitious circuit simulation.

**AEL (ADS Application Extension Language)**
This is a C-like interpretive programming language to configure, customize and enhance the Advanced Design System design environment.

**Affirma Analog Circuit Design Environment**
Cadence's interface for analog circuit design and analysis in versions 4.4.5 and 4.4.6.

**bindkeys**
Settings used to map individual keystrokes to a particular function within the software.

**callback**
A function or expression that gets evaluated when certain events occur; for example, clicking on a menu item.

**CDF (Component Description Format)**
The CDF is Cadence's mechanism to interactively define and evaluate parameters and attributes for individual components and designs.

**CIW (Command Interpreter Window)**
The CIW is Cadence's command window.

**colormap**
Indexed color table where each entry is a combination of R, G, and B pixel intensity values for UNIX X-windows display. Table size (number of colors) per software application is limited by the number of display bits per pixel, commonly eight.
DFII (Design Framework II)
Cadence's overall IC design environment.

EDA (Electronic Design Automation)
Software and services that give customers a distinct advantage by improving time-to-market, quality and productivity in the design of electronic products.

GUI (Graphical User Interface)
The interface between the user and the application.

HB (Harmonic Balance Simulation)
An iterative method of analysis that is based on the assumption that for a given sinusoidal excitation, there exists a steady-state solution that can be approximated to satisfactory accuracy using a finite Fourier series.

iPar()
The function used in an AEL expression for a parameter which is a function of another parameter of the same instance. For example, for MOSFET instances we might use \( AD = \text{iPar}("w") \times 5u \).

IPC (Inter-Process Communication)
The protocol for passing messages between two or more processes.

OASIS
Open Analog Simulation Integration Socket. The procedural interface for simulator integration into the Cadence simulation environment.

optimization
Mechanism by which a simulator finds the optimal value of a global parameter within a user-supplied range of values.

OS (Operating system)
Such as, HP-UX, Solaris, AIX, Win95.

pPar()
The function used in a Cadence AEL expression for a parameter which is a function of some parameter of the parent instance. For example, for CMOS inverters we might use \( W = \text{pPar}(wp) \) (where \( wp \) is a parent instance parameter) on
one of the pull-up FETs, enabling use of the same inverter symbol for different size inverters.

**PSF**

Parameter Storage Format. This is a Cadence-defined file format for storing complex structured data.

**RFIC Dynamic Link (Dynamic Link)**

RFIC Dynamic Link (Dynamic Link) for Cadence is an EDA framework integration software product. The product enables both tops-down and bottoms-up design and simulation in Advanced Design System(ADS) using IC designs from the Cadence database. RFIC Dynamic Link is based on IPC rather than data file translation maximizing data integrity and ease of use.

**SKILL**

Cadence's C/lisp-like interpretive programming language for framework and database integration.

**testbench**

Top-level schematic used to analyze a sub-circuit using a circuit simulator.

**tuning**

Mechanism by which a simulator can quickly re-simulate a circuit using new values for a number of parameters without having to re-input the netlist and recreate its data structures.
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